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Children's Environment in Brazil: From Domestic (Indoor) to Regional Threats

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Abstract

Background: This research has been carried out with Brazilian children living in heterogeneous environments and vulnerable to multiple factors that can interact and influence the likelihood of their exposure to harmful agents. A review focused on the impacts of threats from domestic indoor to outdoor environment on this children's health was held. The assessment was based on scientific research produced from 1999 to 2013 and conducted exclusively in Brazil. We grouped the studies in three, the first one, considered as Home Life (HL) refers to the effects on children's health of hazardous components related to the household area, related to two subthemes: unintentional ingestion of chemical compounds and home environmental pollution. Medications, cleaning products and pesticides were the most common agents of poisoning and parental smoking and the use of wood stove for cooking were directly responsible for respiratory diseases. The second group called Social (S) correlates socio-environmental factors focused on childhood diarrhea, geo-helminthiasis and urban sanitation conditions. Precarious households, lack of sewage system, improper waste management enhanced the importance of water-transmitted illness in children health. The third group, considered as Regional (R), exposes environmental chemical contaminations and biological agents as regional risk factors to child morbidity-mortality. Air pollution due to increased levels of PM10, SO_2 and O_3 were associated with higher prevalence of respiratory diseases, which can be also influenced by the region seasonality. Agrochemicals, mercury, arsenic and in special lead were considered potential risk factors to children's health throughout the country. Infectious tropical diseases and accidental contacts with biological agents of pathologies for children were related to regional peculiarities. This review highlights that the occurrence of environmental exposed diseases in Brazilian children is extremely serious and not random, and it is possible to establish causal links and, thus, to define protection factors that must be considered by stakeholders and government to improve the quality of life of that age bracket.

Key words: Child health; Environmental risks; Brazil; Developing countries;

Introduction

In the globalized world of the 21st century, most of the child population has been stimulated by many opportunities and challenges, but they have also found huge barriers in relation to their health, development and well-being in the form of environmental threats [1]. According to international data, in 2015, approximately 5.9 million children died under age five, in an estimated rate of 16,000 deaths per day, mostly from diseases that are promptly preventable and treatable with tested, cost-effective and quality-delivered interventions [2]. The number of under-five deaths over the past two decades is astounding: between 1990 and 2015, nearly 230 million children worldwide died before their fifth birthday, more than today's population of Brazil, the world's fifth most populous country [3]. But the good news is that nowadays, under-five mortality rate has decreased. In 2015, there were 19,000 fewer deaths of children in this age group than in 1990, the reference year for measuring progress [2].

The survival of every child is still an unpostponable priority and varies enormously depending on where a child was born and grows. Environmental risk factors, such as air, water and soil pollution, chemical exposures and climate change, contribute to more than 100 diseases and injuries [4]. In low and medium-income nations, the most commons environmental disorders, constituting major public health problem, are the lack of potable water and sanitation access, resulting in waterborne diseases, such as diarrhea [5] and lower respiratory tract infections. While in developed countries, the most prevalent diseases are allergy and asthma [6]. Researchers have been analyzing the way the environment can change the expression of the genes and how that can cause diseases. Medications, pesticides, air pollutants, chemicals, heavy metals, hormones, nutrition products and behaviors can change the genetic expression by way of a huge amount of gene regulatory mechanisms [7].

Important information regarding accidental poisonings and intoxications is that children, by nature, are curious, and can open, eat and drink what adults know to be dangerous agents. Parents and caretakers, by negligence or lack of information, keep medications and domestic products in inappropriate places, underestimating what children can do. The habit of self-medication can lead to a higher intake of medication, which makes it easier for those agents to reach domiciles, where children can potentially get access and be poisoned by them [8].

Pollution in the indoor environment is a multifaceted mixture of agents migrating indoors from the outdoor air in addition to agents generated by indoor sources [9]. Tobacco smoke is a threat to children's health with adverse effects on their pulmonary function [10, 11]. The smoke of tobacco is full of exogenous mutagenic and cancerous agents [12, 13].

Data from the WHO [14] shows secondary domestic pollution due to the burning of solid fuel (wood, coal, manure, crop residue) on fires or traditional stoves as one of the top ten risks to health in the world, affecting children directly. The inefficient burn of those solid fuels releases a dangerous mixture of thousands of substances such as particulate matter, carbon monoxide, nitrous oxide, sulfuric oxides, formaldehyde, hydrocarbons and polycyclic organic matter, which includes carcinogenic substances such as benzopyrene [15]. The amount of smoke women and their young children inhale can be equal to that of two packs of cigarettes a day [16]. Through the air, the smoke from forest fires is made up of gases, such as water vapor, molecular nitrogen, SO_2, CO, CO_2, CH_4, among others, and ash micro particles [17]. The total suspended particulate matter, inhalable particulate matter and nitrogen dioxide can cause, on children who live near where fires take place, side effects through a combination of harm caused by heat, pulmonary irritation, oxygen deprivation (asphyxia) and poisoning [17].

The contamination of the environment by chemical agents (aluminum, mercury, pesticides, petroleum hydrocarbons, silver, vinyl chloride, arsenic, cyanide, benzopyrene) resulting from untreated water; industrial activities; mineral exploration and agriculture can be responsible for the increase in congenital malformations, asthma, cancer, disruption of the endocrine system, neurological and behavioral disorders in children [18, 19]. The physical agents that can also present hazards to children's health are sediment resuspension, turbidity, corrosive materials, and water offensive odors and incompatible color [20].

This vulnerability children have to environmental hazards occurs because the child population is a peculiar demographic group that shows very specific physiological characteristics: it is during the early childhood that several biological systems, like the brain, lung structure and the immune system develop and mature [9]. Toxic gases can compromise pulmonary function and neurodevelopment or exacerbate preexisting conditions, and children born prematurely can be more vulnerable to environmental hazards due to pulmonary immaturity at birth [21]. Children ingest more water and food and breathe more air by body weight unit than adults. Infants, during the first 6 months, ingest seven times more water, and, at pre-school age (1 to 5 years of age), from three to four times more food by kilogram of body weight than the average adult [22]. The intake of air of resting infants is twice as high in average adults [23]. Peculiar habits, such as constantly putting their hand in their mouth [9] and playing and crawling in the ground also contribute to a higher exposure. Thus, agents present in the air, the water, the ground and in food have a higher probability to be absorbed by children than by adults.

Facing these facts, the authors conducted a review on the relationship between exposure to environmental pollutions and diseases in Brazilian children. Brazil is a large country, being the fifth in overall surface area, and has a wide regional diversity in terms of biomes and socioeconomic development. Several unfavorable environmental conditions and toxic substances present in several regions of Brazil, but independent of socioeconomic and cultural differences and occurring in rural and industrialized areas, are a threat to the lives of children, and a prolonged exposure could compromise the survival of their generations and others to come. The scope of the review covers indoor and outdoor pollutants for the entire Brazil from 1999 to 2013. The main knowledge and environmental issues acting on children health were identified and discussed, as well the remaining gaps.

Material and Methods

An ample bibliographic revision was carried out using the following electronic databases: MedLine, PubMed, Scielo, Lilacs and BDENF (Nursing Database) were used to retrieve relevant articles in the Brazilian literature published from 1999 to 2013. Besides the use of the aforementioned databases, a research was also carried out on the websites of organizations such as the World Health Organization – WHO, the United Nations Children's Emergency Fund - UNICEF the Pan American Health Organization – PAHO in order to update information found on the selected documents. Texts published on the website of Brazilian organizations of research in health and human geography such as Brazilian Institute of Geography and Statistic (IBGE) were also used. The databases were searched separately and then combined to eliminate duplication.

The search strategy involved terms as referred to Brazilian Virtual Health Library/Health Sciences Descriptors (DeCS) that includes, concomitantly, the Portuguese, the English and Spanish languages. The criteria for inclusion were: articles with data from research carried out exclusively in Brazil, published in national and evaluated according to criteria of journal classification in the QUALIS system of CAPES (Brazilian Federal Agency for the Improvement of Higher Education) (https://sucupira.capes.gov.br/) as A1-A2-B; international journals, available access to the full text of articles in the databases and whose methodology allowed for the discovery of evidence regarding the environmental influence in the health of children. The following types of papers were excluded: case study, dissertations, theses and guidelines. The research strategy included the following descriptors: "children health", "environmental risks", "health vulnerability", "accident prevention", "poisoning", "sanitizing products", "pesticide exposure", "environmental pollutants", "air pollution", "tobacco smoke pollution", "diarrhea infantile", "basic sanitation" "parasitic diseases", "water pollution", "environmental health", as well as Boolean operators (AND, OR and NOT) made available by databases.

We grouped the studies in three, as follow: The first group, which we will call HOME LIFE (HL), refers to the possible effects on children's health hazardous components related to the household and its surrounding area might have, such as unintentional injuries caused by chemical compounds and home environmental pollution. The second group, called SOCIAL (S), correlates sanitation and socio-environmental factors, such as diarrheal diseases and soil-transmitted parasites and their influence on children's health. The third group, REGIONAL (R), exposes the regional environmental physical, chemical and biological agents as a risk factor to child morbidity and mortality. The references of the identified articles are shown in supplementary material.

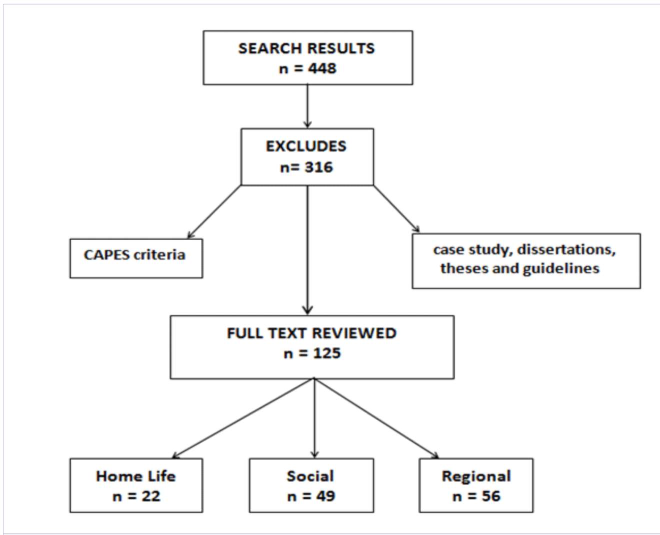

Figure 1: Categorization of studies for analysis.

