American Journal of Infection Control

Volume 18 Number 6 December 1990

ARTICLES

Occurrence of infectious symptoms in children in day care homes

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Transmission of enteric pathogens is facilitated in child day care centers, including family day care homes, by frequent and intimate exposure among susceptible hosts, with diaper changing as the highest-risk procedure for such transmission. The objective of this study was to evaluate the effectiveness of an intervention program in decreasing the incidence of infectious disease symptoms in children attending family day care homes during a 12-month period. Each of 24 family day care homes was randomly assigned to an intervention or control group. The intervention included four components: (1) a handwashing educational program and (2) use of vinyl gloves, (3) use of disposable diaper changing pads, and (4) use of an alcohol-based hand rinse by the day care provider. Symptoms of enteric disease (diarrhea and vomiting) were significantly reduced in intervention family day care homes ($p \leq 0.05$), whereas respiratory symptoms were not significantly different between intervention and control family day care homes ($p = 0.35$). Diarrhea was reported in 1 of every 100 child care days, representing one diarrhea episode per month in a typical family day care home. (AM J INFECT CONTROL 1990;18:347-53).

More than half of U.S. women with children under the age of 6 years are currently in the labor force. Child care is provided for more preschool age children in family day care homes (37%) (FDCHs) than in in-home care (31%) or day care centers (23%).[1] Thus most children spend a minimum of 10 hours per week in day care.[2]

Transmission of certain infectious diseases have been associated with day care centers, including *Haemophilus influenzae* type b,[3] hepatitis A,[4] and infectious diarrhea caused by *Giardia lamblia, Shigella,* and rotavirus.[5-8] Outbreaks of infectious diseases, especially those associated with diarrhea, in day care centers pose direct threats to infants and toddlers, who are subsequently likely to infect others.[9, 10] Diarrheal attack rates in children attending day care centers range from 50% to 71% during diarrheal

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17/46/21693

outbreaks,[5,6] whereas secondary attack rates to family members range from 15% to 71% for various enteropathogens.[11]

Asymptomatic shedding of specific enteropathogens is an additional source of transmission in children in day care. Asymptomatic excretion of rotavirus in stools occurred in 32% of children tested during the first week after diarrhea and in 50% of children 1 day before diarrhea. This shedding represents a source of transmission that could potentially be interrupted by handwashing and hygienic diaper handling.[12]

Transmission of enteric pathogens through person-to-person spread or through fomites is facilitated in child day care centers, including FDCHs, because of increased and intimate exposure among susceptible hosts,[13,14] the predominance of hand-to-mouth or object-to-mouth contact, and the need for hands-on contact by day care personnel.[14,15] Contaminated communal toys, toilet areas, and hands of children and personnel play a role in the transmission of enteropathogens in diarrhea outbreaks.[8,16]

Diaper changing has been suggested as the highest-risk procedure for transmission of enteropathogens among day care children and personnel.[17] Although a rigorous handwashing intervention was demonstrated in one study to reduce the incidence of nonspecific diarrheal illness in large day care centers,[15] few studies have examined the association of inadequate handwashing and poor hygienic diaper handling practices on the transmission of diarrheal disease in FDCHs.

The objective of this study was to evaluate the effectiveness of an intervention program in decreasing the incidence of symptoms associated with enteric and respiratory infectious diseases among 2-month-old to 7-year-old children attending FDCHs.

MATERIAL AND METHODS

FDCHs are defined (in Maryland) as registered day care homes that enroll six or fewer children for part-time or full-time day care. Forty-seven family day care providers were randomly selected by number from a list of FDCHs registered in the city of Baltimore and were contacted by telephone; 24 (51%) agreed to participate in the study. Names were obtained from a list of FDCHs provided by the local Department of Social Services, Division of Day Care. After signed consent was obtained from day care providers, each FDCH was randomly assigned to the control group (n = 12) or intervention group (n = 12). To reduce reporting bias, all day care providers were aware that the intervention program was being tested in certain homes. Parental consent for recording of daily symptoms for each child (n = 114) enrolled in the FDCHs was obtained by telephone. The study was approved by the Human Subjects Committee of The Johns Hopkins University Medical School.

Baseline health data on each child were obtained from the parent by telephone interview within 2 months of enrollment in the study. All new children who entered the FDCHs were recruited into the study. Children departing from a FDCH were not followed after their departure. Sociodemographic data on day care personnel were obtained on their entry into the study.

