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RESEARCH

PREDICTOR FACTORS OF THE ACUTE RESPIRATORY INFECTION IN PRESCHOOLS ATTENDED BY A PUBLIC DAYCARE CENTER

FATORES PREDITORES DA INFECÇÃO RESPIRATÓRIA AGUDA EM PRÉ-ESCOLARES ASSISTIDOS POR CRECHE PÚBLICA

FACTORES PREDICTIVOS DE INFECCIÓN RESPIRATORIA AGUDA EN PREESCOLARES ATENDIDOS POR GUARDERÍAS PÚBLICAS

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ABSTRACT

Objective: to evaluate the predictive factors between the occurrence of acute respiratory infection and the clinical and sociodemographic conditions of preschool children in a public daycare center. **Method:** a cross-sectional study was developed with 121 guardians responsible for children between two to six years old, in a daycare center in Recife, Pernambuco, Brazil. A semi-structured form was used for data collection, carried out from May to August 2018, whose information related to the clinical and sociodemographic characteristics of preschool children and their families. Data were subjected to association tests in bivariate statistical analysis and multiple logistic regression was applied. **Results:** there was a prevalence of 40.5% of acute respiratory infections among children. The multivariate analysis revealed that the length of stay in the daycare center was longer than five hours (OR=2.448; 95%CI 1.126-5.323; p=0.024) and the low educational level of the guardian (OR=2.552; 95%CI 1.179-5.528; p=0.017) doubled the chance of the child acquiring an acute respiratory infection. **Conclusion:** the identification of factors related to the development of respiratory infections in the preschool environment provides support for the promotion of children's health, reducing hospitalizations for respiratory disorders in this age group.

Keywords: Respiratory Tract Infections; Child Day Care Centers; Preschool; Child Health; Pediatric Nursing.

RESUMO

Objetivo: avaliar os fatores preditores entre a ocorrência de infecção respiratória aguda e as condições clínicas e sociodemográficas de pré-escolares em uma creche pública. ***Método:*** estudo transversal desenvolvido com 121 acompanhantes responsáveis por crianças de dois a seis anos, em uma creche do município de Recife, Pernambuco, Brasil. Formulário semiestruturado foi utilizado para coleta de dados, realizada no período de maio a agosto de 2018, cujas informações diziam respeito às características clínicas e sociodemográficas dos pré-escolares e da família. Os dados foram submetidos a testes de associação na análise estatística bivariada e aplicada regressão logística múltipla. ***Resultados:*** encontrou-se prevalência de 40,5% de infecção respiratória aguda entre as crianças. A análise multivariada revelou que o tempo de permanência na creche superior a cinco horas (OR=2,448; IC95% 1,126-5,323; p=0,024) e a baixa escolaridade do responsável (OR=2,552; IC95% 1,179-5,528; p=0,017) dobraram a chance de a criança adquirir infecção respiratória aguda. ***Conclusão:*** a identificação dos fatores relacionados ao desenvolvimento de infecções respiratórias no ambiente pré-escolar fornece subsídios para a promoção da saúde das crianças com vistas à redução das internações por distúrbios respiratórios nesse grupo etário.

Palavras-chave: *Infecções Respiratórias; Creches; Pré-Escolar; Saúde da Criança; Enfermagem Pediátrica.*

RESUMEN

Objetivo: *evaluar los factores predictivos entre la ocurrencia de infección respiratoria aguda y las condiciones clínicas y sociodemográficas de niños en edad preescolar en una guardería pública.* ***Método:*** *estudio transversal desarrollado con 121 acompañantes a cargo de niños de dos a seis años, en una guardería en Recife, Pernambuco, Brasil. Para la recolección de datos se utilizó un formulario semiestructurado, realizado de mayo a agosto de 2018, cuya información se relacionaba con las características clínicas y sociodemográficas de los niños en edad preescolar y sus familias. Los datos fueron sometidos a pruebas de asociación en análisis estadístico bivariado y se aplicó regresión logística múltiple.* ***Resultados:*** *se encontró una prevalencia del 40,5% de infección respiratoria aguda en niños. El análisis multivariado reveló que la estancia en la guardería fue superior a cinco horas (OR=2,448; IC 95% 1,126-5,323; p = 0,024) y el bajo nivel educativo del tutor (OR=2,552; 95% CI 1,179-5,528; p=0,017) duplicó la posibilidad de que el niño contrajera una infección respiratoria aguda.* ***Conclusión:*** *la identificación de factores relacionados con el desarrollo de infecciones respiratorias en el ámbito preescolar brinda apoyo para la promoción de la salud infantil, con objetivo de reducir las hospitalizaciones por trastornos respiratorios en este grupo de edad.*

