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RESEARCH MEMORANDUM

TILBURG UNIVERSITY

DEPARTMENT OF ECONOMICS

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SHIFT WORK IN HEALTH CARE

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Inhoudsopgave

Voorwoord

In februari 1983 verscheen het rapport 'Onregelmatig werk in de gezond-
heidszorg'. Het was de neerslag van een onderzoek dat in de periode
1979-1983 in de intramurale gezondheidszorg heeft plaatsgevonden. Hoewel
hiermede het onderzoek eigenlijk werd afgerond, leek het zinvol een aan-
vullende analyse te verrichten met het LISREL-model. Deze analyse lever-
de enkele belangwekkende resultaten op, zowel in vergelijking met de
oorspronkelijke resultaten als in vergelijking met resultaten van onder-
zoek op het gebied van ploegenarbeid in de industrie. De resultaten van
deze aanvullende analyse zijn in dit Research-Memorandum verwerkt.
Op deze plaats willen wij graag Prof. Dr. Ir. A. Kapteyn (KHT) dank zeg-
gen voor zijn kommentaar op een eerdere versie van dit artikel.

Tilburg, februari 1985
Leon Bosch
Willem de Lange

1. Introduction

During the last decade shift work has been studied extensively (e.g. Carpentier and Cazemian 1977, Reinberg et.al. 1981, Colquhoun et.al. 1975). However the main part of these studies deals with shift work in industry. In consequence most research into shift work is concerned with the adaptation of male workers to shift work. In the Netherlands night work for women is tolerated in only a small number of occupations. Certain exceptions are made for experiments, and notably for health care where the demands of patients care make night work a necessity. Because of the female majority in the profession health care is an interesting exception which can be an important source of information concerning the effects of shift work on women. Therefore it is rather remarkable that hardly any attention has been paid to shift work in health care, in particular because a major part of all shift work takes place there. For example, in all about 100,000 persons are on irregular duties in the intramural institutions of health care in the Netherlands.

In industry, the effects of evening and night work on the health of workers and on their family and social life now seem to be sufficiently well established. To investigate the differences and similarities between the effects of shift work in industry and health care, we approached service institutions of health care in the Netherlands and found twelve institutions willing to participate in an investigation. These twelve institutions are general hospitals, psychiatric hospitals, homes for mentally handicapped patients and nursing homes (for the elderly and physically handicapped). More than 1,500 nurses with shift work, and if possible their partner filled out an extensive questionnaire.

In contrast with the research into industry, there are no perfect control groups, because nearly all the nurses have shift work. For our research this was a difficulty. To solve this problem, we surveyed two so called comparison-groups. One group consists of employees of the twelve institutions with just day duties and with a profession close to the nursing profession. The second comparison-group which filled out a questionnaire is the group of former employees of the institutions involved, who resigned no longer than three years ago. Altogether, more than 4,200 persons completed a questionnaire.

De Lange (1983) presented the first results of this research in which data were analysed largely by means of regression-methods. In this paper we analyse the outcomes by means of a model containing latent variables. Latent variables are variables which are not directly observable or only observable with measurement error. Health and social well-being are such variables; they are postulated in theory but difficult to measure.

Using the concept of latent variables we will formulate a model representing causal relationships between several health variables, explaining the health complaints reported by the respondents to the survey, the social well-being of the nurses and the self-reports of physical and mental stress. The model assumes that there is a causal structure among the set of latent variables. Each equation in the model represents a causal link rather than a mere empirical association. This has the advantage that we can analyse the influences of one variable on another and that we can decompose total causal effects into direct and indirect causal effects.

Notice that the data used to estimate the model come from the questionnaire for nurses doing shift work. In this paper the data of the comparison-groups are only mentioned if they give different and/or supplementary results.

Section 2 gives a brief review of the literature concerning evening and night work and its effect on the worker and his/her family. Section 3 presents the model and the estimation results. The sections 4 and 5 discuss these results. Section 6 concludes.

2. General results of research into shift work in industry

In most of the research on shift work principal attention is focused on the harmful consequences that call for amelioration. Shift work creates many discontented evening and night workers because it puts them "out of rhythm" with their families and social lives of the rest of the community. This section summarizes what is currently known about the major effects that irregular working hours may have on employees and their families. The scope of this section is confined to the consequences, advantages and disadvantages, of shift work which concern:
- the health of the shift worker;
- the social well-being of the shift worker and his/her family.

Health

Research into shift work in industry emphasizes the disturbance of circadian rhythm as being the cause of various health problems. This rhythm, which has a fixed pattern of approximately 24 hours, governs many biological functions of the human body. Examples are temperature, heart beat, hormone production and blood pressure. Shift work interrupts these rhythms and requires a pattern not in harmony with the way the body is genetically programmed or environmentally conditioned (see e.g. Rutenfranz et al. 1977, Reinberg et.al. 1975). Consequently problems related to sleep, fatigue, appetite and tension/nervousness are persistent complaints for many shift workers. Particularly widespread among shift workers are fatigue and a lack of adequate sleep. Sleep is often also of a poor quality.

