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Women and occupational health risks

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INTRODUCTION

The Working Group on Women and Occupational Health Risks, convened by the WHO Regional Office for Europe in collaboration with the Government of Hungary, was attended by 16 temporary advisers from 13 countries of the European Region and representatives from the Commission of the European Communities and the International Labour Office.

The participants were welcomed by the Secretary of State for Health, who expressed Hungary's deep interest in work pertaining to women's health and in relevant legislation to promote this. The practical realization of this awareness is still being formulated in Hungary. Dr M. Mikheev, Regional Officer for Workers' Health, welcomed the participants on behalf of the Regional Director and thanked the Hungarian Ministry of Health for hosting the meeting.

Professor M. Timar was elected Chairman, Professor A. Kilbom Vice-Chairman, and Dr C. Bishop Rapporteur. Dr M. Mikheev acted as Secretary.

The objectives of the meeting were to:

- (a) discuss health aspects of working women with emphasis on problems arising from their exposure to toxic chemicals and physical, biological, psychosocial and ergonomic factors;
- (b) consider occupational health and ergonomic surveillance and services to be provided for working women; and
- (c) identify research needs.

There has been growing concern regarding women's health and several physiological, biological, sociopolitical and economic issues have been raised in recent years. One of the changes taking place is in the social role of women in employment outside the home. Cultural traditions influence women's attitudes and behaviour in several respects. There are differences between the sexes in, for example, physical ability, anthropometry, psychology, biology, physiology and reproductive function. These should be

planning occupational health services.

The developed countries have health and social problems associated with technological development, industrialization, an increasing number of chemicals and automation (1). Taking these factors into consideration, the WHO Regional Office for Europe has formulated a regional strategy for attaining health for all by the year 2000 (2). It is directly relevant to health protection at work and comprises three main components:

(a) the promotion of lifestyles conducive to health and the reduction of exposure to self-imposed health risks;

(b) the reduction of preventable conditions including exposure to environmental risks; and

(c) the provision of adequate health care which is accessible and acceptable to all.

Each component of the regional strategy has elements relating to health protection for both men and women. A WHO working group concluded in 1980 (3) that working women who have additional heavy responsibilities outside the workplace and young workers who are at an important stage of their development deserve special consideration, and recommended that WHO, in collaboration with governments and interested institutions, should stimulate and coordinate research to fill gaps in the knowledge in this field.

The meeting in Budapest was the first WHO activity in this field. Participants realized that the knowledge available in many relevant areas is at present limited. They were, however, in a position to review the experience accumulated in countries of the WHO European Region. It was agreed that executive and national agencies should undertake efforts to protect the health of working women, conscious of the need to avoid all kinds of discrimination.

Participants appreciated that the subject was very broad and therefore selected the following principal topics for discussion: reproductive effects and chemical hazards; psychosocial factors and mental health; ergonomic factors; and physical factors. A fundamental aspect was whether, in the light of current knowledge, women should be considered as a vulnerable group with regard to occupation. Participants also considered the morbidity and mortality experience of women at work and attempted to identify problem areas and gaps in existing knowledge.

Before concluding, participants also discussed whether the term "different" might be more appropriate than the term "vulnerable" when applied to women with regard to their health status.

Conflict areas between protective health measures and discrimination, although touched upon during the course of this meeting, were not fully explored as they were not considered to be within the remit of the Working Group.

REVIEW OF CURRENT ATTITUDES AND LEGISLATION

General

The current situation with regard to health aspects of working women in the countries of the European Region was reviewed with the presentation of country statements summarized below. Attitudes to health protection of working women, social implications and existing legislation were noted.

All the countries viewed the subject against a background of equal rights/opportunity legislation. In all the countries the percentage of women in the total work force has increased over the past 30 years. ILO statistics for 1980 gave the percentage of women in the labour force as follows: eastern Europe, 46.8; northern Europe, 32.2; southern Europe, 24.0; and western Europe, 30.5. There was some variation among countries in the percentage of female labour in the various segments of industry.

Bulgaria

Radical advocates of total equality between men and women at work resist separate discussion of the problem of protection of men and women at work. It is therefore necessary to organize protection for women at work in parallel with full equality, taking measures to adapt the process, machinery and equipment to women, and finally to introduce the necessary protective labour legislation applicable to women.

The following problem areas must be taken into account:

(a) the small muscle strength of women and their limited physical capacity for lifting and weight carrying;

(b) the need to protect pregnant women and nursing mothers against adverse physical, chemical and biological factors including physical and mental stress in the work environment;

(c) social aspects affecting duration of work and rest periods;

(d) the adaptation of workplaces, machines and equipment to women's capabilities; and

(e) current evaluation and re-evaluation of admissible and non-admissible working places for women.

The technical qualifications and skills of women still restrict their access to a number of professions.

Bulgarian labour legislation gives equal rights to men and women with regard to pay, social insurance, rest periods, leave, etc. Women constitute over 40% of the work force necessitating the establishment of labour legislation for women's protection. The pension age for women is 5 years lower than that of men and the number of children is taken into account in assessing women's annual leave. The following practices have also been introduced:

- in all industries more suitable work conditions are determined and registered regularly;
- the prohibition of certain dangerous jobs — a list has been drawn up which (a) identifies harmful and difficult professions for women of all ages; (b) specifies jobs from which pregnant and nursing mothers are excluded; and (c) prohibits exposure of women up to the age of 40 years to suspected embryotoxic, teratogenic and mutagenic agents.

Examples considered harmful, and from which women of any age are excluded, include jobs in mining, metallurgy and metal-working, and certain sectors of the chemical and construction industries.

In principle pregnant women are not allowed to work:

- where exposure to chemical or physical agents is above the maximum allowable limit;
- in jobs involving excessive loading, e.g. lifting weights above maximum allowable limits, and uncomfortable working postures;
- with sealed sources of ionizing radiation;
- in jobs involving exposure to embryotoxic, teratogenic or mutagenic agents — the list of these has recently been enlarged and is supplemented annually (as indicated above this restriction applies to all women of fertile age).

The right of the pregnant woman to work is also embodied in the regulations. Job readjustment without a decrease in salary is obligatory after the fourth month of pregnancy and, where there are certain disturbances of pregnancy, at the time of disclosure of pregnancy.

Among statistical data on the number, distribution and health of working women, it was noted that 50% of sick-leave in women is due to pregnancy or caring for a sick member of the family.

There are a number of organizations in Bulgaria concerned with the policy of the integration of women in the development of society and the further enhancement of their role.

Czechoslovakia

The rate of employment of women has increased, the share of employed women of reproductive age (i.e. 15–55 years) being about 70%, with two peaks, the first and higher one at 20–24 years, the second at 40–49 years.

Work should not impair the health of women or adversely affect the fulfilment of their basic biological and social role — motherhood and the raising of children. In Czechoslovakia the legal basis for workers' care is the labour code. It is also directed to the needs of women and states that women must not be given work for which they are physically inadequate or which is physically harmful to them, especially work which threatens their motherhood (Paragraph 150, Article 2). Governmental decree 32/67 excludes women from work:

(a) in environments where, at the given level of technological protection, there is no reliable guarantee that the dose from external or internal sources of ionizing radiation will not exceed 13 mJ/kg in the abdominal region over 3 months (applies to women under 45 years);

(b) with an exceptionally high danger of adverse effects of mechanical vibration transmitted locally or generally, especially in connection with physical exertion;

(c) where there is exposure to the effects of irradiation from electromagnetic fields in high and very high frequency bands, where observation of maximum permissible values is not assured;

(d) where there is permanent exposure to extreme microclimatic conditions that are potentially harmful;

(e) in microclimatic conditions potentially harmful in pregnancy;

(f) where there is exposure to very high or very low atmospheric pressure or to increased intrapulmonary pressure;

(g) where there is exposure to the danger of infections or the effect of irritating and excessively polluting substances, or an excessively dusty atmosphere;

(h) with poisons and harmful substances if present to a degree that, or if contact is such that, they are a health hazard in certain specified ways;

(i) where physical exertion is required for which women are inadequate; and

(j) where there is danger of accidents that could permanently reduce fertility and where unphysiological postures with higher demands on nervous activity are required.

