Infectious Diseases

Transient and sustained effects of child-care attendance on hospital admission for gastroenteritis

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Abstract

Background: There is evidence that children experience a transient increase in mild episodes of gastroenteritis when they start attending out-of-home child care. We assessed the transient and sustained effects of cumulative day-care attendance, age at first enrolment and type of child care facility attended on hospitalization rates for gastroenteritis.

Methods: Cox proportional hazard models were used to estimate the risk of being hospitalized for gastroenteritis in two large cohorts of preschool (<6 years old) and elementary school-going (6–10 years old) children in Denmark. Day-by-day child-level registry data were used. Together, the two cohorts comprised 443 872 children, 21 038 hospitalizations and 1742 284 child-years (1994–2011).

Results: From first day-care attendance until 12 months of cumulated attendance, preschool children attending day-care centres, but not those attending day-care homes, had an increased risk of hospitalization for gastroenteritis compared with children never attending registered day-care. Such increased risk was highest shortly after starting day-care attendance and then gradually declined. After 12 months of attendance, attending either day-care centres or day-care homes was associated with a lower risk for hospitalization. Such decreased risk was confined to children starting day-care attendance before the age of one year and extended throughout, but not beyond, their preschool years.

Conclusions: Attending day-care centres is associated with a higher risk for gastroenteritis hospitalization until completing 1 year of attendance. However, if children start attending day-care before the age of 1 year, they experience a lower risk of being hospitalized during their preschool years. This apparent protective effect does not last into the elementary school years.
Key Messages

- With over 400,000 children followed for 1,700,000 person-years from 1994 to 2011, during which over 21,000 hospitalization events occurred, this study determined the transient and sustained effects of cumulative day-care attendance on hospitalization rates for gastroenteritis, and assessed how the child’s age at first enrolment and the type of child-care facility influenced this association.
- From first day-care attendance until 12 months of cumulated attendance, preschool children (aged <6 years) attending day-care centres, but not day-care homes, displayed a transiently increased risk of hospitalization for gastroenteritis compared with children never attending registered day care.
- Children attending day-care activities experienced a sustained decreased risk of hospitalization for gastroenteritis during subsequent preschool years, but only if these children started attending day care before the age of 1 year. This sustained decreased risk did not extend into the elementary-school years (age 6–10 years).

Introduction

Children attending out-of-home day-care are at an increased risk of experiencing episodes of gastroenteritis. The reported outcomes associated with day-care attendance are typically mild and transient, limited to the early years of life. However, attending day care may well have a severe and sustained impact—positive or negative—on gastrointestinal morbidity due to, for example, repeated infections, treatments and diverse immune challenges posed by enteropathogens in day care.

The leading cause of severe childhood gastroenteritis is rotavirus, which is responsible for about 40% of the annual gastroenteritis-associated hospitalizations in Danish children of <5 years of age. The prevalence of rotavirus infections in Danish day-care centres has been found to be as high as 60% during the winter. Although two rotavirus vaccine candidates have recently obtained licensure in Denmark, a national rotavirus vaccination programme does not exist to date. It has been reported that rotavirus infections occurring in early childhood might confer natural immunity against further rotavirus infection with severe symptoms later in life. Conversely, gastroenteritis during childhood might lead to sustained detrimental effects such as chronic inflammatory diseases of the intestine. Such effects have been reported for respiratory illnesses, suggesting that the excess of day-care-related morbidity experienced during the preschool years reduces the risk of developing allergic disease and mild respiratory infections during the elementary school years.

Assessing the sustained health risks of day-care-associated gastroenteritis is challenging, particularly for outcomes requiring hospitalization. Such assessments require child-level information on movements between out-of-home day-care and parental care along with detailed hospitalization records, both not commonly available over long periods. Most studies, therefore, have used proxies for day-care attendance, such as years spent in day care, degree of peer exposure and number of individual child-care arrangements. However, the extent to which day-care attendance is associated with the occurrence of severe gastroenteritis might be more subtle than can be detected using proxies. Health effects may persist during the preschool years, for example when children are cared for at home after having previously attended day care. These sustained effects may also differ between preschoolers (aged <6 years) and elementary school-going children (aged 6–10 years), given the different developmental stages of these children. Finally, the type of child-care facility attended might play a role.

