

Determinants of Indoor Air Quality: A Comprehensive Analysis of Household Factors Based on South Korean Data

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This cross-sectional analysis identifies strong associations between **larger floor areas, increased ventilation and reduced levels of key indoor air pollutants** such as CO₂, HCHO, and TVOC in Korean households. Lifestyle factors like **smoking and cooking fuel type** are also linked with variations in indoor PM2.5 levels.

BACKGROUND

Indoor air pollution has emerged as a critical health concern globally, particularly with increased indoor time due to the COVID-19 pandemic. This study leverages the Eighth KNHANES dataset, uniquely inclusive of indoor air quality variables, to explore household and lifestyle factors affecting indoor air quality across Korean households.

METHODS

A cross-sectional analysis was conducted using data from 1,182 households sampled via a stratified design the Eighth KNHANES. Data on PM2.5, CO₂, HCHO, and TVOC levels were collected through direct measurements in living spaces, complemented by detailed household questionnaires covering demographics, building characteristics, and lifestyle behaviors. Advanced statistical techniques, including multiple regression models, were employed, adjusting for the complex survey design.

RESULTS

Household and lifestyle factors significantly influenced indoor air pollutant levels. Higher PM2.5 levels were associated with smoking and type of cooking fuel, while increased ventilation reduced CO₂, HCHO, and TVOC concentrations. Larger floor areas correlated with lower PM2.5 and CO₂ levels. Recent home renovations were linked with elevated TVOC levels, underscoring the impact of building materials and resident activities.

CONCLUSIONS

This study highlights critical associations between architectural features, household behaviors, and indoor air quality in a nationally representative Korean sample. Findings advocate for targeted interventions, such as improving ventilation and minimizing indoor smoking, to enhance indoor air quality. Future research should expand on these insights through longitudinal studies to capture seasonal variations and long-term trends in air quality dynamics.

Table 1. Logarithmic regression analysis of Household factors and indoor air quality indicators

	PM2.5		CO ₂		HCHO		TVOC	
	β	p-value	β	p-value	β	p-value	β	p-value
Area								
Urban	-	-	-	-	-	-	-	-
Rural	-0.081	0.239	-0.043	0.450	-0.057	0.432	-0.187	0.308
Household Composition								
One generation	-	-	-	-	-	-	-	-
Two generation	-0.096	0.049	0.016	0.581	-0.027	0.650	0.188	0.071
≥Three generation	0.123	0.248	0.033	0.549	-0.076	0.520	0.228	0.302
Resident floor								
≤3	-	-	-	-	-	-	-	-
4 - 10	0.012	0.847	-0.076	0.128	-0.133	0.170	-0.481	0.003
≥ 11	-0.040	0.586	-0.073	0.157	-0.034	0.749	-0.433	0.023
Floor area								
≤ 66 m ²	-	-	-	-	-	-	-	-
66-99 m ²	-0.136	0.100	-0.058	0.163	0.025	0.738	0.027	0.856
99-132 m ²	-0.130	0.162	-0.076	0.097	0.158	0.115	-0.015	0.927
≥ 132 m ²	-0.258	0.019	-0.190	0.003	0.022	0.853	-0.388	0.089
Living Room Floor Material								
PVC	-	-	-	-	-	-	-	-
Wood	-0.067	0.319	0.010	0.810	-0.007	0.919	-0.109	0.334
Tile	-0.400	0.025	0.075	0.444	0.196	0.466	0.418	0.318
Cooking Fuel Type								
Gas	-	-	-	-	-	-	-	-
Electricity	-0.182	0.001	-0.015	0.739	0.117	0.102	-0.065	0.651
Gas and Electricity	-0.017	0.787	0.029	0.503	0.139	0.055	-0.059	0.661

Additional variables included in the model but not displayed due to non-significant results include type of housing, completion date, cooking frequency, ventilation method during cooking, new furniture purchase in the last 6 months, and presence of pets.

	PM2.5		CO ₂		HCHO		TVOC	
	β	p-value	β	p-value	β	p-value	β	p-value
Ventilation Frequency								
< 7 times/week	0.057	0.329	-0.034	0.386	-0.066	0.324	-0.288	0.026
7-13 times/week	0.062	0.438	-0.100	0.019	-0.193	0.015	-0.489	0.001
14-20 times/week	-0.060	0.496	-0.128	0.021	-0.154	0.098	-0.527	0.006
≥ 21 times/week	-	-	-	-	-	-	-	-
Daily Ventilation Duration								
< 1 hour	-	-	-	-	-	-	-	-
1-6 hours	0.094	0.298	-0.152	0.003	-0.094	0.221	-0.108	0.458
6-12 hours	0.099	0.255	-0.212	<0.001	-0.235	0.009	-0.350	0.023
> 12 hours	0.033	0.749	-0.245	<0.001	-0.352	<0.001	-0.587	0.003
Cleaning Frequency								
≤ 1 time/week	-	-	-	-	-	-	-	-
2-6 times	-0.006	0.926	-0.011	0.756	-0.188	0.004	-0.113	0.303
≥ 7 times/week	0.018	0.776	0.020	0.531	-0.074	0.232	0.022	0.849
Home Renovation in Last 6 Months								
No	-	-	-	-	-	-	-	-
Yes	0.089	0.334	0.072	0.148	-0.056	0.526	0.449	0.015
Air Purifier Usage								
No	-	-	-	-	-	-	-	-
Yes (No maintenance)	-0.080	0.285	0.029	0.580	0.046	0.672	0.060	0.738
Yes (with Maintenance)	-0.112	0.026	0.047	0.144	0.140	0.010	0.297	0.003
Air Freshener Usage								
No	-	-	-	-	-	-	-	-
Yes	0.009	0.848	0.050	0.079	0.037	0.492	0.244	0.023
Household Smokers								
No	-	-	-	-	-	-	-	-
Yes	0.156	0.016	0.049	0.109	0.020	0.697	0.157	0.159
Humidifier Usage								
No	-	-	-	-	-	-	-	-
Yes	0.150	0.008	-0.016	0.615	-0.042	0.459	0.019	0.853

ADDITIONAL INFORMATION

Resources: KNHANES (Korea National Health and Nutrition Examination Survey)

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