The effect of employee influence on working time arrangements among nursing personnel in the eldercare

1. Aims of the study
This project aims to examine if increased influence on working hours reduces stress symptoms and work-family conflicts and thereby decreases ischemic heart disease-related biochemical and behavioural risk factors in nursing personnel in the Danish eldercare. The project also aims to study to which extent primary selection into shift work takes place among a group of newly educated home care helpers and assistant nurses.

2. Background
2.1 Shift work, nursing personnel and heart disease

Normal working hours, i.e. full-time work between 7.00 h and 18.00 h from Monday to Friday, represent more the exception than the rule in the EU. Only 24% of the population studied in the SALTS Project has working hours that neither includes shift work, weekends, part-time nor night work (1).

In Denmark health care personnel are one of the occupation groups where shift work is most common (2). Results from a study in the Danish eldercare show that 19% of the nursing personnel have permanent evening work, 7% have permanent night work, and 15% have irregular working hours (3).

Epidemiological studies have been focusing on the possible detrimental effects of shift work on health and well-being and several studies have shown that shift work is associated with circulatory diseases including ischemic heart disease (IHD) (5;6). Among the hypotheses that may explain the association between shift work and IHD is disruption of circadian rhythms, stress (i.e. caused by work-family conflicts and lack of restitution) and behavioural changes in terms of dietary habits and smoking (4).

Compared to other occupational groups the age-standardized hospitalization ratio (SHR) for ischemic heart disease was significantly elevated among home care helpers, and the incidence is rising (7). Thus shift work could maybe explain some of the elevated risk of IHD among nursing personnel in the eldercare along with other occupational and individual risk factors.

2.2 The effect of influence on working hours
Low decision latitude especially in combination with high job demands has been shown to be associated with an increased risk of heart disease (8). In cross-sectional studies low decision latitude is associated with increased plasma fibrinogen concentration (9), decreased physical activity (10;11), and increased smoking intensity among smokers (12). Employee control (also called employee flexibility or control)

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1 Shift work can be defined as work outside normal day working hours, this could be either permanent evening or night work or variable working hours including day, evening and/or night work (4).
specifically in relation to working hours has also shown a positive effect on health and well-being in both intervention and follow-up studies. The possibilities of influencing one’s working hours may enable workers to better adjust their work schedule to individual resources and to the demands of their private lives (13).

In an intervention study in a Danish psychiatric hospital nursing teams were asked to develop an appropriate work schedule for their team and manage the intervention for 20 months. The results showed a significant increase in the participants’ work-life balance, job satisfaction, social support and sense of community (14).

In another Danish intervention study the effect of introducing several “ergonomic principles” into the shift scheduling was examined. Through a participatory approach, the principles of shift scheduling, problems related to shift work, preferences, and the possibilities for changing the applied schedules were discussed among the participants (16).

The effect of the intervention in the wards introducing 1) a maximum of 3-4 consecutive night shifts followed by an extra day off; 2) more regular and predictable schedules with maintained but reduced flexibility to allow staff to choose special arrangements; 3) rotating staff choosing either day/evening or day/night shifts; and 4) minimizing weekend work was an increased satisfaction with the schedules, slightly higher self-rated health, and worsened impact on family life. Moreover this intervention group showed an increase in HDL cholesterol, a decrease in total cholesterol, LDL-cholesterol and total:HDL-cholesterol ratio.

The effect of the intervention in the wards introducing one to three of the above changes was a decrease in somatic and emotional stress symptoms. In this intervention group there were no statistically significant changes in the measured biomarkers. In neither of the intervention groups lifestyle factors changed with the intervention (16).

One follow-up study among full-time employees in Finland showed that control over one’s working hours modified the effect of total work hours (including both paid and domestic work) on medically certified sickness absence (13). Control over daily working hours also moderated the effect of high job demands, high job strain, and low job control on medically certified sickness absence (17). Moreover, a low level of work time control was associated with both poor self-rated health and psychological distress (18).

Thus, there are indications that employee influence on working hours can decrease the negative consequences of demanding working hours and job strain.

2.3 Methodological concerns in shift work research

Most epidemiological studies in shift work research focusing on employee control on working hours are non-randomized intervention studies or non-experimental follow-up studies with both self-reported exposure and outcome measurement. The typical methodological concerns are therefore confounding (e.g. in terms of motivational factors that are not controlled for) and differential misclassification (e.g. employees with influence reporting better health and well-being but with unknown physiological correspondence).