There is a list of work and workplaces forbidden to pregnant women, from the day of ascertainment of pregnancy, and to mothers until the end of the ninth month after delivery. Women are further excluded from work and workplaces where they are exposed to toxic influences that could endanger the course of pregnancy or the development of the foetus, or damage the foetus and endanger health during pregnancy, at delivery or in the period until the end of the ninth month after giving birth.

Finland

The Occupational Health Law in Finland states that if a worker for some reason, for example pregnancy, is exposed to a health hazard, he/she should not be employed on that work. The determination of what constitutes a health hazard is based on the discretion of occupational health physicians, who may, under relevant circumstances, consider that improvements in the working conditions or relocation of the worker are necessary.

Pregnant and nursing women are not allowed to work in jobs where there may be exposure to benzene or to solvent mixtures containing more than 11% benzene. Under special laws, females are not allowed employment involving heavy stevedoring operations (if under 21 years of age), in underground mines, and in painting operations with compounds containing lead. These provisions were related to ILO conventions No. 13, 1921, No. 45, 1935 and No. 136, 1971. Additionally, night work in industry is prohibited but exemptions are frequently granted (ILO conventions No. 4, 1919 and No. 89, 1948).

There is a specific law related to the dose of ionizing radiation for pregnant and fertile women. The maximum gonadal dose for both sexes is also stipulated.

German Democratic Republic

Some 88% of the able-bodied population, constituting 50% of the total population, is currently employed. It has been estimated that by the year 2000 there will be 10 million women and girls in the country — 50.8% of the total population — and 56.4% will be of the age group 15–60 years.

It is the responsibility of occupational medicine to institute care for the complex health and work protection of working women and mothers by intensive cooperation with other medical disciplines.

Regulations for the prevention of ill health should take account of the reaction to long-term stress, the different morbidity of women, biological and mental characteristics specific to women, and adaptive mechanisms relevant to women.

In 1979 it was estimated that 18.7% of working women were exposed to harmful physical agents and 39.0% to toxic chemicals and heavy physical work. Evaluation of the initial and periodic health assessments carried out gave similar data.

In 1974, regulations came into force stipulating that women above the age of 18 years can only engage in work involving exposure to toxic agents if the critical values are not exceeded. Pregnant women are prohibited from work involving exposure to very high or low temperatures, vibration, ionizing radiation, electromagnetic fields, specified noise levels and micro-organisms, and on the production or manufacture of sex hormones. The early diagnosis of pregnancy is considered to be of great importance.

In 1982 a regulation on prevention, registration and acceptance of occupational disease was passed. This requires initial and periodic health assessments of employees to be carried out. These are considered necessary in order to apply an ergonomic approach to the individual, and to provide valuable and essential information on work capacity, etc. in different occupations in order that epidemiological studies may be carried out. Such examinations are also necessary for the initiation of measures for the preservation, promotion and restoration of health. Such studies have indicated that women have a different morbidity pattern to men, and that they may react differently to long-term hazards. The average age for all occupational diseases was found to be 36.8 for women and 51.2 years for men.

In order to initiate practical measures at plant level the occupational physician not only requires knowledge of the incidence of diseases, but also their relevance to fitness for employment in a particular job. From studies undertaken in the German Democratic Republic it has been concluded that the health of working women is significantly influenced by social conditions in general, and by the family status in particular. The increasing use of drugs, especially long-term use of hormonal contraceptives, and the relatively high proportion of female adolescent smokers also have an influence.

Future work should aim at:

- reducing the incidence of occupational diseases in women by the detection of health effects at an early stage;
- determination of sex-related differences in dose-effect responses and stress;
- gaining further knowledge of the relationship between the work environment and health/disease of working women by the identification and quantification of cause-effect relationships of hazardous agents; social conditions and influences should also be taken into account in such studies.

Hungary

The social and economic status of Hungarian women is determined by the Constitution of the Hungarian People's Republic which guarantees equality before the law of both sexes and the right of every citizen to work.

With the realization of constitutional rights and the increase in female employment, the social and economic role of women has changed. The increase in total employment figures is due to the increasing number of women at work, rising from 36% of the total working population in 1960 to 43% in 1980. The field of female employment has also broadened and female employment has increased in almost all occupations during the past two decades. Improved opportunities for education and the gaining of professional qualifications have had their effect and of the 2.6 million women of working age, 90% are now in employment.

The Constitution also embraces the citizen's right to protection of health and physical fitness. In practice, the state has organized a system of medical institutions and in addition provides free public health services. Occupational health problems lie within the framework of the public health services. In addition to general regulations applying to both sexes, a number of special regulations exist which concern only women. These take account of the anthropological and physical differences between the sexes as well as potential problems with regard to reproductive function. One section of these regulations deals with safety and health aspects only and the other is concerned with labour rights. The worker also has an obligation under the law to observe these regulations.

The general principles advocated have not been changed during the last decades. It was, and still is, a general requirement of the Code of Labour that the employment of women is not permitted in occupations which could be harmful to them because of the nature of their physical constitution.

New recommendations set out the conditions of employment of women and pregnant women. When these regulations come into force they will apply to every employer. Employers, in collaboration with occupational physicians, will complete a list which specifies conditions under which females may not be employed. These new labour regulations:

- (a) guarantee employment for pregnant women and young mothers; and
- (b) allow maternity leave — the working mother may apply for paid leave until the child reaches the age of 3 years.

Occupational health control is carried out by the Hygiene Inspectorate and the Occupational Health Services who are responsible for environmental monitoring and health surveillance. The Occupational Health Department, in addition to its therapeutic role, undertakes preventive

measures including both initial and periodic assessments. The pre-employment examination is mandatory for every employee prior to a contract of employment being made. Occupational physicians may prohibit temporary or permanent employment of an individual for a job or advocate relocation of a female employee, e.g. during pregnancy. The Occupational Health Services work closely with the Department, e.g. in evaluating the relationship between occupational diseases and the effects of exposure in the work environment. Information from this type of exercise can be used to take effective preventive measures in the field of occupational health. Services employing large numbers of women should be developed and in addition a medical specialist service should be provided taking into account the need for therapeutic medicine (e.g. prenatal care, gynaecology).

Norway

In 1980, the number of women aged 16–74 years employed or seeking employment was 805 000 out of a total population of about 4 million. The number of women employed was 786 000, i.e. 55% of all women in that age group. The corresponding percentage in 1975 was 42. The increase in employment of women in the period 1975–1980 was mainly related to an increased number of women in part-time jobs. In 1980 women worked an average of 29 hours per week compared to 41 hours for men. The hours worked by women decreased with age. There was a definite correlation between the number of children in the family and working activity outside the home; an increased number of children decreased the working activity. A decrease in working activity also occurred with increasing age, probably indicating some change in attitude towards work outside the home. Nearly 75% of these women were employed in governmental, private or social service work, commercial trade or hotel/restaurant activities, and only 12% were employed in industry.

The Norwegian act relating to worker protection and the working environment makes the general statement that a safe working environment should be provided for all workers. However, under this act there is the possibility of restricting employment of groups who may be exceptionally vulnerable to health hazards. Such restrictions may contain regulations pertaining to relocation of workers. Specific restrictions already apply to work with cytostatic agents and have also been suggested for work involving exposure to anaesthetic gases. These provisions include requirements for the relocation of pregnant women and women with a past history of difficult pregnancies or fertility problems. The latter provision is dependent on certification by a physician and with regard to fertility the same provision is valid for male workers. With regard to cytostatic agents, relocation has not been linked to exposure levels, as at present suitable

methods are not available for monitoring exposure levels. For anaesthetic gases the recommended exposure level must be exceeded before such provisions come into effect.

A provision dating back to 1916 restricts the employment of pregnant women on work with lead, zinc and toxic substances in general and excludes pregnant women from silver, zinc plating and enamelling work and also porcelain manufacture if toxic substances are used. A 1929 act excludes female workers from painting where white lead or other toxic pigments are used. Both the 1916 and 1929 acts are likely to be revised to take account of the new act of 1977, which states as a general principle that the environment shall be safe for all. Exclusion of specific groups is only permitted in exceptional circumstances, for example pregnant and fertile women where there is exposure to lead and pregnant women where there is exposure to mercury.

