

JENNIFER ST. SAUVER, MPH ■ MICHELLE KHURANA, MPH ■ ANNIE KAO, MPH ■ BETSY FOXMAN, PHD

Hygienic Practices and Acute Respiratory Illness in Family and Group Day Care Homes

Ms. St. Sauver and Dr. Foxman are with the Univ. of Michigan School of Public Health. Ms. St. Sauver is a doctoral student, and Dr. Foxman is an Associate Professor of Epidemiology. At the time of this study, Ms. Khurana and Ms. Kao were graduate students, Univ. of Michigan School of Public Health. Currently, Ms. Khurana is a medical student in the Dutch West Indies, and Ms. Kao is a doctoral student at the Univ. of California, San Diego, and San Diego State Univ. Joint Doctoral Program in Epidemiology and a Research Assistant at the San Diego County Health and Human Services Agency.

S Y N O P S I S

Objective. To describe hygiene practices in licensed group day care and family day care homes and the association between these practices and the prevalence of respiratory illnesses in the children in attendance.

Methods. Self-administered surveys were mailed to 137 group and 204 family day care providers.

Results. Wearing diapers and being younger than age three were associated with a higher frequency of respiratory illness. Children attending family day care homes had more respiratory illness than children attending group day care homes. Infrequent washing of children's or providers' hands after nose wiping, after diapering, before meals, and before food preparation was significantly associated with a higher frequency of respiratory illness. Use of shared cloth towels instead of individual paper towels and washing of sleeping mats less than once a week were also associated with a higher frequency of respiratory illness.

Conclusions. The findings underscore the importance of handwashing and other hygiene practices in reducing the spread of disease in day care settings.

Address correspondence to:

Ms. St. Sauver, Dept. of Epidemiology, School of Public Health, 109 S. Observatory, Ann Arbor MI 48109; tel. 734-647-3943; fax 734-764-3192; e-mail <stsauver@umich.edu>.

According to 1998 U.S. Census Bureau statistics, 61% of families with preschool children use some type of out-of-home child care.¹ Children who attend day care centers suffer more episodes of acute infectious illnesses than children who stay at home,²⁻⁵ resulting in higher medical costs and more lost days of work by parents.

Black et al. found that a training program in handwashing for day care providers resulted in a 50% reduction in diarrheal illnesses in children.⁶ An investigation of an outbreak of aseptic meningitis in day care centers showed that low frequency of handwashing on the part of providers was associated with a fourfold higher risk of disease in children.⁷ These studies focused on the handwashing practices of providers; few studies have documented an association between handwashing practices of children and occurrence of disease.

Further, little is known about hygiene practices in home-based day care, which has minimal licensing requirements in most states. Moreover, more children are placed in home-based day care than day care centers.¹ We describe the frequency and timing of handwashing and other hygiene practices as reported by a sample of home-based day care providers and the association of these practices with provider-reported respiratory illness in children.

METHODS

Sample. In Michigan, there are two categories of home-based day care: family day care homes are licensed to care for up to six full-time children, and group day care homes are licensed to care for up to 12 full-time children. We obtained a list of all licensed home-based day care providers in Washtenaw County from the Michigan Department of Social Services. Washtenaw County has a population of 282,937. The median age of the population is 29.2 years, and per capita income is \$22,782.⁸ We sent questionnaires to all licensed group day care providers and a sequential sample of half of the family day care providers in Washtenaw County.

Questionnaires. In January 1995, the Washtenaw County Health Department sent out notification cards to all home-based day care providers informing them of our study and encouraging participation.

In March 1995, we mailed self-administered questionnaires, inquiring about handwashing, disinfection, and diapering practices, to the 341 day care providers in

the sample. Cover letters, sent along with the questionnaires, requested that providers answer all questions as honestly as possible. Providers were also informed that all responses were strictly confidential and would only be identified by number.

Questions about handwashing used a four-point scale (never, rarely, frequently, or always), while questions about cleaning and disinfecting practices used a five-point scale (less than once a week, every week, every two to three days, every day, and twice a day or more).

