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EPIDEMIOLOGY OF INDUSTRIAL ENVIRONMENTAL HEALTH IN TANZANIA

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In this paper, environmental epidemiology data have been used in order to correlate air pollutants emitted from the Wazo Hill Cement Factory with the health of human communities Tegeta and Boko villages, which surround the factory. In this study, descriptive routing data and retrospective and cross-sectional studies of environmental epidemiological approaches are used. Data are collected from three dispensaries and two hospitals. The cross-sectional studies were then applied to compare the diseases in selected places with predicted ground level air pollution concentration and the measured exposure. Diseases such as PUO, chest pain, cough, RTI, and eye problems in the two-case study villages have shown that they may be environmentally derived due to cement dust. Moreover, the higher percentage of related diseases occurs near the source of pollutant. A relative risk ratio assessment indicates that in the two villages, the exposed subjects are 7.5 and 22.5 times in the two villages as likely to develop the disease during the follow-up period than the unexposed subjects.

INTRODUCTION

The relation between environmental hazards and the health of human communities is a growing concern, and interest among professionals dealing with industrial planning and location in general, and medical professionals, environmental engineers, and scientists in particular, is increasing. Physical and chemical agents generated by man's activities may have serious effects on human beings. Some substances may not affect human beings, and some may not produce any adverse effects, while others may be liable (if exposures are sufficient) to affect such basic phenomena as growth and development.

In most developing countries like Tanzania, industries are located haphazardly without considering the environmental impacts and public health of the people in general. Many low income earners in developing countries can not afford to own or lease shelter, and they are attracted to squat near industrial complexes due to the accessibility of the infrastructure facilities in the vicinity of industrial areas. These facilities are water supply, electricity, transport, houses, etc. (Yhdego 1991).

The pollution from such industries has important adverse health effects, and the impact is often difficult to assess. For example, dust is the major air pollutant in the cement industry. Exposure to excessive concentration of dust increases the frequency of mild respiratory ailments such as colds and influenza. For this reason, air pollution in and around cement plants is of environmental health concern. Inefficient performance of electrostatic precipitators is the main cause for dust emission into the atmosphere from the Wazo Hill Cement Factory, which is situated about 24 km from the central business district of Dar es Salaam (Yhdego 1989). If one travels

by air from Kilimanjaro to Dar es Salaam and as one approaches the city, a thick cloud of yellow fumes spreading over many kilometers from Wazo Hill can be seen. The discolourization of the area near the vicinity of the factory from falling particles is visible.

The main objective of this paper is to show a correlation between the dust concentration emitted from Wazo Hill Cement Factory and the environmental health of the human communities surrounding the industry. It is important to point out the difficulties in conducting an epidemiological study in a developing country such as Tanzania. Therefore, the approach used in this study has possible shortcomings. These are unreliable epidemiological and emission data; the most serious shortcoming is that people who don't go to the dispensaries or hospitals are not included in the study.

METHODOLOGY

The dividing lines between epidemiological approaches are not always clearly defined, and there may be advantages combining several approaches within a single survey (WHO 1983; Alderson 1986). The choice of the method must depend on the objects of the study and the resources available (Lebowitz 1977). Descriptive studies of morbidity patterns related to environmental air pollutants were gathered from hospitals and dispensaries. A retrospective study on the pattern of common diseases related to dust, i.e., pyrexia of unknown origin (PUO), chest pain, cough, respiratory tract infection (RTI), and eye problems, from two hospitals and three dispensaries over a four-year period was conducted. The retrospective statistics from the hospitals and dispensaries have provided information on prevalent diseases and their distribution for the population in the vicinity of the industries at historical and given times. The cross-sectional studies are then compared to the diseases in selected places with the Gaussian Plume Mode predicted ground level air pollution concentration and the measured exposure.

