Housing Characteristics and Children's Respiratory Health in the Russian Federation

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Objectives. We studied housing characteristics, parental factors, and respiratory health conditions in Russian children.

Methods. We studied a population of 5951 children from 9 Russian cities, whose parents answered a questionnaire on their children's respiratory health, home environment, and housing characteristics. The health outcomes were asthma conditions, current wheeze, dry cough, bronchitis, and respiratory allergy.

Results. Respiratory allergy and dry cough increased in association with the home being adjacent to traffic. Consistent positive associations were observed between some health conditions and maternal smoking during pregnancy, many health conditions and lifetime exposure to environmental tobacco smoke (ETS), and nearly all health conditions and water damage and molds in the home.

Conclusions. Vicinity to traffic, dampness, mold, and ETS are important determinants of children's respiratory health in Russia. (*Am J Public Health.* 2004;94:657–662)

Numerous studies have associated indoor housing factors with increased prevalence of respiratory symptoms in children as well as adults.[1–4] Yet there are few studies from the Russian Federation or the former Soviet Union, where a large percentage of the population live in concrete apartment buildings, in which water and heat are supplied by district heating systems and gas is used for cooking. Furthermore, most Russian families benefit from a state health care system that provides pre- and postnatal care.[5] It therefore behooves us to examine housing factors such as smoking, moisture, indoor combustion sources (e.g., gas cooking, tobacco use), and ventilation on the health of school-aged children living in contemporary Russian housing.

METHODS

Study Population

The study population comprised 5951 8- to 12-year-old children in 9 Russian cities. Eight cities of the Sverdlovsk Oblast region and the city of Cherepovets in the Vologda Oblast participated in the study. Cities were selected to participate in a cross-sectional study of air pollution and children's health. In 4 cities, 2 areas were selected—1 to represent a more polluted area and 1 a less polluted area; in 5 cities, only 1 area was included.

Within each area, 1 or 2 elementary schools were selected for participation. The principals of the selected schools were informed about the study and agreed to participate. Teachers were given verbal and written instructions, questionnaires, envelopes, and forms to record questionnaire distribution and collection. Parents were invited to a parents' night where teachers explained the study and the conditions of consent. Teachers were instructed not to urge parents to fill out the questionnaire, as compliance was strictly voluntary. Parents who wished to participate completed the questionnaire either in the classroom or at home, and returned it (via the child) to the teacher in a sealed envelope. There was a 98% response rate.

The questionnaires, which were identified by identification number only, were reviewed by the field coordinators for quality assurance and for encoding written replies. The questionnaires were then sent to the Harvard School of Public Health for optical scanning using internal consistency checks to identify questionnaires requiring additional verification.

The questionnaire had been modified from previous European and North American questionnaires, which originated from respiratory health questionnaires of the British Medical Research Council and the American Thoracic Society.[6] The questionnaire was composed of the following: the child's personal characteristics; the child's respiratory health, presence of atopic diseases, and number of infections during the past year; parents' education and job category (as an indicator of socioeconomic status); parents' smoking habits as well as respiratory and allergic diseases; and details of the home environment and building characteristics. Details of health, housing characteristics, and socioeconomic factors were adjusted for the current Russian conditions.

Health Outcomes

Twenty health outcomes were derived from the questionnaire (Table 1). We focused on the children's current symptoms and conditions of allergy and eye irritation. Some of the health outcomes were composite variables derived from multiple questions. Believing that asthma may be underdiagnosed or not clearly remembered by the parent, we defined a composite variable called "asthma-like symptoms" that included wheezing and shortness of breath. Other outcomes examined the consistency of associations. When parents reported hearing their child wheeze for 3 or more consecutive days or using medication for wheezing in the past year, the child was classified as having severe wheezing within the last 12 months. A child was classified as having current wheeze if within the past 12 months their wheezing caused shortness of breath, woke them at night, or occurred with exercise in addition to any of the conditions described above for severe wheezing.