2 Ergonomic principles (or criteria) refers to a set of guidelines which can be used to assess and compare shift systems. The principles concern both family and social life as well as health and well-being (15).
This PhD-project is based on a randomized intervention study (reducing confounding) with a thorough description of the procedures for employee involvement in the planning of work schedules (improving the exposure measurement), and employing both self-reported outcome measures and biochemical markers (reducing misclassification for some variables and making us able to estimate the degree of misclassification for other).

Also the selection bias of the healthy worker effect is a major methodological concern. The consequence can be an underestimation of the potential effects of shift work on health due to a self-selection in and out of shift work (19). Health based secondary selection away from shift work has been investigated in several studies. The results show that the risk of cardiovascular disease is elevated among ex-shift workers. An explanation could be that shift workers with increase IHD-risk are transferred to daytime work (4).

Less focus has been on primary selection into shift work (19). One study compared individuals applying for day work with individuals applying for shift work. The results showed that mainly sleeping behaviour was associated with applying for shift work. Compared to prospective day workers, prospective shift workers were significantly younger, to a greater extend evening-types, and had a less rigid sleep pattern measured by self-report (19).

However, more knowledge on the selection into shift work among nursing personnel in the eldercare is necessary to elucidate the effect of shift work on health and well-being in this occupational group. This methodological issue will therefore be addressed specifically by separate analyses in this PhD-project.

3 Hypotheses and research questions

The first hypothesis of this project is that employee influence on working hours reduces stress symptoms and work-life conflicts and thereby changes biochemical and behavioural risk factors for IHD.

Thus, the first and second research question in this study are:

1. How does increased influence on one’s working hours affect lifestyle factors measured as smoking habits, leisure time physical activity and waist-hip ratio? And is the association mediated by stress-symptoms and/or work-life conflicts?

2. How does increased influence on one’s working hours affect biochemical markers for IHD-risk measured as the apoB:apoA1-ratio, the total-cholesterol:HDL-ratio and the HbA1c-concentration? And is this association mediated by stress-symptoms and/or work-life conflicts?

The second hypothesis of the project is that shift work has the potential for introducing a selection of healthy workers.

The third research question of this study is therefore:

3. Do we observe primary selection to shift work in a group of newly educated home care helpers and assistant nurses (i.e. differences in the baseline distribution of gender, age and self-reported health, life style habits, hypertension and diabetes)?
4 Subjects and Methods
This project uses data from one intervention study (*Nye tider i ældreplejen*) and one longitudinal cohort study (*SOSUÃ¥r årgang 2004*). These studies are briefly summarized below.

4.1 *Nye tider i ældreplejen* (research question 1 and 2)
The aim of the intervention study is to introduce and examine the effect of increased employee influence on working hours on health, well-being, sleep and work ability, however, this PhD-project focuses specifically on the effect on IHD-related risk factors. The recruitment of participants and data collection is part of the PhD-project.

Figure 1 illustrates the mechanisms by which influence on one’s working hours is thought to alter risk factors for IHD.

![Figure 1: The theoretical background of the PhD-project.](image)

- It is presumed that increased influence on one’s working hours leads to a better adjustment of the work schedule to the needs of the individual health care worker. The intervention implies that the needs and preferences differ between individuals, and that these needs are met by the intervention. These needs could be related to domestic tasks, family and social arrangements or sleep and other recreational activities. Since nursing personnel are mostly women who have the main responsibility of the domestic work (20:21), it is plausible that demanding working hours in the eldercare more often result in work-family conflicts compared to male dominated occupations. Better individual adjustment is therefore thought to
  - reduce self-reported stress symptoms
  - reduce work-life conflicts
  - lower the amount of smoked cigarettes per day
  - lower the waist-hip ratio
  - increase leisure time physical activity
  - decrease the apoB:apoA1-ratio in serum
  - decrease the total-cholesterol:HDL-ratio in serum
  - decrease the HbA1c-concentration in serum

The effect of the intervention will depend on the reversibility of the outcomes under study. However, the effect is also conditional on how each employee chooses to utilize her influence: It is plausible that the individual work schedule is mainly adjusted to
family needs and that circadian rhythms and needs for restitution and recreational activities therefore to a lesser extend are taken into account. The consequence of this possible mismatch between physiological and social requirements could be better well-being (i.e. less stress and fewer work-family conflicts) in the short run but the long-term effect might be negative health effects.