EPIDEMIOLOGICAL DATA

The data was gathered from the Wazo Hill, Tegeta, and Boko dispensaries and two hospitals at Lugalo and Mwananyamala. The aim was to establish a correlation between air pollutants emitted from the factory and the diseases which prevail near the vicinity of the factory. The reference villages were Tegeta and Boko and the control areas were at the Lugalo and Mwanayamala hospitals. The data were gathered from 1982-1985 from the dispensaries and hospitals; they are presented in Table 1 and Table 2.

Wazo Hill Dispensary: It is located about 5 km from Wazo Hill and serves people from the factory and nearby area. As can be seen in Table 1, there were 15 859 cases in the dispensary in 1982. From these 565 (3.56%) were PUOs, 790 (5.02%) RTIs, and 592 (3.73%) eye problems.

Tegeta Dispensary: It serves the people from Wazo Hill. There are about 180 people working at the factory and living in Tegeta. The people working with the Asbesco factory are also living in Tegeta, but their number is not more than 15. The dispensary is located about 2 km from the cement factory. As it is shown in Table 1, the number of cases in the Tegeta dispensary are higher compared to the Wazo Hill dispensary. In 1982, there was a total of 24 260 cases with the number either increasing or staying constant in the following years.

Boko Dispensary: From the village questionnaire, it has been found that 120 people work with the Wazo Hill cement factory, and 15 people work with the Asbesco factory. During the blasting process, large quantities of pollutants are inhaled due to the location of the Boko villages. The large increase in pyrexia of unknown origin (PUO) may be due to the increase in limestone blasting in the cement production. The indicated values may be less than expected because the cases in the years 1984 and 1985 were incomplete due to changes in the dispensary staff.

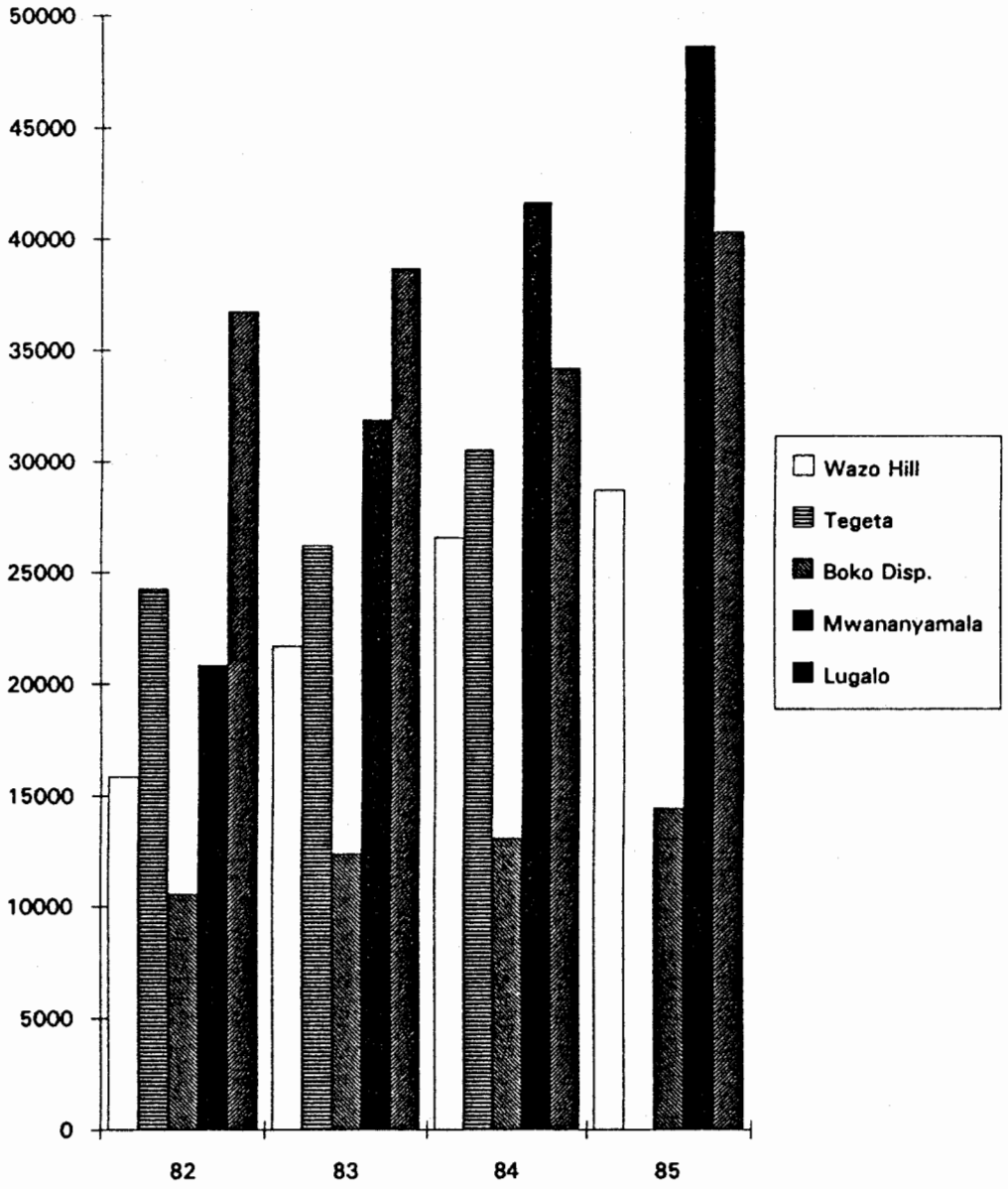
Lugalo Hospital: It was chosen for comparison with the Tegeta, Boko, and Wazo Hill dispensaries. The hospital is located about 8 km from the cement factory. The number of reported cases were very low due to the long distance from the point of emission.

