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Shifting schedules: the health effects of reorganising shift work.

INTRODUCTION

Shift work is an increasingly common form of work organisation. Around one fifth of workers are engaged in some kind of shift work.¹ Technological advances, changes in the economy, and the emergence of 24 hour societies^{2,3} mean that shift work is no longer confined to the manufacturing and industrial sectors, and it is now an important aspect of employment in the retail and service sectors. Shift work continues to be commonplace amongst health care and emergency services personnel, with up to 50% of hospital staff working on shifts.⁴ However, it remains socially patterned with a higher prevalence amongst lower socio-economic groups,⁵ and so it is they who most experience the adverse consequences of shift work on health and work-life balance (WLB).

Possible negative effects of shift work on health and WLB are well known.^{1,6-8} Reported health problems include sleep disturbances, fatigue, digestive problems, emotional problems and stress-related illnesses, as well as increases in general morbidity, and in sickness absence.⁹ These problems may derive from disruption to physiological, psychological and social circadian rhythms.^{6,7} Shift work, particularly that involving night work, disrupts the natural circadian rhythm as it requires people to be active at times when they would normally be sleeping and vice versa.⁷ This leads to sleep problems (as natural alerting mechanisms such as the cortisol surge and temperature rise will interrupt sleep) as well as daytime functioning (wakefulness at night will be reduced by temperature drops and melatonin surges). Sudden changes in schedule can therefore have an effect akin to 'jet lag'. Disruption to the circadian

rhythm can also lead to disharmony within the body as some functions (e.g., heart rate) adapt more quickly than others (typically endogenous functions such as body temperature, melatonin). This leads to desynchronisation which itself can result in psychological malaise, fatigue and gastro-intestinal problems. Realignment can take several weeks.⁷ Previous studies have explored associations between the physiological and psychological aspects of long term exposure to shift work and health issues such as cardiovascular problems, pre-term births or breast cancer.¹⁰⁻¹² Shift work may also involve increased risk of injuries and accidents as performance fluctuates.^{13,14} For example, a review of injuries related to shift work concluded that workers on rotating shiftwork had a higher risk of injury than workers on fixed shifts, that there was a greater risk of injury from shifts that rotated more frequently and that longer workdays were no more hazardous than the more usual 8-hour workday.¹³

Most existing research emphasises the physiological changes which shift work induces, but shift work also involves significant *social* desynchronisation, involving working at times and on days that may make it difficult to maintain a balanced domestic and social life.¹⁵ The Work Foundation defines work-life balance (WLB) as: “people having a measure of control over when, where and how they work. It is achieved when an individual’s right to a fulfilled life inside and outside paid work is accepted and respected as the norm to the mutual benefit of the individual, business and society”.¹⁶ It has been suggested that work-life imbalance can lead to poorer health. For example, a study of the Swedish working population found that a majority of employees experienced work-life imbalance and that this was due to work interfering with non-work activities. Self-reported health (GHQ) was significantly worse amongst employees who experienced work-life imbalance.¹⁷

A range of interventions has been suggested to address the negative effects of shift work.¹ These include interventions at the individual level: exposure to bright light or napping; training, counselling and education; countermeasures against sleep problems, problems with appetite and digestion; educational interventions (e.g., to help workers to cope with shift work); regular medical surveillance and pharmaceutical interventions (e.g. melatonin administration); and selection strategies to remove the most vulnerable.^{7,18,19} At the organisational level interventions include decreased shift length (especially on night shift); redesign of shift work schedules (according to ergonomic criteria or to increase flexibility); improvements in working conditions (reducing noise or improving unfavourable working environments); and legislation limiting working hours or exposure to shift work (e.g. the EU Working Time Directive, and its subsequent revisions).¹

The effects of some of these interventions on health and WLB have been evaluated in primary studies. This article presents the results of a systematic review of the health and WLB impacts of organisational level changes to shift work and any differential impacts by social group. The review was conducted between October 2005 and November 2006. Although previous literature reviews exist in the area of shift work and health, these often concentrate on observational epidemiological (descriptive or comparative) rather than evaluative intervention studies, tend to cover individual level interventions only, focus on certain occupational groups, or have not been conducted using full systematic review methodology.^{1,4,8,9,13,20}

METHODS

Inclusion and Exclusion

The review sought to identify all primary empirical studies that examined the effects of organisational level interventions on the health and WLB of shift workers and their families. We excluded studies of controlled exposure to darkness and light, as we defined these as individual-level, rather than organizational-level interventions within the context of this review. We also excluded selection strategies as these interventions seem to be primarily focussed on characteristics of the individual rather than on the organisation. For the purposes of the review, shift work was defined as “any regularly taken employment outside the hours of 0700 and 1800”.⁷ Laboratory-based studies were excluded. The range of health-related outcomes included incidence of specific diseases (such as musculoskeletal disease) as well as measures of physical or psychological health and well-being (such as the General Health Questionnaire). Sickness absence, health service usage, health behaviours and occupational injuries were also included. Physiological measures, such as hormone excretion levels or body temperature, were also included as were measures related to tiredness, fatigue and sleep. WLB was conceptualised in terms of the impacts of the interventions on social and domestic life (such as time spent with family). Organisational effects (for example individual or organisational performance or job satisfaction) when reported alongside the primary outcomes (health and WLB), were also recorded. Differences in outcome by social group, age and gender were also noted.

Search strategy

27 electronic databases were searched from start date to November 2005 as well as bibliographies, reference lists, and websites for documents of any type, from any

country, at any time and in any language, including conference proceedings, unpublished manuscripts, theses and government-commissioned reports. Details of the databases searched and an example search for MEDLINE are detailed in Boxes 1 and 2. The full search strategy is available in Web Appendix 1.

Data Extraction and Quality Appraisal

13287 titles were initially located, of which 398 were examined in more detail, and of these 64 were retrieved for full paper analysis. The lead reviewer (CB) excluded obviously irrelevant titles and abstracts from the initial literature search, and retrieved full text copies of the remainder. Studies making any reference to health or wellbeing were independently appraised by two reviewers (CB and MP), who re-examined papers jointly to resolve disagreements.

Quality appraisal criteria were adapted from existing systematic reviews of the health effects of social interventions and, guidance for the evaluation of non-randomised studies (Box 3).²¹⁻²⁴ Two reviewers (CB and MP) independently appraised the included studies according to these criteria.²¹⁻²⁴ Amongst other things, the appraisal process included an examination of sampling strategy, as well as response and follow up rates, and adjustment for one or more of the following confounders: demographic, lifestyle, job content or shift work experience (Box 3). The quality appraisal criteria were used for descriptive purposes only and to highlight variations in the quality of studies (see ‘Design and Quality Appraisal’ column, tables 1-3), with the numbers 1-10 representing satisfactory fulfilment of the corresponding criterion. No quality score was calculated and papers were not excluded on the basis of quality.

Synthesis

Data heterogeneity meant that meta-analysis of the results was not possible and so narrative synthesis was performed with the results tabulated (Tables 1 – 3) as well as summarised in the following text.

RESULTS

Twenty-six studies of organisational level interventions were synthesized. These covered a diverse range of interventions: changes to the speed, direction and use of rotation, changes to night work, later start and finish times, changes to weekend working, decreased shift lengths, and self-scheduling.²⁵⁻⁵¹ One study was a crossover controlled trial,²⁹ and there were twenty prospective cohort studies,^{25-27,30-37,39,41,42,44-50} of which twelve had a control group.^{25,26,30,31,33,36,37,41,42,44-47} The cohort study controls were generally recruited from different sections of the same organisation (e.g. different production lines within a factory or different wards within a hospital) although in two cases^{36,46} a different organisation was used (which may have resulted in confounding due to, for example, different management practices). Similarly, only six of the studies stated that they had adjusted for confounders: age, gender, shift work experience, lifestyle factors, or job content.^{25,31,37,46,47,51} The majority of studies were conducted in fairly homogeneous populations (e.g. male production workers, or female nurses) and, perhaps in part due to this, only one study (a multiple intervention study of backward to forward rotation and slow to fast rotation)⁵⁰ differentiated outcomes by age, and none of the studies differentiated by socio-economic group or gender.

Speed of rotation

Three small prospective studies examined the health related effects of changing the speed of shift rotation (table 1).²⁵⁻²⁸ All examined the effects of changing from slow to fast rotation (in each study, the switch to fast rotation consisted of a change from 6 or 7 consecutive shifts of the same type e.g. 7 consecutive morning shifts, to a maximum of 3 or 4) and all reported positive health effects. In one German prospective cohort study with a control group of 50 chemical processing workers,^{25,26} fatigue, sleep disturbances, and appetite disturbances, improved in the intervention group. However, no differences between the control and intervention groups were found for gastrointestinal problems, and some complaints (i.e. hot flushes, sweating) actually worsened. In a small prospective cohort study of 39 traffic controllers in the Netherlands,²⁷ sleep complaints reduced slightly, although there were no changes in levels of fatigue. Similarly, in an Australian study of 26 emergency control room operators,²⁸ physical and mental health indicators improved (sleep difficulties, absence, headaches, digestive disorders, high blood pressure, diarrhoea, constipation, anxiety, and nervousness) but there were no statistically significant effects on health behaviours (alcohol and cigarette consumption were unchanged).

A similar pattern emerged for the WLB outcomes with most studies of changes to the speed of rotation reporting improvements or no change in WLB amongst the intervention groups. In the chemical processing study,^{25,26} disturbance to social and family life improved when working the morning shifts, but there were no differences when on the afternoon or night shifts. In the study of traffic controllers,²⁷ domestic and child care problems, workload, and satisfaction with evening leisure time all improved. However, complaints about leisure time remained unchanged and

satisfaction with days off actually decreased. In the Australian study,²⁸ work pressure improved, but the other indicators of WLB remained unchanged.

It is not possible to comment with any confidence on the organisational effects of changing from a slow to a fast rotating shift schedule as only one small study (n=26) study²⁸ provided any information. This study reported an increase in levels of job satisfaction after the intervention (increase from 36% to 50% of staff “satisfied” or “somewhat satisfied”).

Seven of the studies of the effects of multiple interventions (table 3)^{44-47,49-51} also examined the effects of changing from a slow to a fast rotation. One of these studies (which also included a change from backward to forward rotation) compared outcomes by age. It found that sleep quality improved in older workers compared to younger workers.⁵⁰ However, these changes occurred alongside other concurrent interventions making it difficult to identify the effects of any single intervention.

Direction of rotation

Two studies of single interventions examined the effects of changes in the direction of rotation (table 1).^{29,30}

One study,²⁹ a crossover controlled trial of 45 Swedish police officers, examined the effects of changing from backward (night, afternoon, morning) to forward (morning, afternoon, night) rotation. It found that some coronary risk factors (levels of triglyceride and serum glucose), mean systolic blood pressure, and mean sleep quality and duration during the day shift, all improved during the intervention period whereas

cholesterol and serum uric acid levels, diastolic blood pressure, sleep quality and duration on the night shift, and tobacco consumption were unchanged during the intervention phase, and self-rated health actually worsened. However, for the latter outcome there were very short periods of follow up of only three and five weeks.

Another study, a prospective cohort study with a control group of 263 male car production workers,³⁰ examined the effects of changing rotation in the opposite direction - from forward to backward rotation. It reported a mix of health effects with health related behaviour indicators, cigarette and alcohol consumption improving in the intervention group compared to the control group, whilst general health measures (sleep quality on morning and night shifts, GHQ 12, chronic fatigue, gastrointestinal symptoms, sleep difficulties, duration and onset times) were no different in the intervention group, and sleep quality on afternoon shift days actually worsened.

In both studies, WLB (except satisfaction with the amount of leisure time²⁹ or social disruption³⁰) was unchanged by the interventions. Job dissatisfaction, the only organisational indicator measured, was also unaffected.³⁰

Removal of shift work rotation

Two prospective cohort studies of police officers in the USA, one with a control group³¹ and one without,³² examined the removal of shift work rotation (the change from a rotating shift system in which all the different types of shift e.g. morning, afternoon, night are worked, to a permanent shift system in which only one type of shift is worked e.g. afternoon) as a single intervention (table 1). One other study³³ examined the removal of rotation alongside changes to the speed of rotation (table 3).

The single methodologically-sound intervention study with a control group examined 239 police officers³¹ and reported an improvement in sleep but all other self-reported health indicators (trouble digesting, on the job tiredness, appetite problems, general health, amount of smoking and drinking, and headaches) were unchanged. In the other study of 63 police officers,³² all of the health indicators improved significantly after the intervention: sleep quality and duration improved (e.g. sleep required decreased slightly from 8.11 hours to 7.77 hours and sleep adequacy and quality of sleep improved); psychological symptoms decreased and mean severity of symptoms reduced slightly; and the amount of sickness absence decreased (from a total of 1400 hours in the six months before the intervention to 883 hours in the six months after the intervention).

In terms of WLB and organisational outcomes, the study with a control group³¹ provided equivocal findings as whilst spousal satisfaction improved in the intervention group compared to the control group, a number of other WLB indicators were unaffected (table 1). Similarly, whilst productivity increased (number of arrests and tickets issued increased by 6% in the intervention group), there was no difference in reported job satisfaction.

Changes to night work

Three studies each examined slightly different changes to the nature of night work (table 2).³³⁻³⁵

One study, a sizeable (n=305), prospective cohort with a control group and 12 months follow-up,³³ examined the removal of night shifts in a Swedish steel factory. This study found that sleep and gastrointestinal complaints improved although there were no changes in shift specific health problems, sleep length or sickness absence. WLB, measured in terms of the number of complaints made about social life (e.g. mean amount of time available to spend on clubs and hobbies, going out, political activity, etc.), also improved in the intervention group compared to the control group. No organisational outcomes were measured.

In a prospective cohort of 76 UK police officers,³⁴ a reduction in the number of consecutive night shifts on the Ottawa system (the Ottawa system consists of three or four 10 hour morning or afternoon shifts spread over four days then two days off. This is followed by a block of seven 8 hour nights then six days off) was examined. It reported that night shift fatigue and sleepiness worsened. Caffeine intake was unchanged. However, the small sample and short length of follow-up limited the generalisability of the findings.

Another much smaller (n=18) but well-conducted prospective cohort study, this time among Japanese nurses,³⁵ examined the effects of increasing the rest period before the rotation onto night shift. This study suggested that although the intervention enabled an increase in sleep before the night shift, there was no change in irritation or tiredness once the night shift began.

Later start and finish times

One larger study (table 2) examined the introduction of later start and finish times to the shifts of 208 workers in a Finnish steel mill.³⁶ Changes in the rates of health complaints and chronic fatigue were no different in the intervention group compared to the control group although the sleep indicators were more mixed with improvements only in sleep duration on the evening shifts, satisfaction with amount of sleep for those on the morning shifts, and awakening refreshed from sleep for those on the morning shifts). WLB outcomes worsened as interference of shift work with domestic activities increased, although workload was unchanged in the intervention group. Similarly, there were no differences between the intervention and control groups in terms of job satisfaction. The quality appraisal suggested that some observed changes may actually be due to differences between the control and intervention groups at baseline, and the length of follow-up is short (4 months).

One of the studies of multiple interventions (table 3)⁴⁹ examined the introduction of later start and finish times. However this occurred alongside changes to both the speed and direction of rotation so it is not possible to isolate the specific effects of later start and finish times.

Changes to weekend working

One methodologically-sound (n=101) prospective controlled study examined the switch from continuous (weekends on) to discontinuous (weekends off) shift work (table 2).³⁷ The change was introduced to make the shift schedule more ergonomically-acceptable for the 101 nurses in a Danish hospital. HDL cholesterol

worsened in the intervention group but total and LDL cholesterol improved. No other outcomes more directly relevant to health were reported.

A multiple-intervention study,³³ in which a concurrent change to the speed of rotation occurred, also examined this type of intervention. It was not possible to isolate any unique effect of the change to discontinuous working, and furthermore, the quality appraisal process suggested that the intervention and control groups may not be comparable.

One small, well-conducted, retrospective study dating back to 1956³⁸ examined the effects of the extension of shift working to cover weekends (a change from discontinuous to continuous shift work). The study, of 73 wives of UK steel workers, reported only on WLB outcomes (social life, domestic routine, time with husband) which were unaffected by the move to weekend working.³⁸ A small (n=52) prospective multiple-intervention study⁴⁶ also examined this intervention, although it occurred alongside a change from slow to fast rotation and so its positive findings on sleep cannot be solely attributed to the change to continuous working. Conversely, though, it was possible for the authors to link a decrease in workers' income to the introduction of continuous working on the basis that weekend overtime payments ceased. There were some methodological problems with this study (see table 3).

