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EUROPEAN STUDY ON PUBLIC HEALTH ASPECTS OF HOUSING - Stand

Europe

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Note

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1. Introduction

Scope and purpose of the Consultation

Health aspects of housing and problems of housing hygiene in recent years have been the object of a large number of studies. The significance of the various health problems in this field, which already have been identified may change in time according to change of economic, technological and social conditions. In the more advanced countries of the European Region, some well-known health problems of former decades have lost some of their importance (for instance overcrowding and lack of sanitary facilities). New risks are, however, developing and need attention. A WHO study concerned with the present situation in this field took place in 1977/78, resulting in the report "Environmental Health Aspects of Human Settlements" (ICP/BSM 002, 1978) prepared by Dr A.E. Martin (United Kingdom) and Dr D. Oeter (Federal Republic of Germany). In their report, these two WHO consultants described subjects identified for further study and recommended that a comparative study be organized in a number of selected European towns.

As a follow-up of this recommendation, the WHO Regional Office for Europe organized a Planning Consultation in Copenhagen, from 4 to 7 December 1979, in order to make the preparatory arrangements for this comparative study. Of the subjects identified for further study, the Regional Office selected indoor climate and air quality and noise protection as priorities to be studied under the changing circumstances, such as the impact of energy crisis and the increasing need to save energy.

The subjects selected as priorities have been reviewed only recently by two working groups on "Noise control in buildings" (Budapest, 23-25 September 1976, ICP/CEP 702 (1977)) and on "Health aspects related to indoor air quality" (Bilthoven, 3-6 April 1979, EURO Reports and Studies, No. 21). The report of this latter working group is already emphasizing that the adoption of current energy-saving proposals in many countries, whereby the ventilation rates in buildings would be lowered, could aggravate existing problems of indoor air quality and create new health problems by increased levels of indoor air pollutants.

A number of pollutants released from indoor sources were identified in this report, such as formaldehyde from particle board and foamed insulation, radon from building materials and fibres of asbestos. In some heating systems, as for instance unvented gas-burning appliances, harmful combustion residues such as carbon monoxide and oxides of nitrogen may pollute the indoor air. Other annoying or even harmful substances result from human metabolism, or stem from various human activities inside the buildings, such as cooking, whirl-up of dust, and the use of chemicals in the household, in cosmetics, in hobby activities, etc. The situation is even more aggravated by the introduction of various new products in the household such as sprays which give off aerosols and harmful volatile chemicals.

Dust and microorganisms in indoor air also pose a major problem since they may be harmful to human health, especially in buildings of multiple occupation.

With respect to noise control, major problems are the need for better protection from outdoor noise, especially increasing motor traffic in the vicinity of residential buildings, and better prevention of indoor noise and noise transmission from staircases, elevators, doors, bathtubs, toilets, pipes, etc. Quite often better thermal insulation of buildings at the same time will improve the protection of inhabitants from outdoor noise.

2. Assessment of present knowledge of the health effects of the housing environment

During the past 50 years many research studies have been conducted linking certain housing aspects to an index of the health of occupants. Some of these studies have related an element of housing such as ambient air temperature to a physiological response such as decrease in body temperature. However, housing embraces many environmental factors and the human response to these factors as pertains to health may be such that a physiological need is not fulfilled, or a psychological imbalance may be caused, or an infection may become manifest, or a chain of events leading to an accidental injury may be initiated. Some human responses to a housing factor may be immediate, some may require an incubation period, while others may be dormant for many years before manifesting themselves as disease. It is therefore highly desirable that comprehensive assessments of the results of these many researches be initiated and completed before undertaking new and extensive research studies. Such comprehensive assessments would be, in fact, state-of-the-art reports.

Some partial assessments of the health effects of housing have been made by various persons and/or agencies. However, there is a need to update some of these assessments taking into account the results of some of the recent research studies and to initiate other assessments where comprehensive literature reviews indicate that knowledge of the human health effect is lacking or inadequate.

In making these assessments, special emphasis should be placed upon those housing conditions and characteristics which may be affected by existing poor heat insulation capacity and poor heating or ventilation facilities, or by energy conservation programmes and programmes aimed at more efficient use of energy. These assessments may be made according to the manner by which human health is affected, or they may be made by examining the total human health effect of a particular facet of housing.

2.1 Human physiological responses to the housing environment

A general overview of the basic physiological needs of humans as pertains to the housing environment may be found in Public Health Papers No. 33 by M.S. Goromosov. This presentation includes discussions of the human physiological responses to the climatic factors and conditions of the housing environment.

In a more general sense, basic physiological and health needs related to indoor environment may be listed as follows:

- fresh and clean air (adequate ventilation);
- air humidity in the optimum range;
- thermal comfort (absence of excessive heat, cold and draught);
- noise protection;
- adequate lighting (natural and artificial, for good orientation);
- protection against radiation risks (non-ionizing and ionizing);
- protection against risks of infection;
- protection against toxic risks;
- protection against accidental risks;
- protection against burns injuries from clothing in homes, electricity, etc.;
- furthermore, a large variety of suitable physiological stimuli to all our senses, which keep us in contact with our environment, are indispensable for our physical, psychological and social wellbeing.

The Working Group on Health Aspects related to Indoor Air Quality gave a review of current knowledge of the relationship between health and indoor air quality as may be affected by lowered ventilation rates. The working group identified some of the ways in which there may be adverse physiological responses to the energy conserving process of reduced rates of ventilation. They gave strong encouragement to research institutes and organizations to study the physiological effects of indoor air contaminants as reduced rates of ventilation are expected to cause increases in the concentration of toxic substances in indoor air.

