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Shiftwork and food consumption

The relationship between composition and intake on health.

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December 2011

Introduction

For more than four decades the influences of shift work on health and eating behavior have been investigated (Debry et al. 1967). In Europe and the United States shift work has increased in the last 50 years and about 20% of the labour force is operating in shift work (Niedhammer, Lert & Marne 1996), which explains the continued interest on shift work and its impact on health. Part of the research on shift work focuses on the relationship between shift work and food intake, food quality and timing of meals. Compared to day workers shift workers have an increased risk for several diseases, such as peptic ulcer disease and coronary heart disease (Karlsson, Knutsson & Lindahl 2001, Knutsson 2003). If and to what extent these increased risk factors are caused by alterations in meal pattern, food quality and total food intake is still unclear, but these factors might have an influence on the increased pathogenesis in shift workers (Lowden et al. 2010).

First the effects of shift work on food intake have to be investigated. When influences of shift work on food intake, meal pattern, etc. are found the possible increase of risk factors caused by food alternations can be examined.

The effects of shift work on food intake and meal composition has already been the focus of a great deal of research (de Assis et al. 2003, Waterhouse et al. 2003, Morikawa et al. 2008, Lennernas, Hambraeus & Akerstedt 1995, Sudo, Ohtsuka 2001). However, there are some limitations to those previously performed investigations. Different shift work schedules might induce different food intake patterns and, hence, might have different health consequences. For example, the investigations by *De Assis et al 2003* and by *Waterhouse et al 2003* were not performed in a work force with rotating shifts, but in several groups with fixed shift work schedules (night shift workers always worked in the same night shift, etc.). Other inquiries were performed in rotating night shift workers, but did differ from other experiments in, for example work time length, shift rotation speed and the sex and age of participants.

Also differences are found in the methods of classifying food intake in subjects. Some questionnaires ask for precise measures of consumed food (for example 25 gram of bread for breakfast, which is hard to estimate for participants). Other questionnaires ask for a less precise description (two slices of bread, a spoonful of sugar). In contrast, also questionnaires just asking for a description of the type of meal (breakfast, lunch, cold food, snack, etc.) are used. This variety in scoring methods used makes it hard to compare the results obtained in the reports. Results are also hard to compare because the pattern of food intake in shift workers might be altered by not only biological, but also cultural and social factors (Chiva 1997).

When previous reports are compared, ignoring the previous stated limitations, it is hard to draw solid conclusions. In the review of (Lowden et al. 2010) previous performed investigations on the influence of shift work on food intake were analyzed. Although some suggestions for beneficial ways of food consumption in shift work were delivered, it was concluded that “more research is needed to understand more fully the relationship between shift

workers and their diets and the effects on their metabolism and performance". In their review the authors found that most papers reported no difference in total food intake over 24 hours between night and day shift workers (Debry et al. 1967, de Assis et al. 2003, Reinberg et al. 1979, Pasqua, Moreno 2004, Lennernas, Akerstedt & Hambraeus 1994). Only in two articles an increase in in food intake between night and day workers was mentioned (Morikawa et al. 2008, Cervinka et al. 1984).

Of course, in addition to the previously mentioned results, some more results were reported. However these results are not consistent and are therefore not mentioned in this report. Results were regarded as non consistent if they were only found in their own report, or by multiple authors, but not in all reports. Replication and general acceptation of these results has not yet occurred. The non-consistent results found are: a higher total food intake during night shifts, but only by older men working in oil industry (Cervinka et al. 1984) and production of light metal products (Morikawa et al. 2008). Other results found are that during night shifts more animal fat and proteins were consumed (Debry et al. 1967), but also more carbohydrates due to snacking (Reinberg et al. 1979). Further it was found that subjects ate more meals during the night period (nibbling) (Reinberg et al. 1979, Pasqua, Moreno 2004) and that participants had a less regular meal pattern (de Assis et al. 2003, Waterhouse et al. 2003, Reinberg et al. 1979, Takagi 1972), compared to day time workers.

As previously stated, the relationship between shift work and several diseases, as for example coronary heart disease, and alternations in feeding habits, is still unclear. In 1980 Armstrong et al. proposed the "lipogenesis-lipolytic" theory, which suggests possible negative effects of night time feeding (Armstrong 1980). This hypothesis could explain the negative relationship between nocturnal eating and several diseases. According to the "lipogenesis-lipolytic" theory daytime food intake is associated with glucose metabolism and fat storage while fasting at night is associated with fat metabolism. Over the years, data in support of this theory was found. Night food consumption results in altered cholesterol synthesis (Cella, Van Cauter & Schoeller 1995) and there was a direct relationship found between nocturnal carbohydrate consumption and LDL-cholesterol concentration (Lennernas, Akerstedt & Hambraeus 1994). In addition, shift work is associated with alterations in glucose and insulin tolerance (Lund et al. 2001, Van Cauter, Polonsky & Scheen 1997). These findings don't explain the higher incidence of shift work associated diseases, but can give a first indication of physiological alterations possibly leading to development of these diseases. Next to the previous mentioned parameters it is also known that several other physiological components have a circadian rhythm. This includes components involved in nutrient processing, like lipid tolerance (Arasaradnam et al. 2002), intestinal blood flow and diet-induced thermogenesis (Romon et al. 1993).

In this report the influence of timing and composition of meals on the health of shift workers is investigated. This is done with the goal to generate hypotheses which can be verified in further investigations. Because of the broad

nature of the main research question more specific sub questions will be investigated. Extra focus will be put on food consumption during the night shift, because negative effects can be expected after nocturnal eating, as mentioned earlier. It is interesting to analyze the meal composition during night hours and to see if specific food components have an effect after nocturnal consumption. Furthermore, we are interested in the effects of fatty acid consumption over the day. In the article of (Dattilo et al. 2010) a negative correlation was found between fat consumption in the morning and several anthropometric variables (like BMI and waist circumference). On the other hand, consumption of fatty acids at night resulted in a positive correlation. Although that paper is somewhat debatable, due to their used methodology and analysis, and the subjects do not perform in shift work, similar results might be found.

The influence of timing and composition of meals on the health of health care shift workers will be investigated with the help of a questionnaire, consisting of several subparts, which will inquire about food intake and about health, stress, recovery from night shift and midtime of sleep on free days. These subparts of the questionnaire will, when they are combined, provide a general indication about the health status of the participants, which can provide new hypotheses and approaches for future experiments.

Methods

Subjects

The subject group fully consisted of health care workers, working in the UMCG hospital In Groningen, The Netherlands, working in eight different departments. The participants did not work in fixed shift schedule but worked in a roster varying per individual. There was variety in schedules between health care workers but also in the schedule of an individual health worker over time. Work days are split in three shift groups: early shift (07:30-16:00), late shift (15:00-23:30) and night shift (23:15-07:45). Of the 48 participants 43 subjects were female. The age of the subjects ranged from 21 to 57 years, with an average age of female subjects of 32,7 ± 9,52 years and for male subjects of 42,2 ± 10,69 years (See Fig. 1).

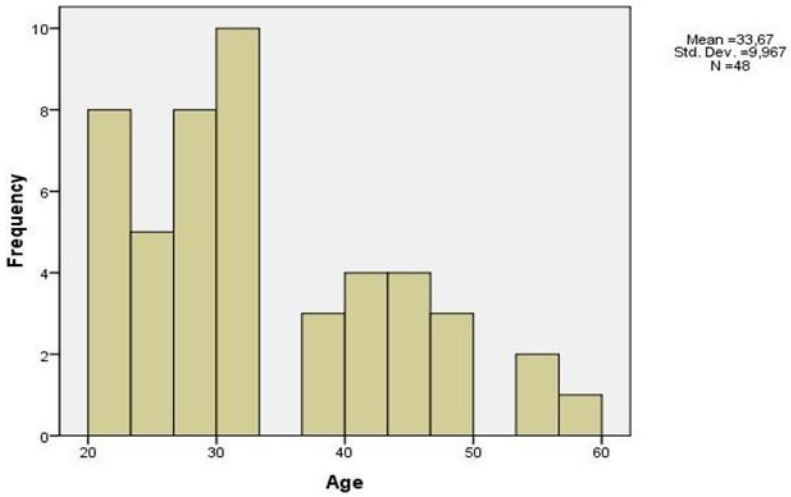


FIG. 1 Age distribution in participants.

All participants had the Dutch nationality and were all born in the Netherlands. The average weight of the participants was 72,1 ± 12,50 kilograms, average length was 174,0 ± 7,74 centimeters and the average BMI value was 23,73 ± 3,13, as is shown in Fig. 2. The highest educational grade completed by the subject group was in majority (60,4%) university of applied sciences (called HBO in The Netherlands).

