Diarrhea in children and sanitation and housing conditions in periurban areas in the city of Guarulhos, SP

Prevalência de diarreia em crianças e condições de saneamento e moradia em áreas periurbanas de Guarulhos, SP*

Abstract

A cross-sectional study was carried out to identify the association between diarrhea in 0-2 year-old children and children´s characteristics, access to sanitation and housing conditions in a periurban area served by the Family Health Program, in the city of Guarulhos, SP. Data were obtained from FHP registration forms. Multiple logistic regression showed interaction for *Housing*Sewage* (other materials and non collected wastewater, p < 0.001), age group (4 - 9 months old, p = 0.054; 10 months and older, p = 0.008) as risk factors for diarrhea. Information collected by the *Family Health Program* could be an excellent tool to identify populations with poor housing and sanitation conditions at locations where sanitation indicators are not efficient to identify populations living at risk.

Keywords: Diarrhea. Sanitation. Family Health Program. Periurban area. Epidemiologic study. Environmental health.

Mariana Gutierres Arteiro da Paz[I]
Márcia Furquim de Almeida[II]
Wanda Maria Risso Günther[III]

[I] Programa de Pós-Graduação em Ciência Ambiental do Instituto de Eletrotécnica e Energia da Universidade de São Paulo

[II] Departamento de Epidemiologia da Faculdade de Saúde Pública da Universidade de São Paulo

[III] Departamento de Saúde Ambiental da Faculdade de Saúde Pública da Universidade de São Paulo

Resumo

Foi realizado estudo transversal em área periurbana do Município de Guarulhos, SP, atendida pelo Programa Saúde da Família (PSF) para verificar associação entre ocorrência de diarreia em crianças de 0-2 anos de idade e características da criança, condições de saneamento e tipo de moradia. Os dados foram coletados nas fichas de registro do PSF. Foi realizada análise de regressão logística multivariada, a qual indicou a interação *Moradia*Esgoto* (outros materiais e ausência de rede de esgoto, p < 0,001) e *idade* (4 - 9 meses, p = 0,054; e 10 meses e mais, p = 0,008) como fatores de risco para ocorrência de diarreia. Em localidades com falta de dados para compor indicadores de saneamento básico que permitem identificar populações que vivem situações de risco para a ocorrência de diarréia, as informações coletadas pelo PSF podem se constituir em excelente ferramenta para identificação de núcleos populacionais com precárias condições de habitação e saneamento.

Palavras-Chave: Diarreia. Saneamento básico. Programa Saúde da Família. Área periurbana. Estudo epidemiológico. Saúde ambiental.

Introduction

Diarrhea is a relevant public health issue related to hygiene conditions and water quality (Özkan et al[1], 2007). WHO reports diarrhea as the second leading cause of death in children, representing about 1.5 million annual deaths in children under five years old (UNICEF/WHO[2], 2009). In global data, diseases related to diarrhea are among the greatest causes of mortality in underdeveloped countries (Fewtrell et al[3], 2005), where they are frequent and can be fatal (Bozkurt et al[4], 2003), especially in young children (Moe e Rheingans[5], 2006). In these countries, it is estimated that 1.5% of newborn deaths in 1993 (Bozkurt et al[4], 2003) and 7.1% of deaths between 1998 and 2002 in Latin America and the Caribbean (Teixeira e Pungirum[6], 2005) were caused by diseases related to diarrhea. Transmission of infectious diseases such as diarrhea is a complex process, with many determinants (Trevett el al[7], 2005). Nevertheless, 88% of the deaths caused by diarrhea are a consequence of unsafe water, unsuitable sanitation and poor hygiene conditions (UNICEF/WHO[2], 2009). This is why water provision in quality and amount, treatment and removal of domestic waste and promotion of sanitation in the community are actions that can be taken to prevent diarrhea in children (UNICEF/WHO[2], 2009). These services must be promoted by the urban infrastructure sector, with participation from the public health sector, jurisdiction of the *Sistema Único de Saúde* (SUS – Brazilian Unified Health System) and community, as stated in the Federal Constitution of 1988 (BRASIL[8], 1988).

