

RESEARCH ARTICLE

# Excess Risk of Head and Chest Colds Among Teachers and Other School Workers

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ABSTRACT

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**BACKGROUND:** Work-related injuries and illnesses in the educational services sector have not been well studied. This analysis examined whether teachers and other school workers are at higher risk of head/chest cold compared to all other workers in the United States.

**METHODS:** Seven years (1998-2004) of National Health Interview Survey data on currently employed workers were combined to provide a basis for estimating the incidence proportion of head/chest cold.

**RESULTS:** The adjusted odds ratio for head/chest cold was significantly elevated for teachers and other workers employed at schools compared to all other workers. When examined by month, an excess of increased head/chest cold risk during the school year suggested that a portion of head/chest cold among teachers and other school workers is attributable to their workplace, perhaps due to close contact with students at school.

**CONCLUSION:** Head/chest cold, a surrogate for acute respiratory infection, was more common among school workers during the school year and less common during July than for all other workers in the United States. Targeted training for school workers and students may be beneficial to reduce work-related exposure to viruses and bacteria that infect the respiratory system.

**Keywords:** communicable diseases; employee health promotion; public health.

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The educational services industry is the second largest US industry with approximately 12.7 million workers and is surpassed only by the manufacturing industry. The majority of workers (8.5 million workers) are employed in elementary and secondary schools.<sup>1</sup> Work-related injuries and illnesses in the education sector have not been well studied.<sup>2</sup> Most available epidemiologic studies on occupational health outcomes among teachers focus on voice disorders<sup>3,4</sup> and job burnout.<sup>5,6</sup> Recent studies have shown that teachers are at higher risk for work-related asthma compared to other occupations

in the educational services industry<sup>7</sup> and for work-related upper respiratory symptoms compared to the general working population.<sup>8,9</sup> However, studies that estimate the magnitude of these conditions among workers employed in the educational services sector are needed.

In this study, we investigated whether teachers and other service workers at schools are at increased risk of head/chest cold due to their workplace exposures. Data from the National Health Interview Survey (NHIS), a large population-based annual survey designed to monitor the health of the US population, were

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used to obtain national estimates of head/chest cold among teachers and other school workers and to compare these estimates with those for other currently employed workers in the United States. The specific aim of this study was to examine whether teachers and other school workers in the educational services sector have higher rates of head/chest cold, a potential indicator of acute respiratory infections, than all other workers and whether the risk of this condition is associated with their work in the school environment.

## METHODS

The NHIS is an annual cross-sectional, multi-purpose, and multistage probability survey of the US civilian non-institutionalized population living at addressed dwellings.<sup>10,11</sup> Since the survey was conducted year-round, the data are collected throughout the year. Approximately 40,000 households are selected annually to participate in the NHIS. Data on adult health conditions are available from the sample adult core questionnaire. One adult from each household included in the NHIS is selected at random and administered the sample adult core questionnaire. Although the sampling unit for the NHIS is the household, survey sample weights are calculated for each member of the household to allow for person-level analyses. Because the NHIS adopted a different coding system for industry and occupation in 2005, “teachers in elementary and secondary schools and college” could no longer be identified in the public use data set. Therefore, we only used the data for 1998-2004, which were then combined to increase the precision of the incidence proportion estimates.

### Study Subjects

Among the total of 228,092 respondents, we restricted analyses to working-age adults (age 18 to 65) who were “working at a job or business” or “with a job or business but not at work” during the week prior to their interview. A total of 129,873 adults were included in the analysis.

Information on occupation and industry was obtained from respondents aged 18 or older regarding their main job during the week prior to their interview, and then recoded by the NHIS to align with the US Standard Occupational Classification (SOC) system.<sup>12</sup> Using these data, we defined teachers as those employed in the NHIS occupational category 09 (teachers, librarians and counselors) within the NHIS industry category 82 (elementary and secondary schools and colleges), based on the 1987 Standard Industrial Classification (SIC). “Other service workers employed at schools” were defined as those employed in food service, health service, cleaning and building service, and motor vehicle operators (SOC 52 and

82) within the elementary and secondary schools and colleges (SIC 82). All other workers were defined as those whose information on occupation and industry was ascertained but who did not fit into either category above. Thus, some occupations such as managers and administrators, secretaries, typists, and financial records processing occupations (SOC 12, 13, 46, and 47) in elementary and secondary schools and colleges (SIC 82) are also included in the “all other workers” group.