For shift work in health care it is important to add that the reason why women were not permitted to do shift work has been "to safeguard the function of maternity and the welfare of future generations" (Carpentier and Cazemian 1977). Because of physiological differences between women and men, women adapt to shift work in a different way. Women have a specific "temporal structure", which is a function of the menstruation cycle. Within this structure there are variations in the resistance of women. Every month there is a "time of diminished resistance" during which there is a stronger deactivation in the night and more tiredness (Carpentier and Cazemian 1977).

Social well-being

What emerges most clearly from the literature is that the social con-
sequences of shift work are considerable. Not just for the shift wor-
kers, but also for the entire family. Shift work causes a fundamental
change of the traditional allocation of time to work, leisure and sleep
(Rutenfranz et al. 1981). With regard to the social aspects of shift
work a distinction has to be made between family life and social life.
Shift work influences the worker's role of husband, father and citizen.
It is found, that the more these roles are disturbed, the more signi-
ficantly the psychological equilibrium is affected (Carpentier and Caze-
mian 1977).

Family life

The family has to adjust to the shift work continually. For example,
the shift worker has to sleep during the day very often, so that the
rest of the family has to be quiet. Shift work also influences the edu-
cation of children. When children are still very young, it may be plea-
sant to be at home in the day time and at work in the evenings. Yet the
majority looks upon shift work as disadvantageous to the education of
the children. One is less able to spend time with their children, espe-
cially small children who go to bed early.

Partners find it particularly annoying to be alone at night or during
the weekend. For many partners shift work results in the decrease of
contact with friends, acquaintances and relatives, in the fact that they
have to go to parties on their own quite often and in the diminishing
possibilities of having a job for their own. A large group of partners
even has sleeping problems.

These aspects of shift work cause a negative attitude from many part-
ners of shift workers against shift work. Sometimes this attitude is
also influenced by a suffering sexual relationship as a consequence of
shift work. Bunnage (1981) reports that, the greater the irrigularity,
the more the family life is disturbed and the more negative the part-
ner's opinion.

Social life

Rutenfranz et al. (1981) state that shift work hinders the confrontation with new tasks, other groups and different patterns of life and this is the reason that the shift worker is less active after his work. Social life is concentrated in the evenings and the weekend. Whether difficulties are experienced by the shift worker is, according to Walker (1976), dependent on his/her personal characteristics, his/her rota and the community he/she lives in.

Several inquiries have shown that shift workers have less friends than day workers. When there is no work on Sunday, problems are significantly less (Carpentier and Cazemian 1977). Unfortunately, for nurses work on Sunday is inevitable.

There are also several studies showing that the workers' activities in groups suffer from shift work and that they have less memberships of clubs than day workers (Meers 1976).

The results of inquiries in industry, that have been described above, cannot be compared simply with results of our research in health care. Nevertheless we use them as a starting point because, in spite of all the differences, the consequences of shift work could be the same. But we have to be aware of all differences in the work and personal characteristics of shift work(ers) between health care and industry.

In health care there are many more female employees and on an average employees are younger than in industry. Moreover there are differences in family situations, living conditions, education etc. (Gadbois 1981).

There is also an important difference in the rota. In industry, shift workers have as much night duties as day and evening duties. In health care, employees have less night duties than day and evening duties. In this respect it is important to notice, that the work in the health care institutions during the night, in contrast with industry, is not the same as in the day time. The emphasis is more on watching; therefore only a few nurses are present at that time.

3. The model

3.1. Introduction

In this section we formulate a model which helps us to get a better view on the health conditions and the social well-being of workers in health care.

If we want to deal with the medical aspects of shift work we have to be aware of the impossibility to establish the impact of shift work on a worker's health without reference to the social context. As Carpentier and Cazemian (1977) pointed out: "[...] any attempt to do so would be in flagrant contradiction with the very definition of health which consists in complete physical, mental and social well-being". At the same time, however, it is difficult to make assessments about health because one has to know how these several aspects are related to each other.

By specifying a causal structure we want to get a better insight in these relations. We use a so-called linear structural equation model. This model can be obtained by imposing appropriate restrictions on the general theoretical framework of LISREL. LISREL has the advantage that latent variables can be incorporated into the model. As we already pointed out in the introduction, the measurement of variables can give problems and it is better to consider health and social well-being as latent variables.

The model consists of two parts: the measurement model and the structural equation model. The measurement model specifies how the latent variables are measured in terms of the observed variables (indicators) and is used to describe the measurement properties (validities and reliabilities) of the observed variables (section 3.2). The structural equation model specifies the causal relationships among the latent variables and is used to describe the causal effects and the amount of unexplained variance (section 3.3). The estimation results will be discussed in the next sections.

It is possible to estimate the parameters of the model by means of maximum likelihood methods. For this purpose we used the LISREL-V version (Jöreskog and Sörbom 1981). To be clear, the name 'LISREL' is used to indicate both the model and the computer program to estimate the mo-

del. The estimating and testing of the general model was discussed by Jöreskog (1973).

