Healthy and Safe School Environment, Part II, Physical School Environment: Results From the School Health Policies and Programs Study 2006

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ABSTRACT

BACKGROUND: As society continues to focus on the importance of academic achievement, the physical environment of schools should be addressed as 1 of the critical factors that influence academic outcomes. The School Health Policies and Programs Study (SHPPS) 2006 provides, for the first time, a comprehensive look at the extent to which schools have health-promoting physical school environment policies and programs.

METHODS: The Centers for Disease Control and Prevention conducts the SHPPS every 6 years. In 2006, computer-assisted telephone interviews or self-administered mail questionnaires were completed by state education agency personnel in all 50 states and the District of Columbia and among a nationally representative sample of school districts (n = 424). Computer-assisted personal interviews were conducted with personnel in a nationally representative sample of elementary, middle, and high schools (n = 992).

RESULTS: One third (35.4%) of districts and 51.4% of schools had an indoor air quality management program; 35.3% of districts had a school bus engine-idling reduction program; most districts and schools had a policy or plan for how to use, label, store, dispose of, and reduce the use of hazardous materials; 24.5% of states required districts or schools to follow an integrated pest management program; and 13.4% of districts had a policy to include green design when building new school buildings or renovating existing buildings.

CONCLUSIONS: SHPPS 2006 results can guide education and health agency actions in developing and implementing evidence-based tools, policies, programs, and interventions to ensure a safe and healthy physical school environment.

Keywords: environmental health; schools; school policy; surveys.

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A child typically spends about 1300 hours in a school building each year, and teachers and other staff are there even longer.[1] In 1998, the average school building was 42 years old, and more than 75% of America's schools were built before 1970.[2] Many school buildings are in poor condition and present environmental conditions that inhibit learning and pose unnecessary, increased health risks to students and staff.[3] As society continues to focus on the importance of academic achievement, the school physical environment should be addressed as a critical factor that influences academic outcomes.

The toll that environmental hazards take on children's health is not completely understood, nor has it been quantified. Nonetheless, environmental exposure to air pollution, lead in paint and drinking water, tobacco smoke, radon, asbestos, and many pesticides and other chemicals in and around school environments is known to be hazardous to children's health.[4-7] In addition, biological contaminants such as bacteria, viruses, and allergens that are known to contribute to childhood diseases are commonly found in school environments.[5-7]

The extent to which environmental hazards negatively affect children depends in part on the developmental stage of the exposed child. In other words, during each developmental stage, different kinds of exposure have different effects. Young children are possibly at greater risk of exposure to environmental hazards than adults in that, especially during play, they breathe air closer to the floor, where some metals, gases, and chemicals settle (eg, lead, radon, mercury, and pesticides).[8]

Because children have higher metabolic rates than adults do, they consume more oxygen relative to their size than adults do.[8,9] Children tend to spend more time outside than most adults and, while outside, often engage in physical activities that increase their breathing rates, thereby increasing their exposure to air particulates, ozone, and other forms of air pollution.[9] Damage to the lungs during development, through exposure to indoor or outdoor air pollution, may interfere with proper lung development and may lead to chronic lung disease later in life.[4] Because of their higher metabolic rate, children also consume, relative to their size, more calories than adults do in the form of fruits and vegetables that may have been treated with harmful pesticides.[4,8,9]

Furthermore, the brain is not fully developed until adolescence, and thus, children's brains are more vulnerable than adults' brains to such toxins as metals, solvents, insecticides, and certain gases.[8,10] Also, because of their potentially longer life span, children have more time than adults to develop environmentally triggered diseases.[11]

Poor indoor air quality (IAQ), diesel exhaust emitted from school buses, hazardous materials, pesticides, contaminated drinking water, and lead are environmental hazards that sometimes are found in schools and can adversely affect the health, attendance, and academic success of students, as well as the health of teachers and other staff.[12-22]

Indoor Air Quality

Studies conducted by the US Environmental Protection Agency (EPA) suggest that the levels of many pollutants can be 2 to 5 times higher indoors than outdoors.[23,24] Outdoor air pollutants, such as pollen, dust, fungal spores, industrial and vehicle emissions, and radon, can be drawn in from outdoors. Sources of indoor pollutants include emissions from office equipment (eg, volatile organic compounds or ozone), new furnishings and finishes (eg, flooring, paint, caulk, and adhesives), vocational art supplies, cleaning products, pesticides, insects, and cigarette smoke. Indoor air pollutants can originate within the building's heating, ventilation, and air conditioning (HVAC) equipment through microbiological growth in drip pans, ductwork, coils, and humidifiers; improper venting of combustion products; and dust or debris in ductwork.[23,24]