Decreased shift lengths

Two studies^{39,40} were identified in which the health and WLB effects of decreasing the length of shifts were examined. A small prospective cohort study (uncontrolled) of 35 American paramedics³⁹ examined a reduction in average on-call shift length from 24

hours to 12 hours. It found that emotional exhaustion improved significantly two months after the reduction (but this was not maintained at the 12 month follow-up) as did the impact of work schedule on social and family life. However, no effects were found for depersonalisation or job satisfaction.

In a retrospective study from 1933 of 265 female factory workers in the USA,⁴⁰ the change from 8hr to 6hr shifts had little effect on fatigue levels (56.1% reported no difference in fatigue levels before and after the intervention) or on domestic life. However, the decreased working hours resulted in wage reductions for the majority of employees. The quality appraisal process raised a number of questions about the quality of the study (table 2) and the generalisability of such an old study is also questionable.

Self-scheduling

Self-scheduling enables individual shift workers to have some control over which shifts they work, their start times, or when their rest days occur. Three prospective studies examined the introduction of self-scheduling.⁴¹⁻⁴³ In all three of the studies, the intervention was introduced to improve working conditions. The two prospective cohorts with control groups examined bus drivers,^{41,42} whilst a repeat cross sectional study focused on 45 nursing staff at a UK hospital.⁴³ Health and WLB outcomes were almost universally improved in all three: with decreases in absence, fatigue, and complaints about family life recorded in the study of 50 bus drivers in the Netherlands,⁴¹ accidents decreased by 20% and opportunities to plan leisure time, and social contacts improved in the study of 24 German bus drivers,⁴² whilst the ability to maintain a WLB was also improved in the hospital based study.⁴³ Only complaints

about free time and time spent with the children in the Netherlands study were unimproved by the intervention.⁴¹ Similarly, in the two studies which measured organisational outcomes,^{41,42} there were improvements in the number of productive work hours (from 50% to 54% of hours)⁴¹ and the number of customer complaints (decreased by 52%).⁴²

Two of the studies of multiple interventions (table 3)⁴⁷⁻⁴⁹ also incorporated aspects of self-scheduling. However, self-scheduling was one of three or four different concurrent changes in both studies so they cannot be used as evidence of the independent effects of self-scheduling interventions.

DISCUSSION

Effects of the interventions

Overall, most types of organisational shift work intervention examined in this systematic review appear to have either positive or neutral effects on health and WLB (see Box 4). No one type of organisational intervention was found to be consistently harmful to workers (although this may be due to publication bias or methodological problems - see below). Three types of intervention though were reported to have beneficial effects: switching from slow to fast rotation, changing from backward to forward rotation, and self-scheduling of shifts.

Switching from slow to fast shift rotation

The studies of interventions which redesigned shift work schedules so that they used fast rather than slow rotation reported consistently positive effects on the health related outcomes of sleep and fatigue.²⁵⁻²⁸ This is in keeping with the broader

epidemiological and laboratory-based research literature, in which fast rotations have been shown to be more closely matched to the natural circadian rhythm and therefore potentially less damaging to health.⁵²⁻⁵⁴ Although somewhat less conclusive, the evidence suggested that WLB (in terms of disruption to domestic routines) also generally improved with the introduction of fast rotating schedules.²⁵⁻²⁸ Organisational effects were positive in terms of job satisfaction, but this was only considered in one study.²⁸

Changing from backward to forward shift rotation

Epidemiological and laboratory studies have also suggested that changing the direction of shift schedules from backward to forward rotation is more in keeping with the body's circadian rhythm, and that therefore positive health effects could ensue, especially in terms of sleep.^{7,14,48,54} Only one single intervention study, a crossover trial, was located which examined the change from backward to forward rotation, and it confirmed this view.²⁹ Backward to forward rotation had no notable impact on WLB and no organisational factors were measured.

Self-scheduling of shifts

Health, WLB, and organisational effectiveness were positively enhanced in all three of the studies which examined the introduction of self-scheduling amongst shift workers.⁴¹⁻⁴³ Self-scheduling necessarily entails increasing employee control at work, something which has been strongly associated in the epidemiological literature, most notably by the Whitehall Studies,⁵⁵⁻⁵⁷ and other reviews of work reorganisation interventions,^{21,22,58} with improved health and well-being. In line with such research, the intervention studies included in this review suggest that, even amongst specific

occupational groups such as shift workers, increasing control can have beneficial health, social, and organisational effects.

Quality appraisal

Although the twenty-six intervention studies reviewed represent the available evidence base on the health and well-being effects of changing the organisation of shift work, the quality appraisal process revealed a number of limitations.

The evidence base was small and only one trial was found.²⁹ Furthermore, whilst the interventions were often evaluated using a prospective controlled study designs,^{25,26,30,31,33,36,37,41,42,44-47} these were usually not matched or randomised and in at least one case there were significant group differences at baseline.^{25,26,30,32,33,36,37,41,42,44-46} In addition, a sizeable number of studies reported concurrent (multiple) interventions.^{33,44-51}

As noted earlier, this was the first systematic review of the effects of changing the organisation of shift work so we elected to include all studies regardless of sample size (or quality). However, a number of studies had such small final sample sizes (e.g. eleven studies had final sample sizes of 50 or fewer^{25-29,35,39,41,42,43,49,50}) that their value in informing policy may in some cases be limited. This raises the possibility that any positive findings may be due to publication bias, in which small studies with positive findings are more likely to be published than those with negative findings. Similarly, publication bias may have arisen as only studies in the public domain were locatable thus excluding the majority of commercial studies.

The outcomes were usually self-reported and they varied greatly from study to study. Similarly, there was a dearth of well validated questionnaires, such as the General Health Questionnaire.³⁰ The study follow ups were generally 12 months or less²⁷⁻⁵¹ and so it was not possible to analyse the longer term effects on health or WLB of the interventions. Furthermore, it was unclear what the effects of changing the organisation of shift work are on health inequalities as no studies examined this outcome.

Conclusions

The results of this systematic review of intervention studies supports the results of descriptive epidemiological research and laboratory-based studies which have suggested that slow to fast rotation and backward to forward rotation are less harmful to the health and WLB of shift workers.^{1,7,14,48,52-54} Furthermore, the review reinforces previous research showing that increased control at work, in this case via self-scheduling, can be beneficial to the health and WLB of workers.^{22,23,55-58} There are however some reservations about the extent and quality of the evidence base, which future prospective, well controlled, intervention studies should address.

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Table 1: Changes to shift work rotation (grouped by intervention type)

Study	Design & Quality Appraisal (see criteria in box 3)	Setting & Participants	Intervention	Detailed results ^A	Summary results ↑ = improvement ↓ = worsening ↔ = little change
SPEED OF ROTATION					
Hornberger & Knauth, 1995, ^{25,26} 1998 ^{25,26}	Prospective cohort with comparison group (T1 and T2), no comparison group (T3) 8 and 54 month follow-ups Final sample: n=50 (no separate n for intervention and comparison groups) Quality appraisal: 1 7 8 9 10	Chemical industry, Germany. Chemical processing workers, all male.	Intervention(s): Slow to fast rotation Shift systems: Continuous slow rotation 4 shift to continuous fast rotation 5 shift.	Fatigue (0-100, low-high number of disturbances): reduction in intervention group compared to comparison group from 38 at T1 to 21 at T2 (F=9.43, p=.0001). NS difference at T3 (24). Sleep disturbances (0-100, low-high number of disturbances): reduction in intervention group compared to comparison group from 30 at T1 to 20 at T2 (F=5.11, p=.007). NS difference at T3 (23). Appetite disturbances (0-100, low-high number of disturbances): reduction in intervention group compared to comparison group from 20 at T1 to 18 at T2 (F=3.96, p=.021). This remained at T3 (18). Neurovegetative complaints (0-100, low-high number of disturbances): increased T1 to T3 from 20 to 22 (f=3.54, p=.031) Gastrointestinal disorders: NS change. Disturbance in social and family life (0-100, low-high number of disturbances): reduction in intervention group compared to comparison group on morning shift days from 39 at T1 to 28 at T2 and T3 (F=4.11, p=.018). NS differences on night or afternoon shift days.	Fatigue ↑ Sleep disturbances ↑ Appetite disturbances ↑ Neurovegetative complaints ↓ Gastrointestinal disorders ↔ Disturbance to social and family life (am) ↑ Disturbance to social and family life (pm) ↔ Disturbance to social and family life (night) ↔
Ng-A-Tham & Thierry, 1993 ²⁷	Prospective cohort 6 month follow-up Final sample: n=39 Quality appraisal: 1 2 4 7 9 10	Railway, Netherlands. Traffic controllers.	Intervention(s): - Slow to fast rotation Shift systems: Slow backward rotating to fast rotating morning and evening (1 fixed evening off). Night shifts remained slow rotating.	Sleep complaints (1-5, few - many complaints): decreased from 2.77 to 2.35 (t=3.33, df 42, p<.001). NS change: Fatigue, leisure time complaints. Domestic and childcare problems(1-5, few - many complaints): decreased from 2.64 to 2.33 (t=2.63, df 44, p<.01) Weekly workload decreased (1-5, few - many complaints):	Sleep complaints ↑ Fatigue ↔ Leisure time complaints ↔ Domestic and child care problems ↑ Weekly workload ↑ Satisfaction with evening leisure time ↑ Satisfaction with days off ↓

				<p>from 2.64 to 2.10 ($t=4.12$, $df\ 41$, $p<.001$).</p> <p>Satisfaction with leisure time in the evening (1-10, not satisfied at all - very satisfied): increased from 5.8 to 6.4 ($t=2.63$, $df\ 45$, $p<.01$).</p> <p>Satisfaction with days off (1-10, not satisfied at all - very satisfied): decreased from 7.1 to 5.8 ($t=3.01$, $df\ 45$, $p<.001$). Perhaps because the number of consecutive free days decreased.</p>		
Williamson & Sanderson, 1986 ²⁸	<p>Prospective repeat cross section</p> <p>5 month follow-up</p> <p>Final sample: n=26</p> <p>Quality appraisal: 1 2 4 5 7 9 10</p>	<p>Emergency Service, Australia.</p> <p>Control room operators</p>	<p>Intervention(s): Slow to fast rotation</p> <p>Shift systems: Slow rotating 3 shift to a fast rotating 3 shift.</p>	<p>Decrease in % reporting sleep difficulties from 70% to 58% ($\chi^2=33.98$, $df=5$, $p<.001$): initial difficulties falling asleep decreased from 87% to 67%, waking too early 61% to 12%, feeling unrefreshed after sleep 52% to 0%, feeling tired at work 61% to 0%, being irritable 67% to 0%. Being disturbed by noise increased from 26% to 33%.</p> <p>Sickness absence (3 month average pre, 3 month average post) fell from 6% to 4%.</p> <p>Decrease in overall illness rates ($\chi^2=28.32$, $df=7$, $p<.001$): headaches 64% to 0%, digestive system disorders 46% to 4%, high blood pressure 21% to 12%, diarrhoea from 12% to 0%, constipation from 6% to 0%, Strait-trait anxiety inventory (Spielberger et al, 1970, 1-4, not at all - very much so): anxiety scores of over 90th percentile decreased from 6% to 0. Nervousness increased from 33% to 54%.</p> <p>NS change in levels of alcohol consumption, caffeine consumption or smoking.</p> <p>Job satisfaction (1-5, dissatisfied - satisfied) levels were higher with 50% reporting satisfied or somewhat satisfied at T2 compared to 36% at T1 ($\chi^2=12.18$, $df=4$, $p<.03$).</p>	<p>Sleep difficulties</p> <p>Absence</p> <p>Headaches</p> <p>Digestive system disorders</p> <p>High blood pressure</p> <p>Diarrhoea</p> <p>Constipation</p> <p>Anxiety</p> <p>Nervousness</p> <p>Alcohol consumption</p> <p>Caffeine consumption</p> <p>Smoking</p> <p>Job satisfaction</p>	<p>↑</p> <p>↑</p> <p>↑</p> <p>↑</p> <p>↑</p> <p>↑</p> <p>↑</p> <p>↓</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↑</p>
DIRECTION OF ROTATION						
Orth-Gomer, 1983 ²⁹	<p>Cross over controlled trial</p> <p>3 and 5 week follow-ups</p> <p>Final sample: n=45 (45 intervention, 45 comparison)</p> <p>Quality appraisal:</p>	<p>Police Force, Sweden.</p> <p>Police Officers</p>	<p>Intervention(s): Backward to forward rotation</p> <p>Shift systems: Fast backward rotation to fast forward rotation</p>	<p>Coronary risk factors: triglycerides ($t=2.95$, $p=.005$) and serum glucose ($t=4.65$, $p<.001$) but not cholesterol levels ($t=1.33$, $p=.191$) were significantly lower during the intervention compared to the comparison condition. NS difference in serum uric acid levels.</p> <p>Mean systolic blood pressure was lower ($t=2.52$, $p<.05$) during intervention (111.6mg) compared to comparison condition (115.6mg). NS difference in diastolic.</p>	<p>Coronary risk factors</p> <p>Systolic blood pressure</p> <p>Diastolic blood pressure</p> <p>Sleep quality (day)</p> <p>Sleep quality (night)</p> <p>Sleep duration (day)</p> <p>Sleep duration (night)</p> <p>Self-rated health</p> <p>Tobacco consumption</p>	<p>↑</p> <p>↑</p> <p>↔</p> <p>↑</p> <p>↔</p> <p>↑</p> <p>↔</p> <p>↓</p> <p>↔</p>

	1 3 5 7 9 10			<p>Duration (9hrs compared to 8.4hrs, $t=2.04$, $p<.05$) and quality of sleep (Akerstedt and Torsvall, 1981, 1-5.25 scale, low quality – high quality) at night after day work (3.7 compared to 3.2, $t=2.96$, $p<.01$) improved during the intervention compared to the comparison. NS differences in sleep duration of quality after night shift.</p> <p>Self-rated health status (1-5, higher = worse) worsened ($t=3.29$, $p<.01$) during intervention (1.84) compared to comparison (2.28).</p> <p>NS change in tobacco consumption.</p> <p>NS difference work load</p> <p>Dissatisfaction with the amount of leisure time (1-5, higher = worse) between shifts decreased ($t=7.36$, $p<.001$) during intervention (1.44) compared to comparison (3.16).</p>	<p>Work load</p> <p>Dissatisfaction with amount of leisure time between shifts</p>	<p>↔</p> <p>↑</p>
Barton et al, 1994 ³⁰	<p>Prospective cohort with comparison group</p> <p>6 month follow-up</p> <p>Final sample: n=263 (92 intervention, 171 comparison)</p> <p>Quality appraisal: 1 7 9 10</p>	<p>Automotive plant, UK.</p> <p>Car production workers, majority male.</p>	<p>Intervention(s): Forward to backward rotation</p> <p>Shift systems: Discontinuous forward slow rotating 3 shift to discontinuous backward slow rotating 3 shift.</p>	<p>Workers slept less well after the afternoon shift in the intervention group (Standard shift work index) compared to the comparison groups ($F=4.85$, $p<.05$). Difference for the morning or night shifts.</p> <p>Cigarette consumption decreased in the intervention group compared to the comparison groups (from 49.28 cigarettes per week to 38.8, $F=7.54$, $p<.01$).</p> <p>Alcohol consumption decreased in the intervention group compared to the comparison groups (from 10.59 drinks per week to 8.18, $F=6.99$, $p<.01$).</p> <p>NS differences for GHQ-12, chronic fatigue, gastrointestinal problems, sleep difficulties, sleep duration, sleep onset times.</p> <p>Social disruption (Standard shift work index) decreased in the intervention group compared to the comparison groups (from 3.42 to 3.12, $F=6.18$, $p<.01$).</p> <p>NS differences for domestic disruption, non-domestic disruption, social life dissatisfaction.</p> <p>NS difference job dissatisfaction.</p>	<p>Sleep quality (pm)</p> <p>Sleep quality (am)</p> <p>Sleep quality (night)</p> <p>Cigarette consumption</p> <p>Alcohol consumption</p> <p>GHQ-12</p> <p>Chronic fatigue</p> <p>Gastrointestinal problems</p> <p>Sleep difficulties</p> <p>Sleep onset times</p> <p>Sleep duration</p> <p>Social disruption</p> <p>Domestic disruption</p> <p>Non-domestic disruption</p> <p>Social life dissatisfaction</p> <p>Job dissatisfaction</p>	<p>↓</p> <p>↔</p> <p>↔</p> <p>↑</p> <p>↑</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↑</p> <p>↔</p> <p>↔</p> <p>↔</p> <p>↔</p>
REMOVAL OF ROTATION						

Owen, 1985 ³¹	Prospective cohort with comparison group 12 month follow-up Final sample: n=239 (122 intervention, 117 comparison) Quality appraisal: 1 2 3 7 8 9 10	Police Force, USA. Police Officers, mainly white males.	Intervention: rotating to permanent Shift systems: Backward slow rotating 3 shift to permanent shift	Trouble sleeping decreased in the intervention group compared to the comparison group (-0.41 and -0.2 respectively, $t=2.92$, $p<.025$). NS change: Trouble digesting, On the job tiredness, Appetite problems, Headaches, General health, Smoking, Drinking. Spousal satisfaction with shift schedule increased in the intervention group compared to the comparison group (.47 and .02 respectively, $t=2.19$, $p<.025$). NS difference in: Satisfaction with work load, Satisfaction with time spent with spouse, Satisfaction time spent with children, Time spent on social activities. Productivity (numbers of arrests and tickets issued) increased by 6% in the intervention group. NS change in job satisfaction	Trouble sleeping Trouble digesting On the job tiredness Appetite problems General health Smoking Drinking Headaches Spousal satisfaction with shift schedule Satisfaction with work load Satisfaction with time spent with spouse Satisfaction with time spent with children Time spent on social activities Productivity Job satisfaction	↑ ↔ ↔ ↔ ↔ ↔ ↔ ↔ ↑ ↔ ↔ ↔ ↔ ↑ ↔
Phillips et al, 1991 ³²	Prospective cohort 4 month follow-up Final sample: n=63 Quality appraisal: 1 2 9 10	Police Force, USA. Police Officers.	Intervention: Rotating to permanent Shift systems: Rotating 3 shift to permanent shift	Florida Sleep Questionnaire: officers required less sleep from 8.11 hours to 7.77 hours ($t=2.75$, $p<.01$) and they needed less sleep time to feel well from 7.30 to 7.01 hours ($t=2.18$, $p<.03$). Increase in adequacy ($t=-2.61$, $p<.01$) and quality of sleep (-2.20, $p<.03$). Officers felt more rested upon awakening ($t=2.94$, $p<.01$) and had less daytime sleepiness ($t=2.31$, $p<.02$). Awakening earlier than usual decreased ($t=2.31$, $p<.02$) and there was less difficulty falling asleep ($t=3.0$, $p<.001$). SCL-90 psychological symptoms checklist (0-4, no discomfort to extreme discomfort): decrease in number (19.25 to 15.18, $p<.05$) and severity of symptoms (0.282 to 0.214, $p<.05$). Sickness absence (6 months pre and post) decreased from 1400 hours to 883 hours.	Sleep duration required Sleep adequacy Sleep quality Rested upon awakening Daytime sleepiness Awakening too early Difficulty falling asleep Psychological symptoms (number) Psychological symptoms (severity) Absence	↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑ ↑

^A Specific scales and measures used are also recorded when cited in the studies. Similarly, statistical detail varies depending on the amount of information available in the original studies.

