SHIFT WORK AND IRREGULAR WORKING HOURS IN SWEDEN: RESEARCH ISSUES AND METHODOLOGICAL PROBLEMS

Jan E. Fröberg
National Defence Research Institute
Stockholm, Sweden

When the Swedish Work Environment Fund started its activities in 1972, it was considered that research on the problems connected with irregular working hours, particularly their social effects, seemed to be a neglected area. A book will be published shortly (Magnusson & Nilsson, 1979) which reviews and summarizes the findings to date in a form convenient for all those concerned with these problems (an English version will hopefully appear in the near future). The present paper contains a review of the results of this Swedish research over the last eight years, and also considers the methodological aspects of the work. Since the author was a member of the publishing committee for the book, this review relies heavily on the material collected for it.

The working party (The Swedish Work Environment Fund, 1975), appointed to present a research program for the Fund in the area of hours of work, concluded that high priority should be given to the following studies:

- A broad survey of how working hours are presently scheduled in Sweden, and an analysis of ongoing developments in this regard.

- A study of compensatory payments made for shift work and inconvenient working hours.

- Research into the effects of shift work, rostered-duty work and other inconvenient working hours on social patterns and activities. This program should concentrate primarily on the effects on family relationships at different stages of the life cycle (man-wife, parent-child, etc.), and also on such things as opportunities for education, contacts off the job, etc. Consideration should also be given in this context to general changes of attitudes and value judgments in the community, not least as regards sex roles.

- Research into the medical consequences of shift work, etc. This program should analyze ill health and sickness-absence in depth, especially in relation to their social consequences. Comparisons within work-scheduling systems (rather than, as in the past, between day working and shift working) should be made since the results would be more directly applicable to the real-life situation.

- Research on individual differences in adjustment to work at different times of day. This research would aim to develop instruments for identifying people who can adapt to shift work without significant physical and mental consequences.

- An evaluation of the economic consequences of shift work and different forms of inconvenient working hours. This program would include a study of the cost aspects of alternatives which do not have the drawbacks attached to existing procedures.

- Assessment of the social and economic consequences of overtime work. After a preliminary survey, this program should concentrate on defining the costs incurred by firms and the social consequences for employees who do a great deal of overtime work.

Fields of Study

The research work was conducted in the following areas:

- Biological rhythms and their adaptation to different types of working hours;

- Health effects of inconvenient and irregular working hours, including sleep problems, gastrointestinal and psychic symptoms or diseases, and other diseases and symptoms;

- The relationship between work hours and absenteeism;

- Accidents and work hours;

- Social consequences of irregular and inconvenient work hours, including family relationships, care of children and house work;

- Consequences for leisure-time activities;

- Effects on participation in political and union activities;

- The reasons why people start working shifts, and why they leave.

In the different projects, the concern was with one or more of the following kinds of irregular working hours arrangements:

- Three-shift work, including continuous three-shift (with four or five shift teams, sometimes referred to as four-shift or five-shift work, respectively);

- Two-shift work, and overlapping day shifts;

- Rostered-duty work, i.e., schedules with extremely irregular work hours;

- Night, early morning, and late evening work;

- Flexible work hours;

- Part-time work;

- Overtime and moonlighting.

The present paper considers the various effects of the irregular work hours imposed by shift work and rostered-duty scheduled work.

Statistics on Working Hours in Sweden

According to an investigation by the Work Environment Fund in cooperation with the Board of Statistics (Ribbing, 1974), about 33% of the working popula-

tion (i.e., about 1.2 million) is involved in different forms of "abnormal" working hours, such as shiftwork, night work, or irregularly timed working hours. The incidence of irregular working hours has tended to increase somewhat over the years (data from 1968 to 1974 confirm this).

About one-third of the group referred to above have a stable working hours arrangement (i.e., night work, early morning work, or evening work), while the remaining two-thirds have irregular work hours (shiftwork, etc.). The largest proportion of shiftworkers are men, while women dominate in the other forms of work hours arrangements. Only 5% of the working population are involved in shiftwork, but as much as 8% have rostered-duty work with even more irregular hours, including work at night.