In addition to the questionnaire, we asked providers to complete a health log for each child attending on either a full-time or part-time basis for the five days prior to receiving the questionnaire.

We gave them a list of common symptoms of illness (runny nose, cough, sore throat, ear infection, vomiting, fever, diarrhea, or other) and asked them to indicate if any child in their care had experienced one or more of these symptoms during the previous five days. Under "other," providers had the opportunity to list other illnesses or symptoms that were not among those listed. For example, "chicken pox" was recorded by three day care providers. If symptoms included a runny nose, cough, cold, or ear infection, we classified the illness as respiratory.

As an incentive, providers who completed and returned the questionnaire were entered in a raffle for a gift certificate from "Toys R Us."

We made one telephone call to each provider who did not return the questionnaire within three weeks. Seven providers completed the questionnaire and health log by telephone.

The study protocol was approved by the University of Michigan Human Subjects Review Board.

Analysis. Each questionnaire and health log was coded, and the coding was checked by another person. All data were entered into two separate files using Epi Info.⁹ The two files were then compared to verify accuracy of data entry.

We first examined the frequencies and distributions of each of the variables. We then conducted a bivariate analysis to determine whether each potential risk factor was associated with upper respiratory illness. We also examined the association of each of the potential confounding variables with upper respiratory illness, and found that upper respiratory illness was associated with age, diaper use, and type of home. Age and diaper use were highly correlated; therefore, we included only diaper use and type of home in the multivariate analyses. We then stratified the associations of each potential risk factor and upper respiratory illness by diaper use and type of home.

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Next, we fit three types of logistic regression models predicting respiratory illness, using SAS¹⁰:

- Model 1 predicted respiratory illness with a logistic regression model including diaper use, home type, and, in turn, each of the remaining variables.
- Model 2 predicted respiratory illness including the same variables described above with a logistic regression model adjusting for clustering between children in the same day care using generalized estimating equations (GEE), an SAS macro.
- Model 3 predicted respiratory illness at the home rather than the individual level with a logistic regression model including the same variables as Models 1 and 2.

The three models yielded approximately the same results; therefore, only the GEE results are presented below.

RESULTS

We sent questionnaires to 204 family day care providers and 137 licensed group day care providers in Washtenaw County. Of these, 40 family and four group day care homes were excluded because providers no longer practiced day care or had moved outside of Washtenaw County. We received completed questionnaires and illness logs from 89 (54%) of the 164 remaining family day care providers and 55 (41%) of the 133 remaining group day care providers, for an overall response rate of 48%. The sample thus consisted of 144 day care providers providing data on 1029 children ages 12 and younger.

The children were approximately half male (48% in family day care and 52% in group day care) and half female. The large majority of children in both types of day care homes were at least one year old (85% in family day care and 86% in group day care). About half of the chil-

dren in family day care (48%) and group day care homes (46%) used diapers. Family day care providers cared for an average of five different children at a time (range: 1–13), and group day care providers cared for an average of 11 different children (range: 4–17). Because some children attended day care part-time, over the course of a week providers were able to care for more than the six-child maximum for family day care homes or the 12-child maximum for group day care homes.

Family day care providers were all female, the majority (69%) ranged in age from 30 to 50 years, and most (73%) had at least 12 years of education. Similarly, group day care providers were all female and typically between the ages of 30 and 50 (70%), although somewhat fewer (65%) had at least 12 years of education. Group day care providers were more likely to have received training in child care (ranging from completion of a bachelor's degrees in education to attendance at seminars, workshops, and child care classes offered in Washtenaw County) than family day care providers ($\chi^2 = 8.1$; $df = 1$; $P = 0.004$).

Hygiene practices. Group day care providers were more likely to use paper towels to dry hands than family day care providers ($\chi^2 = 4.1$; $df = 1$; $P = .004$). Group day care and family day care providers did not differ significantly in any other hygiene practices (Table 1).

