Otitis Media in Day-Care Children

A Report From the International Primary Care Network

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The relationship between day care and acute otitis media and its adverse consequences was analyzed as part of a collaborative multinational study. Data from primary care research networks in eight countries were collected on 1335 children, aged 0 to 60 months, at the time of initial visits to their primary care physicians for acute otitis media. A history of recurrent acute otitis media, poor hearing, and tonsillectomy or adenoidectomy were all more frequent in day-care children aged 25 to 60 months, compared with those cared for at home. Day-care children were brought to their physicians more promptly after the onset of symptoms and received more referrals to otolaryngologists at the time of the index visit for acute otitis media. Day care may pose a significant risk for otitis media and its adverse consequences. *J Fam Pract 1991; 32:289–294.*

The number of children who receive day care outside of their homes has greatly increased during the last 25 years. In the United States more than 11 million children attend full-time or part-time day-care facilities.[1] Growth of day-care facilities is largely the result of an increased number of single-parent households[2] and a doubling of working women. The highest rate of increase is in working mothers with preschool children.[3]

The large increases in the number and types of facilities have produced concerns about the spread of infection among day-care children. Several infectious agents pose potential risks, but "conclusive data are not available to assess the relative risk of infection among children attending or not attending day care or whether specific characteristics or practices of some day-care settings affect such risk. Little is known about the infectious experience of the several million children cared for in day-care homes."[1]

A relationship between child day care and the incidence of acute otitis media (AOM) was reported by Hesselvic[4] almost 40 years ago. When compared with children cared for at home, those in day care had significantly more attacks of both upper respiratory tract infections and AOM. Subsequent investigators, however, reported conflicting results. Strangert[5] found significant increases in AOM in day-care center children when compared with those in home care but only for children aged 6 to 17 months; no increase was found for older children, and no difference was found between children in day-care centers and those in family day-care homes. Fleming et al[6] demonstrated increased risk for ear infection among day-care children but only for full-time attendees. In a critical review of the literature, Haskins and Kotch[7] conclude that "most studies have shown elevated incidence of mild acute respiratory illness among children in day care as compared with home-reared children and that this effect occurs primarily in younger children. There is stronger evidence that day-care children are at elevated risk for contracting initial cases of otitis media." Most of the reviewed studies, however, were reported from Scandinavian countries, "necessitating the well-known caveats attendant to cross-cultural generalization of research findings."[7] Accordingly, this analysis used previously collected data from eight countries to assess the relationship of day care to AOM and its complications.

Methods

The International Primary Care Network (IPCN) consists of several national networks of primary care physicians who collaborate on research and surveillance of health problems in their respective patient populations. A description of the purpose, methods, and policies of IPCN, as well as the conduct and organization of the otitis media study, has been reported,[8] as has the distri-

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bution of symptoms and treatment patterns.[9] For this study of AOM, physicians from Australia, Belgium, Canada, Great Britain, Israel, the Netherlands, New Zealand, Switzerland, and the United States reported data on up to a total of 15 consecutive patients with new episodes of AOM. A new episode was defined as a new infection with or without a past history of AOM or chronic serous otitis.

Diagnostic criteria were not given. Instead, from a prepared list physicians checked duration and type of symptoms (ear pain, nasal discharge, fever, diarrhea and vomiting, sore throat, reduced hearing, ear discharge), characteristics of each tympanic membrane (not visualized, opaque or dull, red, fluid, bulging, bullae, retracted, perforated, draining pus, tympanostomy tubes visualized), and certainty of diagnosis (very certain, somewhat certain, somewhat uncertain, very uncertain). In addition, demographic data, the number of attacks of AOM in the preceding 18 months, investigations, therapy, and the presence or absence of day care outside of the home were recorded on a standard form. Translations in Dutch were used by physicians in the Netherlands and in Belgium, in French by some Belgian and some Swiss physicians, and in German by the remainder of the Swiss physicians. Physicians in other countries used forms printed in English.