Currently there is general antagonism towards special provisions for women as opposed to men at work because of the possibility of discrimination. However, the relocation practice with regard to exposure to cytostatics is implemented. It is the employer's responsibility if the worker is allowed to continue in a job where such exposure occurs. If the worker refuses relocation, he/she may in an extreme case lose his/her job. Wages, seniority and job satisfaction pertaining to relocation conditions are left to agreements between employers and trade unions. No such agreements exist to date. If relocation is not feasible, women can apply to an employment office and have the right to unemployment benefit. To date, this provision has been applied only to a very limited degree. Pregnant women may be officially reported sick by the physician, but the provisions do not allow this to be based upon pregnancy alone.

There are also regulations applying to maternity leave but these were not discussed.

Practice has shown that a number of pregnant women leave work when they find that the working conditions are not compatible with their pregnancy, probably mainly because of physically demanding work conditions rather than chemical risk factors. "Typical" female occupations often involve heavy work (e.g. nursing, cleaning, child care, store clerks and waitresses). In principle, the law also offers relocation for pregnant women in such cases. However, in practice it has not yet been applied. This is not an ideal situation and the practice in the future should be such that the working environment is sufficiently safe for all workers, including pregnant women.

Poland

The degree of occupational risk is affected not only by adverse working conditions but also by the general health status of employees and

constitutional factors such as sex, age and genetic make-up which determine individual sensitivity or resistance. Pre-employment examinations and epidemiological studies, when correctly carried out, provide the basis for evaluation of occupational health risks.

At present working women are employed in all spheres of socio-economic life. However, in spite of general acceptance, this creates some problems related to the role played by women in the socioeconomic development of rural areas or industrial complexes. For a number of years, women at work have been of interest to various different disciplines in the occupational health field. Investigations have been undertaken in an urban area of Poland, where there is a concentration of light industry. Attention was given mainly to the effects of night and shift work on sickness absence, and the health of women working in the textile industry in this industrial complex. Some 57% of women were employed in this area as compared with up to 48% over the rest of the country, and higher sickness absence rates were noted in these women. Effects on the health of these women and environmental factors were discussed.

Legislation has been established with regard to night work.

Regulations in Poland cite many chemical substances to which exclusion of women's occupational exposure applies. The Ordinance of 19 January 1979 of the Council of Ministers lists workplaces prohibited to women. The Decree covers physical, biological and other agents. Regarding chemicals not listed, the same principles of protection apply to both sexes; that is, no one may work under conditions where the environmental levels exceed the limit values. This Decree also requires the exclusion of pregnant women and nursing mothers from exposure to benzene and its derivatives.

The Regulation of the Minister of Health and Social Welfare, 1974, states that pregnancy is an absolute contraindication where the job involves exposure to electromagnetic fields of high frequency or to ionizing radiation.

The evaluation of the health status of women exposed to chemicals calls for:

- better recognition of the effects of chemicals to which women are exposed at work; particular care should be focused on women aged 18–40 years (reproductive age);
- compliance with the law (prohibited workplaces);
- specialist health care for women of reproductive age and pregnant women;

- appropriate specialist health care (gynaecological) for women over 40 years, who are exposed to chemicals not included in the banned list —the care should involve the recognition of cancer of the female genital organs; acquired statistical data would provide a basis for epidemiological studies.

Sweden

In 1978 a new work-environment act was passed superseding all previous special regulations concerning occupational hazards of working women, with the exception of the special regulations, remaining in force, concerning provision for women to breastfeed their babies.

The Equality Act of 1980 aimed at furthering equality between the sexes and this was strengthened by the simultaneous institution of the Office of Equality. The aim is to ensure that the law is observed and, if necessary, represent anyone subjected to sexual discrimination in the Labour Court. An important duty of the "equality ombudsman" is to promote voluntary observance of the law through advice and instruction and to strive for equality by informing and influencing the general public.

In the near future the attitude of the Swedish National Board of Occupational Safety and Health towards the occupational hazards of women may be slightly modified in the light of current discussions regarding the risk of damage to the foetus in pregnant women exposed to lead. A proposal quoting new maximal blood levels is expected. This will involve a tightening of current standards and appropriate action will be based upon individual blood sample results and not on group mean values, as was previously the case. The proposed levels do not differ for men and women. However, a woman is obliged to report a pregnancy and will then be transferred to a non-exposure environment. It is envisaged that in future similar proposals may be issued for mercury and cadmium.

From this information it might be concluded that no special occupational hazards for women are acknowledged in Sweden. However, the most important effects of occupational hazards may be identified using statistics on disablement pensions, sick-leave and notifications of occupational injuries. On average, men receive disablement pensions more frequently than women, probably because a large proportion of the working male population are engaged on heavy work. If, however, women are compared with men in the same branches of industry then women reach higher rates of pensioning than men. In respect of sick-leave there are slight or non-existent differences between the sexes in days lost per annum. However, any specific occupational risk occurring in one section of the employed population would not be identifiable in statistics covering the entire working population. These data indicate no gross differences between the sexes. With regard to notified cases of occupational injuries, in

the engineering industry, the proportion of accidents among male employees exceeds the proportion of employed males, whereas the opposite applies for women. Females, however, represent a large proportion of occupational disease cases. Males apparently represent somewhat more dangerous and accident-prone jobs. A corresponding sex difference could not be identified in public service where males and females (e.g. in geriatric nursing) can be assumed to have equally dangerous jobs. However, the number of days of sick-leave is higher among women than men in all branches.

Occupational disease accounts for more days lost than accidents and here a larger proportion of females are involved. Disorders of the locomotive organs dominate and of these a large proportion involve the neck and upper extremities. Women constitute the majority of these cases. Data from the engineering industry indicate that females and immigrants constitute a high-risk group. It is considered that chronic work-related disorders of the locomotive organs, especially in the neck, shoulders and arms, are a major occupational hazard for women. The prognosis is good in the short term, but in the long run many cases have to be transferred to other jobs or may even have to be given disablement pensions. No single preventive measure can be recommended, but several parallel steps must be considered including information and training of designers and constructors, consideration of the ergonomic aspects of tools, working postures and movements, the organization of rest periods, piece rates and "job enlargement", and individual factors as determined by pre-employment examination, selection and training.

Union of Soviet Socialist Republics

Health protection of women in the USSR is a matter of importance to the state.

The involvement of women in different branches of the national economy is steadily increasing annually and has now reached a level of 50%. The proportion of males to females with higher and specialized secondary education among the working population is almost equal. In social insurance 78% of workers are women, in the communication service 68%, in scientific work 48%, and in agriculture 49%.

The health of women is protected by state legislation and by certain physiological and hygiene standards. The decree on the foundation of the department of maternity and infancy protection under the People's Commissariat of Health, signed by Lenin in 1917, enabled women to combine work with family commitments. In 1970 the Supreme Soviet adopted the fundamentals of legislation of the USSR and Union Republics on labour. In 1978 a decision was approved on additional measures for improvement of working conditions of women. This provision listed

industries, occupations and jobs involving heavy work and harmful conditions and where the employment of women was prohibited. In 1981 a decision on measures to enhance state aid to families with children was adopted. This has provisions for working and student mothers.

Regulations on the protection of women at work stipulate that women should only be employed in jobs which are safe for them, taking into account their physical and physiological characteristics. The regulations provide for:

- the prohibition of work involving heavy and harmful jobs;
- the setting of maximum values for load carrying and moving (calculated from established norms);
- the creation of favourable conditions of work and rest periods and the restriction of night work;
- the employment of women on part-time or short-week jobs.

Legislation on the protection of women at work envisages the provision of improved working conditions, additional maternity benefits, increased guarantees for mothers in employment, and the gradual reduction of working hours for women with young children.

Technical progress, improvement of production processes by integrated mechanization and automation allows the use of female labour on a large scale. However, there are still labour-intensive employment areas in a number of branches of industry and agriculture.

Health problems considered to be specific to female employees have been identified. Physiological evaluation of energy expenditure has also been undertaken and standards have been laid down.

The problems associated with women at work should be tackled and involve the active participation of appropriate specialists in relevant fields of activity such as hygiene, physiology, sociology, obstetrics, gynaecology and paediatrics. It is essential to study both the individual and groups of workers: Such work is at present being carried out in the USSR.