Environmental surveys that collect and analyze air or dust samples are increasingly being conducted in schools.[25-33] One of the largest studies of this type was conducted in elementary schools located in a large urban school district in southeast Texas. In many of the school classrooms, significant levels of allergens were detected, including dust mites in 20% of the classrooms, mold spores in 58%, and cockroach allergens in 10%. Other adverse environmental conditions also were detected, such as elevated carbon dioxide in 86% of the classrooms and elevated humidity in 65%.[25] Although it is unclear to what extent these results are generalizable to elementary schools nationwide, these results, along with results from other studies, suggest that allergens from various sources are commonly present in school indoor air.[25-33] Poor IAQ not only can trigger asthma episodes in susceptible children, who may then miss school, but also can cause drowsiness; fatigue; lethargy; headache; eye, nose, throat, and skin irritation; and inability to concentrate—all of which compromise learning.[6,18,26]

According to the National Institute of Medicine of the National Academies, sufficient evidence shows an association between damp indoor spaces and upper respiratory tract symptoms, wheezing, coughing, and asthma symptoms in sensitized asthmatic persons.[34] A recent meta-analysis of the associations between respiratory health effects and dampness and mold in homes found that building dampness and mold were associated with 30% to 50% increases in many respiratory and asthma-related health outcomes,[35] and

dampness and mold have been estimated to cost $3.5 billion annually in mortality, medical care, and lost days of work or school.[36]

Mold can grow on wood, paper, carpet, foods, and insulation. Because its growth requires both dampness and oxygen, controlling moisture is essential.[37] To prevent mold growth, schools should fix leaky plumbing and building envelopes (ie, roofs, walls, and floors), prevent moisture due to condensation by insulating cold surfaces, reduce humidity, keep HVAC drip pans clean, keep air flowing properly, clean and dry wet or damp spots within 24 hours, and prevent foundations from staying wet.

Diesel Exhaust From School Buses

Exposure of students to school bus diesel emissions is receiving increased attention because of emerging information regarding the associated health risks. As many as 24 to 25 million students spend, on average, 1.5 hours each weekday riding a school bus.[38,39] Most school buses run on diesel fuel,[38,40,41] and buses built before 1990-1991 (approximately one third of school buses) are allowed to release substantially higher levels of air pollutants than more recently built models.[38] Diesel exhaust is classified as a probable human carcinogen, and emissions from diesel engines contribute to asthma and other lung-related damage.[38,40,42] Diesel exhaust exposure may cause as many as 23 to 46 cancer cases per million students exposed.[40]

Recent studies suggest that students' exposure to pollution from diesel exhaust is far higher than that previously believed.[40,41] Airborne particulate concentration in buses is sometimes 5 to 15 times higher than background particulate levels.[41] School bus drivers experience even higher exposure than do students because they spend more time in a bus.[41] Factors that influence air quality on school buses include bus idling, queuing practices, window ventilation, driving up or down hills, and outdoor concentrations.[40,41] Buses traveling in intense traffic and on routes that accommodate many other diesel-powered vehicles (including other school buses) have higher fine-particulate concentrations.[41]

Hazardous Materials

Potentially hazardous materials are used throughout schools by students, teachers, and other staff in science classrooms and laboratories, art classrooms, vocational training shops (eg, auto body, auto repair, and printing), and facility maintenance and operation, including cleaning, painting, and pest control.[43] Mismanagement and improper storage of hazardous materials pose both immediate and long-term threats to school occupants. Accidental spills of hazardous materials present physical danger, result in lost school days, cost millions of dollars annually for cleanup, and are, in many instances, preventable.[44] Proper hazardous material use and management (eg, storage, labeling, and disposal) are critical for reducing dangerous exposures and costly accidents and for maintaining a healthy school environment.[43]

Pesticides

Schools are particularly vulnerable to pest problems because of the large size of school structures, the numbers of occupants, the provision of food on the premises, and the abundance of books, supplies, and equipment that provide potential habitats for various types of pests.[6] Students can be exposed to pesticides at school when pest control chemicals are applied, a practice that is particularly problematic when schools conduct ''routine'' spraying (ie, applying pesticides based on routine schedules rather than on evaluation of need).[6]

Analysis of data from 1998 to 2002, which were collected as part of 2 sentinel surveillance pesticide programs and the American Association of Poison Control Centers Toxic Exposure Surveillance System, indicated that pesticide exposure at schools has produced acute illness among students (incidence rate of 7.4 cases per million) and staff (incidence rate of 27.3 cases per million).[45] The extent to which pesticides are used in schools and, thus, the extent to which students and staff are exposed to pesticides are not currently known.[46]

By 1999, more than 900 chemicals were registered as pesticides, including insecticides, herbicides, fungicides, rodenticides, fumigants, and insect repellents.[7,47] The Federal Insecticide, Fungicide, and Rodenticide Act[48] regulates the use of pesticides in the United States by governing registration of pesticides and prohibiting use of any pesticide in a manner not in conformance with label restrictions and precautions. No language in the law specifically addresses the use of pesticides in schools.[46] However, states have passed laws regulating such use. A 2002 review of state pesticide laws affecting schools found that 7 states restricted pesticide applications in areas neighboring a school; 16 states required posting of signs for indoor school pesticide applications; 25 states required posting of signs for pesticide applications made on school grounds; 21 states required prior written notification to students, parents, or staff before pesticide is applied in schools; 10 states restricted when or what pesticide might be applied in schools; and 16 states recommended or required schools to use an integrated pest management program.[49]

