applied sciences

MDPI

Supplementary Materials A: The Short Form 8 Health Survey

Table S1. The Short Form 8 Health Survey.

1. Does your health now limit you in some activities (walking or climbing stairs)? [PF]
2. Have you had problems with your work or other regular daily activities as a result of your physical health? [RP]
3. How much bodily pain have you had? [BP]
4. In general, would you say your health is? [GH]
5. Do you have a lot of energy? [VT]
6. To what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups [SF]
7. Have you had problems with your work or other regular daily activities as a result of any emotional problems? [RE]
8. Do you have some mental problems (depressed or anxious)? [MH]

Supplementary Materials B: The Variability of $PM_{2.5}$ and CO_2 Concentration over Time in the Selected Residential Buildings

We selected 12 residential buildings randomly from the sample (81 residential buildings in total) to explain the variability of indoor air pollutants. Considering relatively high level of CO_2 and $PM_{2.5}$ concentration (Figure 3), we would take CO_2 and $PM_{2.5}$ for example to illustrate the variability over time for the measured air pollutants.

Figure S1 shows indoor and outdoor CO_2 concentration change in 24 h. As can be seen, indoor CO_2 concentration fluctuated greatly over time, while outdoor concentration remained relatively steady. Moreover, indoor CO_2 concentration was significantly higher than outdoor concentration. It was due to the fact that CO_2 is the most important biologically active agent whose production is proportional to the human metabolic rate (it was also the reason why CO_2 concentration was selected as the indicator of contamination caused by persons indoors). Hence, indoor CO_2 concentration was affect by the number of persons indoors and indoor activity pattern (metabolic rate) to a large extent. In addition, air change rate, fuel combustion (cooking), floor area and other factors can also influence indoor CO_2 concentration. These factors together led to the fluctuation of indoor CO_2 concentration randomly to some extent. In addition, it was found that indoor CO_2 concentration remained at a high level and fluctuated slightly at night (20:00–6:00 (+1)) because of sleeping.

Figure S2 depicts the fluctuations of indoor and outdoor $PM_{2.5}$ concentration over time. The relationship between indoor and outdoor $PM_{2.5}$ concentration was more complicated than CO_2 concentration. It can be found that indoor $PM_{2.5}$ concentration was not necessarily higher than outdoor concentration over time. This phenomenon existed for a number of reasons. First, concentrations of particles generated indoors were influenced by the outdoor [1]. Moreover, there were big differences between outdoor $PM_{2.5}$ concentration of different residential buildings. Because outdoor concentration was influenced by the meteorological conditions and the variation of outdoor sources (such as vehicular traffic). Second, indoor $PM_{2.5}$ concentration was also influenced by daily activities conducted in the indoor micro environments (such as cooking and smoking) [2]. Similarly, we can also find that the fluctuations of indoor $PM_{2.5}$ concentration were relatively stable at night. Overall, the fluctuations of indoor $PM_{2.5}$ concentration were rather complex because of indoor and outdoor origins.

In addition, there were peak exposures, as shown in Figures S1 and S2. For example, we can find that there were $PM_{2.5}$ peak exposures between 16:00 and 20:00 for house 8, 9, 10 and 12. Similarly, there were also CO_2 peak exposures between 16:00 and 20:00 for house 2, 5 and 6. Because the evening meals were often cooked during this time period. Cooking (that is, the use of liquefied petroleum gas, coal, wood or other fuel to prepare food) can increase indoor $PM_{2.5}$ and CO_2 concentration significantly [3].