United Kingdom

The last quarter of a century has witnessed a marked change in female employment in the United Kingdom. Whilst male activity rates declined slightly from 88% to 77% between 1951 and 1981, due mainly to enhanced educational provision and early retirement, there have been two striking, but opposing, trends in activity rates of the female work force. First, amongst non-married females there has been a decrease in activity from 22% in 1951 to a low point of 12% in 1974, since when it has increased only slightly to 16% in 1981. Second, the likelihood of married women being in employment has increased from 21.7% in 1951 to 48.8% in 1981. Thus by

far the most significant change in the last 30 years has been an increased propensity for married women to work (4), which is reflected in the female share of the overall labour force having increased from 34% in 1951 to 42% in 1982. The rise in activity rates for women seems to have been due to several factors — the availability of work, financial pressures and the desire for social contact. Family structures have perhaps changed to accommodate the increased opportunity for working.

Women are not distributed equally throughout industries or occupations but are concentrated in a narrow range of activities (compared with males) with clerical and personal service occupations and the education and health professions accounting for two thirds of female employment. Although the proportion of women in the higher level professional and managerial occupations is roughly similar to that for males (22.6% and 24.3% respectively) this is largely due to the concentration in the education and health professions where teaching accounts for 7% of economically active women and nursing 5%. The majority of women are thus concentrated disproportionately in lower level occupations, mainly in the service sector, and at a lower level in the hierarchy. This occupational segregation is often associated with inferior conditions of work, notably lack of adequate training and insecure or part-time employment.

Protective legislation mainly covers women (and young persons) engaged in manual work in the manufacturing industry and it applies to those restrictions introduced for their health, safety and welfare. The long working hours and poor working conditions of men, women and children in the factories and mines during the early Industrial Revolution need no elaboration. Statutory restrictions on the employment of women in factories developed from legislation intended to protect children, starting with the Health and Safety Apprentices Act (1802). Many of the existing legislative provisions are encapsulated in the Factories Act (1961), the Employment of Women, Young Persons and Children Act (1920) and the Hours of Employment (Conventions) Act (1936). Women are mentioned in 28 sections of the Factories Act (1961) and in over 26 codes of regulations. Broadly speaking these cover social categories, e.g. sanitary accommodation and restrictions of hours of work, and medical categories, e.g. work involving exposure to hazardous agents such as toxic substances and ionizing radiation, and manual handling. Further relevant legislation includes the Health and Safety at Work Act (1974), the Sex Discrimination Act (1975), the Equal Pay Act (1970), the Employment Protection (Consolidation) Act (1978) and the Congenital Disabilities Act (1976).

The Health and Safety at Work Act (1974) requires an employer to ensure the health, safety and welfare of his employees. The employer must maintain all equipment in a sound condition, have safe systems of work and provide adequate instruction, training and supervision. Employees have a duty to exercise “reasonable care” to avoid injury to themselves or

issued shortly. Until then the Factories Act (1961) remains in force. The lead code of practice under the Lead Regulations Act (1981) stipulates lower blood lead limit values for women of reproductive capacity. New regulations related to work with ionizing radiation are currently in preparation.

Under the Sex Discrimination Act (1975) it is an offence to treat a woman less favourably than a man on grounds of her sex in areas of training and employment. Direct discrimination is self-explanatory but indirect discrimination is more complicated. For example, if an employer applies a requirement of employment for both sexes, which is proportionately more difficult for either of the sexes to comply with, indirect discrimination could be considered to have occurred. Such a requirement might be difficult to justify. The physiological factors of strength and stamina are not generally acceptable as genuine occupational qualifications. This is because employers are expected to organize their work pattern in such a way that women are not exposed to excessive stress.

The Equal Pay Act (1970) stipulates that a man or woman should not be treated less favourably than a member of the opposite sex, with respect to pay and other terms of contract where equal work is undertaken. Exceptions to this include situations where the sex of the employee is a genuine occupational requirement or where the regulations relating to the employment of women, for example working in mines, require the position to be filled by a man.

The Employment Protection (Consolidation) Act (1978) enables pregnant women to remain in employment until 11 weeks prior to their expected date of confinement. There are limitations on the type of work they can be given once pregnancy has been confirmed. In the postpartum period women are also protected by the Public Health Act (1936), which prohibits the employment of women in a factory during the first 4 weeks following parturition.

The Congenital Disabilities (Civil Liability) Act (1976) gives rise in certain circumstances to liability for disabilities suffered by a child as a result of injury to the parent, which causes a child to be born with a mental or physical disability.

Yugoslavia

In 1974, 32% of the working population were women. The proportion of female labour is higher in certain industries, e.g. 70% in the textile industry and 60% in shoe manufacturing. The pension age is 50 years (or 25 years' service) for females as compared with 55 years (or 30 years' service) for males. There are also differences in the retiring age.

Collaboration among those interested in occupational health and safety, e.g. safety engineers, occupational health physicians, work physiologists, industrial psychologists and social workers, is still somewhat unsatisfactory, although safety engineering and health care have advanced rapidly.

Employment of women in many jobs is increasing. In 1974, 32.64% of those employed were women, whereas this had increased to 36.66% by 1980. In Serbia a third of the employees are women. The percentage of women employees is higher (up to 70%) in some industries such as textiles, tanning and shoe manufacturing, catering, printing and the food industry.

It is accepted that women form a vulnerable group under some working conditions, for example heavy work and that involving certain chemical and physical agents. Social and health protection legislation applies to working women and includes limits on working hours for pregnant women and for mothers with infants less than 2 years of age. Specific measures are taken with regard to night shift work and pregnancy.

Occupational skin diseases are more frequent among women, as are conditions such as tenosynovitis of the wrist, but hypertension, coronary heart disease, arthritis and chronic bronchitis do not occur more frequently in women. However, neuro-behavioural disturbances, psychosomatic disorders and thyrotoxicosis occur more frequently in working women than in their male counterparts.

Absenteeism attributable to illness or injury is higher among men than women, although the percentage is higher for women when pregnancy and maternity leave are included. Working women have a higher morbidity rate but their average duration of sickness is shorter. In some places of work higher absenteeism is found among women with heavier family responsibilities.

With regard to preventive measures there are regulations governing working tools and safety equipment for girls and older working women, and limits on the employment of women exposed to some physical, chemical and biological agents. Specific as well as general regulations apply to a number of such agents.

Commission of the European Communities

The subject under discussion is most important and raises policy issues that have been touched upon but not dealt with. There is a sensitive area of interaction between work and social policy. In 1976 WHO mentioned women as a vulnerable group — this in itself places large scientific demands on the academic community.

In February 1976, the Council of Europe adopted a directive stating the principle of equal treatment for men and women as regards access to employment, vocational training and promotion, and working conditions.

This was without prejudice to provisions concerning the protection of women, particularly as regards pregnancy and maternity. Since then a new action programme for promotion of equal opportunities for women has been adopted and an Advisory Committee established.

Recent experience has shown that the women's movement, which is now worldwide, will not accept that women *per se* are a "vulnerable group" and will challenge the scientific basis of all legislation which attempts to make special provisions for women of "child-bearing age" or of "reproductive capacity" as unacceptable, discriminatory and limiting job opportunity.

Many biases and assumptions are revealed in discussions of the special requirements and provisions for women's protection. In almost all studies the problems of self-selection into and out of the occupation are ignored. Further, the additional effect of limited job opportunities for women in the past compounds this problem and makes many studies of little value.

Much research is needed which must proceed along proper lines, on the basis of the "null hypothesis" of no difference in vulnerability between males and females, in order that sound conclusions and recommendations be reached.

International Labour Organisation

Guidelines for the employment of women have been laid down in various ILO labour conventions and recommendations (5).

On the subject of maternity protection, Convention No. 3, adopted in 1919, was revised in 1952 by Convention No. 103, and two recommendations were adopted in 1921 and 1952.

Employment of women during the night is regulated by three conventions — the one adopted in 1919 having been revised in 1934 and 1948 — and one recommendation adopted in 1921. All three conventions lay down the principle that women shall not be employed during the night in any public or private industrial undertaking but allow for exceptions. However, they contain different definitions of the term "night", growing more flexible with time.

