AIR POLLUTION HEALTH STUDIES : FUTURE DIRECTIONS

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SUMMARY:
Of all forms of pollution, air pollution is believed to have the most extensive and profound effects on human health and on the ecosystem. Air pollution health studies have in the past relied on single fixed monitoring sites in a study community to characterize exposure. This approach has been realized to be unsatisfactory and weakened results of air pollution epidemiological studies due to the inaccurate determination of exposure to a pollutant suspected to have caused the observed effect. The concept of total human exposure changed the approach of air pollution epidemiological studies and provides a means of investigating the health effects of air pollution more adequately. The purpose of this paper is to convey the background and rationale behind the new approach to air pollution epidemiological studies based on the concept of total exposure assessment.

OPSOMMING:
Lugbesoedeling word beskou as die vorm van besoedeling wat die grootste effek op die mens se gesondheid en op die ekosisteem het. Lugbesoedelingsepidemiologiese studies het in die verlede staat gemaak op enkele gefikseerde metingstasies vir die bepaling van blootstelling binne die gemeenskap wat bestudeer word. Hierdie benadering word vandag as onaanvaarbaar beskou as gevolg van die onakkurate blootstelling wat hieruit bereken word vir korrelasie met waargenome siektepatrone of simptome. Die beginsel van totale blootstelling het die benadering van lugbesoelingsepidemiologiese studies verander, en het meegebring dat blootstelling beter bepaal word vir korrelasie met siektes. Die doel van hierdie artikel is om inligting oor te dra oor die rasionaal vir die nuwe benadering tot lugbesoelingsepidemiologiese studies wat die konsep van totale blootstelling inkorporeer.

1. INTRODUCTION

Firm evidence that air pollution can affect health seriously comes from air pollution episodes such as the Meuse Valley in Belgium (1930); Donora, Pennsylvania (1948); and London (1952), in which excess mortality was clearly demonstrated[1]. Since then numerous epidemiological studies investigating the health effects of community air pollution have been undertaken and provided information used in establishing some of the Air Quality Standards for the USA. However, the usefulness of many past air pollution epidemiological studies has been severely limited by their inability either to identify or to measure the pollutant parameters responsible for the observed effects (cause-effect relationship)[2]. Reliance on outdoor measurements only, therefore, weakened epidemiological studies. The realization that exposure assessment is critical in air pollution health studies, marked a change in the era of air pollution epidemiology. The purpose of this paper is to convey the background and rationale behind the relatively new approach to air pollution epidemiological studies based on the concept of total exposure assessment.

2. HISTORICAL PERSPECIVE

Conventional air pollution epidemiology, which developed as a result of past air pollution episodes, investigated the chronic effects of air pollution in populations living in communities or geographic areas with sharply contrasting air quality[3]. The earliest studies collected few, if any, air pollutant measurements while later studies sought to characterize the heterogeneity of air quality within study communities by gathering data at multiple stations. Outdoor measurements were however found to be of little value in predicting personal exposure to indoor pollutants due to the large percentage of time spent indoors by the average person[4]. Since then, however, regulatory action, economic changes, and new technology have combined to reduce outdoor air pollution in the most severely affected communities. At the same time, tall stack and long-range transport of air pollutants have affected air quality in small communities and rural areas. Progress in understanding the chemistry and particle size composition of polluted air, along with the capacity for more sophisticated measurements, have further undercut the validity of a simple dichotomy between polluted and clean cities[3]. The contemporary setting of relatively low air pollution exposures and multidimensional measurements of air quality required fundamental changes in the design of epidemiological studies. Chief among these changes is the growing emphasis on the measurement of air pollution exposure of individuals rather than communities and the associated emphasis on the measurement of total human exposure rather than exposure due solely to outdoor sources[2]. Total exposure is defined as the product of the pollutant concentration in each location and the time spent in that location, summed over all locations a person visits[5]. This approach therefore includes characterization of both outdoor and indoor levels of the pollutants under investigation in order to determine a cause-effect relationship between pollutants and the health effects observed.

3. INDOOR-OUTDOOR AIR QUALITY RELATIONSHIPS

Indoor air quality is substantially different from outdoor air quality[6]. Considering that people spend most of their time indoors, outdoor air quality standards represent only an indirect method of regulating human exposure to air pollutants. For example, outdoor concentrations of sulfur dioxide overpredict indoor exposure by a factor of 2 while in the case of total particulate matter indoor exposures bear little relationship to outdoor concentration patterns. In the case of indoor sources of respirable particles the indoor/outdoor ratios may be in excess of 5. In the case of ozone, outdoor concentrations overpredict indoor exposure by a factor of five[7].

There are certain pollutants which have spatial variations which can only be characterized by outdoor monitoring programs, for example, automobile emissions which vary temporally and spatially near major roadways, but can be relatively uniformly distributed away from these roadways. For pollutants with primary outdoor sources, such as sulphates, ozone and sulphur dioxide the variation between indoor and outdoor concentrations is determined by differences in air exchange rates and the presence or absence of sinks indoors. For pollutants with indoor sources, variation in indoor concentrations is even more substantial, and indoor concentrations can exceed outdoor values in many instances[3]. The differences between indoor and outdoor air pollution levels illustrate the importance of monitoring both to characterize total exposure for correlation with observed health effects[8].

4. EXPOSURE MEASUREMENTS FOR AIR POLLUTION EPIDEMIOLOGY

Great advances have been made during the last two decades in our ability to measure air pollutants. Human exposures to air pollutants can be studied with direct measurements (personal monitoring) or with estimates of exposure obtained through fixed monitoring sites. In both approaches knowledge of time-activity patterns is important[4]. Continuous sampling records of personal exposures, along with time-activity data, provide the most detailed sampling information and enable researchers to determine the relative contributions of various sources to peak as well as integrated (time-averaged) pollutant concentrations[2].

5. FUTURE STUDIES

Epidemiological studies on the health effects of air pollution are difficult to design and to perform in an unbiased fashion. However, air pollution epidemiology is alive and is now ready to make important contributions to our understanding of the human health consequences of exposure to air pollutants.

Future studies on the health effects of air pollution should be designed to account for important variables such as: pollutant exposures other than those from ambient air, the influence of personal acivity on pollutant uptake, host responsiveness, and the separate contributions of recent transient peak exposures and long-term chronic exposures on the effects endpoints. Independent research projects which should be done includes: determination of the influence of indoor air pollution only on an individual's total exposure, and the influence of the level of physical activity and the shift from nose to mouth breathing on pollutant uptake and effects.

6. REFERENCES

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