

Implementation of ergonomics at the workplace

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Ergonomic activities began in Swedish industry in the 1940s. By the 1950s, about 50 major Swedish companies had occupational health units. Today, about 75 % of the Swedish work force is covered by occupational health services. Preventive measures also became the subject of increasing attention.

The Institute of Work Physiology, with Dr NPV Lundgren as its director, was founded in 1955. The first major occupational physiology and ergonomic studies started primarily in the forestry, manufacturing, and construction fields. The ergonomic studies were made in collaboration with experts from different disciplines. The research was aimed at comparing different work methods from an ergonomic viewpoint (3).

Industrialization in the manufacturing industries often led to high demands on adaptation to the work process, which often led to health problems among the employees. As a result, companies soon became interested in ergonomic issues. Volvo's Skövdeverken factory and Drs Heijbel and Yllö were pioneers in the implementation of ergonomics in the Swedish manufacturing industry.

The International Ergonomics Association held its first conference in Stockholm in 1961. The Nordic Ergonomics Association was founded in 1968. Ergonomics is now a familiar concept in present-day Sweden. Occupational health services play a major role in the implementation of ergonomics at Swedish workplaces.

Legislation and regulations

The 1978 Work Environment Act regulates the work environment in Sweden (7). The National Board of Occupational Safety and Health is responsible for the implementation of the Act, which attaches particular importance to ergonomic matters. A special ordinance on work postures and work movements has been in force since 1983 (8). The National Board of Occupational Safety and Health operates through regional labor inspectorates (19 districts) whose activities are based on the Work Environment Act and relevant ordinances.

Health hazards

Industrialization has produced many changes in the organization and physical characteristics of work. Many physically strenuous tasks have been replaced by sedentary work with monotonous arm movements which create new problems. Unilateral or strenuous movements and work positions, ie, work factors, accounted for half of all the occupational illnesses reported in 1984 (table 1) (9). Musculoskeletal diseases of the neck and cervical spine were more common in women than in men and caused longer sickness absenteeism than other occupational diseases, ie, an average of 98 d per case. The mean number of sickness days of the neck/ cervical spine and back was especially long, ie, an average of 102 d per disease. The older age groups had the largest number of sickness days due to musculoskeletal diseases.

Research

Research is conducted by the Swedish National Institute of Occupational Health for the purpose of identifying the causes of the increasing prevalence of musculoskeletal disorders. It devotes special attention to work containing a low level of physical activity, eg, repetitive assembly work and work at video display units. Studies are carried out in the laboratory and in the field, often in collaboration with the staff of occupational health units. Epidemiologic cross-sectional, longitudinal, and follow-up studies are attempting to correlate musculoskeletal disorders to physical work load and to individual variables such as muscular strength, work technique, and predisposing factors.

Table 1. Musculoskeletal diseases by site and sex in 1984 (9).

Injury site	Male		Female		Total	
	N	%	N	%	N	%
Back	1 485	22	1 150	16	2 635	19
Neck, cervical spine	1 109	16	2 404	33	3 513	25
Shoulder, arm	2 511	37	2 260	31	4 771	34
Hand, wrist	747	11	1 057	14	1 804	13
Hip, leg, knee	758	11	229	3	987	7
Foot, ankle	83	1	39	1	122	1
Other sites	157	2	157	2	314	2
Total ^a	6 850	100	7 296	100	14 146	100

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^a Number of cases per million workhours was 2.7.

The following areas are important for the application of ergonomic research:

1. *Design and organization of workplaces, machinery and tools.* There is a need for specially designed ergonomic guidelines for the design of, eg, machinery. Experience from the use of checklists on guidelines established for fork-lift trucks and large transport and materials-handling machinery has been favorable (4, 5). The design of a special checklist for agricultural tractors has started.

2. *Modification, repair, and service of machinery and workplaces.* For example, many machinery operators develop musculoskeletal disorders. In many instances, the modification of their equipment enables the operators to hold on to their jobs; the cost of such modifications is usually very reasonable.

3. *Registers of successful solutions.* Access to successful ergonomic solutions from different sectors is often very helpful in ergonomic programs. Sweden has a computerized register, called the Work Environment Bank, which is open to industry. Tabulations are also performed by, eg, the Swedish Work Environment Fund and the National Institute of Occupational Health (1).

4. *Involvement in standardization.* Consideration of ergonomic factors in standardization work is particularly important, both with respect to standardization within the international bodies and standardization within industrial branches or industries. For example, the handling of beverage crates imposes heavy loads on the lumbar spine of shop staff and customers. New, lighter, and better-designed crates and bottles have been designed in collaboration with specialists in ergonomics and production. The new items will be successively introduced in different parts of Sweden over a three-year period. An evaluation of the new system produced highly favorable results.

