World Journal of Biology Pharmacy and Health Sciences
eISSN: 2582-5542
Cross Ref DOI: 10.30574/wjbphs
Journal homepage: https://wjbphs.com/

(RESEARCH ARTICLE)

Check for updates

Noise and PM2.5 levels in children's park adjacent to airport

Shigeru Suna *

Private Health Research Laboratory, 14-22 Shinkita-machi, Takamatsu-shi, Kagawa 760-0001, Japan.

World Journal of Biology Pharmacy and Health Sciences, 2024, 17(03), 060–066

Publication history: Received on 26 January 2024; revised on 03 March 2024; accepted on 05 March 2024

Article DOI: https://doi.org/10.30574/wjbphs.2024.17.3.0115

Abstract

Background: Sanuki Kodomo-no-Kuni Children's park adjacent to Takamatsu airport is a facility where visitors can watch airplanes take off and land up close and learn about science and technology. However, because it is not a school facility, the hygienic conditions such as noise and PM2.5 levels are not well known despite the current situation where many infants and elementary school students use this facility.

Method: Noise and PM2.5 levels were measured at a point in the park 170 m from the runway center.

Rsults: Three takeoffs and three landings were made during the measurement period. Instantaneous noise levels of 92.5 to 96.5 dB(A) were recorded during takeoff and 79.9 to 82.2 dB(A) during landing. The PM2.5 level every 30 minutes was 8 μg/m^3 at the beginning of the measurement, but 21 μg/m^3 was measured at the end, and a trend of increasing PM2.5 levels over time was observed.

Conclusion: Noise levels during takeoffs and landings were instantaneous but high. Since previous studies have reported health effects of chronic exposure to aircraft noise, including misbehaviours in young children, memory loss in school children, increased birth rate of low birthweight infants, and hearing loss due to chronic exposure. It was considered desirable to avoid excessive exposure to aviation noise.

Keywords: Children's park; Jet noise; PM2.5; Community environment

1. Introduction

Sanuki Kodomo-no-Kuni Children's park, located at the foot of the Sanuki Mountains and adjacent to Takamatsu Airport, is the only large-scale children's park in Kagawa Prefecture that supports the healthy development of children's minds and bodies through a variety of hands-on activities. This park is located just south of Takamatsu Airport, where visitors can watch airplanes take off and land close up under the big sky. Within the narrow 2.5 km east-west park along the runway, there is a "Waku Waku Children's Center" with a planetarium, a "Cycle Center" where visitors can enjoy unique bicycles, and other facilities. On weekends, families and aviation enthusiasts visit the park to watch planes take off and land on the runway, and on weekdays, there is no end to the number of groups of elementary school students who visit the park. However, the actual state of environmental health, including noise [1, 2] and air pollution [3, 4] caused by the arrival and departure of jet aircraft, is unknown. The author clarified the noise environment and PM2.5 pollution at this park facility.

* Corresponding author: Shigeru Suna.

2. Methods

2.1. Measurement condition and measurement point

The survey was conducted on November 4, 2009 from 10:00 to 14:00. The weather was clear, the temperature ranged from 14.9 to 16.8°C, and the wind speed was 2 to 3 m/s (southwest to north-northwest) (according to the weather station in Konan, Japanese Meteorological Agency).

Noise and PM2.5 levels were measured 170 m away from the runway center marker (Figure 1）.