Exposure Assessment

Exposure assessment was based on questionnaire information on housing character-

TABLE 1—Prevalence of Respiratory Symptoms and Other Conditions

Term	Description	Frequency, %
Ever asthma	Ever told by doctor that child has asthma	1.9
Current asthma	Doctor-diagnosed asthma with parental reporting of shortness of breath or wheeze, or use of asthma medication within past 12 months	1.5
Severe asthma	Hospitalization for asthma/regular medication for asthma within past 12 months	0.8
Ever wheeze	Wheezing heard from distance without a cold	3.1
Current wheeze	Wheezing heard from distance with or without a cold, shortness of breath with wheezing, awakening at night by wheezing, wheezing with exercise, or use of medication or hospitalization within past 12 months for wheezing	13.4
Current severe wheeze	Wheezing heard from a distance for ≥3 consecutive days, hospitalization or medication use for asthma within past 12 months	10.1
Current asthma-like symptoms	Asthma symptoms or asthma medication use, awakening by asthma, wheezing upon exercise, or hospital care for wheezing within past 12 months	10.3
Severe asthma-like symptoms	Current asthma-like symptoms with routine medication use within past 12 months	2.2
Ever cough	Usual cough day or night	25.7
Persistent cough	Cough ≥3 consecutive months within past 12 months	5.5
Ever phlegm	Wet cough or phlegm produced without a cold	7.0
Persistent phlegm	Wet cough or phlegm ≥3 consecutive months within past 12 months	1.5
Dry cough	Ever cough without phlegm	17.8
Persistent dry cough	Persistent cough without phlegm for ≥3 consecutive months within past 12 months	3.6
Upper respiratory infection	Acute upper respiratory infection within past 12 months	76.9
Severe upper respiratory infection	Two or more acute upper respiratory infections within past 12 months	24.2
Current bronchitis	Doctor-diagnosed bronchitis within past 12 months	8.3
Any allergy	Doctor-diagnosed allergy, reported hay fever, or pollenosis	33.2
Respiratory allergy	Hay fever or doctor-diagnosed allergies to airborne substances (e.g., dust, animals, molds, pollens, air pollution, environmental tobacco smoke)	8.0
Eye irritation	Eye irritation sometimes	20.8

istics. Questions inquired about the age of the building, the type of construction, and its proximity to traffic. Apartment-related factors included heating and cooking methods, presence of ventilation, and geographic orientation and size. Respondents reported on smoking within the apartment, water damage, presence of mold, and the number of occupants. Ancillary information on cleaning frequency, parental occupational exposures to chemicals, and parental income, as well as variables related to nonrespiratory health outcomes, was collected. Density indicators were derived from information on apartment size and number of occupants.

Covariates Used for Adjustment

Univariate analyses explored several potential confounders. Gender, age, preterm birth, parental atopy, parents' education in a specialty field beyond high school, and smoking variables were used as core adjusting covariates in logistic regression unless the variable of interest was smoking itself. Additional models that included income, presence of furry pets, and sharing a bedroom as adjusting variables were explored but not presented because our basic findings were not altered.

Statistical Methods

The odds ratio (OR) was used as a measure of effect between the outcome and exposure. We calculated crude ORs and 95% confidence intervals (CIs) based on the Mantel-Haenszel test statistics. We estimated the adjusted ORs in logistic regression analysis. The ORs were adjusted for the covariates described above. The results from the adjusted logistic regression analyses are reported in this paper.

RESULTS

The response rate across schools varied from 96% to 99% and averaged 98% overall. Half of the buildings/homes were constructed within the past 20 years, and 70% of the buildings were concrete high-rises. Eighty-five percent of the respondents lived in single-family apartments, of which 50% were smaller than 40 m^2. Seventy-four percent of the children shared a bedroom. District heating plants provided heat and hot water requirements for 95% of the apartments/homes. Only 5% had a combustion heat source within their home. Gas was the cooking fuel for 80% of the homes, and 73% had no mechanical means of venting exhaust. Only 5% of the housing units had gas water heaters. Sixty percent of the respondents reported that their apartments did not face roadways.