Results

Over 448 studies were reviewed in this paper to identify emerging patterns and gaps in the children's environmental health field. After exclusions, the search performed retrieved 127 articles (Fig.1). In the HL group, there were 22 articles, in the S category 49 articles were raised and in the R group, there were analyzed 56 studies.

Geographic distribution

In order to have an overview of the geographic distribution of the studies, we considered for the analysis the five geographic regions of Brazil: North (N), Northeast (NE), Central-West (CW), Southeast (SE) and South (S). The N Region, takes up 45.25% of the absolute area of the country, has an estimated population of 17,186,877 people and is the region with the lowest population density [24]. The NE Region has 18.2% of the country's area and an estimated population of 56,241,859 inhabitants [24]. The CW Region has 18.86% of the country's area and an estimated population of 15,251,494 inhabitants [24]. The SE Region has 10.85% of the country's area and an estimated population of 85,241,641 inhabitants. This region has the highest Gross Domestic Product - GDP of Brazil [22]. The S Region has 6.77% of the country's area. It has an estimated population of 29,041,466 [24], and the one with the highest Human Development Index – HDI [25]. It can be observed that 42% of the studies were carried out in the SE Region, which relates the richest region with the number of research.

The SE Region, predominate in the majority of papers. In the N Region, the majority of the articles deal with one subtheme of the R2 group, with relation to peculiar questions of the region, which comprehends most of the Amazon Basin, with its local particularities, such as mining, forest fires, and malaria cases, among others. The CW Region, despite holding the country's capital, has the fewest number of papers. Although Brazil is a federative union, few studies included two or more regions in their researches showing low number of integrated research on children's environment in the country.

Home Life

In this section, 22 articles related to two subthemes were selected: "unintentional ingestion of chemical compounds" and "home environmental pollution".

In the first subtheme, 9 articles were used (Tab. I).

Table I: HOME LIFE

Unintentional ingestion of chemical compounds						
Reference	**Purpose**	**Type of Study**	**Health Efects**	**Age**	**Region**	**Outcomes**
Tavares et al. (2013)[26]	to analyze the risk factors associated with poisoning in children	longitudinal	acute intoxication	newborn -14 y	S	Associated factors: male gender and age (from zero to four years), easier access to drugs at home and the adult's presence did not prevent the occurrence of intoxication.
Lira et al. (2009) [27]	to analyze the intoxication by pesticides in children, adolescents and youngsters	longitudinal	acute intoxication	newborn -19 y	NE	Associated factors: male gender and age (from zero to four years); trigger factor: raticides - as individual accident in children and with intentional character (attempted suicide) among teenagers.

Lessa & Bochner (2008) [28]	to identify the main therapeutic classes responsible for drug intoxications related to the hospitalization of children	longitudinal	1,21% lethality	< 1 y	N, NE, CO, SE,S	Associated factors: male gender and infants (85%); trigger factor: antiepileptic, sedative-hypnotic and antiparkinsonism drugs, with 15.2% of hospitalizations in children under one month and 21.1% in infants.
Lourenço et al. (2008) [29]	to describe the epidemiological characteristics of all exogenic poisoning cases in children	longitudinal	3,84% lethality	newborn -12 y	NE	Associated factor: male gender and age under five (64.5%), easier access to drugs at home (80%) and parents present in 57.7% of the incidents; trigger factor: anticonvulsants and bronchodilators.
Siqueira et al. (2008) [30]	to describe the profile of the acute exogenous intoxications, among children	cross-sectional	39.7% vomiting / 20.7% sleepiness	0-12 y	CO	Associated factor: male gender and children (1-3 y), easier access to drugs at home; trigger factor: drug (34%), rat poison (14%) and chemical products for domestic use (13%).
Martins et al. (2006) [31]	to analyze the characteristics of accidental poisoning among children and adolescents	longitudinal	17.2% hospitalization	0-15 y	S	Associated factor: female gender and children (1-3 y); trigger factor: drugs (47.5%), pesticides (14.1%) and cleaning products (11.3%), with 17.2% of children's hospitalization.
Ramos et al. (2005) [32]	to establish the profile of poisonings among children	cross-sectional	acute intoxication	0-4 y	S	Associated factor: male gender and children (1 y), easier access to drugs at home and the adult's presence in 76.2% of the incidents; trigger factor: analgesics.
Bucaretchi et al. (2003) [33]	to study acute exposure to imidazoline derivatives in children	longitudinal	15% asymptomatic	2 m- 13 y	SE	Associated factor: female gender and 21 months of median age. Easier access to drug in the house. The exposure pathway was oral and nasal.
Matos et al. (2002) [34]	to describe drug intoxication among children	longitudinal	0,11% lethality	0-4 y	SE and S	Associated factor: children (2-3 y); trigger factor: drugs administration errors and medicinal use. Analgesics, decongestants, bronchodilators, antiepileptics and oral contraceptives were the therapeutic classes involved, and decongestants, antiepileptics, antihistamines and expectorants were associated to cause of death.

According to the authors, during early childhood, children are very curious and have no idea how dangerous toxic agents can be. The medication was the toxic agent most commonly found in the research with 77.7% of the studies. Included anti-epileptic, sedative-hypnotic and antiparkinsonian drugs [28, 29], bronchodilators [29], imidazole derivatives [33] and painkillers [32, 34]. There is also the hypothesis of medication poisoning through transplacental transmission and breast-feeding in children less than one month of age [28].

Pesticides were the second toxic agent (55.5%) found in the study [26, 27, 29, 30, 31], and poisoning was generally accidental in children and intentional in adolescents. In both cases the home was the locus of such occurrences.

Ease of access to those products was essential for self-harm and the adult's presence did not prevent the occurrence of intoxication [26, 29, 30, 32]. Vomiting and somnolence were considered a common clinical manifestation on children seen on hospital units [30] and infant deaths were reported as a complication of acute intoxication to toxic agents [28, 29, 34].

On the subtheme called "home environmental pollution", 13 articles were found (Tab.II). Articles demonstrated the impact of secondhand smoking on children's health since the intrauterine stage, affecting negatively anthropometric measurements (weight, length, and head circumference) of newborns [37, 44]. Parental smoking was also responsible for wheezing babies [35], ear infections and eye irritation [36] and history of respiratory diseases [42, 45, 47]. In the case control studies, children exposed to smoking show higher risk to develop the abovementioned diseases than those who are not exposed [35, 36, 39, 40]. In addition, children living in crowded environments and poor housing conditions play a fundamental role in the causal chain of respiratory diseases [38, 42, 46]. As well, the use of a wood stove for cooking was responsible for a higher occurrence of recurrent wheezing [41].

Table II: HOME LIFE

Home environmental pollution						
Reference	**Purpose**	**Type of Study**	**Health Efects**	**Age**	**Region**	**Outcomes**
Schvartsman et al. (2013) [35]	to investigate parental smoking patterns and their association with wheezing in children	cross-sectional	wheezing	6 - 23 m	SE	Associated factors: male gender, age < 2 y, exposure to cigarettes smoking in the households of cases indicated that the risk of wheezing was dose dependent.
Coelho et al. (2012) [36]	to investigate if there is a relation between respiratory diseases and passive tobacco smoking among children	cross-sectional	otitis / wheeze / coryza	newborn - 4 y	SE	Associated factor: children under two years; trigger factor: exposure to secondhand smoke - 17.39% of the passive smoker group had ear infections, wheezing, coryza and eye irritation.
Zhang et al. (2011) [37]	to investigate the prevalence of maternal smoking during pregnancy and its impact on anthropometric measurements of newborns	cross-sectional	reduced anthropometric measurements	newborn	CO	Maternal smoking throughout the entire pregnancy had negative impact on anthropometric measurements of newborns with reduction in the weight, length and head circumference.
Prietsch et al. (2008) [38]	to determine the prevalence of acute lower respiratory illness and to identify associated factors among children	cross-sectional	wheezing / pneumonia	< 5 y	S	Household crowding and maternal smoking with a clear dose-response effect and increased risk of acute lower respiratory tract disease.
Casagrande et al. (2008) [39]	to assess asthma prevalence and potential risk factors associated	cross-sectional	eczema / rhinoconjunctivitis	6-7 y	SE	Associated factor: male gender, smoking mother during children's first year of life, presence of eczema and rhinoconjunctivitis.
Macedo et al. (2007) [40]	to evaluate risk factors for acute respiratory disease hospitalizations in children	cross-sectional	wheezing	newborn -11 m	S	Associated factors: male gender and babies under six months of age, lack of or low maternal education, previous history of wheezing, early weaning and maternal smoking.
Prietsch et al. (2006) [41]	to study the prevalence of and major factors associated with recurrent wheezing in children	cross-sectional	wheezing	0-12 y	S	The use of wood stove was a 2.5 times higher risk for the occurrence of recurrent wheezing compared to those who did not use this type of stove.
Gonçalves-Silva et al. (2006) [42]	to identify factors associated with respiratory disease in children	cross-sectional	Asthma / bronchiolitis	< 5 y	CO	Children with lower socioeconomic status and exposed to household smoking.
Gonçalves-Silva et al. (2005) [43]	to estimate the prevalence of exposure to smoking in households in children to identify the main determinants of that exposure	cross-sectional	short stature	< 5 y	CO	Associated factors: female gender, parental smoking associated with low infant stature even after adjusting for smoking during pregnancy and sociodemographic variables.
Chatkin & Menezes (2005) [44]	to study the prevalence and risk factors for asthma in a cohort of children born in 1993 and followed up to the age of six years	longitudinal	12.8% asthma / allergic rhinitis	6-7 y	S	Associated factors: female gender, non-white skin, asthma in the family, smoking during pregnancy and allergic rhinitis in children.
Carvalho & Pereira (2002) [45]	to study the prevalence of respiratory morbidity among passive smoking children and to determine the effects of environmental tobacco smoke in the respiratory system	cross-sectional	wheezing / asthma / dyspnea / pneumonia	< 5 y	NE	Associated factors: male gender, parental smoking and respiratory diseases history. Regarding the respiratory tract the most frequent complaints were wheeze, dyspnea, asthma, bronchitis or pneumonia and rhinitis.
Prietsch et al. (2002) [46]	to study the prevalence of acute disease of the lower airways and the role of the domestic environment and maternal smoking	cross-sectional	acute resp. disease	< 5 y	S	Associated factors: similar distribution according to age and sex, passive smoking, living in crowded environments and poor housing conditions
Pereira et al. (2000) [47]	to determine the effects of second-hand smoke in the respiratory system in children	cross-sectional	82% wheezing / dyspnea	< 5 y	NE	Associated factors: male gender, environmental tobacco smoke: from 55.3% of passive smoking children in the study, 82% had respiratory problems.