Drinking Water

Although most schools in the United States obtain their water from a community water system, about

10,000 schools use their own well, spring, or small reservoir.[50,51] A school-operated water system is defined by the US EPA as any school with its own individual water supply serving at least 25 of the same people for at least 4 hours per day, at least 4 days per week for at least 26 weeks per year.[50] The Safe Drinking Water Act (SDWA)[52] classifies these systems as ''non-transient non-community'' water systems and through EPA regulations require specific minimum monitoring (and public notification of elevated levels) of substances such as coliform bacteria, nitrates, and volatile organic chemicals.[50,52,53] Approximately 90,000 public elementary and secondary schools are not regulated under the SDWA and may or may not be conducting voluntary drinking water quality testing.[51] Schools obtaining water from a community water system rely on the public water supplier to provide safe drinking water and are not required to monitor for substances. Contamination, however, can occur after the water enters school buildings.[51] As a result, schools are encouraged to regularly test and, when appropriate, flush drinking water outlets.[54,55]

Lead

Lead is a neurotoxic metal that particularly targets the nervous system.[54] The health effects of lead exposure vary according to the levels ingested and the exposed person's diet, age, and pregnancy status.[47] Effects can include reduced cognitive functioning, decreased growth, hyperactivity, impaired hearing, damage to the brain and kidneys, and death.[47,54,56] Because children's bones are still growing, their bodies require and, therefore, absorb more calcium than adults do.[8] If their bodies do not contain enough calcium and iron, however, they are more likely to absorb lead when it is present.[47,56]

The most common source of lead exposure among children is from lead paint found in older homes.[47] Many older schools (especially those built before the mid-1970s) were also painted with lead paint and thus may be a source of lead exposure.[1,6] Other common sources include drinking water that has been contaminated by certain plumbing materials, especially lead solder and air that has been polluted by smelters, battery plants, and industrial facilities that process lead.[6,47,54] EPA ''encourages states and local school districts to test for lead in school drinking water, inform the public of results, and remove lead contaminated coolers from service. ... EPA also suggests that such programs be designed within a framework that works to reduce children's risk of exposure to lead from all potential sources, including paint, dust, and soil.''[57(p3)]

Decisions about where a school is built, how the building is designed, and how the school is maintained, along with the implementation of school policies and programs relevant to the physical school environment, are linked to the health and learning potential of students. *Healthy People 2010*, which sets public health objectives for the nation to achieve by the year 2010, recognizes this link with Objective 8-20, which specifically focuses on the school setting: ''increase the proportion of the Nation's primary and secondary schools that have official school policies ensuring the safety of students and staff from environmental hazards, such as chemicals in special classrooms, poor indoor air quality, asbestos, and exposure to pesticides.''[58]

School Health Policies and Programs Study (SHPPS) 2006 provides, for the first time, a comprehensive look at the extent to which schools have health-promoting physical school environment policies and programs. At the state and district levels, this article describes policies and practices related to IAQ, school bus engine idling, hazardous materials, pest control, drinking water, green schools, and policy support and staff development. At the school level, this article describes policies and practices related to IAQ, hazardous materials, pest control, drinking water, green schools, and staff and training. While this article is primarily descriptive in nature, the Centers for Disease Control and Prevention intends to conduct more detailed analyses and encourages others to conduct their own analyses using the questionnaires and public-use data sets available at www.cdc.gov/shpps.

METHODS

Detailed information about SHPPS 2006 methods is provided in ''Methods: School Health Policies and Programs Study 2006'' in this issue of the *Journal of School Health*. The following section provides a brief overview of SHPPS 2006 methods specific to the physical school environment section of the healthy and safe school environment component of the study.

SHPPS 2006 assessed the physical school environment at the state, district, and school levels. State-level data were collected from education agencies in all 50 states and the District of Columbia. District-level data were collected from a nationally representative sample of public school districts. School-level data were collected from a nationally representative sample of public and private elementary schools, middle schools, and high schools.

Questionnaires

Questions assessing the physical school environment were included in the healthy and safe school environment questionnaires at the state, district, and

school levels. Because the entire district- and school-level questionnaires took longer than 20 to 30 minutes each to complete and covered such a wide range of topics that a single respondent might not have sufficient knowledge to complete it, the questionnaires were divided into modules (4 modules at the district level and 3 at the school level), 1 of which (module 2 on both questionnaires) contained almost all the questions on the physical school environment.

The state-level questionnaire and module 2 of the district-level questionnaire assessed policies related to building inspection and maintenance, phase I environmental site assessments, pest management, IAQ, and policy support and staff development related to the physical school environment. Module 2 of the district-level questionnaire also assessed policies and programs related to drinking water, school bus engine idling, low-emitting products, hazardous materials, and green building design. Module 2 of the school-level questionnaire assessed policies and practices related to building inspection and maintenance, IAQ, pest control, drinking water, low-emitting products, hazardous materials, and staffing and training related to the physical school environment. The state-, district-, and school-level questionnaires also assessed policies and practices related to the inspection or maintenance of physical facilities; these data are reported in ''Healthy and Safe School Environment Part I: Results From the School Health Policies and Programs Study 2006'' in this issue of the *Journal of School Health*.