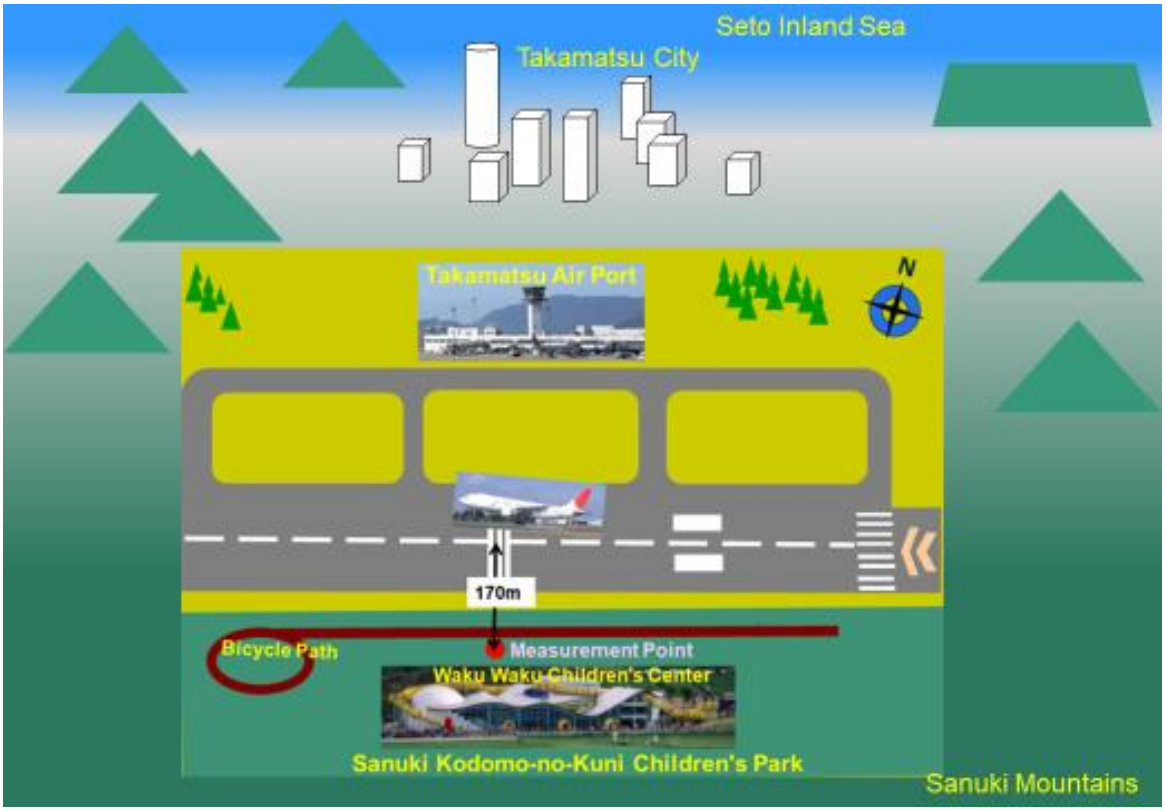

Figure 1 Location of Sanuki Kodomo-no-Kuni Children's park and noise and PM2.5 measurement points

2.2. Noise level

Noise level measurements and frequency analysis (real-time analysis) were performed with a RION Precision Sound Level Meter NA-27 (Figure 2-(a)).

2.3. PM2.5 level

PM2.5levels were measured by SIDEPAK AM510 relative density dust meter, 2.5 micron cut. (Figure 2-(b)).