There is great need to make a comprehensive assessment of present knowledge concerning the thermal environment of housing and the fulfilment of basic physiological needs. It is well known that heat loss or gain to the human body is affected by ambient air temperature, radiant temperature, humidity and air movement. However, most efforts to conserve energy, or to use energy more efficiently, have been directed towards the control of the ambient air temperature without compensating adjustments of the other factors. What health effect, if any, may stem from such action is not well understood. It may be that there will be no discernible physiological effect, except that of human discomfort, or it may be that there are distinct health effects upon selected segments of the population, e.g., the elderly who tend to have less efficient thermo-regulatory processes, or it may be that a demonstrable health imbalance may occur.

Some researchers have assumed that better insulation of dwellings will automatically reduce airborne and conductive noise. However, it may be that some insulating measures will provide better sound absorption than others. On the other hand, increasing cost of heating and of energy conservation activities or a shortage of new housing units, may lead to increased crowding of dwellings and an increased noise level in the interior of occupied space.

Adequate natural and artificial lighting are needed to perform most household activities in a safe manner. Reduced or inadequate illumination may result in some injury to the occupants. Until recently, there has been a trend in many European nations to increase the size of windows and the levels of provided illumination. However, the concern about improved thermal and sound insulation of windows and about the more efficient use of artifical illumination in dwellings dictates that a comprehensive assessment should be made of physiological requirements of vision. Some studies of the quantity and quality of lighting have been made, but there is a need to amalgamate these findings into a single comprehensive report for use by housing and health authorities and to identify areas for future research.

A relatively new area of concern in housing and health pertains to the human physiological effects of exposure to various forms of radiations including not only ionizing radiations, but also

non-ionizing radiations. The WHO Working Group on Health Aspects related to Indoor Air Quality identified some problems associated with human exposure in dwellings to radon. The problems of housing and health associated with ionizing radiations are not limited to radon, but include also exposures to other radioisotopes.

Non-ionizing radiations also pose potential health risks to some humans in the housing environment. There are indications that some occupants of housing are often exposed for considerable periods of time to microwaves of an appreciable magnitude. However, no comprehensive assessment of the health effects has been made to date.

2.2 Infection potential associated with housing

Public health authorities have been concerned for a long period of time with the role of the environment in the transmission of infectious agents to humans. This concern has included the housing environment.

The present trend to adapt energy conservation methods in some European countries with concommitant lowering of ventilation rates and with reduced infiltration of outside air through cracks and holes and around openings in doors and windows has restimulated concern among health professionals about the transmission of airborne microorganisms within dwellings. Also, there is concern about an increase in contact-transmitted diseases which may result from increased crowding in dwellings, and from an increase of bacteria in the air. Dampness and mould, as well as the occurrence of house-mite according to increased humidity, will lead to allergic conditions.

There is a need to assess the scope and magnitude of present knowledge about the role which the housing environment plays in the transmission of disease agents to humans, to initiate research studies where present knowledge is lacking and to formulate guidelines on changes in housing facilities and practices that would result in reduced morbidity and mortality for housing-associated infections.

2.3 The psychosocial stress of changes in housing

Mr J.M. Mackintosh in a chapter of his book entitled "Housing and family life" (Cassell & Co., London, 1952) summarized the state of the art at that time for the relationship of housing to mental health and physical wellbeing. Since that time many independent studies have been conducted that have assessed some aspect of the housing environment in relation to psychosocial stress of the occupants. In 1969, at the request of the United Nations, the Swedish Institute for Building Research, Stockholm, performed a thorough literature search on the social implications of various housing conditions and published it under the title of "Social aspects of housing and urban development (Bibliography)".

Today there is a great need to update these assessments, paying particular attention to the psychosocial factors and the mental health aspects of high density and increased crowding, and of loss of various stimuli from direct contact with nature in the modern housing environment, which might even be aggravated as various nations are initiating energy conservation or energy efficient methods in housing.

2.4 The housing environment and accidental injuries

A major cause of disability in all European countries is accidental injury in the housing environment. Several studies have linked housing quality to accidental injuries, showing in general that as the hygienic quality of housing and optical orientation in houses deteriorates the rate of accidental injuries and the severity of such injuries increases.

Special hazards tend to be created in housing when energy conservation methods are initiated or when alternate forms of energy are used. Reduced rates of ventilation may in some circumstances permit the carbon monoxide levels of air in housing to increase to hazardous levels. Sealing of holes, cracks and crevices in housing and thereby reducing infiltration may lead to asphyxiation of the occupants of enclosed space in which there is an open flame.

The use of alternate means of providing thermal comfort, e.g., the use of unit heaters to heat limited areas instead of the use of centralized heating facilities, may increase the rate of fires. While basic knowledge of fire prevention is available readily, application of this knowledge in practical situations is lacking in many areas.

The science of preventing home accidents is lacking everywhere and there is much need to identify, through a comprehensive literature search, the state of existing knowledge and to assess some of the critical areas where new information is needed to prevent or reduce effectively the incidence of accidental injuries in the housing environment.

3. Development of new knowledge concerning the relationship of housing and health

One of the purposes of assessing present knowledge of the health effects of the housing environment is to define areas where additional research is needed. Once a research area has been defined there are usually many approaches which may be used to study the potential relationship.

3.1 Medical considerations in designing housing research

3.1.1 The more common medical approach to studies of housing and health has been the utilization of data concerning acute health effects, i.e., the effects which may be demonstrated at a single point in time as probably being related immediately to exposure to a housing factor, e.g., elevated carboxyhaemoglobin in a person who has been for several hours in a room with a defective heating device which employs a flame. In many circumstances, it is easier to establish a causal relationship between a medical condition and a housing factor when acute effects are considered.

Studies of acute health effects of housing conditions may involve the physiological responses, or the psychosocial stress due to noise, or the incidence of morbidity or mortality due to exposure to infectious agents, or the rate of accidental injuries.