Almost 60% of the families reported having a furry pet at home. Toxic substance exposures of parents at the workplace were reported for 21.7% of the children, and 1.9% had parents with the potential for bringing toxic material home as they did not change their clothes at their workplace. Cleaning of homes was infrequent; nearly 80% said they cleaned less than once per month, with only 3.2% cleaning weekly. Water damage was reported for 22.4% of the living units, and 10.4% reported water damage within the past 12 months. The appearance or detection of molds within the past 12 months occurred in 10% of the homes. A small percentage of mothers (4.2%) admitted smoking during pregnancy. Environmental tobacco smoke (ETS) exposure at home at various stages of the child's life—less than 2 years of age, 2 to 6 years of age, and currently—occurred for 45%, 51%, and 46% of the children, respectively.

Additional variables were derived from smoking responses, occupancy, and size of

TABLE 2—Adjusted ORs for Respiratory Symptoms and Housing Conditions

	Building Age (> 40 y vs ≤ 10 y) OR (95% CI)	Building Material (Concrete vs Wood) OR (95% CI)	Density of Children (4th vs 1st Quartile) OR (95% CI)	Area of Residence (> 60 m^2 vs < 25 m^2) OR (95% CI)	Traffic Near Apartment (Medium vs None) OR (95% CI)	Cooking Fuel (Gas vs No Gas) OR (95% CI)
Current doctor-diagnosed asthma	1.59 (0.75, 3.33)	1.28 (0.46, 3.62)	1.40 (0.50, 3.86)	0.60 (0.24, 1.48)	0.89 (0.41, 1.91)	2.28 (1.04, 5.01)
Current wheeze	1.37 (1.04, 1.80)	1.00 (0.72, 1.38)	1.34 (0.92, 1.96)	0.99 (0.71, 1.37)	1.22 (0.94, 1.57)	1.06 (0.86, 1.31)
Current asthma-like symptoms	1.41 (1.04, 1.92)	1.08 (0.74, 1.56)	1.31 (0.82, 2.09)	1.16 (0.86, 1.69)	1.28 (0.96, 1.69)	1.19 (0.94, 1.52)
Persistent cough	1.78 (1.12, 2.60)	1.24 (0.73, 2.10)	2.55 (1.44, 4.51)	0.48 (0.30, 0.79)	2.27 (1.64, 3.14)	1.19 (0.85, 1.65)
Persistent phlegm	1.83 (0.83, 4.06)	0.69 (0.30, 1.57)	3.49 (1.29, 9.47)	0.27 (0.11, 0.72)	2.21 (1.20, 4.06)	0.85 (0.48, 1.53)
Current dry cough	1.16 (0.91, 1.48)	1.13 (0.83, 1.54)	1.84 (1.31, 2.57	0.54 (0.40, 0.72)	1.30 (1.04, 1.63)	1.04 (0.86, 1.25)
Persistent dry cough	1.65 (0.98, 2.78)	1.40 (0.70, 2.79)	2.08 (1.03, 4.17)	0.66 (0.36, 1.19)	2.46 (1.66, 3.62)	1.31 (0.86, 1.99)
Current upper respiratory infection	1.02 (0.82, 1.27)	0.94 (0.72, 1.23)	1.28 (0.95, 1.72)	0.90 (0.68, 1.17)	1.02 (0.83, 1.25)	0.91 (0.77, 1.08)
Current bronchitis	1.24 (0.90, 1.73)	0.98 (0.66, 1.45)	1.31 (0.82, 2.08)	0.93 (0.60, 1.44)	1.19 (0.87, 1.61)	1.13 (0.87, 1.47)
Any allergy	0.89 (0.74, 1.08)	1.34 (1.05, 1.72)	0.87 (0.66, 1.14)	1.04 (0.81, 1.32)	1.09 (0.91, 1.32)	1.06 (0.92, 1.23)
Respiratory allergy	0.97 (0.69, 1.36)	2.61 (1.45, 4.72)	1.23 (0.78, 1.93)	0.99 (0.65, 1.52)	1.41 (1.04, 1.90)	1.08 (0.83, 1.40)
Eye irritation	0.93 (0.74, 1.16)	1.20 (0.91, 1.60)	0.91 (0.67, 1.25)	0.76 (0.58, 0.99)	1.31 (1.06, 1.61)	0.98 (0.83, 1.16)

Note. OR = odds ratio; CI = confidence interval.

the living unit. Exposure to ETS sometime during the child's life occurred for 63% of the children. We hypothesized that internal sources of air pollution, including airborne pathogens, might result in higher concentrations that vary inversely to volume of the residence or directly with crowding factors, based on occupant density. The area of the residence was separated by quartiles as a proxy for volume. The number of children and total number of occupants were divided by reported floor area and divided into quartiles to create 2 indicators of crowding.

