

Letters to Editor

Assessment of the Environment in Studies on Health Using the Example of Płock

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Abstract

The course of 20-year studies on the health of the population of Płock and its neighbourhood has been discussed as regards environmental pollution generated by refinery-petrochemical plant. Analysis of environmental factors and general principles of health-promoting phenomena were of particular concern. This paper demonstrates an increase in options of environmental factors in studies on health in ecologically polluted areas.

Keywords: environment evaluation, health condition assessment, epidemiological studies

Introduction

Different kinds of contaminants related to industrial activity are assumed to be a direct menace to the environment. Penetrating air, water and soil they change ecological conditions of the whole living world. Evaluation of the effect of these changes on health brings about a number of methodological difficulties concerning both environmental factors and the measurement of the effect on health. The studies in Płock province in the 1970s on the effect of refinery-petrochemical plant on the health of the population manifest certain difficulties in this range. They enable at the same time to show progress in this field. The aim of this study is to discuss models of research and their scopes of environment evaluation and assessment of health.

Range of Studies on Health Phenomena in Environmental Aspect

Conceived on a wide scale studies on the effect of environmental contaminants generated by the Mazovian Refinery - Petrochemical Plant in Płock (called at present *Petrochemia Płock*) were carried out by teams from

the Military Medical University in Lodz and Medical University in Warsaw. Initially, the Institute of Biopharmacy from Medical University in Warsaw played the leading part but since 1984 the Institute of Social Medicine took over. To a lesser degree, studies were also conducted by the Institute of Oncology in Warsaw. Until the beginning of 1980 these studies were financed by the Mazovian Refinery - Petrochemical Plant in Płock but since 1984 by different entities including the Governor of Płock, Scientific Research Committee, Provincial Fund for Environmental Protection and Water Resources in Płock, and the Medical University in Warsaw.

From 1977-82 the scope of studies comprised two main subjects:

- evaluation of health and the effect of professional exposure of workers - realized by Military Medical University in Lodz [1];
- effect of crude oil processing products and petrochemical synthesis on health condition of workers and their families (mainly experimental studies) - Medical University in Warsaw [12, 13, 14].

After 1984 the studies concerning health consequences of petrochemical plant in the population of Płock and the province of Płock comprised the following subjects:

- comparative studies on the health condition on the basis of documentation and reports (1985-88) [17];
 - epidemiologic and clinical examinations of the Ptock and Kutno population and the evaluation of the effect of harmful agents of work and residence environment on health (1985-90) [4];
 - studies on health of children and youth in Ptock and Kutno based on methodology of detailed balance studies (1985-91) [2];
 - studies on the course of pregnancy in the area of Ptock and Kutno (1986-91) [16];
 - selected problems of health of Ptock province population in the aspect of environmental factors particularly: health of children and youth in the years 1987-94, deaths due to respiratory tract diseases in the years 1984-94, prevalence of malignant neoplasms in the years 1984-95, analysis of medical diagnoses from a group of symptoms, signs and not clearly determined states (all analyses were performed in the years 1995-96) [5, 11, 18, 19];
 - wide prevalence of neoplasms and diseases with autoimmunological basis (1994-95) [8];
- In the years 1998-99 there were performed:
- examinations of children and youth from Ptock and Kutno comprising the population and with the use of research tools like in the years 1985-89 (results in the course of study).
 - cohort study of adults from Ptock with the use of modified research tools from the years 1985-89 (results in the course of study).

In the above-mentioned studies comprising the period of over 20 years, the range of evaluation of environmental factors and the scope of health assessment were subject of evolution.

Scope of Environmental Factors

Criteria and the range of evaluation of environmental factors were different. In the initial period of studies, in the subjects: „evaluation of health condition and the effect of professional exposure of workers" and "effect of crude oil processing products and petrochemical synthesis on health condition of workers and their families", the following criteria of environmental variable could be distinguished:

A. Quantitative measurement which comprised among others:

- benzene and phenol vapours and toluene on a work place with simultaneous testing of the concentration of these substances or their derivatives in blood and urine of the exposed workers [1];
- controlled in the conditions of experiments with rats, inhaling or dosed intraperitoneally with furfural, xylene, crude oil, crude oil R-33 fraction vapours and heavy metals - vanadium and nickel; as biological effect in this case the influence of furfural on metabolism of higher organisms, rat reproductive process of intestinal absorption, lipid metabolism, changes of antioxidants level, level of neuroregulators in brain, detoxication process in liver [12, 13, 14].

