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Measurement of Particle Concentration in Treatment Room during Traditional Chinese Acupuncture & Moxibustion Therapy

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Abstract
Acupuncture & moxibustion treatment is a very important therapy method in traditional Chinese medicine, which is widely used in Chinese medicine hospital. However, smoke including fine particles is produced due to combustion of artemisia argyi during acupuncture & moxibustion treatment. It is well known that smoke especially fine particles threat the health. Study is needed to investigate the particle concentration and size distribution in the treat room during acupuncture & moxibustion treatment.
Twelve acupuncture & moxibustion treatment rooms in different hospitals in Nanjing were investigated to evaluate the particle levels during acupuncture & moxibustion treatment. The Q-Trak indoor air quality monitor and Aero Trak particle counter were employed to measure particles number concentration, temperature, RH and CO_2 and CO concentration during acupuncture& moxibustion treatment in the heating period when the windows are usually closed.
The I/O (indoor particle concentration/outdoor particle concentration) for 3 sizes in 12 treat rooms are all higher than 1, ranged from 3.3-71.1 for particle with size 0.5μm-5μm.
Combustion of artemisia argyi during acupuncture & moxibustion treatment will produce large number of particles especially fine particles, which is the most important pollutant source in the treatment room. The controlling methods are needed to reduce particles level in the treatment room.

Keywords - Traditional Chinese medicine, Acupuncture & Moxibustion Therapy, Particle

1. Introduction

By lighting moxa cone and moxa made of artemisiae argyi and fire-curing human body, moxibustion is a traditional Chinese medicine therapy method for health care. However, during acupuncture & moxibustion treatment, a large number of fine particles is produced due to combustion of artemisia argyi and diffused in the treat room. There also emerging method, electronic moxibustion, which used electronic irritation instead of moxa buring. Fine particles can stay in the air for a long time. Fine particles can enter the lungs and deposit along with human respiratory system, even enter the blood circulation by alveolar, really do harm to body health [1-4]. Han[5] did experiment to study the effect of inhalable particle in the moxa smoke to the chromosome aberration through determining the genetic toxicity of moxa smoke by detecting whether inhalable moxa smoke particle changeed cell DNA structure. Comparative experiment shows that moxa smoke has biological activity and is poisonous to the cells in high concentrations. People who expose to high concentration particle for a long time, will be easily attacked by respiratory disease, along with dry eyes, skin allergy, etc [6], worse to death [7]. Therefore, the indoor air quality in the treat room has a direct impact on patients' health and the doctors' working efficiency. To improve the indoor air quality is significant to influence the patients' and the doctors' health.

This paper field measured indoor air quality of 12 acupuncture & moxibustion treatment rooms in Nanjing for different conditions. The factors influencing particle concentration in the treat room was also analyzed. The comparison of traditional moxibustion and electronic moxibustion was also given.

2. Experiment method

The filed measured was during from December 2013 to April 2014, including heating season and transition season in Nanjing. During heating season, doors and windows are usually closed to save energy and maintain thermal comfort, while windows and doors are usually open during transition seasons. Twelve acupuncture & moxibustion treatment rooms in 3 hospitals whose area ranged 25-45m^2 were investigated. Main particulate source in the treat room was due to traditional moxa burning. CO_2 concentration, temperature, relative humidity and particle concentration were measured in the treat room and CO_2 concentration, particle concentration in the outside. CO_2 concentration, temperature and relative humidity were tested by TSI9555-P made by U.S. TSI, while the particle number concentration was tested by TSI AeroPack9303-1. The sample point for each treat room was chosen in the middle of the room.It's easily measured that the temperature in the treat room ranged 24.5-26.0℃ and the relative humidity ranged 50%-60%. The difference of temperature and relative humidity between different treat rooms is slight and most of them can meet the relative humidity standard 30%-60% (GB/T 18883-2002 in China).

