The relationship between sleep timing and smoking behaviour

Research report

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Abstract

Many people have to shift their sleep timing several hours between their workdays and freedays, a phenomenon called social jetlag. Studies indicate that social jetlag contributes to nicotine consumption, and that nicotine consumption in turn contributes to sleep disturbances. The aim of this study was to investigate the relationship between social jetlag and smoking in further detail. In our study this relationship was further investigated in smokers using questionnaires addressing sleep timing, smoking behaviour and lifestyle. Addiction was not affected by sleep timing or sleeping behaviour. Daylight exposure did not affect chronotype or social jetlag. The time between getting up and smoking the first cigarette and the time between smoking the last cigarette and going to sleep, was associated with the amount of cigarettes smoked. Larger social jetlag was associated with an earlier internal time of the last cigarette on workdays and a later internal time of the first cigarette on freedays. Internal time is the biological time point in relation to an individual's chronotype. These findings require follow-up experiments.

Introduction

The human circadian clock

Organisms adapt their daily activities to the natural alternation of day and night. An endogenous circadian clock is present in almost all phyla to produce such daily biological rhythms. In mammals, the circadian clock resides in the suprachiasmatic nucleus (SCN) of the anterior hypothalamus (Weaver, 1998). This endogenous timing system is synchronised to the environment by zeitgebers, a process that is called entrainment (Roenneberg et al. 2003a).

In mammals, the biological clock receives information about the environmental light condition via melanopsin, a photopigment expressed by retinal ganglion and amacrine cells, which project to the SCN via the retinohypothalamic tract (Provencio et al. 2000, 2002; Panda et al. 2002; Moore and Lenn, 1972; Moore, 1973). A molecular feedback loop within SCN cells is the molecular basis of the circadian clock, as is reviewed in (Golombek and Rosenstein, 2010). The circadian clock responds differently to light at different times of the day. Light advances the phase of the circadian clock during the late subjective night and early subjective morning, while light delays the phase of the circadian clock during the subjective evening and early subjective night. During the middle of the subjective day the biological clock does not respond or only little to light pulses, this period of the subjective day is called the dead zone (Roenneberg et al. 2003a).

That light is the most important zeitgeber for the human circadian clock as was illustrated by a German study showing that chronotype was correlated to sun time rather than social time (Roenneberg et al. 2007b). The longer the exposure to outdoor light the more advanced was the sleep period: each additional hour spent outdoors advanced sleep by about 30 minutes (Roenneberg et al. 2003b). Increased exposure to sunlight and decreased exposure to artificial light also advanced sleep times with approximately 1.2 hours and all the measured markers of internal circadian time such as onset, midpoint and offset of melatonin, to approximately 2 hours earlier (Wright et al. 2013). Late chronotypes showed even a larger circadian advance than early chronotypes (Wright et al. 2013). Thus, more exposure to artificial light and less exposure to sunlight delays the circadian clocks of especially late types stronger compared to early types, possibly exacerbating sleep and circadian problems (Wright et al. 2013).

Challenges to entrainment

The coupling between chronotype and sun time is progressively weaker in bigger cities (Roenneberg et al. 2007b). Sleep problems, therefore, might increase in modern society due to a decreased exposure to natural light. Data assessed using the MCTQ (Munich ChronoType Questionnaire) showed that sleep duration has decreased over the past decade due to a shortening of sleep duration on workdays (Roenneberg et al. 2012). In addition, chronotype was delayed over the last decade which was accompanied by a decrease in time spent outdoors (Roenneberg et al. 2012). This delay of chronotype could be explained by decreasing zeitgeber strength (Roenneberg et al. 2012).

Social jetlag

Individual sleep timing often is constrained by work schedules. Early work schedules lead to sleep debt over the workweek in especially late chronotypes which is compensated by sleeping longer on work-freedays. Many people have to shift their sleep and activity times several hours between workdays and freedays, which is comparable to jetlag. An investigation in 55.000 people showed that sleep timing differs between freedays and workdays: average wake-up time on free-days was 8:45 a.m., but was on average two hours earlier on workdays and average sleep-onset was around 00:30 a.m. at freedays, but was only 50 minutes earlier on workdays (Roenneberg et al. 2007a). This phenomenon is called 'social jetlag' (Wittmann et al. 2006).