In many Brazilian localities, populations without urban infrastructure such as sanitation services and public equipment are served by the *Programa de Saúde da Família* (PSF – Family Health Program). This program was created in 1994 as an alternative health promotion program in the country. Teams of *Agentes Comunitários de Saúde* (ACS - Communitarian Health Agents) visit families periodically to collect data about

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habitation and family and health conditions for records and to compose the *Sistema de Informação da Atenção Básica* (SIAB – Information System for Primary Care). ACS follows the families monthly and records the information regarding housing, sanitation and health of children 0 to 2 years old.

In periurban areas, sanitation services are usually not universal, ergo in many localities there is no access or it occurs irregularly. Precarious access is often responsible for a large part of occurrences of diarrhea, and it is associated with poverty (Blakely et al[9], 2005).

The objective of this study is to verify if there is an association between the dependent variable prevalence of diarrhea and the variables: i) child characteristics (gender, age, nutritional state, breastfeeding and birth weight); ii) sanitation conditions (water supply, home water treatment and sewage); and iii) housing type.

Methods

Area and studied population

The study examined a county in the metropolitan region of São Paulo (RMSP), a low-income periurban settlement with the PSF implemented since 2005. Considering that the PSF can be an instrument in identifying priority areas of sanitation investment, a transversal study was done in order to verify the possibility of using information raised by ACS in the health-environment interface. The study field is represented by the Recreio de São Jorge neighborhood, Guarulhos, SP. The locality is attended by health unit Recreio de São Jorge, from PSF and is located in the supply reservoir catchment protection area of the Cabuçu reservoir. In 2006 (research interest period) the Recreio de São Jorge neighborhood had an estimated population of 17,502 inhabitants and unsatisfying sanitation indices with 88.7% of the houses served by the public water supply system and only 16.9% served by sewer collection. Considering the number of records in the PSF register for the period of May 2005 to April 2006, all children between 0 and 2 years old were studied during the reference period (817 children) as well as registered families responsible for these children (771 families).

Variables used and data collection

The dependent variable is the *diarrhea occurrence* in children between 0 and 2 years old. This indicator is used in most studies to assess sanitation impacts on public health Andreazzi et al[10] (2007), for response capacity, viability in its use and easy determination of disease (Heller[11], 1997). The exposure variables refer to child characteristics, housing and sanitation conditions. As information sources were used *Form A* – family characteristics and *Form C* – health conditions form and medical monitoring for children under 2 years old.

From *Form A* the variables used were: i) Material used in habitation construction: wood, brick, reused material, others; ii) number of rooms in the house; iii) number of residents; iv) adult residents per home, by age; v) water supply conditions: by public network, by well or spring or others; vi) kind of water treatment in house: by filtration, boiling, chlorination or without treatment; vii) waste disposal: by public collection, burned or buried, waste dump; and viii) sewer destination: sewer, sink or open sewers. The *waste disposal* variable is not part of the study because according SIAB information, 99% of local families were served by city public collection. Information found on *Form A* was collected by the ACS between March and April 2005, when the program was implemented, being that there were no sanitary or educational interventions in the referenced period (May 2005 to April 2006).

The variables used on *Form C* were: i) age (age group); ii) birth weight; iii) nutritional state (presented malnutrition during period, yes or no); and iv) breastfeeding (exclusive or mixed). The *age* variable was stratified across three age groups: 0-3 months, 4-9 months and 10 months or more.

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Information about child characteristics was collected monthly by the ACS during home visits.

Data analysis

Univariate analysis was initially performed between the closure *diarrhea occurrence* and environment and child health variables to the variables pre-selection, using the value of p<0.2 (Table 1) as a cutoff. The association measure was the Prevalence Ratio (PR) for a Confidence Interval (CI) of 95%. To calculate the *age* PR and the *diarrhea occurrence* the Mantel and Haenszel PR to CI 95%, were used (Kelsey et al[12], 1996). This analysis was used to identify the variables that should be used in the logistical regression analysis. In the multivariate analysis, the multivariate logistic regression model was used, in STATA 9 statistical software.

Three adjustments were made until the final model was complete, selecting the variables that were associated with the closure of statistical level of significance <0.05.

Ethical aspects

The *Comitê de Ética em Pesquisa de Saúde Pública* of *Universidade de São Paulo* (COEP – Research Ethical Committee) reviewed and approved the Research Protocol N° 1435, according to requirements of *Resolução* CNS/196/96 (Resolution of Brazilian National Health Council).

