



Influence of day care attendance on morbidity in children under 12 months of age

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Abstract

Introduction: the current structure of Spanish society favors the attendance of children at day care to increasingly early ages. This is a risk factor in itself to the condition of infection of the upper and lower respiratory tract, as well as acute otitis media, gastrointestinal infections and other infections.

Objective: to evaluate the influence of day care attendance on the risk of infections in children under 12 months of age.

Population and methods: prospective longitudinal study. Children born between 1 January and 30 September 2010, attending primary care pediatrics' offices, were included. We excluded children who had severe respiratory or cardiac disease or severe immune deficiency. The data were obtained from computerized medical records and interviews with parents in scheduled visits at 6 and 12 months. In the statistical analysis of the data the statistical software R[®] (R Development Core Team, 2011) was used.

Results: children who attend day care have one or more infectious episodes in higher percentages with statistically significant (p-value <0.05) differences for bronchiolitis, bronchitis, conjunctivitis, tonsillopharyngitis, acute gastroenteritis, laryngitis, pneumonia, acute otitis media, common cold, wheezing, sinusitis and for total pathologies. Attendance at nursery could be responsible for between 35% and 50% of the acute otitis, gastroenteritis, bronchiolitis and bronchitis.

Conclusion: taking into account these results, it seems advisable to try other different ways for the care of children in early ages.

Key words:

- Nursery
- Risk
- Infectious diseases
- Prospective study

Resumen

Influencia de la asistencia a guarderías sobre la morbilidad en niños menores de 12 meses de edad

Introducción: la estructura actual de la sociedad española favorece la asistencia de los niños a guarderías infantiles a edades cada vez más tempranas. Esto es un factor de riesgo por sí solo para el padecimiento de infecciones del tracto respiratorio superior e inferior, otitis media aguda, infecciones gastrointestinales y otras infecciones.

Objetivo: evaluar la influencia de la asistencia a la guardería sobre el riesgo de padecer infecciones en los niños menores de 12 meses de edad.

Población y métodos: estudio longitudinal prospectivo. Se incluyeron en el estudio los niños nacidos entre el 1 de enero y el 30 de septiembre de 2010 que acuden a consulta de Pediatría de Atención Primaria. Se excluyeron los niños que presentaban patología respiratoria o cardiaca grave o inmunodeficiencias graves. Los datos se obtuvieron de la historia clínica informatizada y de las entrevistas en visitas programadas a los padres a los 6 y a los 12 meses. Para el análisis estadístico de los datos se utilizó el programa estadístico R[®] (R Development Core Team, 2011).

Palabras clave:

- Guarderías
- Riesgo
- Enfermedades infecciosas
- Estudio prospectivo

Resultados: los niños que acuden a la guardería presentan más episodios infecciosos que los que no lo hacen, siendo estadísticamente significativas (p -valor $<0,05$) las diferencias respecto a bronquiolitis, bronquitis, conjuntivitis, faringoamigdalitis, gastroenteritis aguda, laringitis, neumonía, otitis media aguda, resfriado común, sibilancias, sinusitis y para el total de patologías. Los niños que asisten a guarderías tienen un riesgo dos o más veces mayor de padecer bronquiolitis, bronquitis, faringoamigdalitis y otitis media, que los que no acuden.

Conclusiones: teniendo en cuenta estos resultados, parece aconsejable intentar otras fórmulas diferentes para el cuidado de los niños en edades tempranas.

INTRODUCTION

The current structure of Spanish society, with the incorporation of women into the workforce, the increase in the number of single-parent homes, and the economic burden involved in hiring a childminder, encourages the enrolment of children in childcare centres at increasingly early ages. According to the latest population surveys in our country, 20.7% of the employed population reports using specialised services for the care of their children, with a wide variation between autonomous communities, from 13% in Extremadura to 28.9% in Madrid¹. The maternity leave period in Spain lasts 16 weeks, while in the rest of the European Union (EU) it is 20 weeks long, and 96 weeks long in Sweden. The breastfeeding breaks in Spain consist of one hour a day until the ninth month. Thus, the childcare centre becomes a social demand and need, and does have an influence on the child's health².