### Measures

*Head/chest cold* case was defined as those respondents who answered affirmatively to the question “Did you have a head cold or chest cold that started during the last 2 weeks?” We considered this as a surrogate for acute respiratory infection, including sinusitis, pharyngitis, laryngitis, and bronchitis. Because the precise date of the head/chest cold is unknown, the month the respondent answered in the affirmative was considered to be the month the illness occurred. We estimated the incidence proportion of head/chest cold, which measures the proportion of workers who reported having a head/chest cold during the last 2 weeks (number of incident cases divided by persons at risk). There are no other questions in the NHIS that capture information on upper respiratory infections over the previous 2 weeks. There are NHIS questions asking if the respondent during the previous 12 months had an asthma attack or physician-diagnosed pneumonia, but this lengthy recall period precluded an examination of the seasonality of these illnesses.

The number of family members who are under 18 was categorized into 3 groups: (1) no children, (2) 1 child, and (3) 2 or more children. Age was categorized into 5 groups, of which the last group (56 to 65 years) was used as the reference group. A dichotomous variable was created for education—respondents with college or higher education (16 years or more) and respondents with less than 16 years of education. For smoking status, subjects were categorized into never smokers, former smokers, and current smokers. Current smokers were defined as persons who reported having smoked at least 100 cigarettes during their lifetime and who reported presently smoking every day or some days. Former smokers were defined as persons who had smoked 100 cigarettes or more in their lifetime, but at the time of interview reported that they were no longer smoking. Never smokers were defined as persons who never smoked or smoked fewer than 100 cigarettes in their lifetime. For race and ethnicity, subjects were categorized into non-Hispanic White, non-Hispanic Black, Hispanic, and other. The school year was defined as the months of September through December and February through June. The

school recess months (ie, January, July, and August) were chosen because these months correspond well to school break periods, such as winter and summer breaks after taking into consideration the 2-week time interval (lag) built into the head/chest cold survey question.

### Statistical Analysis

The weighted population size and incidence proportion for head/chest cold were estimated. All analyses were completed using SAS (v 9.2) taking into account sample weights and design effects due to the complex sample survey design.<sup>13</sup> Variance estimates were adjusted for the population survey units, strata, and sampling weights assigned by the National Center for Health Statistics.<sup>10,11</sup> We compared the incidence proportion of head/chest cold among teachers and other service workers employed at schools with that of all other currently employed workers, using odds ratios (ORs). The SAS SURVEYLOGISTIC procedure was used to estimate ORs and the 95% confidence intervals (CIs) for head/chest cold compared to all other workers adjusted for the effect of age, sex, race/ethnicity, smoking status, number of children under 18 in the household, and education. The incidence proportions of head/chest cold for these 3 groups were also examined by month of interview using the Wald chi-square test.

### RESULTS

Annual response rates to the 1998 to 2004 sample adult core questionnaire ranged from a low of 70% to a high of 79% over the 7 years, resulting in an average annual response rate of 74%. From 1998-2004, 228,092 adults aged 18 years and over completed the sample adult core questionnaire. Among all respondents ( $n = 129,873$ ) who were currently employed at the time of the survey, 5739 were teachers (which include librarians and counselors) in elementary, secondary schools and colleges representing an annual average of about 5.5 million individuals. The total sample included 1359 other service workers employed at schools, representing about 1.2 million persons. All other workers ( $n = 122,775$ ) represented an annual average population estimate of 119.1 million. Among teachers, there were more female (69%), non-Hispanic White (83%), college educated (76%), and nonsmokers (91%, including former smokers [17%] and never smokers [74%]) than among all other workers (Table 1). Other service workers employed at schools were more likely to be female, less likely to be college educated, and older than all other workers.

Table 2 shows the incidence proportion and the adjusted ORs for head/chest cold among US workers.

The incidence proportions across the age categories decreased significantly with age, which indicates that younger workers reported more head/chest cold compared to older workers. Non-Hispanic White workers reported the highest proportion of head/chest cold (13.9%) among the different racial/ethnic groups. Fifteen percent of teachers and 16% of other service workers at schools reported that they had head/chest cold that started in the past 2 weeks. The ORs of head/chest cold among teachers (OR = 1.28; 95% CI: 1.17-1.41) and among other service workers at schools (OR = 1.33; 95% CI: 1.12-1.59) were significantly higher than among all other workers. Current smokers had significantly higher OR of head/chest cold (OR = 1.29; 95% CI: 1.23-1.35) than former smokers and never smokers.