3. The change of particle concentration in the treat room

The particle concentration in the treat room increased during the combustion of moxa while decrease to original level after burning. Fig. 1 shows the change of particle concentration in the moxibustion treat room, electronic moxibustion treat room and outside. It can be found from the figure. The particle concentration in the electronic moxibustion treat room is significantly less than in the moxibustion treat room, but greater than outside. And there is a little change of particle concentration in the electronic moxibustion treat room during the day. There is a lot of change of particle concentration in the moxibustion treat room during the day. During working time i.e. 9am-11am and 14pm-16pm, the particle concentration in the treat room is high and significantly greater than outside. During lunch time and break time, i.e. 11am-14pm, the particle concentration in the treat room showed a trend of decline and gradually decreased to outside. The particle concentration in the treat room decreased gradually after 16pm. The particle concentration in electronic moxibustion treat room is much lower than traditional moxibustion treat room but higher than outside may because it is close to traditional moxibustion treat room.

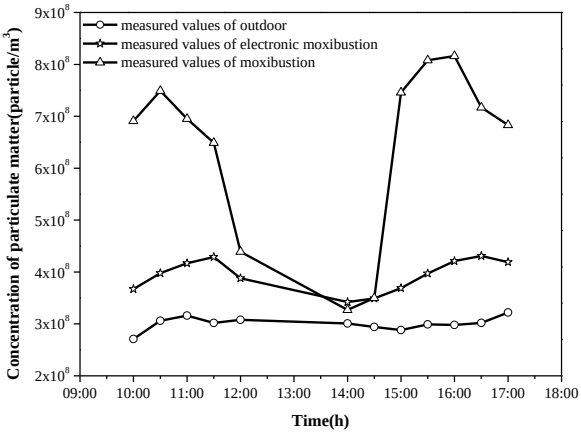


Fig. 1 Timely particle concentration in the treat room and in the outside

Fig. 2 compare the particle size distribution in the treat room and outside. It can be seen that most size of the particle concentration in the treat room is significantly greater than outside; however, for the particle with size 0.3μm - 0.5μm, the particle concentration in the outside is significantly greater than in the treat room. The results indicate that the combustion of moxa mostly produce particles size ranged 0.5μm - 5μm.

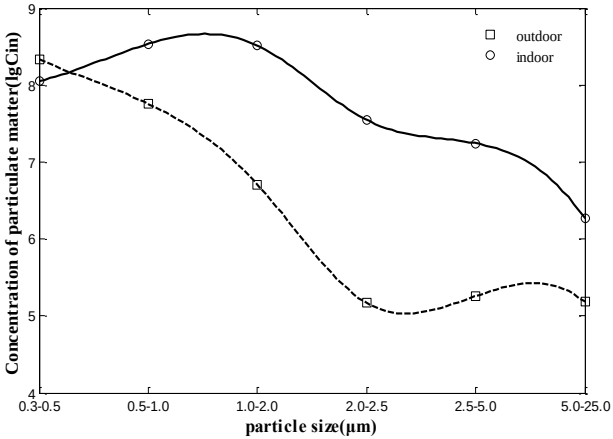


Fig. 2 Particle size distribution in the treat room and outside

4. Analysis of indoor and outdoor particle size distribution

In order to measure the effect of particle in moxibustion treat room from outside, the rate of the indoor particle concentration and outdoor particle concentration is usually defined as in (1):

$$I/O=C_{in}/C_{out}. \quad (1)$$

Where, C_{in} express the particle concentration in the moxibustion treat room, while C_{out} express the particle concentration in the outside. $I/O \geq 1$ means the indoor particle is mainly induced by the indoor pollution source, and $I/O \leq 1$ means the indoor particle is mainly influenced by the outdoor particle.

Fig. 3 shows the different *I/O* with different indoor particle size. It can be found that *I/O* is greater than 1 for almost all size range, some even more than 75. The size of the particle produced by the moxa combustion mostly between 0.5μm-5μm with I/O ranged from 3.3-71.1, indicating that indoor particle source mainly due to the moxa combustion. The concentration of particle with size 5μm-25μm is small, possibly because the moxa combustion produced a little particle among this size and the particle with such size are easily deposition.

Fig. 4 shows how the particle size distribution in the treat room change with time. It's observed that after the moxa combustion, large size particle concentration decays much more rapidly than small one, which cause peak size of particle concentration changed from 0.5μm -1μm to 0.3μm -0.5μm.