Data Collection and Respondents

State- and district-level data were collected by computer-assisted telephone interviews or self-administered mail questionnaires. Designated respondents for each of 7 school health program components (ie, health education, physical education and activity, health services, mental health and social services, nutrition services, healthy and safe school environment, and faculty and staff health promotion) completed the interviews or questionnaires. At the state level, the state-level contact designated a single respondent for each questionnaire. At the district level, the district-level contact could designate a different respondent for each of the 4 modules. All designated respondents had primary responsibility for, or were the most knowledgeable about, the policies and programs addressed in the particular questionnaire or module.

After a state- or district-level contact identified respondents, each respondent was sent a letter of invitation and packet of study-related materials. Each packet contained a paper copy of the questionnaire(s) so that respondents could prepare for the interview and provided a toll-free number and access code that respondents could use to initiate the interview. Respondents were told that the questionnaire(s) could be used in preparation for their telephone interview or completed and returned if self-administration was preferred. One week after packets were mailed to respondents, trained interviewers from a call center placed calls to them to schedule and conduct telephone interviews. In April 2006, telephone interviewing ceased, and most of the remaining state- and district-level data collection occurred via a mail survey. All remaining respondents were mailed paper questionnaires and return envelopes; however, interviewers remained available for any respondents who chose to contact the call center.

At the end of the data collection period (October 2006), 80% of the healthy and safe school environment state-level questionnaires had been completed via telephone interview and 20% as paper questionnaires. For the completed district-level questionnaires, module 2 was completed via telephone interview 51% of the time.

School-level data were collected by computer-assisted personal interviews. During recruitment, the principal or another school-level contact designated a faculty or staff respondent for each questionnaire or module, who had primary responsibility for or the most knowledge about the particular component. The principal or school-level contact could designate a different respondent for each questionnaire or module. For the physical school environment module, the most common respondents were principals, assistant principals or other school administrators, and other school staff.

Response Rates

One hundred percent (n = 51) of the state education agencies completed the state-level healthy and safe school environment questionnaire. District eligibility for each module was determined prior to beginning the interview; 720 districts were eligible for the physical school environment module (module 2) and 424 (59%) of these districts completed it. School eligibility for each module was also determined prior to beginning the interview; 1415 schools were eligible for the physical school environment module (module 2) and 992 (70%) completed it.

Data Analysis

Data from state-level questionnaires are based on a census and are not weighted. District- and school-level data are based on representative samples and are weighted to produce national estimates.

Because of missing data, the denominators for each estimate vary slightly. Figures 13 and 14 in

Appendix 1 in this issue of the *Journal of School Health* show the estimated standard error associated with an observed estimate from the district- and school-level healthy and safe school environment questionnaires.

RESULTS

The Physical School Environment at the State and District Levels

Indoor Air Quality. About 1 in 5 (20.5%) states required districts or schools to have an IAQ management program defined as a set of specific activities for preventing and resolving IAQ problems. Among states that required a program, 50.0% required and 50% recommended that the program be based on EPA's *Indoor Air Quality Tools for Schools*.[59] About one third (35.4%) of districts had an IAQ management program. Among districts with a program, 84.3% of the programs were based on EPA's *Indoor Air Quality Tools for Schools*.

More than half (57.4%) of states required districts or schools and 75.4% of districts required schools to conduct periodic inspections of the HVAC system (Table 1). More than one third (37.3%) of districts required that schools meet the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) ventilation standards,[60] and 16.5% of districts required schools to keep relative indoor humidity below 60%.

Nationwide, 47.4% of districts had a policy on how schools should address mold problems, and 47% required schools to respond to moisture-related issues, such as floods, leaks, or condensation, within 48 hours or less. Less than half of states required districts or schools to conduct periodic inspections for mold; for condensation in and around the school facilities; of the building foundation, walls, and roof for cracks or leaks; or of the plumbing system (Table 1). More than half of districts had similar requirements for schools.

School Bus Engine-Idling Reduction Programs. One third (35.3%) of districts had implemented an engine-idling reduction program for school buses, 56.6% had not implemented such a program, and 8.1% of districts had no school buses. Among districts with an engine-idling reduction program, 88.7% provided bus drivers with training related to the reduction program during the 2 years preceding the study.

Hazardous Materials. Most districts had a policy on how to use, label, store, dispose of, and reduce the use of hazardous materials, defined as materials that may be harmful to people or the environment such as paint, chemicals used for science experiments, cleaning products, and medical waste (Table 2).

Pest Control. One fourth (24.5%) of states required and 30.6% recommended that districts or schools follow an integrated pest management program, 28.6% neither required nor recommended such a program, and respondents from 16.3% of states were unsure about the policy on integrated pest management programs. About half (48.9%) of states required districts or schools and 81.7% of districts required schools to conduct periodic inspections for pests (Table 1).

