Association between child-care and acute diarrhea: a study in Portuguese children

Associação entre cuidados infantis e diarréia aguda em crianças portuguesas

Henrique Barros[a] and Nuno Lunet[b]

[a]Serviço de Higiene e Epidemiologia. Faculdade de Medicina do Porto. Porto, Portugal. [b]Instituto Superior de Ciências da Saúde – Norte. Gandra, Portugal

Keywords
Diarrhea. Child-care. Acute disease. Risk factors. Child day care centers.

Abstract

Objective
To quantify the influence of the type of child-care on the occurrence of acute diarrhea with special emphasis on the effect of children grouping during care.
Methods
From October 1998 to January 1999 292 children, aged 24 to 36 months, recruited using a previously assembled cohort of newborns, were evaluated. Information on the type of care and occurrence of diarrhea in the previous year was obtained from parents by telephone interview. The χ^2 and Kruskal-Wallis tests were used to compare proportions and quantitative variables, respectively. The risk of diarrhea was estimated through the calculation of incident odds ratios (OR) and their respective 95% confidence intervals (95% CI), crude and adjusted by unconditional logistic regression.
Results
Using as reference category children cared individually at home, the adjusted ORs for diarrhea occurrence were 3.18, 95% CI [1.49, 6.77] for children cared in group at home, 2.28, 95% CI [0.92, 5.67] for children cared in group in day-care homes and 2.54, 95% CI [1.21, 5.33] for children cared in day-care centers. Children that changed from any other type of child-care setting to child-care centers in the year preceding the study showed a risk even higher (OR 7.65, 95% CI [3.25, 18.02]).
Conclusions
Group care increases the risk of acute diarrhea whatsoever the specific setting.

Descritores
Diarréia. Cuidado da criança. Doença aguda. Fatores de risco. Creches.

Resumo

Objetivo
Quantificar a associação entre o tipo de cuidados infantis e a ocorrência de diarréia aguda, sendo dada especial atenção aos diferentes tipos de cuidados infantis prestados a grupos de crianças.
Métodos
De outubro de 1998 a janeiro de 1999, foram avaliadas 292 crianças, com idades entre 24 e 36 meses, recrutadas com base numa coorte de recém-nascidos previamente constituída. Foi obtida informação acerca do tipo de cuidados infantis e da ocorrência de diarréia no ano anterior ao estudo por meio de entrevista telefônica aos pais das crianças participantes. Foram utilizadas as provas do χ^2 e de Kruskal-Wallis para comparar proporções e variáveis quantitativas, respectivamente. O risco de diarréia

Correspondence to:
Henrique Barros
Serviço de Higiene e Epidemiologia
Faculdade de Medicina do Porto
Al. Prof. Hernâni Monteiro
4200-319 Porto, Portugal
E-mail: hbarros@med.up.pt

Supported by Comissão de Fomento da Investigação em Cuidados de Saúde, Ministério da Saúde (n. 155/95) and Programa de Desenvolvimento Educativo para Portugal (PRODEP) – Fundo Social Europeu.
Received on 11/9/2002. Reviewed on17/3/2003. Approved on 8/5/2003.

Rev Saúde Pública 2003;37(5):603-8
www.fsp.usp.br/rsp

foi estimado pelo cálculo de odds ratios *(OR) incidentes e respectivos intervalos de confiança a 95% (IC 95%), brutos e ajustados por regressão logística não condicional.*

Resultados

Utilizando como classe de referência as crianças cuidadas sozinhas na própria casa, o OR para a ocorrência de diarréia foi 3,18, IC 95% [1,49-6,77] para as crianças cuidadas na própria casa mas em grupo, 2,28, IC 95% [0,92-5,67] para as cuidadas em casas de amas, em grupo, e 2,54, IC 95% [1,21-5,33] para as cuidadas em creches (instituições de prestação de cuidados infantis, em grupo). Nas crianças que mudaram de qualquer outro tipo de cuidados infantis para creches no ano que antecedeu a entrevista o risco de diarréia foi 7,65, IC 95% [3,25-18.02].