Social – Sanitation and Socio-environmental Factors

In the second block, 49 articles related to two subthemes were selected: "waterborne diseases" and the "prevalence of intestinal parasites".

Regarding the first subtheme, 22 articles were used (Tab.III). Researchers identified that precarious households [63, 65], the lack of a sewage system [65, 69], rudimentary lavatories, lack of a garbage collection [48, 50, 53, 58, 62] and the use of no potable water [60] are variables that influence the morbimortality rate of children under 5 years of age due to water-transmitted illnesses, like diarrhea [57]. In this sence, cities with a low Human Development Index (HDI) have the highest mortality coefficients due to diarrheal disease [49] with 20% of the children in those regions having a deficit of > 2 standard-deviations for the height/age index [55], leading these children to chronic malnutrition [62].

Table III: SOCIAL - SANITATION AND SOCIO-ENVIRONMENTAL FACTORS

Waterborne diseases						
Reference	**Purpose**	**Type of Study**	**Health Efects**	**Age**	**Region**	**Outcomes**
Torres et al. (2013) [48]	to analyze the spatial distribution of morbidity due to diarrhea among children and its relation with lifestyle conditions	longitudinal	15.5% hospitalization	< 5 y	SE	the suburbs with the highest DHR- Diarrhea Hospitalization Ratio - were, in most cases, those with the highest population agglomerations.
Mendes et al. (2013) [49]	to verify the temporal trends of the indicators of overall mortality and hospital morbidity due to diarrheal disease in children	cross-sectional	80% lethality < 1 y 62,6% hospitalization	< 5 y	N, NE, CO, SE, S	mortality due to diarrheal disease in Brazil showed a downwards trend. The Northeast Region accounted for 46% of hospitalization.
Paz et al. (2012) [50]	to identify the association between diarrhea in children and children characteristics, access to sanitation and housing conditions	cross-sectional	hospitalization/ malnutrition	0 -2 y	SE	male gender; age 4-9 months; the risk of diarrheal occurrence in children is almost 15 times greater than that of children living in good water and sanitation conditions.
Ciaccia et al. (2012) [51]	to discover the prevalence of serological markers for the hepatitis A virus among children and teenagers	cross-sectional	jaundice	7m- 18 y	SE	female gender; age 8 y; children playing in streams, residence without sewage collection, parents with low education, and low family income.
Markus et al. (2011) [52]	to determine the seroprevalence of hepatitis A (HAV) in children and to identify factors associated with a history of infection	cross-sectional	positive serology	1-14 y	S	male gender; use of community refectory, low-income per capita and indoor crowding.
Bellido et al. (2010) [53]	to determine the relationship between the variables for water conditions, environmental sanitation, and mortality in children associated with a group of waterborne diseases	longitudinal	3.004 deaths	< 5 y	N, NE, CO, SE, S	inadequate sanitation in the dwelling ;modest economic conditions and low levels of parental education, major population concentration.
Melli & Waldman, (2009) [54]	to analyze the trend in mortality due to diarrhea among children between1980 and 2000	longitudinal	94,3% mortality < 1 y	< 5 y	SE	male gender; age < 1 y; improved sanitation coverage, expanding coverage of health services, improving prenatal care and childhood and increasing schooling.

Cesar et al. (2009) [55]	to evaluate child health indicators in two municipalities	cross-sectional	20% had a height-for-age deficit > 2 standard deviations	< 5 y	N	60% were from families with incomes less than one monthly minimum wage (approximately U$200), 41% had no type of sewage treatment or disposal, 10% of mothers reported zero prenatal visits.
Genser et al. (2008) [56]	to investigate the impact of a city-wide sanitation intervention in a large urban center in Northeast Brazil on determinants of child diarrhea	longitudinal	< morbidity due to diarrhea	0-2 y	NE	poor socioeconomic status; the prevalence of diarrhea decreased from 9.2 to 7.3 diarrhea days per year after the intervention; a reduction of 21%..
Melo et al. (2008) [57]	to determine the incidence of diarrhea and to assess some relevant associated factors to it in children living in two slums	longitudinal	each child:11.1 days of diarrhea per year	< 40 m	NE	male gender, age < 1y; early weaning; mother younger than 25 years; malnourished, missed immunizations and previous pneumonia.
Vasconcelos MJ; Batista F. (2008) [58]	to comparatively assess the prevalence of diarrhea and the implications of the disease regarding outpatient appointments and hospitalizations	cross-sectional	4.1% hospitalization	< 5 y	NE	poor conditions of collective life in geographical areas; diarrhea accounted for a quarter of all admissions with a ratio of almost 33% in the urban inland and 35.3% in the rural inland.
Barreto et al. (2007) [59]	to investigate the epidemiological effect of this city-wide sanitation programme on diarrhea morbidity in children	longitudinal	22% < morbdiity due to diarrhea	< 36 m	NE	diarrhea prevalence fell from 9·2 days per child-year before the citywide sanitation intervention to 7·3 days per child-year afterwards.
Teixeira & Heller, (2005) [60]	to determine diarrhea prevalence and to identify factors associated to the condition in children living in subnormal settlement areas	cross-sectional	17.5% diarrhea	1 - 5 y	SE	mine water consumption; sewage disposal on the streets or in the yard; inadequate garbage disposal and flies; child hospitalization during the first month of life.
Zago-Gomes et al. (2005) [61]	to describe specific anti-HAV prevalence among school children	cross-sectional	38.6% seropositive	6-14 y	SE	male=female gender; age< 10 y; absence of domestic water filter, absence of sewage system and a past history of hepatitis.
Teixeira JC; Heller l. (2004) [62]	to identify the environmental factors related in children living in areas occupied by homeless or landless people	cross-sectional	11.23% chronic malnutrition	1 - 5 y	SE	intermittent water supply, poor quality child hygiene before feeding, and dumping children's diapers with feces in the area around the house.
Vanderlei et al. (2003) [63]	to investigate the socioeconomic, demographic, and biological determinants of hospitalization due to acute diarrhea (AD) in children	longitudinal	100 % hospitalization	< 2 y	NE	age < six months; unfavorable socioeconomic conditions, greater multiparity, younger age of the child, and severity of the diarrhea.

Strina et al. (2003) [64]	to study the determinants of hygiene behavior and of its role in the transmission or prevention of diarrheal disease	longitudinal	2.2% diarrheal disease	< 5 y	NE	the prevalence of diarrhea among children for whom mainly unhygienic behavior and households with inadequate excreta disposal was 1.9 times that among children in the "mainly hygienic" group.
Schnack et al. (2003) [65]	to study the etiology of childhood diarrhea in a population sample in a metropolitan area	longitudinal	95.7% of diarrhea	< 5 y	S	*Cryptosporidium* (85.1%), *Entamoeba histolytica* (56.4%), *Giardia lamblia* (4.3%); environmental conditions.
Medronho et al. (2003) [66]	to estimated risk areas for hepatitis A in four census tracts in children living in a metropolitan area	longitudinal	33,3% seropositive	1-9 y	SE	area with poor environmental and sanitary conditions.
Assis et al. (2002) [67]	to assess the prevalence of antibodies to hepatitis A and E viruses in children who were students of nurseries and public schools	cross-sectional	86,4% anti-HAV/ 4,5% anti-HEV seroprevalence	2-9 y	N	male=female gender; low socioeconomic status and poor sanitary hygienic.
Benicio & Monteiro, (2000) [68]	to characterize and analyze trends of children with diarrhea using two household surveys undertaken in mid-80s and mid-90s.	cross-sectional	1.70% to 0.9% morbidity	< 5 y	SE	age: 6 to 23 m; reduction in both the prevalence of diarrhea and the hospitalizations due to the disease. A more significant reduction was observed among the third poorest families.
Catapreta & Heller, (1999) [69]	to describe the effects of inadequate solid waste collection on the health in a sample of children living in low-income neighborhoods and favelas	cross-sectional	diarrheal, parasitic, and dermatological diseases	< 5 Y	SE	age: 6 to 23 m; absence of solid waste collection.

Even though diarrheal diseases represent the second most common cause for hospital admissions in children under 5 years of age [48], researches have seen a considerable decrease in morbimortality caused by those illnesses. The factors that may have contributed to that decrease were the increase in purchasing power and consequently the betterment of living conditions [54] and the increase in the coverage of basic sanitation services [56, 59].

Author's suggested that hepatitis A, another disease related to water-transmitted illnesses, is also present in area with poor environmental and sanitary conditions. The prevalence of positive anti-HAV among school children was significantly associated with low socioeconomic status [51, 66, 67], absence of both domestic water filter and sewage system [61] and indoor crowding [52].

Still in the Social research block, in the "prevalence of intestinal parasites", 27 articles were used (Tab. IV). The studies suggest that geo-helminths represent a major public health problem and are an important indicator of the sanitary conditions in which a certain population lives. The association between the prevalence of intestinal parasitic diseases with socioeconomic and environmental factors was reported in the most of researches like: children from slums [71] or residing in townships with a low HDI in the N and NE regions, especially in rural areas [74]; households with no proper waste management and no solid residue collection [78]; the unhealthy condition to which this population is subjected [72, 87], with a direct relationship with low maternal schooling [81, 95] and low income family [80, 85-91, 95]. The higher prevalence of *Ascaris lumbricoides, Giardia duodenalis, Trichuris trichiura* and hookworm infections in children living in contaminated environments [75, 90, 92, 93] with inadequate daily caloric intake [94] may result in hospitalizations due to diarrheal disease [79], compromising their future anthropometric status [76, 94].