3.1.2 An approach that is used less often, but in the long run may be the more valuable, employs data concerning the health effect of repeated exposures over long periods of time to certain housing conditions. Chronic health effects of environmental factors are taking on new significance as the attention of medical and health personnel is being focused upon such chronic conditions as cancer, emphysema, and cardiovascular disease. However, epidemiological studies of the chronic effects of any agent of the environment are difficult to organize, conduct and analyse. These conditions should not detain the initiation of needed research but are identified only to urge much care and consideration in the planning of studies.

3.1.3 A health consequence of a defective housing environment may be disability. Permanent disability is a frequent consequence of home accidents. An evaluation of the causes of permanent and temporary disabilities in any population group may identify a possible causal relationship between a health condition and a housing environment factor.

3.1.4 Some housing conditions may not cause pathological conditions, but rather may cause discomfort. An example of this health relationship to a housing factor is the irritation of the eyes and the respiratory tract of persons exposed to low concentrations of formaldehyde whose source may be glue used in the manufacture of plywood or urea/formaldehyde foam insulation.

While discomfort may not be of major concern for physical disease processes, it may be a major factor leading to dissatisfaction with the housing environment. Satisfaction and mental wellbeing seem to be closely related and, therefore, a healthful housing environment should not cause major discomfort or dissatisfaction.

3.1.5 The medical consequence of some housing factors may be discernible only in selected population groups. Therefore, some short-term and long-term studies of the relationship of housing and health should be directed to inclusion of only selected groups of people.

3.2 Some basic considerations on designing housing hygiene research studies

Research on the possible relationship of housing and health may be directed at specific factors of the housing environment, acknowledging that a particular aspect of housing may give rise to a variety of forms of ill-health, some of which may be of an acute nature but others of which may be of a chronic nature.

3.2.1 Research on the health effects of housing may be directed at the quality of air inside dwellings. To some extent some of the areas where research in this area is needed has been defined by the WHO Working Group on Health Aspects related to Indoor Air Quality.

In broad general terms, the parameters defining air quality may be classified as:

(a) physical parameters

(b) chemical parameters

(c) microbiological parameters

(d) aesthetic parameters.

In those nations which need to conserve energy in the residential environment there is great need to undertake immediately short-term research on the effects upon the health of the occupants of dwellings in which there is a low rate of ventilation and to use results of this research for immediate remedial action. This should be complemented by long-term research on the respective long-term effects on health.

3.2.2 Conservation and/or more efficient utilization of energy is frequently associated with the thermal environment (heating and cooling) of dwellings. The housing environment in many climates must be such that two physiological conditions may be fulfilled at various times of the year, namely (1) that there should not be undue heat loss from the human body when clothed in apparel appropriate for the activities at hand, and (2) that there should be an opportunity for body heat to be dissipated at a rate sufficient to prevent overheating, discomfort and/or physiological changes within the body.

Since in enclosed spaces sensory perception of warmth or coolness is largely dependent upon the combined effect of the ambient air temperature and the radiant temperature of the enclosure, a feeling of thermal comfort may be maintained when the ambient air temperature is reduced if there is an appropriate increase in radiant temperature.

While some of the parameters of human comfort as defined by ambient and radiant temperatures have been researched thoroughly, there is need to determine the most economical balance of these two parameters in the light of present economic conditions.

The relative humidity of the air is important not only in defining thermal comfort but also in the survival of airborne pathogenic microorganisms. In the optimal range of humidity in physiological terms, there is also the lowest concentration of airborne microorganisms. However, in many housing environments, the optimal relative humidity conditions may not be attainable on a practicable basis as the absence of appropriate insulation may cause some surfaces, particularly outside walls and windows which face the north, to have a temperature below the dew-point. If the temperature of a surface is below the dew-point, condensation will occur. This condensation may give rise to the growth of moulds and fungi.

In most circumstances, if a condition of thermal warmth is to maintained in a dwelling, air movement should be held to a low value. This means that draughts should be minimized. On the other hand, during those periods of the year when cooling is needed, increased air movement is highly desirable. It appears that more research by housing technicians is needed to fulfil these conditions in an optimal manner with the greatest efficiency and effectiveness.

3.2.3 Noise in dwellings in a range which leads to physiological reactions and psychosocial stress is a rather common condition.

While some research has been conducted on reducing noise levels in housing, more basic research is needed. Future research studies should be conducted on the health effects of noise to supplement the knowledge already acquired by previous studies, particularly of the practical and economic means of absorbing both airborne and conductive noise within dwellings, and of the prevention of noise which may be generated either inside the dwelling or in the environs of the dwelling.

3.2.4 Up until now, basic research in the lighting of dwellings has tended to indicate that an illumination which is of better quality was needed generally. The implementation of the results of such research findings when artificial illumination is required has resulted generally in the expenditure of greater quantities of energy to provide the proper lighting. In those countries in which energy conservation is mandatory, an immmediate review of artificial lighting practices is required. The goal of such review is to determine how optimal lighting levels may be attained with the minimum expenditure of energy.

Since single-glazed windows have very poor thermal insulating qualities, a restudy of window design, placement and orientation within dwelling units is needed, not only from the viewpoint of making windows more energy efficient, but also for the provision of aesthetic satisfaction which may be gained by occupants of a dwelling looking out of a window, and also of the other functions which some windows must play in a dwelling, such as providing an adjustable means of natural ventilation, providing an exit from a dwelling in emergencies, etc.

3.2.5 As basic research provides increasing knowledge of the human health effects of various types of radiation, and as building materials, technologies and use of equipment and devices change, there is an immediate need for much additional applied research on total health effect upon humans who may be exposed to a variety of ionizing and non-ionizing radiations of differing magnitudes.

In many European cities, residential structures are being constructed largely of cement, concrete and stone, some of which have high natural ionizing radiation levels. The magnitude of this additional body burden of radiation has not been researched sufficiently to provide definitive answers to some of the questions concerning the health consequences of such exposures.

