

Impact of caregivers' education regarding respiratory infections on the health status of day-care children: a randomized trial

Ana S Alexandrino^{a, b, *}, Rita Santos^a, Cristina Melo^a and José M Bastos^b

^aDepartment of Physiotherapy, School of Allied Health Technologies, Polytechnic Institute of Porto, Vila Nova de Gaia and ^bDepartment of Health Sciences, University of Aveiro, Aveiro, Portugal.

*Correspondence to Ana S Alexandrino, Department of Physiotherapy, School of Allied Health Technologies, Rua Valente Perfeito, 322, 4400-330 Vila Nova de Gaia, Portugal; E-mail: ama@estsp.ipp.pt

Abstract

Background. Acute respiratory infections are the most common illness in childhood, and caregivers often make an excessive use of medication and medical consultations. It is vital to design and implement educational interventions in order to minimize the burden of the disease.

Objective. This study aimed to evaluate the impact of a health education session (HES) about respiratory infections on the indicators of individual health and health care utilization of day-care children.

Methods. Randomized controlled trial in 10 day-care centres in Porto, including caregivers (parents or legal tutors) of children under 3 years of age. Children's caregivers were randomly distributed into an Intervention Group (IG), who attended a HES, and a Comparison Group (CG). Children's indicators of individual health and health care utilization were evaluated in both groups, during the month after HES.

Results. Children whose caregivers attended to the HES had fewer lower respiratory tract infections (IG = 5.8%; CG = 19.0%; $P = 0.050$) and fewer acute otitis media (IG = 9.5%; CG = 27.0%; $P = 0.030$), as well as fewer medical consultations (IG = 38.5% versus CG = 61.9%; $P = 0.015$) and less antibiotic consumption (IG = 11.5% versus CG = 29.5%; $P = 0.022$). They were also less absent from day care (IG = 21 days versus CG = 59 days; $P = 0.037$) and their caregivers were less absent from work (IG = 15 days versus CG = 44 days; $P = 0.046$). Caregivers who attended HES made more use of nasal irrigation (IG = 79.6% versus CG = 53.3%; $P = 0.011$).

Conclusions. The HES about respiratory infections has positively influenced the indicators of individual health and health care utilization of children attending day-care centres in Porto.

Key words. Health promotion, nasal irrigation, patient education, paediatrics, primary health care, respiratory tract infections.

Introduction

Acute respiratory infections (ARI) are the most frequent illness in childhood and the most frequent reason for children's visits to a GP (1). Children generally develop 3–8 colds a year, while day-care children may present up to 12 episodes (2). Families make a considerable use of health care services to cope with ARI, thus becoming a burden for children and their families (3,4). Yet, there is no evidence of an effective pharmacological treatment for ARI in children, so it is vital to design and implement educational interventions in children's social

support networks, such as day-care centres (5,6). This includes health education of the children's caregivers, such as parents, relatives, legal tutors or day-care workers, with focus on modifiable risk factors and upstream determinants of health regarding ARI (7). Moreover, health educational interventions should be designed according to the caregivers' needs (7). In what matters respiratory infections, caregivers' needs are related to primary and secondary prevention measures, signs and symptoms, pharmacological and non-pharmacological treatments (8,9). This comprises nasal saline irrigation, often used

by respiratory physiotherapists in the treatment of rhinopharyngeal obstruction in children. Saline solutions have been recommended for children with upper respiratory tract infections (URTI), since they are well tolerated and potentially reduce the use of medications (2,10,11). Therefore, they could be included in health educational programmes in order to minimize the impact of URTI in children and their families, improving health outcomes.

The aim of this study was to evaluate the impact of a health education session (HES) about respiratory infections on the indicators of individual health and health care utilization of day-care children. Secondly, we aimed to analyse the association between the caregivers' use of nasal clearance techniques and respiratory infections among day-care children.

Methods

A randomized controlled trial was conducted following the 'CONSORT Statement' during winter (between January and March of 2015) in 10 private day-care centres in Porto, including caregivers (parents or legal tutors) of children aged up to 3 years old and excluding caregivers of children with preterm birth and chronic neuromuscular or respiratory diseases. In that winter, 'influenza' activity was considered high, with an epidemic pinch between the 1st and 8th week of 2015 (12).