Convention No. 45, 1935, concerning the employment of women in underground work in mines, lays down the principle that no woman, whatever her age, shall be employed in underground work at any time, but provides that national laws or regulations may make exemptions, for instance, for women holding positions of management or those employed in health and welfare services.

Convention No. 13, adopted in 1921, prohibits the employment of women in any industrial painting work involving the use of white lead or sulfate of lead or products containing these pigments. Recommendation No. 4, 1919, concerning the protection of women and children against lead

poisoning, recommends that, in view of the dangers to reproductive function, women should be excluded from employment in various specified processes involving the use of zinc and lead, and should be permitted to engage in processes involving the use of lead compounds only when certain safety and health measures are complied with.

Recommendation No. 114, 1960, on radiation protection provides that, in view of the special medical problems associated with the employment of women of child-bearing age in radiation work, every care should be taken to ensure that they are not exposed to high radiation risks.

A recommendation adopted in 1971 provides that pregnant and lactating women shall not be employed in work processes involving exposure to benzene or compounds containing it.

A convention adopted in 1967 on the maximum permissible weight to be carried by one worker provides that the assignment of women and young workers to manual transport of loads other than light loads shall be limited, and that the weight of such loads shall be substantially less than for adult male workers. A recommendation on the same subject provides that, as far as possible, adult women workers should not be assigned to regular manual transport of loads. No woman should be assigned during pregnancy or the 10 weeks following confinement if, in the opinion of a qualified physician, such work is likely to impair her health or that of her child.

In drawing up protective legislation for women, discrimination should be avoided. It is the ability of the individual to do a job that should be evaluated.

REPRODUCTION AND HEALTH PROTECTION

Within WHO strategy it is considered that there should be equality of health protection for men and women. Reproduction is a function of both sexes and should be appropriately protected. The scope of this meeting was confined to women at work. A wide range of potential reproductive effects were discussed.

Mutagenicity

A chemical may be mutagenic or may become so after metabolic activation. Injury (dominant or lethal) to the genetic material may occur at the level of the gene or the chromosome. Chromosomes may be damaged structurally or the chromosome content of cells may be altered. The chemical or its active metabolite has to cross various barriers and penetrate

the cell membrane before reaching the genetic material of the gonadal cell. Even having done so, repair mechanisms may operate so that a mutation may not be produced. A sufficiently high exposure to the chemical or its metabolite may lead to death of the germinal cells resulting in sterility or reduced fertility. Induction of a genuine mutational change in germinal cells may also reduce fertility or, if fertilization does occur, gross abnormality of the foetus may result in an early abortion. Survival may result in a congenitally malformed infant, in genetically induced disease, or in a predisposition to disease. Such outcomes may or may not be compatible with life and with being passed on to future generations.

Exposure of the genetic apparatus of somatic cells to mutagenic chemicals may incur no effect or may result in cell death. In sublethal amounts there is a possibility that exposure may lead to induction of cancer. A further possibility is that a chemical or its mutagenic metabolite may pass from the exposed mother to the foetus causing foetal death or induction of cancer in the foetus or, if exposure occurs during the period of organogenesis, producing congenital abnormalities by a teratogenic rather than a mutagenic mechanism (6).

The relationship between mutagenic effects in bacterial or somatic cells and mutagenicity in germ cells is poorly understood. Little is known with regard to the mutagenicity of industrial chemicals in germ cells and it is not known whether germ cells are more or less susceptible to mutagens than are somatic cells. The capacity of genetically altered spermatozoa or ova to fertilize or be fertilized may well be reduced but some evidence (animal and human) suggests that fertilization can occur.

Teratogenicity

Most congenital malformations originate during the period of organogenesis. However, functional disturbances may be caused by exogenous teratogens during the latter part of intrauterine life. Also, parts of the central nervous system are differentiating throughout intrauterine life and this system remains sensitive even during the latter part of pregnancy. The mildest damage may become manifest only during later life. A single teratogen may cause several types of anomaly and the pattern of anomalies may change with the stage of development of the embryo. Also, several teratogens may cause the same anomaly, either by different or by unknown mechanisms.

The group discussed whether women in general, women of reproductive age/capacity, and/or pregnant women should be considered as "at risk" groups. Some participants did not consider that specific provisions for women of reproductive age/capacity should be laid down, taking into consideration the difficulty in defining terms and the paucity of existing data and documentation to indicate that in reality women are indeed more

susceptible than men to reproductive hazards. However, it was also noted that pregnancy may not be recognized in the first weeks after conception, during which time damage to the foetus may occur and lead to early abortion which may not be recorded as such, but rather as a fertility problem. Hence some participants considered that women with fertility problems should be given the opportunity for relocation at work if exposure to toxic agents could be assumed to be the likely cause of such problems. It was noted that any such provision should equally apply to men.

When considering genotoxic effects it was noted that oogenesis is a perinatal event, the female germ cell population being finite at birth with no further replication, the egg cell being in metaphase for years. In spermatogenesis, however, the cell population is continuously replicating and the sperm cell is in metaphase for only 6-8 weeks. Potential problems of fertility were considered important.

Fetotoxic effects were discussed and it was noted that alterations in detoxification mechanisms and metabolic pathways, and physiological changes might occur during pregnancy.

Unfortunately, present knowledge is inadequate to define the mechanisms of chemical mutagenesis and its influence on male and female cells. Thus, both sexes must be considered at risk from mutagenic hazards. Exposure to genotoxic agents should be minimized for all. There is inadequate evidence to permit the formulation of a definitive policy on the need for specific provisions for women of reproductive age/capacity in occupational health services. However, due to physiological differences, genotoxic effects might possibly be more frequently transmitted to the foetus by the female rather than the male. The importance of the early diagnosis of pregnancy was noted. It was considered that special protection was required throughout pregnancy for the protection of the foetus, the first trimester being the period of active organogenesis, but noting that functional effects might occur on exposure to adverse conditions during the later stages of pregnancy. It was considered advisable that exposure to hazardous chemical and physical agents should be avoided during the period of lactation if the woman is breastfeeding because of the possibility of the excretion of such agents in the breast milk.

Teratogenicity, mutagenicity and transplacental carcinogenesis were briefly discussed. The subject of smoking was also raised. Smoking has been shown to induce placental enzymes that metabolize foreign compounds (7), thus the foetus of a smoker might be exposed to higher levels of active foreign compounds. Some evidence suggests that smoking, in addition to being directly harmful to the developing foetus, might potentiate the effects of occupational chemicals.

The field of reproductive toxicology is relatively new and there are large gaps in current knowledge. The difficulties of extrapolation from animals to humans in this field were noted.

With improvements in the equality of employment, women in the fertile age groups may be exposed to potentially harmful chemicals which might lead to an increased risk of occupationally induced reproductive hazards. This has created a new challenge for occupational health personnel — that of estimating the magnitude of the problems and the provision of preventive measures. This is a difficult task as information regarding numbers of workers and the chemical agents to which they are exposed is meagre. In addition the origin and mechanisms of reproductive capacity are complex as both maternal and paternal effects are of note.

It was concluded that pregnant women require specific measures of protection with regard to known teratogenic and embryotoxic agents, and that caution should also be exercised when women of reproductive age/capacity are exposed to such agents, although there is insufficient evidence in the latter case to formulate definitive policy. Preventive measures of occupational health services should limit undue exposure of pregnant and lactating women to toxic agents;

Occupational exposure associated with spontaneous abortions and congenital malformations

The Group paid particular attention to this subject.

Maternal effects which may be considered are:

- genetic (taking place before conception) or
- toxic or genotoxic (taking place during pregnancy) (8,9).

As no maternal, preconceptional, occupational chemical hazard has been ascertained, only harmful agents affecting the foetus during pregnancy were considered.

Possible adverse outcomes which might be elicited during pregnancy include spontaneous abortion, stillbirth, or a premature malformed, mentally retarded or tumour-prone child. Research has been stimulated in the past few years but most attention at the meeting was directed to occupational hazards associated with spontaneous abortions or malformations.