Thus, one limitation of this study is that we can not elucidate the long-term consequences of increased influence on one’s own schedule. However, to accommodate to this the work schedules before and after the intervention will be compared by means of ergonomic criteria since these criteria take both social/family life and health related aspects into account (15).

**Study design**

The study is designed as a randomized intervention study with one year follow-up in the eldercare in three Danish municipalities. With a one-year follow-up the labour turnover and thereby the drop-out rate from the study will be lower compared to a longer follow-up time. On the other hand, as before-mentioned the disadvantage is that we are only able to study the immediate effect of the intervention.

The study is planned to include 600 persons working as nursing personnel from about 20 work units. The recruitment of participants is not completed (we now have 420 participants in 15 work units and ongoing negotiations with another 2 municipalities). We expect a response rate of 80% in the baseline study, a turnover of 20% during baseline and follow-up, and an 80% response rate at follow-up. Under these conditions we have follow-up data from 307 persons in clusters of 15 persons.

The work units are assigned to the reference and intervention groups at random (cluster randomization). The randomization is stratified in order to ensure that each participating district or local old people’s home have at least one intervention group and one reference group. In this intervention study cluster randomization rather than individual randomization is necessary since working hours are interdependent between employees in the same work unit but with lack of power as a consequence.

The sample size formula to compare two population means assuming individual randomization is therefore adjusted using an inflation factor to accommodate to cluster randomization. The inflation factor is based on the intraclass correlation (ICC) and the cluster size (Figure 2) (22).

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N' = N(1 + (m-1) ICC)
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- \(N'\) = adjusted sample size (cluster randomization)
- \(N\) = sample size (individual randomization)
- \(m\) = cluster size
- \(ICC\) = intraclass correlation (the degree of dependence within the cluster)

**Figure 2: Sample size formula for cluster randomization**

To estimate the power of this study the ICC for two behavioural outcomes (cigarettes per day and Body Mass Index) is calculated. The ICC expresses the amount of

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3 Body Mass Index is not an outcome in this PhD-project but is used as an approximation of the ICC of bodily distribution of fat which is measured as the waist:hip-ratio.

4 The Mixed Procedure, SAS, analyzed by Karl Bang Christensen, data from the project "Arbejde i ældreplejen" 2005.
variation in the outcome measures that is accounted for by the work units in the Danish eldercare. It is assumed that behavioural factors have a higher ICC compared to biochemical factors since the latter have a considerable genetic component which is independent of the workplace.

Table 1 shows the minimal detectable difference in one- and two-sample tests with an estimated cluster size on 15 employees (m) and 300 participants (N).

Table 1: The intraclass correlation (ICC), standard deviation (SD) of outcomes under study, adjusted number of corresponding number of participants in a individually randomized study, and the minimal detectable differences (MDD) for one- and two-sample tests with the actual sample size.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>ICC</th>
<th>SD</th>
<th>N</th>
<th>MDD in one-sample tests</th>
<th>MDD in two-sample tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of cigarettes per day among smokers</td>
<td>0.03436</td>
<td>5.9</td>
<td>207</td>
<td>1.7</td>
<td>2.3</td>
</tr>
<tr>
<td>Body mass index (kg/m²)</td>
<td>0.01767</td>
<td>4.4</td>
<td>246</td>
<td>1.1</td>
<td>1.6</td>
</tr>
</tbody>
</table>

As Table 1 shows, we can detect a difference of 1.7-2.3 in the mean number of smoked cigarettes per day. Regarding Body Mass Index we can detect a difference of 1.1-1.6 (this corresponds to a weight loss of 3-5 kg in a person with a height of 1.65 m). Thus, this intervention study has the statistical power to detect differences in the outcome measures which especially when added may be of relevance for the health among nursing personnel.

The interventions

In each intervention group an intervention with an element of employee influence on work time arrangements is implemented. Each work unit has the responsibility of choosing, preparing and implementing their own intervention. The design of the intervention therefore varies between work units. The advantage is that the interventions will better match local needs, but as a consequence this study will not be able to test the effect of a "standardized intervention". A thorough qualitative description of each intervention is compiled in order to obtain an understanding of effects – either positive or negative.