Methodological Considerations

One of the difficulties involved in the interpretation of results from shiftwork studies is the fact that there is a 'selection' of people into (and out of) shiftwork. Individuals with health or social problems leave shiftwork. People who do not consider themselves "strong" enough to be able to adapt to the irregular schedules stay in day work. Thus, comparisons between shiftworkers and dayworking control groups may be misleading. Nevertheless, most studies in the field are 'transverse' studies using dayworkers as control groups. In a 'longitudinal' approach, information on the selection process is obtainable, which allows this factor to be controlled for.

The use of 'experiments' also seems to be relatively scarce in shiftwork research except in laboratory studies. In the field, it is possible to mount 'intervention' studies where the whole (or parts) of the shift system is changed in order to assess the effects of different parameters in the system (e.g., speed of rotation, length of shifts, etc.).

Since the problems of shiftwork are both medical, social and psychological, a 'multidisciplinary' approach may be fruitful, since this allows e.g., the social and physiological drawbacks or advantages of a certain shift system to be compared.

As was said above, the selection processes may make the results of transverse studies difficult to interpret. Comparisons of different shifts within a given system have already been mentioned as one solution to this. Another method would be to study groups where the "amount" of shiftwork varies in order to examine individual differences in the number of night shifts that lead to particular levels of disturbance.

In many of the earlier studies of effects of shiftwork on health, the dependent measures were diagnosed illnesses only. The use of 'questionnaires' on health, symptoms and disturbances may give quite different results, since it is known that shiftworkers do not consult physicians as frequently as other workers, considering e.g., stomach dysfunctions as a normal part of their lives.

A further approach is to investigate the relationship between the duration of exposure to shiftwork and the frequency of different indicators of dysfunctions.

Circadian Rhythms and Adjustment to Shiftwork

Since the shiftworker lives in an environment where the usual 24-h rhythm is maintained, the shiftworker's adjustment to an altered time schedule has been considered to be of great importance.

Methods

Most of the studies in this field have used both physiological and psychological measures as indicators of adjustment to shiftwork or to experimental changes in the 24-h pattern. The physiological measures were usually body temperature and the excretion of different hormones such as adrenaline and noradrenaline. In one of the projects, changes in the EEG pattern were measured, as well as in cardiovascular variables. Psychological tests have been applied to measure variations in performance, subjective fatigue, and mood changes assessed by means of ratings or interviews. The adjustment process was studied by taking repeated measurements. There have also been longitudinal studies in which the data collection was repeated after e.g. one year, in order to study long-term adjustment to the shift system. In one study, dayworkers who temporarily worked night shifts were investigated. Most of the investigations were field studies where measures were taken under relatively controlled conditions in the factories, but laboratory studies with experimental changes in the subjects' sleep/wake pattern were also undertaken, as were combinations of field and laboratory studies. It is mostly three-shift work, and especially continuous three-shift, that has been the focus of investigation.

Results

In most shiftwork systems in Sweden, people work about one week on each of the different shifts. There is, however, a trend towards shift systems with shorter cycles. The studies of the adjustment of 24-h patterns to changes in work hours have shown that a certain degree of adjustment may take place towards the end of a week on a particular shift (Patkai, Åkerstedt, & Pettersson, 1977; Åkerstedt, Patkai, & Pettersson-Dahlgren, 1977; Dahlgren & Patkai, 1978). The circadian curve was, however, flattened and body temperature and other physiological variables never approached the maximum level of dayworkers. In one study (Östberg, 1973), it was found that the body temperature rhythm changed during the afternoon-shift week, while there was only a slight change during the week on the morning shift and no "adaptation" at all in the night-shift week. Åkerstedt, Theorell, and Thorsvall (1976a) showed that, in a group of dayworkers who were transferred to night work for a couple of weeks, there were only marginal changes in 24-h patterns after a week.