† Morning shift days only. No changes on night and evening shift days.

Table 2: Other changes to shift working schedules (grouped by intervention type)

Study	Design & Quality Appraisal (see criteria in box 3)	Setting & Participants	Intervention	Detailed results ^A	Summary results ↑ = improvement ↓ = worsening ↔ = little change
CHANGES TO NIGHT WORK					
Akerstadt & Torsvall, 1978 ³³	Prospective cohort with comparison group 12 month follow-up Final sample: n=305 (127 intervention, 178 comparison) Quality appraisal: 1 2 4 5 7 9 10	Steel company, Sweden. Steel factory workers, majority men.	Intervention: No night shifts Shift systems: 3 or 4 shift system to 2 shift system with no night shifts	Sleep complaints improved in intervention compared to control: mean change = 0.3 (p<.01). Gastro-intestinal complaints improved in intervention compared to control: mean change = 0.2 (p<.01). NS changes in shift specific problems, sleep length, sickness absence. Social life complaints (time spent on clubs and hobbies, going out, political activity etc scored 4-1, enough to far too little) improved in intervention group compared to control: mean change 0.38 (p<.01).	Sleep complaints ↑ Gastro-intestinal complaints ↑ Shift specific problems ↔ Sleep length ↔ Absence ↔ Social life complaints ↑
Smith & Mason, 2001 ³⁴	Prospective cohort 6 month follow-up Final sample: n=76 Methods: 1 2 7 9 10	Police Force, UK. Police Officers.	Intervention: less consecutive night shifts Shift systems: Ottawa system (with 7 consecutive night shifts) to Ottawa (with a maximum of 4 consecutive night shifts).	Subjective fatigue (Standard Shiftwork Index): more fatigue on night shifts under the new system (F7.99, p<.01) Sleepiness (Standard Shiftwork Index): more sleepiness on the new system (F7.93, p<.01) NS decrease in caffeine intake.	Night shift fatigue ↓ Sleepiness ↓ Caffeine intake ↔
Kobayashi et al, 1997 ³⁵	Prospective cohort No details of follow-up Final sample: n=18 Quality appraisal: 1 2 4 5 6 7 9 10	Hospital, Japan. Nurses, all female.	Intervention: increase of rest period before night shift Shift systems: Irregular rotating 3 shift system with a full day shift (0830-1630) before night shift to irregular rotating 3 shift system with a half day shift (0830-1230) before night shift.	Sleep duration (minutes) before the night shift increased amongst both single nurses (from 146.6 to 232.2, p<0.05) and nurses who were married with children (from 127.0 to 187.2, p<.05). NS change in irritation and tiredness levels during night shift.	Sleep duration before night shift ↑ Irritation on night shift ↔ Tiredness on night shift ↔
LATER START & FINISH TIMES					
Rosa et al, 1996 ³⁶	Prospective cohort with comparison group 4 month follow-up	Steel rolling mill, Finland. Mill workers.	Intervention: later start & finish times Shift systems: Rotating 3 shift	Sleep duration (hours) increased on the evening shift in intervention group, no change in comparison group (F=11.27, p<.001).	Sleep duration (pm) ↑ Sleep duration (am, night, rest) ↔ Sleep quality (pm, night) ↓

	Final sample: n=208 (68 intervention, 140 comparison) Quality appraisal: 1 2 4 7 9 10		system (with shift starts at 0600, 1400, 2200) to rotating 3 shift (with shift starts of 0700, 1500, 2300).	<p>Sleep quality (Standard shiftwork index, 1-5, very bad - very good): decrease in intervention group in evening shift (3.68 to 3.39, mean difference -0.29, p<.05) and night shift (2.89 to 2.63, mean difference -0.26, p<.05). NS change on morning shift or days off. NS changes in comparison group.</p> <p>Satisfaction with amount of sleep (Standard shiftwork index, 1-5, not enough – plenty): increase in intervention group in morning shift (2.74 to 3.31, mean difference 0.57, p<.05). Decrease on evening shift (4.07 to 3.63, mean difference -0.44, p<.05) and night shift (3.20 to 2.83, mean difference -0.37, p<.05). NS change in days off. NS changes in comparison group.</p> <p>Awaken refreshed from sleep (Standard shiftwork index, 1-5, not at all – extremely): increase in intervention group in morning shift (2.65 to 3.15, mean difference 0.50, p<.05). Decrease on evening shift (3.89 to 3.60, mean difference -0.29, p<.05) and night shift (2.8 to 2.51, mean difference -0.29, p<.05). NS change in days off. NS changes in comparison group.</p> <p>NS changes in health complaints or chronic fatigue.</p> <p>Interference of shift work with domestic activities increased in intervention group but not in comparison group (F=5.54, p<.03).</p> <p>NS changes in Mental and physical workload</p> <p>NS changes in Job satisfaction</p>	<p>Sleep quality (am, rest) ↔</p> <p>Satisfaction with amount of sleep (am) ↑</p> <p>Satisfaction with amount of sleep (pm, night) ↓</p> <p>Satisfaction with amount of sleep (rest) ↔</p> <p>Awaken refreshed from sleep (am) ↑</p> <p>Awaken refreshed from sleep (pm, night) ↓</p> <p>Awaken refreshed from sleep (rest) ↔</p> <p>Health complaints ↔</p> <p>Chronic fatigue ↔</p> <p>Interference of shift work with domestic activities ↓</p> <p>Mental and physical workload ↔</p> <p>Job satisfaction ↔</p>	
CHANGES TO WEEKEND WORKING						
Boggild & Jeppesen, 2001 ³⁷	Prospective cohort with comparison group 6 month follow-up Final sample: n=101 (41 intervention, 60 comparison) Quality appraisal: 1 2 4 6 7 8 9 10	Hospital, Denmark. Nurses.	Intervention: continuous (weekends on) to discontinuous shift system (weekends off) Shift systems: Irregular continuous flexible rotating shift to A. regular continuous or B. discontinuous regular shift.	Group B compared to control: Increase in HDL cholesterol (median change of 0.1 mmol/l, p=.004), decrease in total (median change of -0.1 mmol/l, p=.043) and LDL cholesterol (median change of -0.2 mmol/l, p=.005), decrease in total:HDL ratio (median change of -0.3 mmol/l, p=.000). Changes in total:HDL ratio and LDL cholesterol were still significant when data were adjusted for age and lifestyle. NS changes in Group A.	HDL Cholesterol (A) ↔ Total Cholesterol (A) ↔ LDL Cholesterol (A) ↔ HDL Cholesterol (B) ↓ Total Cholesterol (B) ↑ LDL Cholesterol (B) ↑	
Banks, 1956 ³⁸	Retrospective cross section After only recall data.	Steel Factory, UK. Wives of steel workers.	Intervention(s): discontinuous (weekends off) to continuous (weekends on)	38% of wives said that the change had most negatively affected their social life (going out, visits to friends and family, hobbies and clubs), 11% their domestic routine (meal preparation, washing etc), and 10% time with their husband. 25% reported no detrimental	Social life ↔ Domestic routine ↔ Time with husband ↔	

	Final sample: n=73 Quality appraisal: 2 4 7 9 10		Shift systems: Discontinuous rotating 3 shift to a continuous rotating 3 shift.	effect as a result of the change and 11% said that social and domestic life had improved. NS difference in responses by household size or number of dependents.		
DECREASED HOURS						
Boudreaux et al, 1998 ³⁹	Prospective cohort 2 and 12 month follow-ups Final sample: n=35 Quality appraisal: 1 2 4 7 9 10	Emergency Services, USA. Paramedics.	Intervention: decrease in shift length Shift systems: 24 hr shifts (1 day on, 2 days off) to 12hr shifts (2/3 days on, 2/3 off) with monthly rotation between day and night shifts.	Emotional exhaustion (Maslach Burnout Inventory, 0-6 never to everyday, higher scores represent more burnout) decreased at 2 month follow up from 23.6 to 19.8 (t=3.06, p<.01). NS change between baseline and 12 month follow up. Schedule impact on social and family life (schedule attitude survey, 1-5, strongly agree to strongly disagree, higher scores represent less interference) improved at 2 month (7.2 to 10.8, t=-4.52, p<.001) and 12 month follow ups (10.9, t=-5.0). NS change job satisfaction.	Emotional exhaustion Social and family life Job satisfaction	↑ ↑ ↔
Best, 1933 ⁴⁰	Retrospective cross section After only recall data. Final sample: n=265 Quality appraisal: 2 4 7 9	Factory, USA. Factory workers, all female.	Intervention: decrease in shift length Shift systems: 8 hour three shift to 6 hour four shift	25.2% reported less fatigue, 56.1% the same amount of fatigue and 18.7% more fatigue. 64.7% reported no inconvenience or upset to domestic arrangements Due to the decrease in working hours, earnings of 77% of workforce decreased by 10-20% despite an increase in hourly pay.	Fatigue Domestic inconvenience Wages	↔ ↔ ↓
SELF-SCHEDULING						
De Haan, 1990 ⁴¹	Prospective cohort with comparison group 12 month follow-up Final sample: n=50 (25 intervention, 25 comparison) Quality appraisal: 1 7 9 10	Bus Company, Netherlands. Bus drivers.	Intervention(s): Self-scheduling of shifts Shift systems: Irregular to regular self-scheduled.	Sickness absence rates decreased in the intervention group from an average of 28 days per driver to 20 days. Rates increased in the comparison group from 32 to 47 days. Fatigue (0=minimum, 11=maximum) decreased in intervention group (from 3.31 to 1.94, p<.05). NS decrease in comparison group (3.57 to 3.09, p>.05). Complaints about family life (1=very good, 5= very bad) decreased in intervention group (from 2.77 to 2.11, p<.05). NS decrease in comparison group (from 2.52 to 2.40). NS change in complaints about free time or time with children. Productive work hours increased from 50% to over 54% in the intervention group. No data for the comparison group.	Absence Fatigue Complaints about family life Complaints about free time Complaints about time with children Productive work hours	↑ ↑ ↑ ↔ ↔ ↑
Gauderer &	Prospective cohort with	Public transport	Intervention: Self-scheduling of	Accidents decreased by 20%	Accidents	↑

Knauth, 2004 ⁴²	comparison group 12 month follow-up Final sample: n=24 (no details of n for intervention or comparison groups) Quality appraisal: 1 9	depot, Germany. Bus drivers.	shifts Shift systems: No details provided of shift systems.	79% said that the new rotas gave better opportunities to plan their leisure time. 66.6% said that the new system was better for social contacts. Customer complaints by 52% in intervention group whilst there were slight increases for both measures in the comparison group.	Opportunities to plan leisure time Social contacts Customer complaints	↑ ↑ ↑
Wortley & Grierson-Hill, 2003 ⁴³	Prospective repeat cross-section 6 month follow-up Final sample: n=45 Quality appraisal: 1 2 5 9	Hospital, UK. Nurses.	Intervention: Self-scheduling of shifts Shift systems: No details provided of shift systems.	21% said that they were rarely or never able to maintain a work-life balance under the old system compared to 0% after the change.	Work-life balance	↑

^A Specific scales and measures used are also recorded when cited in the studies. Similarly, statistical detail varies depending on the amount of information available in the original studies.

* A separate group were exposed to multiple changes (see table 3)

Table 3: Multiple interventions

Study	Design & Quality Appraisal (see criteria in box 3)	Setting & Participants	Interventions	Detailed results ^A	Summary results ↑ = improvement ↓ = worsening ↔ = little change
Akerstadt & Torsvall, 1978 ^{*33}	Prospective cohort with comparison group 12 month follow-up Final sample: n=305 (127 intervention, 178 comparison) Quality appraisal: 1 2 4 5 7 9 10	Steel company, Sweden. Steel factory workers, majority men.	Intervention(s): Fast to slow rotation, continuous to discontinuous. Shift systems: Fast rotating 4 shift with weekend working to slow rotating 3 shift with weekends off.	Shift specific problems (difficulty in falling asleep, disturbed sleep, waking up too soon, slept well, fatigue, irritation, good appetite, gastrointestinal complaints, scored 4-1, never to often) increased on all shifts: mean change morning -0.2, afternoon -0.18, night -0.18 (p<.05). Sleep length (hours): decreased on rest days (0.4, p<.05). NS change on morning, afternoon or night shift days. NS changes in sleep complaints, gastro-intestinal complaints, sickness absence. Social life complaints (time spent on clubs and hobbies, going out, political activity etc scored 4-1, enough to far too little) improved in intervention group compared to control: mean change 0.18 (p<.01).	Shift specific problems Sleep length (days) ↓ Sleep length (pm, night) ↔ Absence ↔ Sleep complaints ↔ Gastro-intestinal complaints ↔ Social life complaints ↑
Poole et al, 1982 ⁴⁴	Prospective cohort with comparison group 6 month follow-up Final sample: n=298 (189 intervention, 109 comparison) Quality appraisal: 1 5 7 9 10	Engineering factory, UK. Production line workers	Intervention(s): Slow to fast rotation; Backward to forward rotation Shift systems: Discontinuous slow forward rotating 2 shift to discontinuous fast backward rotating 3 shift.	Increase in percentage reporting difficulties in 'getting up for work' (from 39% to 50%, p<.05). Decrease in percentage reporting 'feeling sleepy on the night shift during previous month' (from 73% to 64%, p<.05). Increase in percentage reporting indigestion problems in previous week (from 22% to 35%, p<.05). Stress and Arousal Checklist (Mackay et al, 1978): deterioration in 'arousal' scores (from 6.9 to 6.3, p<.05). NS change in 'stress'. NS change in anxiety or depression. NS change in 'felt stressed'. Alcohol consumption in previous week (units of alcohol) increased from 12.0 units to 13.4 units (p<.05). NS change in reported abdominal pain, heartburn, or bowel movements.	Difficulties getting up for work ↓ Feeling sleepy on the night shift ↑ Indigestion problems ↓ Arousal ↓ Stress ↔ Anxiety ↔ Depression ↔ Alcohol consumption ↓ Abdominal pain ↔ Heartburn ↔ Bowel movements ↔ Difficulty going to sleep ↔ Visits to doctor ↔ Absence ↔ Enjoyment of social and sex life ↓ Tension at home ↔ Enjoyment of work ↔