Families often consult with the paediatrician and seek advice regarding the best care for their children: the use of a specialised centre (childcare centre) as opposed to other options in those cases where they may be available (a grandparent, another family member, or a hired caregiver).

Attendance at childcare centres is in itself a risk factor for suffering upper³ and lower respiratory tract infections, as well as acute otitis media⁴, gastrointestinal infections, and other infections.

Most of the published studies have been done in countries with education and employment systems (maternity leaves and breastfeeding breaks) that differ from our own. The few studies carried out in Spain also show a higher risk of infection^{5,6},

although the proportions are different. The literature review published in 2007 compiles the information of 52 studies, of which only one was done in Spain⁷. Among the factors that have an influence, the most important one is the age at which the child starts attending the childcare centre⁸.

Thus, we face a reality that has a marked influence on the everyday health of children, on the healthcare burden, on the emergence of antibiotic resistance, and therefore on the decisions that the paediatrician has to make on a daily basis. Since the studies in our environment are scarce, it seems pertinent that we do a prospective multi-centre study analysing several dependent variables.

Our stated objective is to assess the influence of childcare centre attendance on the risk of infection in children younger than 12 months.

POPULATION AND METHODS

Type of study

Prospective longitudinal study of two cohorts of children aged 0-12 months, differentiated solely by their attending or not attending childcare (exposure factor).

Population under study

The study included children born between January 1st and September 30th 2010 served by the Paediatric Primary Care (PC) clinic and whose families agreed to their participation after being informed in full about the study.

It excluded children who presented a severe respiratory pathology, a severe heart pathology re-

quiring surgical treatment, or severe immunodeficiencies, and children who did not come routinely to paediatric visits.

The study involved the participation of 35 paediatricians and 20 nurses from the eight healthcare districts of the Principality of Asturias.

Sample size: we calculated a sample size of 1025 cases taking into account the incidence of pneumonia (4%) as the most important of the common infections that were the subject of our study.

Variables in the study

Independent variable: childcare centre attendance (dichotomous qualitative variable), which defines both cohorts.

As dependent variables, we analysed the number and type of infections contracted (bacteraemia, bronchiolitis, acute bronchitis, conjunctivitis, exanthematous viral diseases, pharyngitis, pharyngoamygdalitis, acute gastroenteritis, influenza, laryngitis, meningitis, pneumonia, acute otitis media, common cold, sepsis, wheezing, sinusitis, others) that were pre-defined according to the Nelson Textbook of Pediatrics². We also analysed personal and family characteristic variables.

Data collection

The data were collected from the computerised clinical histories and in interviews performed during scheduled routine check-ups at 6 and 12 months of age. The data pertaining to the characteristic variables were gathered in the first visit, and those regarding the response variables were collected at 6 and 12 months and recorded in forms that had been designed for that purpose.

The informed consent given to parents included an explicit statement of compliance and adherence to laws and ethical guidelines.

During the first visit, at six months of age, we gathered the data pertaining to:

- Personal characteristics: code, date of birth, sex, gestational age, birth weight, and presence or absence of neonatal pathology, BF, routine im-

munisations scheduled in the Autonomous Community of the Principality of Asturias, and optional immunisations (pneumococcal and rotavirus vaccines), weight, height, and growth percentiles.

- Family characteristics: siblings, and, in regard to the father and the mother, the age, level of education, whether employed or not, tobacco use, allergies, and asthma.
- Attending or not attending a childcare centre; age at initial enrolment and reason for attending or not attending.
- Number and type of infections (according to pre-set definitions).

During the 12-month visit, we collected:

- Vaccine schedule (routine and optional), BF.
- Attendance at a childcare centre, or not.
- Infectious pathology suffered, and number of episodes.

Statistical analysis

To do the statistical analysis of the data, we used the statistical software R[®] (R Development Core Team, 2011), version 2.14. To analyse the relationship between childcare centre attendance and the factors under study, we used Pearson's chi-square test.