In a study of long-term adjustment to shift- and night work, measures were repeated one year after the workers had started shiftwork (Dahlgren & Patkai, 1978). The 24-h curves were found to have somewhat flattened, especially during the night shifts, and there was no change during the night-shift week (as had been the case when the workers had just started working shifts). A flattening of the EEG rhythm was observed in one study where measures were taken first in the laboratory and then at work. No variation over the 24-h cycle was found on the evening shift.

No studies have yet been performed on adjustment to fast rotating shift schedules, but such a study is now being planned.

Morning and evening active people. In some of the studies referred to above, scores on a "morningness-eveningness" factor were obtained by questionnaires, and related to types of working hours and adjustment to shift- or other irregular working hours. The majority of night and shiftworkers were shown to be "evening type" people (even before they started shift work: cf. Patkai & Dahlgren, 1977). It seems that this factor acts as a selection agent, so that "evening active" people start working shifts and stay in shiftwork more often than "morning active" people. It was also shown that morning active people who work shifts tend to have more disturbances; and in one study, where measures of different dysfunctions were obtained before and after the night shift was discontinued, morning types showed the largest improvement (Åkerstedt, Fröberg, Levi, Thorsvall, & Zamore, 1978; Appel & Östberg, 1974). It was further shown that evening types were in better physical and psychic shape during the night shift than morning types.

Age. Age is important in the etiology of dysfunctions and symptoms related to shiftwork. It seems as if 45 is about the critical age in this aspect (Åkerstedt & Thorsvall, 1977a, 1977b). It has been speculated that this may be due to a change towards "morningness" with increasing age.

Shiftwork and Health

The research on health problems in shiftwork was mainly centered around sleep disturbances, gastrointestinal dysfunctions and psychic symptoms, although, in some of the studies, a broader approach was taken.

Methods

Sleeping habits and sleep disturbances were mainly investigated by means of questionnaires, interviews and diaries. EEG indices were used in some studies, one of which also investigated the interrelationship between these indices and subjective measures of sleep quality. Experiments on sleep at different hours of the day, as well as a field study on sleep quality, used EEG and other electrophysiological measures, and also the excretion of hormones, and self-ratings, in order to investigate the relationship between sleep and circadian rhythms.

The methods used in the study of gastrointestinal malfunctions were essentially questionnaires and interviews. In one study, nutritional analyses were made of the shiftworkers' diets.

Different psychic symptoms such as fatigue, restlessness, etc., as well as subjectively felt health hazards, were also assessed by means of questionnaires and interviews.

One study used the Swedish twin register (32,000 individuals born between 1926 and 1958) to study subjective symptoms and illnesses.

Sleep Disturances

The amount of sleep obtained in shiftwork varies considerably with the shift. During the night-shift week, there is a clear deficit, which is, to some extent, compensated for during the other shifts and on days off. There may be up to three hours' difference in sleep length between the shifts (Åkerstedt & Thorsvall, 1977a). Three-shift workers report sleep disturbances more often than day-workers; these disturbances have been shown to occur mainly on the night shift, but also, to some extent, on the morning shift. In an intervention study where the night shift was discontinued, total sleep time was increased and sleep disturbances diminished (Åkerstedt & Thorsvall, 1977a). Another investigation showed that starting to work on shifts leads to an increase in sleep problems (Åkerstedt, Thorsvall, & Theorell, 1976b).

Even in a case where sleep on the night shift was no shorter than on the morning shift, it was the former that caused the sleep problems (Åkerstedt & Thorsvall, 1977a, 1976). This implies that sleep difficulties are not only a matter of sleep length, but also depend on time of day and perhaps on the interaction between circadian rhythms and quality of sleep. The fact that housing conditions do not interact with sleep problems may also be taken as evidence that internal factors rather than external disturbances are the main causative factors.

In an EEG study of two-shift and night workers' sleep, it was shown that day sleep had a different distribution of sleep stages than normal sleep during days off; the proportion of Stage 1 sleep diminished while Stage 2 and REM sleep increased during the week. The deviations from "normal" sleep were considered to be less pronounced in night workers than in shiftworkers (Patkai & Dahlgren, 1977; Dahlgren & Patkai, 1978).