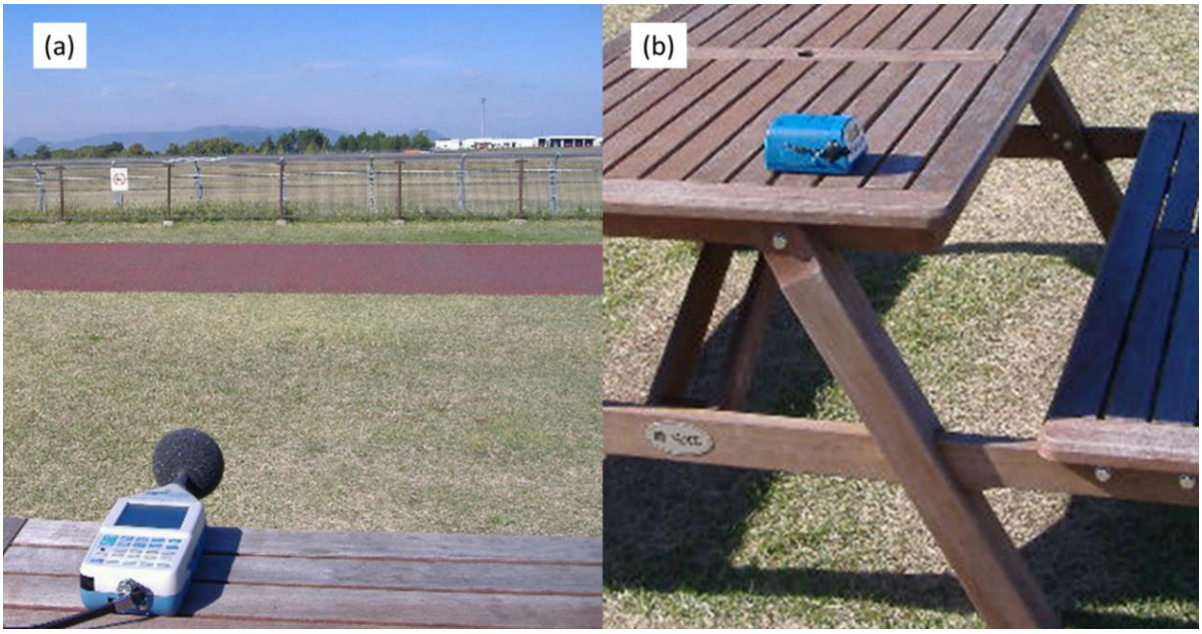

Figure 2 Measurement devices

3. Results

3.1. Noise levels

Three takeoffs (Boeing767-300: 1, A300-600R: 2) and three landings (Boeing767-300: 2, A300-600R: 1) were made during the measurement period (Table 1). Instantaneous noise levels of 92.5 to 96.5 dB(A) were recorded during takeoff and 79.9 to 82.2 dB(A) during landing.

Equivalent noise levels at 30-minute intervals are shown in Figure 3, and 1/3-octave frequency analysis of the jet's takeoff and landing sounds are shown in Figure 4. Aircraft takeoff and landing noise was found to contain high levels of infrasound.

Table 1 Time table of events

Time	Events	Remarks
10:00	Start of measurement A300-600R takeoff (10:27) Boeing767-300 landing (10:45)	Five shots were fired in the air to keep wild birds away (10:05) Helicopter passing overhead (10:43) Passing over Cessna (10:58)
11:00	A300-600R landing (11:40) Boeing767-300 takeoff(11:45)	
12:00		Twin-engine propeller-driven aircraft passes overhead (12:19) Twin-engine propeller-driven aircraft passes overhead (12:36)
13:00	A300-600R takeoff (13:00) Boeing767-300 landing (13:30)	Cessna takeoff (13:37)
14:00	End of measurement	