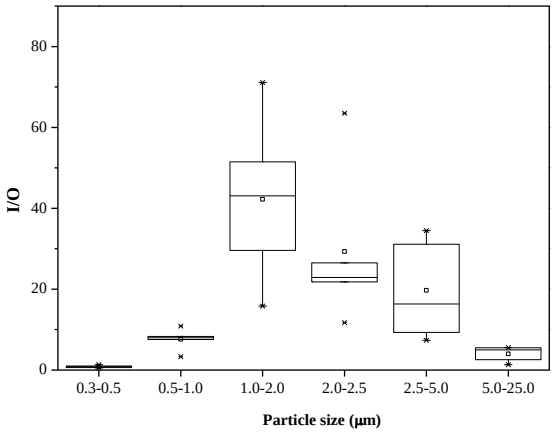


Fig. 3 The indoor particle concentration/outdoor particle concentration

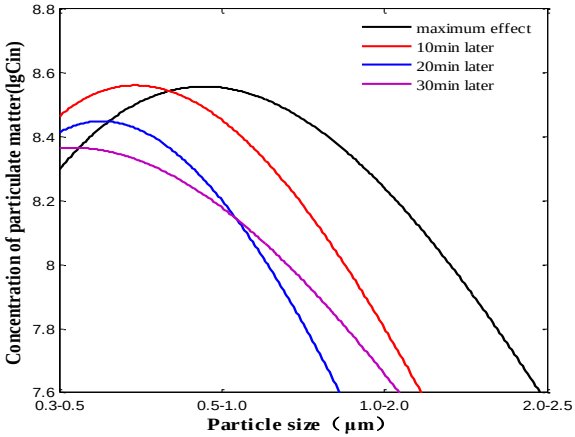


Fig. 4 Timely particle size distribution in the treat room

Fig. 5 shows the different *I/O* with different number of burning moxa in the treatroom. It can be found that all *I/O* is greater than 1 and increases along with the number of moxa increasing. This results suggest that the exceed standard of the indoor particle concentration is mainly due to combustion of the moxa.

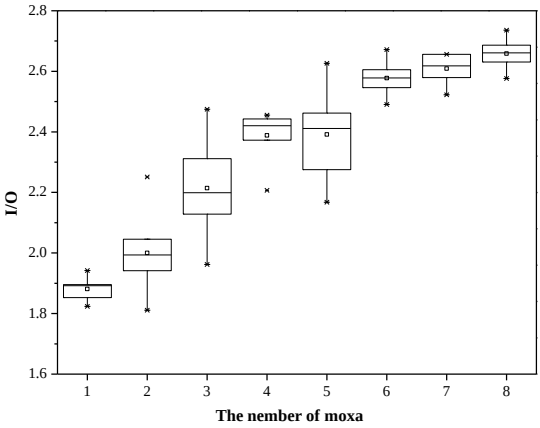


Fig. 5 The I/O with different number of moxa

During field measurement, the researchers find that the use of electronic moxibustion treatment is obviously more frequent than before it showed in Fig.6. This indicates that medical workers have realized moxa smoke has a negative effect on the indoor air quality and will help to maintain a good environment for the treat room.

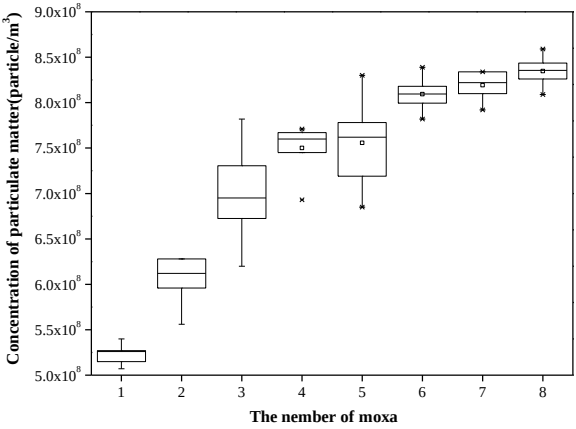


Fig. 6 The relationship between the concentration of particles and the number of moxa

It was found that there were not all the air exhaust devices installed in the treat rooms during field measurement. In order to explore the effect of the air exhaust device on indoor particles concentration, the concentration of particles in treatrooms with/without the air exhaust devices were compared.