Male workers were less likely to report having had a head/chest cold than female workers. Having 1 or more children in the family was found to be associated with a higher incidence of head/chest cold among workers. Education was not associated with elevated odds of head/chest cold in the past 2 weeks.

The overall head/chest cold incidence proportions combined by month over the study period (January 1998 to December 2004) showed clear seasonal variation (Figure 1). The seasonal variation was evident across all 3 occupational groups. Peaks in incidence occurred from the winter to early spring (December, January, February, and March), corresponding to seasonal activity of many viral respiratory pathogens including influenza, rhinovirus, and respiratory syncytial virus (RSV). Winter incidence proportions were 3-fold higher than summer months (ie, July). As evident from Figure 1, the incidence proportions of head/chest cold for teachers and other service workers employed at schools were higher than for all other workers during the school year.

### DISCUSSION

Teachers and other workers employed at schools in the United States suffer disproportionately from head/chest cold. To our knowledge, this is the first study estimating the incidence proportion of head/chest cold among teachers and other workers employed in the educational services sector. Our results indicate that, on average, during any 2-week time period over 1 million teachers and other workers employed at schools (ie, 16% of all teachers and other workers employed at schools) are experiencing a head/chest cold. These figures are even higher during months of peak illness incidence (ie, November through March) compared to all other workers. During the low incidence month (ie, July), on the other hand, the incidence proportions of head/chest cold were found to be much lower among teachers and other school workers compared to all other workers. Our

Table 1. Weighted Estimates of Demographic and Other Factors Among 3 Groups of US Workers: NHIS 1998-2004

		Teachers*			Other Service Workers at School			All Other Workers		
		Weighted Estimate			Weighted Estimate			Weighted Estimate		
		n	N	%	n	N	%	n	N	%
Total		5739	5535.8	100.0	1359	1238.8	100.0	122,775	119,103.3	100.0
Sex	Male	1659	1734.6	31.3	421	419.7	33.9	62,138	65,339.7	54.9
	Female	4080	3801.2	68.7	938	819.1	66.1	60,637	53,763.5	45.1
Age (years)	18-25	490	504.6	9.1	114	122.7	9.9	17,102	19,259.1	16.2
	26-35	1490	1418.2	25.6	209	166.2	13.4	31,822	28,833.2	24.2
	36-45	1410	1330.6	24.0	399	371.3	30.0	34,648	33,332.1	28.0
	46-55	1673	1677.9	30.3	351	331.1	26.7	26,483	25,992.3	21.8
	56-65	676	604.6	10.9	286	247.4	20.0	12,720	11,686.6	9.8
Race and ethnicity	Non-Hispanic White	4426	4589.6	82.9	747	818.2	66.1	80,175	87,094.5	73.1
	Non-Hispanic Black	648	484.0	8.7	305	229.2	18.5	16,270	12,902.9	10.8
	Hispanic	480	286.4	5.2	261	146.0	11.8	21,751	13,917.8	11.7
	Other	185	175.8	3.2	46	45.3	3.7	4,579	5,188.1	4.4
Smoking	Current smoker	565	513.2	9.3	322	291.7	23.5	31,497	29,942.6	25.1
	Former smoker	983	946.1	17.1	250	222.2	17.9	22,768	22,906.8	19.2
	Never smoker	4191	4076.6	73.6	787	724.9	58.5	68,510	66,253.8	55.6
Number of children under 18 years in the household	None	3526	3174.4	57.3	737	679.0	54.8	69,629	64,146.8	53.8
	One	990	1065.8	19.3	234	224.6	18.1	22,346	23,458.1	19.7
	Two or more	1230	1299.5	23.4	390	336.1	27.1	31,081	31,679.4	26.6
Education	Less than 16 years	1331	1333.0	24.1	1312	1192.1	96.2	96,858	93,524.8	78.5
	16+ years	4408	4202.9	75.9	47	46.7	3.8	25,917	25,578.4	21.5
Head/chest cold	No	4859	4677.5	84.5	1157	1038.4	83.8	106,972	103,451.7	86.9
	Yes	880	858.4	15.5	202	200.4	16.2	15,803	15,651.6	13.1

n, number of study participants; N, estimated annual average number of US workers in thousands; NHIS, National Health Interview Survey.