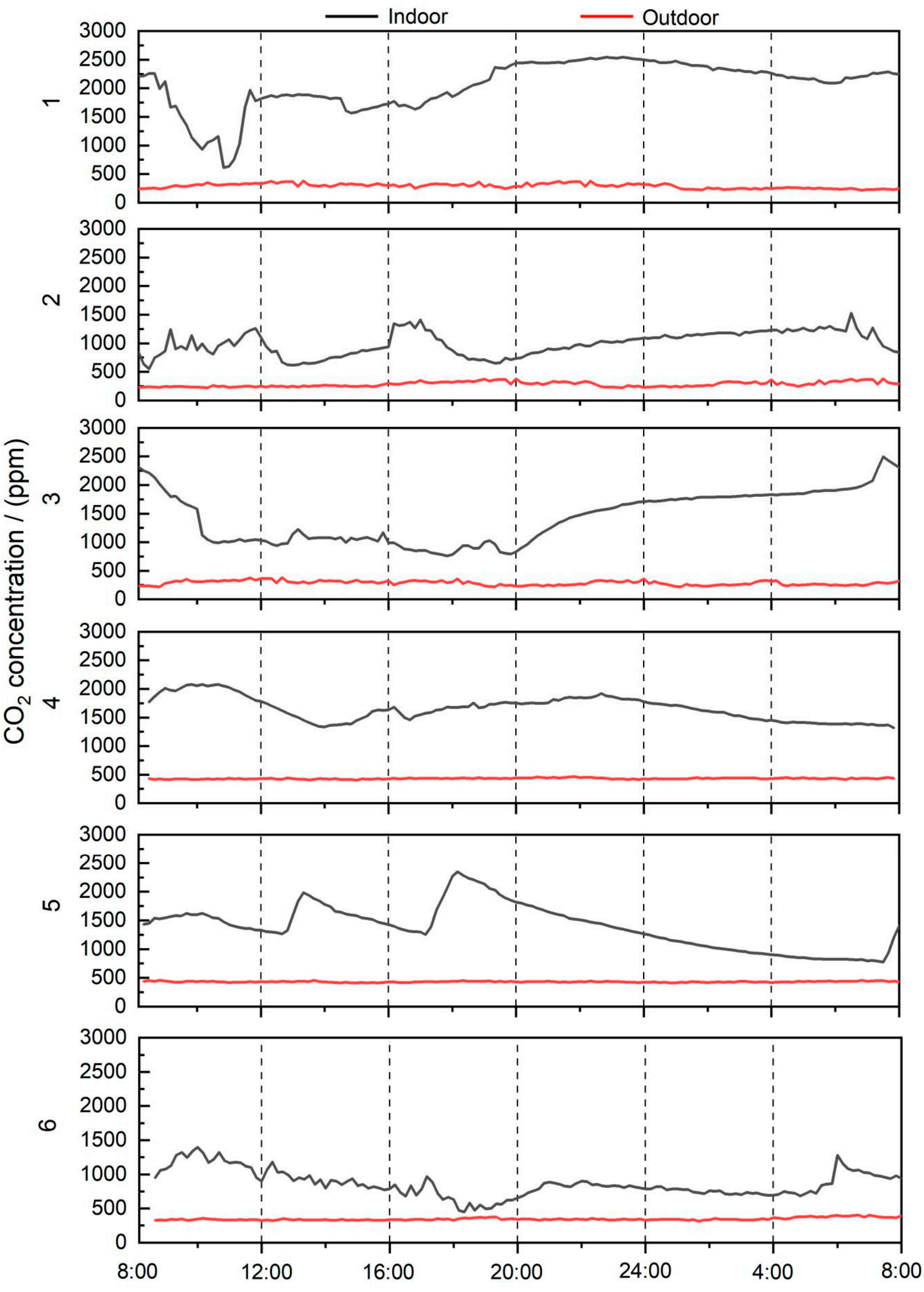

Figure S1. CO_2 concentration in the selected residential buildings.