5. *Purchases of new machinery, equipment, etc.* Health hazards and fatiguing physical loads can be avoided by the purchase of tools, workplace furniture, and machinery with better ergonomic design. For example, vibration injuries from impact wrenches employed in the assembly of trucks were common. The vibration generated by the wrenches normally used was compared under standardized conditions. Major differences were found. The wrenches generating the most vibration were replaced with wrenches with torque control which vibrated less. A two-year follow-up study showed that the level of vibration had decreased by about half.

6. *Educational materials in the field of ergonomics.* Supplying industry's technicians, occupational health personnel, etc, with educational material is becoming an increasingly important task. In 1987, a large textbook (827 pages) called *Man at Work* was published (6). It contains contributions from more than 60 sci-

tists. Educational material, such as video films and brochures on different subjects, can be acquired or rented from the National Board of Occupational Safety and Health.

The ergonomic program of the National Board of Occupational Safety and Health

The main objective of the ergonomic program of the National Board of Occupational Safety and Health is to reduce musculoskeletal disorders in Sweden and to increase the possibilities of all employees to achieve normal retirement age without occupationally induced disability. The aim is to make a significant reduction in sickness absenteeism and also to improve work conditions for employees with functional disabilities.

The basic idea of the program is to go through every branch of Swedish work life (25 branches altogether) in a step-by-step process in which different units of the Board and of the various labor market organizations take part. For every branch three typical ergonomic problems will be documented. They will be filmed on video, and an analysis of possible physical and organizational changes to improve the work situation will be made. The Board will then determine which ergonomic short- and long-term measures should be taken for the three illustrated work situations, as well as for other musculoskeletal problems within this branch. The points of views of the Board will then be discussed with employers and employee representatives for every branch of industry. The aim is to reach agreement about joint branch-specific strategies for reducing musculoskeletal disorders in each sector and to utilize every available channel for implementing necessary changes. Later the labor inspectorate will take part in this process more specifically.

Training personnel of the National Board of Occupational Safety and Health and the labor inspectorate is essential. During the next two years a special training course in ergonomics will be given to 30–35 employees of the Board and the regional labor inspectorates. Ergonomics will also be introduced in other regional training courses.

Information is also a vital part of the program. For instance, the Ministry of Labour and the National Board of Occupational Safety and Health held a conference last autumn (1987) for management and labor representatives, and the objective of the program was presented. The theme of the conference was "Changing Work is Profitable." Further development of information from the Board is in progress.

Training

Special training for occupational health physicians and nurses plus safety and hygiene engineers was being offered in Sweden as early as the 1940s and 1950s.

Since 1967, these types of training have been provided by the National Institute of Occupational Health (2).

Courses are offered to occupational health physicians (9 weeks over a period of 10 months), occupational health nurses (8—20 weeks), occupational physiotherapists (5 weeks), behavioral scientists in occupational health (5 weeks), safety and industrial hygiene engineers (15—40 weeks), and qualified safety delegates (5 weeks). Continued training in ergonomics for technical planners and designers has been successfully provided but has been canceled because of the need to increase the occupational health specialist training courses.

Another way to provide training and information about ergonomics is through the 2-d conference held every second year for the occupational health services personnel and the employees of the National Institute of Occupational Health, the labor inspectorate, and the National Board of Occupational Safety and Health. These days are devoted to presentations of new research findings and practical experience. The conference is attended by about 1 000 persons.

The basic education in ergonomics provided for polytechnical engineers especially is currently inadequate at many universities and institutes of technology. This inadequacy impedes the implementation of ergonomics in industry.

Concluding remarks

Research has provided a good body of knowledge about the physical work capacity of human beings and especially about sound work postures, work movements, and the types of workplaces that give rise to musculoskeletal disorders. It has often been difficult, however, to reach industry's decision makers, planners, designers, production technicians, buyers, etc. The ergonomic program of the National Board of Occupa-

tional Safety and Health has greatly increased interest in ergonomic matters.

To facilitate the implementation of ergonomics in industry, projects showing the connection between ergonomics, economics, sickness absenteeism, and the quality of products are needed.

A successful ergonomic implementation program requires cooperation. Planners, designers, etc, need examples of successful solutions which can inspire them to become involved in ergonomics.

The training of polytechnical engineers, technical planners, and inspectors in ergonomics needs improvement.

Ergonomists ought to participate in international standardization more than hitherto has been the case.

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