Palabras clave: *Infecciones del Sistema Respiratorio; Guarderías Infantiles; Preescolar; Salud del Niño; Enfermería Pediatrica.*

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INTRODUCTION

Respiratory diseases, including acute respiratory tract infections, are the most frequent cause of hospital admissions in children in the world.[1] In Brazil, they are responsible for 22% of deaths in the child population between one and four years old. In Recife, a municipality located in the Northeast region of the country, from January 2017 to December 2018, more than 13 thousand hospitalizations due to respiratory diseases in children under five years were registered.[2]

Respiratory infections can lead to severe acute respiratory syndrome (SARS) which is a frequent cause of hospitalization in children. In 2019, more than half of the cases of hospitalizations for SARS were among children under two years old and the most frequent etiology was related to the respiratory syncytial virus (RSV), a scenario modified after the advent of the new coronavirus (SARS-CoV-2) in 2020 in the country, which resulted in a greater number of hospitalizations.[3]

Several risk factors are associated with the involvement of children with respiratory diseases, such as nutritional status, hygiene, and sanitary conditions, basic sanitation conditions, and length of stay in daycare centers. The inclusion of children in daycare centers has been growing mainly due to changes in the population's economic and social patterns, in addition to changes in the lifestyle of women and families.[4, 5] A cohort study with 4,018 children identified an association between attendance at daycare centers and higher occurrence of infectious morbidities and symptoms at 12 months of life. It also revealed that most of the research conducted on the situation is carried out in high-income countries, remaining a knowledge gap related to this object of study, especially in Latin American countries.[5]

In Brazil, the daycare center belongs to the scope of the Health Program at School (HPS), created by the Ministry of Health in 2007 to articulate health actions in the school environment. The activities are guided by the teams of the Family Health Strategy (FHS) in cooperation with education professionals. In this scenario, nurses perform relevant practical activities, as they have technical and scientific competence aimed at identifying, minimizing, and/or preventing harm to child health and evaluating the symptoms of sick children, providing opportunities for growth and integral development through health-promoting actions.[6]

Understanding the dynamics of risk factors linked to episodes of acute respiratory infection helps to develop protective measures for the child's health. Educational interventions under the supervision of the professional nurse favor the autonomy of children for self-care and the instruction of parents and teachers regarding the minimum necessary care in the early childhood education environment.[7,8]

Therefore, the following research question was raised: "do the sociodemographic and clinical characteristics of preschool children attending a public daycare center interfere in the manifestation of acute respiratory infection?" Thus, this study aimed to evaluate the predictive factors between the occurrence of acute respiratory infection and the clinical and sociodemographic conditions of preschool children in a public daycare center.

METHOD

Analytical cross-sectional study carried out in a Municipal Center for Early Childhood Education (*Centro Municipal de Educação Infantil* - CMEI) located in the city of Recife, Pernambuco. The CMEI, also known as daycare, is the educational unit responsible for the first stage of basic education and aims at the integral physical, psychological, intellectual, and social development of children up to six years old. This place offered morning or afternoon services for children aged four to six years old, restricting the full-time regime for children under four years old.

All guardians responsible for children between two and six years old who were regularly enrolled in the CMEI participated in the study. We excluded those under 18 years old, legal guardians of sheltered children, or those who did not take the child in person during the fieldwork period. We surveyed the population of preschool children assisted at the CMEI in the year before the study to approach their respective guardians. A total of 153 preschoolers attended in 2018 were counted. From this, we calculated the size of the sample needed for this research, considering the calculation of a finite population with an absolute sampling error of 5% and a confidence level of 95%, resulting in the amount of 110 responsible guardians. To this total, 10% was added for possible losses, totaling the final sample of 121 guardians. However, there were no sample losses.