In many homes, various devices have been introduced and are in use which have the capability of producing microwaves. Also, in some areas, residents in structures are being exposed to high intensity microwaves from industrial, commercial and research sources. There is much need to evaluate the totality of the effect of all of these non-ionizing radiations upon human health.

4. Suggested methods of research

While it is one major objective of WHO activities to protect and strengthen human health by improved environmental health conditions, this objective would need, on the one hand, quick action to reduce any existing and already identified risks, but on the other hand, to be successful, it would also need full knowledge of physiological and health needs of human beings and of all environmental factors which might be relevant to human health.

This implies that neither short-term assessment and action concerned with the more obvious risk factors nor long-term studies to identify the often less obvious long-term risks but rather a combination of both would be the proper approach to this complex problem.

It is therefore proposed to consider the state-of-the-art report to be prepared (see section 2) as the first step in the research and distribute it already to the national health authorities. On the basis of this report a field research programme should be devised which would have to consist of two stages.

The first stage of the entire programme would be a short-term study mainly depending on physical and chemical measurement of environmental conditions and microbiological samples, and would be aimed at gaining knowledge for immediate remedial action. The second stage would have to include prospective epidemiological surveys of the respective residential populations and therefore would have to be devised as a long-term study.

For the entire programme a number of towns in various European countries should be selected as fields of study. In several districts of differing characteristics in each of these towns a number of residential buildings of different size and design (family houses, blocks of multiple occupation, high-rise buildings) should be chosen for study. These buildings should be representative of prevailing types of old and new housing, and to some extent should be considered as setting an example for good housing in all relevant respects (healthy, aesthetic, economical to build and to maintain). It should be possible to identify and include in the study pairs of residential buildings in the same outdoor conditions and of identical characteristics which in part have undergone energy conservation measures and in part have not.

4.1 Short-term study

In the first stage (short-term study) the evaluation of the residential environment would take place mainly in the form of applying accepted standards of indoor climate and air quality, and standards of noise protection, and the respective methods of measurement, to the indoor environment. Where outdoor space in close connexion to the dwellings (like gardens, courtyards, terraces, roof-gardens and balconies) is at hand, measurements should also to some extent cover these places. Physical and chemical measurements should cover all climatic factors and all pollutants which are relevant for the respective buildings.

Of those buildings which are covered by the study, all details which might have influence on residential environmental conditions (building type, size and design, main building materials, thickness of walls, roof construction, thermal insulation of walls and roof, window size and type of glazing, sun shading devices, heating and air conditioning systems, sanitary equipment, etc.) should also be listed and described. Some information on the state of health and the lifestyle of inhabitants, especially leisure time activities, which possibly could be collected from local health statistical surveys and other sources or by a few retrospective epidemiological studies of limited size, might already be included in this first short-term study. The number of inhabitants per dwelling and per room, and the average indoor floor space and air space per person in each residential building, and for each individual the time he or she has already been resident in the present dwelling, should already be recorded in this part of the study. If possible, some time-budget studies - at what places and with which activities people spend their days, their daily spare time and their weekends - should be included. This first part of the study should cover at least one period with typical weather conditions in the hot season and another period in the cold season as well, so as to evaluate the capacities of various residential buildings and their fittings to maintain a healthy environment over the year.

4.2 Long-term study

For better identification of long-term health risks in residential environments, it would be advisable to plan a second study (long-term study), which should follow, if possible, not later than the following year, so as to minimize changes in residential populations and in building characteristics. In this study a check-up will be needed if major changes in the buildings or their immediate physical environment have taken place.

This time, the physical and chemical measurements of the first study will have to be repeated. At the same time prospective epidemiological studies of the residential populations will have to take place, recording physiological functions, all new cases of morbidity (incidence of morbidity), all cases of death of the residents and the respective medical diagnoses. In this study, the above-mentioned time-budget studies would be even more essential. These long-term studies would have to record factors of indoor environment and health conditions of inhabitants under the changing climatic conditions in all seasons of the year, and probably would have to cover a period of three years (this should, however, like all other details of the study, be the decision of an interdisciplinary planning group including an epidemiologist).

Both parts of the study will need - from the planning to implementation and final evaluation - the multidisciplinary cooperation of various professions: physicians, physiologists, epidemiologists, sociologists, chemists, physicists (or noise technicians), sanitary engineers and architects. Therefore, teams including these professions should be asked to cooperate in the study.

Basic physiological and health needs

- Fresh and clean air (adequate ventilation)
- Medium air humidity (30-60%)
- Thermal comfort (absence of excessive heat, cold and draught)
- Noise protection
- Adequate lighting (natural and artificial, for good orientation)
- Protection against radiation risks (non-ionizing and ionizing)
- Protection against risks of infection
- Protection against toxic risks
- Protection against accidental risks

Furthermore, a large variety of suitable physiological stimuli to all our senses, which keep us in contact with our environment, are indispensable for our physical, psychological and social wellbeing.

Annex I

PROTOCOL OF THE EUROPEAN STUDY ON PUBLIC HEALTH ASPECTS OF HOUSING

Aim of the study

The aim of this interdisciplinary study, which is proposed to be conducted in several European countries, is to identify current health problems of indoor environment and housing hygiene, especially health risks which are possibly increasing under the impact of increasing cost of domestic heating and implementation of energy-saving measures. Data shall be collected on all indoor climatic factors and all indoor air pollutants, radiation and noise, which are to be expected in the respective residential buildings and which might be relevant to human health. Data should also be collected on the lifestyle and the health of inhabitants in the respective buildings/dwellings, so as to provide a set of data to compute possible interrelationships between various factors of the residential environment and lifestyle of inhabitants, and direct and indirect consequences of environmental factors in residential buildings for the health of the inhabitants.