Almost all providers reported that they “frequently” or “always” washed their hands before food preparation and after diapering (family day care 99%; group day care 100%), and most said they frequently or always washed their hands after wiping a child's nose (family day care 90%; group day care 98%) (Table 1). In addition, almost all providers reported that they frequently or always had the children wash their hands before meals and after bathroom use (family day care 96%; group day care 97%). However, 61% of family day care providers and 60% of group day care providers reported that they “rarely” or “never” washed the children's hands after diapering. Thirty-four percent of family day care providers and 27%

Table 1. Frequency of provider-reported respiratory illness over a five-day period, by hygienic practice, Washtenaw County, Michigan, 1995

<i>Hygienic practice</i>	<i>Family day care homes (n=476)</i>		<i>Group day care homes (n=600)</i>	
	<i>Number of homes</i>	<i>Percent of children with respiratory illness</i>	<i>Number of homes</i>	<i>Percent of children with respiratory illness</i>
Provider handwashing after nose wiping				
Never/rarely	43	18.6	10	20
Frequently/always.	428	18	587	10.9
No response	5	—	3	—
Provider handwashing before food preparation				
Never/rarely	4	25	0	—
Frequently/always.	467	18	597	11.1
No response	5	—	3	—
Provider handwashing after diapering				
Never/rarely	0	—	0	—
Frequently/always.	443	18.7	563	11.7
No response or not applicable.	33	—	37	—
Child handwashing after nose wiping				
Never/rarely	158	24.6	154	14.9
Frequently/always.	300	13.7	420	9.3
No response	18	—	26	—
Child handwashing after diapering				
Never/rarely	264	19.3	341	14.7
Frequently/always.	167	16.8	226	6.2
No response or not applicable.	45	—	33	—
Child handwashing before meals				
Never/rarely	8	37.5	24	12.5
Frequently/always.	463	17.7	563	10.8
No response	5	—	13	—
Child handwashing after bathroom				
Never/rarely	27	22.2	9	11.1
Frequently/always.	432	17.6	578	10.9
No response	17	—	13	—
Type of towel				
Shared cloth.	209	21.1	157	17.2
Individual paper.	219	15.5	399	9.0
No response or not applicable.	48	—	44	—
Cleaning sleeping mats				
Once a week or less	270	21.5	394	12.4
More than once a week.	101	6.9	155	7.7
No response or not applicable	105	—	51	—
Total	476	18.1	600	11.1

NOTE: Some homes did not care for children in diapers and some homes did not have sleeping mats. Some homes also used methods for drying hands other than a shared cloth or individual paper towels. No more than 4% of respondents refused to answer any one question.

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of group day care providers said they rarely or never washed the children’s hands after wiping a child’s nose. Forty-nine percent of family day care providers and 28% of group day care providers said they used a shared cloth towel to dry children’s hands. Only 27% of family day care providers and 28% of group day care providers washed sleeping mats more than once a week. We did not ask if sheets were used on the mats.

Association of respiratory illness with potential confounding variables. We examined the effects of children’s age on individual risk for respiratory illness by fitting a logistic regression model using a GEE macro, which adjusts for clustering within day care homes. Indicators were included for each age group, with the >8 years age group used as the referent. Children in the

youngest age groups (0–1 year, >1–2 years, and >2–3 years) experienced significantly more illness than children in the oldest age group (>8) (Table 2).

A GEE model including only diaper use found diaper use was associated with increased respiratory illness (odds ratio [OR] = 2.96; 95% confidence interval [CI] 2.02,4.32). Diaper use and age categories were highly correlated ($\chi^2 = 755.6$, $df = 8$, $P = 0.001$), but diaper use was more strongly correlated with respiratory illness than age. Therefore, we used diaper use as a surrogate predictor for developmental age in children and controlled for it in all further analyses.

Respiratory illness was not significantly associated with full-time attendance (40 or more hours per week) (OR = 1.29; 95% CI 0.90,1.86) or number of children in the day care home (OR = 0.97; 95% CI 0.90,1.04), according to GEE models including diaper use, day care attendance, number of children, and home type (data not shown). Family day care homes had significantly more respiratory illness than group day care homes (OR = 1.86; 95% CI 1.08,3.20) in a GEE model including diaper use and home type (data not shown).