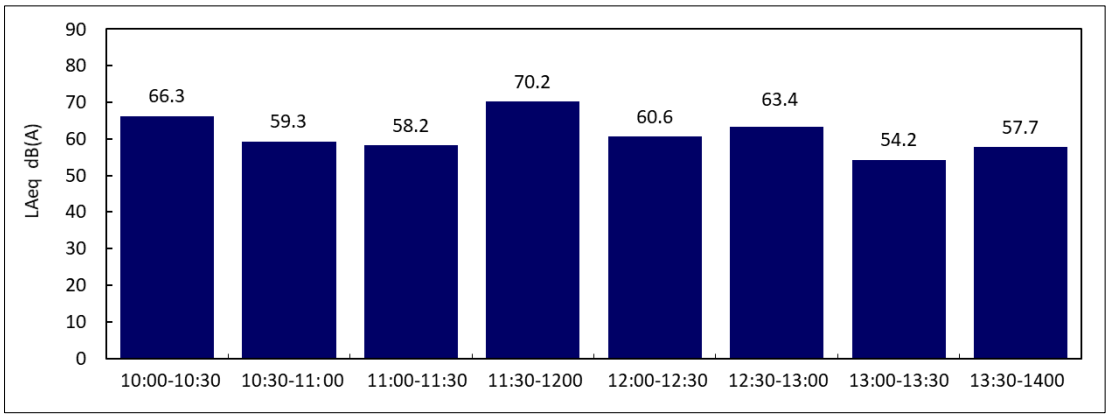

Figure 3 LAeq level every 30 minutes

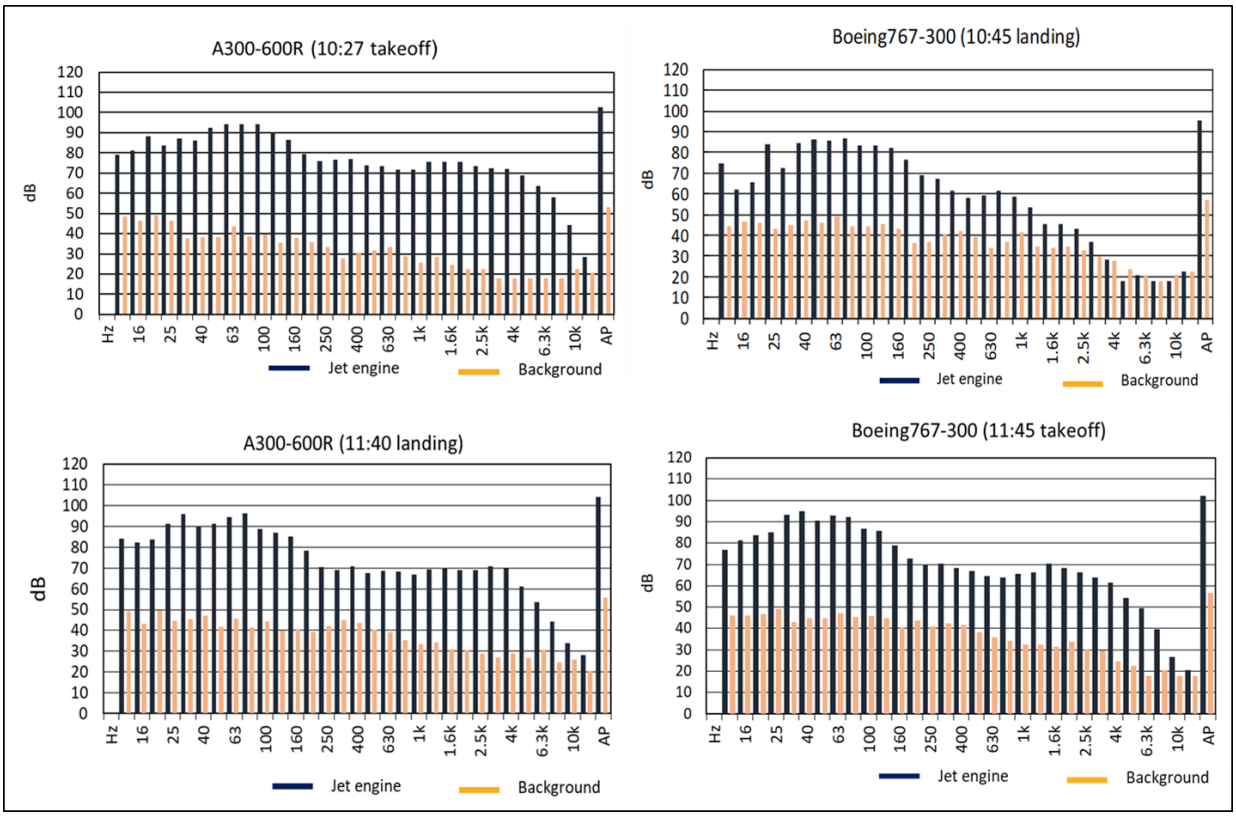

Figure 4 1/3-octave frequency analysis of the jet's takeoff and landing sounds

3.2. PM2.5 levels

The PM2.5 level every 30 minutes was 8 μg/m³ at the beginning of the measurement, but 21 μg/m³ was measured at the end, and a trend of increasing PM2.5 levels over time was observed (Figure 5).

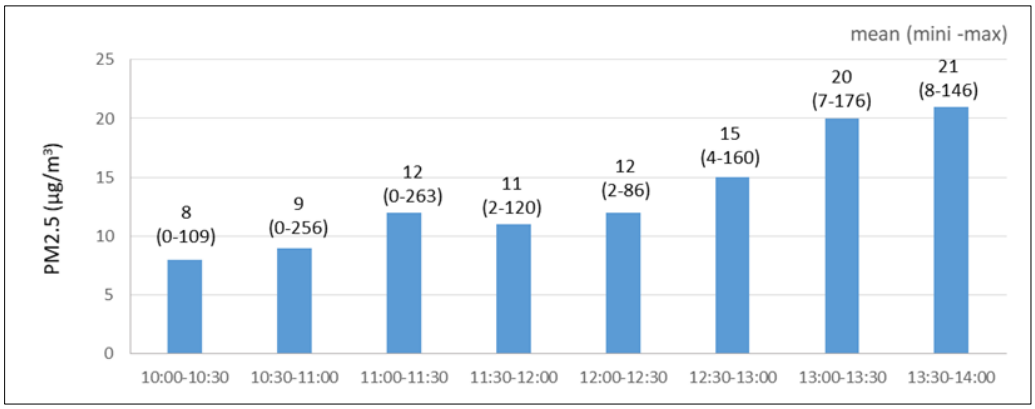

Figure 5 PM2.5 level every 30 minutes

4. Discussion

Sanuki Kodomo-no-Kuni Children's park is a popular amusement park where school children can watch airplanes take off and land up close and learn scientific and technological studies at the "Waku Waku Children's Center". The school environment in Japan is regularly monitored by school pharmacists based on the school environmental health standard established by the School Health and Safety Law. It is the important role of community pharmacists to clarify the actual hygiene situation of the community environment. However, since this facility located in a community environment is not a school, the hygienic condition is not well known despite the current situation where many infants and elementary school students use this facility. Therefore, it is necessary to investigate the hygienic condition in the facility.