Data collection took place from May to August 2018 in a reserved room at the daycare, through the application of a semi-structured form prepared by the researchers. Initially, the participants were approached by the first author when they left or picked up the children at the service, with no need for prior appointments. They were informed about the objectives of the study and invited to participate.

The responsible guardian who agreed to participate signed the Informed Consent Form (ICF) in duplicate. Then, they answered the form with the help of the researcher, who read the items and wrote down the answers.

Before the beginning of data collection, we carried out a pre-test to verify the suitability of the instrument and enable the interviewer. The instrument consisted of thematic blocks that included sociodemographic and clinical variables related to the current health condition of preschool children.

The dependent variable was the occurrence of acute respiratory infection in the month before the date of collection (yes/no). The independent variables analyzed in the study were: child's age, gender, pregnancy complications, prematurity, length of stay in daycare, the occurrence of anemia, hospital stay, use of medications, education of the guardian, and the number of people living in the house.

We used the Statistical Package for Social Sciences (SPSS, version 23.0) program for data processing and analysis. For the descriptive analysis of categorical variables, absolute frequency, relative frequency, and the respective 95% confidence intervals (95% CI) were calculated. A bivariate analysis was performed using the chi-square test to verify the association between categorical variables. Subsequently, the variable that presented $p<0.20$, as a result of the bivariate analysis, were included in the multiple logistic regression model. Odds ratios (OR) adjusted to their respective 95% confidence intervals (CI) were calculated, with significance determined by Wald's chi-square test. The significance value adopted in the analyzes performed was p-value<0.05.

The multicollinearity test, according to the parameters of Tolerance and Variance Inflation Factors (VIF), confirmed the absence of multicollinearity between the independent variables, as there was no VIF greater than 10 or tolerance less than 0.2.9 evaluated by the Hosmer-Lemeshow test. The Nagelkerke R2 was estimated to quantify the proportion of variation explained by the logistic regression model.

Regarding the treatment of missing data, when the participants did not respond to the information, the variables were kept in the analysis, indicating the missing values. Therefore, in the analyzed variables that had data omission, individuals were automatically excluded by the statistical program. We identified that only one participant did not respond to the variables "had anemia" and "hospitalization" and three did not provide the information "guardian's educational level", which represents a small magnitude of missing values.

This research started in a residency conclusion work presented to the Nursing Uniprofessional Residency Program in Child Health at the Universidade Federal de Pernambuco, whose execution was approved by the Research Ethics Committee of the institution, obtaining the Presentation Certificate for Ethical Appreciation (*Certificado de Apresentação para Apreciação Ética* - CAAE) number 83865818.3.0000.5208, in compliance with Resolution 466/12 of the *Conselho Nacional de Saúde*.

RESULTS

Most study participants were mothers or fathers (62.8%), with a mean age of 32 (+7.8) years old. The minimum age of guardians was 18 years old and the maximum was 56 years old. Only 55.8% were employed at the time of the survey. The average age of preschoolers was four (+1.1) years. In the month before data collection, the diagnosis of acute respiratory infection was prevalent in 40.5% of children (95%CI 31.75 - 49.25). Most (84.3%) never had anemia and 12.5% of preschoolers had been hospitalized in the last year. Table 1 describes the profile of the children attended at the daycare center.

In the bivariate analysis, the variables that showed a statistically significant association with the occurrence of acute respiratory infection were the child's age, maternal complications during pregnancy, length of stay in the daycare center, episode of anemia, hospital stay, the child using medication, and parent's education (Table 2).

Table 3 shows the multiple logistic regression model for acute respiratory infection in children. Were included only variables with $p<0.02$ in the bivariate analysis. The data allow us to infer that the length of stay of more than five hours a day at the daycare center and the education of the person responsible for less than eight years of study were consolidated as predictors of acute respiratory infection in children, with these variables more than doubling the chance of occurrence respiratory diseases in this age group.

The model's coefficient of determination (Nagelkerke R2) indicated that these related factors included in the regression model explained 12.5% of the occurrence of the investigated outcome. Finally, the observed and expected frequencies in the final model did not have significant differences according to the Hosmer-Lemeshow test, evidencing the good adequacy of the adjustment (Table 3).