One experimental study (Åkerstedt et al., in preparation) investigated the effect of sleep at different hours of the day on sleep quality (EEG and self-ratings). The same investigators also monitored sleep in subjects on rostered-duty schedules in order to investigate the effect of very irregular working hours on sleep length and quality.

Rostered-duty schedules, which often imply an extremely irregular distribution of work hours and include night work, have also been shown to cause shortened sleep and sleep disturbances (Kolmodin-Hedman & Svensson, 1973; Svensson, 1977; Gardell, Aronsson, & Ryden-Lodi, 1977; Åkerstedt & Zamore, 1976). These sleep problems are most frequent in connection with night shifts. In one study (Åkerstedt & Zamore, 1976) about 50% of the employees said they often had difficulties getting to sleep after a night shift and 64% said they could not sleep as long as they would like to.

Gastrointestinal Dysfunctions

Food habits of three-shift workers were studied in one project, the aim of which was to develop dietary recommendations for people on night work or with irregular work hours (Appel & Östberg, 1974). As one would expect, there was wide variation between individuals. The time for the main meal was different for the different shifts. Also, "evening-active" workers tended to change their food habits more than "morning-active" types when working shifts.

On the other hand, investigation showed that shiftworkers tried to maintain "normal" meal hours and other dietary habits, and that the difference in meal time between the shifts was only a couple of hours. Appetite is reduced during night shifts and very few workers take a full meal then (Åkerstedt & Thorsvall, 1977a). A nutritional analysis showed that the food habits of shiftworkers were, on the whole, satisfactory and that they showed about the same slight deficiencies as those of the average Swedish population.

In several of the investigations, significantly more stomach disorders and complaints were recorded in shiftworking groups than among dayworkers. In one case, three-shift workers reported much more gastrointestinal dysfunction than a group of former three-shift workers (Appel & Östberg, 1974). When the complaints were related to specific shifts, the night shift was considered the worst although the morning shift was also bad (Åkerstedt & Thorsvall, 1977). When people stopped working shifts the problems diminished, while they increased on starting shiftwork (Åkerstedt & Thorsvall, 1977a, 1977b; Åkerstedt et al., 1976a). One interesting finding was that those shiftworkers who tried to change their meal habits to fit the work hours better had a higher frequency of disturbances.

"Morning-active" three-shift workers were shown to differ in several respects from "evening-active" with regard to food habits (Appel & Östberg, 1974). Thus, they had less variation in meal times, etc. between the shift weeks and less variation during the shifts. In other words, the morning-active workers had more stable dietary habits than the evening-active. The former also had fewer gastrointestinal complaints.

Psychic Symptoms

In most of the studies where sleep and gastrointestinal disturbances were shown to exist, there were also more psychic symptoms. Thus, three-shift workers reported fatigue, irritation, and aggression more often than dayworkers. These mood symptoms were mostly ascribed to sleep deprivation, but also to the fact that spare time did not coincide with that of other people (Appel & Östberg, 1974). The symptoms were more common in connection with night-shift work (Åkerstedt & Thorsvall, 1977a, 1977b). When the night shift was abolished (Åkerstedt & Thorsvall, 1977a), this had a clear positive effect. A group of workers with a rapidly rotating shift schedule (so-called four-shift), who were transferred to conventional three-shift schedule, showed a moderate increase in symptoms.

A direct correlation between well-being (work satisfaction, less sleep disturbances) and adjustment of the circadian body rhythm was obtained in one study (Patkai & Dahlgren, 1977).

Other Illnesses

In one large project (Åkerstedt & Thorsvall, 1977a, 1977b), no differences were found in the occurrence of diagnosed illnesses in three-shift, four-shift, two-shift, and dayworkers (despite the existence of differences in subjective symptoms between the groups). One explanation given for this apparent anomaly is the selective mechanism referred to above.