Conclusões

Os cuidados infantis em grupo associaram-se a um maior risco de diarréia aguda, quer fossem prestados na própria casa, em casas de amas ou em creches.

INTRODUCTION

Young children have an increased susceptibility to infectious diseases and present high age-specific attack rates for numerous infections.[6] Child-care centers are increasingly contributing to that situation, as a growing number of children are cared out of home and are exposed to the common interaction in the absence of appropriate hygienic practices, favoring the transmission of pathogenic agents.[6] A large body of evidence, mostly gathered in the US, and to a lesser extent in Europe, showed that children attending child-care centers are at a higher risk of diarrhea,[2,6] especially when under the age of three.

An international study[5] showed that 4-year-old Portuguese children were cared primarily by family members, with less than one third being cared at a formal institution, and a similar proportion applies to children under three. In Portugal, the availability of official child-care settings is insufficient and many children are often cared at home, individually or in groups by relatives or unskilled personnel. This situation may reveal risk factors less often observed in other developed societies, especially those related to group care out of professional settings. In this study it is quantified the influence of the type of child-care on the occurrence of acute diarrhea in a community sample of Portuguese children aged two to three years.

METHODS

From October 1998 to January 1999, 292 children born in a Portuguese central hospital were evaluated. Children were recruited using a previously assembled cohort of newborns whose mothers participated in an investigation on risk factors for preterm delivery. Detailed methodology of the original study was published elsewhere.[8] In short, from January to October 1996 all women who delivered live preterm newborns and mothers of term newborns, matched for the day of birth, were consecutively included in the study.

From 404 eligible children aged 24 to 36 months at the time of interview, parents of 102 could not be reached due to address changes. Eight refused to participate and the interview could not be completed for two participants. The overall participation rate was 72.8%. Data on newborns and parents were collected during the cohort assembling and allowed the comparison of baseline characteristics between participants (n=292) and non-participants (n=112). No significant differences were found regarding participants and non-participants' newborn birth weight (2,896±739.9 g vs. 2,955±748.0 g), gestational age (43.5% vs. 46.4% preterms), newborn's sex (42.5% vs. 51.8% females), and age at the time of interview (32±2.6 vs. 31±3.1 months). However, non-participating mothers were younger (27±5.0 vs. 32±5.1 years, $p<0.001$), less educated (8±4.0 vs. 9±4.3 school years, $p<0.05$) and more frequently single (11% vs. 3%, $p<0.005$).

Information on the type of care and the occurrence of diarrhea in the previous year was obtained from parents (the mother was the informant in 98.6% of the interviews) by telephone interview using a structured questionnaire and a single interviewer.

Acute diarrhea was defined as a change in usual bowel movements or stool consistency (towards more frequent bowel movements and/or less consistent stools), during more than 24 hours and less than 15 days, as stated by parents. Distinct diarrhea episodes were considered for each child when occurring after a symptom-free period of at least one week.

Child-care was provided at home (care provided by parents or other family members in their houses), in

day-care homes (care provided by a non-family member at her/his house, mostly in an unofficial basis) or day-care centers (care provided in child-care settings, mostly official institutions receiving a relatively large number of children). Additionally, day-care centers and other settings that provided care for at least two children of similar age were classified as group care.

In the year preceding the interview 149 children (51.0%) were cared at home, 41 (14.0%) were cared in day-care homes (38 were unofficial and caregivers had no specific training), and 54 in day-care centers (18.5%). Forty-eight children (16.6%) changed child-care settings during the study year (38 to day-care centers, seven to day-care homes, and three returned to care at home).

For data analysis the presence of diarrhea was only considered when at least two episodes were identified in the year preceding the interview.

Data were analyzed using the software Epi Info 6.04a.[4] The χ^2 and Kruskal-Wallis tests were used to compare proportions and quantitative variables, respectively. Risk estimates were obtained through the calculation of incident odds ratios (OR), and their respective 95% confidence intervals (95% CI), crude and adjusted for maternal education, child age and preterm status by unconditional logistic regression using Stata®.

RESULTS

Parents of children cared in day-care centers were more educated and maternal occupation was more frequently white collar. Mothers of children cared at home were more often unemployed. Children stayed significantly more time per week in day-care homes than in day-care centers, and the cost of child-care was significantly higher in day-care centers than in day-care homes (Table 1).