3.2. The measurement model

Latent variables are unobservable. Several observed variables called indicators are constructed to approximate these theoretical variables. The measurement model specifies how the latent variables are measured in terms of the observed variables. Each indicator (denoted by y) is largely related to the latent variables (denoted by η) for which it is an indicator.

Our model contains six latent variables: three health variables, and one for social well-being, physical and mental stress each.

Physical stress (η_1) and mental stress (η_2) are part of the model as endogenous latent variables. However in contrast with the other latent variables, which are presented below, we assume that both physical and mental stress are measured exactly. This means that the measurement-errors are zero and that the latent variables are equal to their indicator variables. As these indicator variables are taken the self rating of the nurse on the physical and mental stress respectively.

The health variables are:
- a latent variable concerning the mental well-being (η_3) for which psychological complaints are used as indicators;
- two variables representing physical well-being, one concerning the sleeping problems (η_4), the other fatigue (η_5).

Five indicator variables are used to measure mental well-being: restlessness, irritability/tension, nervousness, trouble falling asleep and the sexual relationship.

To measure the sleeping problems, restlessness, sleeplessness, restless nights and trouble falling asleep are used as indicators. The latent variable fatigue has been measured by sleepiness and fatigue.

The sixth latent variable concerns social well-being (η_6). Problems in family and social life are not separated so that both are seen as caused by one (latent) variable, social well-being. We choose five indicators:
- adjustment of the family;
- relationship with the partner;

- sexual relationship with the partner;
- relationship with friends and acquaintances;
- possibilities to participate in social life.

We have to remark that, since the latent variables are unobserved, they do not have a definite scale. Both the origin and the unit of measurement in each latent variable are arbitrary. To define the model properly the origin and the unit of measurement of each latent variable must be assigned. The origin has been assigned by the assumption that each latent variable has zero mean. The scale unit of the latent variable is arbitrarily established by assigning it the scale of one of its indicators. This can be done by giving one of the λ-parameters corresponding to each latent variable the value 1 a priori.

Notice too that the measurement model is not estimated separately from the structural equation model. The parameters of both parts of the model are estimated simultaneously. We just present the estimation results in different sections.

The indicator variables can be found in table 1. The questions from the questionnaire to which the indicator variables are related, are presented in the appendix A. With this information it is possible to present the measurement model in figure 1. Table 1 shows also the estimation-results for the λ-parameters of the measurement model. An indication of the quality of the measurement model can be obtained by the squared multiple correlations (R^2) for the indicators.
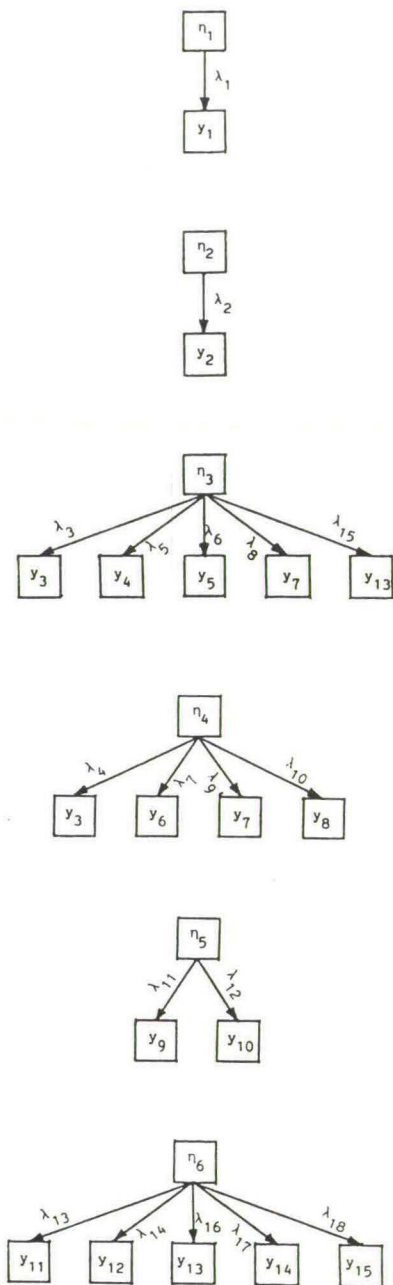
Figure 1. The measurement model and its parameters

Table 1. The estimation results for the λ-parameters and the squared multiple correlations for the indicators.

Indicator description/(notation)	latent variable	parameter	estimated value	standard error	R^2
self-rating on physical stress (y_1)	η_1	λ_1	1	–	1
self-rating on mental stress (y_2)	η_2	λ_2	1	–	1
restlessness (y_3) {	η_3	λ_3	0.853	0.049	} 0.48
	η_4	λ_4	0.150	0.042	
irritability/tension (y_4)	η_3	λ_5	1	–	0.55
nervousness (y_5)	η_3	λ_6	0.892	0.041	0.44
sleeplessness (y_6)	η_4	λ_7	1	–	0.54
trouble falling asleep (y_7) {	η_3	λ_8	0.319	0.041	} 0.50
	η_4	λ_9	0.761	0.046	
restless nights (y_8)	η_4	λ_{10}	1.060		0.61
sleepiness (y_9)	η_5	λ_{11}	0.775	0.041	0.38
fatigue (y_{10})	η_5	λ_{12}	1	–	0.64
adjustment of the family (y_{11})	η_6	λ_{13}	1	–	0.25
relationship with the partner (y_{12})	η_6	λ_{14}	0.867	0.081	0.19
sexual relationship (y_{13}) {	η_3	λ_{15}	0.267	0.043	} 0.13
	η_6	λ_{16}	-0.498	0.080	
relationship with friends and acquaintances (y_{14})	η_6	λ_{17}	1.159	0.095	0.33
possibilities to participate in social life (y_{15})	η_6	λ_{18}	-1.033	0.088	0.27

Note: If there is no standard error given this means that the value of the corresponding parameter is fixed at one.