Table 1 - Demographic and clinical characteristics of children

Variable	n (%)	CI 95%
Age		
< 4 years old	40 (33.1)	24.71 – 41.48
≥ 4 years old	81 (66.9)	58.51 – 75.28
Race		
White	25 (20.7)	13.48 – 27.91
Black	17 (14.0)	7.817 – 20.18
Brown	79 (65.3)	56.81 – 73.78
Gender		
Male	72 (59.5)	50.75 – 68.24
Female	49 (40.5)	31.75 – 49.24
Age when started in the daycare		
< 24 months old	45 (37.2)	28.58 – 45.81
24 to 36 months old	52 (43.0)	34.17 – 51.82
> 36 months old	24 (19.8)	12.69 – 26.90
Length of stay at the daycare		
≤ 5 hours	71 (58.7)	49.92 – 67.47
> 5 hours	50 (41.3)	32.52 – 50.07
Birth weight		
< 2.500 g	27 (22.3)	14.88 – 29.71
2.500 g to 3.999 g	81 (66.9)	58.51 – 75.28
≥ 4.000 g	13(10.7)	5.192 – 16.20
Prematurity		
Yes	24 (19.8)	12.69 – 26.90
No	97 (80.2)	73.09 – 87.30
Duration of breastfeeding		
≤ 60 days	30 (24.8)	17.10 – 32.49
61 to 360 days	71 (58.7)	49.92 – 67.47
Not breastfed	12 (9.9)	4.578 – 15.22
Unknown	8 (6.6)	2.176 – 11.02
Iron supplementation up to 2 years		
Yes	62 (51.2)	42.29 – 60.10
No	52 (43.0)	34.17 – 51.82
Unknown	7 (5.8)	1.635 – 9.964
Follow-up in the FHS		
Yes	78 (64.5)	55.97 – 73.02
No	43 (35.5)	26.97 – 44.02
Went to the dentist*		
Yes	60 (49.6)	40.65 – 58.54
No	60 (49.6)	40.65 – 58.54

* The number of observations does not match the sample size as one answer was ignored (*missing*).

Table 2 - Bivariate analysis of the occurrence of respiratory infection in preschool children

Factor evaluated	Respiratory infection		p-value[1]
	Yes n (%)	No n (%)	
Age			
< 4 years old	22 (55.0)	18 (45.0)	0,022
≥ 4 years old	27 (33.3)	54 (66.7)	
Gender			
Male	26 (36.1)	46 (63.9)	0,234
Female	23 (46.9)	26 (53.1)	
Pregnancy complications			
Yes	22 (53.7)	19 (46.3)	0.035
No	27 (33.8)	53 (66.3)	
Prematurity			
Yes	12 (50.0)	12 (50.0)	0.289
No	37 (38.1)	60 (61.9)	
Length of stay at the daycare			
≤ 5 hours	23 (32.4)	48 (67.6)	0.031
> 5 hours	26 (52.0)	24 (48.0)	
Anemia*			
Yes	11 (61.1)	7 (38.9)	0.047
No	37 (36.3)	65 (63.7)	
Hospital admission*			
Yes	10 (66.7)	5 (33.3)	0.024
No	38 (36.2)	67 (63.8)	
Use of medication			
Yes	15 (57.7)	11 (42.3)	0.044
No	34 (35.8)	61 (64.2)	
Guardian Education years*			
< 8 years	14 (53.8)	12 (46.2)	0.048
≥ 8 years	34 (37.0)	58 (63.0)	
Number of people in the house			
≤ 4 People	32 (42.1)	44 (57.9)	0.639
> 4 People	17 (37.8)	28 (62.2)	

[1]Chi-square test.
*The number of observations does not match the sample size, as some responses were ignored (*missing*).