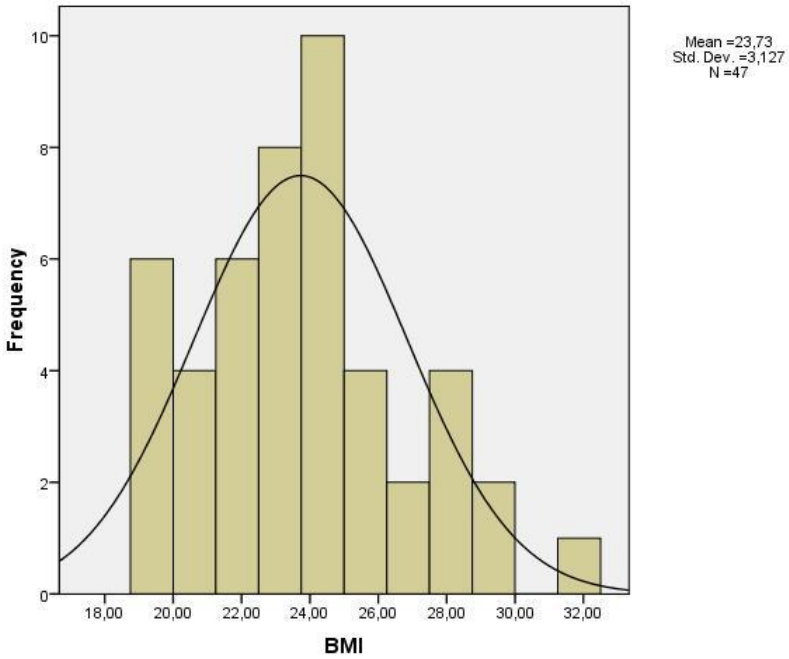


FIG. 2 Distribution of body mass index (BMI) in participants. The bell curve indicates normal distribution.

Questionnaires

The questionnaire consisted of several elements, some were asked once, and other questions were repeated over the four different conditions (early shift, late shift, night shift and free days). The complete questionnaires are shown in the appendix (in Dutch). In the general part, with which the survey started, basic information about the participants was asked, for example about their weight, their level of education and their smoking habits. This was followed by a physical health survey. The repeated questionnaires focused on work conditions, fatigue, food intake and questions about sleep.

The current questionnaire was printed and physically distributed to the health care workers. A total number of 170 questionnaires were distributed, at first during lecture days for the health care workers, later on questionnaires were distributed on request. The questionnaires were distributed in the first week of January 2011 and collected in the following two months. During these two months the health care workers were reminded via the hospital intranet system to fill in and return the questionnaires.

Physical health survey

The general part, in which basic information about the participants was inquired, was followed by a physical health survey of 18 questions, divided in 5 categories: gastrointestinal health (I suffered from a stomach ulcer last month), immune system resistance (I suffered from the flu last month), fatigue (last month I slept worse than normal), mood (I suffered from mood swings during the last month) and cardiovascular health (during the last month I suffered from chest pains). These questions could be answered within a range of 5 options: totally true, true, I don't know, not true and totally not true. The scores of these subcategories where summed, the sum of these categories combined gave a total health score, in which a higher score indicated a better health. The general part was concluded by the checklist individual strength (CIS) (Beurskens et al. 2000), which measures chronic fatigue on four dimensions: reduction of motivation, activity and concentration and the subjective experience of fatigue. Questions could be answered with a score from 1 (yes, that is true) to 7 (no, that is not true). A higher CIS score indicates higher chronic fatigue.

In Fig. 3 the range and frequency of individual results of the physical health survey are shown. The total score of the physical health test is displayed. This score is the sum of five subcategories (gastrointestinal health, immune system resistance, fatigue, mood and cardiovascular health) tested in this survey. A low score indicates a poorer health then a higher score.

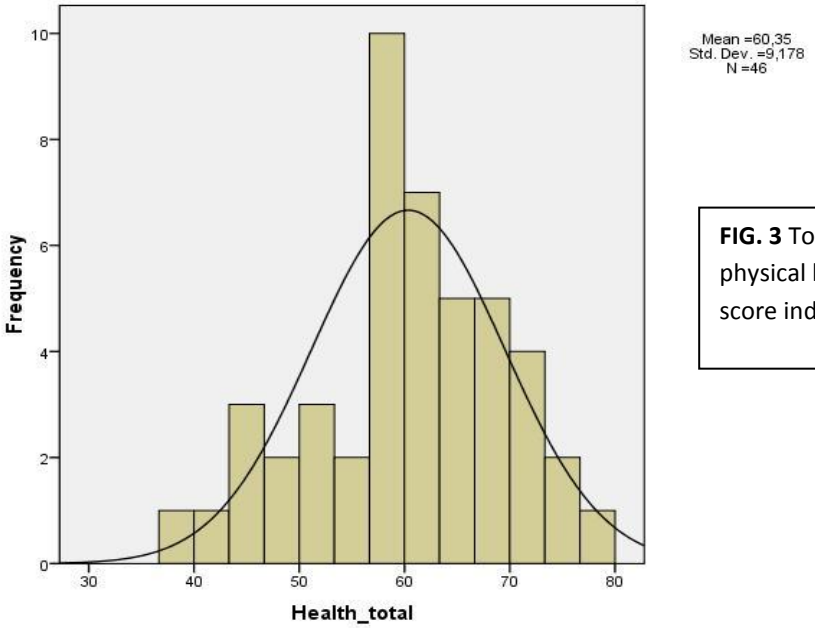


FIG. 3 Total score of the physical health survey. A higher score indicates a better health.

Repeated questionnaires

The following sections of the survey were repeated four times for the early, late and night shift and for free days. First, the experience on the work floor was queried. 15 questions were asked about light conditions and temperature of the workspace during a specific shift, but also about the physical activity required during a specific shift. Hereinafter the Munich Chronotype Questionnaire (MCTQ) (Roenneberg et al. 2004) was queried. This questionnaire determines

On days with a ... shift:

Food \ Time	02:00-06:00 uur	06:00-10:00 uur	10:00-14:00 uur	14:00-18:00 uur	18:00-22:00 uur	22:00-02:00 uur
Meat, fish, shell fish, chess, milk, eggs, etc.	☐	☐	☐	☐	☐	☐
Bread, beans, rice, pasta, potatoes, etc.	☐	☐	☐	☐	☐	☐
Vegetables, fruit, berries, carrots, etc.	☐	☐	☐	☐	☐	☐
Nuts, olives, avocado	☐	☐	☐	☐	☐	☐
Whipped cream, sauces, chips, french fries, fried snacks etc	☐	☐	☐	☐	☐	☐
Chocolate, ice cream, cookies, cake, candy, desserts, etc.	☐	☐	☐	☐	☐	☐
Fruit juices etc	☐	☐	☐	☐	☐	☐
Soda's (not light)	☐	☐	☐	☐	☐	☐
Tea, water, light soda's	☐	☐	☐	☐	☐	☐
Coffee, cola. Red Bull, other caffeine containing drinks	☐	☐	☐	☐	☐	☐
Alcoholic beverages	☐	☐	☐	☐	☐	☐
Nothing	☐	☐	☐	☐	☐	☐
Did you had a meal during this period?						
If yes, grade the meal: 1 = light, 2 = medium, 3 = heavy	__	__	__	__	__	__

FIG. 4 Food diagram in which participants can indicate if and what they have eaten during each time frame (four hour block).

the chronotype of participants by determining the mid time of sleep (MSF) on free days (for example going to sleep at 24:00 and waking up at 09:00 gives a mid time of sleep of 4:30). This is done by asking when subjects go to bed, how much time it takes to fall asleep and when they wake up again. The time when an individual endogenous circadian clock synchronizes is indicated by the chronotype. The chronotype is mostly determined by behavior, the time at which an individual wakes up is strongly correlated with the time an individual goes to sleep. The chronotype depends on age, next to genetic and environmental factors. The most frequent MSF (14,6% of the population when using half-hour-bins of MSF times) in a sample of more than 55000 participants living in Germany, The Netherlands, Switzerland and Austria, is 4:14 a.m, without further adjustments made for 1) sleep debt accumulated in the work week and 2) sex and age (Roenneberg et al. 2007). 35,02% of the population sleep earlier, while 50,38% sleep later. These data are based on non-shift workers.

The focus of this report, food consumption in the different shifts, is questioned after the MCTQ. The food-intake questionnaire used in this study is an updated version of a previously (online) used questionnaire in a study with shift workers working at Corus (now Tata Steel), a Dutch blast furnace company. The questionnaire is based on the study by Lennernas *et al.* (1999).

The food intake questionnaire consisted of a fill-in chart. In this chart participants can indicate if they have eaten something of a specific food category during 4-hour time periods, see Fig. 4. The food categories questioned were not really specified, as is visible in the figure. For further analysis and in the following graphs and charts, the different categories were named as follows: proteins, carbohydrates, vegetables/fruit, nuts, fatty acids, chocolate/candy, fruit juices, sodas, water, caffeine, alcohol and nothing. In this enumeration the first food category correspondents with the first row in Fig. 4, the second with the second row etc.

The data obtained by the nutritional consumption fill-in chart was categorized in several types of meals or snacks, according to the method of (Lennernas, Andersson 1999). If, for example, a participant indicated in the fill-in chart that proteins and carbohydrates were consumed in the 06:00 – 10:00 period, the meal in this period is scored as an incomplete meal. The categories of meals and snacks are shown in Fig. 5.

Code	Meaning	Food Groups
CM	Complete meal	Proteins + carbohydrates + (vegetables or juice)
IM	Incomplete meal	Proteins + carbohydrates
LM	Less-balanced meal	Proteins + (vegetables or juice)
VM	Vegetarian meal	Carbohydrates + (vegetables or juice)
HS	High-quality snack	Proteins or carbohydrates or vegetables and/or juice
MS	Mixed-quality snack	High-quality and low-quality snack or nuts
LS	Low-quality snack	Cream, fries, and/or chocolate, cookies and/or caffeine containing drinks
NS	No energy snack	Tea, water, light soda

FIG. 5 Categories of meals and snacks, made up from the food groups listen in figure 4.