Late chronotypes, who have to readjust their sleep timing to social demands, suffer most from social jetlag (Wittmann et al. 2006). Especially adolescents tend to be very late chronotypes (Carskadon et al. 1999; Giannotti et al. 2002; Roenneberg et al. 2003b). However, social jetlag is also present in early chronotypes on freedays when they stay up late without the possibility to sleep longer the next morning due to their early wake-up time (Wittmann et al. 2006).

The consequences of social jetlag

Social jetlag may impact our daily functioning and health negatively. Social jetlag is associated with obesity (Roenneberg et al. 2012), increased morning heart rate in shift-workers (Kantermann et al. 2013), higher depression scores (Levandovski et al. 2011) and with impaired academic performance (Haraszti et al. 2014).

Social jetlag is also strongly correlated with the probability of smoking cigarettes (Wittmann et al. 2006). Wittmann and colleagues showed that social jetlag rather than chronotype is responsible for this correlation: when the percentage of smokers is plotted against social jetlag instead of chronotype, the distribution changes from an asymmetrical U-shape function into a linear trend (Wittmann et al. 2006). Further support for this idea comes from the age group of elderly which is characterized by a more early chronotype compared to younger age groups. In this age group the chance of being a smoker only correlated with social jetlag and not with chronotype (Wittmann et al. 2006). However, there are also studies showing that smoking habits are influenced by chronotype (Adan 1994; Kabrita et al. 2014).

Interestingly, only the probability of being a smoker and not the quantity of cigarettes was positively correlated to the amount of social jetlag (Wittmann et al. 2006). Wittmann and colleagues suggested that having started to smoke or not having been able to quit are the smoking-related parameters affected by social jetlag. Further indirect support comes from a study in nurses showing that nurses who work in night shifts have a higher chance of being a smoker (Trinkoff and Storr, 1998), suggesting that a chronic challenge to the circadian clock increases the use of nicotine (Hasler et al. 2012b). However, also a chronic lack of sleep could contribute to the increased use of nicotine.

Further support for a relationship between social jetlag and the probability of smoking comes from the age category of puberty and adolescence, which tend to be late chronotypes (Carskadon et al. 1999; Giannotti et al. 2002; Roenneberg et al. 2003b) and is most challenged by social jetlag (Wittmann et al. 2006). Wittmann and colleagues point to the fact that the amount of smokers peaked between the ages of 20 to 25 years old and decreases thereafter together with social jetlag that decreases due to an age-related advance in chronotype (Wittmann et al. 2006). Furthermore, a later chronotype was associated with more cigarette use in adolescence (Negriff et al. 2011). Adolescents experiencing a greater social jetlag also showed reduced activation in both cortical and subcortical reward-related brain regions (Hasler et al. 2012a). Although caution must be taken into consideration, this indicates that circadian misalignment also might contribute to altered reward function, substance use and other risk-taking behaviours (Hasler et al. 2012a).

Nicotine and the circadian clock

There is evidence that nicotine affects circadian rhythmicity. Circadian rhythmicity seems to be different in smokers compared to non-smokers (Adan and Sánchez-Turet, 1995, 2000; Adan et al. 2004). Optimal moments of high activation and good mood occurred later in smokers than in non-smokers (Adan and Sanchez-Turet, 2000). The amount of addiction also influenced the rhythm in the levels of mood and activation. A comparison of non-smokers, low-dependent and high dependent smokers showed that non-smokers had highest levels of activation in the morning while they showed lowest levels of activation in the evening, but high-dependent smokers showed the opposite pattern (Adan et al. 2004). Rhythmicity in cardiovascular parameters was also different in smokers compared to non-smokers: heart rate peaked an hour later in smokers, and blood pressure tended to be at the maximum in the afternoon-evening for smokers while it was at its maximum in the morning in non-smokers (Adan and Sánchez-Turet, 1995). These differences in rhythmicity between smokers and non-smokers might indicate a difference in chronotype.

Interestingly, nicotine consumption also has a circadian pattern. When smokers were asked which cigarette they would miss the most, 44% indicated the after-dinner cigarette, followed by the first cigarette in the morning chosen by 33%, while 23% indicated another cigarette (Jarvik et al. 1993). Most smoking occurred between 07:00 and 09:00 in the morning and between 21:00 and 23:00 (Chandra et al. 2007). Thus, smoking tends to be the first thing in the morning and the last thing before sleep for most smokers (Chandra et al. 2007).