Using Danish registry data, this study aimed at answering three questions: (i) what are the transient and sustained risks of hospitalization for gastroenteritis associated with day-care attendance; (ii) do these risks depend on the age at which children start attending day care; and (iii) are these risks modified by the type of child-care facility attended? These questions were addressed for both preschoolers and elementary-school-going children.

Methods

In Denmark, residents have a unique 10-digit identification number used in national registries. This enabled us to perform identity-secure linkage of several Danish registries to

**Key words:** Gastroenteritis, hospitalization, child care
provide day-by-day, child-level information on family characteristics, day-care arrangements (attendance and type of day-care facility) and hospitalization events for children born and living in Denmark during 1994–2011. The study was approved by the Danish data protection agency.

The Danish Civil Registration System

The Danish Civil Registration System (DCRS) provides the aforementioned identification number (DCRS-id), along with the birthday, day of death, first-degree relatives, emigration and current and earlier addresses of all Danish residents.24 This registry allowed us to cross-reference parents’ age and number of children in the household.

The Danish National Patient Registry (DNPR)

The Danish National Patient Registry (DNPR) encompasses both in-patient and all-day contacts of all Danish residents.25 DCRS-id, International Classification of Diseases 10th revision (ICD-10) codes and date(s) of admission and discharge were extracted for all children born in the study period and hospitalized for gastroenteritis (ICD-10 codes: DA00–DA09).

Child-care registry

This registry26,27 was developed to assess the impact of child-care attendance on common childhood illnesses. It combines data on child-care attendance and child-care facility, as follows. (i) In Denmark, municipalities collect person-identifiable data on child-care arrangements to manage bill payments and child-care capacity. For each child, the dates of enrolment at, and withdrawal from, child-care facilities (identified through their unique codes) were extracted. (ii) Denmark’s national statistical bureau, Statistics Denmark (SD), routinely collects child-care facility data for administrative purposes. Reporting to SD is mandatory and nationwide. From this database, we extracted the unique child-care facility codes and type of facility (créche, kindergarten, age-integrated day-care centre and day-care home). Créches are facilities with an average of ~40 children aged 6 months–3 years. Kindergartens are day-care centres for children aged 3–6 years, with an average of ~56 children enrolled. Age-integrated day-care centres are a mixture of a créche and kindergarten, targeting children of 6 months–6 years of age, with an average of ~73 children enrolled. Finally, day-care homes are designed for small groups of children of the same age. Often run by a single, professionally supervised and registered child minder, day-care homes look after 1–5 children. Child-care facility data were linked to the other child-level data through the unique child-care facility code. Data covered 49 of the current 99 municipalities, accounting for 54% of the Danish population.

Assembly of study cohorts

We defined a preschool cohort and an elementary school cohort. Figure 1 provides a summary of the cohort structure and available data over the study period.

The preschool cohort included children aged <6 years born and living in the 49 Danish municipalities for which
we had complete day-care information between 1 January 1994 and 1 November 2005. This cohort was followed up from birth to 1 November 2005, to 1 August of the year the children became 6 years old (as they started attending elementary school), the day of death, movement outside the 49 municipalities or hospitalization for gastroenteritis, depending on which condition came first.

The elementary school cohort included children aged 6–10 years born and living in the 49 municipalities between 30 November 1994 and 1 November 1999. This cohort was followed-up from 1 January 2000 or the day the children became 6 years old, to 1 January 2013, or to the above conditions.

The transient risk for hospitalization due to day-care attendance was assessed for children still enrolled for day care, or within 2 months from last day-care attendance, and were therefore assessed for preschoolers only. Conversely, the sustained risk was defined as that occurring among children no longer attending day care (last day-care attendance at least 2 months previously). Among preschoolers, the sustained risk was assessed for children who stopped attending day care more than 2 months before and were home-cared since, as well as for children who were attending day care and had been doing so consistently over time. For elementary-school-going children, the sustained risk was determined as that occurring in children who attended day care in the past. All risks were estimated relative to children who were never registered for out-of-home day care.

