Form of Day Care and Respiratory Infections among Finnish Children

Pekka J. Louhiala, MD, PhD, Niina Jaakkola, MSc, Risto Ruotsalainen, MSc, and Jouni J. K. Jaakkola, MD, DSc

ABSTRACT

The relationship between respiratory infectious diseases and form of day care was assessed in a retrospective cohort study of 2568 randomly selected children aged 1 through 7 years in Espoo, Finland. Day-care center children had an increased risk for the common cold, acute otitis media, and pneumonia. The risk concentrated in 1-year-old children, for whom the adjusted relative risks (incidence density ratios) for the common cold, otitis media, and pneumonia were 1.69 (95% confidence interval [CI] = 1.43, 2.01), 1.99 (95% CI = 1.57, 2.52), and 9.69 (95% CI = 2.31, 40.55), respectively. Among 1-year-old children, the proportion of infections attributable to care at day-care centers were 41% (95% CI = 30, 50) for colds, 50% (95% CI = 36, 60) for otitis media, and 85% (95% CI = 57, 98) for pneumonia. The results provide evidence that care in day-care centers is a determinant of acute respiratory infections in children under 2, whereas family day care does not essentially increase risk. (*Am J Public Health.* 1995;85:1109–1112)

Introduction

It has been known since the 1940s that many infections are more common in children who receive group day care than in children who receive family or home care.[1,2] The differences in morbidity are particularly great in children under 2 years of age, but are less evident in older age groups. An increased risk for mild infections has mostly been observed in cohort and cross-sectional studies[3–10] and for serious infections in case–control studies.[11–13]

Most of the studies have concerned mild respiratory infections, diarrhea, hepatitis A, and *Haemophilus influenzae* type b infections. There are also some publications about day care and lower respiratory[3,8] and cytomegalovirus[14] infections.

Several contributing factors probably explain this increased morbidity. It is not clear, however, to what extent the increase is due to factors in the physical environment, like indoor air quality, and to what extent it is due to the number of people in the daily environment.

The aims of this study were to assess the relation between morbidity from respiratory infectious diseases and the form of day care and to evaluate their consequences for public health.

Methods

Study Population and Data Collection

The source population included all the children of the city of Espoo born between January 1, 1984, and December 31, 1989. Located across the western border of Helsinki, Espoo is an urban–suburban municipality with a population of 170 000.

A questionnaire for parents was distributed in March 1991 to a random sample of children drawn from the roster of Finland's Statistical Center. The study population included a total of 2568 children (age range = 1–7 years) whose parents filled in the questionnaire (response rate = 80.3%).

Parents and other guardians were asked about their child's personal characteristics, occurrence of respiratory symptoms, allergic diseases, and number of different infectious diseases (common cold, tonsillitis, otitis, sinusitis, bronchitis, pneumonia, conjunctivitis, and gastroenteritis) during the past 12 months; parents' education, profession, smoking habits, and respiratory and allergic diseases; exposure to environmental tobacco smoke during pregnancy and life; details about the home environment; and the type of day care and details about the day-care environment. Data concerning absence from day-care centers were also collected retrospectively from the files of the centers.

Statistical Methods

The outcomes of interest were the occurrence of the common cold, acute otitis media, and pneumonia. The determinant of interest was the form of full-time or part-time day care. There were four categories: day-care center (n = 513), family day care (n = 252), home care (n = 940), and a combination (n = 863), by which we mean instances in which children changed their form of day care during the past 12 months. All day-care centers were licensed. Family day care included both private and state-subsidized homes. We concentrated on the first three categories, and home care was used as a reference category.

The following variables were included in the analyses as potential confounding factors: gender; history of allergic diseases including asthma, allergic conjunctivitis, rhinitis, and eczema; length

Pekka J. Louhiala and Niina Jaakkola are with the Department of Public Health, University of Helsinki, Finland. Risto Ruotsalainen is with the Laboratory of Heating, Ventilating and Air Conditioning, Helsinki University of Technology. Jouni J. K. Jaakkola is with the Department of Public Health, University of Helsinki; the Laboratory of Heating, Ventilating and Air Conditioning, Helsinki University of Technology; and the Department of Epidemiology, National Institute of Public Health, Oslo, Norway.