Compared to children cared at home the risk of diarrhea in children cared in day-care homes or day-care centers was not significantly different from unity, but children cared in groups presented an increased risk of diarrhea, regardless of the care provider. For those in day-care homes or day-care centers the risk decreased when the monthly cost of care was 100 dollars or higher (Table 2).

A non-conditional multiple logistic regression model was fitted, controlling for the effect of maternal education (≤9 years or >9 years), child age (≤30 months or >30 months) and preterm status (Table 3). The adjusted risks for diarrhea using the group of children individually cared at home as reference were higher than unity in children cared in groups, at home (OR 3.18, 95% CI [1.49, 6.77]), day-care homes (OR 2.28, 95% CI [0.92, 5.67]) or day-care centers (OR 2.54, 95% CI [1.21, 5.33]). Children that changed to day-care centers during the previous year showed an even higher risk (OR 7.65, 95% CI [3.25, 18.02]).

DISCUSSION

This study showed that being cared in groups increased the risk of acute diarrhea regardless of care provider. The results do not support the hypothesis

Table 1 - Parental, children and child-care characteristics according to different types of care.*

Parental, children and child-care characteristics	Type of care: Home N=149	Day-care home N=41	Day-care center N=54	Changed care N=48
Mother				
Age (yrs)	31.5±5.4	31.7±4.5	31.3±4.7	32.3±5.0
Education (yrs)**	8.0±4.0	7.9±3.9	11.6±4.3	10.6±4.3
Occupation**				
White collar (%)	33.8	39.0	69.8	72.9
Blue collar (%)	33.8	58.5	30.2	20.8
Unemployed (%)	32.4	2.4	0	6.3
Father education (yrs)**	7.8±3.8	7.1±3.6	10.4±4.5	10.2±4.3
Household				
Crowding index***/**	1.20±0.52	1.21±0.54	1.00±0.23	0.98±0.31
Children				
Proportion with siblings under six yrs (%)	9.4	7.5	16.7	8.3
Age at interview (months)	31.6±2.6	31.9±2.8	31.6±2.7	31.1±2.6
Sex (% male)	58.4	58.5	53.7	58.3
Birthweight (grams)	2,814±760	3,002±678	3,029±624	2,909±829
Preterm (%)	47.7	36.6	40.7	39.6
Child-care				
Group care (%)**	28.2	63.4	100	—
Number of children/group**	1.4±0.7	2.7±2.1	13.2±4.9	—
Time spent in care (hours/week)**	—	48.9±9.7	41.5±8.3	—
Cost of care (dollars/month)**	—	68.6±28.4	87.9±36.6	—

*Results are presented as mean ± standard deviation except when indicated.
**p<0.05 (home vs. day-care home vs. day-care center vs. changed care).
***Number of persons/room.

that care provided in day-care homes or day-care centers is by itself related to a higher risk of acute diarrhea, except in the year of enrollment.

Previous studies showed a consistent increase in diarrhea risk among children attending day-care centers though the magnitude of effect differed widely.[2,6] The risk of diarrhea among children in child-care centers is 2 to 3.5 times[2,6] that of children cared for at home although it may be much greater among subgroups of children, such as infants or toddlers in diapers, or those recently admitted to the facility.[2,6] Differences in quality of care, a difficult parameter to measure, and methodological heterogeneity across studies regarding design, age groups, child-care exposure definition, child-care characterization, diarrhea definition and data analysis probably contributed to the effect variation reported.[2]

The definition of day-care center is similar across studies. However, the definition of other types of care is heterogeneous,[2] making comparisons very difficult. In the present investigation group care was considered when a child was cared with at least another one of the same age because it was considered that any interpersonal contacts are prone to increasing the risk of diarrhea. Thus, children cared at home or in day-care homes were classified as individually or in groups and data was analyzed considering both categories. The results showed a higher risk of diarrhea in children cared in groups regardless of care provider. The risk of diarrhea among children in child-care centers is about 2.5 times higher than in children cared individually at home, but it is about the same as in children cared at home in groups. A similar relationship was shown for children cared at day-care homes when compared with care at home.