Association of respiratory illness with hygiene practices. We examined the associations between hygiene practices and respiratory illness, adjusting for diaper use, using a logistic regression model with a GEE macro. In family day care homes, a higher frequency of respiratory illness was found for children whose hands were never or rarely washed after their noses were wiped (OR = 1.88; 95% CI 1.01,3.52) or never or rarely washed their hands before meals (OR = 2.22; 95% CI 1.63, 3.03) than for children whose hands were frequently or always washed at these times (Table 3.) Children in family day care homes in which providers never or rarely washed their hands before food preparation were more likely to have respiratory illness than children in homes in which providers frequently or always washed their hands (OR = 3.49, 95% CI 2.09,5.81). Failure to clean sleeping mats more than once a week was also associated with higher

Table 2. Associations between age group and provider-reported respiratory illness over a five-day period among children attending licensed family and group day care homes, Washtenaw County, Michigan, 1995

Age category (years)	Odds ratio	95% confidence interval
0–1	3.34	1.28,8.67
>1–2	4.48	1.92,10.44
>2–3	2.47	1.02,5.99
>3–4	1.40	0.54,3.61
>4–5	1.71	0.68,4.33
>5–6	1.26	0.43,3.68
>6–7	0.27	0.02,3.55
>7–8	0.87	0.11,6.92

NOTE: Odds ratios and 95% confidence intervals are from logistic regressions using generalized estimating equations (GEEs) to adjust for clustering within each home. Odds ratios were calculated using respiratory illness in the oldest age group (>8 years) as the baseline. Respiratory illness was predicted using GEE logistic regression models including an age indicator variable.

Table 3. Generalized estimating equation (GEE) analysis of associations between selected hygiene practices and provider-reported respiratory illness over a five-day period among children attending licensed family and group day care homes, Washtenaw County, Michigan, 1995

Hygienic practice	Family day care homes			Group day care homes		
	Number	Odds ratio	95% CI	Number	Odds ratio	95% CI
Provider handwashing: never/rarely vs frequently/always						
After nose wiping	471	1.26	0.48,3.34	597	2.98	1.85,4.82
Before food preparation	471	3.49	2.09,5.81	597	— ^a	—
After diapering	443	— ^a	—	563	— ^a	—
Child handwashing: never/rarely vs frequently/always						
After nose wiping	458	1.88	1.01,3.52	574	1.63	0.58,4.57
After diapering	431	1.19	0.63,2.24	567	2.69	1.07,6.74
Before meals	471	2.22	1.63,3.03	587	1.81	0.99,3.31
After bathroom	459	1.75	0.36,8.61	587	1.33	0.83,2.14
Type of towel: shared cloth vs individual paper						
	428	1.46	0.78,2.73	556	2.47	0.94,6.50
Sleeping mats cleaned: weekly or less often vs more often than once a week						
	371	3.76	1.27,11.12	549	1.96	0.67,5.73

NOTE: GEE adjusts for the correlation between children in a given home. Each model included diaper use and the selected practices. Separate models were fit for family and group day care homes.

^aAll providers stated that they frequently or always washed their hands following diapering and before food preparation, so no estimates were possible.

CI = confidence interval

frequency of respiratory illness in children in family day care homes (OR = 3.76; 95% CI 1.27,11.12).

In group day care homes, children whose hands were never or rarely washed before meals (OR = 1.81; 95% CI 0.99,3.31) or after diapering (OR = 2.69; 95% CI 1.07, 6.74) were also more likely to have respiratory illnesses than children whose hands were frequently or always washed at these times. Children in group day care homes in which providers never or rarely washed their hands after nose wiping were more likely to have respiratory illnesses than children in group day care homes in which providers frequently or always washed their hands after nose wiping (OR = 2.98; 95% CI 1.85,4.82). In addition, children in group day care homes who used shared cloth towels to dry their hands had a higher frequency of respiratory illness than children who used paper towels to dry their hands (OR = 2.47; 95% CI 0.94,6.50).