A follow-up form containing six questions was completed at 2 months following the initial patient encounter by either the patient (mailed questionnaire) or physician, based on telephone contact or repeat examination. The questions concerned follow-up examination by another physician, placement of tympanostomy tubes (ear tubes), changes in medication since the index visit, subsequent hospitalization for the problem presented at the index visit, total number of subsequent visits, and an assessment of recovery (yes, no, uncertain). The study extended from March through October 1986.

Analyses were limited to patients aged 0 to 60 months. Only cases reported by physicians enrolling nine or more patients (average 13.6) were included because follow-up data in this group exceeded those data from physicians reporting fewer than nine patients (84% vs 66%).[8] This exclusion removed patients cared for by physicians who either did not continue participation throughout the study interval or saw AOM patients only rarely (7% of reported patients were excluded). To improve the validity of the conclusions about AOM and day care, only patients for whom the physician was very certain of the diagnosis were included in the final data set; analyses using all cases for which the physician was less than very certain yielded results similar to those reported. Canadian data were excluded because only a small number of Canadian physicians participated.

Table 1. Day-Care Distribution, By Demographic Characteristics

Demographics	No.	Percent in Day Care
Country Network		
Switzerland	74	17.6
Netherlands	145	29.7
New Zealand	203	38.9
Australia	139	41.7
Great Britain	186	46.2
Belgium	79	46.8
United States	225	48.4
Israel	284	60.9
Age (months)		
0–6	73	27.4
7–12	209	21.5
13–24	349	33.2
25–36	253	42.3
37–48	226	62.4
49–60	225	75.1
Sex		
Male	701	45.2
Female	619	44.4
Total	1335	44.8

Analysis of variance techniques were used to assess differences in frequency of day-care participation and number of previous episodes. Least-squares means techniques were used to identify the adjusted average number of past episodes controlling for country and age group differences. Mantel-Haenszel chi-square and odds ratios were computed to assess relative risk of historical data adjusting for country strata. Because of the low potential for very young patients to incur events (poor hearing, past history of ear tube placement, past history of tonsillectomy or adenoidectomy, referral at the initial visit for this episode of AOM, or placement of ear tubes during the 2-month follow-up interval), analyses of the relationship between day-care enrollment and these events were limited to patients aged 25 to 60 months. Because no patients from Switzerland received either tonsillectomy or adenoidectomy, or ear tubes, Swiss patients were not included in the calculation of relative risk for these events but were included in all other analyses. The relative risk of past episodes was calculated adjusting for age groups.

Results

A total of 1335 children aged 0 to 60 months met study inclusion criteria. Of this total, 44.8% (598 children) were in day care. The distribution of the total number of cases of otitis media and the percentage in day care by country is given in Table 1. The percentage of children in day care varied from 17.6% in Switzerland to 60.9% in Israel. Table 1 details the age and sex distribution of the population, demonstrating that the percentage of chil-

Table 2. Percentage of Children With No Past Episodes and With Three or More Past Episodes of Otitis Media Within 18 Months, By Age Group and Day-Care Status (%)

Age (months)	No Past Episode		3+ Past Episodes	
	Day Care	No Day Care	Day Care	No Day Care
0–6	80.0	77.6	10.0	10.2
7–12	35.6	50.3	33.3	20.3
13–24	21.4	32.9	48.2	34.8
25–36	31.6	35.8	38.8	34.3
37–48	35.8	52.6	26.1	19.2
49–60	26.1	51.0	34.4	13.7
Total	31.1	44.2	35.0	26.2

dren in day care in the study sample increases with increasing age except for those younger than 6 months. Using an analysis of variance model incorporating country, age, and sex, country and age differences in day care were highly significant ($P = .0001$), but sex was not.