To analyse the quantitative variables we used Student's t-test or Welch's test, after ensuring the normality of the distribution using the Shapiro-Wilks test, and the equality of scale by the Ansari-Bradley test. In the case of qualitative variables, we used Pearson's chi-square test. We are also presenting the relative risks and the corresponding 95% confidence intervals to quantify the risk of suffering the pathologies with the highest incidence rates in association with whether the child does or does not attend a childcare facility.

RESULTS

We gathered data for 1139 children at six months of age and for 1092 children at 12 months, which

entailed a 4.1% attrition rate that was mostly due to changes in residence.

Description of the population under study

- Personal data. **Table 1** shows the characteristics of sex, gestational age, birth weight, and presence or absence of neonatal pathology for the children included in the study.
- BF. 80% of the children were BF as newborns; the highest percentage of weanings occurred before six months of age (**Fig. 1**) and at 11 months, 8.9% of the children continued to breastfeed.
- Vaccine schedule. At 12 months of age, 100% of the population under study had been immunised in compliance with the official schedule of the Principality of Asturias. 19.4% of the children were vaccinated against rotavirus; 82.6% had been vaccinated against pneumococcus.
- Family and social characteristics. 59.7% did not have siblings, 33.8% had one sibling, 5.2% had two, and 1.3% had more than two. The fathers' ages were distributed as follows: 43% were between 21 to 34 years old; 39.4%, between 35 and 40 years old, and 16.8% were older than 40; 93.5% were employed. As for the mothers, 59.7% were between 21 and 34 years old; 33.7% between 35 and 40 years old, and 5.2% were older than 40; 70.6% were employed. The data on the educational level of both parents and their tobacco use are presented in percentages in **Fig. 2**.
- Infectious pathology. The study describes (in percentages) the evolution of pathology record-

ed at 6 and 12 months of age in the entire study sample. **Fig. 3** shows pathologies with incidence rates below 6%, and **Fig. 4** the pathologies with higher incidence rates. We observed that in the second semester of life the rate had increased for all infectious pathologies except for sepsis cases, which were more frequent in the first trimester on account of neonatal sepsis. The section devoted to other pathologies is larger in the first six months of life, and corresponds to non-infectious pathologies.

Childcare centre attendance

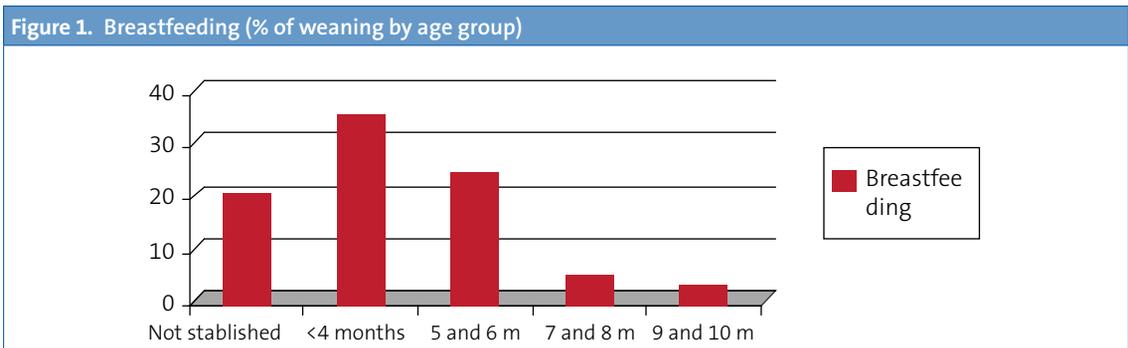
By 12 months of age 21.34% of the children attended childcare (**Table 2**). The age at initial enrolment was before age four months in 3.94% of the children, and it peaked between five and six months of age, coinciding with the end of the maternity leave period; after that, enrolment increased gradually until 12 months.

Factors that influence attending a childcare centre

- Among the factors we studied, the employment status of the mother and the educational level of both parents had a significant influence (p=0.05) on childcare centre attendance (**Table 3**).
- The mother was employed in 89.4% of the cases in which children attended childcare, and children attended in higher proportions when the parents had attended college (**Table 4**).