3.3. The structural equation model

The structural equation model specifies the relationships among the la-
tent variables and it specifies the impact of the exogenous explanatory
variables (so-called "causes") on the latent variables. Table 2 gives
the list of explanatory variables. To illustrate the meaning of the de-
scription of these explanatory variables, appendix B presents the cor-
responding questions of the questionnaire.

Table 2. A list of explanatory variables.

Notation	Description	Notation	Description
x_1	part time employed	x_8	night duties
x_2	age	x_9	weekend duties
x_3	sex	x_{10}	intermittent duties[*]
x_4	marital status	x_{11}	overtime
x_5	licensed	x_{12}	tension during work
x_6	supervising	x_{13}	afraid during night duties
x_7	evening duties	x_{14}	satisfaction with the at-tention that can be paid to the patients

*) Duties with a pause of more than one hour at noon.

A part of the estimation results of the structural equation model is
presented in figure 2. This figure illustrates the (significant) rela-
tionships between the latent variables. In this figure the coefficients
are given, which represent the mutual relationships among the (endoge-
nous) latent variables; it concerns the direct impact on each other. The
numbers in brackets are the standard errors of the coefficients invol-
ved.
Table 3 presents the direct impact of the (exogenous) personal and func-
tional characteristics on the latent variables.

Figure 2. The causal structure of the latent variables*)
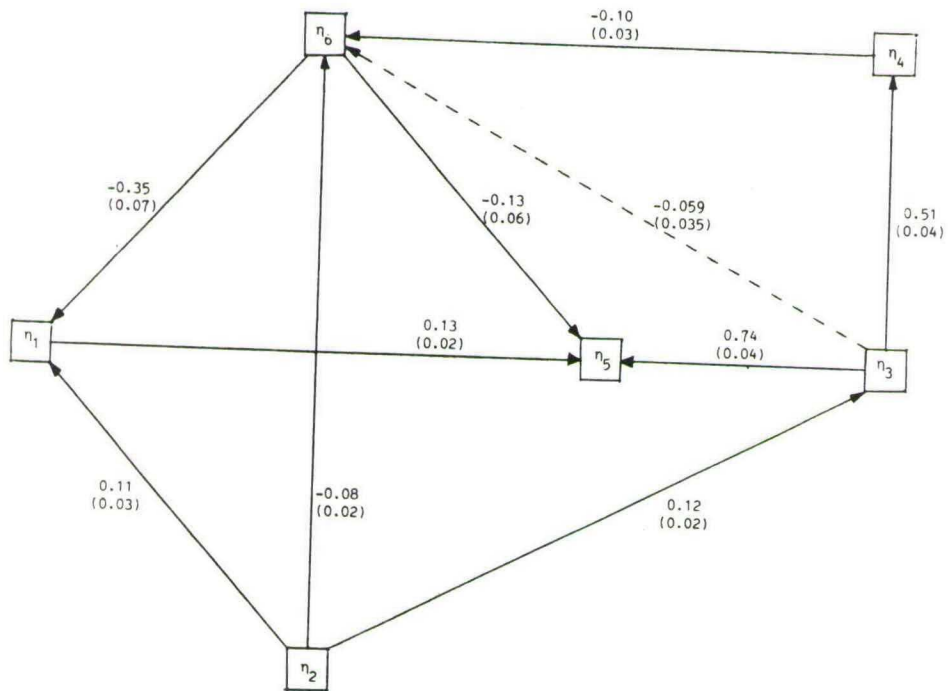
*) A dotted line refers to a relationship which is not significant.

Table 3. The impact of personal and functional characteristics on the latent variables[*)]

explanatory variable latent variable	part time employed x_1	age x_2	sex x_3	marital status x_4	licensed x_5	supervising x_6
physical stress	n.s	-	0.09 (0.02)	n.s	n.s	-0.10 (0.03)
mental stress	n.s	-	-0.06 (0.03)	n.s	-	0.08 (0.03)
mental well-being	n.s	-	n.s	0.05 (0.02)	-0.06 (0.02)	-
sleeping problems	n.s	0.08 (0.02)	-	-0.08 (0.02)	n.s	n.s
fatigue	n.s	-	0.05 (0.02)	n.s	-	-0.06 (0.02)
social well-being	n.s	n.s	n.s	-0.06 (0.02)	-	-

*) Illustration:
- A hyphen (-) in the table means that the explanatory variable is not taken into the model to explain a latent variable. For example, sex (x_3) is not used to explain sleeping problems (η_4).
- n.s. means not significant and is used for the case that an explanatory variable is taken into our model, but we find no significant impact on the latent variable involved. For example, part time employed (x_1) has no significant impact on each of the latent variables (η_1 to η_6).
- For the case that an explanatory variable has a significant impact on a latent variable, the coefficient is given. The standard error of the coefficient involved, is given between brackets. For example age has a significant impact on sleeping problems; the coefficient is 0.08, the standard error 0.02.