The ORs for housing conditions are shown in Table 2. The results suggest that living in apartments more than 40 years old might increase the risk of wheeze. Similar results were seen for ever phlegm, ever cough, and persistent cough. The ORs for buildings aged 10 to 20 and 20 to 40 years, compared with buildings less than 10 years old, showed no evidence for a trend by age of residence. Only allergy (any or respiratory) showed an association with concrete versus wooden houses or apartments. Reporting of cough and phlegm conditions was significantly higher for more crowded housing and significantly less for larger residences. Findings are consistent when density is calculated by total number of occupants or just total children per area of the home. There were no observable trends over the 4 quartiles, and higher prevalences were observed for the quartile of most densely crowded residences. A protective effect of a larger apartment/home was seen only for cough and phlegm symptoms and was more pronounced for the larger-area apartments (>60 m^2) versus the smaller units (<25 m^2).

Those reporting a self-defined medium exposure to traffic outside their residence had higher prevalence of both respiratory allergy and eye irritation (nonsignificant). However, the cough and phlegm symptoms showed a significant positive association with traffic, with an apparent trend from light to medium traffic.

Health outcomes were examined for internal heating, gas cooking, gas water heaters, and whether or not exhaust ventilation made any difference in response rates. Only 12 families had unvented gas water heaters, so these results were not reported. Although gas cooking and a combustion heating device were positively associated with increased symptoms, none reached significance. Having some form of exhaust ventilation reduced the risk for respiratory allergy and dry cough, but only the latter was significant (OR=0.77 [95% CI=0.64, 0.93]). For completeness, we examined other symptoms for the influence of combustion and exhaust ventilation and found that doctor-diagnosed asthma and current asthma had a significant positive association with gas cooking. The adjusted ORs were 2.28 (95% CI=1.04, 5.01) for current asthma and 2.12 (95% CI=1.09, 4.11) for doctor-diagnosed asthma. Although the severity of asthma and the various wheeze-related outcomes all had positive adjusted ORs, none were significant at the 95% CI.

In examining all smoking variables, we found for the most part that all adjusted ORs across all outcomes showed positive associations with smoking exposure variables. Current dry cough showed significant associations, as did ever cough, persistent cough, and persistent dry cough. Experiencing a respiratory tract infection within the past year was associated with ETS exposure sometime in the child's life but not necessarily with current smoking in the home. Doctor-diagnosed bronchitis was strongly associated with lifetime ETS exposure (OR=1.26 [95% CI=1.10, 1.44]), but not for bronchitis within the past year. Table 3 presents the adjusted ORs and 95% CIs for 12 of the health variables and 2 of the smoking variables (smoking during pregnancy and the composite variable of any ETS exposure during the child's life). Other smoking variables similar to smoking during pregnancy showed few statistically positive associations, unlike the composite variable of ever being exposed to ETS.

The housing conditions with the strongest and most consistent associations with health outcomes were reported moisture (water damage) and the presence of molds on surfaces. Table 4 presents the adjusted ORs for reported water and mold conditions within

TABLE 3—Adjusted ORs for Respiratory Symptoms and Tobacco Smoke Exposure During Child's Lifetime