More than one fourth (27.7%) of districts required and 41.4% recommended that schools use spot treatments rather than widespread applications of pesticides. Nearly half (48.7%) of districts required and 16.9% recommended that schools inform staff, students, and parents prior to the application of pesticides. Among districts, 41.5% required and 16.9% recommended that schools clearly mark areas treated with pesticides.

Drinking Water. More than half (55.6%) of states required districts or schools and 56.0% of districts required schools to conduct periodic inspections

Table 1. **Percentage of All States and Districts That Required School Inspections and Percentage of All Schools That Conducted School Inspections, SHPPS 2006**

Inspection	% of All States That Required Inspections	% of All Districts That Required Inspections	% of All Schools That Conducted Inspections
Of the HVAC system	57.4	75.4	96.0
For mold	41.3	68.5	81.2
For condensation in and around the school facilities	32.7*	58.2	78.5
Of the building foundation, walls, and roof for cracks or leaks	44.9†	69.3	93.3
Of the plumbing system	45.7	67.7	86.3
For pests	48.9	81.7	94.2
That test drinking water outlets for lead	55.6	56.0	55.7
Of on-site, large-capacity drinking water tanks	NA	53.5‡	35.1§

HVAC, heating, ventilation, and air conditioning; NA, not asked at this level.

*Respondents from 13.7% of states were unsure of state requirements on this issue.

†Respondents from 9.8% of states were unsure of state requirements on this issue.

‡Among the 56.9% of districts that had on-site, large-capacity drinking water tanks.

§Among the 34.6% of schools that had on-site, large-capacity drinking water tanks.

Table 2. **Percentage of All Districts That Had a Policy on Hazardous Materials* and Percentage of All Schools That Had a Plan for Hazardous Materials, SHPPS 2006**

Topic	% of All Districts That Had a Policy	% of All Schools That Had a Plan
How to use hazardous materials	80.9	91.5
How to label hazardous materials	84.9	89.9
How to store hazardous materials	88.2	93.1
How to dispose of hazardous materials	87.0	92.6
How to reduce the use of hazardous materials	68.5	80.6

*Defined as materials that may be harmful to people or the environment (eg, paint, chemicals used for science experiments, cleaning products, and medical waste).

that test drinking water outlets for lead (Table 1). Among the 56.9% of districts with schools that had on-site, large-capacity drinking water tanks, 53.5% required that schools periodically inspect the tanks.

About 1 in 5 districts (21.1%) had schools with a school-operated water system from which the school obtained drinking water from its own well, spring, or small reservoir. Schools with school-operated water systems are required by law to test drinking water for certain contaminants.[61] Schools that do not have their own water system (ie, they use a community water system) may conduct voluntary water testing. Among the 78.9% of districts without school-operated water systems, one fourth required schools to periodically test drinking water for bacteria (26.4%), coliforms (24.4%), or other contaminants (24.4%).

Green School Policies. State and district respondents were queried about phase I environmental site assessments, which can include a physical survey of the property and surrounding properties to assess general land use and occupants of the area; an on-site visual inspection of the site to identify environmental concerns; an assessment of current and past uses of the property, particularly if any hazardous materials were stored or disposed of at the site; a review of owner records; and a review of local, state, and federal regulatory agency records maintained for the site. More than half (60.0%) of states required phase I environmental site assessments prior to the construction of a new school facility, 20% of states did not require such assessments, and respondents from 20.0% of states were unsure about the policy on phase I environmental site assessments. Among districts, 34.5% required phase I assessments, 30.4% did not require such assessments, and 35.1% had no new facilities planned.

One fourth (25.6%) of districts had a policy to purchase low-emitting products (ie, those designed to give off low levels of fumes or vapors) for use in and around the school and school grounds, including in art classes, industrial art classes, and science laboratories. Nationwide, only 13.4% of districts had a policy to include green design when building new schools or renovating existing buildings. Table 3 describes the percentages of all districts that used specific green building design practices.

Policy Support and Staff Development. States and districts can help foster the development and implementation of policies through the provision of model policies, staff development, and funding. Model policies were defined as an example of what an actual policy on a particular topic or issue might address. The content might be based on scientific evidence, best practices, or state laws or policy. Model policies are provided for districts or schools to consider when they are developing their own policies. They are recommendations, not mandates. During the 2 years preceding the study, at least one fifth of states provided districts or schools with model policies on drinking water quality (28.9%), green building design (20.8%), IAQ (48.9%), and integrated pest management (44.4%). A lower percentage of districts than states provided schools with model policies on drinking water quality (22.3%), green building design (12.7%), IAQ (25.8%), and integrated pest management (36.3%).