Furthermore, in rats single and multiple daily nicotine injections (Gillman et al. 2008; 2010) were able to induce a circadian locomotor activity pattern that persisted when nicotine was withheld. Only a higher dose of nicotine (1.0 mg/kg) produced episodic entrainment, although the lower doses could be able to produce entrainment if administered for a longer period of time (Gillman et al. 2013).

However, there is also evidence that nicotine directly affects the timing of the circadian clock in the suprachiasmatic nucleus (SCN). An *in vitro* study showed that nicotine advanced the phase of the SCN (Trachsel et al. 1995), while *in vivo* studies showed that nicotine induced both phase advances and delays in the SCN like light-pulses do (Miller et al. 1987; Ferguson et al. 1999). The site of pharmacological stimulation was crucial for the effect on the phasing of circadian rhythms: direct cholinergic stimulation on the SCN with carbachol induced phase advances during subjective night while indirect cholinergic stimulation of the SCN with carbachol induced a biphasic phase-response similar to light (Buchanan and Gillette, 2005). Interestingly, most cigarettes are also shown being smoked when nicotine is most effective (Chandra et al. 2007). These studies all suggest that nicotine consumption affects the circadian rhythm.

Aim of the study

These studies discussed above indicate that circadian disturbance contributes to nicotine consumption, but that nicotine consumption in turn contributes to circadian disturbance. It might be interesting to integrate chronobiological aspects into drug prevention and addiction treatment (Adan 2013). Circadian rhythms may be realigned and reinstated by environmental and lifestyle changes like temporally structured light-exposure, meals and exercise (Schroeder and Colwell, 2013), which may also be relevant for smoking cessation. This could lead to supplementing current substance abuse treatments which focus on sleep and circadian interventions (Hasler et al. 2012b).

The aim of my study was to investigate the relationship between social jetlag and smoking in further detail.

- I expected that cigarette consumption on workdays and freedays, and also average cigarette consumption do not correlate with chronotype, social jetlag or any other sleeping behavior as was found by Wittmann and colleagues (Wittmann et al. 2006).
- I expected that the first cigarette is consumed earlier to overcome the effects of sleep loss, sleep inertia, short sleep duration on workdays and might also be correlated with social jetlag and chronotype.
- In addition I expected that the last cigarette is consumed to relax before going to sleep and is correlated with chronotype and social jetlag. Later consumption of the last cigarette before going to sleep might also induce sleeping problems like higher sleep loss and a longer sleep latency.
- Furthermore, I expected that the last and first cigarette also act as a zeitgeber. I hypothesized that a later internal timing of both the first and last cigarette was correlated with chronotype and social jetlag.
- Finally, I expected that as light acts as a zeitgeber, more exposure to sunlight correlates with an earlier chronotype and a smaller social jetlag.

Material and Methods

Participant recruitment

Our study was based on 21 subjects (11 women and 10 men) recruited between September and November 2014. Volunteers who were planning to quit smoking were approached to participate in the study via the University Medical Centre Groningen general practice, other general practices and also via Dutch companies who support people to quit smoking. In addition, participants were also recruited by advertisement in public areas. Volunteers were eligible to participate in the study if they were current and healthy smokers, and aged 18 years or older, but participants were excluded if they traveled over two time zones or more in the month prior to the study, if they performed shift work in the last two years, if they consumed more than five alcoholic drinks per day, or more than eight caffeinated drinks or if they used other drugs regularly. The study protocol was approved by the Medical Ethical Commission of the University of Groningen.

Questionnaires

All participants filled out the Munich ChronoType Questionnaire (MCTQ). Mid-sleep on freedays (MSF), mid-sleep on workdays (MSW), sleep duration on workdays, sleep duration on freedays, average sleep duration during the week, sleep inertia on workdays and on freedays, and sleep latency on workdays and on freedays were calculated from entries to the MCTQ. Sleep loss was calculated from the difference between sleep duration on workdays and freedays (see page 8). Chronotype was estimated by the mid-point between sleep onset and sleep end on freedays (MSF), which was calculated from the MCTQ. Because sleep debt during workdays leads to longer sleep on freedays also MSF is later (Roenneberg et al. 2003b). We corrected for these excessive freedays sleep durations, based on the individual (weekly) average sleep need (see page 8). The resulting sleep-corrected mid-sleep on freedays (MSF_{sc}) is used as the indicator for chronotype (Roenneberg et al. 2003b). Social Jetlag was calculated as the absolute difference between MSF and MSW (Wittmann et al. 2006).