The last part of the questionnaire consisted of the "need for recovery scale" survey (van Veldhoven, Broersen 2003). In this questionnaire the need for recovery is measured by an 11 items scale. The questions in this survey inquire about the severity and duration of symptoms that indicate that the participant is not fully recovered from effort during the working day. More specific, questions are asked about (the lack of) concentration, attention and motivation after working days. Questions asked are for example: "I find it difficult to relax at the end of a working day" and "when I get home from work, I need to be left alone for a while". Summing the questions asked with yes (except question 4, which is counted in reverse) and dividing that number by 11 gives a general score percentage for the "need for recovery scale".

Statistical analysis

All data analyses were done with SPSS 16 statistical software (correlation tests) (IBM, Armonk, New York, United States) or Microsoft Office Excel (chi-square test and Fisher's exact test, the latter with an Excel Add-In made by http://www.obertfamily.com/software/fisherexact.html) (2007 Microsoft, Redmond, Washington, United States) after all data was collected in Microsoft Office Excel 2007 . The collected data was analyzed in two different ways. The first analytical method was the Pearson product-moment correlation coefficient in which the following factors were correlated: BMI, the five categories (gastro-intestinal, resistance, fatigue, stress and mood and cardiovascular complaints) and the total score of the health questionnaire and last the checklist individual strength (CIS) score. These factors were correlated against the 4-hour time intervals in all four different shift types (early, late and night shift and free days) for each different food group (proteins, carbohydrates, vegetables/fruit, nuts, fatty acids, chocolate/candy, fruit juices, sodas, water, caffeine, alcohol and food and drink consumption). Following this, the resulting charts were analyzed for significant Pearson correlations. This was done with the goal to find larger patterns of significant correlations, for example during specific time intervals, shifts or for specific food groups.

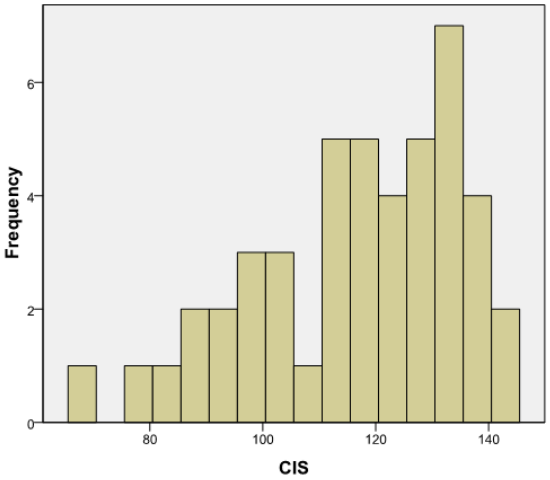
The second way of statistical data analysis was performed to avoid problems encountered with the Pearson correlation test. The binary character of a part of the factors used (for example: consumption of carbohydrates between 06:00 and 10:00 on a workday with an early shift: yes or no?) in this correlation test is likely to have influenced the obtained results. To evade this problem another approach to analyze the data was used. For five different factors (the main score of the health test, the main score of the CIS test, the score for recovery after a night shift, midtime of sleep during free days and the BMI score) the average and quartiles were calculated. Hereafter food consumption behavior of the upper and lower quartile groups of all five factors were calculated and plotted in graphs for each food group and for all four shifts. First, the total food consumption in different food groups by the lowest and highest quartile for the five factors was compared. Shift type and timeframe of day was ignored. The differences between the upper and lower quartile groups (for example, in total 45% of the lower quartile group consumed fruit and vegetables during24 hours versus 32% of the higher quartile group) were then tested for significant differences with a chi square test. This statistical test is useful for categorical data, as is the Fisher's exact test, but the chi square test was used due to the sufficient size of the samples. The same procedure

was followed on a lower, more specific level: food consumption of all food groups by the lowest and highest scoring quartile for all five parameters was compared, without the further separation of the data in the different shifts, but with separation for six different time intervals per day. The lowest and highest quartile scores were compared by means of a chi square test, since sample sizes were also large enough in this approach. Differences in food consumption in a specific time frame between different shifts are still lost in this approach, but the increased separation of the time points showed more differences in detail. Last, the differences between the upper and lower quartile groups in both time interval and shift type (for example, in the night shift 45% of the lower quartile group consumed fruit and vegetables between 14:00 and 18:00 against 32% of the higher quartile group) were tested for significant differences with Fisher's exact test. This statistical test is useful for categorical data, as is the chi square test. The Fisher's exact test is preferred over the chi square test when sample sizes are small, if expected values are below 10 (with 1 degree of freedom, which is the case) and if the values are unequally distributed over the cells of the 2X2 table. In all statistical tests a confidence interval of 5% was used.

Results

Checklist individual strength and recovery after night shift

The distribution of the total score of the checklist individual strength is presented in Fig. 6. In this checklist a higher score indicates a higher rate of chronic fatigue. The total score is the sum of several questions regarding reduction of motivation, activity and concentration and the subjective experience of fatigue. Fig. 7 illustrates the general score percentage for the “need for recovery scale”. A higher score indicates a higher need for recovery.



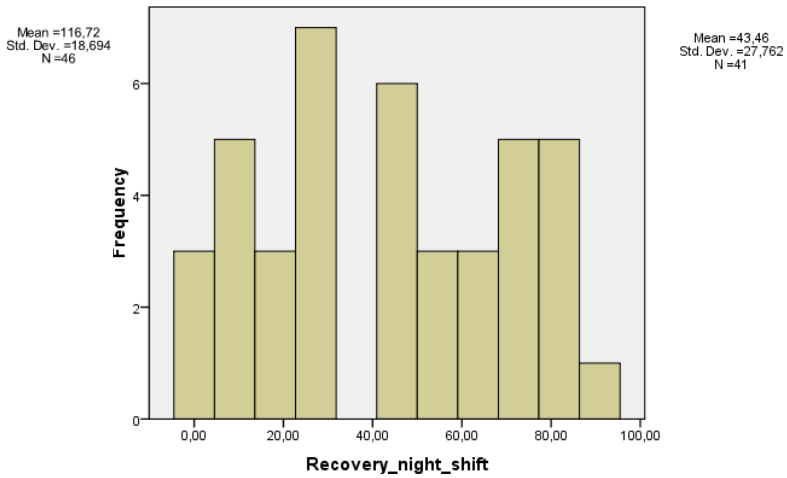
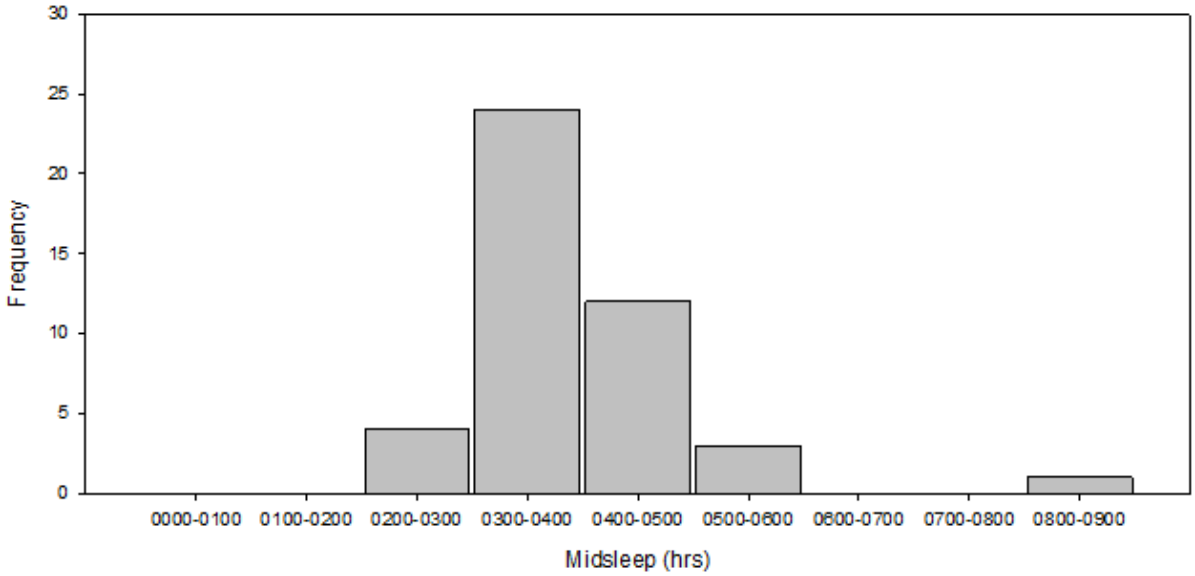


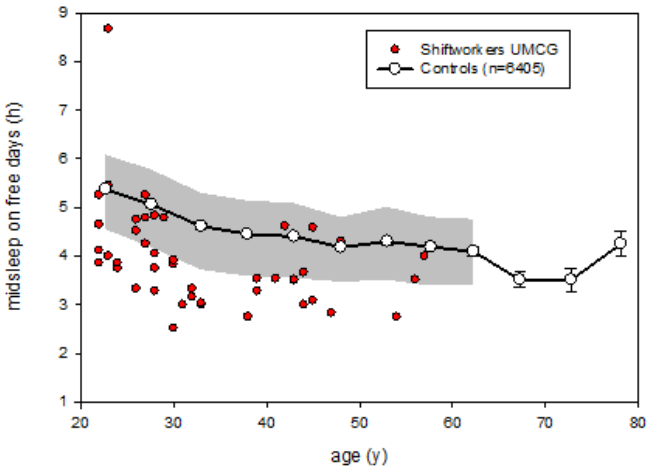
FIG. 6 (left): Frequency distribution of the total score of the checklist individual strength, a higher score indicates a higher rate of chronic fatigue.
FIG. 7 (right): Frequency distribution of the score of the “need for recovery scale” survey after night shifts. A higher percentage indicates a higher need for recovery.