**Statistical analysis**

For the preschool cohort, we constructed a time-dependent variable specifying the children’s attendance status. This variable had three categories: ‘never attended day care’, ‘previously attended day care, but currently home-cared’ and ‘currently attending day care’. Children entered the category ‘never attended day care’ if they were never cared for by a registered child-care facility during the study period (although these children might temporarily have attended unregistered and unsupervised private family care). Children considered to be ‘currently in day-care’ were stratified based on the cumulated time spent in day care (1–29, 30–59, 60–89, 90–119, 120–149, 150–179 and 180–365 days, 1 year, 2 years and 3–6 years). Children within the category ‘previously attended day-care, but currently not attending day-care’ were stratified according to the time since last day-care attendance (same time categories). This time-dependent attendance variable ensured that at any given point in time, every child fell into only one category, while allowing the attendance variable to vary over time. In all analyses, children who ‘never attended day-care’ were used as reference category. Using Cox proportional hazard models, we examined the hazard ratios (HRs) for hospitalization due to gastroenteritis at different levels of previous cumulative attendance to the three categories defined above. Age of the child was used as underlying time-scale variable, ensuring that only children of exactly the same age were compared with each other.

In addition to cumulative day-care attendance, we assessed whether the HRs varied according to the child’s age at first enrolment (<1 year vs ≥1 year) and the type of child-care facility attended (day-care centre vs day-care home). In these analyses, crèche, age-integrated day care and kindergarten were combined as ‘day-care centre’. This was done based on initial analyses showing that the median age at which children started attending day care was 1 year.

For the elementary school cohort, we used the cumulative amount of time spent in day care until children’s enrolment at elementary school, stratified as ‘never attended day care’ (reference category) vs <1, 1, 2, 3, 4 and 5 years of day-care attendance.

**Assessment of confounders**

Time-independent variables (parents’ age at child’s birth, child’s gender, child’s nationality, season of birth) and time-dependent variables (number of children in household, current residence municipality) were considered as potential confounders. A child’s nationality was categorized based on the respective parents’ country of birth. Children were considered ‘Danish’ if at least one of the parents was born in Denmark, ‘Other Western’ if one of the parents was born in one of the 15 European Union countries as of year 1998 (excluding Denmark), USA, Canada, Australia or New Zealand, and ‘Other’ in all other instances. To be included as a confounder, these variables needed to produce a change of ≥10% in the HRs of some of the parameters of interest. If a variable was identified as a confounder, the baseline hazard function was stratified on that variable in all analyses.

**Supplementary analyses**

As rotavirus is the leading cause of severe childhood gastroenteritis in Denmark, two supplementary analyses were run to assess whether any transient or sustained day-care effects could be attributed to seasonal rotavirus dynamics. First, we restricted the analyses to those children specifically hospitalized for rotavirus infection (ICD-10: DA080) rather than hospitalization for gastroenteritis as a whole, reasoning that if rotavirus was solely responsible for the effects presented here, the increased transient risk
for hospitalization would become even higher in this analysis, as would the decreased sustained risk. Second, we introduced the rotavirus season (February–April) as an effect-modifier for the day-care effect in all models.

Results

Descriptive statistics

The percentages of enrolled children according to their age and type of child-care facility attended are depicted in Figure 2. In Denmark, children are eligible for day-care attendance from the age of 6 months onwards. Until the age of 3 years, day-care homes were the most commonly used child-care facility (about 24% at 1.5 years old). Between 3 and 5.5 years old, children were predominantly cared for in kindergartens (40%) or age-integrated centres (30%). From 5.5–6 years onwards, attendance at out-of-home care declined overall. The number of child-years and hospitalizations stratified by cumulative day-care attendance, time since last attendance, age at first attendance and type of day-care facility attended are shown in Table 1. The preschool cohort comprised 443,872 children (1,045,523 child-years, 13,340 hospitalizations). The elementary school cohort included 180,490 children (696,761 child-years, 1363 hospitalizations). Although 56% of Danish children were included in our study population at birth, 51.4% and 46.0% of child-years were included from the preschool and elementary school cohorts, respectively.

Except for nationality and season of birth, none of the explored covariates changed the HRs more than 10%. Therefore, the baseline hazard function was stratified on nationality and season of birth only. Compared with ‘Danish’ children, children in the ‘Other’ nationality category were twice as likely to be hospitalized when in day care [HR: 2.01, 95% confidence interval (CI): 1.94–2.09]. Children with ‘Western’ nationality did not differ from children with a ‘Danish’ nationality (HR: 1.01, 95% CI: 0.87–1.17). Compared with summer (June–July), children experienced a higher risk of hospitalization in the winter (December–February) (HR: 2.02, 95% CI: 1.94–2.11), spring (March–May) (HR: 1.64, 95% CI: 1.57–1.71) and autumn (September–November) (HR: 1.09, 95% CI: 1.04–1.14).