The percentage of children with a history of a previous episode of otitis media varied with age (Table 2). In all age groups there was a greater percentage of children with a history of at least one past episode of otitis media, as well as three or more episodes, among the day-care children than among those in home care. An analysis of variance model incorporating country, age, and day-care participation as independent factors predicting the number of past episodes was constructed. Day care was highly significant ($P = .0093$). The mean number of past episodes during the preceding 18 months for those not enrolled in day care was 1.5 and for those enrolled in day care, 1.9. For children aged 7 to 60 months in day care, the relative risk of three or more past episodes of AOM is 1.8 (95% CI, 1.4–2.4); for any past episodes the relative risk is 1.7 (1.3–2.2). Increased frequency of past episodes in day-care children as compared with those in home care occurred in all of the countries participating in this study.

A history of decreased hearing, tonsillectomy or adenoidectomy, and receipt of ear-ventilating tubes may represent adverse consequences following previous episodes of otitis media. Table 3 provides the relative risk for all of these events, comparing children in day care with those in home care. The relative risk for history of poor hearing, history of tonsillectomy or adenoidectomy, and past receipt of ear tubes was in each case significantly increased for those in day care. At the initial visit, however, the incidence of pus or perforation of the tympanic membrane was not greater for those in day care. At their initial visit, day-care children were almost twice as likely as those in home care to be referred for further evaluation of their ears. These data were examined separately for children in each country. In children aged 25 to 60 months, a history of decreased hearing, tonsillectomy or adenoidectomy, and referral to other physicians was in every case greater in children in day care than in those not in day care in all countries with the exception of Belgium.

Table 4. Comparison of the Duration of Symptoms Between Patients In and Not In Day Care (%)

Age Group (months)	In Day Care		Not In Day Care	
	≤1 Day	≥4 Days	≤1 Day	≥4 Days
25–36	77.7	4.9	85.3	4.4
37–48*	90.4	5.2	81.5	11.1
49–60†	93.9	2.5	83.3	5.6

*P = .027, Mantel-Haenszel chi-square adjusting for country strata.
†P = .036, Mantel-Haenszel chi-square adjusting for country strata.

The increased rate of adverse consequences in day-care children was not caused by delays in seeking medical care. Data from Table 4 demonstrate that the duration of symptoms prior to receiving medical care was generally less in the day-care group: over 89% of children aged 37 to 60 months received medical care within a day of onset of symptoms. Delays of 4 or more days in contrast to 0 to 1 day are more common in those not in day care.

Discussion

Other investigators[4–6] have demonstrated a relationship between day care and AOM, but not for all age groups or for part-time attendees. Sipil et al[10] reported that attendance at a day-care center was the most important risk factor for contracting AOM, and that the risk increased with increased recurrence of attacks. In some studies statistical significance was not achieved because of

Table 3. Risks for Selected Events in Day-Care Children Aged 25 to 60 Months With Those in Home Care

Risk Item	Day Care Percent	No Day Care Percent	Relative Risk* (95% CI)
History of poor hearing	20.4	13.5	2.0 (1.3–3.0)
History of ear tubes	6.5	2.9	2.5 (1.0–6.1)
History of tonsillectomy or adenoidectomy	5.8	4.1	2.1 (0.93–4.6)
Pus or perforation on examination	12.9	12.9	1.0 (0.6–1.6)
Referred at initial visit	8.0	4.2	1.9 (1.0–3.7)

*Adjusting for country strata. CI denotes confidence interval.

the small number of subjects.[11,12] The study by Fleming et al[6] contained data on 575 children, but these data were collected from the children's guardians by telephone rather than from physicians' recordings at the time of examination.

The IPCN data reported here offer additional evidence of a relationship between day-care attendance and AOM. Because almost three quarters of AOM cases are preceded by an upper respiratory tract infection,[13] and the risk of AOM is increased with respiratory syncytial virus, influenza virus, and adenovirus infections,[14] this relationship could be a consequence of an increased incidence of respiratory tract infections among day-care children.