Requests for reprints should be sent to Pekka J. Louhiala, MD, PhD, Department of Public Health, PO Box 21, FIN-00014 University of Helsinki, Finland.

This paper was accepted January 11, 1995.

TABLE 1—Estimated Crude Incidence Density of the Common Cold, Acute Otitis Media, and Pneumonia among Children in Home Care (n = 940), Family Day Care (n = 252), and Day-Care Centers (n = 513)

		Common Cold (per Person-Year)			Acute Otitis Media (per Person-Year)			Pneumonia (per 100 Person-Years)		
Age, y	No.	H	F	DCC	H	F	DCC	H	F	DCC
1	346	3.07	2.97	5.06	1.60	1.81	2.53	2.15	35.48	11.11
2	308	2.63	3.53	3.28	1.04	1.60	2.47	5.91	4.26	8.62
3	276	2.64	2.37	2.84	0.81	0.80	1.04	0.61	5.71	6.33
4	285	2.44	2.40	2.53	0.62	0.35	1.03	3.85	8.77	0.0
5	308	2.15	2.22	2.40	0.56	0.69	0.60	4.03	0.0	1.67
6–7	182	1.90	2.56	2.34	0.33	0.33	0.36	0.0	0.0	3.28
All	1705	2.64	2.64	2.74	1.01	0.91	1.04	3.01	7.93	3.90

Note. H = home care; F = family day care; DCC = day-care center.

TABLE 2—Estimated Relative Risk (Incidence Density Ratio) for the Common Cold, Acute Otitis Media, and Pneumonia among Children in Day Care Centers (n = 513) Compared with Home Care (n = 940)

	Common Cold IDR		Acute Otitis Media IDR		Pneumonia IDR	
Age, y	Point Estimate	95% CI	Point Estimate	95% CI	Point Estimate	95% CI
1	1.69	1.43, 2.01	1.99	1.57, 2.52	6.69	2.31, 40.55
2	1.23	1.04, 1.47	2.31	1.84, 2.89	1.31	0.42, 4.11
3	1.07	0.90, 1.27	1.28	0.95, 1.73	10.01	1.13, 88.86
4	1.02	0.85, 1.22	1.65	1.21, 2.25	. . .[a]	
5	1.11	0.93, 1.32	1.15	0.82, 1.61	0.43	0.07, 2.68
6–7	1.17	0.91, 1.52	1.21	0.66, 2.23	. . .[a]	
All	1.22	1.13, 1.31	1.71	1.52, 1.91	1.84	0.99, 3.42

Note. Estimates are from Poisson regression models and are adjusted for gender, atopy, length of breast-feeding, parents' education, single parenthood, presence of other children at home, and passive smoking. IDR = incidence density ratio; CI = confidence interval.
[a]Not enough episodes.

of breast-feeding; parents' education; single parent or guardian; and exposure to environmental tobacco smoke at home.

Incidence density was used to describe the number of infection episodes relative to the corresponding population experience, expressed in episodes per person-years. Information on the number of infection episodes during the past 12 months was given by parents. Average incidence densities were estimated for each annual age group by the form of day care. Incidence density ratio was used as a measure of association between the form of day care and the occurrence of disease. Poisson regression analysis was applied, as suggested by McGullagh and Nelder,[15] to calculate the adjusted incidence density ratios, taking into account the potential confounders mentioned above. A macro written for the NLIN Procedure of PC-SAS version 6.06[16] was used in the multivariate analyses.

The attributable risk due to being in a day-care center or in family day care compared with home care was calculated by multiplying the average incidence density for the children in home care by the corresponding adjusted incidence density ratio and by subtracting the incidence density from the product. This measure corresponds to the adjusted incidence density difference and is expressed in excess episodes per person-year (or 100 person-years). Further, attributable proportion (syn. etiologic fraction[17]) was calculated to indicate the proportion of episodes explained by the form of day care. Absolute numbers of excess episodes were calculated based on the total number of children receiving different forms of day care according to the Central Statistical Office of Finland.

Results

The proportion of children in home care was inversely related to age (i.e., home care was most common in the youngest age groups). The older the children were, the more often they spent their days in day-care centers. The children in day-care centers were significantly more likely to have a single parent, were more often exposed to environmental tobacco smoke at home, and had more siblings and hairy pets than the children in home care.