Mwananyamala Hospital: It was chosen as the control station. The nearby residents experienced little dust pollution from Wazo Hill (Table 2d).

The following observations can be made:

—The epidemiological data on human diseases related to cement dust in both villages indicate that PUO, chest pain, cough, RTI, and eye problems are environmentally derived. It is obvious that as the pollutant dose increases (i.e., by accumulation), the incidence of related diseases increases and the induction period becomes shorter.

Table 1. Total number of cases and diseases related to dustfall.



—A higher incidence of related diseases occurs near the source of pollutants; that is, the presence of a hazardous substance in the air indicates extended contact for a high-risk group in an area where large amounts of dust are emitted from the Wazo Hill cement factory.

—As is shown in Tables 1 and 2d and e, the Mwananyamala and Lugalo hospitals have had only very few cases related to dust pollution. This means that there was no pollutant source to initiate disease.

ASSESSMENT OF HEALTH RISK

Although no adequate clinical data exist to relate specific diseases to specific concentrations of pollutants, a certain general relationship is possible. This requires, however, the use of measures of associations such as relative risk and odds ratio. A ratio measure of association (or effect) is a frequency measure for an exposed group divided by a comparable frequency measure for an unexposed or reference group. An example for a ratio measure for incidence comparison is the risk ratio or relative risk (RR). It is computed as follows:

Table 2a. Summary of epidemiological data from theWazo Hill dispensary related to five diseases.