Section 4 will deal with the estimation results of table 3 and figure 2, supplemented by results of our first research (De Lange 1983). Until now we have not yet payed attention to the exogenous variables, concerning the rota (x_7 to x_{11}). Section 5 will discuss this part of the estimation results.

Remains to report the squared multiple correlations for the structural equations and the total coefficient of determination as a measure of the strength of several relationships jointly. The magnitude of this coefficient of determination is 0.523. The squared multiple correlations are presented in table 4.

Table 4. The squared multiple correlations (R^2) for the structural equations.

Equation	Latent variable	R^2
1	physical stress (η_1)	0.22
2	mental stress (η_2)	0.15
3	mental well-being (η_3)	0.27
4	sleeping problems (η_4)	0.28
5	fatigue (η_5)	0.61
6	social well-being (η_6)	0.25

4. Estimation results

4.1. Physical and mental stress

Both physical and mental stress (n_1 respectively n_2) are measured by self-reports on the respondents. The self-rating on physical stress (n_1) is influenced by two important variables, social well-being (n_6) and mental stress caused by work (n_2). Generally a lower social well-being gives rise to a higher (self-report of) physical stress.

Mental stress is also one of the explanatory variables for physical stress. If mental stress is heightened, whatever the reason may be, this causes also a raising of the physical stress. Perhaps a little bit surprising may be that the model suggests that the reverse doesn't hold. Physical stress forms no part of the explanation of mental stress.

A surprising result may be that there are no complaints influencing physical and mental stress. On the other hand physical stress causes fatigue (n_5). Mental stress isn't conducive for mental well-being (n_3). Hence mental stress indirectly causes both sleeping problems (n_4) and fatigue.

Mental stress (n_2) is influenced by several exogenous variables which are closely related to the working conditions, e.g. overtime (x_{11}) and afraid during the night shift (x_{13}). These explanatory variables have only an indirect influence on physical well-being.

Generally, women find their work physically harder than men; the reverse is true of mental stress. Worth noticing is the difference between nurses with a surpervisory and with a non-supervisory position: subordinates experience more physical stress, but less mental stress.

4.2. Health complaints

Fortunately, the health conditions of the nurses are nog alarming. According to their own assessment only a very small part of the respondents (less than 5%) considers themselves to be "not so healthy" or "unhealthy". What is so often stated in the literature on shift work, is

perhaps of interest here, viz. the fact, that those people who cannot cope with the shift work or dislike it, give up their job (self-selection).

Even though the health conditions are generally not alarming, analysis of the comparison groups shows negative effects of shift work:
- nurses doing shift work have more complaints about their health than their colleagues without shift work and than the ex-employees of the institutions which have no shift work any more;
- these ex-employees have less problems with their health now compared to when they were still having shift work.

Mental well-being (η_3)

Psychological problems form the first group of important complaints concerning shift work. These problems can be seen as a possible result of the deviation of the work rhythm from the biological rhythm (Carpentier and Cazemian 1977). This does not mean that shift workers always have more psychological problems than day workers. There are even some papers that indicate the contrary. Because of the contradictory reports Koller et al. (1981) conclude that the relationship between psychological disturbances and shift work is not clear.

We have distinguished three complaints in this field. They are taken as indicators for the mental well-being. Irritability/tension (y_4) is, after fatigue, the complaint most mentioned. Nearly one-third of all nurses often has this complaint. Restlessness (y_8) and nervousness (y_5) are mentioned somewhat less frequently. Many investigations suggest a relationship with other complaints (Maurice 1976). According to the model we can confirm such results in that mental well-being (psychological complaints) is a cause of fatigue (η_5) and sleeping problems (η_4).

Among other factors psychological complaints are caused by a number of variables which are closely related to the work situation:
- (the self-rating on) the mental stress of the work (η_2);
- experiencing stress at work (x_{12});
- being afraid during the night shift (x_{13}).
Notice that, in relation to psychological complaints, also dissatisfaction with the attention one can pay to the patients (x_{14}) has importance. Among other reasons, lack of time is a reason why nurses have not

enough possibilities to pay attention to the patients and this can make them discontent and may give rise to irritability and tension.

Generally the student-nurses (x_5) mention more psychological complaints than the group of licensed nurses. This can be caused by lack of experience, the combination of training and work and the gripping situations that may occur. These factors can make the job very hard for young people who just finished secondary school.

Finally, we notice the difference between married nurses and their unmarried colleagues (x_4). Married nurses have more psychological complaints. Possibly they are under greater stress because of the combination of work and care for their family. In any case the complaints are not caused by a greater mental or physical stress due to the work alone.