During the 2 years preceding the study, at least one third of states provided funding for staff development or offered staff development to districts or schools on how to implement policies and programs related to drinking water quality (43.2%), green

Table 3. **Percentage of All Districts That Had Green Building Design Practices,* SHPPS 2006**

Green Building Design Practice	% of All Districts
Use of energy-efficient lighting and electrical systems	12.6
Implementation of recycling programs	11.9
Preservation of green space or protection of the existing the landscape	11.4
Orientation of buildings to optimize energy conservation, use of daylight, and noise reduction	11.1
Use of natural light for visual comfort or energy conservation	10.9
Conservation of water (eg, using rainwater or plumbing fixtures that conserve water)	9.1
Use of alternative transportation, including public transportation, walking, or biking	7.6
Use of landscaping that includes only native planting materials	7.3
Use of renewable energy, such as solar or wind power	3.8

*Defined as a way of designing a building so that it minimizes impact on the environment.

building design (29.2%), IAQ (56.5%), and integrated pest management (45.7%). A lower percentage of districts than states provided funding for staff development or offered staff development to school faculty and staff on how to implement policies and programs related to drinking water quality (16.6%), green building design (8.3%), IAQ (20.3%), and integrated pest management (27.4%).

In addition, during the 2 years preceding the study, some districts provided funding for training or offered training specifically to custodial or maintenance staff on school environment issues (Table 4). Although more than 80% of districts provided funding for training or offered training on the use, labeling, storage, and disposal of hazardous materials, less than two thirds of districts provided funding for training or offered training on how to address mold problems, IAQ, and flushing drinking water outlets.

Most districts (95.8%) had someone to oversee custodial, maintenance, and environmental issues, such as hazardous materials and pest management, at schools in the district. Among those districts, 59.2% required a newly hired person in this position to have formal training (defined as college classes, workshops, seminars, conferences, or any other kind of in-service or preservice) on issues related to the physical environment of buildings and health hazards likely to be encountered in schools.

The Physical School Environment at the School Level

Indoor Air Quality. More than half (51.4%) of schools had an IAQ management program. Among schools with a program, 84.8% based their program on EPA's *Indoor Air Quality Tools for Schools*.[59]

Most (96.0%) schools conducted periodic inspections of the HVAC system (Table 1). During the 12 months preceding the study, 50.3% of schools almost always or always maintained ASHRAE ventilation standards,[60] 19.9% sometimes did, 6.9% rarely did, and 22.9% never did. During the 12 months preceding the study, 55.3% of schools almost always or always kept the relative humidity below 60%, 25.6% sometimes did, 7.8% rarely did, and 11.3% never did.

More than three fourths of schools conducted periodic inspections for mold; for condensation in and around the school facilities; of the building foundation, walls, and roof for cracks or leaks; and of the plumbing system (Table 1). Two thirds (67.0%) of schools had a plan for how to address mold problems. Most schools (72.0%) responded to moisture-related issues (eg, floods, leaks, or condensation) within 48 hours or less, 7.7% did not respond within 48 hours, and 20.3% had no moisture-related issues during the 12 months preceding the study.

Hazardous Materials. About three fourths (78.0%) of schools kept an inventory of hazardous materials used in the school. Most schools had a plan for how to use, label, store, dispose of, and reduce the use of hazardous materials (Table 2).

Pest Control. Most (94.2%) schools conducted periodic inspections for pests. Table 5 describes the frequency with which schools nationwide implemented integrated pest management strategies during the 12 months preceding the study. More than three fourths of schools almost always or always stored food in plastic, glass, or metal containers with tight lids so that it was inaccessible to pests; promptly cleaned food preparation equipment; and promptly cleaned surfaces contaminated by food.

Drinking Water. More than half (55.7%) of schools conducted periodic inspections that tested drinking water outlets for lead, and 60.1% of schools flushed the drinking water outlets during the 12 months preceding the study. Among the 34.6% of schools with on-site, large-capacity drinking water tanks, 35.1% conducted periodic inspections of the tanks.

Few (11.3%) schools operated their own water system (ie, the school obtained drinking water from its own well, spring, or small reservoir). These schools are required by law to test drinking water for certain contaminants.[61] Most (88.7%) schools did not operate their own water system (ie, they used a community water system) and, therefore, were not required by law to conduct drinking water quality testing. Nonetheless, more than half of schools with community water systems conducted voluntary drinking water quality testing during the 12 months preceding the study: 58.8% tested for bacteria, 55.2% tested for coliforms, and 55.9% tested for other contaminants. Among schools served by community water systems that conducted voluntary

Table 4. **Percentage of All Districts That Provided Funding for Training or Offered Training for Custodial or Maintenance Staff on Physical Environment Topics* and the Percentage of All Schools That Required Custodial or Maintenance Staff to Receive Training on Physical Environment Topics, SHPPS 2006**

Physical Environment Topic	% of All Districts That Provided Funding for or Offered Training	% of All Schools That Required Training
Use of hazardous materials†	85.1	80.2
Labeling of hazardous materials	82.8	79.5
Storage of hazardous materials	85.1	83.0
Disposal of hazardous materials	82.6	82.9
How to address mold problems	65.3	59.8
IAQ	56.4	46.1
Flushing drinking water outlets	38.8	38.0

IAQ, indoor air quality.

*During the 2 years preceding the study.

†Defined as materials that may be harmful to people or the environment (eg, paint, chemicals used for science experiments, cleaning products, and medical waste).

