

SUMMARY AND DISCUSSION

1 SUMMARY

"In the world today, accidents cause more deaths than any single illness except cancer and cardiovascular disease. --- Too many people still unthinkingly accept accidents as misfortunes over which the individual has no control. 'Accidents will happen'. --- Yet whenever studies are made of accidents ways can always be found to reduce their number and seriousness." (Candau WHO 1961).

Epidemiological methods are traditionally used in studies of infectious or chronic diseases but are now applied to studies of accidents as well. "The only possibility to learn more about the epidemiology of accidents, than is provided by traditional statistics, lies in an endeavour to analyse the course of events in accidents by means of detailed information, to reconstruct it and attempt to form a conception of the factors which usually play a part and are the most important in originating the accidents" (Berfenstam 1961). Such studies, however, are still uncommon, as is evident, for instance, from an abstract of home accidents (Backett 1965).

1.1 STAIRS VIEWED ARCHITECTURALLY

In Sweden there are more than 3 million dwellings, and more than half of those have been constructed since World War II (Housing census 1965, 1967/68, Lundevall 1971). The opportunities for enforcing certain requirements concerning dwellings, safe stairs for instance, depend on the resources for standardization.

From an architectural-historical view-point the stairs were not paid very much attention as building elements until the end of the 15th century. Far into that century the staircase was seen only as an element which hampered the good planning of a building. Not until the middle of the 1900's the staircase has attracted any interest from the view of safety. In the broad investigation project on stairs begun in 1967 by the architectural section I B at the Lund technical academy it very soon was found that convenience and aesthetical requirements had been allowed to prevail, while the safety requirements had been neglected (Svanström, K. 1973). Collaboratively about 15 investigation projects were launched by the institution mentioned, the institution for building functionology at the Lund technical academy, the Lund university institutions for anatomy, physiology, social and preventive medicine, and the institution for photography at the Stockholm technical academy. Those investigations include, for instance, inventories of staircase wells, flights, handrails, refuse wells and refuse chutes but also studies of space accommodations and stretcher carrying. A lift for low houses has been developed. The medical investigations consist of a physiological and a functional-anatomical study. Finally a socio-medical and epidemiological study has been made; this is reviewed in 1.3.

1.2 STATISTICAL DATA AND EARLIER SURVEYS

The official statistics of fatal accidents, and available studies of fall accidents give us a fair idea of the bearings of the problem. Fall accidents is one of the two most extensive accident groups, and in Sweden alone about 1.000 persons die of this cause each year (National central bureau of statistics 1970). Falls on stairs constitutes about 10% of these accidents. Mainly elderly people contract injuries serious enough to be fatal. There are findings indicating that non-fatal fall accidents are more common among children than among the elderly (Statistical Bulletin, August 1965). Hospital statistics from clinical care in Sweden show that accidents were responsible for about 10% of all cases in clinical somatical care and the biggest group was made up by the fall accidents which, for instance, were responsible for nearly twice as many cases as transport accidents (Swedish Board of Health and Welfare 1970).

1.3 INVESTIGATION METHODS

The epidemiological survey of staircase accidents has been made in Malmö which has about 260.000 inhabitants and thus is the third biggest city in Sweden. The selection includes 273 persons who after falls on stairs have come to the surgical and orthopaedical clinics' receptions for acute cases at the only somatic hospital of Malmö in the course of one year. These persons have been interviewed on background factors and trigger factors but also concerning the course of the accident and the period following the accident. The circumstances that more indirectly have contributed to the accident are called background factors, while those that are the immediate causes of the fall accident are called trigger factors. The interview form contained about 180 variables and has been enlarged with complete studies of hospital diaries and classification of injuries. Possible error sources are discussed in the survey. The epidemiological survey of staircase accidents also includes technical investigation of the accident stairs.

1.4 PREACCIDENTAL PERIOD. BACKGROUND FACTORS

The background factors are classified in factors describing the victims, the stairs and the environment. The age distribution in the investigation material shows that children and elderly persons are especially exposed. Women are overrepresented among younger and older persons, while men prevail among the middle-aged in the material. Previously married persons likewise are overrepresented, and the distribution of social groups indicate some overrepresentation by social group III. Mapping of the victims' alcohol consumption habits and comparisons with fresh Swedish statistics (SOU 1971) indicate that victims in the age group 40-59 years have a greater consumption of alcoholic beverages than the corresponding age group in the population as a whole.

Among the physical background factors circulatory complaints seem to be more important than lowered capacity of motion. The results suggest an overrepresentation of such symptoms as shortness of breath and dizziness, which may have other causes than circulatory complaints.