Within a larger research program on environmental effects on health (Sörenson, unpublished), a study was undertaken on the relationship between shiftwork and medical complaints. The group investigated consisted of 32,000 individuals born 1926-58 (the so-called twin register). The results show that those who work shifts also have higher frequencies of medical symptoms, such as gastric catarrh and low-back pain, than have non-shiftworkers. Shift workers were also found to have had more sick leave. When the data were examined in terms of the number of years in shiftwork, those who had worked shifts for less than six years were found to have a higher frequency of symptoms than those who had been exposed for a longer period. The obvious interpretation of this is that those who get ill leave shiftwork and those remaining will be a selected group as far as health is concerned.

Shiftwork and Absenteeism

Methods

In studies on the relationship between working hours and absenteeism, comparisons between two-shift, continuous three-shift, overlapping day shifts, late working hours and daytime work were made. Interviews with employees were included in this research to supplement data from company absenteeism records. The different reasons for absenteeism, such as illnesses, fatigue, illness due to work conditions, family problems, child care, education or participation in union or other activities, were also examined. In one study of the interrelationship between absence from work and different background variables such as the number of children, occupation, etc., 150,000 individuals in the ages 16-67 were sampled by selecting people who were born on the 15th of each month.

Results

Two-shift workers have higher sickness rates, not only than dayworkers, but also than three-shift workers or people with rostered-duty schedules. This is true for long-term but not for short-term absenteeism. Where three-shift workers are concerned, the results vary and it is not possible to draw any firm conclusions. Absence for reasons other than sickness was generally more common among people who worked irregular hours (Eriksen, 1978; Bostrand, 1978).

Accidents and Shiftwork

Methods

In projects on accidents, both interview data and data from official or company statistics were used. In one case, employees were interviewed regarding their accidents during the last three years and on their views on the causes of the accidents. Data on different work environment factors were also collected by interviews and/or observations, and these data were then correlated with accident frequency. In one case, the distribution of accidents over hours of the day was studied.

Results

Although there was no difference in accident frequency between three-shift workers and dayworkers (Bostrand, 1978), the three-shift workers considered

themselves to be more exposed to risk of accident than did dayworkers and two-shift workers. They also indicated that there was greater risk at certain hours of the day, with a peak between 3 and 6 am. In the two-shift group, the accident frequency was somewhat higher than in that of dayworkers.

Social Consequences of Shiftwork

Methods

In the projects on social consequences of shiftwork, the main tools were questionnaires and interviews, and usually involved substantially sized groups of shiftworkers and dayworker controls. The investigations were in most cases transverse studies but, in a few cases, repeated measures were taken, e.g., after a change in the work hours schedule. One researcher, in cooperation with the workers and management, set up a plan for changing the shift system and conducted a follow-up study after some of these changes had been made. Time budget techniques were applied in some cases.

Participant observation was used for collecting data in one study, and, in other studies, wives and other family members of the shiftworkers were questioned about the different problems that shiftwork presented for them.

Results

Family relationships. One difficulty, found to be especially pronounced among young shiftworkers, is getting enough time to spend with one's children (Gothenburg Psychotechnic Institute, 1975; Åkerstedt & Thorsvall, 1977a; Magnusson, 1978). More than one-third of the three-shift workers in one study considered this to be a major drawback. Fifty percent of those who had school children said their work hours made it impossible for them to see the children every day (Magnusson, 1978).

Similar results were obtained concerning time spent with spouse or fiancee. In about half the shiftworking population, the spouse also works, in many cases on shifts that do not coincide in time. Marital problems were considered to be related to work hours in about 10% of the three-shift workers in one investigation (Magnusson, 1978), and the same proportion said that shiftwork affected their sexual life (see also Appel & Östberg, 1974).

When a continuous three-shift system was changed to a so-called five-shift system with longer spells of spare time and fewer night shifts per cycle, there were clear improvements in family relationships, and the ability to plan and carry out common activities was facilitated (Wallertz-Nilsson, 1978).