Incidence of spontaneous abortions

According to prospective studies applying extrapolation to early spontaneous abortions, the frequency of spontaneous abortions in humans ranges between 14% and 30% of all pregnancies. Retrospective studies have estimated the frequency to be about 15% or less. The differences in these figures are mainly due to the difficulty in observing pregnancies and foetal losses during the first few weeks after conception. Foetal losses are

more likely to occur in the early weeks of pregnancy, and their frequency decreases considerably after the first trimester. Differences in incidence were noted between studies where pregnancy had been detected by choriongonadotropin determination and those where it had been detected by clinical examination.

Incidence of birth defects (10-12)

The frequency of birth defects depends on the time of observation after birth and on the types of malformation included, the figures ranging from 2% to 6% of all living children. Morphological inspection of abortions may be a valuable source for teratological monitoring. The specimens that are intact enough for inspection (usually over 60% of the material) may reveal foetal malformations in at least 5-10% of cases. The percentage is markedly higher than the frequency of congenital malformations (1-3%). The reason for the concentration of malformations in the abortion material is the decreased survival of the malformed foetus. It has been estimated that foetuses with neural tube defects miscarry at a frequency of 60-90%. Chromosome studies of aborted foetuses have revealed that anomalies are about 60-100 times more frequent in spontaneous abortions than in live births, amounting to about 50% of all aborted foetuses.

Study designs

Animal testing is one possible approach in investigations of reproductive toxicity of chemicals. A large number of commonly used occupational chemicals has been tested for teratogenicity and embryotoxicity (13, 14). Extrapolation of teratogenic risk from experimental animals to humans has never been thoroughly validated and the calculation of safety factors has theoretical interest at best. As a regrettable consequence, epidemiological studies are of particular interest in the field of reproductive epidemiology.

Epidemiology

Two basic study designs can be used in analytical reproductive epidemiology: case-control and cohort studies. For birth defects both types of design have been used, while for spontaneous abortions cohort designs have been preferred because of difficulties in choosing appropriate controls.

The source of information on reproductive ill effects and/or exposures is particularly crucial, and the field needs several validating studies before optimal study designs can be recommended. In many countries registers on congenital birth defects are maintained and may be used as sources of

cases. Under-reporting, however, particularly of minor malformations, may harass even an efficient register and in certain occupational studies a bias may be introduced. Spontaneous abortions are not registered and here two sources of data are available: interview data or medical records. Both sources have advantages and disadvantages. Usually the interviews score more spontaneous abortions, partially by ascertaining early spontaneous abortions that would not lead to medical contacts. Medical records on the other hand are more reliable, although hospitalized cases may be biased in so far as there are differential rates for hospitalization on socioeconomic grounds. As most spontaneous abortions are not recognized clinically, even by experienced observers, it is very likely that the ability of women to recognize their spontaneous abortions is highly variable. Thus the reporting may be extremely sensitive to subjective factors such as social status, medical experience, and concern about harmful environmental factors, all introducing a severe and practically uncontrollable bias into the study. Study design may be particularly crucial in a condition as difficult to diagnose as spontaneous abortion, and whenever objective data on spontaneous abortion are available they should be used to control at least a sample of the information collected. "Classical" reporting bias is always possible when subjective data are collected, and this may have particular characteristics in reproductive studies because of their sensitivity and the feeling of guilt which may be involved.

Occupations and exposure with reported increase in risk

Data on the distribution of spontaneous abortions in various socioeconomic groups are meagre. A study in Finland (15) showed an increasing gradient of spontaneous abortions from social class one (higher officials, employers) to social class four (unskilled workers). Analysis by occupation revealed that the rate of spontaneous abortion was higher in industrial and construction workers (8.11%) and students and trainees (8.37%) than in all women (7.43%). In housewives the rate was 6.85%, significantly lower than that of all women. A study from Iran has also noted a higher rate for spontaneous abortions among working as opposed to non-working women, 12% and 8% respectively.

Studies relating the socioeconomic status of the family to the prevalence of malformations have shown a gradient in the United Kingdom and the United States, while no such difference was detected in Hungary or among Jews in Israel and the United States. Socioeconomic factors have also been noted in a British mortality study (Registrar General 1978), and a Norwegian occupational study detected more malformed children among employed and less educated women. From the Finnish register of congenital malformations, a case-referent register was used to analyse the association between parental occupation and children born with malformations.

Women in industrial and construction occupations had more children with central nervous system and musculoskeletal malformations than the referent mothers. No statistically significant odds ratios were found when the data were analysed according to paternal occupation. Some associations were found between low social class and malformations. In a subsequent study the association between maternal occupations in industry and children born with malformations was examined in relation to a number of possible confounding factors using multivariable analysis. The association with oral clefts remained and that with central nervous system malformations was strengthened after the analysis.

An increase in risk has been reported to be associated with, among others, occupations in laboratory work and in the metal, chemical, plastics and rubber industries and exposure to solvents, anaesthetic gases, sterilizing agents and pesticides. Environmental and medicinal risk factors include methyl mercury, lead, dioxins, polychlorinated biphenyls, spray adhesives, antimetabolites, alkylating agents and anticonvulsants.

The evidence presented at the meeting indicated a likely association between pregnant women working in the laboratory or with anaesthetic gases and spontaneous abortion, and the possibility of an association with regard to lead, copper smelting, solder fumes, sterilizing agents and materials in plastics. Also there was evidence of a likely association between laboratory work by pregnant women and malformation in their offspring and suggestive evidence for an association with anaesthetic agents and copper smelting.

The occupational epidemiology of spontaneous abortions and malformations is still in its infancy, and many selective mechanisms and risk factors have to be established before definitive causal relationships or conclusions can be drawn. It was stressed that conclusions should be based not on subjective evidence but on sound data prior to legislative proposals being considered.

Application of existing data

Systematic compilation and analysis of the available data on experimental and epidemiological results of occupational exposure from the aspect of reproductive hazards should be attempted in the near future. The immediate task is the evaluation of the data in humans in relation to chemical exposure, preferably by consultations in this field and by collaborating groups of experts.

New research areas

Experimental studies using appropriate animal models to assess embryotoxic and teratogenic properties of chemicals should be encouraged.

Experimental studies on the detrimental effects of occupational exposure on the outcome of pregnancy should also be facilitated. Important health effects include transplacental carcinogenesis, malformations, stillbirths, spontaneous abortion, effects on birth weight and gestational age in live births, and functional and mental defects. Information on such effects should be collected in a systematic and reliable way and analysed in relation to data sources by occupation and by type of agent.

MENTAL HEALTH AND PSYCHOSOCIAL FACTORS

Women may have an elevated risk of psychiatric morbidity due to work-related factors, although it was acknowledged that there is very little reliable evidence on which to base any firm conclusions. Participants discussed whether such factors should be considered. They realized that the subject is a complex one by virtue of its multifactorial and subjective nature and because of individual differences. They also appreciated the lack of reliable epidemiology and good methodology and the difficulties of interpreting data. The cost-effectiveness of prevention and difficulties in devising policy/surveillance programmes were also touched upon.

Employed females show an elevated level of mental health compared with non-working females, and the aim should be to maintain and embrace any protective factors at work by minimizing demands at work if they can be demonstrated to lead to impaired mental health. One epidemiological study in the United States (16) investigated occupational incidence rates of mental health disorders. Evidence was based upon the sample frequency of psychiatric admissions for each occupation relative to the actual population frequency of that occupation. It was of interest that nurses, waiters and waitresses, secretaries, those in the personal service industries, and inspectors in manufacturing industries had significantly elevated rates of illness. Any inferences drawn from these findings must be tempered with caution, particularly when it is difficult to attribute cause and effect, but many of these occupations and others with high rates of admission were those in which females were over-represented. Although these findings may only reflect an overall relationship, other evidence suggests that many women's jobs have particular stresses associated with them, for example, nursing (17), clerical and administrative work, especially where new technology is involved (18), and repetitive assembly work (19).

It was suggested that job design techniques, which encourage variety and autonomy in work tasks coupled with some areas of responsibility, should be used to design new jobs and modify old ones. Also jobs which

encourage and facilitate social support networks appear to be particularly appropriate in the maintenance of psychological health in the female work force.

Some observations on the mental characteristics of females, including reduced aggressivity, adaptability to professional training and behaviour were presented. It was suggested that differences in aptitude of men and women in the spatial and verbal fields should be taken into account in order to establish, on the basis of modern psychological data, any special aptitudes possessed by men and/or women for certain tasks.