Mid time of sleep and sleep duration

In this experiment the mid time of sleep for all four shift times was determined with the use of the Munich Chronotype Questionnaire (MCTQ) (Roenneberg et al. 2004). The mid time of sleep on free days (MSF) is used to determine the chronotype of the participants. An early MSF indicates an early chronotype, a late chronotype is determined by a later time of the mid time of sleep. In non-shift workers this value is corrected for sleep on working days (Roenneberg et al. 2004, 2007). For shift workers an algorithm to correct Midsleep on Free days in shift workers was not present at the time of the current analysis. For this reason we chose to use the raw midlseep values on free days as an indication of chronotypes. In Fig. 8 the distribution of the mid time of sleep (midsleep) is displayed. These data are not corrected for age, and as (Roenneberg et al. 2004) mentioned, the mid time of sleep is also influenced by age. Therefore the mid time of sleep of the participants was compared with a large database of data collected in the Netherlands, as is depicted in Fig. 9 of non-shift workers. In this figure the comparison of

the mid time of sleep of the participants with the database is supplemented with the age factor, so a better comparison between both groups can be made. Corrected for age our subjects appear to have relatively earlier chronotypes compared to the average mid time of sleep of the control group.





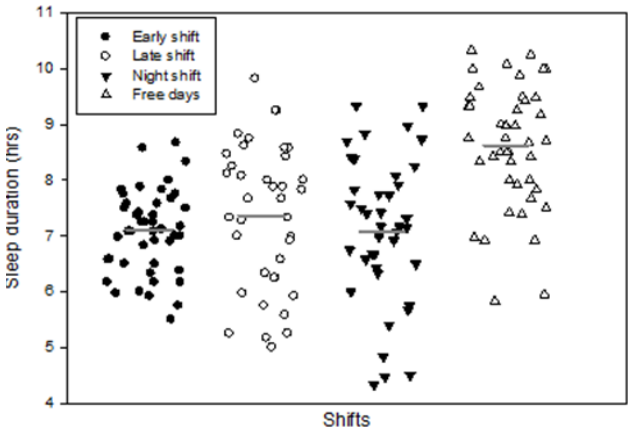


FIG. 8 (top): The frequency distribution of midtime of sleep of subjects (MSF) on free days.
FIG. 9 (left under): MSF of individual subjects (red dots) plotted against age and compared to the Dutch database. The grey area indicates the 25-75% area of the Dutch database.
FIG. 10 (right under): Sleep duration of individual subjects in hours for all four shift types: early, late and night shift and free days. The grey bar depicts the average sleep length in all four shift types.

Sleep duration was also surveyed in the questionnaire. In Fig. 10 the sleep duration in the four different shift types is displayed in hours. The single rounds or triangles indicate the individual sleep duration of the participants per shift. This is displayed in this manner to show the dispersion of sleep duration lengths for each shift. The grey bars drawn through the scatter clouds indicate the average sleep duration in hours per shift. No significant difference

were found between the working shifts, but the sleep duration on free days was significantly longer compared to the three other shifts.

Nutritional survey

The data collected in the nutritional survey was categorized in 8 different meal types, as described by Lennernas and Andersson (1999) and shown in Fig. 2. These 8 groups were combined in two groups: snacks and meals. This was done to make it easier to inspect the pattern of food choices over the day in the different shifts and to compare the food choice pattern between the different shifts. The group of meals is formed from the following 4 meal types: complete meal, incomplete meal, less-balanced meal and vegetarian meal. The snack category consists of the other 4 meal types: high-quality snacks, mixed-quality snacks, low-quality snacks and no energy snacks. The results, for each of the six time intervals per shift, and for the four shift types, are shown in Fig. 11.

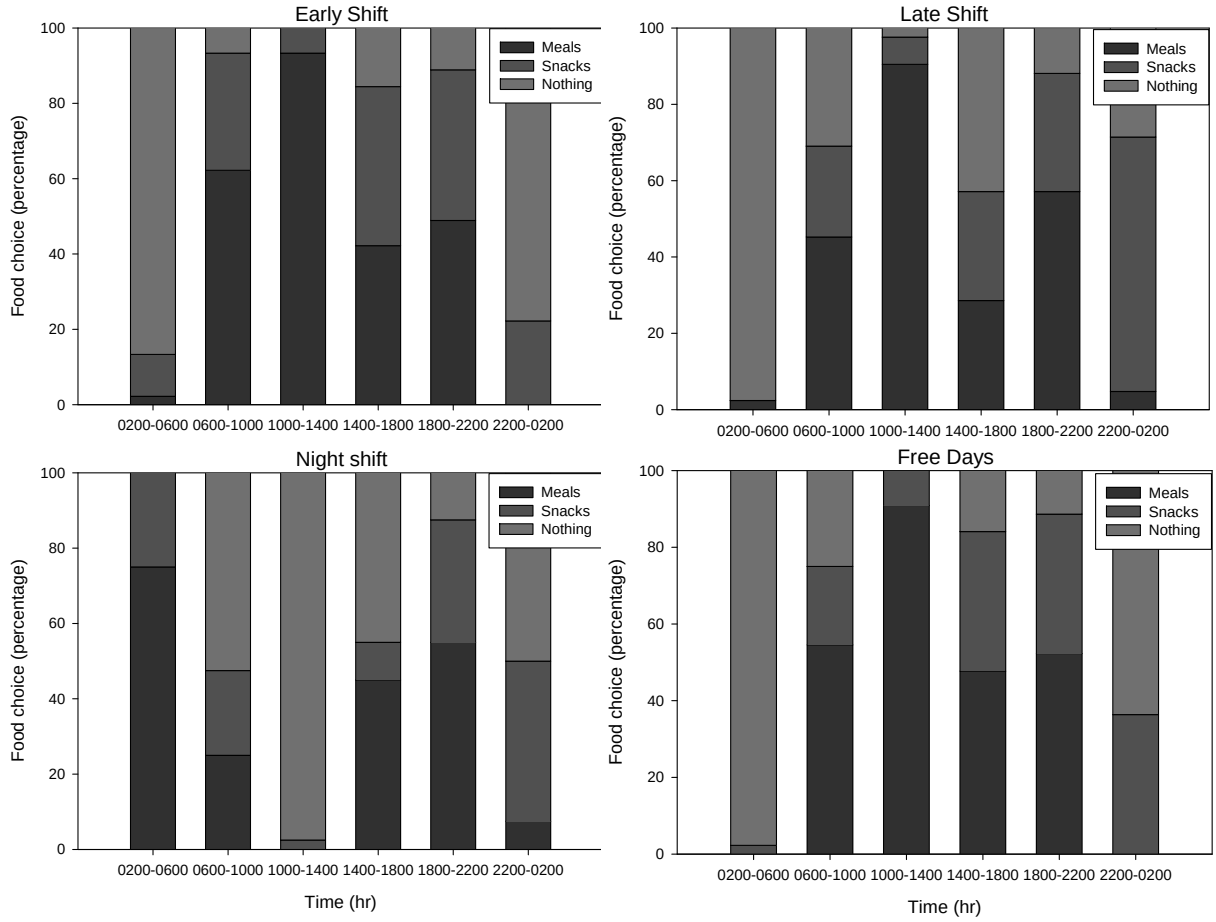


FIG. 11 Food choice for the four different shifts. Meals are: complete meal, incomplete meal, less-balanced meal and vegetarian meal. Snacks are: high-quality snacks, mixed-quality snacks, low-quality snacks and no energy snacks. **(left above):** early shift. **(right above):** late shift. **(left under):** Night shift. **(right under):** free days.

A few observations can be made: the pattern in the early shift and on free days is quite similar, during the night shift a high percentage of snacks are consumed between 22:00 and 02:00 the next day and all participant ate something during the night shift between 02:00 and 06:00.

The graphs above show that there is some variation in the type of food participants choose to eat during a specific time frame. To further elude these variations the influence of specific food groups was investigated. As described before, this was done by correlating the consumption of specific food groups to several read outs of surveys. These surveys regarded health, fatigue (checklist individual strength) and BMI. Against expectations, no significant results appeared in this approach (data not shown). It was expected that clusters of correlations would indicate that food consumption during specific time frames, or the consumption of specific food groups during certain times, would correlate to healthy or unhealthy ratings. No such clusters of correlations were found, there was no clear pattern visible in the significant correlations that were found.

Quartile comparison of total daily consumption

Differences in food choices of the health care workers were then analyzed with the use of a different approach. The outcome of the surveys regarding health, fatigue, the rate of recovery after a night shift and the mid time of sleep and the BMI score was split up in quartiles, from which the lowest (0-25%) and the highest quartile (75-100%) were compared with each other.

Fig. 12 shows the comparison at the least specific level. Only total daily consumption of the specific food groups are compared between the lower and upper quartile group. No distinction is made for shift type or the time (frame) of the day. So, for example, for the factor health all consumptions of proteins during all shifts and all time frames are added up for both extreme quartiles and then compared with a chi square test. In Fig. 12 a summary of these comparisons is displayed graphically. The significant differences are marked with the dark blue and red colors. Differences which were not significant, but could indicate a trend (α between 0,05 and 0,1) are marked with the light blue and red colors. The red color corresponds to a significant higher consumption (or similar trend, lighter red color) of that food group by the upper quartile group. The blue color corresponds with a significant higher consumption (or trend) of that food group by the lowest quartile group. This color coding is reversed for the health score results. For this factor the blue color correspondents to a significant higher intake of that food group by the lowest (most healthy) quartile. This was done to avoid confusion, blue corresponds with a positive correlation, which is more healthy (although this is debatable and still unclear for some of the factors like midtime of sleep on free days), red corresponds with negative correlations, or unhealthy effects.