On the other hand, studies suggested that a reduction of the prevalence of the parasites infections was possible by the increase of sewage systems [73, 88, 89, 91, 92], the use of a water filter [70] and the household being in an urban area [96].

The prevalence of parasitic diseases in children who go to daycare was another topic in this research. Daycares were found to contain giardiasis [82, 83, 95] and several helminths [77, 84, 86]. The variable 'drinking water' showed a great influence on endoparasitic diseases in children of public institutions that ingested water without in-home treatment [81, 95]. Another variable, the relationship between the presence of helminth eggs in the water closet of kinder garden and the frequency of these eggs in the feces of their users were 15,4% positive.

Table IV: SOCIAL - SANITATION AND SOCIO-ENVIRONMENTAL FACTORS						
Prevalence of intestinal parasites						
Reference	**Purpose**	**Type of Study**	**Health Efects**	**Age**	**Region**	**Outcomes**
Belo et al. (2012) [70]	to analyze the prevalence and the factors associated with intestinal parasites infections in children and adolescents in elementary schools	cross-sectional	29% parasitosis	5-14 y	SE	The prevalence of infection was 29%, (7 to 83%) between schools of lower and higher occurrence respectively. The presence of toilets in the home was associated with a lower prevalence of helminths.
Araujo Filho et al. (2011) [71]	to evaluate the association between the prevalence of intestinal parasitosis with socioeconomic and environmental factors in two different socioeconomic groups of children	cross-sectional	> weight, height and body for age in infected children	6-10 y	SE	Intestinal parasitosis occurred in 60.7% of children from the slum, in 5.9% of children from private schools.
Silva et al. (2011) [72]	to analyze the prevalence and intensity of infection by *Ascaris lumbricoides* among children	cross-sectional	3.2% abdominal pain 1.3% diarrhea 0.8% vomiting	1-12 y	NE	The prevalence of *A. lumbricoides* was 53.6%. Analysis revealed alarming results regarding the degree of unhealthy condition to which the population is subjected, in addition to its poor hygiene habits.
Barreto et al. (2010) [73]	to evaluate the impact of a citywide sanitation intervention on the prevalence of *Ascaris lumbricoides, Trichuris trichuria*, and *Giardia duodenalis* infections in preschool children.	cross-sectional	< parasitosis	1-4 y	NE	The prevalence of *A. lumbricoides* infection was reduced from 24.4% to 12.0%, *T. trichuria* from 18.0% to 5.0%, and *G. duodenalis* from 14.1% to 5.3%. Most of this reduction appeared to be explained by the increased coverage in the sewage system constructed during the intervention.
Fonseca et al. (2010) [74]	to estimate the prevalence and identify risk factors for geohelminth infections among children in municipalities with low human development indices (HDI)	cross-sectional	36.5% parasitosis	5-14 y	N e NE	Of all children, 36.5% were infected with one or more geohelminths (*A. lumbricoides*, 25.1%; hookworm, 15.3%; *T. trichiura*, 12.2%). Overall prevalence of geohelminth infections was 45.7% in rural areas and 32.2% in urban areas. Low family income, low maternal schooling, presence of garbage near the home and number of individuals in the household were associated with infection.
Basso et al. (2008) [75]	to study the variation in the prevalence of intestinal parasites among schoolchildren over a 35-year period	cross-sectional	< parasitosis	6-14 y	S	There were positive results from 58% samples and the most prevalent infestations were of *A. lumbricoides* (47%), *T. trichiura* (36%), *Enterobius vermicularis* (8%), *Giardia lamblia* (24%) and *Entamoeba coli* (20%). The overall prevalence diminished from 89% to 37%, indicating an average decrease of 1.4% per year.
Matos et al. (2008) [76]	to estimate the association between *Giardia duodenalis* infection and anthropometric deficits, as measured by weight-for-age and height-for-age	cross-sectional	< G. duodenalis / > anthropometric indices	newborn-2 y	NE	*G. duodenalis* was diagnosed in 13.5% of the children. The children's breastfeeding duration and living conditions (garbage collection and paved streets or sidewalks) modified the effect of *G. duodenalis* infection on anthropometric status.

Araújo et al. (2008) [77]	to test for helminthes in sandboxes public and private in day care centers	cross-sectional	60% helminthiasis	4-6 y	SE	In the private day care centers, 61% were positive for helminthes larvae and 50% for eggs. In the public day care centers, 64% were positive for larvae and 36% for eggs. No influence of either season of the year or day care finance condition was seen.
Moraes et al. (2007) [78]	to study the bagging and collection of household solid waste and the health implications for children living in human settlements	cross-sectional	more than 5 episodes of diarrhea per year	5-14 y	NE	There was a higher prevalence of *A. lumbricoides, T. trichiura* and hookworm in children living in households without proper bagging/ isolation and collection of household solid waste as compared to those in areas with regular garbage collection and adequate isolation of solid waste.
Pereira et al. (2007) [79]	to determine the prevalence and to identify risk factors associated with *Giardia lamblia* infection in diarrheic children hospitalized for diarrhea	cross-sectional	9.9% hospitalization	newborn -10 y	CO	Associated factors: age of children (24-48 months); predisponding factors: number of children and cats in the household, food hygiene, day-care centers attendance, living on a rural farm within the past six months prior hospitalization and the number of household adults.
Buschini et al. (2007) [80]	to analyze the distribution and frequency of enteroparasite occurrence in children from seven community schools	cross-sectional	highly infected by enteroparasites	newborn -15 y	S	They found that 75.27% of children had enteroparasites. A smaller fraction (26.73%) of children harbored several parasites (multiparasitism), especially *G. duodenalis* (56%), and *A. lumbricoides* (18%).
Mascarini & Donalísio (2006a) [81]	to estimate the prevalence and incidence of intestinal parasites among children at municipal daycare centers	longitudinal	23.2% positive	newborn -6 y	SE	The enteroparasite prevalence was 76.74% in 2002 and 34% in 2003. Associated factors to a higher prevalence of enteroparasitosis: gender male and 72-83 month age group children (84.37%). Greater prevalence in enteroparasitosis acquisition in the children that ingested water without in-home treatment.
Mascarini & Donalísio (2006b) [82]	to estimate the prevalence of intestinal parasites among children at municipal daycare centers	cross-sectional	22.5% *G. duodenalis*	0-6 y	SE	*G. duodenalis* presented prevalence of 23.7% (2002) and 21.4% (2003) followed by *Cryptosporidium* sp. with 15.5% (2002) and 3.7% (2003) and *Blastocystis hominis*with 13.1% (2002) and 5.5% (2003).
Carvalho et al. (2006) [83]	to investigate possible associations between occurrence of enteroparasites and the socioeconomic and sanitary conditions of children matriculated in day care centers	cross-sectional	53.4% positive	newborn -6 y	SE	Associated factors: *G. duodenalis* was more prevalent in children from 0 to 4 years and *E. vermicularis* in children between three and four years old. The prevalence of intestinal parasitism was 53.40%, and the most frequent parasite was *G. duodenalis* (26.88%). Predisposing factors: family income, maternal education and factors beyond sanitation should be considered.
Gurgel et al. (2005) [84]	to evaluate whether child daycare centers are an environment that protects against or exposes children to intestinal parasite infestation.	longitudinal	63% positive	1-5 y	NE	The overall prevalence was 51% of at least 1 parasite. There was a higher prevalence of intestinal parasites (63%) in children who attended day care than those who did not attend (41.4%) and the risk of infestation is 1.5 times higher.

Teixeira & Heller (2004) [85]	to characterize the morbidity by intestinal helminth infections and the identification of the factors associated with these diseases, with emphasis on environmental factors, in children residing in subnormal settlement areas	cross-sectional	21.3% positive	1 - 5 y	SE	21.38% of sample children presented intestinal helminth infections. The associated and predisponding factors with these parasitic diseases included the children's age, family income, complaints about the quality of the water from the public system and deficiencies in sanitation.
Quadros et al. (2004) [86]	to determine the prevalence and intensity of infection by intestinal parasites among children attending early education centers	cross-sectional	70% positive	2-6 y	S	Associated factors: gender female. The overall prevalence of helminths and protozoa was 70.5% - *A. lumbricoides* (35%), *G. lamblia* (14%) and *T. trichiura* (13%) among other parasites.
Ferreira et al. (2003) [87]	to verify the occurrence of intestinal parasites and commensal organisms among children attending a school located in a settlement of 'landless farm workers'	cross-sectional	59.7% positive	5-14 y	SE	59.7 % of intestinal parasites and commensals occurred in the study population – *G. lamblia* in 30.5 % of fecal samples and *Schistosoma mansoni* in only 1 case.
Carneiro et al. (2002) [88]	to develop an environmental health indicator for use as a basis for developing preventive measures against *Ascaris lumbricoides* infection in children	cross-sectional	12.2% positive *A. lumbricoides* infection	0-14 y	SE	The results showed the protective effects of availability of water in the washbasin, better hygiene, sanitation and socioeconomic status; the interactive effect of crowding was five times larger in households without water in the washbasin than in those having water.
Carvalho et al. (2002) [89]	to analyze the prevalence of intestinal helminth infections in mesoregions considered harmless for schistosomiasis	cross-sectional	18% positive	7-14 y	SE	The largest helminthes prevalence/ mesoregion was for *T. trichiura* (24.2%) and *A. lumbricoides* (18.7%) in the south/south-west region; hookworm (12.1%) and *Taenia* sp. (0.7%) in the northwest region of the study area.
Prado et al. (2001) [90]	to study the prevalence and intensity of infection by intestinal parasites in a sample of school children	cross-sectional	66.1% positive	7-14 y	NE	The most frequent intestinal parasites: *T. trichiura* (38.6%), *A. lumbricoides* (31.2%), hookworms (8.4%), *Schistosoma mansoni* (2.2%), *G. lamblia* (8.9%) and *Entamoeba histolytica* (5.5%).
Ferreira et al. (2000) [91]	to characterize and analyse trends in infant and child intestinal parasitic diseases using two household surveys undertaken in mid-80s and mid-90s	cross-sectional	< parasitosis from 30.9% to 10.7%	< 5 y	SE	Helminthes in general (from 22.3% to 4.8%) and giardiasis (from 14.5% to 5.5%). A significant decline in prevalence was observed in all social strata and the inverse association between income and intestinal parasites was kept unchanged in the period.
Rocha et al. (2000) [92]	to determine the prevalence of intestinal parasitosis in a school children and reevaluating the snails' breeding places described in the county	cross-sectional	20.1% positive	0-14 y	SE	20.1% of children had at least one parasitic infection; *G. lamblia, E. coli, A. lumbricoides* and hookworm were the most frequent parasites, with a prevalence of 6.2%, 6.2%, 4.8% and 1.4%, respectively. The hookworms were more frequent among students from the rural area ; the prevalence of *E. coli* was greater in the urban area.