B. The assumption of the occurrence of harmful agents - on the basis of knowledge of the technological process; based on such a way of environment evaluation

- laryngologic, audiometric, olfactometric and ophthalmologic assessment was performed; static and dynamic tests were made - dynamic of the system of balance; prevalence of skin and urinary tract diseases was diagnosed; neurological and psychological examinations were carried out; incidence of occupational diseases, non-specific incidence and the workers' sick absence were analyzed [1]; clinical and biochemical indices of exposure to poisons found in petrochemical industry were looked for; thyroidism in pregnant and in labour women employed in petrochemical plants was examined; incidence of chronic catarrhal bronchitis in employees was examined [13].

The studies co-ordinated since 1984 by the Institute of Social Medicine, Medical University in Warsaw were of epidemiological character and comprised the population of then Ptock province, particularly of the towns Ptock and Kutno. In these studies a general assumption was accepted about the effect of harmful agents emitted by the refinery-petrochemical plant in the area of Ptock and about lack of such effects in the area of Kutno - the control object. Justification of such a choice was first of all location of Kutno south-west to Ptock, what practically protected this town from direct exposure to industrial pollution coming from Ptock particularly from petrochemical plant - the main emitter.

Three phases can be distinguished in the evaluation of the environment for the purpose of the discussed epidemiological studies.

1. In the first phase, at the start of survey studies in the state of the population health, data on the size of dust and gas contamination area of the whole Ptock province including Ptock and Kutno, were available. This information came from official reports for environmental protection purposes. The knowledge of technology applied in refinery-petrochemical plant enables to conclude about the composition of the emitted air contaminants. These data enabled to formulate research hypotheses [4, 17].

Based on the presented environment recognition, a set of studies was carried out comprising the subjects:

- comparative studies on health state on the basis of documentation and reports (1985-88) [17];
- epidemiological and clinical studies on Ptock and Kutno population and the evaluation of the effect of work and residence harmful agents on health condition (1985-90) [4];
- studies on health condition of children and youth in Ptock and Kutno - basing on methodology of detailed balance studies (1985-91) [2];
- studies on the course of pregnancy in the area of Ptock and Kutno (1986-91) [16].

2. In the second phase, in the years 1991-93 specialists from the Department of Geography and Regional Studies of the University of Warsaw made an analysis of atmospheric environment menaces in Ptock province [3, 9]. This analysis was based on data on the emission of dust and gas pollution in the area of the province and fairly detailed data - comprising over 20 compounds and groups of compounds emitted by refinery - petrochemical plant. The results of studies on the content of sulphates on the snow layer, testing of birch bark as an indicator of environment acidification and soil degradation analysis were also used. Moreover, air-conditioning

and aerosanitary conditions were taken into account. As a result it was possible to distinguish three zones of the Plock province:

- 1) areas of an excessively menaced environment;
- 2) areas of significantly elevated emission concentrations of SO₂ and recurring inflows of hydrocarbons from the so called low emission and of frequent odour discomfort,
- 3) areas not subjected to pollution from petrochemical plant.

The above discussed evaluation of the environment enabled the realization of the following subjects:

- selected problems of the health condition of Plock province population in the aspect on environmental factors, particularly health condition of children and youth in the years 1987-94, death due to respiratory tract diseases in the years 1984-94, prevalence of malignant neoplasms in the years 1984-95, analysis of medical diagnoses from a group of symptoms, signs and not clearly determined states (all analyses were performed in the years 1995-96) [18];

- wide prevalence of neoplasms and diseases with autoimmunological basis (1994-95) [8].

3. The third phase of environmental evaluation for the purpose of health studies is connected with initiating in 1995 in Plock the Swedish firm „Opsis" measuring centre. It is the most modern, fully automatic, non-serviced system of air quality evaluation. This system assures spatial - not point like in other monitoring systems - measurements of power industry pollution (sulphur dioxide, nitrogen dioxide) and also contaminants specific for refinery - petrochemical plants like: benzene, toluene, phenol [10]. In this phase of environmental recognition the following studies were carried out:

- examinations of children and youth from Plock and Kutno comprising the population and with the use of research tools like in the years 1985-89;

- cohort study of adults with the use of modified research tools from the years 1985-89.