The estimated incidence densities of the common cold and acute otitis media (episodes per person-year) and of pneumonia (episodes per 100 person-years) are presented in Table 1, and the corresponding adjusted incidence density ratios are presented in Table 2. Children under 2 years old in day-care centers had a considerably higher risk of these infections compared with those in home care. The estimated relative risk for pneumonia in family day care was extremely high, but in that group there was one child who had six episodes of pneumonia during the study year. The risk estimates for common cold and otitis media were very similar in the home and family day-care groups. We also performed some analyses in a subgroup in which a change in the form of day care had occurred. There was no evidence of a dose–response relation between months per year in the day-care center and number of respiratory infections.

In 1-year-old children, the proportion of common cold episodes attributable to care at a day-care center was 41% (95% confidence interval [CI] = 30, 50). For otitis media and pneumonia the corresponding figures were 50% (95% CI = 36, 60) and 85% (95% CI = 57, 98).

Because in Finland approximately 7200 1-year-old children received care at a day-care center in 1990, the estimated excess numbers of common cold, acute otitis media, and pneumonia episodes due to care in day-care centers were 15 300, 11 400 and 1300, respectively. In the age group from 1 through 7 years, 105 000 children received care at a day-care center, and the corresponding figures were 60 900, 75 600, and 2700.

Discussion

Our results agree with previous findings about respiratory infections and

day-care arrangements. The differences between day-care center and home care groups were most marked in 1-year-old children. Because pneumonia is rare, there was more variation in the estimates.

Validity Issues

In 1990 only 400 children under 1 year old (0.7%) received care at a day-care center in Finland (unpublished data from the National Research and Development Center for Social Welfare and Health). Others were mostly cared for at their own homes, as a result of the long maternity/paternity leave, which lasts 9 months. In the late 1980s, new governmental support systems were introduced to improve the possibility of parents choosing home care for children up to 3 years.

Because the study population was a random sample of children living in a designated geographical area and the response rate was good (80.3%), any selection bias is unlikely. Biological credibility would presuppose an association between months per year in the day-care center and number of respiratory infections. As mentioned above, we did not find a dose–response relation. This may be because those children who spent only a few months in the day-care center may have changed their form of day care because of infection problems and thus may have represented the most susceptible children.

On the other hand, information bias could have been introduced if there were differences in reporting episodes of illness related to the form of day care. Parents of children in day care have to make arrangements concerning their work when their children are ill. Therefore, it could be assumed that they recall better even minor episodes that could be ignored by parents whose children are in home care. However, in the light of research done with different approaches, this recall bias does not seem probable. Our study was based on questionnaires, but studies based on hospitalization[18] or physician visits[8] also have yielded similar results.

A number of potential confounders (single parent, number of children in the family, length of breast-feeding, owning hairy pets, parents' education, and passive smoking) could be taken into account in the multivariate regression analyses.

Public Health Perspective

From this and several earlier studies it has become evident that children attending day-care centers have considerably more respiratory infections than those in home care. There is also evidence that day-care–associated infections are more protracted[10] and the children need hospitalization more often.[18] In a recent study it was observed that the number of episodes of acute otitis media was not related to the number of hours per week spent in a day-care center.[19] On the other hand, a dose–response relation has been reported between the number of people in the daily environment and the number of infections.[7]

It has been argued that "the degree of human suffering caused by the common cold or a case of diarrhea cannot provide an adequate basis for governmental intervention."[20(p966)] We disagree, because in the youngest age group (under 2 years) the amount of excess illness is great and it is also closely related to the occurrence of otitis media and pneumonia.

Haskins and Kotch also paid attention to the possible medical benefits of attending day-care centers.[20] They suggested that children in day-care centers are more likely to have had their immunizations. This may be true in the United States, but not in Finland, where the public well-baby clinics cover almost all children under school age. Immunization compliance is high, and cases of measles, mumps, and rubella have nearly totally disappeared.

However, some medical benefit may result from attending a day-care center at a young age. A recently published paper[21] indicated that early attendance at a day-care center appeared to protect against childhood leukemia. The authors speculated that this effect may be related to the increased number of infections the children had. To our knowledge, this is the first report of the connection, which remains to be confirmed by future research.