Tsuyuoka et al. (1999) [93]	to describe the prevalence of anemia, parasitic infections, and nutritional status of children attending public primary schools	cross-sectional	26.7% anemia/ 42% parasitosis	4-15 y	NE	Overall prevalence of intestinal parasites was 42%; *A. lumbricoides* (28.7%), *T. trichiura* (15.6%), and hookworm (1.7%). There was an association between parasitic infections and poor sanitary conditions, but there was no association between anemia and presence of intestinal parasites.
Saldiva et al. (1999) [94]	to evaluate the role of intestinal parasites on nutritional status in three rural areas of Brazil	cross-sectional	78% inadequate daily caloric intake/ 34% inadequate protein daily intake	1-12 y	SE	*G. lamblia* (44%), *Endolimax nana* (43%), *A. lumbricoides* (41%) and *T. trichiura* (40%) were the most prevalent; 11% of the children were considered as showing stunting.
Machado et al. (1999) [95]	to show different frequencies of intestinal parasitosis (giardiasis and helminthiasis) among children in day-care centers and junior and high schools (public and private)	cross-sectional	> morbidity in daycare centers	2-15 y	SE	The frequency of giardiasis in public institutions was shown to be greater than in private institutions. Helminthiasi, frequencies were similar among day-care centers, but greater for public schools among children from low-income families and those whose parents had low levels of education.
Coelho et al. (1999) [96]	to establish a relationship between the presence of helminth eggs in the water closet elements and the frequency of these eggs in the feces of their users	cross-sectional	15.4% of infected children	2-6 y	SE	The contamination levels in the children's feces was 37.8% and 16.1% in the toilets. The school which showed the lowest contamination by intestinal helminths (12% in feces and 0% in the toilets) was the one that was located in the most central area of the city. There was not significant relationship between the elements of water closets and user's feces contamination.

The researchers found in 23 infected elements eggs of *Ascaris lumbricoides, Enterobius vermicularis* and larvs of nemathoids partially deformed [96].

Regional – Regional environmental factors

In this segment, 56 articles were chosen and divided in three subthemes ranging from the "impacts of air pollution on respiratory diseases", "exposure to chemical micropollutants" and "exposure to other biological agents" on children's health.

For the first subtheme "impacts of air pollution on respiratory diseases", 28 articles were used (Tab. V). A significant association between risk of low birth weight and exposure to pollutants was found, like PM_{10}, CO [98, 112, 118], SO_2 and O_3 [107]. A research [108] also revealed a gradient of approximately 50% of increasing risk of early neonatal death with higher exposure to traffic-related air pollution, compared with those less exposed.

Several authors have explored the deleterious effect of outdoor air pollution on pediatric respiratory morbidity [117,119,124] with decrease in lung function [106], with increased risk for asthma [111] and pneumonia in children [99, 113] in urban areas like the cities of São Paulo [100, 114, 122, 123], Rio de Janeiro [105], Curitiba [119] and Sobral [104]. Considering the lack of information on the air pollution effects on mortality in children's group, a study [121] showed the significant association between respiratory mortality in children and air pollution, in a city of SE Region. The estimated proportions of respiratory deaths attributed to CO, SO_2, and PM_{10}, when considered individually, were around 15%, 13%, and 7%, respectively.

Authors also observed a higher prevalence of Respiratory Diseases (RD) associated with seasonality. In the SE region [102] the highest number of hospital admissions happened in the peak of the transition between Summer and Fall, in the N and CO regions the hospitalization of RD was seen both in the dry [109, 115] and in the wet season [110, 116, 120].

Another point of focus for the study was a relation between exposure to fine particulate matter from fire and the prevalence of RD in children. Andrade Filho et al. [97] noted that respiratory diseases may be more associated to meteorological conditions, especially humidity, than to exposure to aerosols from fires in the N region. Riguera et al. [101], while studying pollution from burning sugarcane and respiratory symptoms in school age children in the SE region, noted a higher frequency of rhinitis in the harvesting period for sugarcane.

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Table V: REGIONAL- SPECIFIC ENVIRONMENTAL REGIONAL FACTORS

Impacts of air pollution on respiratory diseases

Reference	Purpose	Type of Study	Health Efects	Age	Region	Outcomes
Andrade Filho et al.(2013) [97]	to investigate the effects of fine particulate matter emitted through biomass burning on hospitalizations for respiratory diseases in children living Northern region	longitudinal	45% pneumonia	< 9 y	N	male gender: age:< 1 y (46,6%); 1- 4 y (39,6%); 5-9 y (20,6%); weather conditions: dry season; relative humidity than to exposure to aerosols emitted by biomass burning in the Amazonian region.
Romão et al. (2013) [98]	to analyze the relationship between exposure to PM10 and low birth weight in a city in the southeast region	longitudinal	5,9% of low birth weight	newborn	SE	male gender; air pollution influences pregnancy outcomes ; This effect was dose-dependent and was observed for all pregnancy exposure windows
Vieira et al. (2012) [99]	to evaluate the role of outdoor, indoor and personal exposure to combustion-related pollutants NO_2 and O_3 on respiratory health of children	longitudinal	67.2% wheezing	6 -10 y	SE	male gender; age:8,5 y (media); exposure to higher levels of NO_2 and O_3 was associated with increased risk for asthma and pneumonia in children. The measurements taken in indoor and personal exposure were the most accurate.
Jasinski et al. (2011) [100]	to evaluate the effects of air pollutants in relation to respiratory morbidity among children and adolescents	longitudinal	> respiratory hospital admissions	<19 y	SE	aged: < 5 y (85,6%); 9,6% higher of PM_{10} and 2,4% higher of O_3 increased adverse effects on children and adolescents pulmonary function.
Riguera et al. (2011) [101]	to estimate the prevalence of respiratory symptoms and to analyze associated factors as well as peak expiratory flow measurements in schoolchildren	cross-sectional	11% asthma 33,2% rhinitis	10 - 14 y	SE	male gender; age: < 13 y; 94.5% lived in the urban zone ; greater $PM_{2,5}$ concentration; rhinitis - from June to October, a period that matches the sugarcane harvest season; pollution in the cane trash burn season may contribute to the exacerbation of asthma and rhinitis episodes
Natali et al. (2011) [102]	to analyze the profile of children and adolescents' hospital admissions due to respiratory diseases in a city in the southeast region	longitudinal	51% pneumonia/ 18% asthma	<19 y	SE	male gender; age under 5 y; there is an obvious seasonality to admissions with the most significant peaks occurring in early autumn.
Moraes et al. (2010) [103]	to examine the association between wheezing in children and adolescents and living downwind of the dispersion plume of atmospheric pollutants emitted by the Guamaré Petrochemical Complex	cross-sectional	27,3% wheezing	<-14 y	NE	male gender; age < 5 y; respiratory symptoms in children and adolescents were associated with living downwind of a petrochemical plant.

Barreto & Grisi , (2010) [104]	to assess self-reported morbidity among children and to analyze its conditioning factors	cross-sectional	28,7% respiratory diseases	5-9 y	NE	male=female gender; low-income population; highest rates of respiratory diseases were seen in April, May and June - the rainy months ; finding is suggestive either of over reporting or environmental pollution.
Moura et al. (2009) [105]	to estimate the association between levels of air pollutants and respiratory symptoms in children	longitudinal	6,7% morbidity PM_{10} 3% morbidity O_3	1 m -12 y	SE	age: < 2 y; exposure to air pollutants was associated with a significant increase in emergency paediatric visits due to symptoms of bronchial obstruction in children..
Castro et al. (2009) [106]	to assess the association between daily exposure to air pollution and lung function in school children	cross-sectional	decrease in lung function	6 -14 y	SE	male=female gender; air pollution, especially PM_{10} and NO_2.
Nascimento & Moreira, (2009) [107]	to assess the association between prenatal exposure to air pollutants and low birth weight in a medium-sized city	longitudinal	3.95% low birth weight	newborn	SE	the pollutants SO_2 and O_3 were associated with low birth weight.
Medeiros et al. (2009) [108]	to examine the association between traffic-related pollution and peri- natal mortality	longitudinal	> neonatal death	newborn	SE	mothers exposed to the highest quartile of the distance-weighted traffic density, exhibited approximately 50% increased risk compared with those less exposed
Rosa et al. (2008a) [109]	to analyze hospitalizations for respiratory diseases among children in an area with high levels of environmental pollution	cross-sectional	63,7% hospitalization/ 90,7% pneumonia	< 15 y	N	male gender; age:< 1 y; during the dry season, the rate of admissions for respiratory diseases was 10% higher than during the rainy season.
Rosa et al. (2008) [110]	to analyze the climatic seasonality of primary care visits for respiratory disease (RD) in children	cross-sectional	32.7% respiratory disease	< 15 y	N	male gender; age < 5 y; primary care visits for RD, especially those due to upper airway diseases, are related to the rainy season.
Castro et al. (2007) [111]	to compare the pattern of asthma spatial distribution among children treated at outpatient services from 2001 to 2003	longitudinal	15% asthma	< 6 y	SE	PM_{10}, O_3, and SO_2 concentrations exceeded the WHO guidelines by 1.25%, 1%, and 7.25% respectively; impact of some local pollution sources, poor social, environmental conditions.
Junger & Ponce de Leon, (2007) [112]	to evaluate the effect of air pollution on low birth weight in full term newborns	cross-sectional	SO_2 > low birth weight	newborn	SE	first and third trimesters of pregnancy; especially in the first months of the year; suggesting that there is an association between air pollution and the incidence of low birth weight.
Nascimento et al. (2006) [113]	to estimate the association between pneumonia admissions and increased air pollutants	longitudinal	9,8% hostitalization/ pneumonia	<10 y	SE	the effect of PM_{10} remained statistically significant; air pollution changes would have an effect on the occurrence of children's respiratory illnesses.