\*Teachers include librarians and counselors.

study suggests that these elevated risks of head/chest cold may be attributed to school activities involving close contact with students and exposure to various contagions on school environmental surfaces.

### Strength and Limitations

The large sample size of this study allowed reliable estimation of the incidence proportion of head/chest cold for teachers and other workers in school settings. Limitations in this study included the use of self-reported data to determine the occurrence of head/chest cold. The validity and reliability of this NHIS questionnaire item, "Did you have any head cold or chest cold started in the past 2 weeks?" have not been assessed. Misunderstanding of this question on the part of the respondent could have led to information bias. However, misclassification due to such information bias is likely nondifferential across occupation groups. Acute respiratory infection can be caused by many different viral and bacterial pathogens.<sup>14</sup> Laboratory testing could be useful in evaluating the sensitivity and specificity of this question, although it is not uncommon to fail to

find a pathogen in those with acute respiratory tract infections.<sup>15</sup>

Noninfectious illness may also be responsible for some head and chest colds. A recent study showed that employees from 2 elementary schools in the United States with damp and moldy environments had excess work-related throat and lower respiratory symptoms, as well as eye, nasal, sinus, and wheezing symptoms compared to the general US adult population.<sup>8</sup> Such respiratory symptoms in school environments have been well documented.<sup>16,17</sup> One may argue that the definition of head/chest cold is nonspecific, and those with respiratory symptoms related to indoor allergens may have been misclassified as having a head/chest cold. Damp and moldy environments in some schools across the United States may have contributed to the seasonal pattern observed in our data. Detailed clinical and microbiological investigations focusing on specific communicable diseases would need to be conducted to exclude respiratory symptoms related to indoor allergens. As such, our definition for head/chest cold is unlikely to capture the entire range of infectious and noninfectious respiratory disease such as laryngitis, pharyngitis, pneumonia, otitis media, and bronchitis.

Table 2. Incidence Proportion and Adjusted ORs of Head/chest Cold Among US Workers: NHIS 1998-2004 (n = 129,873)

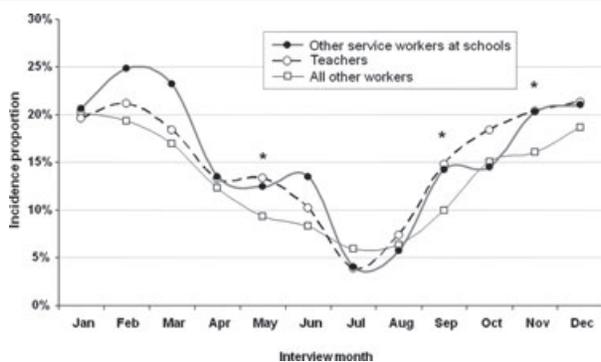
Variable	Category	Weighted Incidence Proportion (%)	SE (%)	OR*	95% CI
Sex	Male	12.6	0.2	<b>0.89</b>	0.85, 0.92
	Female	14.1	0.2	Ref.	
Age (years)	18-25 years	16.7	0.4	<b>1.67</b>	1.54, 1.81
	26-35 years	14.5	0.2	<b>1.37</b>	1.28, 1.49
	36-45 years	12.8	0.2	<b>1.15</b>	1.07, 1.24
	46-55 years	11.3	0.2	1.02	0.95, 1.11
	56-65 years	10.8	0.3	Ref.	
Race and ethnicity	Non-Hispanic White	13.9	0.2	Ref.	
	Non-Hispanic Black	12.8	0.4	<b>0.89</b>	0.83, 0.96
	Hispanic	11.1	0.3	<b>0.74</b>	0.69, 0.80
	Other	10.3	0.5	<b>0.73</b>	0.66, 0.80
Smoking	Current smoker	15.5	0.2	<b>1.29</b>	1.23, 1.35
	Former smoker	12.9	0.3	<b>1.13</b>	1.08, 1.20
	Never smoker	12.5	0.2	Ref.	
Number of children under 18 years in the household	None	12.6	0.2	Ref.	
	One	13.8	0.3	<b>1.09</b>	1.04, 1.14
	Two or more	14.4	0.2	<b>1.18</b>	1.13, 1.24
Education	Less than 16 years	13.4	0.2	1.03	0.99, 1.08
	16 years or more	12.9	0.3	Ref.	
Occupation	Teachers <sup>†</sup>	15.5	0.6	<b>1.28</b>	1.17, 1.41
	Other service workers at schools	16.2	1.2	<b>1.33</b>	1.12, 1.59
	All other workers	13.1	0.1	Ref.	