The above-mentioned problems with family relationships were also found to exist among two-shift workers (Magnusson, 1978; Gardell, Bostrand, Nilsson, Gehlin, & Magnusson, 1978; Åkerstedt & Thorsvall, 1977a; Gothenburg Psychotechnic Institute, 1975). Families where husband and wife work different shifts were specifically investigated in some of the studies (Dahlgren & Styrborn, 1976a, 1976b; Magnusson, 1978).

Child care. Since nurseries are not open at times when shiftworking families need their services, the care of children is a great problem where both

parents work. In one project, this problem was intensively studied and the local community government was persuaded to keep the nurseries open around the clock (Dahlgren & Styrborn, 1976a, 1976b). In all studies in this field, the situation was found to be most unsatisfactory for families with small children (cf. Andersson, 1975; Magnusson, 1978). This was the case for three-shift workers as well as for those who worked two-shifts.

Housework. Housework in families where one or both parents work shifts does not differ from the pattern of dayworkers, i.e., in the great majority of cases, the wife is responsible for all or most of the work at home. The extent to which shiftwork affects housework seems to depend on the amount of work done outside the home rather than the distribution of work hours (Magnusson, 1978).

A number of studies concentrated on female shiftworkers (Gardell, Baneryd, Gombrii, & Lundqvist,1968; Gothenburg Psychotechnic Institute, 1975; Holmgren, unpublished). In some of these investigations the effects of changes in the distribution of work hours, including "unconventional" schedules, were studied.

Social relations outside work. Several investigations were concerned with the shiftworker's ability to build up and retain interrelationships with other people during his spare time. In three of those studies (Gehlin, 1978; Åkerstedt & Thorsvall, 1977a; Gothenburg Psychotechnic Institute, 1975), 40, 49 and 65%, respectively, of the three-shift workers considered that their work hours interferred with social relationships, while the corresponding figure for dayworkers was only 1%. The number of social relationships was also shown to be smaller in shiftworking groups.

Leisure. The results as regards leisure time activities are somewhat contradictory. In one investigation, three- and four-shift workers considered that they had too little time for spare-time activities in comparison with two-shift and dayworkers (Åkerstedt & Thorsvall, 1977a, 1977b). In contrast to this, another investigator (Gothenburg Psychotechnic Institute, 1975) concluded that shiftworkers were rather more satisfied in this respect than were non-shiftworking groups. On the other hand, they were forced to plan such activities in advance, which was considered a negative aspect. Three-shift workers were less engaged in club activities and had fewer commissions than other work-hours groups (Gehlin, 1978).

Participation in political and union activities. Three-shift workers hold fewer Union offices than other groups (Nilsson, 1978), and 25% of those who do hold an office claim that they cannot conduct it properly (as compared to 6% in dayworkers). They also consider that their work hours prevent them from attending union meetings and other activities. The same general findings apply to political activities (Nilsson, 1978; Sundberg, 1977).

The Dropouts

As was mentioned in several contexts above, one difficulty when evaluating the effect of shiftwork on health, etc. is the selective mechanism which makes people who enter shiftwork differ from the rest of the (day) working population in certain respects, and shiftworkers who are adversely affected by shiftwork leave it.

In spite of awareness of this selection problem and its effect on interpretations of results from shiftwork studies, there are very few investigations on this matter.

Two projects looked specifically at the questions of why people start working shifts, and who the dropouts are (Bostrand, 1978; Herbert, 1977a, 1977b). The reason for starting to work shifts most frequently given by three-shift workers was that there had been no alternative for them. About one-fifth of those below 40 said the primary reason was that, at the time, the work hours seemed to be attractive. About 30% of people who started working shifts in a new factory said that they had chosed that job because of the work-hours system. A follow-up study is being performed at this factory to investigate who the dropouts are and why they leave shiftwork.