Results

During the analyzed period 4,048 cases of diarrhea in children between 0-2 years old were recorded. Regarding the characteristics

Table 1 - Child characteristics and prevalence of diarrhea in 0-2 year-old children living in Recreio de São Jorge, Guarulhos, SP, May 2005 to April 2006.
Tabela 1 - *Características da criança e prevalência de diarreia em crianças de 0 a 2 anos de idade no Recreio de São Jorge, Guarulhos, SP, maio de 2005 a abril de 2006.*

Child characteristics		Diarrhea occurrence				Total N°	PR	CI (95%)	p
		Yes		No					
		N°	%	N°	%				
Malnutrition	Yes	5	22.7	17	77.3	22	1.49	0.68; 3.28	0.337
	No	121	15.2	673	84.8	794	1		
Breastfeeding	Mixed	89	16.3	458	83.7	547	1.07	0.75; 1.54	0.696
	Exclusive	35	15.2	196	84.8	231	1		
Gender	Male	63	17.4	299	82.6	362	1.14	0.82; 1.58	0.433
	Female	59	15.3	327	84.7	386	1		
Age group (in months)	0 -3	5	6.0	79	94.0	84	*0.25	0.10; 0.06	<0.001
	4 - 9	51	23.9	162	76.1	213	1		
	10 months or more	70	15.4	386	84.6	456	*0.53	0.38; 0.73	<0.001
Birth weight	<2500g	15	24.6	46	75.4	61	1.34	0.74; 2.79	0.242
	>=2500g	102	18.4	452	81.6	554	1		

Notes: * To evaluate age, Mantel and Haenzel Prevalence Rate –RPMH was calculated
Without information: Malnutrition: 1; Breastfeeding: 39; Sex: 69; Birth weight: 202
Notas: ** Para a variável idade foi calculada a Razão de Prevalência de Mantel e Haenszel - RPMH*
Ausência de informação: Desnutrição: 1; Aleitamento: 39; Sexo: 69; Peso ao nascer: 202

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of children and families in the univariate analysis, greater diarrhea prevalence in children between 4-9 *months old* was identified**. Taking the *age group 4-9 months old* as a reference, *age group 0-3 months old* and *more than 10 months old* showed protection effect to *diarrhea occurrence*. Table 1 shows that *age group* was associated to *diarrhea occurrence*. The variable *elderly* also was associated to *malnutrition*: all children with *malnutrition* (22) lived with adults older than 55 (chi^2=784.00; p<0.001). Due to collinearity between *malnutrition* and *elderly*, the variable *elderly* was not contemplated in the regression model, while *malnutrition* remained in the analysis. *Weight when born* variable was not a part of the model because of high loss of record (24.7%).

Table 2 shows that *material other than brick* used in construction of habitation was considered a risk factor to *diarrhea occurrence* in children (p<0.001). This variable portrays family socioeconomic conditions and is highly correlated to s*ewer destination*, when *absence of sewage* (p<0.001). Because of this high correlation between *housing* and

Table 2 - Access to sanitation, housing conditions and prevalence of diarrhea in 0-2 year-old children living in Recreio de São Jorge, Guarulhos, SP, May 2005 to April 2006.
Tabela 2 - *Acesso ao saneamento e condições de moradia e prevalência de diarreia em crianças de 0 a 2 anos de idade no Recreio de São Jorge, Guarulhos, SP, maio de 2005 a abril de 2006.*

Dwelling conditions		Diarrhea occurrence				Total N°	PR	CI (95%)	p
		Yes		No					
		N°	%	N°	%				
Water supply	No	4	16.0	21	84.0	25	1.04	0.42; 2.60	0.935
	Yes	93	15.4	511	84.6	604	1		
Water treated at home	No	37	18.1	167	81.9	204	1.28	0.88; 1.87	0.191
	Yes	60	14.1	365	85.9	425	1		
Sewage	No	65	16.5	328	83.5	393	1.21	0.84; 1.76	0.300
	Yes	38	13.6	241	86.4	279	1		
Home material type	Others	25	62.5	15	37.5	40	5.14	3.72; 7.10	<0.001
	Brick	72	12.2	520	87.8	592	1		
N° of persons per room	More than 1.5	32	33.0	65	67.0	97	0.098	-0.15; 0.45	0.656
	Less than 1.5	189	35.3	346	64.7	535	1		
Elderly	Presence	5	22.73	17	77.27	22	1.09	0.86; 1.36	0.207
	Absence	118	16.12	614	83.88	732	1		