It would be useful to carry out studies which seek to investigate sex differences in the response to social and psychological demands. Because of possible differences in the manifestation of stress, such studies should include psychophysiological, biochemical and psychological responses. It was emphasized that, because of the complexity of factors in such work, careful consideration should be given to the many methodological problems which exist in this area. Also, because of the domestic burdens that may be carried by women in addition to any occupational demands, assessment and evaluation of the family influence should be considered. The difficulties and specialist nature of such work were noted.

ERGONOMIC FACTORS

When mechanization was introduced, engineers were primarily concerned with designing systems to lower production costs. Even at present very few efforts have been made to take account of the diversity of human beings. Taking account of the ergonomics of work by women is no more than an acceptance and recognition of the existence of human diversity, which can be measured in terms of variability as opposed to the notion of the "average man". Automation and computerization will probably oblige designers to take more account of variability since the same work stations will be used by men and women belonging to different ethnic groups in several continents.

The ergonomic aspects of women at work were considered to be an important topic worthy of careful evaluation. Two main areas were discussed:

- the lack of ergonomic intervention in the workplace and associated deficiencies including effects upon female health; and
- the particular considerations which need to be given to the pregnant female.

These aspects were discussed with regard to any anthropometric differences between males and females and physical working capacity and muscle strength, and a comprehensive review of the literature was presented. Sociological factors, patterns of work in different societies and the effect of urbanization and industrialization were also discussed. To consider the ergonomics of women's work implies that it is of a different nature from that of men. It should be borne in mind, however, that both men and women belong to the same human species, a species in which "sexual dimorphism", though it exists, is not particularly marked. Any existing differences should be described with all possible objectivity before any valid conclusions can be drawn.

Most of the work undertaken on human factors and ergonomics in the area of health is based upon comparisons between males. Because of cultural, social, economic or traditional reasons it is often assumed that differences between the sexes do exist without questioning the scientific validity of that assumption. When the scientific evidence is examined it is sometimes found to be incomplete and of poor quality because of poor methodology. Motivational differences and differences in strategy between males and females may also account for some of the difficulties in interpretation. Crude extrapolations from data based upon measurements taken from male subjects have often been carried out and this approach can be misleading. Of importance also are the different contributions made by sociocultural influences as opposed to what can be attributed to invariable biological factors.

Anthropometric differences

The need to consider anthropometric data in determining optimum job design for women is not a new concept and has been the most frequently studied topic with regard to its ergonomic application. In 1927 the Industrial Fatigue Research Board, United Kingdom, published an extensive report of measurements concerned with the physique of women in industry and the determination of optimum load bearing. This work can be seen as the forerunner to the more recent work on body dimensions and related strengths of women. However, it remains difficult to discover large series of valid and comparable anthropometric measurements of homogeneous populations of individuals of the two sexes.

Many of the existing female anthropometric data have been collected for the purposes of domestic ergonomics. These data are unlikely to be entirely valid for industrial purposes. Comparisons between housewives and men employed in industry have shown substantial differences in some of the variables measured. Values for data on women employed in industry fell between those for the other two groups. The data suggest that there is no indication of the possibility of two different mixed populations. There

are few women who are smaller than all men, and few men larger than all women; in fact less than 5%. Consequently, the morphological proportions are more indicative of the common factors of the species than of the differences between sexes, which are significant only in the matter of probabilities — in a given population women are more likely to be smaller and men larger.

Taking account of such dimensions, ranges of equipment should be adapted to groups of subjects of comparable morphology whatever their sex. It is not acceptable, for example, that certain hand-tools or individual safety appliances are rarely found in the ranges of size covering all workers' needs, from the smallest to the largest dimensions. Most of the errors in dimensions design create a handicap or an impossibility for both men and women. In many fields it would be a step forward to take account of the dimensions of all potential workers, including pregnant women.

In summary, too many anthropometric studies deal only with men. The differences are generally smaller than realized and they are often differences in proportions. However, it is important to define them so as to ensure the comfort, health and safety of all persons concerned.

Physical work

The main parameters considered to be of importance during physical work are muscular strength and endurance, aerobic capacity and oxygen consumption, energy expenditure and pulse rate.

Muscular strength and power

Muscular strength and its relationship to work capacity has been extensively investigated since the beginning of the century. However, much of the work assumes that differences between the sexes in terms of muscle strength are the same for all muscle groups and also that men and women use their limbs in the same way. Work has shown that the differences that do occur tend to be specific to the muscle groups or body parts measured, and that there are very substantial ranges associated with mean values. Great care should be taken in extrapolating from such data in the absence of direct measurement.

All experiments show lower average values in women, these being about two thirds of those in males. This is, for example, the case with maximum force, even if one takes into account the difference associated with the smaller stature of women. Similar differences exist in the maintenance of maximum aerobic power and thus of the maximum consumption of oxygen in the case of physical exercise. It can also be shown that zones representing 95% of the values recorded in men and women are to an extent in alignment and an appreciable number of men have less strength

than the average woman, whereas very few women attain the average strength of men. The differences are less clear-cut if one takes body weight into account, which shows that muscular functioning is of the same type and that it is a quantitative and not a qualitative difference even in the case of pregnant women.

Cardiac function

Females tend to have smaller hearts than males (20) and this affects maximum cardiac output. Heart size reflects body size, and it is the trained state which may account for any differences. The fact that females do tend to have a maximum heart rate 10% in excess of males may offset any effects of heart size on cardiac output. There is, however, a functional similarity between men and women in terms of cardiac output and cardiac frequency. The differences established do not indicate a clear-cut difference between the sexes, and sex is not a satisfactory criterion for discriminating muscular strength or physical capacity. Work demanding most energy expenditure should be reserved for the strongest irrespective of their sex.

The importance of variation among individuals was stressed.

Reproductive system

One of the primary aims of concentrating effort in female occupational health care is the protection of the reproductive system. From the point of view of ergonomic factors, most of the considerations relate to lifting and manual handling. Hayne (21) reviewed manual handling in relation to the female reproductive system including menstruation, pregnancy, the menopause and genital prolapse.

It was concluded that ergonomic aspects need special consideration for the pregnant woman. Work should be adjusted to her capacity and consideration given to work methods.

Energy expenditure

The daily expenditure of energy is less in women than in men. The average basal metabolism is 5850 kJ in women compared with 7100 kJ in men. In the case of equal work the difference is of the order of 2000–2500 kJ. However, this is of the order of magnitude of interindividual, intersexual difference above or below the averages. There was discussion as to whether, because of the large individual differences, there is any necessity for regulating female employment in physical work.

Summary

The uncertainties in specific fields were appreciated and it was noted that caution should be exercised in differentiating between biological differences and existing superimposed behavioural and cultural restrictions. The fictitious nature of the sexual criterion as the sole basis for differentiation was emphasized. Ergonomic factors need special consideration in respect of pregnant women; work should be adjusted to their capacity and consideration should be given to work methods.

Three general areas were considered to warrant further effort:

- determination of the needs of the female work force (particularly during pregnancy) in relation to tasks which require prolonged static posture;
- determination of the extent to which inappropriately designed machines, tools, equipment and personal protection facilities constitute a particular risk for the female work force — epidemiological studies should be undertaken to investigate these issues;
- assessment of the effectiveness of intervention strategies based upon ergonomic criteria — evaluation of such programmes of prevention should be examined bearing in mind the goal of the overall maintenance or improvement of health.

PHYSICAL HAZARDS

Thermal stress

The most important physiological parameters of work under heat stress are pulse rate, core temperature and perspiration. Some studies indicate that sex and age differences are negligible concerning thermoregulation and heat tolerance (22–25). The perspiratory capacity of females tends to be lower and their rectal temperature is higher at a given metabolic heat production. After acclimatization, core temperature and skin temperature are identical or differ only by a small amount between the sexes, Fitness of the individual may play an important role in heat tolerance. In individuals with similar patterns of regular physical activity, heat regulation is mainly dependent on exercise capacity rather than on thermoregulatory function. In one investigation it was noted that with a given relative workload the rectal and skin temperatures of females and males were identical. In acclimatized individuals similar pulse rates and rectal temperatures in both sexes have been recorded (26).