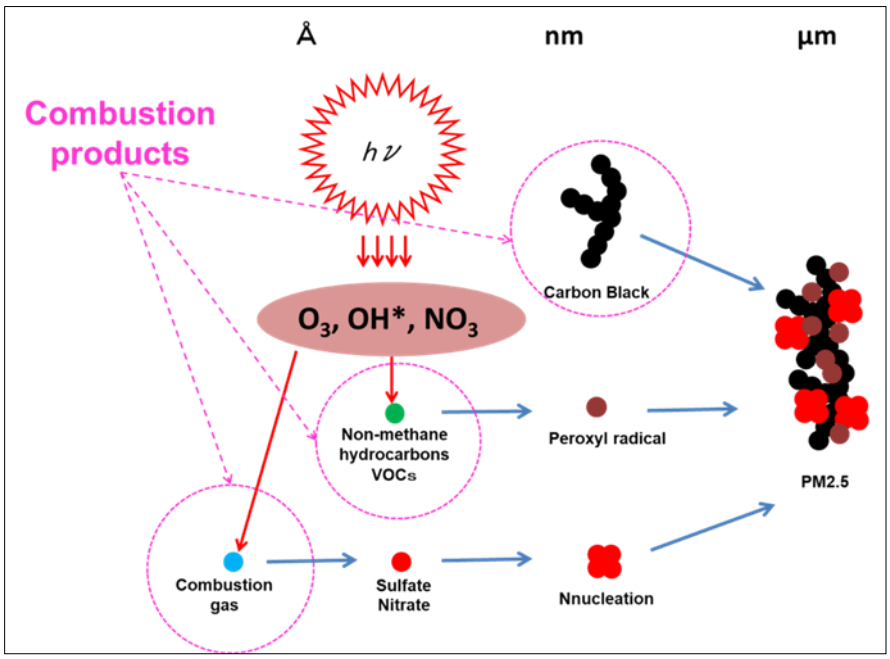

Figure 6 Formation process of PM2.5

In Japan, the weighted equivalent continuous perceived noise level (WECPNL) is exclusively used to evaluate the aircraft noise environment [5], and noise environment standards are also specified at the WECPNL level. However, WECPNL is an index for evaluating loudness. Considering that the purpose of this evaluation of noise levels is to allow the many visitors to the airport park to enjoy the intensity of aircraft arrivals and departures up close, the evaluation should be made from the perspective of "health and safety (especially prevention of health problems caused by noise during arrivals and departures)" rather than from the perspective of "prevention of noise, discomfort and annoyance for residents in the vicinity" which is the purpose of environmental standards. However, there is currently no environmental noise assessment value that includes infants, the elderly, and the infirm in terms of health and safety [6]. However, previous studies have reported that chronic exposure to aircraft noise has health effects such as

misbehaviours in young children [7], memory decline in school children [8, 9], increased birth rates of low birth weight babies [10], and hearing loss[11]. For this reason, it is recommended to avoid frequent exposure to aviation noise.

PM2.5 is a radicalized form of the products of fossil fuel combustion (Figure 6) that can reach deep into the respiratory tract and adversely affect cardiopulmonary function [12-15]. PM2.5 levels in the park were well below the alert criteria for the sick and vulnerable announced by Japan's Ministry of the Environment and the U.S. EPA [11], and did not appear to pose any particular problem.

5. Conclusion

Sanuki Kodomo-no-Kuni Children's park adjacent to Takamatsu airport is a facility where visitors can watch airplanes take off and land up close and learn about science and technology. However, because it is not a school facility, the hygienic conditions such as noise and PM2.5 levels are not well known despite the current situation where many infants and elementary school students use this facility. Therefore, the author investigated the status of jet aircraft noise and PM2.5 pollution.

Noise levels during takeoffs and landings were instantaneous but high. Since previous studies have reported health effects of chronic exposure to aircraft noise, including misbehaviours in young children, memory loss in school children, increased birth rate of low birth weight infants, and hearing loss due to chronic exposure, it seemed desirable to avoid excessive exposure to aviation noise.

Compliance with ethical standards

Acknowledgments

The author appreciates the help of colleagues in the laboratory.