CI, confidence interval; NHIS, National Health Interview Survey; ORs, odds ratios.

\*Odds ratios were statistically adjusted for all other variables in the table. The ORs in bold represent a statistically significant difference compared to the reference group.

<sup>†</sup>Teachers include librarians and counselors.

Figure 1. Estimated Incidence Proportions of Head/Chest Cold by Interview Month for Teachers, Other Service Workers Employed at Schools, and All Other Workers in the United States (\*: Wald Chi-Square Test With 2 Degrees of Freedom, p < 0.01)



Finally, some secretaries, financial records processors, managers, and administrators employed at school may have close contact with many children in schools throughout the day. Because our analysis included these occupations in the reference group (all other workers), if those workers had a higher risk of head/chest cold than other workers in the reference group, an underestimation of the risk of head/chest

cold among teachers and other school workers is possible.

### Conclusion

Head/chest cold, a surrogate for upper respiratory infection, was more common among school workers during the school year and less common during July than all other workers in the United States. The societal disruption of viral respiratory disease in school settings can be substantial. The results of this study support the need to augment targeted education and training programs for school workers and students to reduce the impact of viral respiratory disease among school teachers and other workers during the school year.

### IMPLICATIONS FOR SCHOOL HEALTH

The major reservoir of most respiratory viruses is children attending school.<sup>18</sup> Since school buildings typically house large populations of students in relatively small and confined areas, the potential for spread of viral respiratory infectious disease is high. However, it is impractical to completely prevent respiratory viruses from being introduced into school buildings. The seasonal pattern observed in our analysis of head/chest cold corresponds well to upper

respiratory infections that are generally attributed to many different respiratory pathogens during the winter months.<sup>14,19-21</sup> Increasing the rate of timely vaccinations among teachers, other school workers, and students can reduce the risk of influenza.<sup>22</sup> Common colds in adults are principally caused by rhinoviruses (50%) and coronaviruses (4-15%).<sup>18</sup> Although respiratory viruses spread from person-to-person, the relative importance of different routes of transmission varies by virus (ie, direct, fomites, large droplets, and small-particle aerosols). Consistent hand washing and avoidance of finger-nose and finger-eye contact should be recommended to reduce the risk of infections spread by hand contact with contaminated skin and fomites (eg, infections caused by rhinovirus and RSV).<sup>23</sup> Poorly ventilated indoor air may be an issue in the school environment, thus improving ventilation may play a role in reducing respiratory morbidity at the population level.<sup>24,25</sup> In addition, since the risk of head/chest cold is highest among smokers, public health intervention efforts to reduce smoking among workers could be beneficial.

Training should be provided to school staff, students, and parents on the importance of staying home when ill, hand washing, and respiratory etiquette. School areas and items that are visibly soiled should be cleaned immediately. In addition, all school areas should be regularly cleaned; however, additional disinfection beyond routine cleaning is not considered necessary for infection control.<sup>26</sup> School service workers should be trained to use appropriate personal protection equipment (eg, chemical-resistant gloves) when using disinfectants.

### Human Subjects Approval Statement

This article utilizes national health survey data that are available at the National Center for Health Statistics Web site. The data are without personal identifiers. These data did not require protocol approval, nor was informed consent required or obtained.