The Range of Health Condition Evaluation

Working out the study results systematisation of health consequences was accepted based on the level of organism function disorders or damage [6, 7]. This systematisation distinguishes four levels of health condition evaluation:

- subjective symptoms (complaints about health)
- presence of deviations from normal biological condition
- incidence of diseases and morbidity rate
- mortality.

To illustrate the application of this systematisation selected results are presented below.

In the range of *subjective symptoms* the obtained results show that, contrary to expectations, self estimation of the current health (very good and good - mediocre - bad) was similar in both towns. Very good or good health was reported by about 57% of men in Plock and 59% in Kutno. For women the percentage was about 45% in both towns. However, significant differences were found in self estimation of changes which appeared in the

health state within the last 5 years (improvement - deterioration - without changes). Deterioration was reported by 51% of men in Plock and 37% in Kutno. In women 60% and 51%, respectively.

Also the incidence of the state of exhaustion (tiredness) was generally more frequently signalled by inhabitants of Plock. "Rarely or never" was not experienced by about 51% of men in Plock and 56% in Kutno. In women the percentage was 30% and 39%, respectively. The highest differences unfavourable for Plock were revealed in the age range 18-34 years. This also concerns headaches. The option "never" was declared in the mentioned age range by about 33% of men in Plock and 48% in Kutno. For women the percentage was 10% and 20%, respectively. In the majority of medical registers concerning children and adults of Plock there occurred an excess of symptoms, signs and states not clearly determined.

In the case of deviations from *normal biological condition* among the inhabitants of Plock, among others of alfactory sensitivity, frequent arterial hypertension non-specific changes on ECG [15], excess of eosinophils and monocytes were observed. In children clear stimulation of immunological system was found. Also, many results of earlier studies on animals are within this category of disorders [4, 5, 6].

In the range of *incidence of diseases and morbidity rate* more frequent incidence of respiratory tract diseases among inhabitants of Plock was confirmed. More detailed balance studies on children paid attention to a number of unfavourable phenomena which were more often observed among children from Plock, such as:

- symptoms of hyperexcitability and neurosis;
- the so-called major neurological symptoms, pareses, involuntary movements and other focal symptoms;
- disorders in psychological development assessed by the degree of adaptation to school;
- abnormal physical development (the differences were not statistically significant but were observed in three investigated age groups [2]).

The analyses of *mortality* comprising the years 1985 - 1993 showed more numerous death due to lymphatic and haemopoietic tissue malignancy (mainly leukaemia) in the area polluted by the petrochemical plant [18, 19].

Discussion and Conclusion

The material presented here demonstrates that in 20-years of studies on the effect of refinery-petrochemical plant on health condition of the Plock population, the majority of known research models have been used: experimental studies, selective examinations of the exposed population, representative, cross-sectional and longitudinal studies. The applied models evolved from investigating the effect of certain chemical compounds on elementary biological process to complex evaluation of health in large populations.

In the case of the environmental variable, passing over experimental thread of the studies, its evaluation was initially to some extent of estimated character. Difficulties in performing objective, full description of the environment for the purpose of health condition study were of great problem in the initial period of research. In subse-

quent stages recognition of the environment was better [3, 9] and relatively objective [10]. This recognition confirmed correctness of the assumptions accepted in the beginning of the study. Having objective data on environmental pollution by the petrochemical plant, a number of analyses was performed with the use of the data collected in the earlier period [5, 11, 18, 19].

In the case of health variable, since the very beginning there were good conditions to perform relatively precise and complex measurements, secured by the applied research tools like: detailed history, standardized epidemiological tests, medical examinations performed with the use of established, uniform in each case methodology and additional investigations: echocardiography, spirometry, biochemical, haematological and others made with certified methods and measuring equipment.

If the record and description of health phenomena do not cause any significant problems, the interpretation of these phenomena in the aspect of environmental factors is a methodologically complicated issue. Thus, it should be taken into consideration that a complex of multidirectionally bound genetic, environmental, social factors and health manners affect health.

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