In Fig. 12 the factor midtime of sleep during free days (called midsleep in the chart) is shown. Nuts, fatty acids, tea/water, caffeine containing drinks and alcohol are significantly more consumed by the upper quartile ((relative) late chronotypes) then the lowest quartile (early chronotypes). In contrast, chocolate is more consumed in the

lower quartile. It is necessary to state that although there is a significant difference, the overall consumption of these food groups is not so high. For example, nuts are consumed by 0,46% of the lowest quartile and by 3,03% of the upper quartile. Although this is a significant difference, the importance of this result can be questioned, since the frequency is so low. To further illustrate this, the frequency of consumption of the other food groups was: fatty acids, 2,31 vs 6,44%; tea/water: 6,94 vs 17,05%, caffeine 3,70 vs 11,36%, alcohol: 0,92 vs 7,58%. (23,39 vs 15,91%) and chocolate, more consumed by the lowest quartile (2,39 vs 15,91%). Nevertheless, despite the low frequency of consumption of some of these food groups, there is a difference in total consumption between the two midsleep quartile groups. For the parameter BMI one single significant difference was found: the total consumption of sodas was higher in the highest (highest BMI score) quartile. A similar trend for health score was found between the bad health score quartile and soda consumption, which was the only significant result found for this parameter. The checklist individual strength score also did not show much difference in consumption between the two extreme quartiles, only caffeine was consumed more by the lowest (lower amount of chronic stress) group. The same effect of caffeine was found for the recovery after night shift parameter. Finally, for the recovery parameter chocolate and nuts were consumed more by the highest group (who recovered worse after night shift).

	Proteins	Carbohydrates	Vegetables	Nuts	Fatty acids	Chocolate	Tea	
Health								Health
CIS					#			CIS
Recovery			#	*		*		Recovery
Midsleep		#	#	*	*	*	*	Midsleep
BMI								BMI

	Caffeine	Juices	Sodas	Alcohol	Food Consumpt	Drink consumption	
Health			#				Health
CIS	*						CIS
Recovery	*						Recovery
Midsleep	*	#		*	*		Midsleep
BMI			*				BMI

FIG. 12 Comparison of total food group consumption of the lower and upper quartiles of the 5 parameters: health score, checklist individual strength, recovery after night shift, midtime of sleep on free days and BMI. A * indicates a significant difference ($\alpha < 0,05$), a # indicates a trend ($\alpha < 0,1$). The red colored cells corresponds to a significantly higher consumption (or trend) of that food group during that time frame and shift by the highest quartile group. This color coding is reversed for the health score results. For this factor the blue color corresponds to a significant higher intake of that food group (again, during that time frame and shift) by the lowest (most healthy) quartile.

Quartile comparison of consumption in six time frames

In the previous section only total daily intake of the different food groups was compared. The next approach was to analyze the consumption of these food groups with regard to the time(frame) of day. Fig. 13 is presented in the same way as Fig. 12, with the addition of six time frames per day. Each box represents one of the five parameters by which the subject group was split in a lower and upper quartile group.

The box regarding midtime of sleep on free days stands out as having the largest number of significant differences between the early and late chronotype quartile. In general, food consumption is higher in the quartile of early chronotypes between 06:00 and 10:00 and between 14:00 and 18:00. . Opposite to this the 3 main food groups (proteins, carbohydrates and vegetables) are more consumed between 18:00 and 22:00 by the late chronotype quartile. Also, snacks, nuts and alcohol consumption is larger in late chronotypes between 22:00 and 02:00.

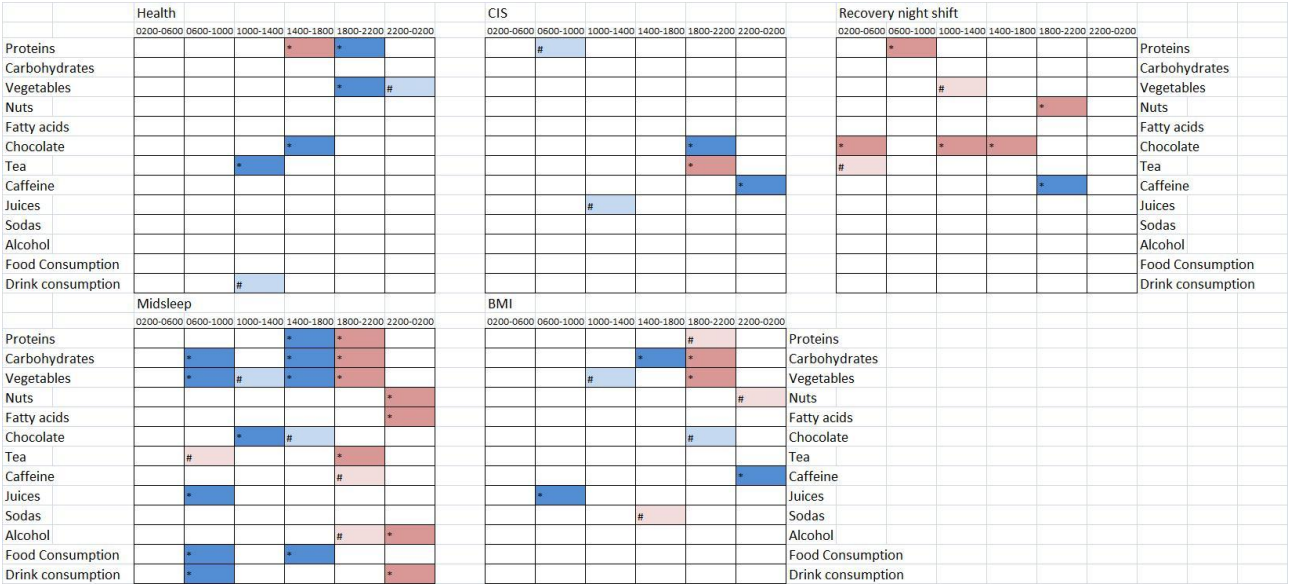


FIG. 13 Comparison of food group consumption of the lower and upper quartiles of the 5 parameters during six time frames. A * indicates a significant difference (α< 0,05), a # indicates a trend (α<0,1). The red colored cells correspond to a significantly higher consumption (or trend) of that food group during that time frame and shift by the highest quartile group. This color coding is reversed for the health score results. For this factor the blue color corresponds to a significantly higher intake of that food group (again, during that time frame and shift) by the lowest (most healthy) quartile.

The health box does not show the same results as in Fig. 12. Some of the significant correlations reported in Fig. 12 are no longer observed after splitting the data up over six time frames. The trend towards higher soda consumption by the group with a low health score is not visible in this figure. Interestingly, for both the proteins and the vegetables/fruit group, consumption was higher in the good health score quartile between 18:00 and 22:00, where protein consumption by the opposite group was higher in the earlier time frame, between 14:00 and 18:00. This is interesting since an alike, but totally opposite pattern can be observed in the BMI box, which was unexpected. Protein, carbohydrate and fruit/vegetable consumption between 18:00 and 22:00 was higher (or had that trend) in the high BMI quartile group and carbohydrates were more consumed by the low BMI group in the earlier time frame (14:00 till 18:00). In the checklist individual strength box no significant interactions appear. In the recovery from night shift box it is found that chocolate consumption is higher in the group which recovers badly in three time frames (between 02:00 and 06:00, 10:00 till 14:00 and 14:00 till 18:00).

Quartile comparison of consumption in six time frames and shift types.

In the last approach the differences in food consumption were investigated for all six time frames a day and for the four different shifts (early, late and night shift and free days. Four graphs (for the four shifts) per food group could be made. With the 11 food groups and the two other conditions (consumption of food or drinks at all) this resulted in a total of 52 graphs. To condense this amount of data a summary is made in Fig. 14 a and b. The summary can be read in the same way as the previous graphs.

A few results can be drawn out of Fig. 14 a and b. First the midtime of sleep is analyzed. Health care workers of the upper quartile of the mid time of sleep, e.g. the later chronotypes, appeared to consume more alcohol in the late hours of their free days. Next, protein and carbohydrate consumption between 14:00 and 22:00 for all shifts, except the late shift, seemed to differ between early and late chronotypes. It appears that the early chronotype quartile have a higher consumption of carbohydrates and proteins between 14:00 and 18:00, while the late chronotype quartile consume these food groups more at a later time, between 18:00 and 22:00. This effect is more clearly visible in early shift and free days and less clear during night shifts.

In the other boxes no clear patterns are visible. Especially in the boxes for health score, CIS and BMI only a few significant results can be observed. Also for the midtime of sleep boxes no pattern of significant results is visible, although chocolate consumption by the upper quartile is elevated (or trending in that direction) in a few timeframes. This is in line with the observations in Fig. 13.

FIG. 14 a and b Summary of the comparisons between the upper and lower quartile for the 5 factors health, fatigue, recovery night shift, midtime of sleep during free days and BMI. A * indicates a significant difference (α< 0,05), a # indicates a trend (α<0,1). The red colored cells correspondents with a significant higher consumption (or alike trend) of that food group during that time frame and shift by the highest quartile group. This color coding is reversed for the health score results. For this factor the blue color correspondents with a significant higher intake of that food group (again, during that time frame and shift) by the lowest (most healthy) quartile.