Conclusions and the Need for Further Research

Summary of Results

The results of the research on irregular working hours have shown that:

- Shiftworkers have more physical, psychical and social problems and symptoms than dayworkers.
- These problems and symptoms increase on starting shiftwork and decrease when night-shift work ceases.
- The effects on health and well-being of two-shift work seem to have been underestimated. These workers have more sickness absence than any of the other groups, and their social inconveniences are pronounced.
- The inconvenient work hours allow people very little opportunity to utilize the services of child care organizations, which means that the situation for the shiftworkers' children becomes more unstable, irregular and less secure.
- Leisure-time activities, especially those that are restricted to certain hours of the day, are less accessible.
- There is less time for building up and retaining relations with other people (including family members), and thus the social network is reduced.
- Certain factors interact with irregular work schedules in producing disturbances. Age, morningness-eveningness, age of children, and whether the spouse works or not, have been shown to be significant.
- The problems are, to a large extent, produced by the mismatch between work hours and circadian rhythms. The specific design of the shift system (number of consecutive night shifts, starting time, etc.) is, thus, important for adaptation to irregular work hours.

The Need for Further Research

Although a considerable amount of research has been directed to the problems of irregular work hours, it is apparent that we still need more knowledge to fully understand the mechanisms by which shiftwork, etc., gives rise to

illnesses and social problems, and thus to be in a position to give practical recommendations to those concerned. I think that the following areas or problems should receive special attention in future research:

- The relationship between circadian rhythm changes and different medical and social complaints should be further elucidated. Research should focus on two-shift workers and people with rostered-duty, since there are definite health problems in these categories.

- The problem of day sleep and measures to improve it should be investigated more intensely. Sleep disturbance is one of the most common complaints among shiftworkers, and it seems clear that external factors such as noise, etc. are not the main causes.

- Since one of the typical complaints of shiftworkers is gastric dysfunction, we need analyses of food intake, and intervention studies in which different ways of changing dietary habits are tested.

- The negative effects of shiftwork on social relations and on participation in different activities in the community must be studied further, and to the same extent as effects on health.

- Previous research has concentrated on three-shift work. Other forms of irregular work hours, such as two-shift and rostered-duty schedules, should receive more attention, not least since the number of workers in these categories is even greater than the number in shiftwork.

- More knowledge is needed on age in relation to circadian rhythm changes, sleep and other factors pertinent to the health and well-being of shiftworkers. Since geriatric research is primarily concerned with the rest-retirement period, studies on middle-age developments in these respects are needed.

Notes on Methodology

Most of the research reviewed utilized conventional methodologies for studying shiftwork problems. However, experimental methods and interventions, longitudinal studies and multidisciplinary approaches tended to be used to a somewhat larger extent than in earlier investigations.

In my opinion, methodological aspects should be given much more attention than has been the case up to now. Although substantial funds have been spent on research in this area, relatively few firm results and recommendations can yet be made to those responsible for planning and designing shiftwork and other irregular work schedules. To this end, I think the following factors should be taken into consideration:

- There are still relatively few intervention studies. Interventions may be conducted as "field experiments", as was the case in some of the studies reviewed. Here, the researcher utilizes changes in shift systems, etc. that occur "spontaneously". However, there is also the possibility that a change in the system could be made deliberately, for experimental purposes. This would, of course, require that both employees and employers took a very

active role in the investigation.

- Although previous studies on the effects of irregular work hours on health were inconclusive, it seems now to be established that there are such effects, and that the main methodological problem here is that of selection into and out of such work-hours systems. One way to tackle this would be to conduct longitudinal investigations where shiftworkers are followed over two or more years and the dropouts are studied specifically. There are a few Swedish studies of this kind under way, although no results have been reported so far.

- Up to now, most of the studies have concentrated either on medical or on social effects. However, the results of some of the investigations indicate that physical and social disturbances are interrelated. Thus, in order to discuss possible changes in shiftwork, we need knowledge about both factors. A multidisciplinary approach to the problems of shiftwork therefore seems to be one important goal in a future program.

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EDITORS

Laverne C. Johnson
Donald I. Tepas
W. P. Colquhoun
Michael J. Colligan

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
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Division of Biomedical and Behavioral Science
Cincinnati, Ohio 45226

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