



Is Practicing Indoor Physical Activity Safe? Consideration of Exposure to PM_{2.5}

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Dear Editor-in-Chief

To reduce premature mortality and morbidity by the lack of physical activities, the WHO recommends taking aerobic activity at least 150 minutes per week for adult health benefits (1). Individuals living in urban environment prefer to indoor facilities such as fitness centers, gyms, and recreation centers with the benefit of a convenient access to exercise equipment, as well as with the recent concern of urban-associated outdoor air pollution (2). Generally, indoor air quality (IAQ) is varied with building maintenance, materials, ventilation system, and occupant behavior which are important factors to contribute to the generation of indoor air pollutants at high concentration (2, 3). However, indoor facilities have presented some peculiarities that can easily resuspend particulate matter (PM) when occupants perform exercise in indoor environments, and they have negatively affected physical health by penetrating deeply into the alveoli of the lung (3, 4). Especially, PM_{2.5}, a complex mixture of smaller than 2.5 μm diameters, can cause cardiovascular, respiratory diseases and is classified by the International Agency for Research on Cancer (IARC) as the Group 1, i.e., carcinogenic to humans due to carrier effect of PM_{2.5} with the toxic pollutants such

as organic, metals, and carcinogenic polycyclic aromatic hydrocarbons (PAHs) (4).

As global concern of adverse effects of PM_{2.5} on public health, several research studies have been conducted to investigate the potential health risks associated with PM_{2.5} pollution caused by the re-suspension in indoor exercise facilities. Fitness centers in Portugal showed PM_{2.5} concentrations between 0.9 - 43 μg m⁻³ at eleven fitness centers in Lisbon and 5-777 μg m⁻³ at four fitness centers in Oporto (2, 5). Furthermore, gymnastics halls in previously mentioned cities also showed higher PM_{2.5} concentrations (means 170-500 μg m⁻³; range 18-405 μg m⁻³) (6). In twelve school gyms performing physical activities such as running, jumping, gymnastics, and ballgames by students, PM_{2.5} concentrations were higher than outdoor PM fractions with the following values of 17-95 μg m⁻³ (7). These results suggest that occupants in indoor physical activity places could be exposed to potential health risk due to the higher mean or maximum values of PM_{2.5} concentrations. As shown in Table 1, previous studies corresponded to 'Unhealthy for sensitive groups' and 'Hazardous' categories of Air Quality Index (AQI) by United States Environmental Protection Agency (US EPA) (Table 1).



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Table 1: Air quality index (AQI) categories corresponding to PM_{2.5} concentration (10) and the PM_{2.5} concentrations reported in the previous studies

<i>AQI Categories</i>	<i>PM_{2.5} (μg m⁻³) [24-hours]</i>	<i>PM_{2.5} (μg m⁻³) of previous studies</i>	<i>AQI level of previous studies</i>	<i>Reference</i>
Good	0-12	Fitness centers	0.9-43	Unhealthy for sensitive groups (2)
Moderate	12.1-35.4		5-777	Hazardous (5)
Unhealthy for sensitive groups	35.5-55.4	Gymnastics halls	18-405	Hazardous (6)
Hazardous	250.5-500.4	School gyms	17-95	Hazardous (7)

To promote public health and reduce health-risk behavior, regulations have been enacted by several international organizations for PM_{2.5}. However, guidelines for PM_{2.5} have focused mostly on outdoor air quality rather than IAQ. There are some drawbacks of IAQ-related regulations that

the limit value for PM_{2.5} does not in accordance with each other. As shown in Table 2, the WHO stipulated 5 and 15 μg m⁻³, which is applicable to both in- and out-door environments for annual and a 24-hours average, respectively (Table 2) (8).

Table 2: Guidelines for indoor PM_{2.5} by the international organizations

<i>Organization</i>	<i>Remarks</i>	<i>Limit Values for PM_{2.5} (μg m⁻³)</i>	<i>Reference</i>
WHO	24-hours annual	15 5	(8)
Health Canada	1-hour long-term	100 40	(9)
US EPA	N/A	N/A	-
EU	N/A	N/A	-

*Note: N/A means not available

Health Canada recommends indoor PM_{2.5} guideline with the two category; 40 μg m⁻³ for the acceptable long-term exposure range (ALTER) and 100 μg m⁻³ for 1-hours in common residential indoor environments (9). While US EPA and European Union (EU) have only the recommended value of outdoor PM_{2.5}, regulations on IAQ have not been established and only WHO and Health Canada has recommended distinct values for indoor PM_{2.5}. However, still there are no comprehensive guidelines for PM_{2.5} in indoor exercise facilities albeit the increased risk of health problems for occupants because of exposure to PM_{2.5}. Thus, it is time to initiate a strategic approach to improving people's awareness of IAQ based on

the consensus on environmental criteria for IAQ-PM_{2.5} and further researches are needed to investigate the human health risk assessment of PM in indoor exercise facilities for an effective legislation for potential stakeholders dealing with public health.

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Conflict of interest

The authors declare that there is no conflict of interest.

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