Table 3 - Predictors of Acute Respiratory Infections in Preschool Children

Variables	Initial Model		Initial Model	
	Odds Ratio (CI95%)	p-value*	*Odds Ratio* (CI95%)	p-value*
Age				
< 4 years old	0.71 (0.15 – 3.28)	0.662	-	-
Pregnancy complications				
Yes	0.59 (0.24 – 1.47)	0.259	-	-
Length of stay at the daycare				
> 5 hours	1.57 (0.37 – 6.65)	0.541	2.45 (1.13 – 5.32)	0.024
Anemia				
Yes	0.52 (0.16 – 1.70)	0.276	-	-
Hospital admission				
Yes	0.46 (0.13 – 1.72)	0.250	-	-
Use of medication				
Yes	0.45 (0.16 – 1.22)	0.114	-	-
Guardian Education years				
< 8 years	2.62 (1.15 – 5.97)	0.021	2.55 (1.18 – 5.53)	0.017

Hosmer-Lemeshow Test: 0.623 (p-values = 0.732). Nagelkerke R^2= 0,125.
* Test significance.

DISCUSSION

The findings showed the prevalence of acute respiratory infections within the educational environment, with the child's length of stay in daycare and the education of the guardians as the predictors associated with greater chances for the occurrence of acute respiratory infections. These results corroborate a cohort study carried out with 1,827 children in Finland, which revealed a 10.5 times greater risk of children attending a public daycare center for acquiring respiratory tract infections (RTI) when compared to those assisted at home or in a family daycare center in early years of life. However, the authors found that high maternal education and high family income were associated with a high frequency of RTIs.[10]

In this study, the lowest socioeconomic position, indicated by the education of those responsible for it, reflected an increase in the occurrence of respiratory infections. The level of education of the parents or guardians of the child demonstrates a close relationship with the maintenance of the children's health. Access to studies provides more knowledge about prevention and health protection and leads to better employment and income opportunities, which represents an expansion in the possibilities of access to health services.

A Danish study found that the risk of developing upper airway respiratory infection was lower in children who have only one parent employed when compared to those who have both parents employed, demonstrating that this injury is associated with social determinants of health.[8] Such determinants, understood by the circumstances in which the population grows, lives, works, and ages, exert an influence on health equity, reflecting the occurrence of problems associated with socioeconomic positions.[11]

The impact of social determinants of health on the population's epidemiological profile requires comprehensive interventions on health problems. Through collaborative work at all levels of care, in addition to treating children with RTI, we need to resolve the conditions that make them sick, the result of a long chain of social processes.

In this context, primary care stands out for performing expanded actions to promote and protect children's health, from the perspective of comprehensiveness in the school environment. To reduce the number of pediatric hospital admissions for RTI, nurses should prioritize community immunization, preventive educational actions, childcare, implementation of integrated care for prevalent childhood diseases (ICPCD), and work all together. These measures allow nurses to work in daycare centers with primary care in coping with acute respiratory infections in a resolute and grounded manner.[12,13]

One of the relevant findings of the study was the definition of longer length of stay in public daycare centers as a predictor of the emergence of acute respiratory infections. A similar observation was found in a study conducted in Ukraine with 180 children between one to five years old, which showed that children have more immunological and physical fragility for the development of RTI, especially when they live collectively with other children, a fact that increases physical contact habitual behavior and the chances of sharing objects that are put in the mouth.[14]

Children who attend daycare centers usually have a regular weekly stay, which can interfere with their health conditions since the risk factors related to the occurrence of infectious and parasitic diseases are enhanced by the collective assistance provided. As the transmission of pathogens is more likely to occur in crowded environments, studies have shown that a high density of children in the classroom tends to increase their exposure to infections through interpersonal contact and reckless habits, such as taking hands and objects to the mouth, which are common in this space.[5,15]

The extension of the length of stay of children in the daycare center hinders properly sanitize common areas and the toys used by them. Also, most daycare centers have poorly ventilated spaces, which contributes to the transmission of causative pathogens of RTI. By coughing and eliminating nasal secretions, children spread the causative agents of RTI nearby due to confinement and crowding, which, added to the extra hours of stay at daycare centers, increase the time of exposure to infectious agents.[14] Research results that involving the theme suggest improvements in hygiene habits and the need for interdisciplinary actions to better control gastrointestinal and respiratory infections.[10,16]

The prevalence of acute respiratory infections among preschoolers in the study was 40.5%, which is in line with observational research conducted in Denmark in 2014 and 2015, with 269 children attending daycare, and in which 47% were diagnosed with upper or lower airway respiratory infection.[8]

In Brazil, children have been inserted into preschool environments at an increasingly early age, as a result of socio-economic changes and greater insertion of mothers in the labor market,[17] which was also mentioned in this research. Most of them started attending daycare within the first six months of life. The early institutionalization of children in school environments favors the development of infectious and parasitic diseases, especially in those under six years old due to habits and immaturity of the immune system.