		Early shift						Late shift						Night shift						Free days					
		0200-0600	0600-1000	1000-1400	1400-1800	1800-2200	2200-0200	0200-0600	0600-1000	1000-1400	1400-1800	1800-2200	2200-0200	0200-0600	0600-1000	1000-1400	1400-1800	1800-2200	2200-0200	0200-0600	0600-1000	1000-1400	1400-1800	1800-2200	2200-0200
Proteins	Midsleep				#	*												#					#	#	
Carboh	Midsleep				*	*			*								*				#		*	*	
Fruit	Midsleep					*												#						*	
Nuts	Midsleep																								
Fatty ac	Midsleep																								#
Chocola	Midsleep									*															
Tea	Midsleep		#									*													
Caffeine	Midsleep																								
Juices	Midsleep								*				*				#		#		*				
Sodas	Midsleep																								
Alcohol	Midsleep																								*
Food Cc	Midsleep								*								#				*			#	
Drink cc	Midsleep						#		*												*				*
Proteins	BMI																								
Carboh	BMI										*	*													
Fruit	BMI																					*			
Nuts	BMI																								
Fatty ac	BMI																								
Chocola	BMI																								
Tea	BMI																								
Caffeine	BMI												#												
Juices	BMI										#														
Sodas	BMI																								
Alcohol	BMI																								
Food Cc	BMI																								
Drink cc	BMI																								

Discussion and conclusion

In this explorative study the relationship between timing and composition of meals on health, mid time of sleep, fatigue, recovery from shift work and BMI was investigated. The goal of this study was to generate hypotheses which can be tested in future research. To achieve this goal healthcare workers working in a shift work schedule at the University Medical Centre Groningen (UMCG) in The Netherlands were given a questionnaire. This survey questioned subject information, sleeping and eating habits during the different shifts and questions about fatigue and recovery from work. The resulting data was analyzed in order to obtain a better understanding of the behavior of shift workers in food consumption and to find out if the consumption of specific food groups at certain time points is worth more attention in future research.

In general, the relationships between meal timing and composition and the five investigated parameters were weaker than expected. Partly this may have been due to the small size of our subject group, this will be addressed later. Also the variation in timing of meals was smaller than expected. The lower left graph in Fig. 11 regarding the night shift shows, for example, that all participants consumed food between 02:00 and 06:00 during the night shift. It was expected that some of the subjects wouldn't eat during their night shift but instead consume their meals at "normal" times which fit better in family (and/or other social) life. This was however not the case in the subject group, what prevented the planned comparison between "eaters" and "non-eaters" during the night and resulted in the comparison of the extreme quartile groups for the different parameters.

Due to those limitations, and also due to the fact that this study was set up to generate hypotheses for future investigations, no strong conclusions can be drawn from the obtained results. It is not possible to conclude from this experiment whether eating during the night shift should be avoided, since all subjects ate during the night hours of the night shift and no health comparison could be made between "eaters" and "non-eaters". Also the beneficial or detrimental effects of specific food group consumption during specific times in specific shifts couldn't be determined in this research project, due to the small sample size of our subject group. In the results presented in Fig. 14 a and b. the two quartile groups compared consisted only of 9 or 10 participants per group. This low n combined with the fact that the statistical methodology used (Fisher's exact test) to test these two quartile groups is rather conservative and has a rejection rate below nominal significance level (Liddell 1976) this resulted in a small number of significant results in this comparison. The results of this comparison were regarded marginal and unreliable; the results of this comparison will not be discussed. The unreliability is due to the large amount of comparisons in a small number of subjects, which will lead to significant results by chance fluctuation alone. Therefore single significant results cannot be recognized with confidence and patterns of significant results are required for additional support. In the following part the results of the other comparisons will be discussed and focus points for future investigations will be advised.

At the most basic level where only total food intake was compared between the quartile groups it is surprising that most differences are found between the early and late midtime of sleep (chronotype) groups. This means that there is a difference in total consumption of several food groups between the early and late chronotypes. Late chronotypes consumed more nuts, fatty acids, tea/water, caffeine containing drinks and alcohol. Early chronotypes ate more chocolate and ate during more timeframes in general. Also there was a trend towards a higher consumption of carbohydrates and fruits/vegetables by early chronotypes. Although this is only a first result obtained in a very small subject group this result could indicate that early chronotypes perhaps consume more food in total and more complete meals (carbohydrates and vegetables are two of the three main ingredients of complete meals), while late chronotypes tend to eat more snacks and other in-betweens. The consistency of this statement can be investigated in future research. Also future focus can be put on the relationship between BMI and soda consumption, to investigate if there is a relationship between the two factors, as is proposed in the literature (Drewnowski, Specter 2004) and to investigate if this relationship is increased in shift workers (Atkinson, Davenne 2007). Finally, some attention might be given to chocolate consumption and recovery from night shift; this will be further addressed in the next paragraph.

When the time frame of the day is taken into account in the food intake analysis again the largest number of significant differences is observed between the early and late chronotype group. However, these results can be interpreted differently than was done above. It is true that the total food intake of some food groups is different between the two groups, but this is not the only explanation for all the differences found. This is because it is logical that most differences in timing of food consumption are found between the two extreme quartile groups when a selection is done on midtime of sleep on free days (MSF). We could assume that the lowest quartile group (early chronotypes) sleeps earlier then the highest quartile group, which can subsequently result in a different timing of meals between the two groups. In other words, differences can also occur because the early group consumes dinner before 18:00 (timeframe 14:00 till 18:00) while the late chronotypes eat later. This also results in, for example, significantly higher protein consumption by the early group between 14:00 and 18:00 and the same for the late group between 18:00 and 22:00. As was pointed out before, chocolate consumption and recovery deserves more attention. Chocolate consumption is overall higher in the quartile group who recovered worse than average after night shift, Fig. 13 shows at which time frames this consumption is higher. The causal relationship of this finding is unclear but worth more investigation. Does chocolate consumption help subjects in recovering or do these participants recover worse because of the chocolate consumption? Finally, as was already found by (Wittmann et al. 2006) also in our subject group alcohol consumption is increased in the late chronotype group. This gives some conformation about our approach of data analysis and the composition of subject group, since the results obtained in this experiment are comparable to other publications. No relationship was found (positive or negative) between BMI and total fatty acid consumption, neither in total daily fatty acids intake (Fig. 12) nor in one of the six time frames (Fig. 13). This was somewhat surprising because Datilla *et* al. (Dattilo et al. 2010) did find such a relationship and they used a very similar approach to correlate fatty acid intake directly to the BMI of

participants. The difference could be due to the fact that there simply is no relationship in our subject sample, or to the fact that the participant reporting of BMI (reported length and weight) or fatty acid intake deviates from the actual situation, muffling the relationship between fatty acid intake and BMI. Validation of food intake reports will be addressed below, control of anthropomorphic values filled in by participants (measuring and weighing all the participants by researchers) was simply not feasible in the set-up and execution of this experiment.

Regarding the differences found between the groups of early and late MSF some remarks must be made. First, the chronotypes of our participants are in general different from the average Dutch inhabitant. As is illustrated in Fig. 9 most of the subjects have an earlier chronotype compared to the average values in the database. This difference is discernible for the whole age range of the participants. Our preliminary results concerning differences found between early and late chronotypes are therefore not directly applicable to the general population, because of the narrowed spread of MSF and the overrepresentation of early chronotypes in our subject population. It is also possible that in this research the differences between early and late chronotypes are less profound than they would be in a general population. The narrowed distribution in midtime of sleep and the lack of (extreme) late chronotypes in our population might muffle differences in food consumption which would occur in a larger and more varying subject group. If this large occurrence of early chronotypes in our subject group is perhaps not coincidental and if it is related to this kind of work with rotating shifts is an interesting question but unfortunately not answerable in this report.
Next, the definition of midtime of sleep on free days and the method how it is calculated in this report differs from the general approach in literature (Roenneberg et al. 2004). Normally, the MSF is adjusted for individual average sleep need MSF_{SC} (Mid-sleep Free, Sleep-debt Corrected). This is done because most of the chronotypes tend to accumulate a sleep debt on work days which is afterwards regained on free days, therefore elongating sleep on free days (and shifting MSF) (Roenneberg et al. 2004). This correction is not performed in this report, because subjects do not work in one general and steady shift. In contrast, each participant has a personal working schedule in which there is also no fixed sequence of early, late, night shifts and free days. This made it impossible to gather data which determines the midsleep on a typical workday (or free day) of the subjects, which is then used to correct the MSF. Besides, the MSF_{SC} can only be determined if the participants have the chance to sleep undisturbed during their free days, and are not woken up by their children (ergo, they should not have (young) children). Since most of the subjects have children, this would have resulted in the rejection of a large part of the subject group, which was not preferable regarding the already small size of the group.