Sleeping problems (η_4)

Sleeping problems (η_4) are often judged to be the most serious problems of shift work. They are not only caused by the disturbed circadian rhythm, but also by the unfavourable conditions in which shift workers have to sleep after a night shift (Knauth and Rutenfranz 1975). Of course there are many differences between shift workers. Research of Folkard et al. (1978) among nurses with only night shifts shows that someone's flexibility (or rigidity) in sleeping habits seems to be an important factor concerning the adjustment to the rhythm.

According to the model, age (x_2) is an important factor in the explanation of the sleeping problems: older nurses have more sleeping complaints than younger ones. Not all research on shift work shows the same results. Foret et al. (1981) found more sleeping problems with older shift workers, Maassen et al. (1980) on the contrary did not. We have the impression that sleeping problems are more common among nurses of 45 years or over. This is not only because of the complaints mentioned but also because this group of nurses needs more days for recuperation after a period of night duties. This result needs some qualification because, in our research, the number of nurses in this age-category is small. Though further research is needed, it seems desirable to create possibilities to give the older nurses less shift work.

Another noticable result concerning sleeping problems (η_4) is that married nurses have less complaints than their unmarried colleagues (x_4). We expected the married nurses to have more sleeping problems because generally spoken they have an older age (x_2). As the model shows, this effect can be strenghted by the fact that married nursus have a worse mental well-being (η_2), which, as we already saw above, is also a cause of sleeping problems. Apparently these results are dominated by an opposite effect. The only way to explain this, is that taking enough rest is very important. The weekend is suitable to get some extra sleep. However social life is concentrated in the weekend. Youth attaches much value to the weekend, which can lead to a lack of sleep. To a certain extent this is confirmed by the fact that, according to the model, more weekend duties (x_9) give rise to sleeping problems.

Fatigue (η_5)

The complaint most often mentioned is fatigue (η_5). Matsumoto et al. (1978) found that nurses were most tired after the night shift and least after the day shift. Fatigue is a serious problem, because especially at night when there are not so much nurses on duty and the nurse's task primarily consists of observing and keeping watch over the patients, critical situations may occur in which quick and adequate performance of nurses is of literally vital importance. For this reason, it is quite important that they are fit when on night duty. Because of the effect of the circadian rhythm, however, they are, generally speaking, not able to function optimally when on night duty. When rest is dictated by their biological rhythm, they have to work and the body is at rest when it ought to be in action according to that rhythm (Carpentier and Cazemian 1977, Reinberg et.al. 1975).

Not surprising is the conclusion that fatigue is partly caused by heavy physical stress (η_1). In some research correlations were found between fatigue and other complaints especially sleeping problems (η_4) (Pternitis 1981, Carpentier and Cazemian 1977). In the first instance we found similar results (De Lange 1983) but our model suggests this is a case of spurious correlation; both fatigue (η_5) and sleeping problems (η_4) are negatively influenced by a lower mental well-being (η_3). Fatigue doesn't cause other complaints about health.

It is often assumed that fatigue leads to an impaired ability to participate in family and social life. Our model cannot confirm such a result. It is rather the opposite: a bad social well-being (η_6) stimulates fatigue (η_5). It seems that fatigue is one of the consequences of the trouble shift work causes, when a family cannot cope well with the evening and night shifts of the shift worker. Perhaps one takes extra trouble to participate in family and social life with extra stress as a consequence. Then fatigue is bound to be the result. The model also suggests that this is accompanied by a higher self rating of the physical stress of the respondents.

The estimation results of the model also show, that fatigue is linked to some personal characteristics. Women mentioned the complaint more often than men. This could be heightened a little by the greater physical stress the women experience. Finally we mention that nurses with a supervisory position complain less about fatigue than their subordinates.

With this we have looked at the most important problems concerning health. All the other complaints, concerning e.g. appetite and digestion, were mentioned less frequently, so we leave them out of consideration here.

4.3. Social well-being (η_6)

The social consequences of shift work are considerable. Not just for the shift workers, but also for the entire family. Our data show that two-third of all nurses with shift work reports that the family has to adjust to the shift work continually. Nearly half of all partners find it unpleasant. 43% of the partners reports to have less contact with one another because of the shift work. A majority of the shift workers considers their work to be disadvantageous to their relationship. The most important reason why shift workers experience more family-related problems, is because of the lack of synchronity between their hours on the job and their families' daily routine.

This 'out of rhythm' argument is also applicable to social life. We found that nurses doing shift work have to contend with a certain degree of social isolation. More than 70% see less of their friends and rela-

tives because of the shift work. The nurses with shift work have signi-
ficantly fewer memberships of clubs than day workers. Nearly all shift
workers report to have less possibilities to participate. These results
are confirmed by the analysis of the comparison-groups.

Already without the model, we suspected that the social consequences
of shift work are certainly as important as the physical and psycholo-
gical consequences of shift work. The model gives some supplementary
results, which we will discuss below. As we mentioned before we used one
variable, social well-being. No distinction is made into family and so-
cial life.