				<p>NS change in 'difficulty going to sleep'</p> <p>NS change in number of visits to doctor in previous month.</p> <p>NS change in sickness absence 10 weeks average pre compared to post.</p> <p>Enjoyment of social life and sex life (0-7, bad-good) decreased (from 5.0 to 4.5, $p < .0.5$ and 4.8 to 4.3, $p < .05$ respectively).</p> <p>NS change in 'tension at home'.</p> <p>NS change 'Enjoyment of work'.</p>		
Bodin, 1983 ⁴⁵	<p>Prospective cohort with comparison group</p> <p>8 month follow-up</p> <p>Final sample: n=129 (104 intervention, 25 comparison)</p> <p>Quality appraisal: 179</p>	<p>Paper Mill, France.</p> <p>Laboratory, maintenance, security workers, machine operators, all men.</p>	<p>Interventions: Slow to fast rotation; Reduction in hours of working week.</p> <p>Shift systems: Continuous backward 3 shift slow rotation to continuous backward 3 shift fast rotation.</p>	<p>Percentage of workers reporting tiredness in intervention group decreased from 34.4% to 30.8%. There was an increase in the comparison group from 21.6% to 41%.</p> <p>Percentage of workers reporting lack of appetite in intervention group decreased from 35.4% to 24%. There was an increase in the comparison group from 10.8% to 20%.</p> <p>Percentage of workers reporting digestive disorders in intervention group decreased from 35.4% to 26%. There was no change in the comparison group (23.5%).</p> <p>Percentage of workers reporting nervous disorders decreased in both the intervention (from 51.9% to 48.4%) and the comparison groups (from 44% to 8.4%).</p> <p>Percentage of workers reporting incidences of physical stiffness increased in both the intervention (from 21.1% to 51%) and the comparison groups (from 18.9% to 44%).</p> <p>Effects of change on family life rated as positive by 65% of workers on the slow rotation and 58% on the fast rotation. 49% of all workers said that they had more time to take part in family life. 39% of fast rotation workers stated that they had more time to enjoy their customary activities compared to 71% on the slow rotation.</p>	<p>Tiredness</p> <p>Lack of appetite</p> <p>Digestive disorders</p> <p>Nervous disorders</p> <p>Physical stiffness</p> <p>Family life</p> <p>Time on customary activities</p>	<p>↑</p> <p>↑</p> <p>↑</p> <p>↔</p> <p>↔</p> <p>↓</p> <p>↓</p>
Knauth & Kiesswetter,	Prospective cohort with comparison group	Food Processing Factory, Germany.	Intervention(s): Slow to fast rotation; Discontinuous to	Sleep difficulties during night shifts decreased in the intervention group compared to the comparison group ($p < .01$).	Sleep difficulties (night) Sleep difficulties (day)	<p>↑</p> <p>↔</p>

1987 ⁴⁶	6 month follow-up Final sample: n=52 (25 intervention, 27 comparison) Quality appraisal: 1 8 9 10	Production and Maintenance workers.	continuous. Shift systems: Backward slow rotating discontinuous system to a fast rotating continuous system	NS decrease in afternoon shifts (p=.079). NS change in sleep duration. NS change in gastrointestinal symptoms. 18/31 (58%) earned less on the new system due to decline in overtime.	Sleep duration Gastrointestinal symptoms Earnings	↔ ↔ ↓
Kandolin & Huida, 1996 ⁴⁷	Prospective cohort with comparison group 6 month follow-up Final sample: n=58 (45 intervention, 13 comparison) Quality appraisal: 1 2 3 4 7 8 9 10	Hospital, Finland. Midwives, all female.	Interventions: Slow to fast rotation; Backward to forward rotation; Self-scheduling of shifts. Shift systems: Slow backward rotating 3 shift to fast forward rotating self-scheduled 3 shift.	Standard shiftwork index (Barton et al, 1992) and Occupational Stress Questionnaire (Elo et al 1992): ns difference in 'mental strain during morning shift' between intervention and comparison group (27% to 11% intervention group stating rather or very strenuous); ns difference in mental strain during evening shift (17% to 9% rather or very strenuous) between intervention and comparison group. Decrease in tiredness during night shift (53% to 44% rather or very tired) NS difference in mental stress (27% to 15% in intervention group somewhat or much).	Mental strain during morning shift Mental strain during evening shift Tiredness during night shifts Mental stress	↔ ↔ ↑ ↔
Czeisler et al, 1982 ⁴⁸	Prospective cohort 3 month follow-up Final sample: n=85 Quality appraisal: 1 4 5 7 9 10	Chemical industry, USA. Chemical processing workers	Intervention(s): Fast to slow rotation; Backward to forward rotation. Shift systems: Weekly backward rotating to 3 weeks forward rotating	Health index scores (Smith et al 1969, 0-100, low-high) improved in intervention group B (from 50 to 60%, t=3.23, p<.01). NS change in group A. Productivity (tonnes processed per hour) increased in intervention group B (from 0.9 to 1.05, t=6.99, p<.001). No data for group A.	Health Productivity	↔ ↑
Totterdell & Folkard, 1990 ⁴⁹	Prospective cohort 4 month follow-up Final sample: n=20 Quality appraisal: 1 7 9 10	Police Force, UK. Police Officers	Intervention(s): Slow to fast rotation; Backward to forward rotation; Later start & finish times, self-scheduling. Shift systems: A. Weekly backward rotating 3 shift (with shift starts at 0600, 1400, 2200) to rapid forward rotating 3 shift with flexible start times of up to 2 hrs delay (with guideline shift starts of 0700, 1500, 2300). B. Weekly backward rotating 3 shift (with shift starts at 0600,	NS difference total duration of sleep or average sleep quality. In both groups, time for social activities improved (F=4.48; df=1,20; p<.05). Disruption to personal life (F=4.67, df=1,20; p<.05); time for social activities (F=9.56; df=1,20; p<.05) and difficulty of planning social life (F=10.17; df=1,20; p<.05) all deteriorated in A (flexible) and improved in B (standard). NS change in 25 other unspecified well-being and satisfaction variables.	Sleep duration Sleep quality Time for social activities Disruption to personal life (A) Time for social activities (A) Difficulty of planning social life (A) Disruption to personal life (B) Time for social activities (B) Difficulty of planning social life (B)	↔ ↔ ↑ ↓ ↓ ↓ ↑ ↑ ↑

			1400, 2200) to rapid forward rotating 3 shift (with shift starts of 0700, 1500, 2300).			
Hakola & Harma, 2001 ⁵⁰	Prospective cohort 12 month follow-up Final sample: n=16 Quality appraisal: 1 5 7 9 10	Steel factory, Finland. Factory workers, all male.	Intervention(s): Backward to forward rotation; Slow to fast rotation. Shift systems: Continuous slow backward rotating three shift to a fast forward rotating three shift.	Standard Shiftwork Index (1-5, never – always): NS changes on evening and night shift days. On morning shift days, 'feels rested' improved (0.8 to 2.6, p=.008), 'quality of sleep' improved (2.1 to 2.7, p<.05), sufficient amount of sleep improved (2.1 to 2.9, p<.003). NS changes on morning shift days for 'easy to fall asleep', 'wakes up when intended'. Overall quality of sleep improved (F=8.48, p<.013) for older workers (mean age 54 years) compared to younger workers (mean age 39 years).	Feels rested Quality of sleep Sufficient amount of sleep Easy to fall asleep Wake up when intended	↑ ↑ ↑ ↔ ↔
Knauth & Hornberger, 1998 ⁵¹	Prospective repeat cross section with comparison group 10 month follow-up Final sample: n=137 (70 intervention, 67 comparison) Quality appraisal: 1 2 4 5 7 8 9 10	Steel industry, Germany. Steel workers.	Intervention(s): Backward to forward rotation; Slow to fast rotation. Shift systems: A. Discontinuous slow backward rotating or B. Continuous slow backward rotating to A. fast discontinuous forward rotating or B. fast continuous forward rotating.	NS change in health, sleep duration, sleep disturbances. Frequency of difficulties with social problems (Knauth & Kiesswetter, 1987, 0-100 scales, no –always) decreased on days with evening shifts on new system A (from 38 to 30, p<.05) and on morning (from 40 to 21, p<.05), evening (from 42 to 26, p<.05) and afternoon (from 43 to 22, p<.05) shift days in new system B. NS change in duration of leisure time.	Health Sleep duration Sleep disturbances Difficulties with social problems Duration of leisure time	↔ ↔ ↔ ↑ ↔

^A Specific scales and measures used are also recorded when cited in the studies. Similarly, statistical detail varies depending on the amount of information available in the original studies.

* A separate group were exposed to a decrease in night shifts (see table 2)

Box 1: Databases and websites

The following 27 databases and websites were searched from start date to November 2005:

ASSIA (CSA), EU Community Research & Development Information Service, Dissertation Abstracts, Eric (CSA), European Commission Libraries Catalogue, Econlit (Webspirs), Electronic Collections Online (FirstSearch), Embase (Ovid), Geobase (FirstSearch), Harvard Business Review, HMIC (OVID), Index to Theses, International Bibliography of the Social Sciences (OVID), JSTOR, Labordoc, Management Contents (Dialog), Medline (Ovid), Medline In-Process & Other Non-Indexed Citations (OVID), NTIS, PAIS (Webspirs), PapersFirst (FirstSearch), Psycinfo (Ovid), REGARD (ESRC), Research Papers in Economics, Social Science Citation Index (Web of Science), Sigle (Webspirs), Sociological Abstracts (CSA).

Box 2: Example search strategy (MEDLINE)

1. shiftwork\$.ti,ab.
2. nightwork\$.ti,ab.
3. ((shift or shifts) adj2 (work\$ or night\$)).ti,ab.
4. (night\$ adj2 work\$).ti,ab.
5. nightshift\$.ti,ab.
6. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).ti,ab.
7. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).ti,ab.
8. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).ti,ab.
9. (hour\$ adj (shift or shifts)).ti,ab.
10. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).ti,ab.
11. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).ti,ab.
12. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).ti,ab.
13. (irregular\$ adj2 (work\$ or shift or shifts)).ti,ab.
14. compressed work\$.ti,ab.
15. long work\$
16. (extend\$ adj (duty or duties or work\$) adj hour\$).ti,ab.
17. overtime.ti,ab.
18. (flextime or flex time or flexitime or flexi time).ti,ab.
19. (flex\$ adj work\$).ti,ab.
20. work schedule tolerance/
21. or/1-20
22. exp Legislation/
23. legislat\$.ti,ab.
24. (law or laws).ti,ab.
25. work\$ time directive.ti,ab.
26. ((eu or europe\$) adj3 work\$).ti,ab.
27. european union/
28. (european adj (commission or union)).ti,ab.
29. bright light\$.ti,ab.
30. (nap or naps or napped or napping).ti,ab.
31. clockwise.ti,ab.
32. (reorganis\$ or reorganiz\$ or re-organis\$ or re-organiz\$).ti,ab.
33. (restructur\$ or re-structur\$).ti,ab.
34. (entrain\$ or re-entrain\$).ti,ab.
35. (countermeasure\$ or surveillance).ti,ab.
36. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).ti,ab.
37. ergonomic\$.ti,ab.
38. (self help or selfhelp).ti,ab.
39. (self schedul\$ or self roster\$).ti,ab.
40. program development/
41. (coping or cope\$).ti,ab.
42. exp counseling/
43. counsel\$.ti,ab.
44. empower\$.ti,ab.
45. circadian rhythm/
46. circadian.ti,ab.
47. phototherapy/
48. phototherap\$.ti,ab.
49. (light treatment or light therap\$).ti,ab.
50. Melatonin/
51. melatonin\$.ti,ab.
52. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
53. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
54. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
55. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
56. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or manag\$ or strateg\$)).ti,ab.
57. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
58. or/22-57
59. 21 and 58
60. animals/
61. humans/
62. 60 not (60 and 61)
63. 59 not 62

hour\$.ti,ab.

Box 3: Quality appraisal criteria²¹⁻²⁴

1. Is the study prospective?
2. Is there a representative sample? (random samples, adequately justified purposive sampling, or 100% samples)
3. Is there an appropriate control group? (random allocation, matched control, case-control, within or between organisation comparison group)
4. Is the baseline response greater than 60%?
5. Is the follow-up greater than 80% in a cohort study, or greater than 60% in a cross-sectional study?
6. Have the authors adjusted for non-response and drop-out?
7. Are the authors' conclusions substantiated by the data presented?
8. Is there adjustment for any of the following confounders: demographic, lifestyle, job content or shift work experience?
9. Were the entire intervention group exposed to the intervention?
Was there any contamination between the intervention and control groups?
10. Were appropriate statistical tests used?

These criteria were used to appraise all of the included studies. The results of this process are presented under the quality appraisal section of the results tables 1-3, with the numbers 1-10 representing satisfactory fulfilment of the corresponding criterion.

Box 4: Summary of intervention effects

Speed of rotation (3 studies)²⁵⁻²⁸

Overall, the studies of the speed of rotation suggest that changing from a slow to a fast shift rotation tended to improve health and well-being outcomes, though the small studies suggest caution in interpretation.

Direction rotation (2 studies)^{29,30}

One high quality study found improvements in health related outcomes as a result of changing from backward to forward rotation. However, the well-being effects were less clear.

Removal of rotation (2 studies)^{31,32}

The evidence base is small and somewhat inconclusive with few negative or positive effects on health, well-being or economic outcomes.

Changes to night work (3 studies)³³⁻³⁵

The current evidence base on the health effects of changes to night working is diverse and quite weak - three uncontrolled studies of three slightly different interventions conducted in three different settings – and so it is not possible to offer any real conclusions about the effects on health and well-being.

Later start and finish times (1 study)³⁶

There is a very small evidence base of one study, reporting inconclusive effects on health-related outcomes, and a worsening of work/life balance.

Changes to weekend working (2 studies)^{37,38}

Very little evidence was located on the health, well-being or economic effects of changes to weekend shift work.

Decreased hours (2 studies)^{39,40}

Only a partial and diverse evidence base was found, from which it is not possible to draw any firm conclusions about the health and well-being effects of reducing shift length.

Self-scheduling (3 studies)⁴¹⁻⁴³

All studies found that self-scheduling improved health and well-being. However, given the small size of the studies, the focus on only two different occupational settings, and the lack of control group in any of the studies, more robust research is needed to add weight to and reinforce this conclusion.

Web Appendix 1: Full search strategy

MEDLINE (1966-2005 Nov week 2) (OVID)

Searched 21/11/05.

3249 records retrieved

64. shiftwork\$.ti,ab.
65. nightwork\$.ti,ab.
66. ((shift or shifts) adj2 (work\$ or night\$)).ti,ab.
67. (night\$ adj2 work\$).ti,ab.
68. nightshift\$.ti,ab.
69. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).ti,ab.
70. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).ti,ab.
71. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).ti,ab.
72. (hour\$ adj (shift or shifts)).ti,ab.
73. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).ti,ab.
74. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).ti,ab.
75. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).ti,ab.
76. (irregular\$ adj2 (work\$ or shift or shifts)).ti,ab.
77. compressed work\$.ti,ab.
78. long work\$ hour\$.ti,ab.
79. (extend\$ adj (duty or duties or work\$) adj hour\$).ti,ab.
80. overtime.ti,ab.
81. (flextime or flex time or flexitime or flexi time).ti,ab.
82. (flex\$ adj work\$).ti,ab.
83. work schedule tolerance/
84. or/1-20
85. exp Legislation/
86. legislat\$.ti,ab.
87. (law or laws).ti,ab.
88. work\$ time directive.ti,ab.
89. ((eu or europe\$) adj3 work\$).ti,ab.
90. european union/
91. (european adj (commission or union)).ti,ab.
92. bright light\$.ti,ab.
93. (nap or naps or napped or napping).ti,ab.
94. clockwise.ti,ab.
95. (reorganis\$ or reorganiz\$ or re-organis\$ or re-organiz\$).ti,ab.
96. (restructur\$ or re-structur\$).ti,ab.
97. (entrain\$ or re-entrain\$).ti,ab.
98. (countermeasure\$ or surveillance).ti,ab.
99. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).ti,ab.
100. ergonomic\$.ti,ab.
101. (self help or selfhelp).ti,ab.
102. (self schedul\$ or self roster\$).ti,ab.
103. program development/
104. (coping or cope\$).ti,ab.
105. exp counseling/
106. counsel\$.ti,ab.
107. empower\$.ti,ab.

108. circadian rhythm/
109. circadian.ti,ab.
110. phototherapy/
111. phototherap\$.ti,ab.
112. (light treatment or light therap\$).ti,ab.
113. Melatonin/
114. melatonin\$.ti,ab.
115. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
116. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
117. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
118. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
119. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or manag\$ or strateg\$)).ti,ab.
120. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
121. or/22-57
122. 21 and 58
123. animals/
124. humans/
125. 60 not (60 and 61)
126. 59 not 62

**MEDLINE In-Process & Other Non-Indexed Citations (November 16, 2005)
(OVID)**

Searched 21/11/05.