Conclusion

As discussions above have indicated, day-care center attendance is associated with the considerable burden caused to families by excess respiratory infections in children under 2 years of age. The diseases are often mild, but increased incidences of acute otitis media and pneumonia cause increased numbers of tympanostomies and hospitalizations. All of these increase parental stress and loss of sleep in the families. More serious consequences, like death due to pneumonia, are unlikely to occur in excess, because the youngest children in day care usually do not have chronic conditions subjecting them to risk of death in case of pneumonia. It is also an extremely rare cause of death in Finnish children: for example only 4 children (aged 1–15 years) died of pneumonia in 1990.[22]

Several possible strategies for day-care policy might help to reduce morbidity from infectious diseases in children under 2 years. Because most of the family day care in Finland is already publicly supervised and supported, the emphasis could be on family day care for the youngest age group. Adequate isolation policies and high quality of indoor air and other environmental factors in day-care centers could also partly help to resolve the problem. □

Acknowledgments

The study was supported by the Academy of Finland, the Finnish Ministry of Social Welfare and Health, and the Finnish Ministry of the Environment.

References

1. Allen-Williams GM. Incidence of infections in war-time day nurseries. A preliminary study. *Lancet.* 1945;249:825–826.
2. Hesselvik L. Respiratory infections among children in day nurseries. *Acta Paediatr Scand.* 1949;74(suppl):1–103.
3. Gardner G, Frank AL, Taber L. Effects of social and family factors on viral respiratory infection and illness in the first year of life. *J Epidemiol Community Health.* 1984;38: 42–48.
4. Bartlett AV, Broome CV, Hadler SC, et al. Public health considerations of infectious diseases in child day-care centers. *J Pediatr.* 1984;105:683–701.
5. Bell DM, Gleiber DW, Mercer AA, et al. Illness associated with child day care: a study of incidence and cost. *Am J Public Health.* 1989;79:479–484.
6. Zielhuis GA, Henvelmans-Heinen EW, Rach GH, et al. Environmental risk factors for otitis media with effusion in preschool children. *Scand J Prim Health Care.* 1989;7: 33–38.
7. Uldall P. Forms of care and children's infections, I: occurrence and causal factors. *Ugeskr Laeger.* 1990;152:2345–2348.
8. Rasmussen F, Sundelin C. Use of medical care and antibiotics among preschool children in different day care settings. *Acta Paediatr Scand.* 1990;79:838–846.
9. Alexander CS, Zinzeleta EM, Mackenzie EJ, Vernon A, Markowitz RK. Acute gastrointestinal illness and child care arrangements. *Am J Epidemiol.* 1990;131:124–131.
10. Wald ER, Guerra N, Byers C. Frequency and severity of infections in day care. Three-year follow-up. *J Pediatr.* 1991;118: 509–514.
11. Istre GR, Conner JS, Broome CV, et al.

Risk factors for primary invasive *Haemophilus influenzae* disease: increased risk from day care attendance and school aged household members. *J Pediatr.* 1985;106: 190–195.
12. Anderson LJ, Parker RA, Strikas RA, et al. Day-care center attendance and hospitalization for lower respiratory tract illness. *Pediatrics.* 1988;82:300–308.
13. Berg AT, Shapiro ED, Capobianco LA. Group day care and the risk of serious infectious illnesses. *Am J Epidemiol.* 1991; 133:154–163.
14. Pass RF, Hutto C, Ricks R, et al. Increased risk of cytomegalovirus infection among parents of children attending day care centers. *N Engl J Med.* 1986;314:1414–1418.
15. McGullagh P, Nelder JA. *Generalized Linear Models.* London: Chapman and Hall; 1983.
16. SAS Institute Inc. *SAS/STAT User's Guide.* Version 6, 4th ed, Vol 2. Cary, NC: SAS Institute Inc; 1989:1168–1173.
17. Miettinen OS. Proportion of disease caused or prevented by a given exposure, trait or intervention. *Am J Epidemiol.* 1974;99:325–332.
18. Wald ER, Guerra N, Byers C. Frequency and severity of infections in day care. *J Pediatr.* 1988;112:540–546.
19. Hardy AM, Fowler MG. Child care arrangements and repeated ear infections in young children. *Am J Public Health.* 1993;83: 1321–1325.
20. Haskins R, Kotch J. Day care and illness. Evidence, costs and public policy. *Pediatrics.* 1986;77(suppl.):951–982.
21. Petridou E, Kassimos D, Kalmanti M, et al. Age of exposure to infections and risk of childhood leukaemia. *BMJ.* 1993;307:774.
22. *Statistical Yearbook of Finland 1992.* Helsinki, Finland: Valtion painatuskeskus; 1992.