After Ethical approval, the caregivers were contacted and informed about the aims and procedures of the study, expressing their formal written consent according to the Declaration of Helsinki. The children's caregivers were asked to fill in a registration form in order to collect baseline sociodemographic characteristics and risk profile history, as well as to complete the Portuguese version of the 'Zung self-anxiety scale' (13).

The HES was developed as a multistage process according to the caregivers' needs. This process has been described elsewhere (8). The HES had a mean duration of 1 hour and 30 minutes and covered the following five domains:

- A) Prevention of ARI: primary prevention measures (correct hand washing and drying, toys' hygiene and light and ventilation in children's rooms) and secondary prevention measures (avoiding day-care or social interactions, covering mouth when coughing or sneezing, using alcoholic solutions and dischargeable wipes).
- B) First signs and symptoms of ARI: correct management of rhinorrhoea, cough and nasal congestion.
- C) Worsening signs of ARI: appropriate actions regarding fever, loss of appetite, dehydration, irritability or apathy, sleep disorders or signs of increased work of breathing.
- D) Medication: attention was drawn to the importance of letting the GP decide when the child should take antibiotics, highlighting that antibiotics are not effective against viral ARI.
- E) Nasal clearance techniques: appropriate positioning according to the child's age, executing slow and prolonged aspirations when using nasal aspirators, as well as using a sufficient dosage of saline solution to insert into a nostril and exit through the other, in order to facilitate the removal of nasal secretions. Caregivers were also advised to play with the child after nebulization, stimulating an effective cough in order to expel secretions.

The HES was conducted by a respiratory physiotherapist among small groups of 10–15 caregivers at the day-care centre. At the end of the HES, the participants received a small booklet with a summary of the information. The HES was assessed in another study,

concluding that it met the caregivers' needs and increased their knowledge and attitudes in relation to ARI, especially in terms of nasal clearance techniques (8).

Instrument

The caregivers from both groups filled a 'Diary of Records' during 1 month of follow-up after the HES. This diary was designed by an expert panel (three blinded respiratory physiotherapists with at least 5 years of experience in the treatment of children) and included questions about the following children's indicators of individual health and health care utilization: (i) ARI: (a) checklist of signs of respiratory infections (cough, rhinorrhoea, nasal congestion, sputum, fever, otorrhoea, eating or sleep disorders or other) and (b) checklist of respiratory infections diagnosed by the child's doctor (common cold, pharyngitis, acute otitis media, tonsillitis, laryngeal or tracheal infection, acute bronchiolitis, acute bronchitis or pneumonia); (ii) Health care utilization of medical consultations, emergency services and/or antibiotics (yes/no); (iii) Absenteeism: number of days that the child was absent from day care, as well as parents were absent from employment; (iv) Nasal clearance techniques, namely the utilization of nasal aspirators, nasal irrigation and/or nebulization (yes/no).

The content validity of the Diary of Records was ensured according to the 'Delphi's Method', in a pilot test with 10 caregivers of children with URTI, who were not included in the final sample. The caregivers filled the Diary of Records as well as a comprehension test, in which they wrote down any ambiguous or misunderstanding terms, as well as suggestions towards a better comprehension. Afterwards, the expert panel analysed the caregivers' answers and agreed on a final version of the Diary of Records. All the questions obtained a test-retest coefficient between 'moderate' and 'very good' ($0.412 \leq \text{Cohen's Kappa} \leq 0.818$).

Case definitions

A child was considered as having experienced a URTI if caregivers reported an episode of common cold along with one of the following symptoms: (i) cough; (ii) rhinorrhoea; and (iii) nasal congestion, or if caregivers reported common cold, pharyngitis or tonsillitis diagnosed by the child's doctor. Moreover, the child was considered as having experienced lower respiratory tract infection (LRTI) if caregivers reported an episode of laryngeal and tracheal infection, acute bronchiolitis, acute bronchitis or pneumonia, diagnosed by the child's doctor (3,14). Children were considered as having experienced acute otitis media (AOM) if caregivers reported an episode of AOM confirmed by the child's doctor.