88 records retrieved

1. shiftwork\$.ti,ab.
2. nightwork\$.ti,ab.
3. ((shift or shifts) adj2 (work\$ or night\$)).ti,ab.
4. (night\$ adj2 work\$).ti,ab.
5. nightshift\$.ti,ab.
6. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).ti,ab.
7. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).ti,ab.
8. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).ti,ab.
9. (hour\$ adj (shift or shifts)).ti,ab.
10. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).ti,ab.
11. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).ti,ab.
12. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).ti,ab.
13. (irregular\$ adj2 (work\$ or shift or shifts)).ti,ab.
14. compressed work\$.ti,ab.
15. long work\$ hour\$.ti,ab.
16. (extend\$ adj (duty or duties or work\$) adj hour\$).ti,ab.
17. overtime.ti,ab.
18. (flextime or flex time or flexitime or flexi time).ti,ab.
19. (flex\$ adj work\$).ti,ab.

20. or/1-19
21. legislat\$.ti,ab.
22. (law or laws).ti,ab.
23. work\$ time directive.ti,ab.
24. ((eu or europe\$) adj3 work\$).ti,ab.
25. (european adj (commission or union)).ti,ab.
26. bright light\$.ti,ab.
27. (nap or naps or napped or napping).ti,ab.
28. clockwise.ti,ab.
29. (reorganis\$ or reorganiz\$ or re-organis\$ or re-organiz\$).ti,ab.
30. (restructur\$ or re-structur\$).ti,ab.
31. (entrain\$ or re-entrain\$).ti,ab.
32. (countermeasure\$ or surveillance).ti,ab.
33. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).ti,ab.
34. ergonomic\$.ti,ab.
35. (self help or selfhelp).ti,ab.
36. (self schedul\$ or self roster\$).ti,ab.
37. (coping or cope\$).ti,ab.
38. counsel\$.ti,ab.
39. empower\$.ti,ab.
40. circadian.ti,ab.
41. phototherap\$.ti,ab.
42. (light treatment or light therap\$).ti,ab.
43. melatonin\$.ti,ab.
44. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
45. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
46. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
47. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
48. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or manag\$ or strateg\$)).ti,ab.
49. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
50. or/21-49
51. 20 and 50

Embase (1980-2005 week 47) (OVID)

Searched 21/11/05.

2836 records retrieved

1. shift worker/
2. shiftwork\$.ti,ab.
3. nightwork\$.ti,ab.
4. night work/
5. ((shift or shifts) adj2 (work\$ or night\$)).ti,ab.
6. (night\$ adj2 work\$).ti,ab.
7. nightshift\$.ti,ab.

8. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).ti,ab.
9. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).ti,ab.
10. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).ti,ab.
11. (hour\$ adj (shift or shifts)).ti,ab.
12. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).ti,ab.
13. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).ti,ab.
14. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).ti,ab.
15. (irregular\$ adj2 (work\$ or shift or shifts)).ti,ab.
16. compressed work\$.ti,ab.
17. long work\$ hour\$.ti,ab.
18. (extend\$ adj (duty or duties or work\$) adj hour\$).ti,ab.
19. overtime.ti,ab.
20. (flextime or flex time or flexitime or flexi time).ti,ab.
21. (flex\$ adj work\$).ti,ab.
22. work schedule/
23. or/1-22
24. law/
25. (law or laws).ti,ab.
26. legislat\$.ti,ab.
27. work\$ time directive.ti,ab.
28. ((eu or europe\$) adj3 work\$).ti,ab.
29. european union/
30. (european adj (commission or union)).ti,ab.
31. bright light\$.ti,ab.
32. (nap or naps or napped or napping).ti,ab.
33. clockwise.ti,ab.
34. (reorganis\$ or reorganiz\$ or re-organis\$ or re-organiz\$).ti,ab.
35. (restructur\$ or re-structur\$).ti,ab.
36. (entrain\$ or re-entrain\$).ti,ab.
37. (countermeasure\$ or surveillance).ti,ab.
38. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).ti,ab.
39. ergonomics/
40. ergonomic\$.ti,ab.
41. self help/
42. (self help or selfhelp).ti,ab.
43. (self schedul\$ or self roster\$).ti,ab.
44. program development/
45. (coping or cope\$).ti,ab.
46. counseling/
47. counsel\$.ti,ab.
48. empower\$.ti,ab.
49. Circadian Rhythm/
50. circadian.ti,ab.
51. phototherapy/
52. phototherap\$.ti,ab.
53. (light treatment or light therap\$).ti,ab.
54. Melatonin/
55. melatonin\$.ti,ab.
56. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.

57. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
58. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
59. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
60. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
61. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
62. or/24-61
63. 23 and 62
64. (cat or cats or dog or dogs or animal or animals or rat or rats or hamster or hamsters or feline or ovine or bovine or canine or sheep).ti,ab.
65. exp animal/
66. animal experiment/
67. nonhuman/
68. or/64-67
69. human/
70. human experiment/
71. 69 or 70
72. 68 not (68 and 71)
73. 63 not 72

**HMIC Health Management Information Consortium (November 2005) (OVID)
Searched 21/11/05.
363 records retrieved**

1. exp shift work/
2. shiftwork\$.ti,ab.
3. night work/
4. nightwork\$.ti,ab.
5. ((shift or shifts) adj2 (work\$ or night\$)).ti,ab.
6. (night\$ adj2 work\$).ti,ab.
7. nightshift\$.ti,ab.
8. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).ti,ab.
9. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).ti,ab.
10. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).ti,ab.
11. (hour\$ adj (shift or shifts)).ti,ab.
12. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).ti,ab.
13. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).ti,ab.
14. exp unsocial hours/
15. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).ti,ab.
16. (irregular\$ adj2 (work\$ or shift or shifts)).ti,ab.
17. compressed work\$.ti,ab.
18. long work\$ hour\$.ti,ab.
19. (extend\$ adj (duty or duties or work\$) adj hour\$).ti,ab.
20. overtime/
21. overtime hours/
22. overtime.ti,ab.

23. flexible working/
24. flexible working hours/
25. (flexitime or flex time or flexitime or flexi time).ti,ab.
26. (flex\$ adj work\$).ti,ab.
27. or/1-26
28. exp legislation/
29. legislat\$.ti,ab.
30. exp law/
31. (law or laws).ti,ab.
32. work\$ time directive.ti,ab.
33. ((eu or europe\$) adj3 work\$).ti,ab.
34. european union/
35. european union directives/
36. (european adj (commission or union)).ti,ab.
37. bright light\$.ti,ab.
38. (nap or naps or napped or napping).ti,ab.
39. clockwise.ti,ab.
40. exp reorganisation/
41. exp organisational change/
42. (reorganis\$ or reorganiz\$ or re-organis\$ or re-organiz\$).ti,ab.
43. (restruct\$ or re-structur\$).ti,ab.
44. (entrain\$ or re-entrain\$).ti,ab.
45. (countermeasure\$ or surveillance).ti,ab.
46. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).ti,ab.
47. ergonomics/
48. ergonomic\$.ti,ab.
49. self help/
50. (self help or selfhelp).ti,ab.
51. (self schedul\$ or self roster\$).ti,ab.
52. (coping or cope\$).ti,ab.
53. exp counselling/
54. counsel\$.ti,ab.
55. empowerment/
56. empower\$.ti,ab.
57. exp circadian rhythm/
58. circadian.ti,ab.
59. light phototherapy/
60. phototherap\$.ti,ab.
61. (light treatment or light therap\$).ti,ab.
62. melatonin/
63. melatonin\$.ti,ab.
64. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
65. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
66. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
67. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.

68. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
69. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
70. or/28-69
71. 27 and 70

Psycinfo (1806-2005 November week 2) (OVID)

Searched 21/11/05.

1482 records retrieved

1. workday shifts/
2. shiftwork\$.ti,ab.
3. nightwork\$.ti,ab.
4. ((shift or shifts) adj2 (work\$ or night\$)).ti,ab.
5. (night\$ adj2 work\$).ti,ab.
6. nightshift\$.ti,ab.
7. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).ti,ab.
8. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).ti,ab.
9. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).ti,ab.
10. (hour\$ adj (shift or shifts)).ti,ab.
11. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).ti,ab.
12. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).ti,ab.
13. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).ti,ab.
14. (irregular\$ adj2 (work\$ or shift or shifts)).ti,ab.
15. compressed work\$.ti,ab.
16. long work\$ hour\$.ti,ab.
17. (extend\$ adj (duty or duties or work\$) adj hour\$).ti,ab.
18. overtime.ti,ab.
19. (flextime or flex time or flexitime or flexi time).ti,ab.
20. (flex\$ adj work\$).ti,ab.
21. or/1-20
22. exp government policy making/
23. legislative processes/
24. legislat\$.ti,ab.
25. (law or laws).ti,ab.
26. work\$ time directive.ti,ab.
27. ((eu or europe\$) adj3 work\$).ti,ab.
28. (european adj (commission or union)).ti,ab.
29. bright light\$.ti,ab.
30. napping/
31. (nap or naps or napped or napping).ti,ab.
32. clockwise.ti,ab.
33. (reorganiz\$ or reorganiz\$ or re-organis\$ or re-organiz\$).ti,ab.
34. (restructur\$ or re-structur\$).ti,ab.
35. exp organizational change/
36. (entrain\$ or re-entrain\$).ti,ab.
37. (countermeasure\$ or surveillance).ti,ab.
38. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).ti,ab.
39. ergonomic\$.ti,ab.

40. exp self help/
41. (self help or selfhelp).ti,ab.
42. (self schedul\$ or self roster\$).ti,ab.
43. exp program development/
44. (coping or cope\$).ti,ab.
45. coping behavior/
46. exp counseling/
47. counsel\$.ti,ab.
48. empowerment/
49. empower\$.ti,ab.
50. human biological rhythms/
51. circadian.ti,ab.
52. phototherapy/
53. phototherap\$.ti,ab.
54. (light treatment or light therap\$).ti,ab.
55. melatonin/
56. melatonin\$.ti,ab.
57. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
58. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).ti,ab.
59. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
60. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).ti,ab.
61. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or manag\$ or strateg\$)).ti,ab.
62. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).ti,ab.
63. or/22-62
64. 21 and 63
65. animal.po.
66. human.po.
67. 65 not (65 and 66)
68. 64 not 67

International Bibliography of the Social Sciences (1951 – 2005 November week 03) (OVID)

Searched 21/11/05.

274 records retrieved

1. shiftwork\$.mp.
2. nightwork\$.mp.
3. ((shift or shifts) adj2 (work\$ or night\$)).mp.
4. (night\$ adj2 work\$).mp.
5. nightshift\$.mp.
6. ((shift or shifts) adj2 (rota\$ or system or systems or schedule\$ or roster\$)).mp.
7. ((shift or shifts) adj2 (extend\$ or pattern\$ or cycle\$)).mp.
8. ((shift or shifts) adj2 (evening or late or early or weekend or twilight)).mp.
9. (hour\$ adj (shift or shifts)).mp.

10. ((shift or shifts) adj2 (continental or continuous or turnaround or split)).mp.
11. ((nonstandard or non-standard) adj2 (work\$ or shift or shifts)).mp.
12. ((unsocia\$ or antisocia\$ or anti-socia\$) adj2 (work\$ or shift or shifts)).mp.
13. (irregular\$ adj2 (work\$ or shift or shifts)).mp.
14. compressed work\$.mp.
15. long work\$ hour\$.mp.
16. (extend\$ adj (duty or duties or work\$) adj hour\$).mp.
17. overtime.mp.
18. (flexitime or flex time or flexitime or flexi time).mp.
19. (flex\$ adj work\$).mp.
20. or/1-19
21. legislat\$.mp.
22. (law or laws).mp.
23. work\$ time directive.mp.
24. ((eu or europe\$) adj3 work\$).mp.
25. (european adj (commission or union)).mp.
26. bright light\$.mp.
27. (nap or naps or napped or napping).mp.
28. clockwise.mp.
29. (reorganis\$ or reorganiz\$ or re-organis\$ or re-organiz\$).mp.
30. (restructur\$ or re-structur\$).mp.
31. (entrain\$ or re-entrain\$).mp.
32. (countermeasure\$ or surveillance).mp.
33. (reschedul\$ or re-schedul\$ or redesign\$ or re-design\$).mp.
34. ergonomic\$.mp.
35. (self help or selfhelp).mp.
36. (self schedul\$ or self roster\$).mp.
37. (coping or cope\$).mp.
38. counsel\$.mp.
39. empower\$.mp.
40. circadian.mp.
41. phototherap\$.mp.
42. (light treatment or light therap\$).mp.
43. melatonin\$.mp.
44. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).mp.
45. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or strateg\$)).mp.
46. ((structur\$ or organis\$ or organiz\$ or management or managerial) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).mp.
47. ((shift\$ or work\$ or hour\$) adj3 (chang\$ or modif\$ or design\$ or intervention\$)).mp.
48. ((shift\$ or work\$ or hour\$) adj3 (impact\$ or alter\$ or adapt\$ or measure\$ or manag\$ or strateg\$)).mp.
49. ((shift\$ or work\$ or hour\$) adj3 (reduc\$ or increas\$ or particip\$ or educat\$ or train\$ or program\$)).mp.
50. or/21-49
51. 20 and 50

EconLit (1969-2005/10) (WebSPIRS)

Searched 21/11/05.

278 records retrieved

1. shiftwork*
2. nightwork*
3. (shift or shifts) near2 (work* or night*)
4. night* near2 work*
5. nightshift*
6. (shift or shifts) near2 (rota* or system or systems or schedule* or roster*)
7. (shift or shifts) near2 (extend* or pattern* or cycle*)
8. (shift or shifts) near2 (evening or late or early or weekend or twilight)
9. (hour* shift) or (hour* shifts)
10. (shift or shifts) near2 (continental or continuous or turnaround or split)
11. (nonstandard or non-standard) near2 (work* or shift or shifts)
12. (unsocia* or antisocia* or anti-socia*) near2 (work* or shift or shifts)
13. irregular* near2 (work* or shift or shifts)
14. compressed work*
15. long work* hour*
16. extend* near (duty or duties or work*) near hour*
17. overtime
18. flextime or flex time or flexitime or flexi time
19. flex* work*
20. #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
21. legislat*
22. law or laws
23. work* time directive
24. (eu or europe*) near3 work*
25. (european commission) or (european union)
26. bright light*
27. nap or naps or napped or napping
28. clockwise
29. reorganis* or reorganiz* or re-organis* or re-organiz*
30. restructur* or re-structur*
31. entrain* or re-entrain*
32. countermeasure* or surveillance
33. reschedul* or re-schedul* or redesign* or re-design*
34. ergonomic*
35. self help or selfhelp
36. self schedul* or self roster*
37. coping or cope*
38. counsel*
39. empower*
40. circadian
41. phototherap*
42. light treatment or light therap*
43. melatonin*
44. (structur* or organis* or organiz* or management or managerial) near3 (chang* or modif* or design* or intervention*)

45. (structur* or organis* or organiz* or management or managerial) near3 (impact* or alter* or adapt* or measure* or strateg*)
46. (structur* or organis* or organiz* or management or managerial) near3 (reduc* or increas* or particip* or educat* or train* or program*)
47. (shift* or work* or hour*) near3 (chang* or modif* or design* or intervention*)
48. (shift* or work* or hour*) near3 (impact* or alter* or adapt* or measure* or manag* or strateg*)
49. (shift* or work* or hour*) near3 (reduc* or increas* or particip* or educat* or train* or program*)
50. #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #48 or #49
51. #20 and #50

**PAIS International (Public Affairs Information Service) (1972-2005/09)
(WebSPIRS)**

Searched 21/11/05.