We found that half of the children in the study had never been to the dentist, an aspect that we highlight due to the potential influence of oral diseases on the progression of systemic diseases. The oral cavity is a potential reservoir of respiratory pathogens due to its anatomical continuity with the respiratory tract. Saliva and dental plaque in patients with periodontal disease can be colonized by pathogens that tend to migrate to the lower airways, implying pulmonary infections.[18] An Indian study found that poor oral health influences lung health, as resident microorganisms in the lungs, come from the bronchoaspiration of oral bacteria, thus initiating the pulmonary inflammatory process.[19]

A divergent finding was evidenced in a longitudinal study carried out in Hong Kong with a population of 288 preschool children, which found an association between dental caries and reduced episodes of acute upper respiratory tract infection. The mechanisms of this inverse association may reside in the possible innate and adaptive immune response induced by tooth decay, demanding a better investigation in epidemiological and experimental studies.[20]

The influence of age at daycare admission on the onset of respiratory infections was demonstrated through bivariate data analysis. This relationship has been investigated and it is confirmed that children who started attending the educational environment with less than one year of age have a higher prevalence of RTI than those assisted at home.[8,10]

In this study, we could identify that part of the children experienced early weaning, and this can be caused by multiple factors such as the low level of parental education. Breastfeeding has beneficial effects for protection against the occurrence of respiratory and diarrheal diseases, in addition to reducing the risk of infant mortality from respiratory and gastrointestinal diseases. The longer the period of breastfeeding, the lower the chances of developing RTI.[21] A prospective population-based cohort study conducted in the Netherlands with 5,322 preschool children found that, compared to children who were never breastfed, breastfeeding for six months or more is associated with a reduced risk of developing RTI up to four years old.[22]

Another factor that had a significant relationship with the emergence of RTI was anemia in children. Iron deficiency anemia is a public health problem and one of its main consequences is the great susceptibility to infections, including RTIs. In a study that analyzed the sociodemographic and health indicators for iron deficiency anemia, factors similar to those found in this research, such as low parental education, lower maternal and child age, housing conditions, and the early introduction of complementary feeding, reflect the social determination of this lack and the need for government actions to improve, especially related to access to appropriate and healthy food.[23]

Measures for the prevention of infectious diseases aimed at parents, teachers, and children during early childhood, such as adequate hand hygiene and cough etiquette, for example, can become allies in the prevention of RTIs and other common conditions. These attitudes, although widely disseminated throughout the world, still face barriers to effective practice, both by guardians and parents of children. We observed this in qualitative research carried out in Australia, in which cultural and social motivations constituted barriers to these practices of effective way.[24] Thus, the active and regular insertion of the FHS nurse in educational services enables the implementation of health promotion in this space, with a direct impact on improving the quality of care offered to the child population that attends daycare centers.

This research offers a limitation related to the cross--sectional design, which makes the causality and longitudinality relationship of the studied event unfeasible. Furthermore, because it was carried out in a single daycare center may limit the generalization of the results to other scenarios. The development of new studies is suggested to verify the risks associated with childhood acute respiratory infection and compare the immediate and/or long-term effects on children's health, through the implementation of preventive programs in different schools.

However, the results promote advances in the area of Nursing/health, as they provide opportunities for knowledge directed towards practice, with attention to the identification of groups of preschoolers in which preventive actions in health education should be prioritized.

Such educational actions need to focus on the interrelationship with teachers and family members and aim at promoting healthy environments to favor early childhood development, with benefits for the child, family, and community. In this scenario, we should plan actions that facilitate the integration between the services of family health units and daycare centers.

CONCLUSION

The low educational level of guardians and the length of stay of more than five hours a day at the daycare center were significant predictors for the development of respiratory infections among preschool children and more than doubled the chances for this outcome. The identification of these factors can help in the recognition of situations involved in the dynamics of illness of respiratory diseases among the population that attends daycare centers and in the development of interventions by public policymakers aimed at controlling the spread and reducing the number of hospitalizations for respiratory disorders in this age group.

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