During the set-up of this experiment it was planned to also perform a food diary study with a part of the subjects. This was planned so the reliability of the food diagrams could be examined. With the food diary the representation of the daily food consumption by the diagrams could be checked for both timing and number of meals a day and also for food intake (for example: do participants who have filled in that they only consume fatty acids between 18:00 and 22:00 in an late shift actually only consume these fatty acids in this time frame and if they do, how much

of this food group is consumed?). This food diary study was however not performed. This was due to time problems (there was a limited time frame in which the questionnaires could be handed out). Another problem was that all questionnaires were handed out anonymously and no questionnaire could be matched to a later filled in food diary. Combined with the low participation rate of the health care workers for the questionnaire it was decided that a food diary study would not succeed and the idea was dropped. This was very unfortunate and future research is absolutely necessary to first, validate the currently used way of questioning food intake and secondly, to get a better view of the food intake patterns in health care shift workers, also in a quantitative way. Validation is, among other reasons, needed to see if the resolution used in the current food diagram (timeframes of 4 hours) is sufficient enough to get a clear view on the daily food intake pattern. One could imagine that both breakfast and lunch could be consumed between 10:00 and 14:00, or both lunch and dinner between 14:00 and 18:00. Although this is not the main focus of this experiment, this would give an incorrect representation about the number of meals consumed per day. What is important for this experiment is that it can also give a wrong indication about the consumption of food groups. If two groups both eat three meals a day, but one group eats twice in one time frame, it would appear that there is a difference in food consumption, while there isn't. This possible problem, the reduced resolution of the method used, should be kept in mind.

In conclusion relationships between meal timing and composition and the five investigated parameters were smaller than expected. This is due to the small variance in food consumption behavior of the health care workers and to the small size of the subject group. Some differences were found in tests scores between the highest 25 and lowest 25% scoring group for MSF, health score, BMI, recovery after night shift and chronic fatigue. These differences can become focus points of future research in which these relationships can be further elucidated.

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.

Appendix 1

Addendum

Questionnaire

A1. Ik ben een: ☐ Man ☐ Vrouw

A2. Leeftijd: _____ jaar

A3. Lengte: _____ meter

A4. Gewicht: _____ kilogram

A5. Hoeveel dagen in de week beweegt u minstens 30 minuten? _____ dagen per week

A6. Is uw nationaliteit Nederlands? ja ☐ nee ☐

A7. Zo nee, waar bevindt zich uw land van herkomst?

(Zet een cirkeltje om het cijfer)

☐ **1.** Europa

☐ **2.** Azië

☐ **3.** Afrika

☐ **4.** Noord-Amerika

☐ **5.** Zuid-Amerikika

☐ **6.** Oceanië

A8. Hoelang woont u al in Nederland?

☐ **1.** Korter dan 1 jaar

☐ **2.** Tussen 1 en 5 jaar

☐ **3.** Langer dan 5 jaar, maar niet hele leven

☐ **4.** Uw hele leven

A9. Wat is de hoogste opleiding die u heeft gehad?

☐ **1.** lagere school

☐ **2.** vmbo/mavo/lager beroepsonderwijs

☐ **3.** middelbaar beroepsonderwijs

☐ **4.** havo/vwo

☐ **5.** hoger beroepsonderwijs

☐ **6.** academisch onderwijs

☐ **7.** anders, namelijk. _____

A10. Burgerlijke staat:

☐ **1.** ongehuwd

☐ **2.** samenwonend

☐ **3.** gehuwd

☐ **4.** gescheiden

☐ **5.** anders, namelijk:_____

A11. Heeft u thuiswonende kinderen? ja ☐ nee ☐

A12. Zo ja, hoeveel? _____

A13. Wat is de gemiddelde reistijd van uw huis naar uw werk? _____ minuten

A14. Welk vervoermiddel gebruikt u om naar uw werk te gaan?

☐ Auto/Motor ☐ trein ☐ bus/tram/metro ☐ brommer/scooter/fiets/lopend

A15. Gebruikt u medicijnen of voedingssupplementen? ja ☐ nee ☐

Zo ja, welke gebruikt u en in welke dosering?

.....

.....

A16. Drinkt u koffie, thee, energydrink als red bull, of andere cafeïne houdende dranken?

☐ **1.** Nee, meestal niet

☐ **2.** Ja, meestal 1-2 kopjes/blikjes/glazen per dag

☐ **3.** Ja, meestal 2-5 kopjes/blikjes/glazen per dag

☐ **4.** Ja, meestal meer dan 5 kopjes/blikjes/glazen per dag

A17. Rookt u?	Nooit	Af en toe, bijv. op feestjes	Minder dan 10 per dag	10 tot 30 per dag	Meer dan 30 per dag
Sigaretten	☐	☐	☐	☐	☐
Shag	☐	☐	☐	☐	☐
Sigaren	☐	☐	☐	☐	☐
Pijp	☐	☐	☐	☐	☐
Overig, namelijk: _____	☐	☐	☐	☐	☐

A18. Drinkt u alcohol?

☐ **1.** Nee
☐ **2.** Ja, gemiddeld minder dan 1 glas per dag
☐ **3.** Ja, gemiddeld tussen 1- 3 glazen per dag
☐ **4.** Ja, gemiddeld meer dan 3 glazen per dag

A19. Hoe lang werkt u al in ploegendienst?

- ☐ **1.** Minder dan een half jaar
- ☐ **2.** Een half jaar tot 1 jaar
- ☐ **3.** 1 jaar tot 5 jaar
- ☐ **4.** Meer dan 5 jaar
- ☐ **5.** Ik werk niet in ploegendienst

A20. Wat is uw dienstverband?

- ☐ **1.** Vast contract
- ☐ **2.** Jaar contract
- ☐ **3.** Part-time contract

A21. Hoeveel dagen per week werkt u gemiddeld ?

___ dagen

A22. Hoeveel vroege/late/nacht/dag diensten had u de afgelopen maand ongeveer:

___ vroege diensten

___ late diensten

___ nachtdiensten

___ dagdiensten

In hoeverre heeft het werken op onregelmatige tijden (ploegendienst) een negatieve invloed voor u op de volgende gebieden?

	nooit	**soms**	**regelmatig**	**vaak**	**altijd**
A23. Slaap	☐	☐	☐	☐	☐
A24. Thuissituatie	☐	☐	☐	☐	☐
A25. Sociaal leven	☐	☐	☐	☐	☐
A26. Werkzaamheden	☐	☐	☐	☐	☐

B1. Als u niet in ploegendienst zou werken en altijd volledig vrij was uw slaaptijden te kiezen, hoe laat zou u dan gaan slapen? _____ **h** _____ **min**

B2. En hoe laat zou u dan wakker worden? _____ **h** _____ **min**

Is uw slaapkamer geschikt om overdag in te slapen met betrekking tot:

	Nee, grote problemen	Nee, niet echt goed	Neutraal	Ja, wel redelijk	Ja, geen probleem
B3. Hoeveelheid licht	☐	☐	☐	☐	☐
B4. Temperatuur	☐	☐	☐	☐	☐
B5. Lawaai	☐	☐	☐	☐	☐

	helemaal waar	waar	weet niet	niet waar	helemaal niet waar
Ik heb de afgelopen maand…..					
C1. …minder trek dan gewoonlijk	☐	☐	☐	☐	☐
C2. …last gehad van maag en/of darmklachten (diaree, verstopping of brandend maagzuur)	☐	☐	☐	☐	☐
C3. …me onverklaarbaar moe en/of uitgeput gevoeld	☐	☐	☐	☐	☐
C4. …last gehad van migraine en/of hoofdpijn	☐	☐	☐	☐	☐
C5. …last gehad van hartkloppingen en veel zweten	☐	☐	☐	☐	☐
C6. …last gehad van kortademigheid en/of duizeligheid	☐	☐	☐	☐	☐
C7. …te maken gehad met persoonlijke problemen	☐	☐	☐	☐	☐
C8. …slechter dan gewoonlijk geslapen	☐	☐	☐	☐	☐
C9. …me prikkelbaar gevoeld	☐	☐	☐	☐	☐
C10. ..last gehad van een onbehaaglijk gevoel/malaise	☐	☐	☐	☐	☐
C11. ..last gehad van stemmingswisselingen	☐	☐	☐	☐	☐
C12. ..te maken gehad met concentratieproblemen	☐	☐	☐	☐	☐
C13. ..last gehad van verkoudheid (o.a. verstopte neus, keelpijn)	☐	☐	☐	☐	☐
C14. ..te maken gehad met griep verschijnselen (o.a. koorts, spierpijn, hoofdpijn)	☐	☐	☐	☐	☐
C15. ..last gehad van pijn op de borst	☐	☐	☐	☐	☐
C16. ..last gehad van een maagzweer	☐	☐	☐	☐	☐

C17. Welke dienst vindt u het prettigst?

- ☐ **1.** Vroege dienst (A1/A3)
- ☐ **2.** Late dienst (C)
- ☐ **3.** Nachtdienst (N)

Bedenk hoe u zich de **afgelopen 2 WEKEN** voelde:

D1. Ik voel me fit	ja, dat klopt							nee, dat klopt niet
D 2. Ik zit vol activiteit	ja, dat klopt							nee, dat klopt niet
D 3. Nadenken kost me moeite	ja, dat klopt							nee, dat klopt niet
D 4. Lichamelijk voel ik me uitgeput	ja, dat klopt							nee, dat klopt niet
D 5. Ik heb zin om allerlei leuke dingen te gaan doen	ja, dat klopt							nee, dat klopt niet
D 6. Ik voel me moe	ja, dat klopt							nee, dat klopt niet
D 7. Ik vind dat ik veel doe op een dag	ja, dat klopt							nee, dat klopt niet

D 8. Als ik ergens mee bezig ben, kan ik mijn gedachten er goed bijhouden.	ja, dat klopt							nee, dat klopt niet
D 9. Ik voel me slap	ja, dat klopt							nee, dat klopt niet
D 10. Ik vind dat ik weinig doe op een dag	ja, dat klopt							nee, dat klopt niet
D 11. Ik kan me goed concentreren	ja, dat klopt							nee, dat klopt niet
D 12. Ik voel me uitgerust	ja, dat klopt							nee, dat klopt niet
D 13. Het kost me moeite ergens mijn aandacht bij te houden	ja, dat klopt							nee, dat klopt niet
D 14. Lichamelijk voel ik me in een slechte conditie	ja, dat klopt							nee, dat klopt niet

D 15. Ik zit vol plannen

ja, dat klopt | | | | | | | nee, dat klopt niet

D 16. Ik ben gauw moe

ja, dat klopt | | | | | | | nee, dat klopt niet

D 17. Er komt weinig uit mijn handen

ja, dat klopt | | | | | | | nee, dat klopt niet

D 18. De zin om dingen te ondernemen ontbreekt mij

ja, dat klopt | | | | | | | nee, dat klopt niet

D 19. Mijn gedachten dwalen gemakkelijk af

ja, dat klopt | | | | | | | nee, dat klopt niet

D 20. Lichamelijk voel ik me in een uitstekende conditie

ja, dat klopt | | | | | | | nee, dat klopt niet

A1. Hoeveel procent van de tijd verblijft u in de vroege dienst gemiddeld op de werkplek?