Table 1. Personal data of the population studied

Sex	Male	50.66%
	Female	49.34%
Gestational age	<37 weeks	8.80%
	Between 37 and 42 weeks	89.20%
	>42 weeks	2.10%
Birth weight	<2 kg	2.20%
	Between 2 and 2.5 kg	6.50%
	Between 2.5 and 4 kg	86.90%
	>4 kg	4.40%
Neonatal pathology	Develop pathology	14.90%



Behaviour of the two cohorts (children who did or did not attend childcare) in relation to specific infectious pathologies and to any of the pathologies

The children who attended childcare centres developed one or more episodes in higher percentages than those children who did not attend childcare, and we found statistically significant differences ($p < 0.05$) in the incidence of bronchiolitis, bronchitis, conjunctivitis, pharyngoamygdalitis, acute gastroenteritis, laryngitis, pneumonia, acute otitis media, the common cold, wheezing, sinusitis, and pathologies in general (Table 5).

The relative risk (RR) of developing pathologies with an incidence rate above 4% in children who attend childcare is presented in Table 6.

The differences are significant for: bronchiolitis, bronchitis, conjunctivitis, pharyngoamygdalitis, acute gastroenteritis, laryngitis, acute otitis media, the common cold, wheezing, and for pathologies in general.

Compared to children who do not attend a childcare centre, children who do attend have twice the RR or more of developing bronchiolitis, bronchitis, pharyngoamygdalitis and acute otitis media.

The cohorts do not behave the same if we study the average number of episodes suffered (Table 6). Compared to children who did not attend a childcare centre, those who did developed more episodes on average (a difference that was statistically significant, $p < 0.05$) for the following pathologies: bronchiolitis, bronchitis, conjunctivitis, gastroenteritis, acute otitis media, common cold, and wheezing.

DISCUSSION

We are carrying out a prospective multicentre study within the framework of primary care paediatric visits that involves the participation of a large number of paediatricians and nurses, which allowed us to obtain a large sample. We have col-

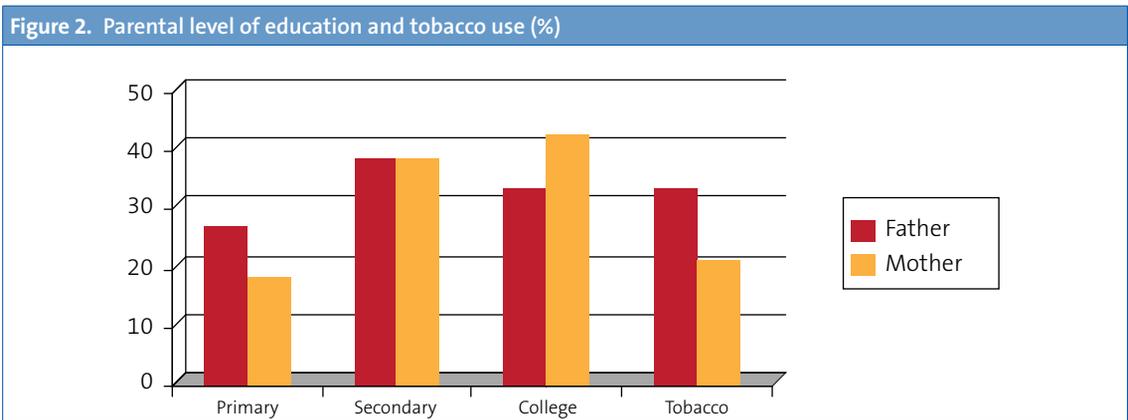
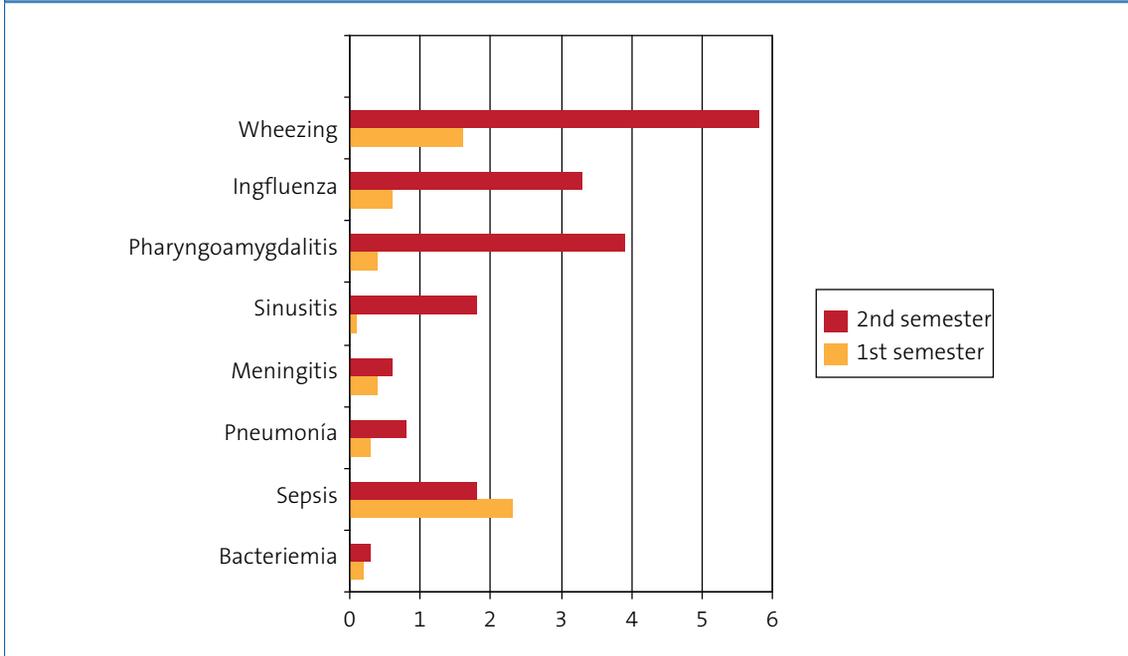