	Tobacco Smoke Exposure	
	In Utero OR (95% CI)	Lifetime Exposure OR (95% CI)
Current doctor-diagnosed asthma	2.07 (0.85, 5.03)	1.22 (0.75, 2.03)
Current wheeze	1.41 (0.97, 2.06)	1.12 (0.94, 1.34)
Current asthma-like symptoms	1.44 (0.95, 2.16)	1.15 (0.95, 1.40)
Persistent cough	0.95 (0.51, 1.75)	1.34 (1.02, 1.75)
Persistent phlegm	0.54 (0.13, 2.29)	1.31 (0.78, 2.19)
Current dry cough	1.24 (0.86, 1.78)	1.35 (1.15, 1.58)
Persistent dry cough	1.17 (0.58, 2.38)	1.53 (1.08, 2.16)
Current upper respiratory infection	0.72 (0.52, 1.00)	1.21 (1.06, 1.38)
Current bronchitis	1.57 (1.00, 2.45)	1.05 (0.85, 1.29)
Any allergy	0.90 (0.66, 1.23)	1.18 (1.04, 1.33)
Respiratory allergy	1.10 (0.66, 1.83)	1.04 (0.84, 1.28)
Eye irritation	1.09 (0.77, 1.54)	1.22 (1.06, 1.41)

Note. OR = odds ratio; CI = confidence interval.

TABLE 4—Adjusted ORs for Respiratory Symptoms and Water Damage and Presence of Molds Within the Past 12 Months

	Water Damage OR (95% CI)	Presence of Molds OR (95% CI)
Current doctor-diagnosed asthma	1.37 (0.69, 2.70)	2.82 (1.63, 4.88)
Current wheeze	1.53 (1.19, 1.95)	1.52 (1.19, 1.94)
Current asthma-like symptoms	1.77 (1.36, 2.30)	1.98 (1.53, 2.55)
Persistent cough	1.51 (1.06, 2.16)	1.88 (1.35, 2.63)
Persistent phlegm	2.15 (1.18, 3.93)	2.46 (1.38, 4.38)
Current dry cough	1.35 (1.08, 1.69)	1.40 (1.12, 1.76)
Persistent dry cough	1.33 (0.85, 2.09)	1.53 (0.99, 2.35)
Current upper respiratory infection	1.23 (0.98, 1.55)	1.74 (1.35, 2.25)
Current bronchitis	1.52 (1.14, 2.03)	1.70 (1.28, 2.27)
Any allergy	1.26 (1.05, 1.52)	1.51 (1.25, 1.82)
Respiratory allergy	1.30 (0.95, 1.77)	1.50 (1.11, 2.02)
Eye irritation	1.21 (0.98, 1.50)	1.42 (1.15, 1.76)

Note. OR = odds ratio; CI = confidence interval.

the last 12 months. Prevalence of symptoms increased from 35% to almost 100% when mold was present in the home. The association was slightly stronger for mold conditions than for just water damage. All health outcomes were more strongly associated with reported mold and water damage within the past 12 months compared with ever having water damage or molds in the living unit. The association was weaker for molds being reported in the child's bedroom.

Having any furry pet was strongly protective for respiratory allergy (OR=0.61 [95% CI=0.50, 0.74]) but less so for severe wheezing (OR=0.84 [95% CI=0.74, 1.01]) and current bronchitis (OR=0.86 [95% CI=0.67, 1.00]). Having a furry pet was strongly negatively associated with current asthma (OR=0.40 [95% CI=0.25, 0.64]), whereas having a cat was specifically associated with higher rates of doctor-diagnosed asthma (OR=3.29 [95% CI=1.01, 10.72]) but not with asthma symptoms (OR=1.06 [95% CI=0.78, 1.44]).

Examining the relationship between parental exposures to toxic material at work and their children's symptoms yielded interesting results. Even though only about 2% of the responding parents had workplace exposures, there were significant associations with dry cough (OR=2.35 [95% CI=1.54, 3.59]), persistent dry cough (OR=2.18 [95% CI=1.05, 4.55], and severe wheezing (OR=1.76 [95% CI=1.03, 3.02]). Reported frequency of house cleaning revealed no consistent or significant relationships.

DISCUSSION

Consistent with similar health surveys conducted in the United States and Europe, conditions of mold and dampness in living areas are strongly associated with increased respiratory symptoms. In an examination of all published literature, a Nordic scientific review panel concluded that the presence of dampness in a home increased the reporting of cough, wheeze, and respiratory symptoms by 40% over a reference population.[3] The risk appears to be similar for Russian housing. However, the prevalence of moisture and mold in the housing stock is approximately half of the prevalence reported for surveys done in the United States and Canada.[7,8] Jacob et al.[9] showed that high counts of *Cladosporium* and *Aspergillus* spores in house dust were associated with increased risk of allergic sensitization. Their results suggest that higher spore counts, particularly in the winter, are likely to increase the prevalence of allergic symptoms in children.