To gain valid information on such interrelationships and relevant risks for human health, and to identify the best alternatives for remedial action in reasonable time, the study should be planned primarily as a short-term study. In a later stage, for the identification of yet unidentified long-term risks in the residential environment, a second stage of research in the form of long-term studies including prospective epidemiological studies might follow. This protocol, however, will deal only with the short-term study.

However, some valid recommendations which can already be implemented in building regulations and in building practice, have been made by the WHO Working Group on Health Aspects related to Indoor Air Quality, Bilthoven, 3-6 April 1979 (EURO Reports and Studies 21). Some of the other recommendations of this group which are encouraging further studies can be followed in designing this short-term study. Some other recommendations would have to be left to a later stage of research (long-term studies).

Methodology of the study

It is proposed to conduct a comparative study in several European countries for evaluation of indoor climatic factors, chemical pollutants and particles, ionizing and non-ionizing radiation and noise in various types of residential buildings and dwellings, in some of which various measures of heat-insulation and energy conservation should already have been applied. The present protocol (draft of protocol) will give only a general outline of the methodology to be used in the study, and the type of information that would have to be collected.

All details of such a study, including sample size of the various types of residential buildings/dwellings, selection of groups and sample size of residential population, environmental factors to be the object of registration or measurement, etc., should be left to an interdisciplinary planning group. Such a group would have to consist of epidemiologists and biostatisticians, public health physicians, possibly physicians in medical practice (maybe a general practitioner or an internal specialist, and a paediatrician), laboratory specialists (chemists, microbiologists), sanitary or public health engineers, and architects or housing specialists with similar expertise in housing technology.

If possible, persons who would be interested in participating in the study should be members of this interdisciplinary planning group. This group would also have to design the final study protocol.

In a short-term programme, it would be possible to include epidemiological studies only in a rather limited degree. Thus the evaluation of conditions of environmental health would mainly have to rely on evaluating data on the environment itself, and to rely on the knowledge, however limited, we already have on the relation of such environmental conditions, pollution levels, noise levels, etc., to human health. It would, however, be advisable to supplement data on the residential environment with epidemiological data on the health of inhabitants, which can be collected without major methodological problems in a short-term programme, i.e., mainly data on actual health conditions during the study and retrospective data.

Geographical areas of study

Since another study-project sponsored by UNEP and UNDP with technical assistance by WHO already deals with housing problems in Mediterranean countries with moderate to warm maritime

climate, and since problems of possible deterioration of indoor environment by actual energy conservation measures and the introduction of new technologies and pollutants in residential environments are more relevant to European countries with moderate to cold climates, the study should geographically be restricted to the latter group of countries.

It would be advisable in selecting a number of European towns within this geographical area to give priority to such towns where scientific institutions are located which might be interested in contributing to the study. If possible, the study should not be restricted to large towns only, but should include a few medium sized and smaller towns, where some problems and adequate solutions might be different.

Environmental data to be collected

The data to be collected on the residential environment should cover all outdoor and indoor climatic factors, and all indoor pollutants, radiation and noise, which are relevant to the respective buildings, building materials, indoor appliances, furniture, household chemicals already in common use, etc. The outdoor climatic factors to be measured would be air temperature, sun radiation, humidity and wind; the indoor climate factors to be measured would be natural and artificial illumination levels, particle concentration in the air, ionizing radiation by radon and possibly other radioactive elements, non-ionizing radiation other than heat and light (i.e., mainly microwaves and electromagnetic fields), levels and quality of noise, outdoors and indoors. Chemical factors to be measured would be: concentrations of carbon dioxide, carbon monoxide, oxides of nitrogen and formaldehyde and possibly, under certain conditions, hydrocarbons, SO_2 and some other pollutants. Microbiological factors to be measured would be: bacteria concentrations in the air, and possibly concentrations of certain strains of microorganisms, when there is some medical evidence for the occurrence of infections of the respiratory system and the skin, or of allergic conditions. Furthermore, especially where allergic conditions occur, the presence of house-mite in household dust and indoor air should be studied.

The interdisciplinary planning group would have to decide, under given environmental and other conditions, which of the factors listed above should be studied, since under certain conditions it will be possible to exclude some factors from the beginning without any measurement.

Outdoor space in close connexion to dwellings (gardens, courtyards, terraces, roof gardens, balconies) which to some extent is used as an extension of the dwelling into the open air should, over periods with more favourable outdoor climate, be included in the research. The group would also have to decide on the measurement methods to be applied. Because of various unsolved methodological problems, and because of the need for valid information in a reasonable time, it might be practical to leave it to the study groups in each respective country to choose the method in which they have experience. Data would then be comparative in each country, or between studies using the same methodology only. Nevertheless, the prevailing trends could be internationally comparable.

Building characteristics to be registered (possibly by a standardized checklist) would be: building type (family house, detached, semi-detached, terraced, block of multiple occupation, high-rise residence, unconventional types of buildings such as modern pueblo or pyramid-shaped buildings of multiple occupation, etc.); size of dwelling/flat in square metres and cubic metres; number of rooms and inhabitants; main building materials; thickness of walls; roof construction; and, if any, type of thermal insulation of walls, ceilings and roof. Furthermore, window size and type of glazing, sun-shading devices, heating systems and possibly air conditioning systems, and main sanitary and kitchen equipment should be recorded and described to an adequate extent (as concisely as possible). Some major physical characteristics of the immediate neighbourhood will also have to be registered (outdoor climate and air quality, large trees or large buildings influencing the microclimate, noisy or quiet streets, etc.). It might be helpful if data could be supplied on the amount of energy spent on achieving the respective indoor conditions in the buildings.

The planning group would have to decide which of the already mentioned building characteristics and which additional characteristics need recording as it is essential to avoid gaps in essential information, or producing a "data-graveyard", and to collect the right data for the right purpose instead.