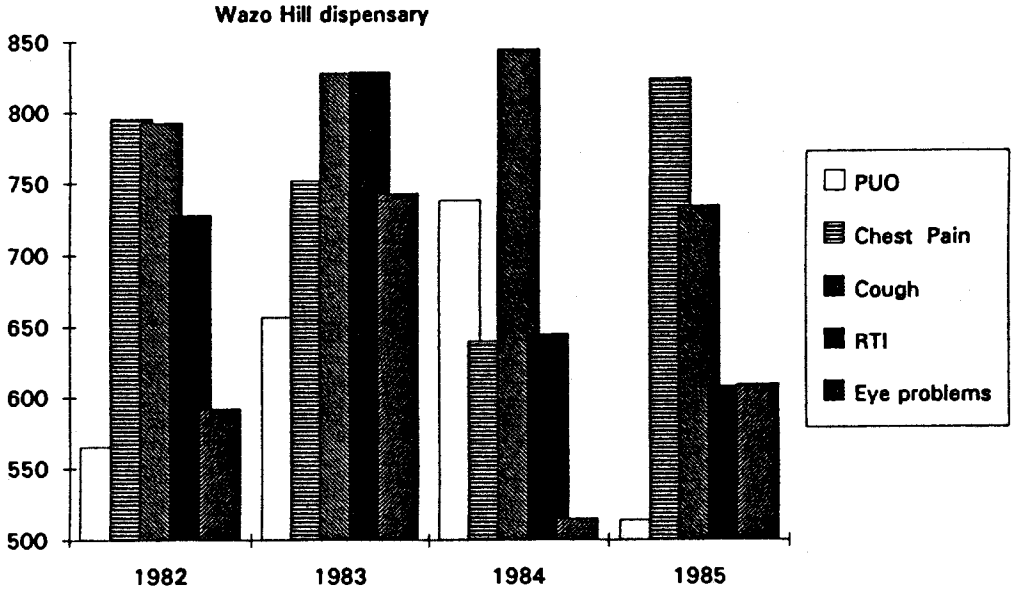


Table 2b. Summary of epidemiological data from the Tegeta dispensery related to five diseases.

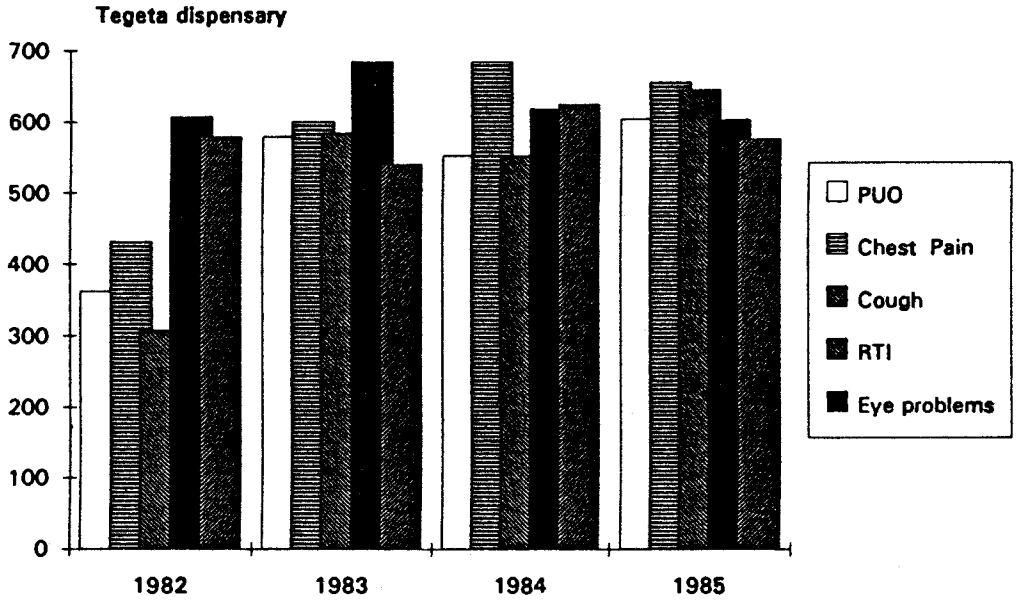


Table 2c. Summary of epidemiological data from the Boko dispensary related to five diseases.