Cook and Strachan[10] conducted pooled analysis of ORs for parental smoking on asthma, wheeze, chronic cough, chronic phlegm, and shortness of breath symptoms in children exposed to ETS. Our Russian results for ever cough, persistent cough, dry cough, and persistent dry cough are similar to the pooled ORs for cough (OR=1.35 [95% CI=1.13, 1.62]). Also, our findings for phlegm were similar to the pooled ORs of 1.31 (95% CI=1.08, 1.59). Asthma and wheeze, although both significantly associated with parental smoking in the pooled analysis, were not significantly associated with any measure of ETS exposure over the child's life.

Gilliland et al.[11] reported that in utero exposure to maternal smoking without subsequent postnatal ETS exposure significantly increased the association with doctor-diagnosed asthma, asthma symptoms, and asthma severity later in a child's life, as well as most of the wheezing outcomes. Our ORs for asthma and wheeze outcomes were all positively associated with smoking during pregnancy (approximately 2.0) but did not reach $P<0.05$ significance. Given the lack of specificity to the smoking questions asked in this survey, it is not possible to ascertain the separate influence of maternal versus paternal smoking or even age-related responses seen in other studies. Gilliland et al.[11] similarly showed that current and previous ETS exposure was not associated with asthma prevalence but was consistently associated with various wheezing variables.

Apelberg et al.[12] performed a meta-analysis of the studies on the effect of early exposure to household pets on the development of asthma and asthma-related symptoms. Inappropriate time sequence of the exposure and outcome information, typical for cross-sectional studies, was an important source of heterogeneity and an indication of potential selection bias. In studies ensuring a meaningful temporal relation between exposure and outcome, the pooled risk estimates for both asthma (fixed-effects OR=1.11 [95% CI=0.98, 1.25]; $P=0.04$) and wheeze (OR=1.19 [95% CI=1.05, 1.35]; $P=0.03$) indicated a small effect. However, the effect was limited to studies with a median study population age greater than 6 years. In younger children, the effect appeared protective for wheezing (OR=0.80 [95% CI=0.59, 1.08]; $P=0.38$). The authors concluded that the observed lower risk among exposed compared to unexposed young children is consistent with a protective effect in this age group, but could also be explained by selection bias.

In a prospective study of asthma incidence in adolescents, McConnell et al.[13] reported a relative risk of 1.6 (95% CI=1.0, 2.5) for having a furry pet at home. The present study was cross-sectional and did not inquire precisely when the pet had been present. Therefore, the negative associations between the presence of pets and the risk of asthma and allergies could be a result of either avoidance or removal of pets in families with children allergic to respiratory allergens and with asthma problems.

Exposure to nitrogen dioxide (NO_2) from gas cooking is a common experience for the majority of children in this survey. From studies that measured NO_2 indoors, it can be inferred that concentrations will be higher in the absence of exhaust vents. Yet examining possible interactive effects for cooking fuel and ventilation offered no evidence for increased association with the inferred exposure gradient (e.g., not using gas but having ventilation versus having gas but not having ventilation). Garrett et al.[14] reported that gas stoves increased the risk of respiratory symptoms in children (OR=2.3 [95% CI=1.0, 5.2]), whereas the association with direct measures of NO_2 was marginal. Shima and Adachi[15] reported that the prevalence of bronchitis wheeze and asthma significantly increased with indoor NO_2 exposures among girls but not among boys. They also showed that wheeze and asthma incidence were associated with outdoor NO_2 but not indoor NO_2. Examining the effects of NO_2 from gas heaters in school rooms, Pilotto et al.[16] found significant increases in sore throats, colds, and absences from school when hourly peak exposures exceeded 80 ppb compared with background levels of 20 ppb. In a large study of respiratory infections among 1000 infants in Albuquerque, New Mexico, Samet et al.[17] found no associations for either gas stove or NO_2 levels measured in the kitchen or the child's bedroom.