In addition, all participants also filled out a general questionnaire. This questionnaire addressed their daily light exposure and their smoking behaviour. All smoking behaviors were subtracted from the general questionnaire: average cigarette consumption per day, cigarette consumption per workday, cigarette consumption per free day, the time between getting up and smoking the first cigarette and the time between the last cigarette and going to sleep. The time point of the first cigarette corrected for internal time on workdays and freedays and the time point of the last cigarette corrected for internal time on workdays and freedays were also calculated (see page 8).

Formulas

Sleep duration on workdays = Sleep end on workdays - Sleep Onset on workdays
Sleep duration on freedays = Sleep end on freedays - Sleep Onset on freedays
Sleep duration during the week = ((Workdays * Sleep duration on workdays) + ((7-Workdays) * Sleep duration on freedays))/7
Sleep loss during the week =
If average sleep duration of the week > sleep duration on workdays: (Average sleep duration of the week - Sleep duration during workdays) * Workdays
If average sleep duration of the week ≤ sleep duration during workdays: (Average sleep duration of the week - Sleep duration during freedays)*(7-Workdays)
MSF = Sleep Onset on Freedays + (Sleep duration on Freedays/2)
MSW = Sleep Onset on Workdays + (Sleep duration on Workdays/2)
MSF_{sc} =
If Sleep duration on Freedays > Sleep duration on Workdays: MSF - (Sleep duration on Freedays - Average sleep duration of the week)
If Sleep duration on Freedays≤ Sleep duration on Workdays: MSF
Social Jetlag = |MSF - MSW|
First cigarette on workdays (Internal Time) = Sleep end on workdays + Sleep inertia on workdays + First cigarette (hours)- MSF_{sc}
Last cigarette on workdays (Internal Time) = Sleep onset on workdays - MSF_{sc} - Last cigarette (hours) - Sleep latency on workdays
First cigarette on freedays (Internal Time) = Sleep end on freedays + Sleep inertia on freedays + First cigarette (hours) - MSF_{sc}
Last cigarette on freedays (Internal Time) = Sleep onset on freedays - MSF_{sc} - Last cigarette (hours) - Sleep latency on freedays

Data and Statistics

Data analysis was performed using IBM SPSS Statistics version 22. First normality and equal distribution of residuals were tested for the following parameters by IBM SPSS Statistics version 22: average cigarette consumption per day, age, MSF_{sc}, MSF, MSW, social jetlag, sleep duration during the week, sleep duration on workdays, sleep duration on freedays, sleep loss during the week, sleep inertia on workdays, sleep latency on workdays, sleep inertia on freedays, sleep latency on freedays, average daylight exposure, first cigarette (hours), last cigarette (hours), the internal timing of the first cigarette on workdays and freedays, the internal timing of the last cigarette on workdays and freedays, the time in between the first and last cigarette on workdays and on freedays.

Participants were divided into two groups for each parameter separately for Mann-Whitney U tests: average cigarette consumption per day (cutting point: 6 cigarettes per day); cigarette consumption on workdays (cutting point: 6 cigarettes per working day), cigarette consumption on freedays (cutting point: 6 cigarettes per free day), chronotype (Cutting point: MSF_{sc}=4,54); social jetlag (Cutting point: social jetlag = 1,00 hour), age (Cutting point: age = 33,21 years) and average daylight exposure (Cutting point: 2,00 hours/day). Mann-Whitney U-tests were performed on average cigarette consumption groups, chronotype groups, social jetlag groups, age groups and average daylight exposure groups. Spearman's rho correlation was performed on all correlations that were not normally distributed. Partial correlation was performed using average cigarette consumption per day as a dependent variable and MSF_{sc} and social jetlag as independent variables with duration of smoking as a covariate. Power analysis was performed by Gpower 3.1.9.2 on the Mann-Whitney U tests to indicate the power and estimate the needed sample size for follow-up studies.

Results

Participant characteristics

	Average	SEM	Min	Max
Age (years)	36,3	3,1	18,9	66,6
Age smoking initiation (years)	17,9	1,4	14,0	43,0
Chronotype (MSF_{sc}, hours)	4,8	0,3	3,5	7,8
Social Jetlag (hours)	1,2	0,2	0,0	3,7
Sleep duration during the week (hours/day)	7,4	0,2	6,1	9,5
Time being a smoker (years)	15,9	3,0	1,0	50,0
Number of quit attempts	1,7	0,5	0,0	10,0
Average cigarette consumption (cigarettes/day)	8,5	1,3	0,6	25,0

Table 1: Participant characteristics given as average, standard error of the mean (SEM) and the minimum (Min) and maximum (Max) values of the sample.