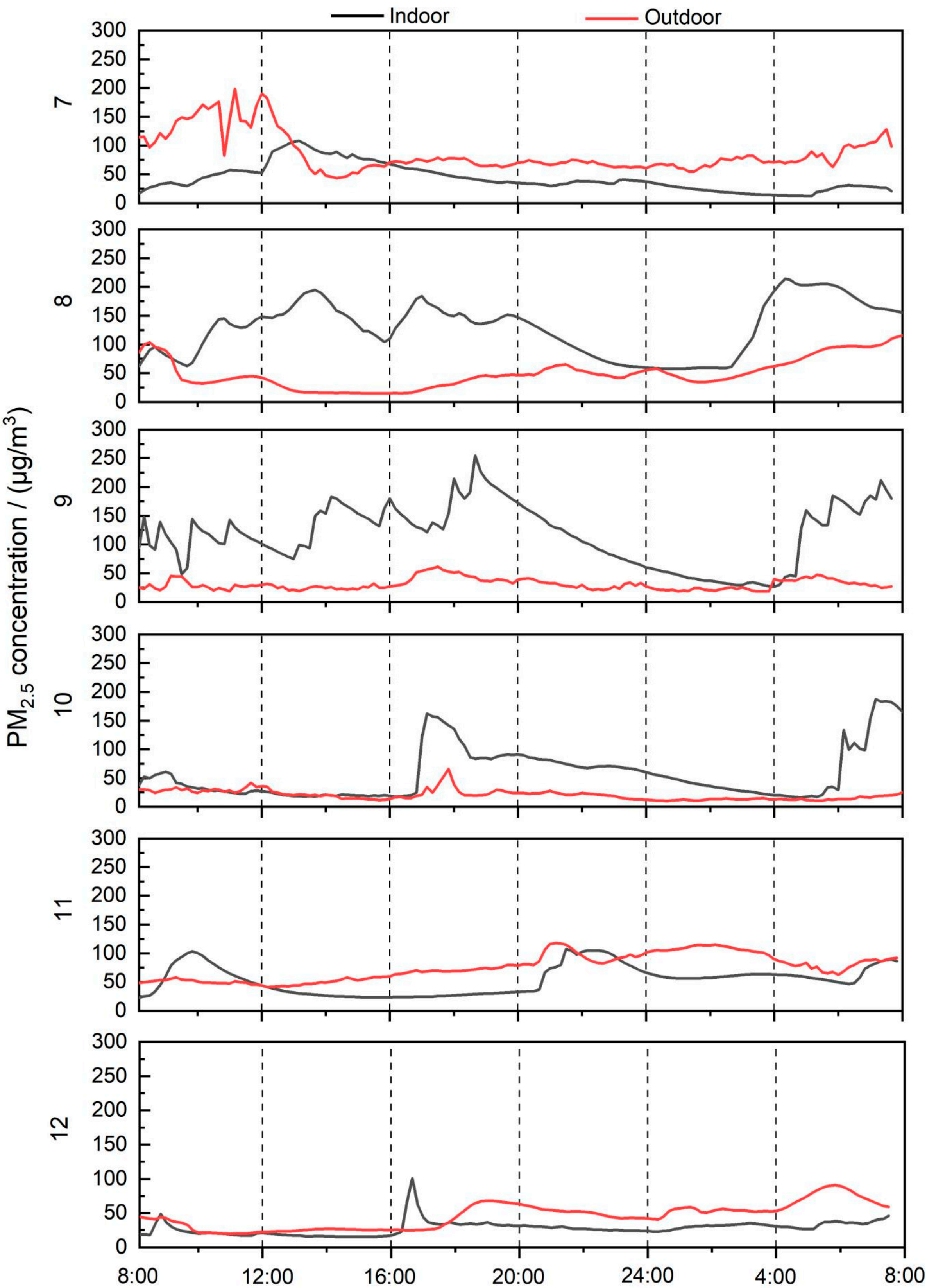

Figure S2. $PM_{2.5}$ concentration in the selected residential buildings.

Supplementary Materials C: The Relationship between the Number of Persons per Floor Area and Average CO_2 Concentration

Figure S3 describes the relationship between the number of persons per floor area and average CO_2 concentration for all the investigated houses during the measurement period. We used the general linear model to identify the link between the number of persons per floor area and average CO_2 concentration. The result showed that the goodness of fit of this model was 0.42 (R^2). It represented the about 42% of the variance in the indoor CO_2 concentration can be explained by the number of persons per floor area. Hence, CO_2 concentration was related to the density of people indoors.

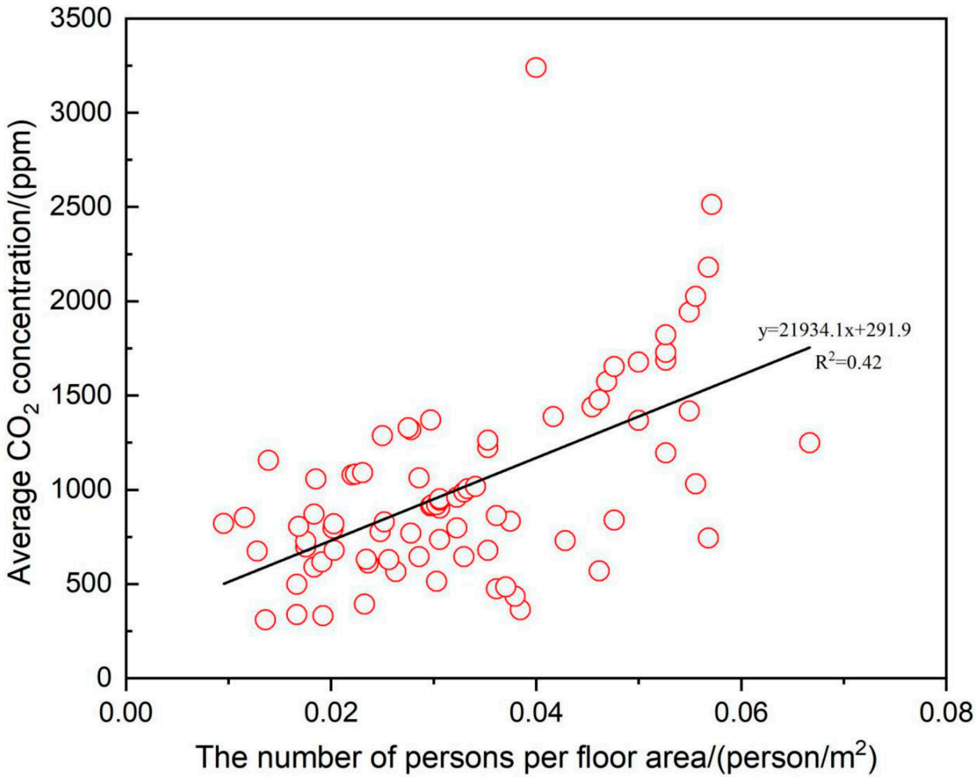

Figure S3. The relation between the number of persons per floor area and average CO_2 concentration for all the investigated houses.

References

1. Diapouli, E.; Chaloulakou, A.; Koutrakis, P. Estimating the concentration of indoor particles of outdoor origin: A review. *J. Air Waste Manag.* **2013**, *63*, 1113–1129.
2. Lance, W. Indoor Particles: A Review. *J. Air Waste Manag.* **1996**, *46*, 98–126.
3. Wan, M.P.; Wu, C.L.; To, G.N.S.; Chan, T.C.; Chao, C.Y.H. Ultrafine particles, and $PM_{2.5}$ generated from cooking in homes. *Atmos. Environ.* **2011**, *45*, 6141–6148.