Table 5. **Percentage of Schools That Implemented Integrated Pest Management Strategies,* by Frequency, SHPPS 2006**

Strategy	% of Schools That Almost Always or Always Implemented the Strategy	% of Schools That Sometimes Implemented the Strategy	% of Schools That Rarely Implemented the Strategy	% of Schools That Never Implemented the Strategy
Surfaces contaminated by food cleaned promptly	97.7	0.9	0.2	1.3
Food preparation equipment cleaned promptly	97.5	1.4	0.0	1.1
Food stored in plastic, glass, or metal containers with tight lids so that it was inaccessible to pests	82.6	7.1	2.2	8.1
Waste stored in plastic, glass, or metal containers with tight lids so that it was inaccessible to pests	73.8	12.8	3.7	9.6
Desks cleaned to remove any food remains	70.2	22.5	4.1	3.3
Infested or diseased plants removed†	66.5	17.4	6.0	10.1
Staff and students informed prior to the application of pesticide‡	65.4	11.8	5.9	16.8
Vegetation, shrubs, and wood mulch kept at least 1 foot away from buildings to control pests§	63.0	13.2	6.7	17.1
Eating allowed only in designated areas to control pests	59.5	15.7	6.6	18.2
Spot treatments and baiting used rather than widespread applications of pesticides‖	57.9	26.4	6.9	8.8
Trash containers cleaned with a disinfectant	57.6	31.1	8.9	2.4
Indoor and outdoor areas that had been treated with pesticides clearly marked¶	56.2	7.6	8.3	27.9
Openings in walls, floors, doors, and windows sealed with caulk or weather stripping#	49.8	25.2	12.9	12.1
Cracks in pavement and sidewalks repaired**	42.8	31.0	17.1	9.0
Lockers cleaned to remove any food remains††,‡‡	39.8	39.5	18.4	2.3

*During the 12 months preceding the study.
†Among the 65.6% of schools with any infested or diseased plants.
‡Among the 77.5% of schools for which the question was applicable to their pest management strategies.
§Among the 91.4% of schools with vegetation, shrubs, or wood mulch outside the school.
‖Among the 85.7% of schools for which the question was applicable to their pest management strategies.
¶Among the 76.3% of schools for which the question was applicable to their pest management strategies.
#Among the 84.0% of schools that had openings in walls, floors, doors, or windows.
**Among the 81.7% of schools with cracks in pavement or sidewalks.
††Only asked among middle schools and high schools.
‡‡Among the 88.2% of schools with lockers.

testing, 49.8% provided drinking water test results to school faculty and staff, 27.8% provided results to students' families, and 23.6% provided results to students.

Green School Policies. More than half (56.5%) of schools had a policy to purchase low-emitting products for use in and around the school and school grounds, including in art classes, industrial art classes, and science laboratories.

Staff and Training. Most (93.9%) schools had someone at the school to oversee custodial, maintenance, and environmental issues, such as hazardous materials and pest management. Among those schools, 64.4% required a newly hired person in the oversight position to have formal training on issues related to the physical environment of buildings and health hazards likely to be encountered in schools. At least 80% of all schools required current custodial or maintenance staff to receive training on the use, labeling, storage, and disposal of hazardous materials (Table 4). Fewer schools required staff to receive training on how to address mold problems, IAQ, and flushing drinking water outlets.

DISCUSSION

According to Frumkin and colleagues, ''a safe and healthy school environment does more than benefit student health; it also improves academic performance and morale. It does more than protect students; it also safeguards teachers and staff ... [A] high performance school ... does more than benefit the people in the school; it also contributes to the environment and helps control costs.''[62(pp 7-8)] Limited resources are a reality for schools everywhere, but policies and programs related to the physical school environment may be justified, supported, and funded more readily when they are of benefit to *all* students and school staff rather than to a smaller subset of building occupants.[62]

Data from SHPPS 2006 suggest that although work still needs to be done, many states, districts, and schools are addressing issues related to the school physical environment that affect the health and safety of their students. For example, most districts and schools have policies on how to use, label, store, and dispose of hazardous materials, and more than three fourths of schools keep an inventory of hazardous materials. These policies and practices will help schools tackle chemical mismanagement, thereby reducing the immediate- and long-term health threats that accidental chemical spills pose to students, teachers, and other school staff. EPA's School Chemical Cleanout Campaign provides best practices for proper chemical management and safety.[63] Likewise, the Agency for Toxic Substances and Disease Registry's Hazardous Substances Emergency Events Surveillance (HSEES) Program promotes the removal of mercury-containing equipment from schools and provides resources for proper cleanup of mercury spills, thereby reducing the risk of exposure and the on-site costs associated with the cleanup. Mercury is the most commonly released hazardous substance in school events reported to HSEES.[44]

To assist schools in addressing IAQ problems, EPA developed *Indoor Air Quality (IAQ) Tools for Schools.*[59] The program is designed to show schools how to implement a practical plan of action to improve indoor air problems at little or no cost by using straightforward activities and in-house staff. The program provides best practices, industry guidelines, sample policies, and a sample IAQ management plan. IAQ programs actively supported by school administration may lead to improved workplace satisfaction, fewer asthma attacks, fewer visits to the school nurse, and lower absenteeism.[64] Only about one fifth of states required districts or schools to have an IAQ management program, and only one third of districts and half of schools had an IAQ management program. SHPPS 2006 results may reflect an improvement in the number of schools with IAQ management programs. During the 2002 school year, the EPA conducted the IAQ Practices in Schools Survey among a representative sample of US public and private schools and found that 42% of schools had some level of an IAQ management program.[64] However, an ''IAQ Practice Index'' score indicated that only about half of the 42% of schools that reported using an IAQ management plan used one that was consistent with EPA's definition of an ''effective'' IAQ management plan.