Chronotype and age

Mann-Whitney U tests showed that participants in the older age group had less social jetlag than the younger age group (p=0,016). Spearman rho's analysis further supported that social jetlag decreased with age (p=0,002;r=-0,629) (Fig.1). Mann-Whitney U tests showed that participants in the older age group slept shorter on freedays than the younger age group(p=0,024). Spearman rho's analysis further supported that sleep duration on freedays decreased with age (p=0,001;r=-0,657) (Fig. 2). Mann-Whitney U tests showed that participants in the older age group had a trend towards an earlier MSF (p=0,072) compared to the younger age group. Spearman rho's analysis showed that MSF did not become earlier with age (p=0,486;r=0,161) (Fig.3). Mann-Whitney U-tests showed that the older age group smoked for more years (p=0,020). Spearman rho's analysis showed that duration of smoking increased with age (p=0,002;r=0,638).

Mann-Whitney U tests showed that the age groups did not differ with respect to chronotype (p=0,152), MSW (p=0,918), average sleep duration during the week (p=0,197), sleep duration on workdays (p=0,756), sleep loss (p=0,468) and average cigarette consumption (p=0,918). Mann-Whitney U tests further showed that the group with more average daylight exposure did not differ from the group with less average daylight exposure with regard to chronotype (p=0,654) and social jetlag (p=0,577). Mann-Whitney U tests showed that late and early chronotypes did not differ with respect to social jetlag (p=0,756), sleep duration during the week (p=0,387), sleep duration on workdays (p=0,605) and on freedays (p=0,557) and sleep loss (p=0,349).

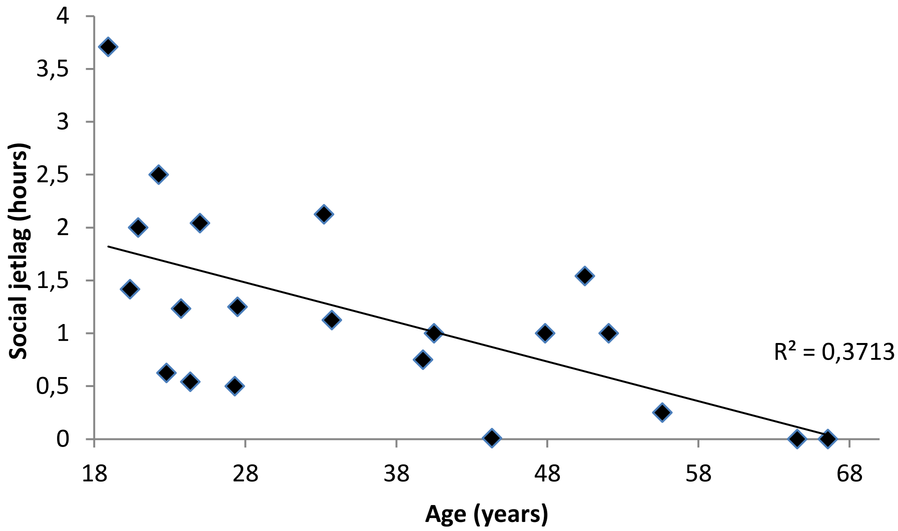

Figure 1: The relationship between age and social jetlag.