Exclusion criteria for sick children were ascertained from each day care provider before data collection. Equal proportion of intervention as well as control day care personnel stated that fever, defined as "forehead warm to touch" or a temperature greater than 100° F (91%), and diarrhea (82%) were used as exclusionary criteria for sick children. Other exclusionary symptoms were reported at lower levels: runny nose (55%), skin rashes (27%), and cough (18%).

Intervention. The intervention program consisted of in-home instruction to day care providers by the investigators during the first four home visits. The intervention instruction included modes of transmission of pathogens in the home, indications for handwashing, and the use of vinyl gloves and disposable diaper changing pads at each diaper change. Providers were instructed to dispose of the gloves, disposable pads, and diapers in plastic bags. Between handwashes, when the providers were unable to wash their hands with soap and water, they

were instructed to use an alcohol-based (60% isopropyl alcohol) hand rinse (Cal STAT, Calgon Corp., St. Louis, Mo.). All supplies were provided to each intervention day care provider. This combined intervention was chosen to maximize any beneficial effects. The control homes received no educational intervention but received biweekly nurse visits for symptom data collection.

Assessment of symptoms. Daily symptom records for each child were kept by all day care providers for a 12-month study period. Each day the provider recorded the following symptoms for each child: diarrhea, vomiting, runny nose, and absence from day care home. All absent days, including those for vacation, maternal illness, and days off, were recorded. Reason for absenteeism was not recorded. If no data were recorded on any given day, that day's data were coded as missing.

Definitions of symptoms were provided to providers. Diarrhea was defined as the occurrence of loose, unformed bowel movements at twice the normal frequency. Normal frequency of bowel movements was further defined for the day care providers: infants, one to two stools per day; and older children, one stool per day. The presence or absence of symptoms was recorded only for days of attendance; no recording of symptoms was attempted in the child's home. Every 2 weeks a registered nurse visited each FDCH to collect the completed symptom records. All providers, control and intervention, were remunerated with $2.00 during the biweekly visits as well as an additional amount three times during the study period for completing the symptom records.

Statistical analysis. The proportion of child symptom days (diarrhea, vomiting, and runny nose) was calculated for all children for each month and plotted across the 12-month study period to ascertain seasonal trends in symptom reporting. The trends reported do not necessarily reflect the same children during the study period. Each month represented an independent proportion of child symptom days. Multiple symptoms are reported as group rates, not by the individual child. Additionally, a series of chi-square tests of association were performed to compare the intervention and control homes for the number of symptom days reported during the 12-month period (significance level $p = 0.05$).

RESULTS

Population. During the period from Jan. 4, 1988, to Dec. 31, 1988, 114 children were enrolled from 24 FDCHs. From all FDCHs, only two children were not enrolled. Baseline data are reported on 108 children (95%) whose parents could be contacted by telephone. During the 12-month period, 47 children (27 control, 20 intervention) departed from and 19 (8 control, 11 intervention) new children entered the FDCHs, accounting for 86 children enrolled at the termination of the study. Two FDCHs (one control, one intervention) discontinued care during the 12-month study period, accounting for 11 of the departing children. The majority (68%) of children departing from day care left during the second half of the study period.

Sociodemographic characteristics of the children by type of home are shown in Table 1. There were no statistically significant differences between the two groups of children by age, sex, race, maternal age, preexisting health condition, or number of siblings in their home. A preexisting health condition, which was reported by 19% of all children, included asthma, recurrent ear infections, cerebral palsy, ventricular septal defect, chronic constipation, cancer, and seizures. There were no statistically significant sociodemographic differences in the control or intervention providers (Table 2). The providers tended to be older (mean age 48.5 years), and more than half (58%) had not completed high school.