Sample size

We calculated that 150 participants would be needed, with 95% power and at a 5% significance level, in order to show an absolute risk reduction of 21.3% in antibiotic consumption, according to the results of Francis *et al.* (15). We contacted the caregivers of 241 children of 10 day-care centres and 189 agreed to participate in the study (response rate = 78.4%). A total of 12 children's caregivers were excluded (11 children with preterm births and 1 asthmatic) and 52 caregivers declined to participate, so a final sample of 177 children's caregivers was obtained. Then, the caregivers were randomly distributed by a blinded collaborator into an Intervention Group (IG): caregivers who attended the HES ($n = 85$) and a Comparison Group (CG): caregivers who did not attend the HES ($n = 92$), according to a table of random numbers between 0 (CG) and 1 (IG), given by the statistical software.

The caregivers of the children from CG as well as the day-care workers (educators and assistants) were invited to participate in an extra HES once the study ended.

Statistical analysis

All statistical analyses were carried out using the IBM® SPSS® Statistics 22 software for Windows 8® with a confidence interval of 95% (significance level of $\alpha = 0.05$).

The sample characteristics and the outcomes were described using means and standard deviations (continuous variables) or percentages (categorical variables).

The Cohen's kappa coefficient was used to assess the test-retest reliability of the Diary of Records.

For the inter-group analysis, it was used 'Fisher's exact Test' (dichotomous variables) and the 'Student's t-test for independent samples' (continuous variables). The 'Chi-square test' was used as an inferential bivariate method to analyse the strength of the associations between dichotomous variables of the Diary of Records.

Results

Participants

The caregivers of 177 children were randomized between January and March of 2015 (Fig. 1). The baseline sociodemographic characteristics and risk profile history of the children from each group are summarized in Table 1.

Impact of the health education session on the children's indicators of individual health and health care utilization

The data concerning the caregivers' reports in the Diary of Records during 1 month after the HES were compared to IG and CG in order to analyse the effect of the HES on the following children's respiratory indicators of individual health and health care utilization.

Acute respiratory infections

The results revealed that children whose parents attended the HES had fewer LRTI and AOM in comparison with CG (Fig. 2).

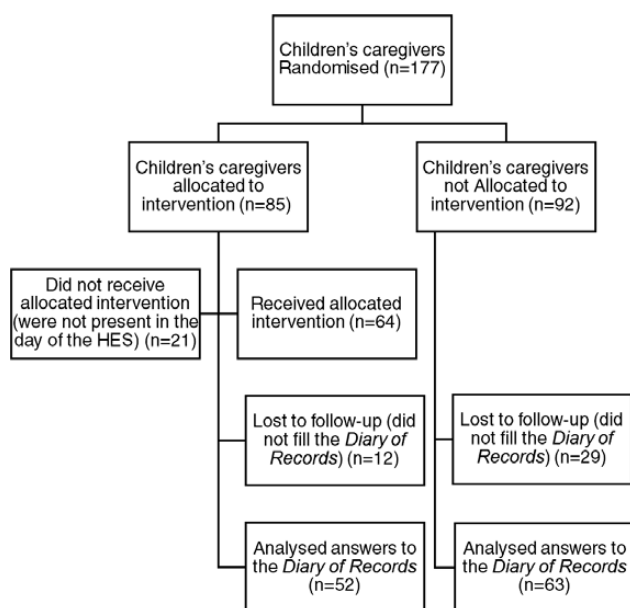


Figure 1. Diagram flow chart according to the 'Consort Statement'

Indicators of health care utilization

Regarding the frequency with which children used health care services due to ARI, it was observed that children from IG had less medical consultations and used less antibiotics than the ones from CG (Table 2).

Days of absence from day care and from employment

Considering absenteeism, the results showed that children from IG missed less days from day care comparing to CG (IG = 21 days versus CG = 59 days; $P = 0.037$). Caregivers from IG were less absent from employment when compared to CG (IG = 15 days versus CG = 44 days; $P = 0.046$).

Use of nasal clearance techniques

Concerning the use of nasal clearance techniques by the caregivers, it could be seen that the caregivers from IG recurred more often to nasal irrigation than caregivers from CG (Table 2).

Associations between nasal clearance techniques and acute respiratory infection

The results concerning possible associations between the caregivers' use of nasal clearance techniques and ARI in the day-care children are shown in Table 3. It was possible to observe in IG a significant association between URTI and nasal irrigation as well as nebulization. Considering CG, it could be observed significant associations between AOM and the use of nasal aspirators and between LTRI and the use of nebulization.