The risk of diarrhea did not increase with group size. This finding probably reflects the fact that the number of children is similar in each type of setting, with group size being a surrogate for type of care, and in the same type ofsetting group size is probably a surrogate for quality of care.

Time spent in out of home care had no significant influence on the occurrence of diarrhea. This could be explained by the large amount of time spent out of home (49 hours/week in day-care homes and 42 hours/week in day-care centers). Only 4.2% of children attended day-care homes or day-care centers for less than 30 hours per week, the usual cut-off for defining full time attendance of care in western societies.

Table 2 - Risk of acute diarrhea according to socio-economic aspects, children characteristics and type of child-care.*

Socioeconomic aspects, children characteristics, and type of child-care	Diarrhea N	%	OR [95% CI]
Maternal education (yrs)			
≤9	160	38.8	1.0 reference
>9	84	28.6	0.63 [0.34, 1.17]
Crowding index**			
<1	71	29.6	1.0 reference
≥1	173	37.6	1.35 [0.71, 2.58]
Sex			
Female	104	39.4	1.0 reference
Male	140	32.1	0.74 [0.42, 1.30]
Children age (months)			
≤30	65	44.6	1.0 reference
>30	179	31.8	0.58 [0.31, 1.09]
Preterm delivery			
No	136	32.4	1.0 reference
Yes	108	38.9	1.33 [0.75, 2.35]
Birthweight (g)			
<2,500	60	40.0	1.0 reference
≥2,500	184	33.7	0.70 [0.36, 1.36]
Group care			
No	122	25.4	1.0 reference
Yes (2 children)	46	50.0	2.94 [1.36, 6.38]
Yes (3-6 children)	27	48.1	2.73 [1.06, 7.05]
Yes (>6 children)	49	38.8	1.86 [0.86, 4.02]
Child-care setting			
Home	149	32.9	1.0 reference
Day-care home	41	36.6	1.18 [0.53, 2.58]
Day-care center	54	40.7	1.40 [0.70, 2.81]
Cost of care (dollars/month)***			
≤50	18	50.0	1.0 reference
50-100	53	49.1	0.96 [0.29, 3.22]
≥100	24	12.5	0.14 [0.02, 0.80]
Time spent in care (hours/week)***			
≤45	47	38.3	1.0 reference
>45	48	39.6	1.06 [0.42, 2.64]

*Only children receiving the same type of care during the whole year were considered.
**Number of persons/room.
***Do not apply to children cared at home.

Table 3 - Risk of acute diarrhea during the year preceding the interview, according to type of child-care.

Type of child-care in the last year	N	Crude OR [95% CI]	Adjusted* OR [95% CI]
Home care, alone	107	1.0 reference	1.0 reference
Home care, group	42	3.26 [1.44, 7.42]	3.18 [1.49, 6.77]
Day-care home, alone	15	1.08 [0.26, 4.15]	1.10 [0.32, 3.76]
Day-care home, group	26	2.17 [0.81, 5.84]	2.28 [0.92, 5.67]
Day-care center	54	2.04 [0.95, 4.37]	2.54 [1.21, 5.33]
Changed to child-care center	38**	5.70 [2.37, 13.87]	7.65 [3.25, 18.02]

*Adjusted for maternal education (≤9 years or >9 years), children age (≤30 months or >30 months) and preterm status.
**Ten children that changed to a setting other than child-care center were excluded from analysis.

Child age was not significantly associated with the risk of diarrhea, but older children presented almost half the risk of having diarrhea as defined for the purpose of this study.

The participation rate in the study was 72.8%. Though the number of refusals was very low, it was impossible to reach parents of a large number of eligible children, mainly due to changes in telephone numbers or new home addresses that could not be traced. As a previously assembled cohort was followed up, it was possible to compare respondents and non-respondents. Respondent parents were older, more educated and had a lower proportion of single mothers at the time of delivery. Non-respondents belonged to families of lower socioeconomic status and most probably have a higher incidence of diarrhea. The exclusion of their children is not expected to influence the risk estimates for children cared in groups, at home or in day care homes, although it might result in an overestimation of risk of acute diarrhea in children cared in child-care centers.