Information on residential population

A questionnaire should seek information - in addition to the data on the number of inhabitants in each dwelling - on the following aspects: health and functional capability at the time of the study; recent occurrence of disease or accidents in the home; way of life, including outdoor activities (time-budget survey); standard of living (per capita income, children respective to their age being calculated as 0.3 - 0.9 persons each). The research should concentrate on groups most often at home: mothers, children and old people. The information needed should be gathered with the help of a standardized questionnaire by trained interviewers.

Information on administrative cooperation

It would be useful also to get some information on how cooperation in planning and environmental control of housing is organized according to the regulations and in practice between the housing and the health authorities.

Analysis and use of the data

Some of the data to be collected can only be made useful by automatic data processing. This will require the help of statisticians. The possibly relevant interrelation between the variables on which data will be collected will have to be pointed out by the members of the planning group. It will then have to be decided which possible correlations could already be checked by more simple statistical methods, and which should be checked by use of automatic data processing. The group should try and give priority to such factors and such correlations which have, or might have more practical importance in the sense that they are more common and possibly have more influence on health than others.

Annex II

DEVELOPMENT OF A PROTOCOL FOR A SURVEY OR STUDY OF THE HEALTH EFFECTS ON THE OCCUPANTS OF DWELLINGS IN WHICH ENERGY CONSERVATION MEASURES HAVE BEEN INITIATED

There is some scientific evidence which suggests that there will be significant impairment of the health of some of the occupants of some dwellings in which energy conservation measures have been initiated. However, since this is not a foregone conclusion, and since there are many variables present in all dwellings that affect the physical and mental health and wellbeing of the occupants, it is prudent to withhold final conclusions of the health effects on occupants of dwellings in which energy conservation measures have been initiated until the specific data concerning the housing conditions and the health effects have been collected, analysed and interpreted.

Before any survey or study is initiated to collect the needed data to make the interpretations, it is mandatory that a protocol of the survey or study be developed carefully and thoughtfully. Many surveys and studies have failed to produce meaningful or useful data because protocols had not been developed with sufficient thought and/or sufficient depth.

1. Responsibility for development of protocol

The final responsibility for the development of a protocol for a study or survey rests with the project director or directors. In many cases an advisory board or committee is constituted to assist the project director in the formulation of the protocol; however, the role of this group is as specific as the title - advisory.

When an epidemiological study or survey is prepared such as one dealing with the health effects of the occupants of housing in which there is reduced ambient air temperature and/or reduced rates of ventilation and/or reduced levels of lighting, it is highly desirable that some of the following types of people assist or advise the project director in the formulation of the protocol (the exact composition of such a group will vary slightly and will depend in part on the availability and interests of such persons to participate in this activity and upon the purpose and scope of the study):

- epidemiologists;
- public health physicians;
- sanitary or public health engineers;
- architects or housing specialists;
- social scientists;
- biostatisticians;
- laboratory specialists;
- public health administrators.

These persons who advise or assist with the formulation of the study or survey protocol may be used effectively by the project director in other ways. They may be used as "consultants" from time to time to assist and advise, either individually or as a group, the project director in solving unanticipated problems that tend to arise during any well-conceived and well-planned project. They may be used very effectively by the project director in interpreting the findings of the research effort.

In the event that the proposed study or survey involves more than one research group, e.g., a study or survey may be conducted simultaneously in several cities or nations by various groups, there must be only one overall project director, but there may be several subproject directors.

While there must be consistency and uniformity between all project units, there is some allowance for flexibility. A subproject director may increase the aim and/or scope of that particular part of the project, provided that the additional coverage by the subproject does not void or negate any of the basic aims or coverage.

2. Defining the purpose and scope of the study or survey

It is imperative that one of the very first sections of a study or survey protocol be a statement of the purpose of the study or of the survey and of the scope of the undertaking. These statements should be clear, distinct and succinct. These statements should leave no doubt in the

mind of the reader as to why the study or survey is being undertaken, what goals are to be achieved, how extensive the project will be and what are some of the distinguishing features of the study or survey.

These statements should include such facts as the nature of the study, e.g., if the study is an interdisciplinary study or if the study is to be solely a collection of housing data garnered by housing specialists. The introductory section of the protocol should describe the type of data which will be collected and the probable uses of the data.

In a study of the health effects on the occupants of dwellings in which energy conservation methods have been initiated, considerable information is given in the title. However, additional facts are needed to clearly understand the purpose of the study. There should be statements expressing some of the concerns found in the report of the WHO Working Group on Health Aspects related to Indoor Air Quality. Further, it should be stated that one of the goals of the study is to provide data upon which a risk assessment of the health of occupants may be used by others in formulating a risk-benefit analysis upon which decisions by the government and others may be made.

The scope should define the subject to be measured or surveyed, the type of dwelling and occupants to be covered, and data concerning the timing of the study and the geographical areas to be involved.

Depending upon the agreed character of the study or survey, other basic or fundamental facts may be included in the paragraphs dealing with the purpose of the project and its scope.

3. Methodology of the study or survey

A second major element of a protocol of a survey or study is a detailed statement of the complete methodology to be used in collecting and analysing the data. It may be necessary to pre-try or pre-test some of the procedures before a final decision is made and the methodology is described in the protocol.

If the study or survey is to be multinational and more than one language is used, it is important to ensure that the methodology of collecting data which is planned for use is accurately described in all the languages involved. This is an especially critical item in the development of data forms which include interview forms.

3.1 Decision concerning what data is to be collected

In conducting any survey or study, only those data should be collected that will have a specific use in the analysis. Some surveys and studies are designed to collect data with a vague aspiration that these data may be useful in analysing and interpreting the results. This is a waste of the valuable resources of manpower and money. Some studies and surveys seem to collect data for the sake of collecting data.