Discussion

This study focused on the impact of a HES on several indicators of individual health and health care utilization related to ARI in children, thus becoming original and relevant, since the existing literature mainly focuses on antibiotics and medical consultations as main outcomes. This study also analysed the use of nasal clearance techniques by the caregivers, finding important associations with ARI. Furthermore, it was assured that children from both groups were exposed to the influence of the same risk factors for ARI, allowing us to assume that the better results in the IG were due to the HES.

In this study, we observed that the children whose caregivers attended the HES had less LRTI and AOM when compared to CG. This is a very important result regarding the caregivers' education about the prevention of URTI complications, once LRTI and AOM often have an onset after URTI, so a correct management of URTI might prevent or diminish more severe episodes (2,6,14). There is some evidence that parents know little about the risk of ARI transmission through contact with objects or by the hands, having also particular concerns regarding the use of protective masks and children's social isolation, thus caregivers' education is vital to an efficient childcare (5,6). In fact, URTI have a predominantly viral origin, spreading easily among children in day care due to the close contact between them as well as sharing common objects, becoming difficult to prevent (3,14,16). This can explain why in our study there were no significant differences between the groups regarding UTRI.

There is a high prevalence of respiratory viruses in children at the day care, which are responsible for the development of both URTI and LRTI (3,4,16). Kusel *et al.* (3) found that in a community setting rhinoviruses are the most common respiratory pathogen detected in children's first year of life and that the burden of disease attributable to infections by rhinovirus was higher than that of respiratory syncytial viruses, even though rhinoviruses revealed a greater tropism for the upper respiratory tract.

Table 1. Baseline sociodemographic characteristics and risk profile history of children from IG ($n = 52$) and CG ($n = 63$)

		Group	Continuous variables ($X \pm SD$)	Dichotomous variables (%)	P value (95%)
Caregivers	Mother's age at birth (years)	IG	31.83 \pm 4.46	–	0.622
		CG	31.19 \pm 4.42	–	
	Pregnancy duration (weeks)	IG	38.2 \pm 1.91	–	0.865
		CG	38.4 \pm 1.58	–	
	Breastfeeding (months)	IG	8.52 \pm 6.51	–	0.356
		CG	7.68 \pm 5.41	–	
Perceived anxiety (Zung's Scale)	IG	32.2 \pm 5.63	–	0.863	
	CG	31.2 \pm 7.20	–		
Level of education (Higher Education)	IG	–	63.5	0.418	
	CG	–	72.1		
Household	Household (<3)	IG	–	44.3	0.331
		CG	–	45.2	
	Siblings (yes)	IG	–	46.2	0.707
		CG	–	41.9	
	Parents' respiratory diseases (yes)	IG	–	38.5	0.568
		CG	–	45.2	
House Smoking (yes)	IG	–	21.2	0.819	
	CG	–	19.4		
Children	Gender (male)	IG	–	46.2	0.259
		CG	–	58.1	
	Age (months)	IG	21.77 \pm 8.44	–	0.251
		CG	24.05 \pm 8.44	–	
Weight at birth (kg)	IG	3.18 \pm 0.46	–	0.364	
	CG	3.16 \pm 0.47	–		
Day care	Room size (m ²)	IG	28.24 \pm 8.58	–	0.573
		CG	30.71 \pm 8.45	–	
	Children per room (Number)	IG	9.92 \pm 3.83	–	0.946
		CG	10.75 \pm 3.06	–	

IG: Intervention Group; CG: Comparison Group; X: Mean; SD: Standard deviation.

Table 2. Absolute and relative frequencies of caregivers' who used health care services and nasal clearance techniques in IG ($n = 52$) and CG ($n = 63$), during 1 month

		Group	Absolute frequency	Relative frequency	P value
Health care utilization	Medical consultations	IG	20	38.5%	0.015*
		CG	39	61.9%	
	Visits to emergency room	IG	6	11.5%	0.591
		CG	10	16.4%	
Use of antibiotics	IG	6	11.5%	0.022*	
	CG	18	29.5%		
Nasal clearance techniques	Nasal aspirator	IG	21	40.4%	1.000
		CG	24	40.0%	
	Nasal saline irrigation	IG	40	79.6%	0.011
		CG	32	53.3%	
	Nebulization	IG	13	25.0%	0.673
		CG	18	30.0%	

IG: Intervention Group; CG: Comparison Group.