The results also indicate overrepresentation of such psychical factors as "general tiredness" and "restlessness". The concept of accident pronenes (the human factor) likewise has been discussed but no results confirming or contradicting that concept have been put forward. According to Thorson (1972) it is to be feared that such a concept could be used as an excuse for omitting preventive measures.

A comparison with an inventory of stairs in Malmö during the period after 1950 indicates that the U-shaped two-flight stair caused substantially fewer accidents than the straight single-flight stair.

Persons with reduced motion abilities seem to have difficulties in stairs with great variations in goings within the same flight of steps. It would seem that elderly persons have special difficulties in stairs that are entirely without handrails, and not less than 18% of the accident stairs are entirely lacking in this respect.

Under environment factors we have mainly discussed the burden of work and the activity immediately before the accident. The findings suggest that persons with heavy work follow a different pattern in staircase accidents. Thus they happen to fall during the day-time to a greater extent than other groups, and this correlation might be an indication that the very burden of work is of great importance as a background factor - a correlation that requires further analysis.

1.5 PREACCIDENTAL PERIOD. TRIGGER FACTORS

The factors that directly have triggered a fall are described in chapter 4. The results are based on interview statements.

Impaired motion ability, dizziness and balance difficulties and "general physical weakness" are the most common physical trigger factors. Hurry and bustle are the prevailing psychical factors, according to the subjects' own statements. In several cases children's play has been reported as the main cause of accidents.

Only 3% have stated alcohol as the main cause, in spite of the fact that 17% have been under the influence of alcohol at the occasion. Among middle-aged persons, however, 35% have been influenced by alcohol. Several investigations confirm the connection between alcohol and accidents in general, while exactly in fall accidents alcohol hardly plays any decisive role and several other main factors are of more importance.

In 27% of the cases factors in and around the stairs have been stated as main factors, mostly construction factors but also wearing and tearing, loose objects and moistness. Certain types of footwear and various loads also have caused accidents.

1.6 ACCIDENTAL PERIOD

The accidental period as such has been classified in three phases: initial movement pattern, defence reaction and injuries.

The downward motion on the stairs is the most dangerous, which is confirmed by the fact that 76% of the victims were on their way down when the accident occurred. Selvik et al. (1973) find that in upward motion the foot is moved only 1 or 2 centimetres above the riser. In our material we find that almost 40% of the stairs have a variation of more than 2 centimetres in their risers.

In experiments on provoked falls (Lichtneckert 1973) the results indicate that the subjects, when stumbling was elicited, more easily avoided falls if they went with lesser speed. This is confirmed, for instance, by the observations that exactly hurry and bustle is an important trigger factor in the staircase accidents we have investigated.

Melvill Jones et al. (1972) feel, after studies of nervous reactions in man, caused by sudden falls, that the so-called functional stretch reflex totally fades away in short, sudden falls, and this fact might be the cause of the astonishing extent injuries can have even after very short falls. That elderly women seem to be particularly exposed to staircase accidents might be explained partly by the duration of the exposition time as such in their homes, partly by a different movement pattern, as well as the frailness of bones that is an effect of aging. Contracted injuries have been diagnosed according to the WHO classification and finally brought together in 5 main groups. Head injuries have befallen 37% of the victims, mostly children. Only 8% have contracted trunk injuries, while injuries of the upper extremities have befallen 19%, mostly elderly persons. The 15% who have contracted injuries of the lower extremities have to a great extent been elderly persons. Foot injuries, which have befallen totally 23% of the victims, also have been characteristic in elderly persons.

1.7 POSTACCIDENTAL PERIOD

Totally 3 of the persons included in the survey have died from accidental falls on stairs, but the death cause statistics from the period concerned has 5 deaths registered.

Totally 67 persons came on the sick-list, which means 60% of the insured persons.

An appreciation of the cost of hospital care and sick-listing alone gives about 15 million crowns a year in Sweden on account of staircase accidents. In addition there are the costs of following-up control, out-patient care, invalidity, losses in production and so on.

1.8 THE RISK FACTORS OF THE STAIRCASE

Within the material two concepts have been construed: "grave" respectively "light" injuries, in view of medical and economical factors and working capacity. The straight single-flight stair appears to be a particular risk factor, while the U-shaped two-flight stair seems to have the best properties.

2 PREVENTION

Backett (1965) feels that home accidents might be tackled as a health problem on two levels:

1. Centrally by means of legislation and "social policy" and emphasis on organizations in reference to health service.
2. Locally on the family level by means of education in order to diminish the risks and/or construction of the environment.