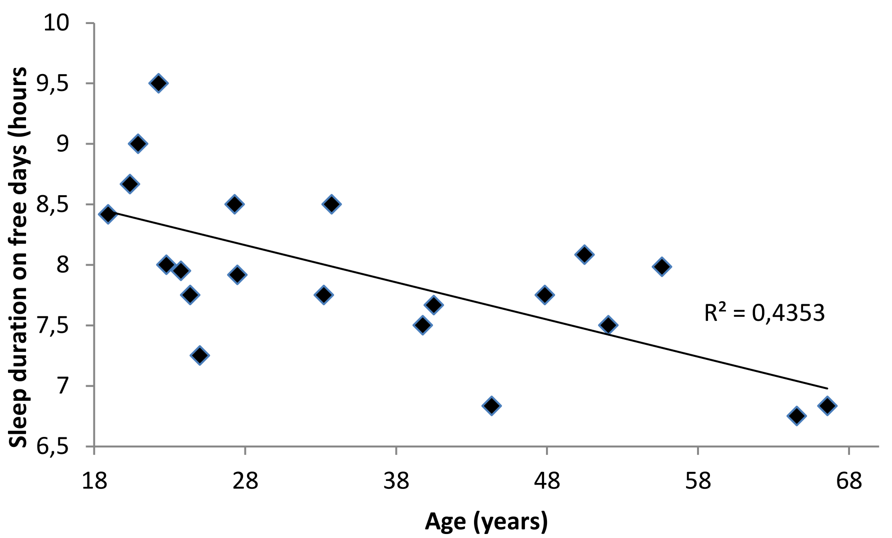

Figure 2: The relationship between age and sleep duration on freedays.

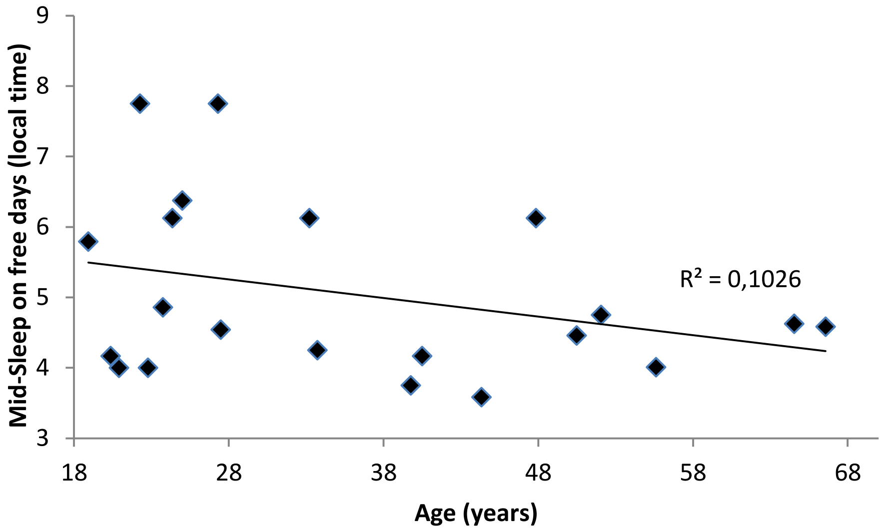

Figure 3: The relationship between age and mid-sleep on freedays.

Cigarette consumption

Mann-Whitney U-analysis showed that the number of years being a smoker showed a trend of being higher in the high cigarette consumption group compared to the low cigarette consumption group (p=0,072) . Spearman rho's correlation showed that average cigarette consumption increased with more years being a smoker (p=0,037; r=0,457) (Fig. 4). The high cigarette consumption group did not differ from the low cigarette consumption group in chronotype (p=0,152), social jetlag (p=0,132), sleep duration of the week (p=0,918), sleep loss during the week (p=0,387) and age starting with smoking (p=0,114). Even when smoking duration was added as a covariate in a partial correlation did not show a correlation between average cigarette consumption and chronotype (p=0,205;r=0,296) or social jetlag (p=0,847;r=0,046).

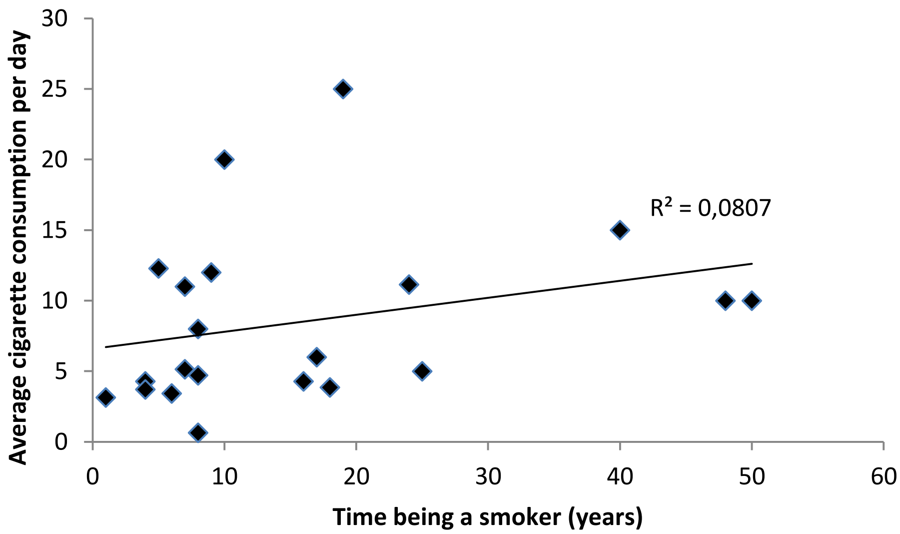

Figure 4: The relationship between duration of smoking and the average cigarette consumption.