Effects of cumulative day-care attendance (preschool)

The results of the Cox proportional hazards model of preschoolers according to their cumulative day-care attendance and time since last attendance are shown in Table 1. The preschool cohort comprised 443,872 children (1,045,523 child-years, 13,340 hospitalizations). The elementary school cohort included 180,490 children (696,761 child-years, 1363 hospitalizations). Although 56% of Danish children were included in our study population at birth, 51.4% and 46.0% of child-years were included from the preschool and elementary school cohorts, respectively.
For instance, children starting attending day-care centres before 1 year of age had an immediate HR of 1.76 (95% CI: 1.53–2.03). Such increased risk was highest shortly after starting day-care attendance and then gradually declined. However, from 12 months of cumulated attendance onwards, children in either day-care centres or day-care homes who started attending out-of-home care before 1 year of age showed a lower risk for hospitalization.

With a few exceptions, the risk for gastroenteritis hospitalization was not different for children who previously attended day care compared with those who never attended day care.

**Effects of cumulative day-care attendance (elementary school)**

The HRs for gastroenteritis hospitalization among elementary-school-going children according to their cumulated day-care attendance are presented in Table 3. HRs were stratified by age to distinguish between children just enrolled in elementary school from children in elementary school for at least 1 year. Compared with children never attending day care, no sustained risks of gastroenteritis hospitalization were associated with previous day-care attendance in the elementary school cohort.

**Supplementary analyses**

Re-running the models for children specifically hospitalized for rotavirus infection, rather than gastroenteritis hospitalization in general, produced similar transient and sustained risks as when all gastroenteric diseases was studied. (Supplementary Table S1, available as Supplementary data at IJE online). We did not observe a systematic difference of the day-care effect in the rotavirus season compared with the day-care effect during the rest of the year.
## Table 2. Transient and sustained effects of cumulative day-care exposure and time since last day care as a function of age at first attendance; the preschool cohort

<table>
<thead>
<tr>
<th>Time (days)</th>
<th>Day-care centre (Age at first attendance &lt; 1 year)</th>
<th>Day-care home (Age at first attendance &lt; 1 year)</th>
<th>Day-care centre (Age at first attendance &gt; 1 year)</th>
<th>Day-care home (Age at first attendance &gt; 1 year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Time (days)</td>
<td>Person-years/1000</td>
<td>Events (n)</td>
<td>Hazard ratio</td>
</tr>
<tr>
<td>Never attended day care</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Attending day care (cumulative exposure time)</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>1–29</td>
<td>5.8</td>
<td>202</td>
<td>1.76 (1.53–2.03)</td>
<td>6.9</td>
</tr>
<tr>
<td>30–59</td>
<td>6.0</td>
<td>202</td>
<td>1.74 (1.51–2.01)</td>
<td>7.0</td>
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<tr>
<td>60–89</td>
<td>5.9</td>
<td>145</td>
<td>1.28 (1.09–1.52)</td>
<td>6.9</td>
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<tr>
<td>90–119</td>
<td>5.8</td>
<td>155</td>
<td>1.41 (1.12–1.60)</td>
<td>6.7</td>
</tr>
<tr>
<td>120–149</td>
<td>5.7</td>
<td>150</td>
<td>1.42 (1.20–1.67)</td>
<td>6.5</td>
</tr>
<tr>
<td>150–179</td>
<td>5.7</td>
<td>157</td>
<td>1.50 (1.27–1.7)</td>
<td>6.3</td>
</tr>
<tr>
<td>180–365</td>
<td>34</td>
<td>690</td>
<td>1.22 (1.12–1.33)</td>
<td>35</td>
</tr>
<tr>
<td>1 year</td>
<td>62</td>
<td>545</td>
<td>0.92 (0.83–1.02)</td>
<td>56</td>
</tr>
<tr>
<td>2 years</td>
<td>76</td>
<td>307</td>
<td>0.84 (0.73–0.98)</td>
<td>21</td>
</tr>
<tr>
<td>3–6 years</td>
<td>141</td>
<td>362</td>
<td>0.84 (0.73–0.98)</td>
<td>1.1</td>
</tr>
<tr>
<td>Previously attended day care (time since last attendance)</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
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<tr>
<td>1–29</td>
<td>8.6</td>
<td>75</td>
<td>1.21 (0.94,1.54)</td>
<td>3.2</td>
</tr>
<tr>
<td>30–59</td>
<td>7.3</td>
<td>80</td>
<td>1.51 (1.18,1.94)</td>
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</tr>
<tr>
<td>60–89</td>
<td>6.9</td>
<td>76</td>
<td>1.22 (0.94,1.58)</td>
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<tr>
<td>90–119</td>
<td>6.4</td>
<td>87</td>
<td>1.19 (0.93,1.53)</td>
<td>2.3</td>
</tr>
<tr>
<td>120–149</td>
<td>6.1</td>
<td>66</td>
<td>0.95 (0.72,1.26)</td>
<td>2.2</td>
</tr>
<tr>
<td>150–179</td>
<td>5.9</td>
<td>44</td>
<td>0.86 (0.62,1.19)</td>
<td>2.1</td>
</tr>
<tr>
<td>180–365</td>
<td>30</td>
<td>138</td>
<td>1.11 (0.91,1.37)</td>
<td>11</td>
</tr>
<tr>
<td>1 year</td>
<td>4.9</td>
<td>29</td>
<td>1.00 (0.69,1.45)</td>
<td>3.6</td>
</tr>
<tr>
<td>2 years</td>
<td>1.6</td>
<td>7</td>
<td>1.08 (0.51,2.27)</td>
<td>1.2</td>
</tr>
<tr>
<td>3–6 years</td>
<td>1.1</td>
<td>3</td>
<td>0.91 (0.29,2.83)</td>
<td>0.3</td>
</tr>
</tbody>
</table>
the year. A stratified analysis including admission during the rotavirus season (February to April) indicated an increased risk of admissions in the first season (HR 1.29, 95% CI: 1.16–1.43) whereas this estimate was 0.81 (95% CI: 0.42–1.55) in a later rotavirus season. These figures represented children in a day-care centre for 180–365 days of cumulated time.