This study of Russian schoolchildren and housing factors poses some interesting observations for further investigation. Only 40% of the respondents reported either light or medium traffic outside their homes/apartments. Persistent cough, phlegm, and dry cough, as well as the prevalence of severe upper respiratory infection in children, were positively associated with medium traffic loadings compared with not living along any roadways. Clustered apartment complexes removed from roadways are common in many Russian cities; it is a situation unlike that of any study reporting associations with asthma and respiratory symptoms for children living close to heavily traveled roads. In US, Western European, and Japanese studies, the reference group always has approximate exposure to some road traffic.[15,18–24] In this Russian study, none of the asthma or wheeze variables showed an association with subjective reporting of traffic exposure. Nevertheless, the possible association of vehicle exhaust on chronic cough and phlegm cannot be dismissed.

Just 1.9% of the children had 1 or both parents reporting occupational contact with potentially toxic substances and not leaving their work clothes at the job site. Another 19.75% had parents who might be exposed but leave their clothing at work. Consistently positive associations were found for wheezing (severe and current) and most of the coughs (persistent dry cough, dry cough, usual cough) as well as asthma-like symptoms and general atopy. These observations suggest that compounds may be carried home on clothing or absorbed in fibers of clothing, leading to children being exposed at home. Many metallurgical and chemical production facilities are located in Cherepovets and throughout Sverdlovsk Oblast. It is likely that some parents are heavily exposed to potentially irritating or toxic materials at work.

Although doctor-diagnosed asthma rates for Russian children were substantially lower than rates children are currently experiencing in the West, the rates are consistent with reports from former Soviet Bloc countries. Jedrychowski et al.[25] reported doctor-diagnosed asthma among 1129 9-year-old children living in Krakow, Poland, as 1.9% for girls and 2.4% for boys in 1995. The International Study of Asthma and Allergies in Childhood showed that the variation in the prevalence of asthma and self-reported asthma symptoms between different countries is striking.[26] In these comparisons the prevalences of all the studied indices of asthma were lower in Eastern than in Western Europe. Corresponding figures for asthma symptoms from video questionnaires were 2% in Russia and between 12% and 20% in the United Kingdom, the United States, Canada, New Zealand, and Australia. Differences in access to health care, diagnostic practice, and environmental and dietary factors are plausible explanations for the large variation in the prevalences of asthma between Russia and Western Europe/North America.

Rates for other conditions and symptoms in Russian children are comparable to rates reported from studies conducted in the United States. In the Harvard 24 Cities Study of air pollution and children's health in 24 North American towns,[27] 33% of the children reported some atopy. The reporting of current asthma symptoms within the past year ranged from 3% to 11% of the children across 24 communities, with persistent wheeze ranging from 4% to 12%. For Russian children, asthma-like symptoms were 10%, with a higher rate of current wheeze (13.4%). Chronic cough in the 24 Cities Study ranged from 4% to 9%, which is consistent with the 5.5% noted in our study. Parents reported chronic bronchitis in the past year at rates of 3% to 10% across the 24 Cities Study, and a rate of 8.3% for our Russian children. The respiratory symptoms in children associated with ETS exposure, water damage, and presence of molds in the Russian housing study were consistent with reports on housing conditions in many other countries.

Russian housing is characterized by large, concrete high-rise structures. Apartments are similar in layout and size, and are served by district hot water for heating and gas for cooking; mechanical ventilation and air conditioning is a rarity. Our study reporting prevalences of conditions and associated health symptoms provides important insights that are applicable to millions of children living in similar housing. ■

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Contributors

J.D. Spengler designed the study and led the analysis and the writing of the article. J.J.K. Jaakkola helped design and oversee the study and analysis, and participated in the writing of the article. H. Parise and A.A. Kosheleva analyzed the data. B.A. Katsnelson and L.I. Privalova helped design and conduct the study, managed staff, checked records, and participated in data analysis.

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Human Participant Protection

Parents were informed that participation was voluntary. No personal identifiers were used in our data files, and all questionnaires have been destroyed. Data were not collected from children.

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