In part, a carefully defined scope and purpose for the study or survey will show what data should be collected. Also, usually an advisory group or committee who are knowledgeable about the subject area to be surveyed or studied will be able to provide valuable information concerning what data should and may be collected with a reasonable degree of validity and with a high degree of usefulness. Care should be taken not to collect data for the purpose of collecting data which at some time and in some manner may be useful.

3.1.1 Interview schedules and recording of data

After it has been decided which data will be collected, it is important to decide how the data will be recorded. In most epidemiological studies and surveys, and as will probably be the case in studies and surveys of the health effects of occupants of dwellings in which energy conservation measures have been initiated, a large amount of data will be collected. For efficient data handling, processing and analyses, an automatic data processing system or methodology will be used. Therefore, the interview schedules, if used, and the data recording forms should be of such design as will permit easy and efficient automatic data processing. Open-ended questions on survey forms should be avoided.

The original survey forms should be of such design that codes for automatic data processing may be placed on them without the need to initiate additional forms. This procedure has several advantages. First, the possibility of incurring errors in transferring data is reduced; second, the scoring, or the transfer of the observations into usable form for automatic data processing may be done by office personnel; and third, the quantity of data forms is reduced, thus making some aspects of the study or survey more manageable.

In recording data which measure an aspect of the environment, e.g., ambient air temperature, there should be prior agreement on which system should be used, e.g., the English system or the metric system, degrees Celcius or Fahrenheit, etc. The measurement units should be uniform to the degree practicable.

3.1.2 Selection of environment measuring instruments

Before any study or survey is initiated, the instruments used to measure the environmental parameters must be standardized to the degree possible and practicable. Many instruments, while intended to measure the same environmental parameter, yield different results. Some instruments are more accurate than others, while some give results with a greater degree of reproducibility.

If a sample is collected and taken to the laboratory for analysis, there must be a standardized method of collecting it and there must be a standardized laboratory method used in examining it. Failure to ensure this may lead to erratic results with much inaccuracy. As an example, if the survey or study of energy conservation measures concerns the concentrations of gaseous air pollutants in a dwelling due to decreased rates of ventilation, the time when the sample is collected, the method of collecting the sample, the way the sample is held and transported to the laboratory, etc., should be standardized for valid and comparable results.

3.1.3 Training of interviewers and/or field investigators

If interviewers are to be used to collect subjective and objective data from the occupants of the dwellings designated for inclusion in the study or survey, they should be trained in the techniques of sorting the information required. Various methods have been developed by various research institutions for the standardized training of interviewers.

Before the beginning of the interview phase of any study, interviewers should be observed in several trial interviews by a superior or supervisor as another measure to ensure uniformity of responses.

If a phase of the study or survey involves the collection of some data by interviews, it is necessary to predetermine the number of attempts which will be made to obtain interview data from a specific sample unit before that unit is designated as "non-respondent".

3.2 The sample size

The size of the sample will be dependent upon many factors and, in the organization and planning phases of a survey or study, the assistance of a biostatistician should be sought to ensure that a sufficient number of observations are made to obtain results with a given degree of reliability.

One of the important considerations to be fulfilled in determining the size of sample to be selected is that the sample should be representative of the universe under study. In general, the more characteristics of the sample to be measured and evaluated, the larger the size of sample needed to obtain valid results.

3.3 Timing of the survey or study

If the survey or study is to involve environmental measures of conditions of the quality of air in dwellings with reduced rates of ventilation, those measurements will have to be taken during those periods of time when the ventilation rates are at their low values. In general, this means that the study or survey will have to be conducted during the cold weather months. On the other hand, if a project involves the respondent's reaction to reduced ventilation or the respondent's memory of symptoms of illness or discomfort probably attributable to the reduced ventilation rates or to reduced ambient air temperatures, the study may be conducted during the spring after the cold weather has ceased but before the memory becomes dim.

4. The analysis of data

The precise steps to be followed in analysing the data will have been determined during the early stages of planning the protocol. For the results of the study or survey to be of value, the analysis of data should begin immediately upon completion of the data collection phase. With few exceptions, the analysis of data should be limited to those procedures for which the study was designed.

5. Drawing conclusions from the data

Care must be exercised in drawing conclusions from the findings identified by the data analysis, unless there is a very high degree of association between the variables under consideration. The findings will be generally a degree of statistical association.

If an advisory group or committee is organized for development of the original plan of the study or survey, consideration should be given to seeking the assistance of that group in interpreting the findings.

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Planning Consultation on the European Study on Public Health Aspects of Housing

Copenhagen, 4-7 December 1979

ICP/BSM 002(4)/1
5 November 1979

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PROVISIONAL LIST OF WORKING PAPERS AND BACKGROUND MATERIAL

Working papers

ICP/BSM 002(4)/1	Provisional list of working papers and background material
ICP/BSM 002(4)/2	Scope and purpose
ICP/BSM 002(4)/3	Provisional agenda
ICP/BSM 002(4)/4	Provisional programme
ICP/BSM 002(4)/5	Provisional list of participants

Background material

ICP/BSM 002	WHO Regional Office for Europe. Environmental health aspects of human settlements; report on a study. Copenhagen, 1978
ICP/CEP 702	WHO Regional Office for Europe. Noise control in buildings; report on a working group. Copenhagen, 1977
ICP/RCE 304(1)(S)	WHO Regional Office for Europe. Health aspects related to indoor air quality; report on a working group (summary report).

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SCOPE AND PURPOSE

In 1978 the Regional Office for Europe of the World Health Organization issued a report on a study, entitled "Environmental health aspects of human settlements" (1). The authors, Dr A.E. Martin (United Kingdom) and Dr D. Oeter (Federal Republic of Germany) suggested in their conclusions that "in the first place a comparative study might be undertaken of a number of selected towns of differing types with the object of determining the varieties of problems, their respective importance, and the ways in which the various countries have sought to deal with them".