Mental stress (η_2) isn't conducive for the social well-being of the
nurse (η_6), neither are sleeping problems (η_4). A possible reason for
both relations is that nurses are often very involved in their work and
their patients. They take home the daily problems of work. This is an
argument which is given by 36% of the nurses with sleeping problems for
their sleeping problems.

On the other hand social well-being is a latent variable which plays a
role in the explanation of other latent variables. We already dealt with
the importance of social well-being for physical stress (η_1). Here we
have to point at fatigue (η_5): the better one's social well-being, the
fewer complaints about fatigue will be recorded.

Finally we notice the difference between unmarried and married nurses
(x_4). Generally spoken married nurses are somewhat less satisfied with
their social well-being than their unmarried colleagues. Certainly not a
surprising conclusion if we consider the greater obligations of the mar-
ried nurses to their family.

5. Health, social well-being and rota

If we want to make a comparison with research results in industry we have to be aware of an important difference. As we said before, in industry shift workers have as much night duties as day- and evening duties. In health care, employees have less night duties than other duties.

Moreover, in industry, it is generally not possible to differentiate as to the degree of shift work because everybody within the firm generally has the same working schedule. This is different in health care. There are not just big differences between (types of) institutions, but even within an institution not everybody works according to the same working schedule. This enables us to check to which extent the (in)conveniences of shift work are dependent on this working schedule. The most important variables concerning that schedule are the proportions of the evening and night shifts (x_7 respectively x_8) in the rota as well the frequency of the weekend shifts (x_9).

In this section we will discuss the influence of the different shifts on health complaints and social well-being. The estimation results can be found in table 5. We will discuss these results below.

Table 5. The impact of rota variables on the latent variables[*)]

explanatory variable / latent variable	evening duties (x_7)	night duties (x_8)	weekend duties (x_9)	intermittent duties (x_{10})	overtime (x_{11})
physical stress (η_1)	−0.16 (0.02)	n.s	0.10 (0.03)	0.13 (0.02)	−
mental stress (η_2)	n.s	n.s	−	0.06 (0.02)	0.19 (0.02)
mental well-being (η_3)	0.07 (0.02)	−	0.04 (0.02)	n.s.	0.05 (0.02)
sleeping problems (η_4)	−	n.s	0.05 (0.02)	−	−
fatigue (η_5)	−0.06 (0.02)	−	−	n.s	0.05 (0.02)
social well-being (η_6)	−	−0.05 (0.02)	−0.09 (0.02)	−0.04 (0.02)	−0.04 (0.02)

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*) Illustration
- A hyphen (−) in the table means that the explanatory variable is not taken into the model to explain a latent variable. For example, evening duties (x_7) are not used to explain the social well-being (η_6).
- n.s. means not significant and is used for the case that an explanatory variable is taken into our model, but we find no significant impact on the latent variable involved. For example, night duties (x_8) have no significant impact on mental stress (η_2).
- For the case that an explanatory variable has a significant impact on a latent variable, the coefficient is given. The standard error of the coefficient involved, is given between brackets. For example, night duties (x_8) have a significant negatieve impact on social well-being (η_6). The coefficient is −0.05, the standard error 0.02.

The model shows that, generally speaking, the evening shifts (x_7) are physically (η_1) not so hard as the other shifts. A relatively great part of the evening shifts in the rota is accompanied with relatively few complaints about fatigue (η_5) and physical stress (η_1). The psychological complaints on the other hand rise.

According to the model night shifts (x_8) are not worse for physical and mental stress (η_1 and η_2) than day shifts. Apparently night shifts do not have a major influence on the self-reports on physical and mental stress. Compared with the day shift, the night shift is more a cause for extra complaints about health. In this context the conclusions differ clearly from shift work in industry. Just from the viewpoint of social well-being night shifts are considered undesirable.

According to the model a lot of weekend duties (x_9) in the schedule are considered unpleasant and have several negative consequences. Weekend duties are physically harder. They can also be related to both psychological complaints (η_3) and sleeping problems (η_4). Last but not least, weekend duties influence social well-being (η_6); too many weekend duties are undesirable for both family and social life.

Concerning the working schedule, we considered two other rota variables: overtime (x_{11}) and intermittent duties (x_{10}). Overtime is accompanied by a greater mental stress. At the same time it causes fatigue (η_5) and is worse for mental well-being (η_3). According to the nurses, also intermittent duties require more mental stress. Physically these duties are even harder. Intermittent duties have no direct impact on health complaints. Just indirectly it can be a cause of complaints because of the higher stress it requires, because physical stress is a cause of fatigue and, to a less extent, the mental exertion of these duties causes psychological complaints.

No less important is the influence of overtime and intermittent duties on social well-being (η_6); these rota variables are not conducive to both social and family life.

6. Conclusions

The health conditions of the nurses are not alarming, certainly not if we compare the results of our research with most inquiries concerning shift work in industry. There is a rather low influence from shift work on the health of the nurse. This is a surprising result, because it's always thought, that shift work for women should be more harmful for women than for men. Indeed, we found women experience more physical stress and more fatigue than men, but that doesn't alter essentially the conclusion mentioned above. Probably the explanation can be found in the rota and in the work itself. In industry work is mostly the same in all shifts. Nurses work relatively more by day and less during the weekends than employees in industry. Moreover, in general work in health care is better qualified than in industry.