173 records retrieved

1. shiftwork*
2. nightwork*
3. (shift or shifts) near2 (work* or night*)
4. night* near2 work*
5. nightshift*
6. (shift or shifts) near2 (rota* or system or systems or schedule* or roster*)
7. (shift or shifts) near2 (extend* or pattern* or cycle*)
8. (shift or shifts) near2 (evening or late or early or weekend or twilight)
9. (hour* shift) or (hour* shifts)
10. (shift or shifts) near2 (continental or continuous or turnaround or split)
11. (nonstandard or non-standard) near2 (work* or shift or shifts)
12. (unsocia* or antisocia* or anti-socia*) near2 (work* or shift or shifts)
13. irregular* near2 (work* or shift or shifts)
14. compressed work*
15. long work* hour*
16. extend* near (duty or duties or work*) near hour*
17. overtime
18. flextime or flex time or flexitime or flexi time
19. flex* work*
20. #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
21. legislat*
22. law or laws
23. work* time directive
24. (eu or europe*) near3 work*
25. (european commission) or (european union)
26. bright light*
27. nap or naps or napped or napping
28. clockwise
29. reorganis* or reorganiz* or re-organis* or re-organiz*
30. restructur* or re-structur*

31. entrain* or re-entrain*
32. countermeasure* or surveillance
33. reschedul* or re-schedul* or redesign* or re-design*
34. ergonomic*
35. self help or selfhelp
36. self schedul* or self roster*
37. coping or cope*
38. counsel*
39. empower*
40. circadian
41. phototherap*
42. light treatment or light therap*
43. melatonin*
44. (structur* or organis* or organiz* or management or managerial) near3 (chang* or modif* or design* or intervention*)
45. (structur* or organis* or organiz* or management or managerial) near3 (impact* or alter* or adapt* or measure* or strateg*)
46. (structur* or organis* or organiz* or management or managerial) near3 (reduc* or increas* or particip* or educat* or train* or program*)
47. (shift* or work* or hour*) near3 (chang* or modif* or design* or intervention*)
48. (shift* or work* or hour*) near3 (impact* or alter* or adapt* or measure* or manag* or strateg*)
49. (shift* or work* or hour*) near3 (reduc* or increas* or particip* or educat* or train* or program*)
50. #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #48 or #49
51. #20 and #50

**SIGLE (System for Information on Grey Literature in Europe) (1980-2005/03)
(WebSPIRS)**

Searched 21/11/05.

86 records retrieved

1. shiftwork*
2. nightwork*
3. (shift or shifts) near2 (work* or night*)
4. night* near2 work*
5. nightshift*
6. (shift or shifts) near2 (rota* or system or systems or schedule* or roster*)
7. (shift or shifts) near2 (extend* or pattern* or cycle*)
8. (shift or shifts) near2 (evening or late or early or weekend or twilight)
9. (hour* shift) or (hour* shifts)
10. (shift or shifts) near2 (continental or continuous or turnaround or split)
11. (nonstandard or non-standard) near2 (work* or shift or shifts)
12. (unsocia* or antisocia* or anti-socia*) near2 (work* or shift or shifts)
13. irregular* near2 (work* or shift or shifts)
14. compressed work*
15. long work* hour*
16. extend* near (duty or duties or work*) near hour*

17. overtime
18. flextime or flex time or flexitime or flexi time
19. flex* work*
20. #1 or #2 or #3 or #4 or #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
21. legislat*
22. law or laws
23. work* time directive
24. (eu or europe*) near3 work*
25. (european commission) or (european union)
26. bright light*
27. nap or naps or napped or napping
28. clockwise
29. reorganis* or reorganiz* or re-organis* or re-organiz*
30. restructur* or re-structur*
31. entrain* or re-entrain*
32. countermeasure* or surveillance
33. reschedul* or re-schedul* or redesign* or re-design*
34. ergonomic*
35. self help or selfhelp
36. self schedul* or self roster*
37. coping or cope*
38. counsel*
39. empower*
40. circadian
41. phototherap*
42. light treatment or light therap*
43. melatonin*
44. (structur* or organis* or organiz* or management or managerial) near3 (chang* or modif* or design* or intervention*)
45. (structur* or organis* or organiz* or management or managerial) near3 (impact* or alter* or adapt* or measure* or strateg*)
46. (structur* or organis* or organiz* or management or managerial) near3 (reduc* or increas* or particip* or educat* or train* or program*)
47. (shift* or work* or hour*) near3 (chang* or modif* or design* or intervention*)
48. (shift* or work* or hour*) near3 (impact* or alter* or adapt* or measure* or manag* or strateg*)
49. (shift* or work* or hour*) near3 (reduc* or increas* or particip* or educat* or train* or program*)
50. #21 or #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 or #35 or #36 or #37 or #38 or #39 or #40 or #41 or #42 or #43 or #44 or #45 or #46 or #47 or #48 or #49
51. #20 and #50

Social Science Citations Index (1956-2005 November 20th) (ISI Web of Knowledge)

Searched 22/11/05.

3259 records retrieved

1. TS=shiftwork* or TS=nightwork* or TS=nightshift* or TS=compressed work* or TS=long work* hour* or TS=overtime or TS=flextime or TS=flex time or TS=flexitime or TS=flexi time or TS=hour* shift or TS=hour* shifts or TS=flex* work*
2. TS=((shift or shifts) same (work* or night*))
3. TS=(night* same work*)
4. TS=((shift or shifts) same (rota* or system or systems or schedule* or roster* or extend* or pattern* or cycle*))
5. TS=((shift or shifts) same (evening or late or early or weekend or twilight or continental or continuous or turnaround or split))
6. TS=((nonstandard or non-standard or unsocia* or antisocia* or anti-socia* or irregular*) same (work* or shift or shifts))
7. TS=extend* duty hour* or TS=extend* duties hour* or TS=extend* work* hour*
8. #1 or #2 or #3 or #4 or #5 or #6 or #7
9. TS=legislat* or TS=law or TS=laws or TS=work* time directive or TS=european union or TS=european commission or TS=bright light* or TS=nap or TS=naps or TS=napped or TS=napping or TS=clockwise
10. TS=((eu or europe*) same work*)
11. TS=reorganis* or TS=reorganiz* or TS=re-organis* or TS=re-organiz* or TS=restructur* or TS=re-structur* or TS=entrain* or TS=re-entrain* or TS=countermeasure* or TS=surveillance
12. TS=reschedul* or TS=re-schedul* or TS=redesign* or TS=re-design* or TS=ergonomic* or TS=self help or TS=selfhelp or TS=self schedul* or TS=self roster*
13. TS=coping or TS=cope* or TS=counsel* or TS=empower* or TS=circadian or TS=phototherap* or TS=light treatment or TS=light therap* or TS=melatonin*
14. TS=((structur* or organis* or organiz* or management or managerial) same (chang* or modif* or design* or intervention*))
15. TS=((structur* or organis* or organiz* or management or managerial) same (impact* or alter* or adapt* or measure* or strateg*))
16. TS=((structur* or organis* or organiz* or management or managerial) same (reduc* or increas* or particip* or educat* or train* or program*))
17. TS=((shift* or work* or hour*) same (chang* or modif* or design* or intervention*))
18. TS=((shift* or work* or hour*) same (impact* or alter* or adapt* or measure* or manag* or strateg*))
19. TS=((shift* or work* or hour*) same (reduc* or increas* or particip* or educat* or train* or program*))
20. #9 or #10 or #11 or #12 or #13 or #14 or #15 or #16 or #17 or #18 or #19
21. #8 and #20

ASSIA (1987 – to date) (CSA)

Searched 21/11/05.

243 records retrieved

((DE=("shiftwork" or "flexible shiftwork" or "night shifts")) or (kw=shiftwork* or nightwork* or nightshift*) or (kw=((shift or shifts) within 2 (work* or night*))) or (kw=(night* within 2 work*)) or (kw=((shift or shifts) within 2 (rota* or system or systems or schedule* or roster*))) or (kw=((shift or shifts) within 2 (extend* or pattern* or cycle*))) or (kw=((shift or shifts) within 2 (evening or late or early or

weekend or twilight))) or (kw=hour* shift or hour* shifts) or (kw=((shift or shifts) within 2 (continental or continuous or turnaround or split))) or (kw=((nonstandard or non-standard) within 2 (work* or shift or shifts))) or (kw=((unsocia* or antisocia* or anti-socia*) within 2 (work* or shift or shifts))) or (kw=(irregular* within 2 (work* or shift or shifts))) or (kw=compressed work* or long work* hour*) or (kw=extend* duty hour* or extend* duties hour* or extend* work* hour*) or (kw=overtime or flextime or flex time or flexitime or flexi time or flex* work*) or (DE="flexitime")) and ((DE=("legislation" or "acts of congress" or "acts of parliament" or "emergency legislation" or "parliamentary bills" or "retrospective legislation")) or (DE=("european union" or "common agricultural policy" or "european commission"))) or (kw=legislat* or law or laws or work* time directive or european commission or european union) or (kw=((eu or europe*) within 3 work*)) or (DE="nap therapy") or (kw=bright light* or nap or naps or napped or napping or clockwise) or (DE=("reorganization" or "social reorganization")) or (DE=("restructuring" or "economic restructuring" or "employment restructuring" or "downsizing")) or (DE="organizational change") or (kw=reorganis* or reorganiz* or re-organis* or re-organiz* or restructur* or re-structur* or entrain* or re-entrain*) or (DE="countermeasures") or (DE=("surveillance" or "aerial surveillance")) or (DE=("ergonomics" or "heat stress" or "time study" or "activity sampling")) or (kw=countermeasure* or surveillance or reschedul* or re-schedul* or redesign* or re-design* or ergonomic*) or (DE="selfhelp") or (kw=self help or selfhelp or self schedul* or self roster*) or (DE=("cognitive coping" or "emotional coping")) or (DE=("coping skills" or "coping strategies" or "coping style")) or (DE=("cognitive behavioural counselling" or "computer assisted counselling" or "crosscultural counselling" or "educational guidance" or "group counselling" or "long term counselling" or "mandatory counselling" or "multicultural counselling" or "pastoral counselling" or "peer group counselling" or "selfcounselling" or "vocational counselling")) or (DE=("empowerment" or "disempowerment" or "psychological empowerment" or "selfempowerment")) or (kw=coping or cope* or counsel* or empower*) or (DE="circadian rhythms") or (DE="phototherapy") or (DE="melatonin") or (kw=circadian or phototherap* or light treatment or light therap* or melatonin*) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (chang* or modif* or design* or intervention*))) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (impact* or alter* or adapt* or measure* or strateg*))) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (reduc* or increas* or particip* or educat* or train* or program*))) or (kw=((shift* or work* or hour*) within 3 (chang* or modif* or design* or intervention*))) or (kw=((shift* or work* or hour*) within 3 (impact* or alter* or adapt* or measure* or manag* or strateg*))) or (kw=((shift* or work* or hour*) within 3 (reduc* or increas* or particip* or educat* or train* or program*)))

Sociological Abstracts (1963 – to date) (CSA)

Searched 21/11/05.

678 records retrieved

((DE="shift work") or (kw=shiftwork* or nightwork* or nightshift*) or (kw=((shift or shifts) within 2 (work* or night*))) or (kw=(night* within 2 work*)) or (kw=((shift or shifts) within 2 (rota* or system or systems or schedule* or roster*))) or (kw=((shift or shifts) within 2 (extend* or pattern* or cycle*))) or (kw=((shift or shifts) within 2 (evening or late or early or weekend or twilight))) or (kw=hour* shift or hour* shifts)

or (kw=((shift or shifts) within 2 (continental or continuous or turnaround or split))) or (kw=((nonstandard or non-standard) within 2 (work* or shift or shifts))) or (kw=((unsocia* or antisocia* or anti-socia*) within 2 (work* or shift or shifts))) or (kw=(irregular* within 2 (work* or shift or shifts))) or (kw=compressed work* or long work* hour*) or (kw=extend* duty hour* or extend* duties hour* or extend* work* hour*) or (kw=overtime or flextime or flex time or flexitime or flexi time or flex* work*) and ((DE=("legislation" or "statutes")) or (DE="legislative bodies")) or (kw=legislat* or law or laws or work* time directive or european commission or european union) or (kw=((eu or europe*) within 3 work*)) or (DE="european union")) or (kw=bright light* or nap or naps or napped or napping or clockwise) or (kw=reorganis* or reorganiz* or re-organis* or re-organiz* or restructur* or re-structur* or entrain* or re-entrain*) or (DE="organizational change") or (kw=countermeasure* or surveillance or reschedul* or re-schedul* or redesign* or re-design* or ergonomic*) or (DE="surveillance") or (kw=self help or selfhelp or self schedul* or self roster*) or (DE="self help") or (kw=coping or cope* or counsel* or empower*) or (DE="coping") or (DE="counseling") or (kw=circadian or phototherap* or light treatment or light therap* or melatonin*) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (chang* or modif* or design* or intervention*))) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (impact* or alter* or adapt* or measure* or strateg*))) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (reduc* or increas* or particip* or educat* or train* or program*)) or (kw=((shift* or work* or hour*) within 3 (chang* or modif* or design* or intervention*))) or (kw=((shift* or work* or hour*) within 3 (impact* or alter* or adapt* or measure* or manag* or strateg*))) or (kw=((shift* or work* or hour*) within 3 (reduc* or increas* or particip* or educat* or train* or program*))))

ERIC (1966 – to date) (CSA)

Searched 21/11/05.

551 records retrieved

((kw=shiftwork* or nightwork* or nightshift*) or (kw=((shift or shifts) within 2 (work* or night*))) or (kw=(night* within 2 work*)) or (kw=((shift or shifts) within 2 (rota* or system or systems or schedule* or roster*))) or (kw=((shift or shifts) within 2 (extend* or pattern* or cycle*))) or (kw=((shift or shifts) within 2 (evening or late or early or weekend or twilight))) or (kw=hour* shift or hour* shifts) or (kw=((shift or shifts) within 2 (continental or continuous or turnaround or split))) or (kw=((nonstandard or non-standard) within 2 (work* or shift or shifts))) or (kw=((unsocia* or antisocia* or anti-socia*) within 2 (work* or shift or shifts))) or (kw=(irregular* within 2 (work* or shift or shifts))) or (kw=compressed work* or long work* hour*) or (kw=extend* duty hour* or extend* duties hour* or extend* work* hour*) or (kw=overtime or flextime or flex time or flexitime or flexi time or flex* work*) or (DE="overtime") or (DE="flexible working hours")) and ((DE=("legislation" or "labor legislation" or "local legislation" or "public health legislation" or "state legislation")) or (kw=legislat* or law or laws or work* time directive or european commission or european union) or (kw=((eu or europe*) within 3 work*)) or (kw=bright light* or nap or naps or napped or napping or clockwise) or (DE="program development") or (kw=reorganis* or reorganiz* or re-organis* or re-organiz* or restructur* or re-structur* or entrain* or re-entrain*) or (kw=countermeasure* or surveillance or reschedul* or re-schedul* or redesign* or re-

design* or ergonomic*) or (kw=self help or selfhelp or self schedul* or self roster*) or (DE="program development") or (kw=coping or cope* or counsel* or empower*) or (DE="program development") or (DE=("adult counseling" or "career counseling" or "cocounseling" or "educational counseling" or "family counseling" or "group counseling" or "individual counseling" or "nondirective counseling" or "peer counseling")) or (kw=circadian or phototherap* or light treatment or light therap* or melatonin*) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (chang* or modif* or design* or intervention*))) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (impact* or alter* or adapt* or measure* or strateg*))) or (kw=((structur* or organis* or organiz* or management or managerial) within 3 (reduc* or increas* or particip* or educat* or train* or program*))) or (kw=((shift* or work* or hour*) within 3 (chang* or modif* or design* or intervention*))) or (kw=((shift* or work* or hour*) within 3 (impact* or alter* or adapt* or measure* or manag* or strateg*))) or (kw=((shift* or work* or hour*) within 3 (reduc* or increas* or particip* or educat* or train* or program*)))

Geobase (1980-16/11/05) (OCLC)

Searched 21/11/05.