In the review of children's accidents in Europe (Council of Europe 1972) three main aspects of safety work are maintained: organization, legislation and accident control. This review then gives an account of several recommendations of ways to avoid children's accidents. Saha et al. (1969) render four prevention aspects:

1. information,
2. protection,
3. education,
4. legislation.

2.1 INFORMATION

Information is given over mass media, and this opportunity for spreading systematic information on investigation results concerning accidents should be utilized. The Swedish newspapers' handling of accidents has been studied by Lagerberg (1970). The primary material for this study consisted of death certificates sent to the National central bureau of statistics concerning persons who had died from accidents in 1966. It was found that the age groups 5-14 years are best covered by the newspapers, where 67.2% of these deaths were mentioned, 25% of the men's against 7% of the women's. Only 4% of all fatal fall accidents were mentioned, against 10% of the poisonings, 25% of injuries from etching substances, 42% of machine accidents, 47% of drownings, 52% of burning accidents and 60% of shooting accidents and explosions. Elucidations contributing to a clearer picture of the accidental happening were rather scarce in comparison with plain reports. In the news items about fall accidents instructions were entirely lacking, in spite of the fact that fall accidents were responsible for more than half of the fatal accidents in 1966.

In the first place the newspapers must be made to pay attention to their role in a general chain of information and education. At present there is no systematic information about accidents from the Swedish broadcasting and television corporation.

In Sweden the health education delegation (HVUD) of the Swedish Board of Health and Welfare is stimulating the regional activities by means of health education. One of its major components should be information concerning accidents. There are, however, many indications that information of a general character is very limited in its effect and rather should be directed as education of certain target groups.

2.2 EDUCATION

In the case of children's accidents the Unesco Courier (1961), for instance, expresses the opinion that "education is the best vaccin against accidents". It is also suggested that education or instruction of the children should start with education of the parents. Some results indicate that a generally directed education or information not has any great effect, either. So, for instance, Cullinan (1971) refers to an investigation from Rockland, New York. There two districts had been selected; one of them was exposed to a massive accident prevention propaganda, and while the investigation was followed up for several years, the number of accidents could not be significantly diminished in the district exposed to the propaganda. According to the author, one cause of this might be failure in reaching the right groups.

In WHO:s great review of home accidents (Backett 1965) the "family doctor's" particularly important position is pointed out. This would at least be the case in countries where there is an adequate number of physicians. In many countries, however, the district nurse or her opposite number is the only home visitor. Control of the design of houses, stairs and so on, as well as secondary safety control by holding the manufacturers responsible, along with the usual legislative measures, are the ways that should be used to make the homes safer. Also Behan (1963), for instance, points out the importance of the general medical practitioner. In the big cities of Sweden, such as Malmö, there is no established general practitioners' organization of the "family doctor's" type. All care of the sick and accident victims is centralized to one hospital, where patients from a district with about 260.000 inhabitants are admitted. In addition there are a few industries' physicians and a for Sweden proportionately great organization of private practitioners (Dahlin et al. 1972).

2.3 LEGISLATION

The existing possibilities to guide the design of housing by means of recommendations and regulations should be utilized. Standardization requirements in connection with government loans can influence the moulding of a safer environment. The Swedish standardization commission is an advisory body in questions of housing construction, but the Housing Board, which is the governmental lending body, states "Swedish standard" as a qualification for governmental loans. In fact, the standardization commission consists of various groups, each of which attends to its special sector of the housing environment. So there is, for instance, a group attending to construction standardization of stairs. This group includes representatives from the Building Industries Association, the Construction Workers' Trade Union, the Housing Board, the Construction Board, the Government's Planning Department, HSB (the tenants' savings and building association), Riksbyggen (another construction enterprise) and so on. The broad scientific research group concerning stairs also is represented (Kvarnström 1973).

2.4 PREVENTION BASED ON STAIRCASE RESEARCH

2.4.1 Risk groups

It is mainly children and elderly people who are particularly exposed to staircase accidents, as well as women, previously married persons and persons belonging to social group III. Persons afflicted with circulatory complaints, with lowered capacity of motion, dizziness or balance difficulties also are among the exposed. The correlation between influence of alcohol and increased accident risk is evident from several surveys, although that factor is not totally predominating in our investigation. Yet it is clear that alcohol-influenced persons in the age groups 40-60 years seem to be particularly exposed to staircase accidents. The risk groups also include persons exposed to psychical stress.