To assess diarrhea prevalence a recall period for diarrhea longer than two weeks has been discouraged.[3] However, the recall bias is not expected to be important in an European population with low birth rates and low incidence of diarrhea compared to developing countries where parents' lower education, large number of children, and high incidence of diarrhea make the recall very difficult over long periods. On the other hand, although some rigid definitions of diarrhea are available, taking into account the number of bowel movements, stool consistency, and duration of symptoms,[1] this study relied on parents' perception of changes in intestinal habits. Such flexible criterion minimizes recall bias but increases confounding due to unidentified variation in personal experience, namely maternal education, either formal or informal.[1] Thus the results were adjusted for mother education but the observed differences may result from other confounders not identified.

As the occurrence of diarrhea was frequent in this population (72.9% of children had at least one episode in the previous year) it was analyzed data considering as having diarrhea the children whose parents reported two or more episodes in the previous year. Similar estimates were obtained when diarrhea was defined as the occurrence of at least one episode in the previous year.

Although no statistically significant association was found in univariate analysis between the study variables and occurrence of diarrhea, except for care in groups, adjustments were also made for preterm status due to over sampling of preterm children in the previously assembled cohort, and for child age as it is known it influences the risk of diarrhea.

Absence from work to care for ill children or visit a doctor is more frequent among parents of children cared out of home making it easier to recall disease episodes.[7] Episodes ignored by parents of children cared at home could lead to risk overestimation. In the present study, the association between day-care centers attendance and diarrhea is not likely to be due to divergent reporting since the risk of diarrhea is also increased in children cared in home groups. Misclassification of the type of child-care and errors in quantification of group size are not plausible explanations for the study findings.

As in other studies[2,6] it was found an increased risk of diarrhea soon after enrollment in day-care centers. It is acceptable to assume that change from home to day-care centers exposes children to newly encountered pathogenic agents. This situation can be compared to the increased risk of diarrhea in travelers from developed to developing countries. In order to avoid overestimation of diarrhea risk due to recent child-care attendance, data were analyzed separately for children that changed child-care settings in the year preceding the interview and children cared in the same setting during the whole year.

Compared to other types of group care, attendance of child-care centers does not increase the risk of diarrhea. Thus, the risk of such infectious disease is not a plausible reason for avoiding child-care centers and missing the expected benefits of preschool education.

REFERENCES

1. Baqui AH, Black RE, Yunus MD, Azimul Hoque AR, Chowdhury HR, Sack RB. Methodological issues in diarrheal diseases epidemiology: definition of diarrheal episodes. *Int J Epidemiol* 1991;20:1057-63.

2. Barros AJD. Child-care attendance and common morbidity: evidence of association in the literature and questions of design. *Rev Saúde Pública* 1999;33:98-106.

3. Boerma JT, Black RE, Sommerfelt AE, Rutstein SO, Bicego GT. Accuracy and completeness of mothers' recall of diarrhoea occurence in pre-school children in demographic and health surveys. *Int J Epidemiol* 1991;20:1073-80.

4. Dean AG, Dean JA, Coulombier D, Burton AH, Brendel KA, Smith DC et al. *Epi Info, version 6.04a: a word processing, database, and statistics for epidemiology in microcomputers*. Atlanta: Centers for Disease Control and Prevention; 1996.

5. Delhaxhe A, Hindryckx G, Olmsted PP, Ma Z. Study findings: children's daily routines. In: Olmsted PP, Weikart DP, editors. *The IEA preprimary study: early childhood care and education in 11 countries.* Oxford: Pergamon Press; 1995.

6. Holmes SJ, Morrow AL, Pickering LK. Child-care practices: effects of social change on the epidemiology of infectious diseases and antibiotic resistance. *Epidemiol Rev* 1996;18:10-28.

7. Reves RR, Pickering LK. Impact of child day-care on infectious diseases in adults. *Infect Dis Clin North Am* 1992;6:239-50.

8. Rodrigues T, Barros H. Factores de risco para trabalho de parto pré-termo. *Acta Med Port* 1998;11:901-5.