SHPPS 2006 data suggest that while actions are needed to promote effective IAQ management programs, many schools already conduct activities consistent with those used to improve IAQ. For example, nearly all schools conducted periodic inspection of the HVAC system, and about half maintained the ASHRAE ventilation standards[60] and kept the relative humidity below 60% during the 12 months preceding the study. Furthermore, even though only two thirds of schools had a plan for how to address mold problems, most schools conducted periodic inspections for mold and for condensation in and around the school facilities and inspections of the building's foundation, walls, and roof for cracks or leaks. In contrast, despite growing evidence of the risks associated with diesel emissions, including those from school buses, only one third of districts had implemented an engine-idling reduction program for school buses.

A comprehensive IAQ management program prohibits tobacco use among students, staff, and visitors anywhere under the control of school authorities (eg, on school property, in school vehicles, and at school-sponsored events).[65,66] Such a policy protects students, staff, and visitors from the harmful effects of secondhand smoke whenever they are involved in school-related activities. As described in ''Healthy and Safe School Environment Part I: Results From the School Health Policies and Programs Study 2006'' in this issue of the *Journal of School Health*, only 38.0% of states, 55.4% of districts, and 63.6% of schools had a policy that prohibited cigarette smoking and smokeless tobacco use among all students, all faculty and staff, and all school visitors in all locations (ie, in school buildings, outside on school grounds, on school buses or other vehicles used to transport students, and at off-campus, school-sponsored events), and prohibited cigar or pipe smoking by all students, all faculty and staff, and all school visitors.

Integrated pest management is an approach to pest control that seeks to reduce the use of toxic pesticides as much as possible by relying on nontoxic methods of pest control such as physical exclusion and by limiting pesticide use, when essential, to the least toxic substances.[67] Half of states required or recommended that districts or schools follow an integrated pest management program. Many schools, whether or not they had an integrated pest management program, were implementing elements of such a plan.

Even though drinking water leaving a community water system typically meets all drinking water standards, contaminants such as lead can enter the water as it comes into contact with plumbing materials containing lead. Other metals also can leach into drinking water if they are present in the plumbing system. Therefore, schools are encouraged to regularly test and, when appropriate, flush drinking water outlets.[54,55] SHPPS 2006 found that slightly more than half of states and districts required schools to conduct periodic inspections that test drinking water outlets for lead and more than half of schools did so during the 12 months preceding the study. Similarly, more than half of schools that used community

water systems also conducted periodic tests for bacteria, coliforms, or other contaminants.

A review of professional journals, trade publications, and the popular press suggests a growing public interest in more healthful and ''green'' physical school environments. In fact, in 2002, the US Senate Environment and Public Works Committee conducted a hearing ''to assess green school initiatives: environmental standards for schools, school siting in relation to toxic waste sites, and 'green' building codes.''[68] Ramona Trovato, with the EPA, in her testimony before the Committee hearing stated, ''To date, school facility conditions have not been widely perceived as playing a critical role in the education process, largely due to the fact that research into the complex relationship between aspects of the physical environment, including environmental factors, and the well-being, health, productivity, and academic performance of students is only now emerging.''[69]

SHPPS 2006 addressed some issues related to green building design. High-performance design, sustainable building, energy-efficient design, green building, and green design are terms often used interchangeably. They describe a building concept that is (1) healthy and productive, (2) cost-effective to operate and maintain, and (3) sustainable (ie, the school integrates energy conservation and renewable energy strategies, high-performance mechanical and lighting systems, environmentally responsive site planning, environmentally preferable materials and products, and water-efficient design).[12,70-72] More than half of states and one third of districts required phase I environmental site assessments before constructing a new school facility, although one third of districts had no new facilities planned. A few (13.4%) districts had a policy to include green design concepts when building new schools or renovating existing buildings. One fourth of districts and more than half of schools had policies to purchase low-emitting products for use in and around the school and school grounds. Thus, while the concept of green schools and high-performance design is reaching some districts and schools, SHPPS 2006 data suggest that many more could benefit from additional information on the topic.

A healthy and safe school environment is an integral component of a school health program. SHPPS 2006 is the most comprehensive study to assess state-, district-, and school-level policies and programs related to the school physical environment. These results can guide education and health agency actions to develop and implement evidence-based tools, policies, programs, and interventions to ensure safe and healthy school environments. It is essential that schools address key environmental and safety issues for students to learn and develop to their full potential.

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