2.4.2 Construction of staircases

It is mainly the construction of the staircases that provides opportunities to prevent staircase accidents as well as limit the extent of possible injuries. The results of the investigation indicate that various factors concerning the staircase have constituted the main cause in at least one fourth of the accident cases.

A staircase should be built as a so-called U-shaped two-flight stair with landing. Winding stairs or straight single-flight stairs are not recommended, nor are stairs with few steps or without handrails. Detailed measures of risers, goings and widths cannot be laid down on basis of this epidemiological study. Yet, in view of the fact that so many accidental falls have occurred in stairs unfamiliar to the victims, it seems that measures in the vicinity of those already existing would be preferable. Types of stairs that entail variations of the different measures within the same flight are to be avoided entirely. The same applies to nosings.

The conditions of friction between shoes and the covering stuff of the stairs is only partly investigated and should be subject to a special study. Special studies of the behaviour of children and elderly persons in staircases are also explicitly desirable. Children deviate from adults in their pattern of movement in stairs, as do elderly people with lowered capacity of motion. Motion impediments are very common among the elderly (Svanström 1972).

The possibility of fitting in double handrails, vertically too, e.g. a special handrail designed for children, should be considered. From the survey it is clearly evident that the handrails not are being used in normal treading as a rule, and therefore the handrails should be designed to provide a firm hold and so be able to brake a fall. The staircase should be made narrow enough to allow use of the handrails on both sides. If greater capacity is needed, each row of steps should be bordered by rails.

The functions of the staircase in "mass evacuations" in public places for instance, have not been completely analyzed either. In view of the accident risks in connection with fires and the like, this question should be subject to a special study.

The lighting factors should be looked into more closely, since this has not been possible in the present study. It is evident, however, that staircase lighting that goes out while a person uses the stairs is not suitable, and permanent lighting should be constructed. In addition the brilliance of the lighting should be looked into, in view of the elderly's overrepresentation in staircase accidents and especially because of the far-reaching consequences fall accidents may have to this group of people.

"Cost-benefit" studies have not been feasible within the program. but the appreciation of social costs that has been made indicates that such a study should be accomplished.

It is obvious, too, that the staircase should not constitute the sole connection between two levels, partly because of its considerable accident risk, partly because of the motion difficulties that bother special groups. In an endeavour to make the environment "available to everyone" stairs alone are inadequate and a lift should be added.

2.4.3 Discussion

In a "conventional" dwelling house the staircase occupies about 15% of the total floor space, equating at least 1/6 of the construction cost (Kvarnström 1973). In the early 1970's more than 100.000 dwellings a year were produced in Sweden (Lundevall 1971). Each year about 50-60.000 staircases are built, approximately half of them in tenement houses for several families (Kvarnström 1973). If the going measures were maintained but the riser measures were kept close to 20 centimetres, there would, compared with a riser measure close to 15 centimetres, be a "profit" of one step on each floor level. With a going measure of about 25 centimetres and a width of about 1 metre the yearly "profit" in Sweden would be at least $50.000 \times 0.25 \text{ m}^2$ or 12.500 m^2 . If the production cost per m^2 of horizontal space is estimated at 700 Swedish crowns the total profit would be between 8 and 9 million Swedish crowns a year (Kvarnström 1973). Against the higher riser speak the difficulties for children and elderly people - but this question is still imperfectly analysed. It is possible that a "concession" to higher risers might be counterbalanced by opportunities for installing lifts in low buildings as well. Previously the technical problems entailed by such lifts could not be solved, but thanks to a new construction developed in connection with the broad staircase research program it is now possible to provide every dwelling house with such a contraption against low cost. It is clear, however, that construction of stairs with risers close to 15 centimetres, and lift in addition, would be the most satisfying solution.

The aim of the sociomedical-epidemiological study has been to produce a basis for preventive work concerning staircase accidents. Here the epidemiological method has presented great advantages, completed with laboratory investigations

and other studies within a broad scientific program. Such research projects are scarce, but the experiences provided by this one seem good enough to indicate that the method might be considerably developed. Then it could be applied primarily to fall accidents in general, since it cannot be denied that those constitute a big social problem. The accident research, by the way, has only to a limited extent utilized the existing opportunities to shed light upon their problems and get many-sided aspects by means of a broad-scientific epidemiological working method. Only in such a way it is possible to obtain a supple foundation for increased knowledge of the feasible contributions to preventive measures.

As Karl Marx says: "Bewusstsein ist bewusstes Sein".