We found no associations between respiratory illness and the type of soap used, type of diaper used, whether gloves were used by the provider when changing a wet or soiled diaper, type of disposal used for diapers, or type of cleaning solutions used for disinfecting surfaces (data not shown).

DISCUSSION

“Never” or “rarely” washing hands—of both children and providers—in a variety of circumstances was associated with a higher frequency of respiratory illness in both family day care and group day care homes. Our findings are inconsistent with the results of a study in day care centers that found no association between handwashing practices and respiratory illness.¹¹ Day care centers enroll larger numbers of children than day care homes; the higher exposure to infectious agents found in the day care setting may overwhelm the effects of good handwashing practices, making it difficult to detect a benefit from such practices.

We found a positive association between diaper use and respiratory illness; this was an unexpected finding—one would expect diaper use to be associated with gastrointestinal illness, not with respiratory illness. In our study population, 97% of toilet-trained children frequently or always washed their hands after bathroom use but only 39% of children in diapers had their hands washed following diapering.

Previous studies examining cleaning of the day care

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environment^{12,13} have addressed the effect on gastrointestinal illness of fecal contamination of surfaces. However, the frequency and timing of cleaning practices in the day care setting have not been examined as risk factors for respiratory disease. Therefore, it was of interest to find that washing sleeping mats more than once a week was associated with lower levels of respiratory illness. Sleeping mats have received little attention in the literature, and these results should be confirmed. It would be of interest, for example, to know whether children slept on the same mat each day and whether sheets were used and washed. Infectious agents may be transmitted by either direct contact or droplet spread of infected secretions to sleeping mats during rest periods.^{14,15} Some respiratory pathogens can remain viable on surfaces for several hours or several days,^{15,16} and infrequent cleaning of infected areas may result in an opportunity for spread of pathogens, possibly explaining the association between infrequent cleaning of sleeping mats and illness.

It is also not clear whether specific practices or the overall level of good hygiene practices are more important in reducing respiratory illness. Homes in which sleeping mats and children's and providers' hands were washed frequently were probably more likely to have higher overall levels of hygiene than homes in which these practices were performed infrequently. Future studies are needed to define more clearly whether frequent performance of specific hygiene practices or maintenance of a very high level of hygiene is more effective in reducing respiratory illness.

Number of children was not significantly associated with respiratory illness. Previous studies have suggested that children in day care are more likely to experience respiratory illness than children cared for at home.^{5,17-19} Our study suggests that in *home-based* day care, being exposed to more children does not increase the risk of respiratory illness; in fact, children in group day care homes, which normally care for more children than family day care homes, experienced less respiratory illness than those in family day care homes.

Group day care providers were more likely to have received some advanced child care training than family day care providers, which may have made group day care providers more aware of illness-prevention strategies than family day care providers and may explain the lower frequency of respiratory illness observed in group day care homes. Alternatively, family day care providers may be more likely to report respiratory illness accurately because it is easier to keep track of fewer children.

Study limitations. Several factors may limit the generalizability of this study's findings. First, home-based day care in the small geographic area of Washtenaw County, Michigan, may not be representative of home-based day care in the rest of the country with regard to providers' education level and child care training or other relevant factors.

Second, hygienic practices in the day care homes were reported by providers, who may have reported what they felt was the correct answer rather than their actual practices. This would have resulted in an overestimation of the prevalence of these practices and an underestimation of the risk of illness associated with specific practices.

The presence of acute respiratory illness was also reported by the day care provider, and we had no clinical confirmation of children's illnesses. Respiratory symptoms not associated with infectious diseases and resulting from asthma, allergies, or other conditions may have been included in the provider reports, so the prevalence of respiratory illness may be overestimated.

Finally, while our response rate was good for a mail-out survey, we could not ascertain if respondents were different from nonrespondents in terms of the variables of interest. Thus, estimates of the frequency of hygiene practices must be interpreted with caution.