Mann-Whitney U-test showed that the high cigarette consumption on workdays group had a later MSW (p=0,029). Spearman rho's correlation also showed that MSW is later with a higher cigarette consumption on workdays (p=0,026;r=0,486) (Fig. 6). Mann-Whitney U-test showed that the high cigarette consumption on workdays group tended to be smokers for a longer time (p=0,072) than the low cigarette consumption on workdays group. Spearman rho's correlation also showed that cigarette consumption on workdays increased with the time being a smoker (p=0,036; r=0,459) (Fig. 5). Mann-Whitney U-tests showed that both groups of cigarette consumption on workdays did not differ with respect to social jetlag (p=0,132), sleep loss during the week (p=0,387), sleep duration on workdays (p=1,000), age of smoking initiation (p=0,114), and chronotype (p=0,152).

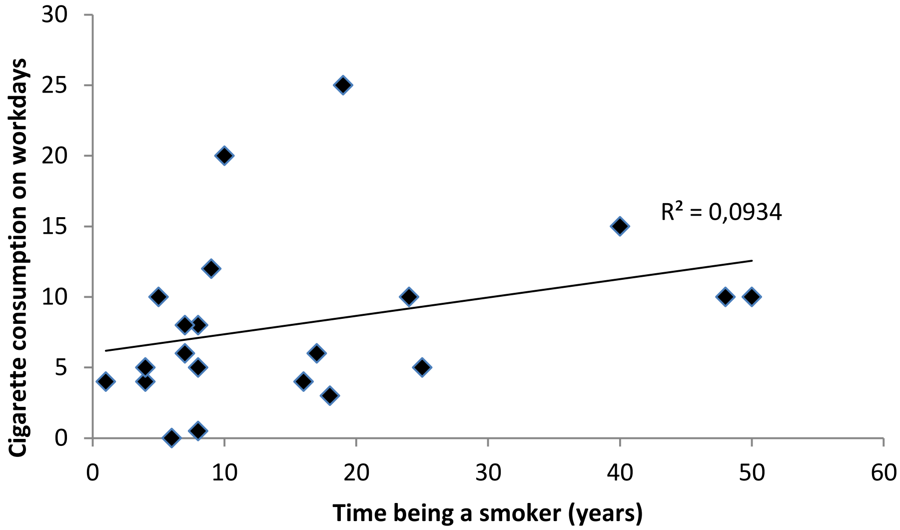

Figure 5: The relationship between duration of smoking and the cigarette consumption on workdays.

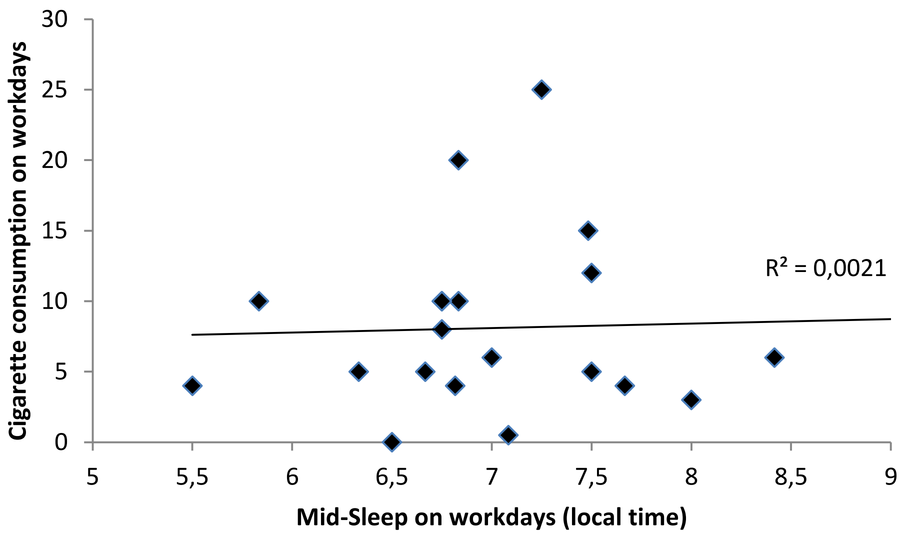

Figure 6: The relationship between mid-sleep on workdays and cigarette consumption on workdays.