Symptom reports. During the study period, a total of 20,587 child days were included (control, 10,428 days; intervention, 10,159 days), with an average daily census of 100 children (control, 47.5 children/day; intervention, 52.5 children/day) aged 1 month to 7 years. Absent days totaled 1727 (8.4%), and missing days totaled 461 (2.2%) during the 12-month study period. Absent and missing days were excluded

Table 1. Sociodemographic characteristics of family day care children (n = 108)

Characteristic	No. of subjects (%)		p value
	Control (n = 50)	Intervention (n = 58)	
Age (mo)			
1-12	3 (6)	11 (19)	0.248
13-24	14 (28)	12 (21)	
25-36	14 (28)	17 (29)	
≥37	17 (34)	14 (24)	
Data missing	2 (4)	4 (7)	
Sex			
Male	29 (58)	25 (43)	0.177
Female	21 (42)	33 (57)	
Race			
Black	49 (98)	52 (90)	0.172
White	1 (2)	4 (7)	
Other	0	2 (3)	
Maternal age (yr)			
15-20	2 (4)	4 (7)	0.731
21-30	28 (56)	30 (52)	
31-40	15 (30)	15 (26)	
Data missing	5 (10)	9 (15)	
Preexisting health condition			
Yes	11 (22)	10 (17)	0.823
No	35 (70)	43 (74)	
Data missing	4 (8)	5 (9)	
No. of siblings in home			
None	20 (40)	24 (41)	0.939
1	22 (44)	23 (40)	
2	2 (4)	4 (7)	
≥3	1 (2)	2 (3)	
Data missing	5 (10)	5 (9)	

from the denominator for calculation of symptom rates.

The seasonal distribution of diarrhea, runny nose, and vomiting symptoms is shown in Fig. 1; diarrhea symptom report rates peaked in mid-winter (February) and mid-summer (July). Vomiting report rates paralleled the mid-winter peak but did not parallel the mid-summer peak. Runny nose report rates also peaked in the winter months, declined through the spring and summer, and peaked again during the fall.

Total days by symptom are shown in Table 3. Runny nose reports occurred during 1951 (9.5%) of all child days. Other symptoms were reported at lower rates for all child days: diarrhea, 226 (1.1%); and vomiting, 85 (0.4%). Significant differences were observed between intervention and control homes for symptoms of diarrhea and vomiting (Table 3).

Enteric symptoms (diarrhea and vomiting) were compared by intervention or control FDCHs across the study period. Diarrhea and vomiting rates were reported at higher or comparable levels in the control homes compared with the intervention homes during the majority of the study period. Diarrhea rates were higher in control homes during the first 8 months, at which time the intervention homes then reported higher rates of diarrhea during the remaining period, but not significantly higher than because of chance.

Compliance with intervention. Distribution of supplies (disposable pads, boxes of gloves (100 gloves per box), and 4-ounce bottles of hand rinse solution were tallied on a monthly basis. Assessment of compliance was based on the continual demand for supplies. The average number of supplies distributed to intervention homes per month included 40 disposable pads, two boxes of vinyl gloves and one to two bottles of hand rinse. Direct observation of supply use

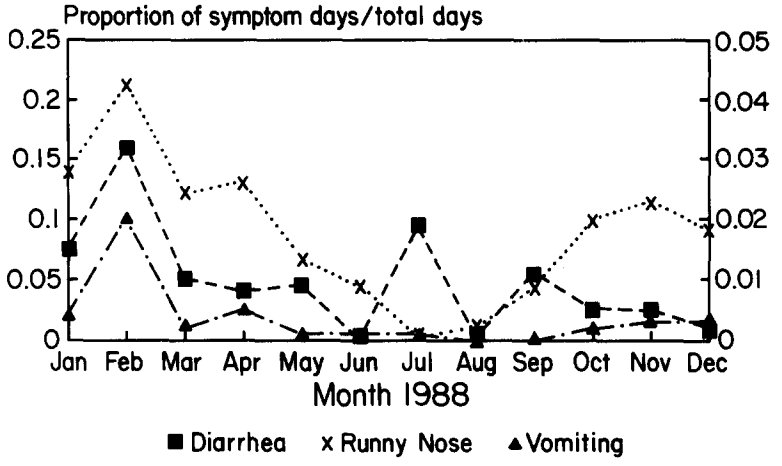

Fig. 1. Symptom rates for both intervention and control homes by month for diarrhea, runny nose, and vomiting. Runny nose rates are plotted on scale at *left*, and diarrhea and vomiting rates are plotted on scale at *right*.