Some work suggests that women's resistance to extreme heat and cold is a little lower. However, individual variations are fairly wide, and the essential element for comfort is therefore to offer sufficient possibilities for individual regulation. On the evidence presented, it was not considered that the sexes should be differentiated in extreme thermal stress.

Vibration

The physiological and pathological effects of whole-body and local vibration were discussed.

Evidence presented from work undertaken in Hungary indicates changes in the pelvic organs and lumber region of the spinal cord in females exposed to low frequency whole-body vibration and suggests that menstrual disorders are associated with whole-body vibration. The character of vibration warrants further examination. There has been little work on differences between the sexes in osteoarticular locomotor and vasculo-nervous pathology related to the use of high-frequency vibrating tools, and protection of workers of the two sexes appears to be based on the same ergonomic measures.

It was concluded that methodological problems concerned with the measurement of dose and with different biological effects in the female need to be overcome before valid recommendations can be made.

Noise

Some studies have indicated that noise-induced hearing loss at equal noise exposure, similar duration of employment and similar age, is less in females than in males. Firm conclusions could not be drawn and further work would be necessary to explore this area. Some authors have proposed that fatigue caused by intense noise is on average greater in women, at least at frequencies of 2000 Hz and in women over 30 years. Work has been vague and based on observations made on too small a number of subjects to be accepted without reservation.

It could not be concluded from the available information that sex differences exist.

Ionizing radiation

The main difference in risk considered was the possible effect of radiation on the gonads. It could be considered legitimate to protect women of childbearing age/capacity from massive doses of irradiation mainly because of the risk encountered even in early pregnancy by the gonads of a female foetus. On the other hand, any difference in preconceptual risks between the sexes, apart from the problem of delay related to the maturation of the

gonads being much shorter in men, would merit more detailed study. It was considered that exposure to ionizing radiation in pregnancy should be avoided. This is also advisable during lactation if there is a likelihood of radioactive contaminants being excreted in the milk during breastfeeding.

Night and shift work

Data were presented on the impact of night and shift work on women's health in the textile industry in one industrial area of Poland. These women had higher sickness absence rates than men employed in analogous jobs and than women in other employment.

In various countries, a number of measures aim to restrict the number of hours worked by women, prohibit night work and overtime, and stipulate a lower age of retirement. Most of these measures are historically based on moral grounds, or for psychological or sociological reasons, and the result may even be the greater longevity of women. Scientifically, the data do not indicate an need to limit the work schedules of women compared with those of men. It is only in relation to family responsibilities, especially of single women, being on the whole greater than those of men, that social measures of this kind may be inaugurated in order that the equality of employment opportunities be maintained. It is nevertheless important to examine more closely, from this particular aspect, the problem of fatigue, while simultaneously considering occupational and extra-occupational loads. The ergonomist is confronted here with a delicate group of problems in which it will be difficult to control for all the sociological and political elements involved.

Others

Among other physical agents discussed briefly were microwave radiation, high-frequency magnetic fields and ultrasound.

The thermal effect is the most commonly encountered biological effect of radio-frequency microwave radiation. Possible effects on the foetus and sperm counts have been reported; however there is a paucity of data on depth-dose distribution in tissues. Reports (27) of sterility in men and miscarriages in women, and impaired embryo development in the early states of pregnancy in both animals and humans are difficult to evaluate. Some work (28) has suggested even broader effects in women. It was agreed that on the evidence available conclusions on any greater susceptibility of women or on any reproductive hazards in the female could not be reached.

A reference was made to one study in which women working in high-frequency electromagnetic fields had menstrual disorders three times

as frequently as controls. However, the Group formed no conclusions on this subject with regard to any increased susceptibility of the female.

Data on the alleged effects of ultrasound were not presented. Much of the work to date on the possible genetic effects of ultrasound has involved treating either microorganisms or mammalian cells in culture. Follow-up studies of the leucocytes of human infants treated with ultrasound *in utero* have been undertaken and no damage has been detected (29-38). Further tests with higher organisms were considered necessary, since there is reason to believe that the effects of absorption of ultrasonic energy in organized tissue might be different from those in cells suspended in liquids such as blood or culture media. In an investigation into the possible genetic hazards of ultrasound (39) there was no evidence in male mice of induction by ultrasound of dominant lethal mutation or sterility, no drop in test weight or sperm count, and no induction of translocations of chromosome fragments in spermatocytes, for up to eight weeks after exposure to ultrasound of frequency of 1.5 MHz for 15 minutes. Similarly in female mice no dominant lethal induction was detected in the period from several days before mating to the day of mating. Gene mutation as opposed to chromosome damage was not tested for, nor was any test specifically undertaken to detect chromosomal nondisjunction. The negative results of dominant lethal tests were taken to indicate no nondisjunction of chromosomes.

CONCLUSIONS AND RECOMMENDATIONS

1. Historically, much of the legislation relating to women has been promulgated on social and moral grounds. Many biases and assumptions are revealed in discussions of the special requirements and provisions for the protection of women's health. In many studies the problem of selection into and out of the occupation has been ignored. Further, the additional effect of limited job opportunities for women in the past compounds this problem and existing studies may be of questionable value.
2. Pregnant women require a specific measure of protection against teratogenic and embryotoxic agents; caution should also be exercised when women of reproductive age and capacity are exposed to these agents. The occupational health services should ensure that undue exposure of pregnant and lactating women to any toxic agent is prevented.
3. There is some evidence to suggest an association between laboratory work with anaesthetic gases by pregnant women and spontaneous

abortion. There is also evidence to suggest that the same risk may exist with regard to lead, copper smelting, solder fumes, sterilizing agents and materials in plastics.

4. There is evidence associating laboratory work by pregnant women and malformations in their offspring, and some suggestion of a similar risk from anaesthetic gases and copper smelting.

5. Animal data may be used as an aid in setting control limits and in identifying problem areas suitable for epidemiological research. The dosages used in animal experiments should be comparable with possible human exposure.

6. Owing to physiological differences, genotoxic effects may more often be transmitted to the foetus by the female rather than the male.

7. Women with fertility problems or suffering spontaneous abortion should be relocated if exposure to toxic substances is suspected of being the cause.

8. The basic philosophy of ergonomics, which is to adapt occupations to the capacities and limitations of specific populations, is the primary consideration. Compared with men, female workers may be at higher risk of health impairment or injury because of physically demanding jobs or inadequately designed machines, tools and personal protective equipment. However, when age, build, stage of acclimatization and training have been taken into account, this does not appear to have an overwhelming influence on the ability of an individual to perform sustained physical work.

9. It was concluded that there was no significant difference in noise-induced hearing loss between males and females. There is some evidence that unacclimatized women have a lower heat tolerance than their male counterparts, but caution is needed in the interpretation of such evidence and further research in this field is indicated.

10. Vibration effects (both local and whole-body vibration) were discussed extensively. It was concluded that methodological problems concerned with the measurement of levels and with differential biological effects in females (when compared with males) need to be overcome before valid recommendations can be made.

11. The ergonomic aspects need special consideration for the pregnant woman. The work should be adjusted to her capacity and consideration given to work methods.

12. Exposure to ionizing radiation in pregnancy should be avoided. This is also advisable during lactation if there is likelihood of contaminants being excreted in the milk during breastfeeding.

13. Much research has been done on the negative effects of shift work. There seems to be no evidence that women are more susceptible to these than men, if given equal opportunities for relaxation. There are, however, indications that the state of health of women performing shift work is not optimal. This can probably be attributed to the total load being too high, especially in those with family duties besides their occupational ones.

14. The following broad research areas were identified:

Reproductive hazards. Systematic compilation and analysis of existing data should be carried out and further experimental studies made on embryotoxicity and teratogenicity. WHO should examine how this work should best be pursued.

Heat tolerance. Experimental studies should be conducted on sex differences in the response to light and moderate workloads under hot conditions.

Psychosocial stress. Differences in the response of males and females to social and psychological demands at work should be explored. Special consideration should be given to methodological issues in such research and also to the potential extra burden placed on some working women because of domestic obligations.

Ergonomics. Research in this area should examine the following:

- (a) the prolonged fixed posture required by some tasks;
- (b) problems with inappropriately designed equipment; and
- (c) evaluation of ergonomic interventions particularly directed to the health of women at work.

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