The Classification of AIDS Cases: Concordance between Two AIDS Surveillance Systems in Italy

Diego Serraino, MD, Silvia Franceschi, MD, Luigino Dal Maso, ScD, Alessandro Cozzi Lepri, ScD, Umberto Tirelli, MD, and Giovanni Rezza, MD

ABSTRACT

This study assessed the concordance between the transmission classification of 725 acquired immunodeficiency syndrome (AIDS) cases by the Italian AIDS Registry (the national surveillance system) and the classification of the same cases by the Italian Cooperative Group on AIDS-Related Tumors. A high degree of concordance emerged for intravenous drug users in both sexes ($\kappa = 0.88$; 95% confidence interval [CI] = 0.84, 0.92), for homosexual men ($\kappa = 0.83$; 95% CI = 0.79, 0.87), and for persons infected through contaminated blood or blood derivatives ($\kappa = 1.00$). The concordance was lower among heterosexual men ($\kappa = 0.51$; 95% CI = 0.37, 0.65) and especially among men whose risk group was not determined ($\kappa = 0.28$; 95% CI = 0.12, 0.44). The discrepancies observed among heterosexual men indicate a need for continuing and accurate monitoring of AIDS reporting by transmission category. (*Am J Public Health.* 1995;85:1112–1114)

Introduction

The prevention and control of human immunodeficiency virus (HIV) infection depends on the completeness and accuracy of case ascertainment and reporting. However, several sources of error—such as underreporting—affect acquired immunodeficiency syndrome (AIDS) surveillance data.[1] These limitations are more severe when the spread of HIV is studied separately in different risk groups. The potential for the heterosexual spread of the virus in the general population, for instance, plays a major role in forecasting the heterosexual diffusion of AIDS in Western countries. Such predictions, however, have provided conflicting results because of a great uncertainty in the interpretation of time trends among heterosexuals.[2]

Few studies have focused on the reproducibility of the classification of AIDS cases as classified by HIV transmission categories. To study this, we examined 725 Italian AIDS cases for whom two independent sources of information on risk group were available: the Italian AIDS Registry and the Italian Cooperative Group on AIDS-Related Tumors.

Methods

In Italy, AIDS cases are compulsorily reported to the Italian AIDS Registry, the national surveillance system located at the Istituto Superiore di Sanità in Rome.[3] At the time of AIDS diagnosis, information on the patient's sociodemographic characteristics, medical condition, and risk factors for HIV infection are collected by interview and are registered on a standard form by the medical staff who report the case. After the risk factors are evaluated, the registry staff classifies each case into one HIV transmission category according to a hierarchical order based on the frequency of cases (i.e., intravenous drug users, homosexual men, homosexual men who are intravenous drug users, recipients of blood or blood derivatives, and heterosexuals).[3] In the absence of a history of intravenous drug abuse and/or homosexual intercourse (for men) and in accordance with the suggestion of the European Centre for the Epidemiological Monitoring of AIDS in Paris, HIV infection is attributed to heterosexual transmission if the patient reported (1) origin from a country where heterosexual transmission of HIV is predominant; (2) sexual

Diego Serraino, Silvia Franceschi, and Luigino Dal Maso are with the Epidemiology Unit, and Umberto Tirelli is with the Division of Oncology and AIDS, Aviano Cancer Centre, Aviano, Italy. Alessandro Cozzi Lepri and Giovanni Rezza are with the Centro Operativo AIDS, Istituto Superiore di Sanità, Rome, Italy.

Requests for reprints should be sent to Diego Serraino, MD, Epidemiology Unit, Aviano Cancer Centre, Via Pedemontana Occ, 33081 Aviano (PN), Italy.

This paper was accepted November 23, 1994.