CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

This study was aimed to evaluate the association between PM_{10} and respiratory symptoms, or lung function, using the ATS-DLD-78-C respiratory questionnaires and spirometry among schoolchildren in different air pollution levels in Bangkok. Since this research has involved many social aspects and communities, the ethical issues have been approved by the Ethical Committee, Faculty of Medicine, Chulalongkorn University.

5.1.1 Prevalence of Respiratory Symptoms

The prevalence of respiratory symptoms increased significantly with odds ratios (95% Confidence Interval) in HR and HG are: 2.44 (1.21-4.93) and 2.60 (1.38-4.91), respectively. Residential locations and family members were associated with the prevalence of respiratory symptoms, whereas those factors of responder of ATS-DLD, gender, age, residential years, home size, parental smoking habits, use of air conditioners, and domestic pets were not associated.

5.1.2 Prevalence of Impaired Lung Function

Children with normal lung function were less observed in H and M-polluted roadside and general area (HR; OR=1.41 (95% CI 0.89-2.22), HG; 1.08 (0.71-1.64), MR; 0.99 (0.63-1.57)). Age was associated with the impaired lung function, whereas others factors were not associated.

5.1.3 Association between Particulate Matter and Respiratory Health

This study indicated that an adverse effect increased in particulate matter on respiratory symptoms and lung function of schoolchildren's health in Bangkok. The respiratory questionnaires and spirometry were used of associations between air environment and human health.

In this cross-sectional study of schoolchildren, chronic health effects increases in high-polluted area were associated with reductions in the level of lung function and increased reporting of NSRD and PCP. The result of this study found that consistent positive associations between exposure to PM_{10}, prevalence of respiratory symptoms, and impaired lung function. The prevalence of respiratory symptoms and impaired lung function were higher among children living in high-pollution areas than those in the low-pollution area. Effects on respiratory health among children living in high-polluted area were found higher than those living in low-polluted area. Children who live in high and moderate-polluted areas are susceptible to air pollution rather than low-polluted area.

5.1.4 Comparison of Respiratory Health

This study showed that the prevalence of chronic bronchitis, dyspnea and wheezing, PCP, and impaired lung function was higher in Bangkok (an urbanized area) than Ayutthaya (a rural area), while the prevalence of bronchial asthma was higher in Ayutthaya than Bangkok.

The results of this study provide convincing evidences that the Bangkok populations are being adversely affected by the particulate matter air pollution to which they are regularly exposed. This has clear implication in public health and regulatory perspectives to protect the most vulnerable populations.

5.2 Recommendations

This study aimed as a guideline for air quality management in the urban area to for achieve and maintain good air environment is one of the key for protecting of good public health. In addition, suggestions for attempt to reduce adverse impacts on human health and establish strategies to control air pollution are as follows:

1. Control source emission
    - 1.1 Mobile sources: Formulate a comprehensive control program that includes the setting of stringent fuel or emission standards such as phase out leaded petrol, vehicular inspection and maintenance systems and enforcement measures.
    - 1.2 Stationary sources: Adopt best available technologies in terms of emission control and fuel efficiency. Industries must have emission equipment in place to reduce particulate pollution.

2. Zoning or land use concept
    - 2.1 Zone and segregate different types of industries. Construction zones try to wet the area they are working in to avoid particles. At the landfill, the dirt roads are kept wet and the vehicles clean their wheels before going back onto the street again.
    - 2.2 Relocate and centralize industries

3. Transport and traffic management

    Develop and accelerate other transit systems for convenience to public transport such as sky train, underground train and create an effective bus system. When combined with good public transportation, zoning is a key strategy for reducing vehicular air pollution.

4. Use of cleaner fuels

    Promote use of cleaner fuels such as natural gas, bio fuels

5. Policy

5.1 Accelerate the reduction of air pollution from vehicles, industries, construction and transportation. Conducts inspections to ensure that the facility is operating within their limit.

5.2 Maintain air quality standards.

5.3 Controls open burning through education to public community.

5.4 Promote participation among government and private sectors and the general public.

6. Public participation

6.1 Raise public awareness in pollution reduction through proper maintenance of vehicle engines.

6.2 Promote use of public transport.

This study suggests reduction of risk exposure to particulate matter. Therefore, there should be air pollution management in school such as:

1. Provide spring or pond in school for trap the particles.
2. Increase ventilation efficiency in classroom.
3. Increase clean filter of air conditioners often.
4. Increase trees and other vegetation as natural air conditioners, cooling the air while absorbing carbon dioxide and producing oxygen.

Suggestions for future health effects research in Thailand:

1. Examine the relationship between exposure to PM_{10}, prevalence of respiratory symptoms, and impaired lung function in other vulnerable groups of population especially elderly, people with asthma, chronic bronchitis, emphysema and heart disease.
2. Determine the relationship between respiratory healths collected on this cross-sectional study in 2004 to long term ambient concentrations of respirable particulate matter as well as to conduct multi-pollutant analyses

for other ambient air pollutants such as $PM_{2.5}$, NO_2, SO_2, CO, and ozone by update exposures throughout the period of follow-up or cohort study design.

3. Several studies suggested that higher levels of ambient particles are associated with reduced heart rate variability (HRV) (Creason *et* al., 2001; Gold *et* al., 2000; Liao *et al.*, 1999; Magari *et* al., 2001; and Pope *et al.*, 1999), but have not been evaluated systematically in Bangkok. Therefore, further study should examine the relationship between personal particulate matter exposure ($PM_{2.5}$ and PM_{10}) and heart rate variability among adult and elderly population.