Discussion

We found that preschool children attending day-care centres, but not day-care homes, experienced a higher transient risk for severe episodes of gastroenteritis requiring hospitalization compared with children who had never been in day care. After 12 months of cumulated attendance, preschool children attending any type of day care experienced a lower sustained risk for severe episodes of gastroenteritis compared with permanently home-cared children, but only if they started attending day care before the age of 1 year. This sustained protective effect did not extend into the elementary school years, suggesting that out-of-home child care neither protects nor predisposes children towards gastroenteritis hospitalization after the preschool years.

The transient increased risk varied from 1.7 at enrolment into day care to 1.2 after 12 months of cumulated attendance. Based on similar data, another Danish study reported an incidence rate ratio of 1.2 for gastroenteritis hospitalization in children during the first 6 months after first day-care enrolment compared with children attending day-care for the second half-year. This study, however, aggregated the first 6 months in day care and only indirectly reported the relative difference in risk between children in institutions and children at home. Our study included type of day care as an effect modifier and divided the first half-year of cumulative attendance into shorter time intervals. Furthermore, different inclusion criteria were applied. Our study was more restrictive in the inclusion of municipalities to achieve data completeness. Finally, we included both inpatient admissions and outpatient visits, whereas the other study included only inpatient admissions. These differences are likely to explain the discrepancy between studies. Our findings are consistent with those of other authors. For instance, a study of severe diarrhoeal illness in the USA reported child care to be associated with an overall relative risk of 1.8 compared with home care. A Dutch network of child day-care centres reported that children aged 0–4 years attending day care required a visit to their general practitioner twice as often as would be expected based on national estimates for this age group.

The transient increased risk was observed only for children attending day-care centres, not day-care homes. This may be explained by the larger number of children day-care centres usually care for, as they may provide more opportunities for children to transmit enteropathogens through direct (person-to-person) or indirect (environment-mediated) contact than is possible in small day-care homes. Moreover, children cared for in day-care centres might be particularly prone to infections due to elevated cortisol levels caused by stressful group interactions.