The test results are shown in Fig. 7. In order to eliminate effect of different number of moxa, the number of moxa in the treat room in this test is the same. The concentration of particulate matter in the consulting room with air exhaust device is significantly smaller than that of the consulting room without air exhaust device, and the concentration is reduced by about 14.7%.

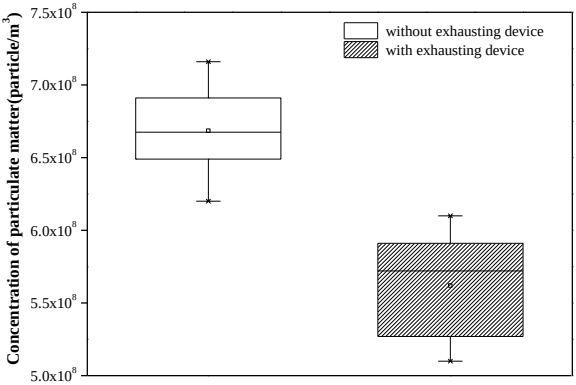
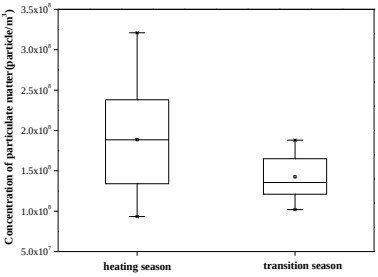
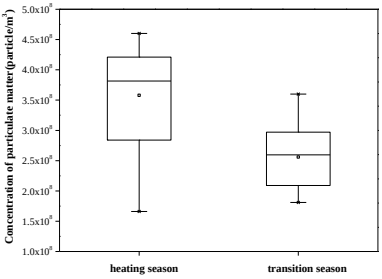


Fig. 7 Effect of the air exhaust device on the concentration of indoor particulate matter

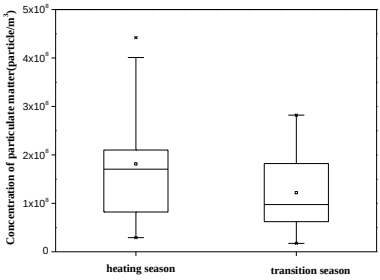
During the field measurement in heating period, the door and window were closed except the time of patients entering. The door and windows of the treatment room are open in the process of acupuncture and moxibustion during transition period. Results are shown from Fig. 8(a)-(d). It can be found that the concentration of indoor particulate matter in heating season is significantly greater than that in the transition season. This is mainly because the ventilation rate is much higher in the treatment room in the transition season.



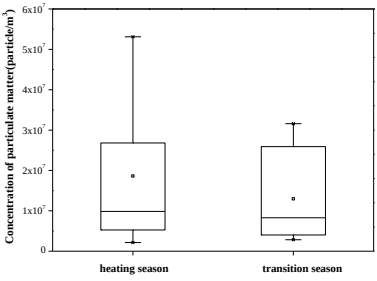
(a) 0.3μm - 0.5μm



(b) 0.5μm - 1.0μm



(c) 1.0μm - 2.0μm



(d) 2.0μm - 2.5μm

Fig. 8 Compare the particle with different size in the heating season and transition season

5. Conclusion

During the heating season and the transition season, 12 acupuncture & moxibustion treatment rooms in 3 hospitals in Nanjing were investigated to evaluate indoor air quality.

(1) In the moxibustion treatment rooms, the particle and CO_2 concentration in the treat room are positively correlated with the number of moxa, and are significantly greater than the outside.

(2) Using electronic moxibustion to replace traditional moxibustion can much reduce indoor air particle concentration.

(3) The heating season and the absent of air exhausting device will increase the particle and CO_2 concentration.

(4) The combustion of moxa mostly produce particles size ranged 0.5μm - 5μm.

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