Farhat et al. (2005) [114]	to assess the effect of air pollution on pediatric respiratory morbidity	cross-sectional	15% hospitalization/ respiratory diseases	< 13 y	SE	NO_2 was positively associated with all outcomes; .significant and positive associations between air pollution and respiratory morbidity in children were found.
Saldanha et al. (2005) [115]	to study variation in climate (dry or rainy periods) and health services use for the treatment of asthma in children	longitudinal	10% hospitalization/ asthma	< 5 y	CO	male gender; age: 1-3 y; dry season was correlated with higher asthma hospitalization rates with patients hospitalized: 52.3% versus 47.7% in the rainy seasons.
Medeiros & Gouveia, (2005) [116]	to study the effect of air pollution on birth weight	cross-sectional	4.6% low birth weight	newborn	SE	maternal exposure to CO, PM_{10}, and NO_2 during the first trimester of pregnancy was significantly associated with decreased birthweight.
Nascimento et al. (2004) [117]	to estimate correlation between atmospheric pollutants and the number of children admissions by respiratory disease in the year 2001	longitudinal	30% hospitalization/ respiratory disease	< 7 y	SE	positive correlation between the number of admissions by respiratory disease and the concentrations of SO_2 and PM_{10}.
Gouveia et al. (2004) [118]	to explore the association between exposure to outdoor air pollution during pregnancy and birth weight	cross-sectional	5% low birth weight	newborn	SE	female gender; birth weight exhibited a seasonal pattern; negative effects of exposure to PM_{10} and CO during the first trimester; for a 1 ppm increase in mean exposure to CO during the first trimester a reduction of 23 g in birth weight was estimated.
Bakonyi et al. (2004) [119]	to assess the effects of air pollution levels on respiratory morbidity among children from 1999 to 2000	longitudinal	4,5% > respiratory diseases.	<14 y	S	all pollutants (PM_{10}, O_3 and smoke) presented an effect on respiratory diseases among children; NO_2 did not exceed limit for air quality.
Botelho et al. (2003) [120]	to study the association between some environmental factors with the need for hospitalization of children with a diagnosis of acute respiratory infection (ARI)	cross-sectional	7,6% hospitalization	<5 y	CO	the dry season and lower relative humidity were associated with increased pediatric hospitalization rate due to ARI.
Conceição et al. (2001) [121]	to evaluate the association between child mortality and air pollution from 1994 to 1997	cross-sectional	> death due to respiratory disease	< 5 y	SE	Significant associations between mortality and concentrations of CO, SO_2, and PM_{10} were detected. The estimated proportions of respiratory deaths attributed to CO, SO_2, and PM_{10}, when considered individually, were around 15%, 13%, and 7%, respectively.
Braga et al. (2001) [122]	to investigate the responses of children of different ages to air pollution exposure, daily records of hospital admissions	cross-sectional	< 2y: 9,4% hospitalization/ >14y: 5,1% hospitalization	<19 y	SE	age: < 2 y and 14-19 y; PM_{10}, O_3, SO_2, CO and NO_2 concentrations in ambient air; daily respiratory hospital admissions for children and adolescents increased with air pollution.

Gouveia N.; Fletcher T. (2000) [123]	to investigate the short term effects of air pollution on the respiratory morbidity of children	cross-sectional	> hospitalization	< 5 y	SE	age: < 1 y; daily admissions of children in hospital for total respiratory disease and pneumonia showed significant increases associated with O_3 (5-8%), NO_2 (9%), and with PM_{10} (9%).
Lin et al. (1999) [124]	to report the association between air pollution and pediatric respiratory emergency visits in the southeast region	cross-sectional	20% hospitalization/ respiratory emergency visits	<13 y	SE	significant associations between the increase of respiratory emergency visits and air pollution were observed; the most robust associations were observed with PM_{10}, and to a lesser extent with O_3; air pollution is a substantial pediatric health concern.

In the subtheme "exposure to chemical micropollutants", 15 articles (Tab. VI) were identified. In the analyzed articles, pesticides, mercury, arsenic and lead were considered potential risk factors to children's health.

Researchers have suggested the relation between the use of agrochemicals and adverse events in children and adolescents. The findings showed that prenatal pesticide exposure is a risk factor to premature birth and inadequate maturation [128] and to some types of cancer in children. Acute Myeloid Leukemia (AML) and Acute Lymphocytic Leukemia (ALL) in young child were significantly associated with periconceptional exposure to pesticides (esbiothrin, tetramethrin, d-allethrin and d-phenothrin) [126]. Curvo [125] analyzed the positive prevalence of morbimortality due to cancer in adolescents in cities of the CO region, where there was an increase in grain harvesting and 48.91% of agrochemicals used were shown to be carcinogenic.

Table VI: REGIONAL- SPECIFIC ENVIRONMENTAL REGIONAL FACTORS						
Exposure to chemicals micropollutants						
Reference	**Purpose**	**Type of Study**	**Health Effects**	**Age**	**Region**	**Outcomes**
Curvo et al. (2013) [125]	to analyze the association between the agricultural use of pesticides and cancer morbidity and mortality in children and adolescents	longitudinal	> morbidity > mortality	<19 y	CO	male gender; the average use of pesticides in the counties showed a statistically significant association for both morbidity as for mortality for cancer children and adolescents, with 95% confidence interval.
Ferreira et al. (2013) [126]	to investigate the association between pesticide exposure during pregnancy and leukemia in children	longitudinal	48.4% of AML/ 47.6%, of ALL	< 2 y	NE, CO, SE e S	male gender; associations with ever use of pesticide exposure during pregnancy may be involved in the etiology of acute leukemia in children.
Dutra et al. (2012) [127]	to study a longitudinal assessment of mercury exposure in schoolchildren in an urban area	longitudinal	1µg/g-8.22µg/g hair 10µg/L-60µg/L blood level at birth	8 -10 y	N	male gender; age: 8 y; there was a significant increase in blood mercury from 2004 to 2006 ($p < 0.001$), exposure through air pollution; the main exposure to mercury was during pregnancy.
Cremonese et al. (2012) [128]	to investigate potential relations between per capita pesticide consumption and adverse events in live born infants	longitudinal	> premature birth low Apgar score	newborn	S	prenatal pesticide exposure is a risk factor for adverse pregnancy events such as premature birth and inadequate maturation.
Ferron et al. (2012) [129]	to estimate the prevalence of lead poisoning in children and to identify associated factors, as well as possible local sources of contamination	cross-sectional	16% blood lead levels ≥ 10.0 **µg**/dL	0 -5 y	S	male gender; age: 2,6 y; waste recylcing activities.; soil, and air pollution.

Sakuma et al. (2010) [130]	to assess children exposure to arsenic from environmental sources in a region of lead mining area	cross-sectional	hight level of urinary arsenic in one group	7-14 y	SE e S	anthropic contamination may explain the higher urinary arsenic values.
Olympio et al. (2010) [131]	to analyze household risk factors associated with high lead levels in surface dental enamel in adolescents living in poor neighborhoods	cross-sectional	high dental enamel lead levels	14-18 y	SE e S	male gender; living in or close to a contaminated area and member of the household worked in the manufacturing of paints, paint pigments, ceramics or batteries.
Mattos et al. (2009) [132]	to identify the contamination sources and potential risk factors of the exposure in children from an economically deprived community	cross-sectional	40% Pb-S > 6µg/dL 5% Pb-S > 10 **µg**/dL	0-16 y	SE	male gender; the carcinogenic risk factor for ingestion was about 4 times; sociodemographic aspects: low income, sewer destiny, dust and contaminated soil.
Farias et al. (2008) [133]	to assess total Hg levels in children's hair from a coastal population	cross-sectional	low Hg levels $0.04 mg.kg^{-1}$	4-12 y	SE	the values were well below the level set by World Health Organization for an adult population unexposed to Hg ($2.0 mg.kg^{-1}$).
Santos et al. (2007) [134]	to evaluate transplacental mercury transfer by measuring Hg in blood samples of mothers and newborns (umbilical cord)	cross-sectional	Hg: 16.68µg/L in newborns	newborn	N	maternal blood Hg showed a strong positive correlation with age and a positive (but weak) correlation with frequency of fish consumption; correlation between maternal and cord blood Hg levels) was strongly positive.
Rodrigues &; Carnier, (2007) [135]	to investigate the general development and the areas in imbalance of children with levels of lead contamination in the blood above 10µg/dl	cross-sectional	important imbalances in Cognition and Language	1 - 5 y	SE	the reduced number of children and the absence of data from a control group made it difficult to confirm the observed results concerning general development following lead contamination, though it is consistent with the research literature.
Padula et al. (2006) [136]	to evaluate the condition of all children living in close proximity to a battery factory	cross-sectional	36,8% ≥ 10µg/dL/> neurological risk	0 - 12 y	SE	blood lead levels in the control group were lower than those presented by the exposed group ($p < 0.05$) 314 children with blood lead rates higher than those acceptable to the CDC (10µgPb / dl blood.
Tavares et al. (2005) [137]	to investigate the use of a battery of neurological development tests in two groups of riverine children	longitudinal	higher exposure to MeHg = 5.37 ± 3.35µg/g	3 - 7 y	N	in the clinical examination, no signs and symptoms were found that could jointly reflect a clinical picture characteristic of mercury poisoning;
Carvalho et al. (2003) [138]	to determine the blood lead levels in children living in an inactive lead foundry and to identify factors associated with differences in these levels	cross-sectional	Pb : 17.1 ± 7. 3 mg/dL	1 - 4 y	NE	visible presence of scum surrounding the home, family history of lead poisoning, and malnutrition; the environmental legacy of the lead foundry, represent a relevant risk factor for increased blood lead levels in children, especially those presenting pica.
Grandjean et al. (1999) [139]	to carry out cross-sectional studies in four comparable riverine communities that had exposure to methylmercury	cross-sectional	80% hair-mercury > 10 microg/g	7 - 12 y	N	the current mercury pollution seems sufficiently severe to cause adverse effects on brain development.