Figure 3. Low-incidence infectious pathology recorded in the first and second semesters (%)



lected data during routine visits, trying to maximise the research potential of the primary care paediatric offices.

The participation of a large number of professionals also brings some weaknesses to the project, the most important of which is the potential het-

erogeneity of diagnostic criteria, which we tried to minimise by setting definitions for these criteria prior to the start of the study.

The sinusitis diagnosis may be controversial; since the computer coding system based on the International Classification of Primary Care (ICPC) used in

Figure 4. High-incidence (>6%) infectious pathology recorded in the first and second semesters (%)

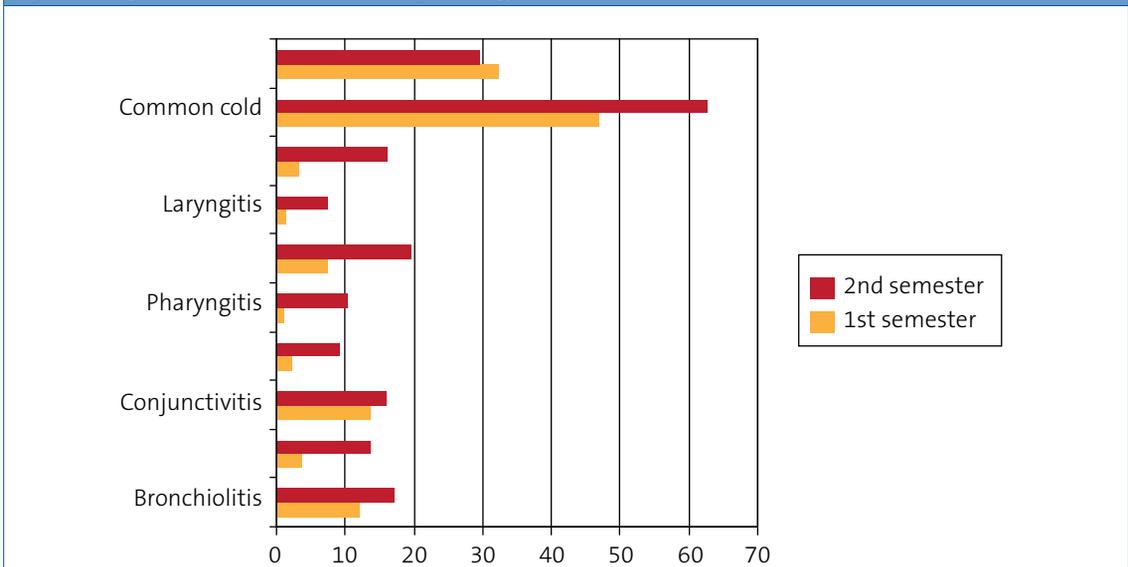


Table 2. Age at start of childcare centre attendance

Never attended	78,66%				
Attended 21.34%	Age at start of attendance				
	<4 months	5-6 months	7-8 months	9-10 months	11-12 months
	3.94%	8.06%	2.84%	2.56%	2.29%

the clinics does not have a diagnostic code for episodes of superinfection in upper respiratory tract pathologies, we decided to include these processes in the sinusitis diagnosis.

We also included wheezing episodes since they can involve a severe pathology, and there is a high prevalence of these episodes in Asturias (45.6% of children suffer from a wheezing episode within the first 36 months of life)⁹. Although this is not an infectious pathology, knowing how its incidence is affected by attending or not attending childcare is of great interest.

While it was not one of the objectives of this study, given the low number of studies that provide morbidity data for these age intervals, we decided to include the data about the incidence of pathologies recorded in the first and second semesters of life. To facilitate their interpretation, we are presenting them in two graphs (for pathologies with higher and lower incidence rates). Consistent with other publications, the common cold is the pathology with the highest incidence rate in both age intervals.

Table 3. Factors that influence childcare centre attendance

	p-value
Sex	0.2784
Gestational age	0.6221
Birth weight	0.4917
Neonatal pathology	0.3594
Breastfeeding	0.4054
Siblings	0.9686
Mother's age	0.2062
Father's age	0.1389
Mother's education	0.0000
Father's education	0.0005
Mother's employment	0.0000
Father's employment	0.7577