* $P \leq 0.05$ is considered to be significant.

There is some evidence regarding the use of nasal saline irrigation to eliminate germs, allergens and other pollutants from the nasopharynx, preventing future episodes of URTI, as well as complications such as AOM in children (2,10,11). In this study, it could be seen that caregivers from IG recurred more often to nasal irrigation than caregivers from CG and that the use of nasal irrigation was associated with URTI episodes. Nasal saline irrigation is considered to be a safe and effective procedure, generally prescribed for both the prophylaxis and therapy of URTI in preschool children (2,10,11). However, many aspects of the procedure are not clarified, such as

frequency of application, method of administration or volume irrigated, and this reduces parental compliance (11). In fact, according to Rouusunides *et al.* (17), many parents expect their paediatrician to prescribe an antibiotic for ARI symptoms rather than nasal irrigators. This might be related to parents' insecurity regarding the application of the nasal solution, decreasing its usage due to the difficulty of administration or the supposed invasiveness of the procedure (11). In the HES, the caregivers were able to practice nasal clearance techniques on paediatric models, acquiring experience, which seems to be a key factor reported by parents that allows them

Table 3. Associations between the caregivers' use of nasal clearance techniques and respiratory infections in the children from the IG ($n = 52$) and CG ($n = 63$), during 1 month

		Group	URTI		LRTI		AOM	
			Yes/Yes	<i>P</i> value	Yes/Yes	<i>P</i> value	Yes/Yes	<i>P</i> value
Nasal clearance techniques	Nasal aspirator	IG	85.0%	0.093	33.3%	1.000	60.0%	0.383
		CG	58.8%	0.293	63.6%	0.097	66.7%	0.031*
	Nasal irrigation	IG	83.9%	0.020*	100%	1.000	80.0%	1.000
		CG	55.2%	0.069	63.6%	0.519	73.3%	0.084
	Nebulization	IG	32.5%	0.024*	66.7%	0.151	20%	1.000
		CG	33.3%	0.255	90.9%	0.000*	33.3%	0.754

IG: Intervention Group; CG: Comparison Group; URTI: upper respiratory tract infections; LRTI: lower respiratory tract infections; AOM: acute otitis media. Frequencies are displayed regarding the percentage of children that used each of the nasal clearance techniques and had experienced each of the following respiratory infections: URTI, LRTI and AOM.

* $P \leq 0.05$ is considered to be significant.

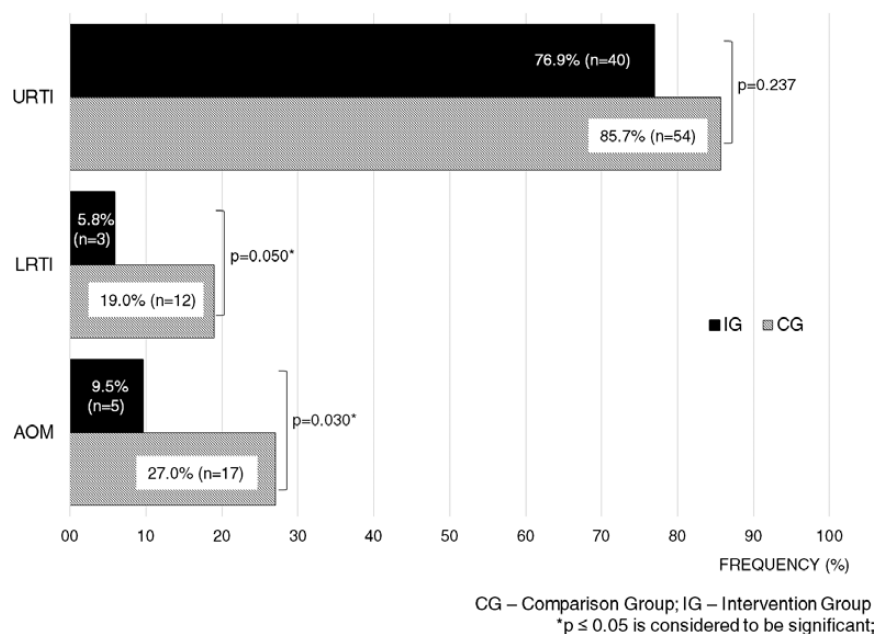


Figure 2. Frequency of the day-care children who experienced an episode of respiratory infection in Intervention ($n = 52$) and Comparison Groups ($n = 63$), during 1 month