Another chemical contaminant related with Brazilian children's health living in several parts of the Amazon basin (N Region) has been mercury, used in the gold extraction process [133] and resulting in the contamination of freshwater fish with methylmercury [139]. Children can be subjected to mercury exposure through: prenatal transfer across the placenta [134] with positive correlation with mother's frequency of fish consumption; breastfeeding, by ingesting breast milk containing mercury; and a diet rich in fish [127] with possible adverse effects on brain development [139]. Riverine children presented higher exposure to methyl mercury (one organic form of mercury) as compared to other communities in the Brazilian Amazon [137], but in the clinical examination, no signs and symptoms were found that could jointly reflect a clinical picture characteristic of poisoning.

Concerning the prevalence of lead poisoning, studies found blood lead levels ≥ 10.0 µg/dl, in children, associated with waste recycling [129] and residing close proximity to a battery factory [136]. Another study showed a strong association between adolescents with high dental enamel lead levels living in or close a contaminated area [131]. In those three studies, the high lead levels seemed not affect the child population health. Another study showed a strong association between adolescents with high dental enamel lead levels living in or close a contaminated area [131]. Sakuma et al. [130] reported that contamination from lead in a former mining area may explain the higher urinary arsenic values among the children living nearly, despite the median arsenic values do not warrant immediate health concern. Conversely, researchers suggested relations among important imbalances in cognition and language in early childhood with indices of contamination for lead up 10.0μg/dl to 45.40μg/dl [135], and also neurological risk factor of exposure to lead on dust and by ingestion, in children from an economically deprived community [132] especially in those presenting pica and malnutrition [138].

On the third subtheme "exposure to other biological agents", we used 13 articles (Tab. VII). Authors have studied the importance of early diagnosis of and correct treatment for dengue fever and malaria in endemic regions. The prevalence of dengue in children living in areas in the N Region [141, 142], CO Region [145] and SE Region [147] have led to a disruption of routine health services, demanding further efforts towards providing technical training to health professionals working on the frontline of dengue treatment in children's patient care. As for malaria, researches had investigated children and adolescents who live in the N region [151, 152]. The lethality was 1.6% and besides the common symptoms of malaria triad (fever, chills and headache) they had among others like pallor, anemia, myalgia, vomiting and some degree of malnourishment [151], and there was a prevalence of malaria among adolescents [152].

Table VII: REGIONAL- SPECIFIC ENVIRONMENTAL REGIONAL FACTORS

Exposure to other biological agents						
Reference	**Purpose**	**Type of Study**	**Health Effects**	**Age**	**Region**	**Outcomes**
(Cruz et al 2013) [140]	To describe an extremely uncommon outbreak of eye lesions in a specific area of the Brazilian Amazonia	cross-sectional	57,8% eye	11.6±6.5 y	N	83 eyes were affected; the most common lesions were corneal opacities observed in 34 eyes and conjunctival nodules diagnosed in 12 eyes; the necessity of caution when tourists interact with unfamiliar ecosystems, especially in disturbed environments.
(Costa CA & Façanha GP. 2011) [141]	to identify dengue virus serotypes, in 2008 in infant population	cross-sectional	17% positive	0 - 10 y	N	occurrence of other febrile illnesses that need to be determined; all zones and eleven districts in the study had positive cases.
(Rocha LA. & Tauil PL. 2009) [142]	to present the clinical and epidemiological characteristics of children affected by dengue, in 2006 and 2007	cross-sectional	46,9% positive (2006) 57,7% positive (2007)	0 - 14 y	N	although the hemorrhagic form was almost three times more frequent in 2007, the mortality rate was lower; 2006 - the highest incidence was in children under 1 year; 2007 - there were a predominance in children 10-14 years.
(Guerra et al. 2007) [143]	to evaluate factors related to the occurrence of cutaneous leishmaniasis in children	longitudinal	34% positive/ 11-14 y	0 - 14 y	N	activities in the forest around the houses and the living situation near the primary forest; cases in very young children, suggested transmission in and around the house, and in a few cases, children entering the forest.
(Volkmer-Ribeiro et al. 2006) [144]	to carry out aiming to detect sponge spicules in surgically removed ocular lesions	cross-sectional	100% freshwater sponge spicules	8 - 13 y	N	freshwater sponge spicules *Drulia uruguayensis* and *D. ctenosclera* may be new etiological agent of ocular pathology injuries that occurred in a town at the right bank of Araguaia river.
(Campagna et al. 2006) [145]	to study the etiology of exanthema cases, in children seen in the emergency room in a region where dengue is endemic	cross-sectional	77,5% positive for dengue fever	0 - 13 y	CO	the most common clinical manifestations among the dengue patients were: fever, itching, prostration, myalgia and positive tourniquet test results; constant control of epidemiological and serological surveillance of exanthematous diseases is necessary.

(Ampuero et al. 2005) [146]	to identify risk factors for cutaneous leishmaniasis transmission in children in an endemic area	longitudinal	33% positive	0 - 5 y	NE	no evidence of association between the disease and other risk factors such as child's habits inside or outside the house, domiciliary or peridomiciliary characteristics, or presence of vectors or probable reservoir animals; the hypothesis is that humans serve as both the reservoir and source of infection for this age group.
(Rodrigues et al. 2005) [147]	to identify clinical characteristics indicative of dengue and to evaluate the applicability to children of the Health Ministry criteria for suspected case	cross-sectional	50,4% positive	1 - 12 y	SE	only exanthema was more often associated with dengue; the Health Ministry criteria for suspected cases was shown to be of little use, particularly with smaller children and during periods of reduced incidence.
(Coelho et al. 2004) [148]	to perform a seroepidemiological survey in order to detect anti-toxocara antibodies among schoolchildren	cross-sectional	38,3% positive	2-8 y	SE	children living in the city outskirts where the socioeconomic conditions were worse than in the central region of the city; enteroparasitism and pet dogs and/or cats without vermifuge treatment.
(Bucaretchi et al. 2002) [149]	to describe the clinical and some laboratory aspects of bites caused by *Crotalus durissus* ssp snakes in children	longitudinal	87% palpebral ptosis/ 74,19% myalgia	1-14 y	SE	occurred from November to April, in rural areas, including around the home; laboratory tests suggesting rhabdomyolysis included an increase in total blood creatine kinase and lactate dehydrogenase levels and myoglobinuria; no deaths were recorded.
(Bucaretchi et al. 2001) [150]	to describe the clinical aspects and outcome of bites caused by *Bothrops* spp. snakes in children	longitudinal	94,5% edema/ 94,5% pain/ 73,4% ecchymosis	1-14 y	SE	most accidents occurred from October to March, in rural areas, including around the home. The main clinical complications observed were local infection (15.1%), compartment syndrome (4.1%), gangrene (1.4%) and acute renal failure (1.4%).
(Noronha et al. 2000) [151]	to study the clinical characteristics of falciparum malaria among children treated at a reference center	cross-sectional	98,4% fever/ 80,3% headache/ 68,9% chills/	0 - 14 y	N	91.5% patients had uncomplicated malaria and the lethality was 1.6%; most children (85.2%) have been infected in rural areas, although there was urban transmission (13.1%), mainly in the suburbs.
(Ventura et al. 1999) [152]	to evaluate epidemiological, clinical and laboratory features of *Plasmodium vivax* malaria in children and adolescents	cross-sectional	97% fever/91% chills/ 85% pallor/ 89,2% anemia	0 - 14 y	N	adolescents (37%) probably working on the farm and mining to help support their family ; primary infection in 80% of the patients; 13,6% malarial triad.

Another cause of illnesses in children related to regional socio-environmental factors are accidents that happen in area contiguous to the household. Authors detected anti-toxocara antibodies positive among schoolchildren living in a house with a yard and/or unpaved street and there was also an association between a seronegative ELISA test and previous treatment of pet dogs and/or cats with vermifuge [148]. The occurrence of cutaneous leishmaniasis in children living in N and NE Region, suggested transmission in and around the house, and in a few cases, children were entering the forest [143] or presence of a family member with a history of these disease [146]. Especially in rural areas in the SE Region where there are deforestation and residences near natural forest children can be stung by snakes and show clinical complications [149, 150]. Clinical researches [140, 144] detected important ocular lesions caused by freshwater sponges species *Drulia uruguayensis* and *Drulia ctenosclera*, in school age children who swam in some rivers near their homes, in the Brazilian Amazon. These works revealed that freshwater sponge spicules may be a dangerous etiological agent of ocular pathology to kids that swim on those rivers.

Discussion

Home Life

We can summarize, in relation to infant exposure to risk factors in the domicile lives that there are three direct threats: toxic substances, parental smoking and the burning of domiciliary biomass and living conditions at home.

According to our research, the exposure to toxic agents at home, in children younger than 5 years of age, was mostly due to household cleaning substances, pesticides and the inappropriate use of medicine. This result is very close to the conclusion of studies conducted by Mowry et al. [153], which suggests there is a need to create stronger national prevention campaigns focused on the inappropriate conditions in which products are purchased, on explaining about packaging of those agents, on raising awareness of the risks of the domestic environment and of the placement of the hazardous substances, which, in the research, were in the children's reach.

The present review has clearly shown the harmful effect of parent smoking on the respiratory health of the children and has identified three critical and biologically relevant windows of exposure to the adverse effect of second-hand smoking on children: i) in-utero, with a negative impact on the anthropometric measures of the newborn, confirmed also by Salihu and Wilson [154]; ii) in the first two years of life, when the respiratory tract infection rates are much higher and maternal smoking has a higher effect because the children stay a longer time at home in direct contact with the grownups [155]; iii) after the first two years, when respiratory diseases like bronchiolitis, asthma or pneumonia are more common, elevating the children morbidity.