1241 records retrieved

(kw: shiftwork* or kw: nightwork* or kw: nightshift*) or ((kw: shift* n2 work) or (kw: shift* n2 work) or (kw: shift* n2 works) or (kw: shift* n2 works) or (kw: shift* n2 working) or (kw: shift* n2 worker*)) or ((kw: shift* n2 night*) or (kw: night* n2 work) or (kw: night* n2 works) or (kw: night* n2 worke*) or (kw: night* n2 working)) or ((kw: shift* n2 rota*) or (kw: shift* n2 system) or (kw: shift* n2 systems) or (kw: shift* n2 schedule*) or (kw: shift* n2 roster*)) or ((kw: shift* n2 extend*) or (kw: shift* n2 pattern*) or (kw: shift* n2 cycle*)) or ((kw: shift* n2 evening) or (kw: shift* n2 late) or (kw: shift* n2 early) or (kw: shift* n2 weekend) or (kw: shift* n2 twilight)) or ((kw: hour* n shift) or (kw: hour* n shifts)) or ((kw: shift* n2 continental) or (kw: shift* n2 continuous) or (kw: shift* n2 turnaround) or (kw: shift* n2 split)) or ((kw: shift* n2 nonstandard) or (kw: shift* n2 non-standard)) or ((kw: nonstandard n2 working) or (kw: non-standard n2 working) or (kw: unsocial n2 working) or (kw: antisocial n2 working) or (kw: anti-social n2 working)) or ((kw: antisocial n2 working) or (kw: anti-social n2 working) or (kw: antisocial n2 work) or (kw: anti-social n2 work) or (kw: antisocial n2 works) or (kw: anti-social n2 works)) or ((kw: unsocia* n2 shift*) or (kw: antisocia* n2 shift*) or (kw: anti-socia* n2 shift*)) or ((kw: irregular* n2 shift*) or (kw: irregular n2 work) or (kw: irregular n2 working)) or ((kw: compressed n work) or (kw: compressed n working)) or ((kw: long n work n hour*) or (kw: long n working n hour*)) or ((kw: extended n duty n hour*) or (kw: extended n work n hours*)) or (kw: overtime or kw: flexitime or (kw: flex n time) or kw: flexitime or (kw: flexi n time)) or ((kw: flex* n work) or (kw: flex* n working)) and ((kw: legislat* or kw: law or kw: laws) or (kw: working n time n directive) or ((kw: eu n3 work) or (kw: eu n3 working) or (kw: europe n3 work) or (kw: europe n3 working)) or ((kw: european n commission) or (kw: european n union)) or ((kw: bright n light) or (kw: bright n lights) or (kw: bright n lighting)) or (kw: nap or kw: naps or kw: napped or kw: napping or kw: clockwise) or (kw: reorganis* or kw: reorganiz* or kw: re-organis* or kw: re-organiz*) or (kw: restructur* or kw: re-structur* or kw: entrain* or kw: re-entrain*) or (kw: countermeasure* or kw: surveillance or kw: ergonomic*) or (kw: reschedul* or kw:

re-schedul* or kw: redesign* or kw: re-design*) or ((kw: self n help) or kw: selfhelp or (kw: self n schedul* or (kw: self n roster*)) or (kw: coping or kw: cope* or kw: counsel* or kw: empower*) or (kw: circadian or kw: phototherap* or (kw: light n treatment) or (kw: light n therap*) or kw: melatonin*) or (kw: chang* or kw: modif* or kw: design* or kw: intervention* or kw: impact* or kw: alter* or kw: adapt* or kw: measure* or kw: manag* or kw: strateg* or kw: reduc* or kw: increas* or kw: particip* or kw: educat* or kw: train* or kw: program*))

Electronic Collections Online (1995-18/11/05) (OCLC)

Searched 21/11/05.

1822 records retrieved

(kw: shiftwork* or kw: nightwork* or kw: nightshift*) or ((kw: shift* n2 work) or (kw: shift* n2 work) or (kw: shift* n2 works) or (kw: shift* n2 works) or (kw: shift* n2 working) or (kw: shift* n2 worker*)) or ((kw: shift* n2 night*) or (kw: night* n2 work) or (kw: night* n2 works) or (kw: night* n2 worke*) or (kw: night* n2 working)) or ((kw: shift* n2 rota*) or (kw: shift* n2 system) or (kw: shift* n2 systems) or (kw: shift* n2 schedule*) or (kw: shift* n2 roster*)) or ((kw: shift* n2 extend*) or (kw: shift* n2 pattern*) or (kw: shift* n2 cycle*)) or ((kw: shift* n2 evening) or (kw: shift* n2 late) or (kw: shift* n2 early) or (kw: shift* n2 weekend) or (kw: shift* n2 twilight)) or ((kw: hour* n shift) or (kw: hour* n shifts)) or ((kw: shift* n2 continental) or (kw: shift* n2 continuous) or (kw: shift* n2 turnaround) or (kw: shift* n2 split)) or ((kw: shift* n2 nonstandard) or (kw: shift* n2 non-standard)) or ((kw: nonstandard n2 working) or (kw: non-standard n2 working) or (kw: unsocial n2 working) or (kw: antisocial n2 working) or (kw: anti-social n2 working)) or ((kw: antisocial n2 working) or (kw: anti-social n2 working) or (kw: antisocial n2 work) or (kw: anti-social n2 work) or (kw: antisocial n2 works) or (kw: anti-social n2 works)) or ((kw: unsocia* n2 shift*) or (kw: antisocia* n2 shift*) or (kw: anti-socia* n2 shift*)) or ((kw: irregular* n2 shift*) or (kw: irregular n2 work) or (kw: irregular n2 working)) or ((kw: compressed n work) or (kw: compressed n working)) or ((kw: long n work n hour*) or (kw: long n working n hour*)) or ((kw: extended n duty n hour*) or (kw: extended n work n hours*)) or (kw: overtime or kw: flexitime or (kw: flex n time) or kw: flexitime or (kw: flexi n time)) or ((kw: flex* n work) or (kw: flex* n working)) and ((kw: legislat* or kw: law or kw: laws) or (kw: working n time n directive) or ((kw: eu n3 work) or (kw: eu n3 working) or (kw: europe n3 work) or (kw: europe n3 working)) or ((kw: european n commission) or (kw: european n union)) or ((kw: bright n light) or (kw: bright n lights) or (kw: bright n lighting)) or (kw: nap or kw: naps or kw: napped or kw: napping or kw: clockwise) or (kw: reorganis* or kw: reorganiz* or kw: re-organis* or kw: re-organiz*) or (kw: restructur* or kw: re-structur* or kw: entrain* or kw: re-entrain*) or (kw: countermeasure* or kw: surveillance or kw: ergonomic*) or (kw: reschedul* or kw: re-schedul* or kw: redesign* or kw: re-design*) or ((kw: self n help) or kw: selfhelp or (kw: self n schedul* or (kw: self n roster*)) or (kw: coping or kw: cope* or kw: counsel* or kw: empower*) or (kw: circadian or kw: phototherap* or (kw: light n treatment) or (kw: light n therap*) or kw: melatonin*) or (kw: chang* or kw: modif* or kw: design* or kw: intervention* or kw: impact* or kw: alter* or kw: adapt* or kw: measure* or kw: manag* or kw: strateg* or kw: reduc* or kw: increas* or kw: particip* or kw: educat* or kw: train* or kw: program*))

PapersFirst (1993-19/11/05) (OCLC)

Searched 21/11/05.

281 records retrieved

(kw: shiftwork* or kw: nightwork* or kw: nightshift*) or ((kw: shift* n2 work) or (kw: shift* n2 work) or (kw: shift* n2 works) or (kw: shift* n2 works) or (kw: shift* n2 working) or (kw: shift* n2 worker*)) or ((kw: shift* n2 night*) or (kw: night* n2 work) or (kw: night* n2 works) or (kw: night* n2 worke*) or (kw: night* n2 working)) or ((kw: shift* n2 rota*) or (kw: shift* n2 system) or (kw: shift* n2 systems) or (kw: shift* n2 schedule*) or (kw: shift* n2 roster*)) or ((kw: shift* n2 extend*) or (kw: shift* n2 pattern*) or (kw: shift* n2 cycle*)) or ((kw: shift* n2 evening) or (kw: shift* n2 late) or (kw: shift* n2 early) or (kw: shift* n2 weekend) or (kw: shift* n2 twilight)) or ((kw: hour* n shift) or (kw: hour* n shifts)) or ((kw: shift* n2 continental) or (kw: shift* n2 continuous) or (kw: shift* n2 turnaround) or (kw: shift* n2 split)) or ((kw: shift* n2 nonstandard) or (kw: shift* n2 non-standard)) or ((kw: nonstandard n2 working) or (kw: non-standard n2 working) or (kw: unsocial n2 working) or (kw: antisocial n2 working) or (kw: anti-social n2 working)) or ((kw: antisocial n2 working) or (kw: anti-social n2 working) or (kw: antisocial n2 work) or (kw: anti-social n2 work) or (kw: antisocial n2 works) or (kw: anti-social n2 works)) or ((kw: unsocia* n2 shift*) or (kw: antisocia* n2 shift*) or (kw: anti-socia* n2 shift*)) or ((kw: irregular* n2 shift*) or (kw: irregular n2 work) or (kw: irregular n2 working)) or ((kw: compressed n work) or (kw: compressed n working)) or ((kw: long n work n hour*) or (kw: long n working n hour*)) or ((kw: extended n duty n hour*) or (kw: extended n work n hours*)) or (kw: overtime or kw: flexitime or (kw: flex n time) or kw: flexitime or (kw: flexi n time)) or ((kw: flex* n work) or (kw: flex* n working)) and ((kw: legislat* or kw: law or kw: laws) or (kw: working n time n directive) or ((kw: eu n3 work) or (kw: eu n3 working) or (kw: europe n3 work) or (kw: europe n3 working)) or ((kw: european n commission) or (kw: european n union)) or ((kw: bright n light) or (kw: bright n lights) or (kw: bright n lighting)) or (kw: nap or kw: naps or kw: napped or kw: napping or kw: clockwise) or (kw: reorganis* or kw: reorganiz* or kw: re-organis* or kw: re-organiz*) or (kw: restructur* or kw: re-structur* or kw: entrain* or kw: re-entrain*) or (kw: countermeasure* or kw: surveillance or kw: ergonomic*) or (kw: reschedul* or kw: re-schedul* or kw: redesign* or kw: re-design*) or ((kw: self n help) or kw: selfhelp or (kw: self n schedul*) or (kw: self n roster*)) or (kw: coping or kw: cope* or kw: counsel* or kw: empower*) or (kw: circadian or kw: phototherap* or (kw: light n treatment) or (kw: light n therap*) or kw: melatonin*) or (kw: chang* or kw: modif* or kw: design* or kw: intervention* or kw: impact* or kw: alter* or kw: adapt* or kw: measure* or kw: manag* or kw: strateg* or kw: reduc* or kw: increas* or kw: particip* or kw: educat* or kw: train* or kw: program*))).

Management Contents (1983-2005/Nov 22) (Dialog)

Searched 24/11/05.

317 records retrieved

S1 SHIFTWORK?/TI,AB
 S2 NIGHTWORK?/TI,AB
 S3 ((SHIFT OR SHIFTS)(2N)(WORK? OR NIGHT?))/TI,AB
 S4 (NIGHT?(2N)WORK?)/TI,AB
 S5 NIGHTSHIFT?/TI,AB

- S6 ((SHIFT OR SHIFTS)(2N)(ROTA? OR SYSTEM OR SYSTEMS OR SCHEDULE? OR ROSTER?))/TI,AB
- S7 ((SHIFT OR SHIFTS)(2N)(EXTEND? OR PATTERN? OR CYCLE?))/TI,AB
- S8 ((SHIFT OR SHIFTS)(2N)(EVENING OR LATE OR EARLY OR WEEKEND OR TWILIGHT))/TI,AB
- S9 ((HOUR?(W)SHIFT) OR (HOUR?(W)SHIFTS))/TI,AB
- S10 ((SHIFT OR SHIFTS)(2N)(CONTINENTAL OR CONTINUOUS OR TURNAROUND OR SPLIT))/TI,AB
- S11 ((NONSTANDARD OR NON-STANDARD)(2N)(WORK? OR SHIFT OR SHIFTS))/TI,AB
- S12 ((UNSOCIA? OR ANTISOCIA? OR ANTI-SOCIA?)(2N)(WORK? OR SHIFT OR SHIFTS))/TI,AB
- S13 (IRREGULAR?(2N)(WORK? OR SHIFT OR SHIFTS))/TI,AB
- S14 COMPRESSED(W)WORK?/TI,AB
- S15 LONG(W)WORK?(W)HOUR?/TI,AB
- S16 ((EXTEND?(W)DUTY(W)HOUR?) OR (EXTEND?(W)DUTIES(W)HOUR?) OR (EXTEND?(W)WORK?(W)HOUR?))/TI,AB
- S17 OVERTIME/TI,AB
- S18 (FLEXTIME OR FLEX TIME OR FLEXITIME OR FLEXI TIME)/TI,AB
- S19 FLEX?(W)WORK?/TI,AB
- S20 S1:S19
- S21 LEGISLAT?/TI,AB
- S22 (LAW OR LAWS)/TI,AB
- S23 WORK?(W)TIME(W)DIRECTIVE/TI,AB
- S24 ((EU OR EUROPE?)(3N)WORK?)/TI,AB
- S25 ((EUROPEAN(W)COMMISSION) OR (EUROPEAN(W)UNION))/TI,AB
- S26 BRIGHT(W)LIGHT?/TI,AB
- S27 (NAP OR NAPS OR NAPPED OR NAPPING)/TI,AB
- S28 CLOCKWISE/TI,AB
- S29 (REORGANIS? OR REORGANIZ? OR RE(W)ORGANIS? OR RE(W)ORGANIZ?)/TI,AB
- S30 (RESTRUCTUR? OR RE(W)STRUCTUR?)/TI,AB
- S31 (ENTRAIN? OR RE(W)ENTRAIN?)/TI,AB
- S32 (COUNTERMEASURE? OR SURVEILLANCE)/TI,AB
- S33 (RESCHEDUL? OR RE(W)SCHEDUL? OR REDESIGN? OR RE(W)DESIGN?)/TI,AB
- S34 ERGONOMIC?/TI,AB
- S35 (SELF(W)HELP OR SELFHELP)/TI,AB
- S36 (SELF(W)SCHEDUL? OR SELF(W)ROSTER?)/TI,AB
- S37 (COPING OR COPE?)/TI,AB
- S38 COUNSEL?/TI,AB
- S39 EMPOWER?/TI,AB
- S40 CIRCADIAN/TI,AB
- S41 PHOTOTHERAP?/TI,AB
- S42 (LIGHT(W)TREATMENT OR LIGHT(W)THERAP?)/TI,AB
- S43 MELATONIN?/TI,AB

- S44 ((STRUCTUR? OR ORGANIS? OR ORGANIZ? OR MANAGEMENT OR
MANAGERIAL)(3N)(CHANG? OR MODIF? OR DESIGN? OR
INTERVENTION?))/TI,AB
- S45 ((STRUCTUR? OR ORGANIS? OR ORGANIZ? OR MANAGEMENT OR
MANAGERIAL)(3N)(IMPACT? OR ALTER? OR ADAPT? OR
MEASURE? OR STRATEG?))/TI,AB
- S46 ((STRUCTUR? OR ORGANIS? OR ORGANIZ? OR MANAGEMENT OR
MANAGERIAL)(3N)(REDUC? OR INCREAS? OR PARTICIP? OR
EDUCAT? OR TRAIN? OR PROGRAM?))/TI,AB
- S47 ((SHIFT? OR WORK? OR HOUR?)(3N)(CHANG? OR MODIF? OR
DESIGN? OR INTERVENTION?))/TI,AB
- S48 ((SHIFT? OR WORK? OR HOUR?)(3N)(IMPACT? OR ALTER? OR
ADAPT? OR MEASURE? OR MANAG? OR STRATEG?))/TI,AB
- S49 ((SHIFT? OR WORK? OR HOUR?)(3N)(REDUC? OR INCREAS? OR
PARTICIP? OR EDUCAT? OR TRAIN? OR PROGRAM?))/TI,AB
- S50 S21:S49
- S51 S20 AND S50

For all of the following databases/websites, the unsophisticated search interfaces made it impractical or impossible to combine lines of search terminology, therefore the sole concept of shiftwork was searched.

Index to Theses (1716-9/11/05) (<http://www.theses.com/>)

Searched 28/11/05.

29 records retrieved

[Results scanned as database does not allow automatic download of material].

1. ti contains (shiftwork* or nightwork* or nightshift* or compressed work* or long work* hour* or overtime)
2. ti contains (flextime or flex time or flexitime or flexi time or hour* shift or hour* shifts)
3. ti contains (flex* work* or shift work* or shifts work* or night* shift or night shifts or night* work*)
4. ti contains (rota* shift* or shift* system or shift* systems or shift* schedule* or shift* roster* or extend* shift*)
5. ti contains (shift* pattern* or shift* cycle* or evening shift* or late shift* or early shift* or weekend shift*)
6. ti contains (twilight shift* or continental shift* or continuous shift* or shift* turnaround or split shift* or nonstandard work*)
7. ti contains (nonstandard shift* or non-standard work* or non-standard shift* or unsocia* work* or unsocia* shift* or antisocia* work*)
8. ti contains (antisocia* shift* or anti-socia* work* or anti-socia* shift*)
9. ti contains (irregular* work* or irregular shift* or extend* duty hour* or extend* duties hour* or extend* work* hour*)

Dissertation Abstracts (1861-to date) (UMI Proquest)

Searched 28/11/05.

194 records retrieved

1. TI(irregular? work?) or TI(irregular shift?) or TI(extend? duty hour?) or TI(extend? duties hour?) or TI(extend? work? hour?)
2. TI(antisocia? shift?) or TI(anti-socia? work?) or TI(anti-socia? shift?)
3. TI(nonstandard shift?) or TI(non-standard work?) or TI(non-standard shift?) or TI(unsocia? work?) or TI(unsocia? shift?) or TI(antisocia? work?)
4. TI(twilight shift?) or TI(continental shift?) or TI(continuous shift?) or TI(shift? turnaround) or TI(split shift?) or TI(nonstandard work?)
5. TI(shift? pattern?) or TI(shift? cycle?) or TI(evening shift?) or TI(late shift?) or TI(early shift?) or TI(weekend shift?)
6. TI(rota? shift?) or TI(shift? system) or TI(shift? systems) or TI(shift? schedule?) or TI(shift? roster?) or TI(extend? shift?)
7. TI(flex? work?) or TI(shift work?) or TI(shifts work?) or TI(night? shift) or TI(night shifts) or TI(night? work?)
8. TI(flextime) or TI(flex time) or TI(flexitime) or TI(flexi time) or TI(hour? shift) or TI(hour? shifts)
9. TI(shiftwork?) or TI(nightwork?) or TI(nightshift?) or TI(compressed work?) or TI(long work? hour?) or TI(overtime)

JSTOR (last updated 17/11/05) (JSTOR)

Searched 23/11/05.