The present study recorded the prevalence of BF and the age at weaning; we did not collect data on exclusive BF, but on BF in general, and our data show rates that are better than those reported in the study performed in Asturias in 2000¹⁰ both for establishing BF (80% compared to 72.7%) and for its prevalence at four months of age (45% versus 19.6%).

According to our data, BF is not a protective factor against infectious disease. This may be due to the fact that we recorded BF in general and not exclusive BF, and that we only analysed the data for the 6 to 12 month age interval.

As for family characteristics, a larger percentage of mothers than fathers had higher education degrees, and the mothers smoked less than the fathers. Only 6.5% of the children had two or more siblings.

The statistical analysis of the two cohorts (attending/not attending childcare) was performed on the data gathered for the age range between 6 to 12 months, since very few children enrolled in childcare at ages below five months.

In the population under study, 21.34% of children attended childcare by age 12 months, and the stated reason for it, in every case except for one, was the employment status of family members. In one case, the decision to send the child to childcare had to do with early socialisation.

When we calculated the RR of developing infectious pathologies in children who attended child-

Table 4. Educational level of parents whose children attended childcare

	Mother	Father
Primary school	11.3%	17.9%
Secondary school	32.5%	39.6%
College	56.6%	42.5%

Table 5. Percentage of children in both cohorts studied (who did/did not attend childcare) who developed one or more episodes of the different pathologies

	Children who did not attend childcare (N=878)	Children who did attend childcare (N=214)	p-value<0.05
Bacteraemia	0.12%	0.93%	0.04
Bronchiolitis	13.86%	30.37%	0.00
Bronchitis	10.19%	25.23%	0.00
Conjunctivitis	14.10%	21.96%	0.00
Exanthematous viral diseases	9.00%	11.68%	0.23
Viral pharyngitis	9.83%	13.55%	0.11
Pharyngoamygdalitis	3.20%	6.54%	0.02
Gastroenteritis	17.77%	27.10%	0.00
Influenza	3.32%	3.74%	0.76
Laryngitis	6.40%	10.75%	0.03
Meningitis	0.47%	0.93%	0.42
Pneumonia	0.36%	2.34%	0.00
Otitis media	13.39%	28.04%	0.00
Common cold	60.43%	71.50%	0.00
Sepsis	1.90%	1.87%	0.98
Wheezing	4.98%	9.35%	0.02
Sinusitis	0.83%	2.80%	0.02
Other	30.69%	27.10%	0.31
Any infectious pathology	83.40	94.90%	0.00
Any pathology	88.15%	96.26%	0.00