Conclusion. Family and group day care homes serve a larger number of U.S. children than day care centers;^{5,20} studies of hygiene practices and risk of illness in these homes have potential implications for more children than studies that focus only on day care cen-

ters. Both provider and child handwashing practices may be important risk factors for acquiring upper respiratory infections among children who attend day care homes. Furthermore, the association of upper respiratory infection with infrequent cleaning of sleeping mats deserves additional study. Although our findings of associations between illness and handwashing may seem obvious, they underscore the importance of frequent handwashing in day care environments. In addition, handwashing practices are relatively inexpensive and easy to modify, making them an ideal method of illness prevention.

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References

1. Bureau of the Census (US). Primary child care arrangements of preschoolers. Available from: URL: www.census.gov/population/socdemo/child/p70-621/tableB.txt
2. Wald ER, Guerra N, Byers C. Frequency and severity of infections in day care: Three-year follow-up. *J Pediatr* 1991;118:509-14.
3. Henderson FW, Giebink GS. Otitis media among children in day-care: epidemiology and pathogenesis. *Rev Infect Dis* 1986;8:533-8.
4. Belongia EA, Osterholm MT, Soler JT, Ammend DA, Braun JE, MacDonald KL. Transmission of *Escherichia coli* O157:H7 infection in Minnesota child day care facilities. *JAMA* 1993;269:883-8.
5. Hurwitz ED, GunnWJ, Pinsky PF, Schonberger LB. Risk of respiratory illness associated with day care attendance: a nationwide study. *Pediatrics* 1991;87:62-9.
6. Black RE, Dykes AC, Anderson KE, Wells JG, Sinclair SP, Gary GW, et al. Handwashing to prevent diarrhea in day care centers. *Am J Epidemiol* 1981;113:445-51.
7. Helfand RF, Khan AS, Pallansch MA, Alexander JP, Meyers HB, DeSantis RA, et al. Echovirus 30 infection and aseptic meningitis in parents of children attending a child care center. *J Inf Dis* 1994;169:1133-7.
8. Washtenaw County Demographic Information:1990 Census data. Available from: URL: mel.lib.mi.us/michigan/Counties/Washtenaw.html
9. Dean A. Epi Info., Version 6.02. Atlanta: Centers for Disease Control and Prevention (US); 1994.
10. SAS Institute, Inc. SAS. Version 6.11. Cary (NC): SAS Institute; 1995.
11. Kotch JB, Weigle KA, Weber DJ, Clifford RM, Harms TO, Loda FA, et al. Evaluation of an hygienic intervention in child day-care centers. *Pediatrics* 1994;94:991-4.
12. O'Ryan M, Matson DO. Viral gastroenteritis pathogens in the day-care setting. *Semin Pediatr Infect Dis* 1990;1:252-62.
13. Van R, Morrow AL, Reves RR, Pickering LK. Environmental contamination in child day-care centers. *Am J Epidemiol* 1991;133:460-70.
14. Hall CB, Douglas RG. Modes of transmission of respiratory syncytial virus. *J Pediatr* 1981;99:100.
15. Gwaltney JM, Moskalski PB, Hendley JO. Hand-to-hand transmission of rhinovirus colds. *Ann Intern Med* 1978;88:463.
16. Centers for Disease Control and Prevention (US). Public health considerations of infectious diseases in child day care centers. *J Pediatr* 1984;105:683-701.
17. Fleming, DW, Cochi, SL, Hightower, AW, Broome, CV. Childhood upper respiratory tract infections: to what degree is incidence affected by day-care attendance? *Pediatr* 1987;79:55-60.
18. Louhiala PJ, Jaakkola N, Ruotsalainen R, Jaakkola JJ. Form of day care and respiratory infections among Finnish children. *Am J Public Health* 1995;85:1109-12.
19. Harsten G, Prellner K, Heldrup J, Kalm O, Kornflaet R. Acute respiratory tract infections in children. A three year follow-up from birth. *Acta Paediatr Scand* 1990;79:402-9.
20. Osterholm MT, Reves RR, Murph JR, Pickering LK. Infectious disease and child day care. *Pediatr Infect Dis J* 1992;11(8 Suppl):531-41. ■