to increase their self-efficacy and thus reduce their need to consult or reconsult the doctor (9). An effective nasal clearance may not only remove secretions but also improve mucociliary clearance, leading to the reduction of oedema and supporting the healing of the nasal mucosa, being related to significantly better outcomes on nasal secretion, obstruction and medication's use (2,10).

Furthermore, we observed in our study a significant association between AOM and the caregivers' use of nasal aspirators in CG, which was not verified in IG. Inter-society consensus recommends superficial aspiration of the upper airways, especially in younger children, in order to improve airway patency and ease feeding difficulties; however, data are limited for the use of nasal aspirators and there is a need to clinically investigate their efficacy and safety (2). Nevertheless, it cannot be excluded that persistent nasal aspiration by caregivers can cause abrupt changes in the infant's middle ear pressure, and this might lead to a higher risk of Eustachian tube dysfunction.

A significant association between LRTI and the use of nebulization was also observed in CG and not in IG, and this may be related

to the higher percentage of LRTI in CG. The use of nebulized saline solutions during bronchiolitis is well documented and demonstrates to be effective in improving clinical scores and decreasing the length of hospital stay, however, further large-scale studies are needed (6). The action mechanism of nebulized saline solutions seems to be linked with a decrease of airway oedema, improved ciliary clearance of mucus and decreased respiratory secretion viscosity (6). Nevertheless, it is vital to promote child's coughing after nebulization in order to expel secretions. Caregivers generally are not aware of this, choosing to perform nebulization when the child is sleeping, what promotes the stasis of secretions and consequent microbial replication.

The results concerning the indicators of health care utilization revealed that children from IG had fewer medical consultations and used less antibiotics when compared to CG and this can be related to the significant lower percentage of LRTI and AOM in IG. Francis *et al.* (15) also found that parents' education led to important reductions in antibiotic prescribing and reduced intention to consult the doctor. Parents seek for medical support in the presence of AOM symptoms,

such as pain and fever or reassurance about possible complications (18). A systematic review by Venekamp *et al.* (18) concluded that antibiotics appeared to be most effective in children under 2 years of age, with bilateral AOM, or with both AOM and otorrhoea. However, regarding LRTI, the American Academy of Paediatrics guidelines suggest that clinicians should not administer antibiotics unless there is a concomitant bacterial infection, due to the risk of side effects, significant costs and possible development of antibiotic resistance (5,6).

Considering absenteeism, our study showed that children from IG missed less days from the day care and caregivers were less absent from employment, in comparison to CG. Although there is a lack of studies about this topic, our results meet the findings of Azor-Martínez *et al.* (19) who concluded that school absenteeism due to infections is reduced when an educational programme is properly carried out, especially during the flu season.

This study faced some limitations. There was a low number of participants, therefore, we cannot infer about the external validity of these results. Moreover, since the IG and CG were both represented in each day-care centre, there was a risk of contamination of the caregivers from CG. Also, the caregivers' socio-economic status may influence their needs, thus only private day-care centres were included, assuming that the parents would have similar economic incomes. Further studies are needed to identify microbiological agents in children with signs and symptoms of respiratory infections, instead of using data reported by caregivers, as well as cluster randomized controlled trials designs with more extensive follow-ups, including caregivers and day-care workers from public and private day-care centres of all across the country.

Conclusion

The HES about respiratory infections had a positive influence on the indicators of individual health and health care utilization of children attending day-care centres in Porto. Children whose caregivers attended the HES had fewer episodes of LRTI and AOM, as well as less medical consultations and less antibiotic consumption; moreover, they were less absent from day care, as well as their caregivers were less absent from employment. URTI were associated with nasal irrigation as well as nebulization only in IG, while in CG AOM was associated with the use of nasal aspirator and LTRI was associated with the use of nebulization.

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