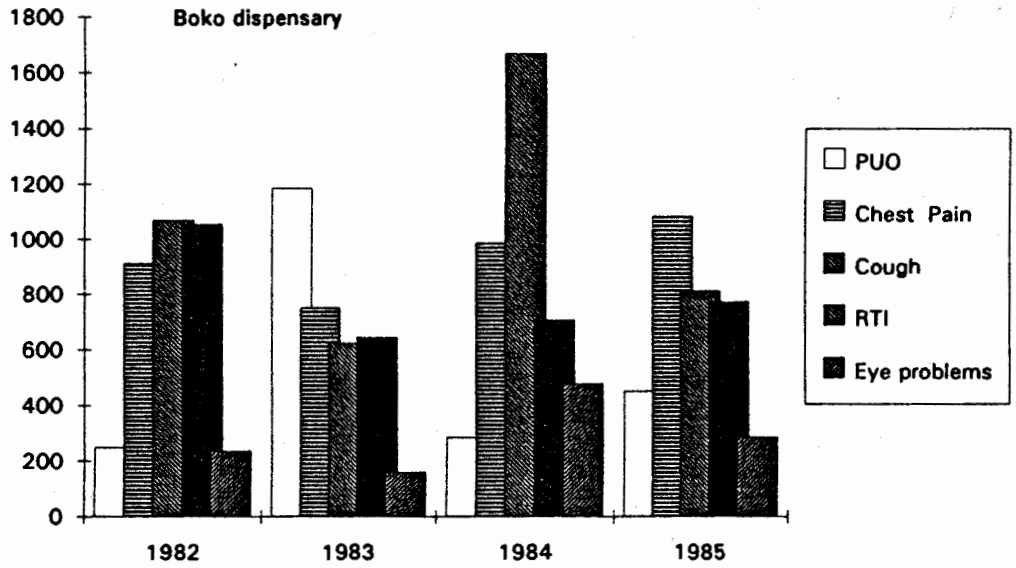


Table 2d. Summary of epidemiological data from Mwanamyamala Hospital related to five diseases.

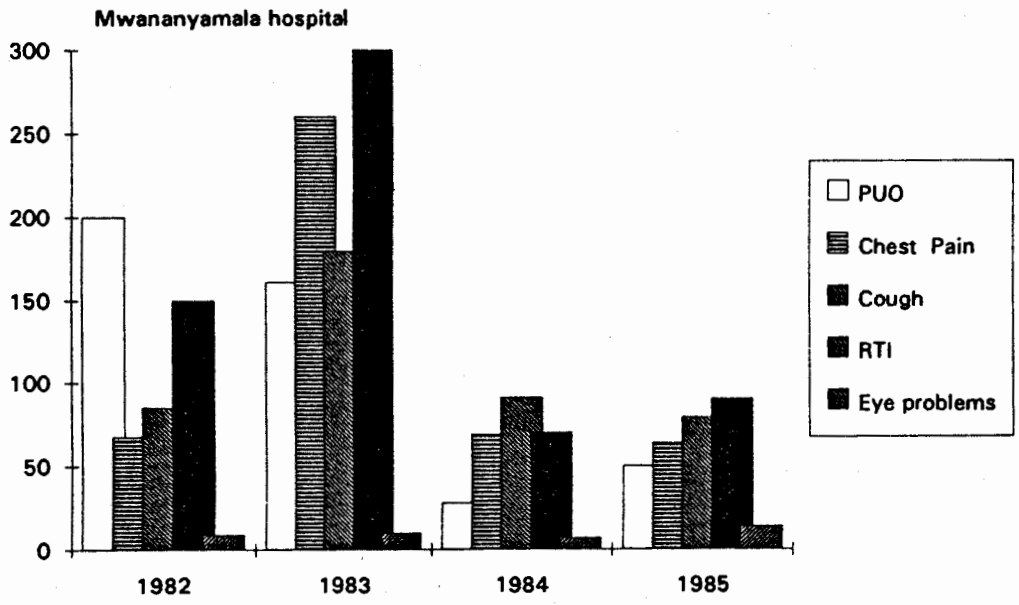
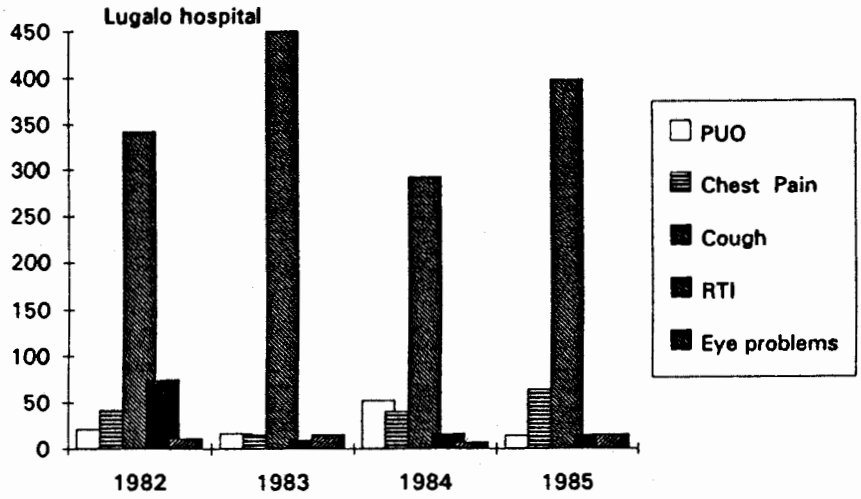