### REFERENCES

- Bureau of Labor Statistics. *Occupational Employment Statistics*. In: US Department of Labor BLS, ed. Washington, DC: US Department of Labor, Bureau of Labor Statistics; 2008.
- Alexander DL. School employees: the forgotten municipal workers. *Occup Med*. 2001;16(1):65-78.
- Mattiske JA, Oates JM, Greenwood KM. Vocal problems among teachers: a review of prevalence, causes, prevention, and treatment. *J Voice*. 1998;12(4):489-499.
- Roy N, Merrill RM, Thibeault S, Parsa RA, Gray SD, Smith EM. Prevalence of voice disorders in teachers and the general population. *J Speech Lang Hear Res*. 2004;47(2):281-293.
- Bauer J, Unterbrink T, Hack A, et al. Working conditions, adverse events and mental health problems in a sample of 949 German teachers. *Int Arch Occup Environ Health*. 2007;80(5):442-449.
- Unterbrink T, Hack A, Pfeifer R, et al. Burnout and effort-reward-imbalance in a sample of 949 German teachers. *Int Arch Occup Environ Health*. 2007;80(5):433-441.
- Mazurek JM, Filios M, Willis R, et al. Work-related asthma in the educational services industry: California, Massachusetts, Michigan, and New Jersey, 1993-2000. *Am J Ind Med*. 2008;51(1):47-59.
- Sahakian NM, White SK, Park JH, Cox-Ganser JM, Kreiss K. Identification of mold and dampness-associated respiratory morbidity in 2 schools: comparison of questionnaire survey responses to national data. *J Sch Health*. 2008;78(1):32-37.
- Whelan EA, Lawson CC, Grajewski B, et al. Prevalence of respiratory symptoms among female flight attendants and teachers. *Occup Environ Med*. 2003;60(12):929-934.
- Fowler FJ, Jr. The redesign of the National Health Interview Survey. *Public Health Rep*. 1996;111(6):508-511.
- National Center for Health Statistics. National Health Interview Survey: research for the 1995-2004 redesign. *Vital Health Stat* 2. 1999;126(2):1-119.
- Bureau of Labor Statistics. *Standard Occupational Classification (SOC) User Guide*. Washington, DC: US Department of Labor, Bureau of Labor Statistics; 2001.
- SAS Institute Inc. *SAS/ETS User's Guide*. 2nd ed. Cary, NC: SAS Publishing; 2007.
- van Gageldonk-Lafeber AB, Heijnen ML, Bartelds AI, Peters MF, van der Plas SM, Wilbrink B. A case-control study of acute respiratory tract infection in general practice patients in The Netherlands. *Clin Infect Dis*. 2005;41(4):490-497.
- Mandell LA. Etiologies of acute respiratory tract infections. *Clin Infect Dis*. 2005;41(4):503-506.
- Patovirta RL, Reiman M, Husman T, Haverinen U, Toivola M, Nevalainen A. Mould specific IgG antibodies connected with sinusitis in teachers of mould damaged school: a two-year follow-up study. *Int J Occup Med Environ Health*. 2003;16(3):221-230.
- Haverinen U, Husman T, Toivola M, et al. An approach to management of critical indoor air problems in school buildings. *Environ Health Perspect*. 1999;107(suppl 3):509-514.
- Hayden FG, Ison MG. Respiratory viral infections. In: Dale DC, Federman DD, eds. *ACP Medicine*. Hamilton, ON: WebMC Inc.; 2006.
- Crighton EJ, Moineddin R, Mamdani M, Upshur RE. Influenza and pneumonia hospitalizations in Ontario: a time-series analysis. *Epidemiol Infect*. 2004;132(6):1167-1174.
- Moineddin R, Upshur RE, Crighton E, Mamdani M. Autoregression as a means of assessing the strength of seasonality in a time series. *Popul Health Metr*. 2003;1(1):10.
- Upshur RE, Moineddin R, Crighton EJ, Mamdani M. Interactions of viral pathogens on hospital admissions for pneumonia, croup and chronic obstructive pulmonary diseases: results of a multivariate time-series analysis. *Epidemiol Infect*. 2006;134(6):1174-1178.
- Centers for Disease Control and Prevention. *Key Facts About Seasonal Flu Vaccine*. Atlanta, GA: Centers for Disease Control and Prevention, US Department of Health and Human Services; 2008.
- Larson E. A causal link between handwashing and risk of infection? Examination of the evidence. *Infect Control Hosp Epidemiol*. 1988;9(1):28-36.
- Burge HA. Indoor air and infectious disease. *Occup Med*. 1989;4(4):713-721.
- Nielsen PV. Control of airborne infectious diseases in ventilated spaces. *J R Soc Interface*. 2009;6(suppl 6):S747-S755.
- Centers for Disease Control and Prevention. *CDC Guidance on Helping Child Care and Early Childhood Programs Respond to Influenza During the 2009-2010 Influenza Season*. Atlanta, GA: US Department of Health and Human Services; 2009.