Table 6. Relative risk of suffering the different pathologies for children who attend childcare and mean number of episodes for the two cohorts under study

	RR	95% CI	Mean number of episodes / "did not attend" (N=844)	Mean number of episodes / "did attend" (N=220)	p-value <0.05
Bronchiolitis	2.19	1.68-2.85	0.14	0.33	0.00
Bronchitis	2.48	1.82-3.36	0.11	0.32	0.00
Conjunctivitis	1.56	1.15-2.11	0.15	0.26	0.01
Exanthematous viral diseases	1.29	0.85-1.19	0.09	0.14	0.15
Viral pharyngitis	1.38	0.93-2.05	0.11	0.18	0.09
Pharyngoamygdalitis	2.05	1.09-3.83	0.04	0.32	0.06
Gastroenteritis	1.53	1.17-1.98	0.20	0.32	0.01
Laryngitis	1.68	1.06-2.67	0.07	0.12	0.08
Otitis media	2.09	1.59-2.76	0.16	0.45	0.00
Common cold	1.18	1.07-1.31	1.11	1.48	0.00
Wheezing	1.88	1.13-3.13	0.09	0.21	0.02
Other	0.88	0.69-1.12	0.56	0.54	0.75
Any infectious pathology	1.14	1.09-1.19	2.37	4.07	0.00
Any pathology	1.09	1.05-1.13	2.93	4.61	0.00

IC 95%: 95% confidence interval; RR: relative risk.

care, we did not take into account pathologies with incidence rates below 4%.

Childcare attendance may have caused from 35% to 50% of acute gastroenteritis, otitis, bronchiolitis, and bronchitis cases; figures similar to those reported in the systematic review “Relación entre la asistencia a guarderías y enfermedades infecciosas en la población infantil” published in 2007⁷.

The low number of pneumonia episodes did not allow us to calculate whether attending childcare increased the risk of suffering this disease; perhaps the follow-up of both cohorts in the upcoming years will produce definitive data.

It is important that we not only know how attending childcare influences contracting the pathologies under study, but also how it influences the number of episodes suffered, so we calculated the difference between the cohort means, and found significant differences for several of these pathologies: bronchiolitis, bronchitis, conjunctivitis, gastroenteritis, acute otitis media, common cold, and wheezing. Still, the study of recurrent otitis in particular did not contribute definitive data; in accordance with the definition included in the consensus document on otitis media¹¹, the presence of at least three episodes of otitis within six months was considered recurrent otitis. In the age range under study (6 to 12 months), only four children who did not attend childcare met these criteria (0.4%) presenting a maximum of four episodes, and among those who did attend childcare, another four met the criteria (3.4%), although they suffered a higher number of episodes, up to a total of eight in this span of time.

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Conclusions

- The percentage of children that attend childcare centres is similar to the percentage in the rest of Spain.
- The data gathered up to 12 months are consistent with previous studies in showing a higher incidence of infectious pathologies in absolute numbers, and in the infectious pathologies most prevalent in children that attend a childcare centre.
- The follow-up of both cohorts will complete the data presented in this study.
- The decision to send children to a childcare centre at an early age is associated with parental employment, and with maternity leave and BF breaks. Considering these results, it would be advisable that other means of caring for young children are sought, and that the duration of maternity leave and BF breaks are extended, as has been done in other EU countries.

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CONFLICT OF INTERESTS

The authors declare that they had no conflict of interest in relation to the preparation and publication of this paper.

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ACRONYMS

PC: Primary Care • **BF:** breastfeeding • **OIB:** Oficina de Investigación Biosanitaria (Biomedical Research Office) • **RR:** relative risk • **EU:** European Union.

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