81 records retrieved

(ti:(shiftwork??? OR nightwork??? OR nightshift??? OR "shift work" OR "shift working" OR "shift worker" OR "shift workers" OR "night shift" OR "night shifts" OR "night work" OR "night working" OR "night worker" OR "night workers" OR "rotating shift" OR "rotating shifts" OR "shift system" OR "shift systems" OR "shifts system" OR "shifts systems" OR "shift schedule" OR "shifts schedule" OR "shift schedules" OR "shifts schedules" OR "shift scheduling" OR "shifts scheduling" OR "shift roster" OR "shifts roster" OR "shift rosters" OR "shifts rosters" OR "shift rostering" OR "shifts rostering" OR "extended shift" OR "extended shifts" OR "shift pattern" OR "shift patterns" OR "shifts pattern" OR "shifts patterns" OR "shift cycle" OR "shift cycles" OR "shifts cycle" OR "shifts cycles" OR "evening shift" OR "evening shifts" OR "late shift" OR "late shifts" OR "early shift" OR "early shifts" OR "weekend shift" OR "weekend shifts" OR "twilight shift" OR "twilight shifts" OR "continental shift" OR "continental shifts" OR "continuous shift" OR "continuous shifts" OR "turnaround shift" OR "turnaround shifts" OR "split shift" OR "split shifts" OR "nonstandard shift" OR "nonstandard shifts" OR "non standard shift" OR "non standard shifts" OR "unsociable shift" OR "unsociable shifts" OR "antisocial shift" OR "antisocial shifts" OR "anti social shift" OR "anti social shifts" OR "irregular shift" OR "irregular shifts") OR ab:(shiftwork??? OR nightwork??? OR nightshift??? OR "shift work" OR "shift working" OR "shift worker" OR "shift workers" OR "night shift" OR "night shifts" OR "night work" OR "night working" OR "night worker" OR "night workers" OR "rotating shift" OR "rotating shifts" OR "shift system" OR "shift systems" OR "shifts system" OR "shifts systems" OR "shift schedule" OR "shifts schedule" OR "shift schedules" OR "shifts schedules" OR "shift scheduling" OR "shifts scheduling" OR "shift roster" OR "shifts roster" OR "shift rosters" OR "shifts rosters" OR "shift rostering" OR "shifts rostering" OR "extended shift" OR "extended shifts" OR "shift pattern" OR "shift patterns" OR "shifts pattern" OR "shifts patterns" OR "shift cycle" OR "shift cycles" OR "shifts cycle" OR "shifts cycles" OR "evening shift" OR "evening shifts" OR "late shift" OR "late shifts" OR "early shift" OR "early

shifts" OR "weekend shift" OR "weekend shifts" OR "twilight shift" OR "twilight shifts" OR "continental shift" OR "continental shifts" OR "continuous shift" OR "continuous shifts" OR "turnaround shift" OR "turnaround shifts" OR "split shift" OR "split shifts" OR "nonstandard shift" OR "nonstandard shifts" OR "non standard shift" OR "non standard shifts" OR "unsociable shift" OR "unsociable shifts" OR "antisocial shift" OR "antisocial shifts" OR "anti social shift" OR "anti social shifts" OR "irregular shift" OR "irregular shifts")) AND ty:FLA

CORDIS (Community Research & Development Information Service)

(<http://www.cordis.lu/en/home.html>)

Searched 28/11/05.

2 records retrieved

[Results scanned as database does not allow automatic download of material].

1. shiftwork* or nightwork* or nightshift* or overtime or flextime or flexitime
2. "night work" or "night working" or "night worker" or "night workers" or "working nights"
3. "long work hours" or "long working hours" or "compressed work" or "compressed working"
4. "extended duty hours" or "extended work hours" or "irregular work" or "irregular working" or "nonstandard working" or "non standard working"
5. "shift work" or "shift working" or "shift worker" or "shift workers" or "working shifts"
6. "night shift" or "night shifts" or "rotating shift" or "rotating shifts"
7. "shift system" or "shift systems" or "shifts system" or "shifts systems" or "shift schedule" or "shifts schedule" or "shift schedules" or "shifts schedules" or "shift scheduling" or "shifts scheduling"
8. "shift roster" or "shifts roster" or "shift rosters" or "shifts rosters" or "shift rostering" or "shifts rostering" or "extended shift" or "extended shifts"
9. "shift pattern" or "shift patterns" or "shifts pattern" or "shifts patterns" or "shift cycle" or "shift cycles" or "shifts cycle" or "shifts cycles"
10. "evening shift" or "evening shifts" or "late shift" or "late shifts" or "early shift" or "early shifts" or "weekend shift" or "weekend shifts"
11. "twilight shift" or "twilight shifts" or "hour shift" or "hour shifts" or "hours shift" or "hours shifts"
12. "continental shift" or "continental shifts" or "continuous shift" or "continuous shifts" or "turnaround shift" or "turnaround shifts" or "split shift" or "split shifts"
13. "nonstandard shift" or "nonstandard shifts" or "non standard shift" or "non standard shifts" or "unsociable shift" or "unsociable shifts" or "antisocial shift" or "antisocial shifts" or "anti social shift" or "anti social shifts"
14. "irregular shift" or "irregular shifts" or "flex time" or "flexi time"

ESRC (Economic & Social Research Council)

(<http://www.regard.ac.uk/ESRCInfoCentre/index.aspx>)

Searched 29/11/05.

8 records retrieved

[Results scanned as website does not allow automatic download of material].

1. shiftwork or shiftworker or shiftworkers or shiftworking or nightwork or nightworker or nightworkers or nightworking or nightshift or nightshifts or overtime or flexitime or flexitime
2. "night work" or "night working" or "night worker" or "night workers" or "working nights"
3. "long work hours" or "long working hours" or "compressed work" or "compressed working"
4. "extended duty hours" or "extended work hours" or "irregular work" or "irregular working" or "nonstandard working" or "non standard working"
5. "shift work" or "shift working" or "shift worker" or "shift workers" or "working shifts"
6. "night shift" or "night shifts" or "rotating shift" or "rotating shifts"
7. "shift system" or "shift systems" or "shifts system" or "shifts systems" or "shift schedule" or "shifts schedule" or "shift schedules" or "shifts schedules" or "shift scheduling" or "shifts scheduling"
8. "shift roster" or "shifts roster" or "shift rosters" or "shifts rosters" or "shift rostering" or "shifts rostering" or "extended shift" or "extended shifts"
9. "shift pattern" or "shift patterns" or "shifts pattern" or "shifts patterns" or "shift cycle" or "shift cycles" or "shifts cycle" or "shifts cycles"
10. "evening shift" or "evening shifts" or "late shift" or "late shifts" or "early shift" or "early shifts" or "weekend shift" or "weekend shifts"
11. "twilight shift" or "twilight shifts" or "hour shift" or "hour shifts" or "hours shift" or "hours shifts" or "continental shift" or "continental shifts" or "continuous shift" or "continuous shifts" or "turnaround shift" or "turnaround shifts" or "split shift" or "split shifts"
12. "nonstandard shift" or "nonstandard shifts" or "non standard shift" or "non standard shifts" or "unsociable shift" or "unsociable shifts" or "antisocial shift" or "antisocial shifts" or "anti social shift" or "anti social shifts" or "irregular shift" or "irregular shifts" or "flex time" or "flexi time"

EconPapers (<http://econpapers.repec.org/>)

Searched 29/11/05.

6 records retrieved

[Results scanned as database does not allow automatic download of material].

1. shiftwork* or nightwork* or nightshift*
2. overtime or flexitime or flexitime
3. "night work" or "night working" or "night worker" or "night workers" or "working nights"
4. "long work hours" or "long working hours" or "compressed work" or "compressed working"
5. "extended duty hours" or "extended work hours" or "irregular work" or "irregular working" or "nonstandard working" or "non standard working"
6. "shift work" or "shift working" or "shift worker" or "shift workers" or "working shifts"
7. "night shift" or "night shifts" or "rotating shift" or "rotating shifts"
8. "shift system" or "shift systems" or "shifts system" or "shifts systems" or "shift schedule" or "shifts schedule" or "shift schedules" or "shifts schedules" or "shift scheduling" or "shifts scheduling"

9. "shift roster" or "shifts roster" or "shift rosters" or "shifts rosters" or "shift rostering" or "shifts rostering" or "extended shift" or "extended shifts"
10. "shift pattern" or "shift patterns" or "shifts pattern" or "shifts patterns" or "shift cycle" or "shift cycles" or "shifts cycle" or "shifts cycles"
11. "evening shift" or "evening shifts" or "late shift" or "late shifts" or "early shift" or "early shifts" or "weekend shift" or "weekend shifts"
12. "twilight shift" or "twilight shifts" or "hour shift" or "hour shifts" or "hours shift" or "hours shifts"
13. "continental shift" or "continental shifts" or "continuous shift" or "continuous shifts" or "turnaround shift" or "turnaround shifts" or "split shift" or "split shifts"
14. "nonstandard shift" or "nonstandard shifts" or "non standard shift" or "non standard shifts" or "unsociable shift" or "unsociable shifts" or "antisocial shift" or "antisocial shifts" or "anti social shift" or "anti social shifts"
15. "irregular shift" or "irregular shifts" or "flex time" or "flexi time"

NTIS (National Technical Information Service)

(<http://www.ntis.gov/index.asp?loc=2-0-0>)

Searched 29/11/05.

35 records retrieved

[Results scanned as database does not allow automatic download of material].

1. shiftwork or shiftworker or shiftworkers or shiftworking or nightwork or nightworker or nightworkers or nightworking or nightshift or nightshifts
2. overtime or flextime or flexitime
3. "night work" or "night working" or "night worker" or "night workers" or "working nights"
4. "long work hours" or "long working hours" or "compressed work" or "compressed working"
5. "extended duty hours" or "extended work hours" or "irregular work" or "irregular working" or "nonstandard working" or "non standard working"
6. "shift work" or "shift working" or "shift worker" or "shift workers" or "working shifts"
7. "night shift" or "night shifts" or "rotating shift" or "rotating shifts"
8. "shift system" or "shift systems" or "shifts system" or "shifts systems" or "shift schedule" or "shifts schedule" or "shift schedules" or "shifts schedules" or "shift scheduling" or "shifts scheduling"
9. "shift roster" or "shifts roster" or "shift rosters" or "shifts rosters" or "shift rostering" or "shifts rostering" or "extended shift" or "extended shifts"
10. "shift pattern" or "shift patterns" or "shifts pattern" or "shifts patterns" or "shift cycle" or "shift cycles" or "shifts cycle" or "shifts cycles"
11. "evening shift" or "evening shifts" or "late shift" or "late shifts" or "early shift" or "early shifts" or "weekend shift" or "weekend shifts"
12. "twilight shift" or "twilight shifts" or "hour shift" or "hour shifts" or "hours shift" or "hours shifts" or "continental shift" or "continental shifts" or "continuous shift" or "continuous shifts" or "turnaround shift" or "turnaround shifts" or "split shift" or "split shifts"
13. "nonstandard shift" or "nonstandard shifts" or "non standard shift" or "non standard shifts" or "unsociable shift" or "unsociable shifts" or "antisocial shift" or "antisocial shifts" or "anti social shift" or "anti social shifts" or "irregular shift" or "irregular shifts" or "flex time" or "flexi time"

Harvard Business Review**(<http://harvardbusinessonline.hbsp.harvard.edu/hbrsa/en/archive/archive.jhtml>)****Searched 02/12/05.****2 records retrieved**

[Results scanned as website does not allow automatic download of material].

shiftwork

shiftworker

shiftworkers

shiftworking

nightwork

nightworker

nightworkers

nightworking

nightshift

nightshifts

overtime

flextime

flexitime

"night work" or "night working"

"night worker" or "night workers"

"working nights" or "long work hours"

"long working hours" or "compressed work"

"compressed working" or "extended duty hours"

"extended work hours" or "irregular work"

"irregular working" or "nonstandard working"

"non standard working" or "shift work"

"shift working" or "shift worker"

"shift workers" or "working shifts"

"night shift" or "night shifts"

"rotating shift" or "rotating shifts"

"shift system" or "shift systems"

"shifts system" or "shifts systems"

"shift schedule" or "shifts schedule"

"shift schedules" or "shifts schedules"

"shift scheduling" or "shifts scheduling"

"shift roster" or "shifts roster"

"shift rosters" or "shifts rosters"

"shift rostering" or "shifts rostering"

"extended shift" or "extended shifts"

"shift patterns" or "shifts pattern"

"shifts patterns" or "shift cycle"

"shift cycles" or "shifts cycle"

"shifts cycles" or "shift pattern"

"evening shift" or "evening shifts"

"late shift" or "late shifts"

"early shift" or "early shifts"

"weekend shift" or "weekend shifts"

"twilight shift" or "twilight shifts"

"hour shift" or "hour shifts"
 "hours shift" or "hours shifts"
 "continental shift" or "continental shifts"
 "continuous shift" or "continuous shifts"
 "turnaround shift" or "turnaround shifts"
 "split shift" or "split shifts"
 "nonstandard shift" or "nonstandard shifts"
 "non standard shift" or "non standard shifts"
 "unsociable shift" or "unsociable shifts"
 "antisocial shift" or "antisocial shifts"
 "anti social shift" or "anti social shifts"
 "irregular shift" or "irregular shifts"
 "flex time" or "flexi time"

European Commission Libraries Catalogue (<http://europa.eu.int/eclas/>)

Searched 02/12/05.

259 records retrieved

shiftwork* nightwork* nightshift* overtime flextime flexitime
 night work*
 working nights
 long work* hours
 compressed work*
 extended duty hours
 extended work hours
 irregular work*
 nonstandard working
 non standard working
 shift work*
 working shifts
 night shift
 night shifts
 rotating shift
 rotating shifts
 shift* system
 shift* systems
 shift* schedul*
 shift* roster*
 extended shift
 extended shifts
 shift pattern*
 shifts pattern*
 shift* cycle*
 evening shift*
 late shift*
 early shift*
 weekend shift*
 twilight shift*
 hour shift
 hours shift

hourly shift
 continental shift*
 continuous shift*
 turnaround shift*
 split shift*
 nonstandard shift*
 non standard shift*
 unsociable shift*
 antisocial shift*
 anti social shift*
 irregular shift*
 flex time
 flexi time

Labordoc (<http://labordoc.ilo.org/>)

Searched 02/12/05.

493 records retrieved

[Most terms were searched in keyword, but some were searched in titles only as yield was high and false using keywords.]

shiftwork?
 nightwork?
 nightshift?
 overtime [titles only]
 flextime
 flexitime
 "flex time"
 "flexi time"
 "night work" [titles only]
 "night working"
 "night worker"
 "night workers"
 "working nights"
 "long work hours"
 "long working hours"
 "compressed work"
 "compressed working"
 "extended duty hours"
 "extended work hours"
 "irregular work"
 "irregular working"
 "nonstandard working"
 "non standard working"
 "shift work" [titles only]
 "shift working"
 "shift worker"
 "shift workers"
 "working shifts"
 "night shift"
 "night shifts"

"rotating shift"
"rotating shifts"
"shift system"
"shift systems"
"shifts system"
"shifts systems"
"shift schedule"
"shifts schedule"
"shift schedules"
"shifts schedules"
"shift scheduling"
"shifts scheduling"
"shift roster"
"shifts roster"
"shift rosters"
"shifts rosters"
"shift rostering"
"shifts rostering"
"extended shift"
"extended shifts"
"shift patterns"
"shifts pattern"
"shifts patterns"
"shift cycle"
"shift cycles"
"shifts cycle"
"shifts cycles"
"shift pattern"
"evening shift"
"evening shifts"
"late shift"
"late shifts"
"early shift"
"early shifts"
"weekend shift"
"weekend shifts"
"twilight shift"
"twilight shifts"
"hour shift"
"hour shifts"
"hours shift"
"hours shifts"
"continental shift"
"continental shifts"
"continuous shift"
"continuous shifts"
"turnaround shift"
"turnaround shifts"
"split shift"
"split shifts"

"nonstandard shift"
"nonstandard shifts"
"non standard shift"
"non standard shifts"
"unsociable shift"
"unsociable shifts"
"antisocial shift"
"antisocial shifts"
"anti social shift"
"anti social shifts"
"irregular shift"
"irregular shifts"