Note: Without information: Water supply: 188; Water treated at home: 188; Presence of Sewer system: 145; type of building material: 185; # of persons per room: 185; Elderly: 63
Notas: *Ausência de informação: Abastecimento de água: 188; Tratamento de água no domicílio: 188; Coleta de esgotos: 145; Tipo de material: 185; Número de pessoas por cômodo: 185; Idoso: 63*

Table 3 - Final model for the occurrence of diarrhea diseases in children living in Recreio de São Jorge. Guarulhos. SP. May 2005 to April 2006.
Tabela 3 - *Modelo final para ocorrência de doenças diarréicas. em crianças residentes no bairro Recreio de São Jorge. Guarulhos. SP. maio de 2005 a abril de 2006.*

Variable	OR adjusted	CI (95%)	p
Malnutrition	2.98	0.89 - 9.91	0.076
Age group (4-9 months old)	4.60	0.97-21.80	0.054
Age group (10 months or more)	7.53	1.71 - 33.13	0.008
Housing * Sewer	14.84	6.91 - 31.87	<0.001

sewer destination, an interaction variable was created: *housing*sewer* to integrate the regression model.

In the first adjustment of the regression model, three variables show significant statistical association with *diarrhea occurrence*: *malnutrition* (p=0.020), *age group* (10 *months and more*) (p=0.056) and *housing*sewer* (p<0.001) as risk factors. In the second adjustment of the regression model, with significant statistical variables to *diarrhea occurrence*, *malnutrition* was excluded.

Table 3 shows final logistic regression model: *housing*sewer* (*material other than brick used in construction of habitation* and *absence of sewage*); and *age group* (*10 months and more*) as risk factors to *diarrhea occurrence*. The final model showed the variables: *housing*sewer* (*materials other than bricks used in construction of habitation* and *absence of sewage*); and *age* (*10 months or more*) as risk factors to *diarrhea occurrence* (Table 3), being that the other variables were no longer significant to the closure.

Discussion

The *material other than brick used in the construction of habitation* was identified as a risk factor to *diarrhea occurrence* in the univariate analysis, suggesting that the precarious housing conditions can result in home hygiene difficulty, a factor that can increase the occurrence of diarrheal diseases. On the other hand, this variable is also an indicator of poverty and low family income (IBGE[13] 2000).

The *absence of sewage* was not associated with *diarrhea occurrence* in then univariate analysis; however, an interaction of this variable with the use of precarious material in the construction of habitation has been identified, raising the risk of *diarrhea occurrence* by almost 15 times for children that live in residences where this condition was found. This result confirms the healthy housing concept of Azeredo et al[14] (2007), which considers that housing is a health agent and relates to the geographic and social territory, the materials used in its construction, health education of the inhabitants and other characteristics in the surrounding context.

Absence of sewage interferes with the health of children by polluting the environment and enabling the spread of excreta related diseases, especially those of the parasitic variety that have diarrhea as the main symptom. Absence of proper sewer disposal systems in urban settlements, is not only an important cause of surface and underground water pollution, but is also a risk to the population's health, especially when there is no knowledge of waterborne diseases. Giatti[15] (2004). Sanitation research in Iporanga (SP), verified that the researched watercourses presented microbiological indices that indicated the presence of pollution caused by domestic sewage due to local sanitation failure, considering that

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91% of the households had feces in trenches, mostly rudimentary.

Scenarios found in Recreio de São Jorge reflect the situation of RMSP´s periurban areas, which are characterized by indices of population increase in protected areas (Porto[16], 2003) or legally restricted areas. This situation generates precarious housing, water and sanitation conditions and contributes to environmental degradation mainly in reservoir catchment protected areas, besides the verified public health problems. Studies verified an association between housing in invaded areas or slums and infant mortality in Campinas (Almeida[17], 2004) and the southern zone of the city of São Paulo (Shoeps[18], 2007); suggest that the locality of this housing is indicative of social exclusion. In this study interaction between precarious home construction materials and non-existence of sewage indicates social exclusion and increment of conditions to pathogen exposure explains the high risk of diarrhea in children living in precarious housing with poor sanitation.

Water supply access and *diarrhea occurrence* do not show significant association with the research results, possibly because almost the whole population has this service. However, according to ACS, many families use water from the public supply together with well and river water because of the high level of intermittence of this service. Access to and consumption of water from public services decrease the probability of diarrheal disease occurrence because of the required potability standard in the system that guarantees the water as a safe for human consumption.