The purpose of this Consultation is to follow up the above recommendation, establish a detailed working plan of the study on public health aspects of housing to be developed in seven selected European towns, identify the collaborating institutions which will be responsible for the study in each town, draft a working protocol and set up mechanisms for coordinating the study. Current problems of housing hygiene in Europe in relation to the increasing cost of domestic heating will be examined, and the impact of labour migration on the environmental health aspects of town planning will be taken into account.

In addition to the above-mentioned report, documents relating to two working groups convened by the Regional Office (on noise control in buildings (2) and on health aspects of indoor air quality (3)) will serve as background material for the Consultation.

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1 Martin, A.E. & Oeter, D. Environmental health aspects of human settlements. Report on a study. Copenhagen, WHO Regional Office for Europe, 1978 (document ICP/BSM 002).

2 WHO Regional Office for Europe. Noise control in buildings. Report on a working group. Copenhagen, 1977 (document ICP/CEP 702).

3 WHO Regional Office for Europe. Health aspects related to indoor air quality. Report on a working group (in preparation) (see summary report-document ICP/RCE 304 (1)(S)).

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PROVISIONAL AGENDA

1. Objectives of the study on public health aspects of housing in Europe

2. Selection of seven cities in areas presenting different climatic and socioeconomic conditions.

3. Identification of collaborating institutions in each of the seven cities

4. Working protocol for the study

   4.1 Indoor climate requirements in terms of minimal ventilation and temperature

   4.2 Noise control in low-cost housing

   4.3 Space and density

   4.4 Sanitary equipment

   4.5 Social, leisure and facilities requirements of the housing surroundings

   4.6 Needs of special groups: elderly, children, pregnant women and babies, handicapped

   4.7 Impact of climatic and socioeconomic conditions

5. Working plan for the study

6. Coordination mechanism for the study

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PROVISIONAL PROGRAMME

Tuesday, 4 December 1979

08.30 - 09.00	Registration of participants
09.00 - 09.30	Opening of meeting
09.30 - 10.00	Scope and purpose of the consultation
10.30 - 12.00	Discussion of background document ICP/BSM 002: "Environmental health aspects of human settlements"
14.00 - 15.00	Discussion of background document ICP/CEP 702: "Noise control in buildings"
15.30 - 17.00	Discussion of background document ICP/RCE 304: "Health aspects related to indoor air quality"

Wednesday, 5 December 1979

09.00 - 10.00	Discussion on the purpose of the European study on public health aspects of housing
10.30 - 12.00	Discussion on the contents of the European study on public health aspects of housing
14.00 - 15.00	Discussion on the collaborating institutions to be selected and the European towns to be selected
15.30 - 17.00	Discussion on the protocol of the European study on public health aspects of housing

Thursday, 6 December 1979

09.00 - 10.00	Preparation of the first draft of the study protocol
10.30 - 12.00	
14.00 - 15.00	
15.30 - 17.00	

Friday, 7 December 1979

09.00 - 10.00	Preparation of the second draft of the study protocol
10.30 - 12.00	Preparation of conclusions and recommendations
14.00 - 15.00	Discussion on the conclusions and recommendations of the consultation and the actions to be taken as a follow-up to the consultation
15.30 - 17.00	Discussions continued; closure of the meeting

Note: Coffee break 10.00 - 10.30 and 15.00 - 15.30
Lunch break 12.00 - 14.00

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LIST OF PARTICIPANTS

BELGIUM

Mr G.F.M. Nelissen
Senior Engineer
National Institute of Housing
Boulevard St. Lazare 10
1030 Brussels

DENMARK

Professor B. Holma
Institute of Hygiene
Faculty of Medicine
University of Copenhagen
Blegdamsvej 21
2100 Copenhagen Ø

GERMANY, FEDERAL REPUBLIC OF

Dr B. Seifert
Scientific Director
Institute for Water, Soil and Air Hygiene
Federal Health Office
Corrensplatz 1
Berlin (West) 33

SWEDEN

Mr G. Skjönberg
Head, Public Health Aspects of Housing
National Board of Health and Welfare
Fack
106 30 Stockholm

OBSERVERS

Associate Professor B. Berg-Munch
Laboratory of Heating and Air Conditioning
Technical University of Denmark
Building 402
2800 Lyngby
Denmark

Associate Professor E.W. Mood
Department of Epidemiology and Public Health
School of Medicine
Yale University
60 College Street
New Haven, Connecticut 06510
USA

CONSULTANT

Dr D. Oeter
Academy of Public Health
Auf'm Henneskamp 70
40 Düsseldorf 1
Federal Republic of Germany

TEMPORARY ADVISERS

Mr F. Gasparović
Councillor
Secretariat for Urban Planning, Civil Engineering, Housing and Communal Affairs of the Republic of Croatia
Marulićev trg 16
Zagreb
Yugoslavia

Dr G.I. Muravieva
Assistant Professor
Chair of Community Hygiene
Central Institute for Advanced Medical Training
Ministry of Health of the USSR
Rahmanovskij pereulok 3
101431 GSP Moscow K-51
USSR

Dr D. Rolny
Research Institute of Preventive Medicine
Ul. Ceskoslovenskej Armady 10
80000 Bratislava
Czechoslovakia

Dr Maria Tchoutchkova
Institute of Hygiene and Occupational Health
Boul. Dimiter Nestorov 15
Sofia 1431
Bulgaria

WORLD HEALTH ORGANIZATION

Regional Office for Europe

Mr E. Giroult (Secretary)
Regional Officer for Basic Sanitary Measures

Dr M.J. Suess
Regional Officer for Recognition and Control of Environmental Hazards

Dr H. Vuori
Regional Officer for Primary Health Care