Though the health conditions are not alarming, analysis including also the comparison groups shows that in health care too, work during irregular hours does affect health. Comparing day-, evening- and night shifts it is not one of these three shifts that has a major influence on health; it's rather the whole complex of irregularity. Therefore, the physical and mental stress of the day shifts may not be underestimated. This is an important supplement of former research results. In this connection weekend duties and overtime are important variables too.

It is important to notice that our first research results concerning health (De Lange 1983) were more in accordance with what is mostly found in industry. Analysis with the concept of latent variables for health and social well-being and with the causal structure of the LISREL-model gives different results concerning the health of the shift worker. LISREL has the advantage that we can get a better insight in the causality of relationships. We can analyse whether there is a direct or an indirect causal relationship, whether the causality is in both directions or in one direction only and whether a correlation is real or spurious.

The results of the model concerning social well-being are in accordance with those of other inquiries and also with our first research. The consequences for social and family life are substantial. Especially

night and weekend duties are not conducive for social well-being. So,
there is no reason to say that shift work in health care is not harm-
full. Working during irregular hours in this field is inevitable. That
does not alter the fact, that measures have to be taken to minimize the
consequences of shift work with a special attention for the social side.

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Appendix A. <u>The questions out of the questionnaire belonging to the in-</u>
<u>dicators.</u>*)

Indicator	Question	Possible answers

1. y_1 How much physical stress does
your work require?

                                                - very litte (1)
- little (2)
- so-so (3)
- a fair amount (4)
- a lot (5)

2. y_2 How much mental stress does
your work require?

- very little (1)
- little (2)
- so-so (3)
- a fair amount (4)
- a lot (5)

3.   Did you have any of the fol-
lowing complaints the last
year?

y_3	restlesness	
y_4	irritability/tension	
y_5	nervousness	
y_6	sleeplessness	- no (0)
y_7	trouble falling asleep	- yes, a litte (1)
y_8	restless nights	- yes, a lot (3)
y_9	sleepiness	
y_{10}	fatigue	

4. y_{11} Because I am working in shifts my family has to adjust itself continually

- disagree (-1)
- neither agree nor disagree (0)
- agree (1)

5. y_{12} Do you think that your shift work has a favorable or an unfavorable effect on the relationship with your partner?

- very unfavorable (1)
- unfavorable (2)
- no effect (3)
- favorable (4)
- very favorable (5)

6. y_{13} Do you have problems with sexual relationship with your partner at the moment?

- no (0)
- some (1)
- a lot (3)

7. y_{14} Do you think that as a result of your working shifts you see more of your friends, acquaintances and relations, or less?

- much less (1)
- less (2)
- neither more nor less (3)
- more (4)
- much more (5)

8. y_{15} You have fewer possibilities
                  to participate in social life
                  because you are working in
                  shifts?

                                                        - disagree (-1)
                                                        - neither disagree nor
                                                          agree (0)
                                                        - agree (1)

*) The numbers between brackets (after the possible answers) are the
   codes we worked with.

Appendix B. <u>The explanatory variables and their corresponding questions</u>
<u>of the questionnaire.</u>[*)]

Explanatory variable	Question	Possible answers
1. x_1	Are you part time employed?	– no (0) – yes (1)
2. x_2	What is your age?	
3. x_3	What is your sex?	– men (0) – women (1)
4. x_4	What is your marital status?	– unmarried (0) – married (1)
5. x_5	Are you licensed?	– no, student-nurse (0) – yes, licensed (1)
6. x_6	What is your position?	– non-supervising (0) – supervising (1)
7. x_7	Can you give on average, the percentage of the evening duties in the total of day, evening and night shifts?	
8. x_8	Can you give on average, the percentage of the night duties in the total of day, evening and night duties?	

9. x_9 How many times do hou have to work in the weekend?**)

      – every week (12)
      – 3 times in 4 weeks (9)
      – 2 times in 3 weeks (8)
      – once a fortnight (6)
      – once in 3 weeks (4)
      – once a month (3)
      – less than once a month (1)

10. x_{10} Do you have intermittent duties?

      – never (0)
      – sometimes (1)
      – often (2)
      – always (3)

11. x_{11} Do you have to work overtime repeatedly?

      – never (0)
      – sometimes (1)
      – often (3)

12. x_{12} Do you often experience stress at work?

      – never (0)
      – sometimes (1)
      – often (2)
      – always (3)

13. x_{13} Are you sometimes afraid during the night shift?

      – never (0)
      – sometimes (1)
      – often (2)
      – always (3)

14. x_{14} Are you satisfied with the
                     attention you can pay to the
                     patients?

- very dissatis-
  fied (1)
- dissatisfied (2)
- doesn't matter (3)
- satisfied (4)
- very satisfied (5)

*) The numbers between brackets (after the possible answers) are the codes we worked with.

**) The codes for the possible answers of these questions are derived from a comparison with a period of three months. For example, three months consists of twelve weeks so the answer 'every week' gets code 12.

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