(1 hokje aankruisen s.v.p.)

☐0-10 ☐11-20 ☐21-30 ☐31-40 ☐41-50 ☐51-60 ☐61-70 ☐71-80 ☐81-90 ☐91-100 %

A2. Variëren de lichtomstandigheden sterk tussen eventuele verschillende werkplekken?

ja ☐ nee ☐ nvt ☐

A3. Kunt u de helderheid van het licht op de werkplek zelf kiezen (bv met een dimmer)?

ja ☐ nee ☐

A4. Wat vindt u van het licht op de plek waar u zich tijdens de vroege dienst het meeste bevindt?

A.

Plezierig ☐ ☐ ☐ ☐ ☐ Onplezierig

B.

Onaangenaam ☐ ☐ ☐ ☐ ☐ Aangenaam

C.

Warm ☐ ☐ ☐ ☐ ☐ Koud

D.

Fel, scherp ☐ ☐ ☐ ☐ ☐ Zacht

A5. Hoeveel hinder van het daglicht (door bijv. schittering of spiegeling) ondervindt u?

☐ Helemaal niet ☐ Een beetje ☐ Nogal ☐ Heel veel ☐ Extreem

A6. Hoeveel last heeft u van verblinding?

☐ Helemaal niet ☐ Een beetje ☐ Nogal ☐ Heel veel ☐ Extreem

B1. Wat vindt u van de temperatuur op uw werkplek tijdens de vroege dienst ?

Koud ☐ ☐ ☐ ☐ ☐ Warm

Onaangenaam ☐ ☐ ☐ ☐ ☐ Aangenaam

B2 Kunt u de temperatuur op uw werkplek zelf instellen?

Ja ☐ Nee ☐

B3. Hoeveel °C bedraagt de temperatuur tijdens de vroege dienst? _____ °C ☐ weet ik niet

B4. Hoeveel procent van de tijd vindt u dat uw vroege dienst zware lichamelijke inspanning vraagt ?

☐0-10 ☐11-20 ☐21-30 ☐31-40 ☐41-50 ☐51-60 ☐61-70 ☐71-80 ☐81-90 ☐91-100 %

B5. Heeft u zich in de afgelopen 10 dagen tijdens een vroege dienst wel eens zo vermoeid gevoeld dat het uw werkzaamheden bemoeilijkte of onmogelijk maakte?

Ja ☐ Nee ☐

B6. Tijdens een vroege dienst

voel ik me vaak moe

ja, dat klopt | ☐ ☐ ☐ ☐ ☐ ☐ ☐ | nee, dat klopt niet

B7. Tijdens een vroege dienst

ben ik gauw moe

ja, dat klopt | | | | | | | nee, dat klopt niet

B8. Tijdens een vroege dienst voel ik me

vaak fit

ja, dat klopt | | | | | | | nee, dat klopt niet

B9. Tijdens een vroege dienst voel ik

me lichamelijk vaak uitgeput

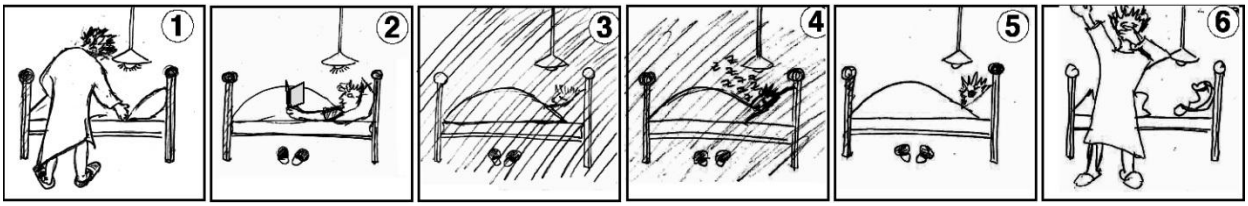
ja, dat klopt | | | | | | | nee, dat klopt niet

MCTQ-NL-ploegendienst

(Münchener Chronotype Vragenlijst)

Vult u a.u.b. alle blokken in, ook als u in niet in loondienst bent

gebruik a.u.b. 24u-tijdschaal: bijvoorbeeld, 17:00 en *NIET* 5.p.m



Op werkdagen met een "vroege dienst" (werktijd ……..u - ……u)

(inclusief de slaap voor de eerste werkdag)

… Ik ga naar bed om _____ uur **(zie cartoon 1)**

… om _____ uur besluit ik te gaan slapen (dwz doe ik mijn ogen dicht) **(zie cartoon 3)**

… Ik heb _____ minuten nodig om in slaap te vallen **(zie cartoon 4)**

… Ik word wakker om_____ uur **(zie cartoon 5)**

zonder wekker ☐ met wekker ☐

… na _____ minuten sta ik ook echt op **(zie cartoon 6)**

Na het opstaan duurt het nog _____ minuten voordat ik mij helemaal wakker voel

Als ik de kwaliteit van mijn slaap een cijfer moet geven dan geef ik een (omcirkel 1 cijfer):	**Slecht**	**Matig**	**Vol-doende**	**Goed**	**Uitste-kend**
	1 2	**3 4**	**5 6**	**7 8**	**9 10**

Hoeveel tijd brengt u gemiddeld buiten door per dag (bij daglicht, niet onderdak)? _____**u** _____**min**

Op de dag met de vroege dienst.

Ik doe vaak nog een dutje en val dan in slaap om ___ uur

Ik word dan wakker en sta op om ___ uur

Op dagen met een vroege dienst:

Eten / Tijd	02:00-06:00 uur	06:00-10:00 uur	10:00-14:00 uur	14:00-18:00 uur	18:00-22:00 uur	22:00-02:00 uur
Vlees, Vis, Schaaldieren, Kaas, Melk, Ei etc	☐	☐	☐	☐	☐	☐
Brood, Bonen, Rijst, Pasta, Aardappelen etc	☐	☐	☐	☐	☐	☐
Groenten, Fruit, Bessen, Wortels etc	☐	☐	☐	☐	☐	☐
Noten, Olijven, Avocado	☐	☐	☐	☐	☐	☐
Slagroom, Sauzen, Chips, Friet, Gefrituurde Snacks etc	☐	☐	☐	☐	☐	☐
Chocolade, IJs, Koekjes, Taart, Snoep, Mars, Toetjes etc	☐	☐	☐	☐	☐	☐
Vruchtensappen etc	☐	☐	☐	☐	☐	☐
Frisdrank (geen light)	☐	☐	☐	☐	☐	☐
Thee, Water, Light Frisdrank	☐	☐	☐	☐	☐	☐
Koffie, Cola, Red Bull of andere cafeïne houdende dranken	☐	☐	☐	☐	☐	☐
Alcoholische dranken	☐	☐	☐	☐	☐	☐
Niets	☐	☐	☐	☐	☐	☐
Heeft u een maaltijd gehad in deze periode? **Zo ja, v**ul een cijfer in: (Licht = 1, matig = 2, zwaar = 3)	___	___	___	___	___	___

C1. Ik vind het moeilijk om me te ontspannen in mijn vrije uren na mijn werk	ja ☐	nee ☐
C2. In mijn vrije uren na het werk ben ik echt op	ja ☐	nee ☐
C3. Mijn baan zorgt dat ik me tijdens de vrije uren na mijn werk nogal uitgeput voel	ja ☐	nee ☐
C4. Na het avondeten voel ik me meestal nog vrij fit	ja ☐	nee ☐
C5. Ik kom meestal pas op een tweede vrije dag tot rust	ja ☐	nee ☐
C6. Het kost mij moeite om me te concentreren in mijn vrije uren na het werk	ja ☐	nee ☐
C7. Wanneer ik zelf net thuis ben gekomen, kan ik weinig belangstelling opbrengen voor andere mensen.	ja ☐	nee ☐
C8 Het kost mij over het algemeen meer dan een uur voordat ik helemaal hersteld ben na mijn werk	ja ☐	nee ☐
C9. Als ik thuis kom moeten ze mij even met rust laten	ja ☐	nee ☐
C10. Het komt vaak voor dat ik in mijn vrije uren na het werk door vermoeidheid niet meer toekom aan andere bezigheden	ja ☐	nee ☐
C11. Het komt voor dat ik tijdens het laatste deel van de werkdag door vermoeidheid mijn werk niet meer zo goed kan doen.	ja ☐	nee ☐