Confirming that data, the research done by Gupta et al. [156] showed that, from over 40 studies, all but one have reported an increased risk among children whose parents smoke, and pooling the studies' results, children whose mothers smoke are estimated to have a 1.7-fold higher risk of these illnesses than children of nonsmoking mothers while paternal smoking alone causes a 1.3-fold increase in risk. Heinrich [157], in an review of the influence of indoor factors in dwellings on the development of childhood asthma, corroborates the above data, suggesting that one of most consistent findings for the cause of asthma in childhood is related to exposure to environmental tobacco smoke.

But even worse than exposing children to tobacco smoke is contaminating them with third-hand smoking – THS [158], which according to Ramírez et al. [159] can cause changes to the DNA and cancer, as the nicotine residues provoke on lesions that break the molecule bonds responsible for transmitting the genetic code. In our research, we did not find any Brazilian study about so important theme.

Another important point to discuss is the smoke resulting from burning the domiciliary biomass and its repercussions on children's respiratory system. In Brazil, a country of vast socioeconomic contrasts, gas cylinders are expensive and/or hard to get, which makes the lower classes use firewood and coal in ovens. Data from the Tolmasquim & Guerreiro [160] shows that firewood is the second highest source of residential energy consumption in the country, accounting for 33.9% of all energy used in domestic supply. The WHO [14] reinforces that data by confirming that worldwide, around 3 billion people cook and heat their homes using open fires and simple stoves burning biomass like wood and coal. The most serious piece of data is that more than 50% of premature deaths among children under 5 are due to pneumonia caused by particulate matter (soot) inhaled from household air pollution [14]. Even with such relevant information, we found only one research done on Brazil about this risk effects: the use of wood stove for cooking as a major factor associated for recurrent wheezing in children [41].

Social – Sanitation and Socio-environmental Factors

In this group, we worked with information about the prevalence of diseases children suffered that are related to sanitary conditions, like having no water supply waste. This data confirm the available scientific evidence that the dissemination of parasitosis and morbidity due to diarrhea are affected by environmental changes, high population concentration, poor hygiene and when faeces are disposed of improperly which can then contaminate food or other humans - person-to-person transmission [161].

Studies have shown that intestinal parasites like *Ascaris lumbricoides* and *Trichuris trichiura* are common in daycares, preschoolers and elementary school-age children. The CDC [162] corroborates that data by declaring that the Ascaris infection is one of the most common intestinal worm infections. It is found in association with poor personal hygiene, poor sanitation, and in places where human feces are used as fertilizer. According to the CDC [162], heavy infestations can affect the nutritional balance and harm the children's growth. Our study confirmed that alterations to the anthropometric state [76] and malnutrition of children can be secondary to parasitosis and are intimately associated to the insalubrious environment [62] especially in household that do not have a proper waste management and collection of solid residues [78]. So improving the living conditions of the deprived population, as well as giving them access to a better healthcare are essential measures to cause a positive change in the situation shown above.

We have seen the general mortality and hospital morbidity rates due to diarrheic diseases in children under five years of age have been decreasing in Brazil. However, the Northern and Northeastern Regions, areas with the lower HDI in the country, still show the highest coefficients of mortality and the highest percentage of admittance of children under one year of age [49]. Even though Brazil has almost 13% of all superficial hydric resources of the planet, it is a country where a vast number of people do not have bathroom inside the household, corresponding to 7.2 million people [163]. Thirty four million people have no access to canalized water; 103 million people have no access to a waste disposal system, and only 38.7% of the generated waste is treated [164]. The NE Region is where the lack of a sewerage system is most dire, and approximately 15.3 million people are affected by the lack of sanitation [165]. The regional heterogeneity of the coefficients of mortality due to diarrhea reflects that socioeconomic and cultural inequality, as well as the difficulty the lowest classes have in getting access to healthcare and to sanitation.

Regional - Regional environmental factors

The relationship between the air pollution and the climatic variables has been a growing concern also on a regional level in

Brazil due to the potential effects on human health, as it is also responsible for the increase of the number of the cases and the gravity of acute respiratory infection in children under five years of age. As a country with a tropical climate, throughout the year the weather is mild and, on occasion, very hot, with marked periods of rain and drought. The reduction of the relative humidity of the air below 30% is considered dangerous to the integrity of the airways, especially for a susceptible population [110].

Some viruses have a seasonal behavior, with a higher frequency in the rain season and during sharp climatic changes, which also causes the precipitation of the particulate matter from the atmosphere in big cities, increasing the number of cases of pneumonia, asthma and bronchiolitis in vulnerable children. D'Amato et al. [166] confirm this data and report that climate change represents a massive direct threat to respiratory health by promoting or aggravating respiratory diseases or indirectly by increasing exposure to risk factors for respiratory diseases. More than 85% of all fires in Brazil during the dry season are concentrated in the Amazon region, accounting for a long-term source of emission of gases from the burning of biomasses during the dry season [167, 168]. Children and adolescents living in the Subequatorial Brazilian Amazon region exposed to high levels of $PM_{2.5}$ had toxicological risk quotients comparable to or higher than in children living in metropolitan regions where the $PM_{2.5}$ air pollution is above the recommended limits to human health [169].

In contrast to large cities in other countries where the main sources of aerosol particles are emissions linked to fossil fuel combustion [170], in Brazil, sugarcane burning contributed to 60% of the fine-mode aerosol mass [171] and can contribute to the aggravation of asthma and rhinitis episodes in susceptible children [101].

We have also found significant and positive relations between air pollution and respiratory morbidity in children who live in urban areas with a huge number of automobiles. The effect of the air pollution was detected in terms of emergency services and admittances in large and small cities in Brazil. Parker et al. [172], in a research conducted with North-American children, came to the same conclusion: the results provide evidence of adverse health effects for children living in areas with chronic exposure to higher levels of O_3 and $PM_{2.5}$ compared with children with lower exposures.

Another threat to the health of children that called our attention was the environmental contamination due to agrochemicals. In the last few years, Brazil has become the number one consumer of agrochemicals in the world [173] and increasingly dependent of such products and chemical fertilizers. In that sense, that exposure to agrochemicals and pesticides increase the prevalence of morbimortality due to cancer in the infant-juvenile population, and is also a possible risk factor for adverse effects during pregnancy, such as acute leukemia, premature parturition and improper maturation [125, 126, 128]. Another perspective on this type of exposure is the study conducted by Rasier et al. [174] that reported exposure of the developing fetus or neonate to environmentally relevant concentrations of certain chemicals, among them endocrine disrupters, induces morphological, biochemical and/or physiological disorders in the brain and reproductive organs, by interfering with hormone actions. In our research, we did not find articles focusing this issue in the Brazilian children.

Conversely, exposure to environmental contaminants, including heavy metals, is a generalized problem relatively well-studied in Brazil. The CDC [175] informs that today there are approximately half a million U.S. children ages 1-5 with blood lead levels above 5 µg/dl, the reference level at which CDC recommends public health actions be initiated. In our review, lead showed morbidity when the levels in the blood were higher than 10µg/dl [136] and could cause alterations in language acquisition [135].

We have also seen in the Amazon the presence of another toxic exposure agent, the mercury. When it transforms into methylmercury (MeHg) – its most toxic form - it can affect the neurological development of children that ingest contaminated fish during a prolonged period of time [137]. According to Bose-O'Reilly et al. [176], even though epidemiologic studies in many countries report that fish intake is the single most influential predictor of blood or hair mercury levels, fish is a good dietary source of lean protein and omega-3 fatty acids, which are important for children to develop properly. So, for the authors, these beneficial effects may obscure adverse effects of methylmercury exposure.

According to literature, seroepidemiological surveys are an important research tool, especially in Public Health, because they allow the determination of the infection coefficient for a given pathology in a given population [148]. In that sense, the subtheme "exposure to other biological agents" showed us the importance of epidemiological studies present in endemic regions in Brazil, where the socioeconomic conditions are worse, or by children activities in the forest around the houses. Studies on pediatric malaria are scarce [177] despite the increasing number of cases in children and adolescents due to malaria urbanization in various cities of the Amazon Region [152].

Concerning dengue fever, more than 2.5 billion people, in over 100 countries, are estimated to live in risk areas for the transmission of *Aedes aegypty's* vector [178]. Our data survey had only 4 (30%) studies dedicated to the risk factors to children exposed to the dengue virus [141, 142, 145, 147]. The researches were conducted in the same Brazilian areas where today there are more cases of the zika virus and chikungunya caused by *Aedes aegypty* [179].

Besides being considered an international public health emergency with its epicenter in Brazil [180], the strong association, in time and place, between infections with the zika virus and a rise in detected cases of congenital malformations and neurological complications in newborns [181, 182, 183] of pregnant women who had contact with the vector highlights the importance of *A. aegypty* control. In January 2016, the Brazilian Ministry of Health [179] confirmed these data by disclosing evidence that the zika virus crossed the placental barrier, transmitting the disease to the developing fetus [179]. Nowadays, the elimination of this vector is becoming a health emergency in countries around the world.

An effective prevention policy for exposure to biological agents to be successful should effectually involve academic community, public health sectors and the society as a whole.

Conclusions

The scenery for children life including adverse effects of danger exposures in home life, lack of sanitation and other socio-environmental factors with regional hazards can generate an unfavorable environment for their health in several parts of Brazil. Studies conducted in all regions of the country have shown that the occurrence of preventable diseases from domestic to regional threats and their determinants in childhood years occur not by chance or at random in any community. It is possible to establish causal relations and, thus, define the protective factors to be considered in order to improve the quality of life of Brazilian children. Poverty and the lack of access to information on inherent healthcare practices that benefit the children population are key factors that must be changed to prevent pediatric diseases.

Other aspects arise when discussing how to improve the health of children all over Brazil. Considering the extensive area of the country and regional peculiarities, there is a need for government actions such as enforcing a tighter control on the use of pesticides and agrochemicals in general, monitoring air quality according to health standards and educational effort on parents and guardians in keeping children far from medicine, medicine cabinets and the like, disposal of waste in a safe and appropriately way, and others. Nonetheless, what can be learned from the studies analyzed is that the public sector as well as legal guardians must work together to reduce the number of preventable infant diseases and deaths due to environmental hazards.

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