The evaluation of the intervention is the responsibility of The National Research Centre of the Working Environment and a part of this PhD-project. This includes planning the intervention together with the leaders in the participating institutions, information meetings with the participants, and data collection before and after the intervention.

The baseline data-collection is taking place during the 1st half of 2007. The intervention period runs 10-12 months and the follow-up data collection takes place in the 1st half of 2008. The time schedule for data collection, intervention start etc. differs between the participating municipalities.
Data and analyses

The intervention study includes data from different sources:

- **Lists of employees from the work place register** (gender, age, job category, work schedules before and after the intervention)
- **Self-administered questionnaires** (stress symptoms, work-family conflicts, time for recreational activities, smoking, leisure time physical activity, influence on work schedule)
- **Biochemical markers** (serum-concentrations of apolipoprotein A1, apolipoprotein B, HDL-cholesterol, total-cholesterol, HbA1c)
- **Waist- and hip-circumference**
- **Structured interviews, mails, and reports** (description of the intervention)

Changes in the prevalent levels of the outcome indicators between baseline and follow-up will be estimated. Data will be analyzed based on the principle of intention-to-treat even though some work units may not (fully) comply with the planned intervention. If the intervention group and reference group differ with respect to known confounders, adjusted analyses will be carried out.

Since we expect a moderate-sized labour turnover a sensitivity-analysis will be carried out to assess the impact of this loss to follow-up on the results. Also the impact of non-respondents will be assessed.

In this study there is a risk of differential misclassification due to the Hawthorne effect – meaning that the intervention group respond more positively on questions on health and well-being only because of the increased attention. On the other hand, the increased and continuous attention on working hours, health, and work-family conflicts may also lead to an over-reporting of symptoms and conflicts. A comparison with the reference group can be used to estimate the degree to which differential misclassification is biasing the results.

Furthermore we look for an internal consistency in the findings, i.e. do the results show a positive effect in self-reported outcomes as well as in biochemical factors. And does it matter whether we use an aggregated exposure-measure – intervention versus reference – or the individual self-reported measure of experienced influence on one’s working hours?

4.2 SOSUår årgang 2004 (research question 3)

The aim of this prospective cohort study was to increase the recruitment and retention of home care helpers and assistant nurses in the Danish eldercare. In the PhD-project it is examined whether there is primary selection into shift work in this occupational group.

Study design

The study was designed as a 3-year prospective study of all the Danish home care helpers and assistant nurses who finished their education during 2004. The study consists of a baseline survey – a self-administered questionnaire filled in a few weeks before the students finished their education – and follow-up questionnaire surveys in
2005 and 2006, following all the respondents who participated in the baseline survey. The study population consisted of 5,696 subjects at baseline and 3,128 subjects at the first follow-up. In the first follow-up 2,870 participants answered the question regarding which time of the day they usually worked. (Data from the second follow-up are not prepared for analyses.)

Data and analyses

The baseline questionnaire included socio-demographic factors, lifestyle factors, and self-reported health, self-reported prevalence of diabetes and hypertension.

At follow-up questionnaires the participants were asked whether they work as home care helper/assistant nurse and at which time of the day they usually work. 52% (1,483) of the population had permanent day work, 17% (482) had permanent evening work, 4% (124) had permanent night work and 27% (781) had irregular working hours (23).

As part of this PhD-project it will be tested whether working hours (i.e. permanent day, evening or night, or irregular working hours) at follow-up are predicted by gender, age, lifestyle factors and health at baseline.

4 Implications

By investigating the effect of employee influence of one’s working hours, this PhD-study may accomplish a better understanding of the possibilities of reducing the detrimental effects of shift work on health and well-being by introducing employee flexibility.

5 Copyright

All data belongs to the National Research Centre of the Working Environment. It is the responsibility of the student and the supervisors to disseminate the knowledge generated in the project in accordance with current rules. Published results will thus be disseminated in accordance with the Vancouver Agreement.

6 Workplace

The PhD-project will be conducted at the National Research Centre of Working Environment, Lersø Parkallé 105, 2100 Copenhagen Ø, Denmark.

7 Ethics

The PhD-project is in accordance with the Helsinki Declaration II. The Danish Data Protection Agency (Biochemical markers: 2004-54-1528; Questionnaire data: 2004-54-1522 and 2003-54-1381) and the regional Ethical Committees have approved the intervention study (KF 01 320850) in the present PhD-project.
Reference List