Table 2e. Summary of epidemiological data from Lugalo Hospital related to five diseases.



$$RR = \frac{P_1 = P(D = 1/F = 1)}{P_0 = P(D = 1/F = 0)}$$

where
D = disease factor,
F = risk factor, and
P_1 = (D = 1/F = 1) denotes the chance an individual has to develop the disease if the risk factor is present.
P_0 = (D = 1/F = 0) denotes the chance of an individual developing the disease in absence of the risk factor.

Thus, the relative risk is the quotient of the chances of an individual developing the disease in absence of the risk factor (i.e., the chances of an individual to become affected with the disease while exposed vs. unexposed.) Under the null-hypothesis of no association between exposure and the disease (i.e., effect), the value of RR is 1 (which is called the null value). The estimation of RR is demonstrated by considering the epidemiological data in Table 1. The data are taken from the dispensaries in the Tegeta and Boko villages; Lugalo Hospital is chosen as the reference. The data show that the exposed subjects in the Tegeta and Boko villages were 7.5 and 22.5 times as likely to develop the disease during the follow-up period as were the unexposed subjects.

The chance of not developing the diseases in absence of the risk factor is denoted as

$$Q_0 = P(D = 0 / F = 1)$$

which is the chance of not becoming affected with the disease in presence of the risk factor. These expressions are used to define a second measure of association, the odds ratio. This ratio compares the exposure of cases (i.e., exposed divided by unexposed) with the exposure of noncases. In other words, the odds ratio is used to quantify the magnitude of the association between the exposure and the disease. The odds ratio is computed as follows:

$$\Phi = \frac{0_1 \times P_1 / Q_1}{0_0 \times P_0 / Q_0}$$

where 0_1 represents the presence of the risk factor (exposure) and 0o the absence of the risk factor. The odds ratio can thus be defined as a function of the chance of a subject becoming diseased. Using the data from Table 1 the odds ratio is estimated to be:

$$\text{Tegeta} = \frac{2851 \times 36968.7}{477.7 \times 26754.5} = 8.2$$

$$\text{Boko} = \frac{3611 \times 36968.7}{477.7 \times 8987.5} = 31.1$$

This indicates that the average of the number of diseases in the Teketa and Boko villages is 8.2 and 31.1 times, respectively, greater in the exposed group than the unexposed group. For low-prevalence diseases (± 20%), the odds ratio approaches the rela-

tive risk ratio, and it is common to use the two synonymously.

CONCLUSION

The epidemiological method presented above involves predominantly observations of subjects who are or were exposed to atmospheric pollutants under controlled conditions (patients visiting physicians because of symptoms supposedly caused by living in dust polluted areas). The results may be valuable for discussion without definitive clinical conclusion. The complexity of the work and the difficulty in interpretation of the data pose problems for the epidemiological approach used in this study. Nevertheless, until an accepted approach and a system of general monitoring has been developed, the interpretation of the data of this study might be valid. The issue of validity of epidemiological data in general and the difficulty of distinguishing statistically significant results when multiple comparisons are carried out are major problems that have yet to be overcome. Therefore, a better approach and an improved system are needed to quickly and accurately obtain relevant data about potential industrial environment impacts on health in developing countries.

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