Disclosure of conflict of interest

There is no conflict of interest in this work.

References

[1] European Commission. “Environmental Noise Directive 2002/49/EC.” European Union (2002).

[2] Jan Otčenášek. Environmental aircraft take-off noise – Sound quality factors associated with unpleasantness. Transportation Research Part D: Transport and Environment. 2019; Volume 67, February: 366-374.

[3] Alper Unal, Yongtao Hu, Michael E. Chang, M. Talat Odman, Armistead G. Russell. Airport related emissions and impacts on air quality: Application to the Atlanta International Airport. Atmospheric Environmenmt. 2005; 39(32): 5787-5798.

[4] M.C. Woody, H.-W. Wong, J.J. West, S. Arunachalam. Multiscale predictions of aviation-attributable PM2.5 for U.S. airports modeled using CMAQ with plume-in-grid and an aircraft-specific 1-D emission model Atmospheric Environmenmt. 2016; 147: 384-394.

[5] ICAO Annex 16 Aircraft Noise First Edition. 1971. 8.

[6] Benjamin Roberts and Richard L. Neitzel. Noise exposure limit for children in recreational settings: Review of available evidence. J. Acoust. Soc. Am. 2019;146: 3922–3933.

[7] Tomohiro Tokuyama, Toshihito Matsui, Kazuo Hiramatsu, Takashi Miyakita, Akiyoshi Ito,Takeo.Yamamoto. Effects of aircraft noise on preschool children’s misbehaviours: Results of research around Kadena and Futenma. Airfields in Okinawa. Nihon Eiseigaku Zasshi. . 2009; 64:14-25.

[8] S A Stansfeld. , B Berglund, C Clark, I Lopez-Barrio, P Fischer, E Ohrström, M M Haines, J Head, S Hygge, I van Kamp, B F Berry; RANCH study team. Aircraft and road traffic noise and children's cognition and health: a cross-national study. Lancet. 2005 Jun;365(9475):1942-1949.

[9] Susan S. Lang. Study of German children living near airports shows jet aircraft noise impairs long-term memory and reading ability. Cornell news. October 7, 2002. [Internet] [cited 2023 Nov 21]. Available from https://news.cornell.edu/stories/2002/10/airport-noise-impairs-long-term-memory-and-

reading#:~:text=Excessive%20noise%2C%20such%20as%20jet%20aircraft%20flying%20overhead%2C,in%20a%20study%20of%20schoolchildren%20living%20near%20airports.

[10] Toshihito Matsui, Tomoyuki Matsuno, Kaoru Ashimine, Takashi Miyakita, Kozo Hiramatsu,Takeo Yamamoto . Association between the rates of low birth-weight and/or preterm infants and aircraft noise exposure. Nihon Eiseigaku Zasshi. 2003; 58: 385-394.

[11] U.S. Environmental Protection Agency (EPA). Revised air quality standards for particle pollution and updates to the Air Quality Index (AQI). [Internet] [cited 2023 Nov 21]. Available from https://www.epa.gov/sites/default/files/2016-04/documents/2012_aqi_factsheet.pdf

[12] Yu-Fei Xing, Yue-Hua Xu, Min-Hua Shi, and Yi-Xin. The impact of PM2.5 on the human respiratory system. J Thorac Dis. 2016 Jan; 8(1): E69–E74.

[13] Stafoggia M, Cesaroni G, Peters A, Andersen ZJ, Badaloni C, Beelen R, Caracciolo B, Cyrys J, de Faire U, de Hoogh K, et al. Long-term exposure to ambient air pollution and incidence of cerebrovascular events: results from 11 European cohorts within the ESCAPE project. Environ Health Perspect. 2014; 122:919–925.

[14] Weichenthal S, Villeneuve PJ, Burnett RT, van Donkelaar A, Martin RV, Jones RR, DellaValle CT, Sandler DP, Ward MH, Hoppin JA. Long-term exposure to fine particulate matter: association with nonaccidental and cardiovascular mortality in the agricultural health study cohort. Environ Health Perspect. 2014; 122:609–615.

[15] Richard B Hayes, Chris Lim, Yilong Zhang, Kevin CromarYongzhao Shao, Harmony R Reynolds, Debra T Silverman, Rena R Jones, Yikyung Park, Michael Jerrett, Jiyoung Ahn, George D Thurston. PM2.5 air pollution and cause-specific cardiovascular disease mortality. Int J Epidemiol. 2020 Feb 1; 49(1):25-35.