Quality and quantity of water for basic needs are not guaranteed when using alternatives sources of water (Razzolini e Günther[19], 2008). However problems with intermittence in water supply enable satisfactory conditions for the infiltration of pathogens in the water supply network because of a negative pressure on it (Lee e Schwab[20], 2005). Another consequence of interrupted provision is the possibility of storing water in precarious recipients

without sanitation, representing a vulnerability factor to water quality.

Checkley et al[21] (2004), in periurban area studies of Lima, Peru, show that young children exposed to precarious sanitation (water source, reservoir localization and sewer destination) present 54% more cases of diarrhea than non exposed children. A study in Asian periurban areas (Briscoe[22], 1987) found a 33% reduction in diarrhea in children served by public water supply and sewage.

Vulnerability factors of the public network such as frequent intermittence of water supply and illegal connections expose water to contamination or housing vulnerability factors like: non existence of housing reservoir sanitation, transport and storage in inadequate recipients, introduction of objects into water reservoir and inadequate practices of users. These vulnerability factors pose the risk of water contamination.

Regarding child characteristics, it was observed that the age group of 10 months and beyond was more associated with occurrences of diarrhea. In this age group, other kinds of food were introduced into the children's diets, and without adequate health care in preparation, could present risks of pathogen transmission. Furthermore, children from this age group possess greater mobility, thus increasing the chance of environmental contamination. It was observed that age group 4-9 months is four times more likely to experience occurrences of diarrhea, but this is statistically insignificant, suggesting that the passage of exclusive breastfeeding to mixing with other foods could have some effect on occurrence of diarrhea in this age group. This fact confirms WHO´s recommendation (WHO[23] 2003) about the necessity of exclusive breastfeeding up to 6 months of age for children's survival and health, especially related to the prevention of diarrheal diseases.

Child *malnutrition* was associated with occurrences of diarrhea in the univariate analysis; but in the last adjustment of the regression model, it was excluded. Many studies show an association between child

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malnutrition and occurrences of diarrhea (WHO/UNICEF/USAID/SIDA[24], 1990). Elderly presence in families and malnutrition were observed collinearly, suggesting that children can live in nontraditional families and such families can present unfavorable characteristics (Camarano[25], 2004).

*Programa Saúde da Família´*s information use in environmental health studies

Results obtained show that SIAB´s information could constitute an important data source to identify populations living in situations of environmental risk.

Often environmental and health studies have been interrupted by the difficulties in obtaining local and specific data. In many cases available information is aggregated on a municipal level, masking heterogeneous living conditions and making it hard to understand the risk factors at local levels. In that sense, SIAB could represent a data source for studies about the interrelation between environment and health, contributing to the obtainment of housing, health and sanitation data that respect the heterogeneity of Brazilian urban areas.

However the use of SIAB data in environmental studies has some limitations that could be easily attenuated. Data records must be improved; especially the environmental information, which should be periodically updated since the environmental conditions are dynamic and can be altered with time. Using families' samples to inspect the homes and update the recorded information or even to add information to the existing data collection record to obtain indices according to the study's needs can be a way to handle this difficulty.

SIAB´s information could be utilized in environmental-health studies; incorporating variables that better characterize environmental and housing conditions. It could also be included as suggestions for improvement, data regarding: water origin from alternatives sources; water quality; water intermittence frequency; existence, type and quantity of domestic animals; housing surrounding conditions; housing at irregular areas or environmental vulnerability; waste reaprovement; and sanitation practices. Regarding the form on children, it is important to contain the age and mother or occupation.

A study about environmental health indicators Calijuri et al[26] (2009) proposed some sanitation variables: lack of water in housing to verify the service intermittence and kind of water supply in cases of alternative sources present. There is also an interesting use of variables that identifies the presence of animals, flies and plants inside the house in the environmental health group.

Conclusion

Large conurbation water and sanitation indicators cannot be efficient in identifying communities that live in at-risk conditions of diarrheal occurrence. Information collected by the *Programa de Saúde da Família* is an excellent tool to identify settlements in which portions of the population live in poor housing conditions and have no access to water and sanitation services. In this scenario this study verified that the risk of diarrheal occurrence in children is almost 15 times greater than that of children living in good water and sanitation conditions.

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