Table 2. Sociodemographic characteristics among control and intervention day care providers (n = 24)

Characteristic	No. of subjects (%)		p value
	Control	Intervention	
Age (mean; yr)	48.1	48.8	0.840
Race			
Black	12 (100)	12 (100)	1.00
Educational level			
Some high school	8 (67)	6 (50)	0.526
High school graduate	3 (25)	3 (25)	
Some college or technical	1 (8)	3 (25)	
Participation in child care course			
Yes	5 (42)	8 (67)	0.207
No	7 (58)	4 (33)	

occurred only during the biweekly visits. Control homes received no supplies, and use of vinyl gloves was not observed in the control homes during the study period.

DISCUSSION

Prevention and control of infectious diseases in day care facilities depends on maintenance of optimal hygienic standards. Handwashing by providers is considered the single most important preventive measure[15] in day care facilities. The results of our study demonstrate that symptoms of enteric disease (diarrhea and vomiting) are lowered in FDCHs when specific hygienic measures such as handwashing, use of vinyl gloves, disposable diaper pads, and alcohol-based hand rinse are used. The relative contribution of each component of the intervention cannot be distinguished in our data because the intervention was devised to produce the maximum effect in low-income, inner-city FDCHs. To test each component of the intervention, a larger sample size would be required. Further studies need to be undertaken to determine which factor is responsible for lowering the symptom rates reported in the intervention FDCHs.

Fecal coliform bacteria and rotavirus have been detected in day care centers on environmental surfaces, including diaper changing areas, carpet, and teachers' hands.[18-20] The simian rotavirus SA-11, suspended in distilled wa-

Table 3. Total symptom days for intervention and control day care homes: Jan. 4 to Dec. 31, 1988 (total child care days = 20,587)

	Days					
	No. of days	% of total	Intervention group	Control group	χ^2 test (p value)	Odds ratio (95% CL)
Symptom						
Diarrhea	226	1.1	93	133	5.814 (0.02)	0.715 (0.54, 0.72)
Vomiting	85	0.4	21	64	19.755 (<0.001)	0.335 (0.20, 0.56)
Runny nose	1951	9.5	983	968	0.883 (0.35)	1.05 (0.95, 1.15)
Total days			10,159	10,428		

CL, Confidence level.

ter, was detected for 30 minutes on counter tops, but the virus survived longer when suspended in fecal material[19] or at high or low humidity.[21] This suggests that these enteropathogens can remain viable on contaminated surfaces, such as the diaper changing area and hands of day care personnel, long enough to be transmitted to susceptible children. Use of vinyl gloves and disposable diaper changing pads may explain the reduced diarrhea and vomiting symptom reports of the intervention homes.

All symptom reports were based on the providers' subjective assessments. Although definitions were provided, no validity testing was possible during the study. However, the fact that seasonal trends were consistent across homes and consistent with patterns associated with infectious diarrhea lends credence to the providers' assessments. Underreporting rather than overreporting of symptoms by the busy providers is more likely in these data. Fever symptoms were recorded. Initial home teaching included use of a thermometer to measure fever. However, because of the providers' inconsistent use of thermometers and use of "tactile fever" determination, the fever data were not reported. With the majority of providers reporting less than a high school education, record keeping by the providers was designed to be simple and efficient, to optimize compliance.

Diarrhea outbreaks in day care centers are generally due to transmission of organisms requiring low inoculum *(Shigella, Giardia lamblia).*[22] However, the infective dose of rotavirus is unknown. Placing children in separate rooms (isolation) in day care centers while they were receiving therapy for shigellosis was useful in containing a diarrheal outbreak, thus allowing children to return to day care sooner.[7] However, segregation of potentially infectious children is not feasible in FDCHs. Rather, excluding ill children from care is the usual practice. Our data demonstrate that young children do frequently attend FDCHs with symptoms of respiratory diseases. Additionally, diarrhea was reported in one of every 100 child care days. This represents one diarrhea episode per month in a typical FDCH.

Increased attention to handwashing by day care providers and the use of disposable diaper changing pads may reduce the incidence of diarrheal disease. In addition, it would be prudent for providers to wear vinyl gloves for diaper changing or for assisting children with toileting when children with symptoms of enteric disease attend their homes. It is possible that certain enteric pathogens will be more sensitive to these measures than others. The lack of effect of our intervention on respiratory symptoms suggest that other measures are required to prevent transmission of respiratory pathogens.

We thank Flora Leister and Constance Johnson for their laboratory assistance, Dr. Chris Markut for her data collection assistance, and the family day care providers.

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