THE MEASUREMENTS OF INDOOR CONCENTRATION OF NITROGEN DIOXIDE USING PASSIVE SAMPLING

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ABSTRACT

The assessment of indoor air quality is important for understanding and preventing the risk of health effects such as respiratory diseases associated with a variety of indoor environmental pollutants and sources of pollution. People spend a lot of their time at homes, where emissions from many indoor pollution sources are released, so the attention to this environmental problem is required. Indoor pollution of nitrogen dioxide (NO_2) is predominantly pollutant causing the most concern, which relationship with health effects is confirmed in various epidemiological studies.

The aim of this study was to assess the concentration of nitrogen dioxide in different indoor environments (bedroom, living room and kitchen) using passive samplers. The measurements were conducted in 7 homes in Kaunas city with population above 300 000. The homes were selected in different locations of the city. Passive samplers were exposed to indoor air for 14 days in four seasons to determine average annual concentration of nitrogen dioxide.

The results showed that the concentration of nitrogen dioxide ranged from 10.3 to 29.8 μg/m^3 in bedroom, from 12.8 to 36.3 μg/m^3 in living room, and from 15.8 to 41.5 μg/m^3 in kitchen. The lowest average annual concentration of nitrogen dioxide was measured in bedroom, while the highest concentration of NO_2 was determined in kitchen.

Keywords: indoor air pollution, nitrogen dioxide, passive sampler

1. Introduction

Recently, scientific studies are performed to evaluate not only outdoor air pollution, but also to assess indoor air quality and its relationship with adverse health effects (Chowdhury *et al.,* 2013; Dutta *et al.,* 2007). The impact of outdoor air pollution on human health outcomes is undeniable, however, increased attention should be focused to the air pollution inside the buildings (residence, workplace, shops, etc.), where many indoor sources of air pollutants may occur (Zhang *et al.,* 2003).

Scientific evidence showed the associations between various air pollutants and respiratory and cardiovascular diseases, allergies, and certain types of cancers in adults and children (Butz *et al.,* 2010; Fullerton *et al.,* 2008; Laumbach *et al.,* 2012; McConnell *et al.,* 2010; Pope C. A. *et al.,* 2011).

Nitrogen dioxide (NO_2) is considered as an indicator of traffic related air pollution in the outdoor air, while combustion appliances in homes are one of the major indoor sources of nitrogen dioxide, which concentrations inside homes can be even higher than in the outdoor air, especially during cooking activities (Esplugues *et al.,* 2010; Morales *et al.,* 2009).

The determination of nitrogen dioxide level in different indoor environments is important for accurate assessment of individual exposure to air pollutants and its risk on health effects.

2. Methods

The study was conducted in Kaunas city, Lithuania. Seven homes were selected in different locations of the city in order to assess nitrogen dioxide concentration. The measurements in all homes were carried out during the same period in all seasons. Passive sampling method was used to determine nitrogen dioxide concentration in bedroom, living room and kitchen. The

passive samplers (Krochmal) were placed in the middle of each room and exposed for 14 days during each season. After exposure the laboratory analysis were made and nitrogen dioxide concentration were calculated.

Statistical analysis of the data was made using STATISTICA software. The mean annual concentration, minimum value, maximum value, standard deviation was calculated.

3. Results

The average annual concentration of nitrogen dioxide in homes is presented in Table 1. The highest average annual concentration of NO_2 was measured in kitchen and it was 26.1 μg/m^3, while in living room and in bedroom the concentration of NO_2 was 11.5 % and 23.0 % lower compared with the kitchen. The NO_2 level ranged from 10.3 to 19.8 μg/m^3 in bedroom, from 12.8 to 36.3 μg/m^3 in living room and from 15.8 to 41.5 μg/m^3 in kitchen.

Standard deviation is a statistical measure, which shows dispersion of a data set from its mean. The largest variance between the measurement data of NO_2 and the mean was in kitchen, while the lowest it was in bedroom.

Table 1: The annual indoor concentration of NO_2 (μg/m^3)

	Mean	Minimum value	Maximum value	Standard deviation
Bedroom	20.1	10.3	29.8	4.46
Living room	23.1	12.8	36.3	5.02
Kitchen	26.1	15.8	41.5	6.42

4. Conclusions

The study has investigated indoor nitrogen dioxide level. The highest pollution of NO_2 was determined in kitchen, where the main indoor sources of this pollutant (such as gas cookers) are conducted.

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