Not reported previously, and of some concern, is the demonstration that a history of reduced hearing, tonsillectomy or adenoidectomy, and receipt of ear-ventilating tubes have a higher prevalence among day-care children than for those in home care. The reasons for the increase in these indicators of possible adverse consequences from AOM among day-care children are uncertain. An increase in the number of past episodes of AOM could account for more reports of impaired hearing in day-care children, compared with those not in day care. Day-care children receive supervision from adults in addition to their parents, and opportunities to detect hearing loss may be greater for them than for home-care children. It is unlikely that the severity of infection was greater in day-care children because the frequency of tympanic membrane perforations and drainage pus was equal in both groups. In addition, day-care children received medical care earlier after the onset of symptoms than did those in home care. Previously, the likelihood of hospitalization for ear-ventilating tube placement has been reported to be increased among children in day-care centers when compared with those cared for in other settings.[15,16] Could the risks of exclusion from day care because of illness serve as an impetus to seeking medical care? Could frequent exclusion from day care because of recurrent illness cause parents to request consultation and subsequently accept surgical therapies with the hope of preventing future episodes of illness? The IPCN data can only suggest these possibilities and additional studies are required to answer these questions fully.

Diagnostic criteria for AOM were not specified for patients included in this study, and it is, therefore, uncertain whether all patients truly had AOM. To minimize the possibility of false-positive results, cases in which physicians were less than very certain of the diagnosis were excluded. Currently, AOM remains a clinical diagnosis for which a "gold standard" is unavailable. In a review of 43 published studies, diagnostic criteria were given for only 26 in which 18 different sets of criteria were used.[17] Even the absence of microorganisms in middle ear effusions does not rule out AOM because in more than 30% of cases of presumed AOM, the effusions are sterile.[18] It is highly probable that the diagnostic criteria used for the home-care group of patients were comparable to those in day care because of similarities in recorded physical findings and identical percentages of pus and perforation recorded for both groups.

Nevertheless, the IPCN data should be viewed with caution. Children included in the study were a sequential sample of children treated by primary care physicians and, therefore, may not be representative of all children with otitis media. Furthermore, children in the the IPCN study may not constitute a representative sample of children attending day-care centers, although there is no reason to believe that the IPCN sample is systematically biased. Study physicians were not given a precise definition of day care. The study was observational in design, but included a 2-month follow-up. Because of the complexity of comparing socioeconomic status between countries, such data were not collected. Thus, whether the income or education level of the parents confounds the relationship between day-care enrollment and previous otitis history, examination findings, or referral was not assessed. Information regarding the temporal sequence of past history events was not collected; therefore, it is not possible to be certain that the enrollment in day care preceded the historical adverse events with which they were associated. Because of the observational nature of this study, it is not appropriate to conclude that the associations found between day care and adverse events were of a causal nature. Instead, the results of this study should be used as a basis for hypothesis generation for studies involving more rigorous research design.

The equation between benefits to the family from additional income from a working spouse, increased opportunities for peer contact for the child, and adverse consequences to the child from increased exposure to infectious agents is complex and beyond the scope of this paper. Nevertheless, measures with a potential for reducing the spread of respiratory tract infection should be used in day-care environments. There is convincing evidence that airborne respiratory droplets are less important in the transmission of respiratory infection than are contaminated surfaces and hands[19,20] and that infection is frequently a result of self-inoculation.[21] Frequent handwashing among both staff and children, as well as isolated play by children with upper respiratory tract infection, could contribute to reducing the incidence of both upper respiratory tract infections and subsequently AOM among day-care children. These preventive measures, however, are unproven and require additional adult supervision with associated increased day-care costs.

Although AOM is in most cases a self-limited disease, adverse consequences are possible. These consequences result in increased patient suffering and increased health care costs. Preventive measures have not yet been shown to be effective and can result in increased costs. Additional research is required to help develop a rational approach to the reduction of respiratory tract infections and otitis media and its adverse consequences in day-care settings.

Summary

In this study, a history of recurrent acute otitis media, poor hearing, and tonsillectomy or adenoidectomy were all more frequent in day-care children aged 2 to 5 years than in those cared for at home. Although day-care children did not have tympanic membrane findings suggestive of more severe illness, they were brought to their physicians more promptly after the onset of symptoms and received more referrals to otolaryngologists at the time of their initial visit. Day care may pose a significant risk for otitis media and its adverse consequences.

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