An explanation for the sustained lower hospitalization risk after 12 months of cumulated attendance could be that infections occurring in early childhood elicit some natural immunity against subsequent infections, thereby decreasing the severity of these infections in older children with each passing infection. This process of acquired immunization has been described for rotavirus, the most common cause of gastroenteritis hospitalization in young Danish children. The increased risk of admission during winter and spring, and a tendency of increased risk of admissions in the first rotavirus season compared with later seasons, underscore the important role of rotavirus as an aetiology of diarrhoea. However, the supplementary analyses also suggest that the transient and sustained effects described here cannot be attributed to rotavirus dynamics alone.

The sustained risk was confined to children who started attending day care before the age of 1 year, suggesting that exposure to enteropathogens during infancy might be relatively more effective in terms of elicited immune response. Several other studies have shown age to be a potent moderator of immunity, arguing that young children require frequent and substantial ‘immunity boosts’ from a wide variety of pathogens, such as those occurring naturally in group day care, to produce adequate and long-lasting immunity. An alternative explanation for the sustained
decreased is reverse causality; particularly frail children more prone to gastroenteritis and/or to other diseases are gradually withdrawn from day care over time, or are a priori not enrolled by parents for day care at all. In addition, the frailest children might be hospitalized shortly after they start attending day care, after which they are censored from further analyses. Indeed, by randomly selecting 20 age-, municipality- and gender-matched control children for each hospitalized day-care child, we calculated that the relative risk of being withdrawn from day care was 1.37 (95% CI: 1.17–1.60) times higher for children in the first 90 days after hospitalization compared with non-hospitalized control children (results not shown). Although this analysis uncensored children after the first hospitalization, the higher withdrawal rate from out-of-home child care after first hospitalization suggest that children might experience similar withdrawal rates for less severe episodes of gastroenteritis not requiring hospitalization. Both the effects of reverse causality and withdrawal would, over time, leave children remaining in day care to be on average healthier than those home-cared.

A possible explanation for the fact that the sustained effect did not extend beyond the preschool years might be that elementary-school-going years are not (any more) exposed to the relatively higher levels of, and specific risk factors for, enteropathogens such as rotavirus and norovirus circulating in the day-care environment. There are several advantages in using nationwide registry-based data. First, the large sample size allows for precise estimation, statistical power, stratification and simultaneous consideration of multiple confounders. Second, selection bias is minimized because children were included irrespective of their socioeconomic and demographic backgrounds. Furthermore, the decision to hospitalize children with gastroenteritis is not directly influenced by the economic status of the family in Denmark, as the Danish healthcare system is tax-funded and free of cost. Third, data do not rely on individual self-reports, but on institutionally collected data where a unique personal identifier ensured accurate linkage. Hospitalization data were classified according to the ICD-10 system, of which the validity and coverage have been confirmed previously.

We could not differentiate between children attending day care for the whole day from those attending day care only part of the day. We also had no information on the number of days a child attended day care per time interval (week, month or year), meaning that we could not study the potential dose-response existing between frequency of day-care attendance and subsequent hospitalization risks. Furthermore, we examined the effect of day-care attendance only for the most severe cases of gastroenteritis, requiring hospitalization. The day-care effect on milder cases of gastroenteritis was not a subject of the present study. However, a Dutch study suggests that the effects of day-care attendance on milder cases would not differ much from the estimates presented in this study. Finally, the Danish national registries obviously do not include unregistered child-care facilities. Therefore, some misclassification will have occurred, resulting in children erroneously being classified as home-cared while actually being cared for in an unregistered and small day-care facility. Although any such misclassification is likely to be of non-differential nature (biasing our estimates towards one of no effect), it may explain why little effect was observed for day-care-homes, as unregistered child-care homes are presumed to be small.

Conclusion

In conclusion, we found transient and sustained risks of hospitalization for gastroenteritis associated with cumulative day-care attendance in preschool children. Compared with children who never attended registered day care, preschool children cared for in day-care centres experienced a transient increased risk of being hospitalized for gastroenteritis within the first 12 months of cumulated attendance, irrespective of their age at first attendance. However, after 12 months of cumulated day-care attendance, children who started attending out-of-home care before 1 year of age experienced a lower sustained risk for gastroenteritis hospitalization in the remainder of their preschool life, irrespective of the type of facility attended. This apparent protective effect did not last into the elementary-school years. Our study also provided evidence that large day-care facilities pose a transient increased risk for gastroenteritis hospitalization compared with permanent home care or even a day-care home.

Supplementary Data

Supplementary data are available at IJE online.

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