Mann-Whitney U-tests showed that the number of years being a smoker tended to be longer in the high cigarette consumption on freedays group compared to the low cigarette consumption on freedays group (p=0,072). Spearman rho analysis also showed that there was a trend towards higher cigarette consumption on freedays with more years being a smoker (p=0,056;r=0,423) (Fig.7). Mann-Whitney U-tests showed that both groups did not differ with respect to chronotype (p=0,152), social jetlag (p=0,132), MSF (p=0,173), sleep loss during the week (p=0,387), sleep duration on freedays (p=0,468) and age of starting with smoking (p=0,114).

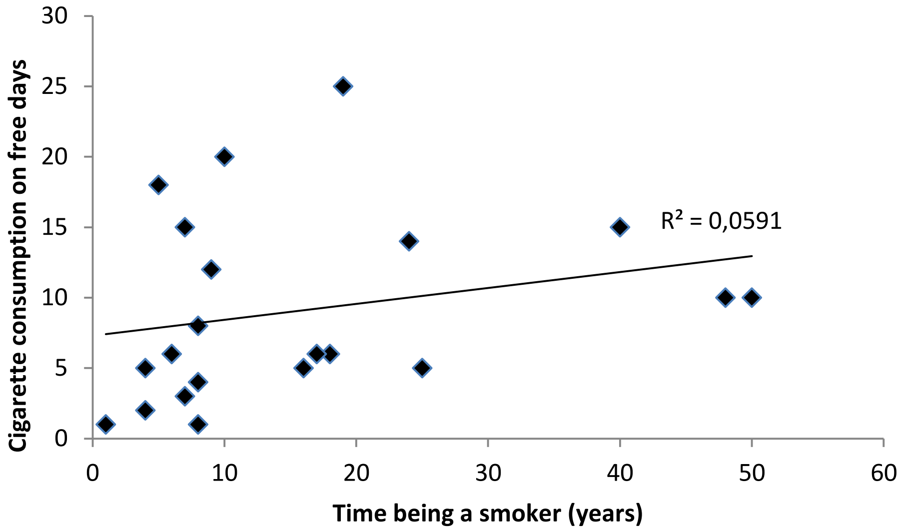

Figure 7: The relationship between duration of smoking and cigarette consumption on freedays.

The timing of the first and last cigarette

Mann-Whitney U-tests showed that the high average cigarette consumption group had a shorter time between getting up and smoking the first cigarette (p=0,000), and a shorter time between smoking the last cigarette and going to sleep (p=0,024) compared to the low average cigarette consumption group. Spearman rho correlation also showed a significant relationship between higher average cigarette consumption and the time in between getting up and smoking the first cigarette (p=0,000;r=-0,820) (Fig. 8). Spearman rho analysis showed that a shorter time in between smoking the last cigarette and going to sleep significantly correlated with higher average cigarette consumption per day (p=0,017;r=-0,516) (Fig. 9). Spearman rho's analysis did not show a correlation between the time between getting up and smoking the first cigarette and sleep loss (p=0,811;r=0,056). Spearman rho's analysis did not show a correlation between the time between getting up and smoking the first cigarette and sleep inertia (p=0,753;r=-0,073). Spearman rho analysis did not show a correlation between the time between smoking the last cigarette and falling asleep and sleep loss (p=0,552;r=-0,138), sleep duration (p=0,534;r=0,144), sleep latency on workdays (p=0,269;r=0,253) and sleep latency on freedays (p=0,612;r=0,117). Mann-Whitney U tests showed that late and early chronotypes did not differ in the time in between getting up and smoking the first cigarette (p=0,809), and the time in between smoking the last cigarette and going to sleep (p=0,605). Mann-Whitney U tests showed that the groups with high and low social jetlag did not differ with regard to the time in between getting up and smoking the first cigarette (p=0,314), and the time between smoking the last cigarette and going to sleep (p=0,314).

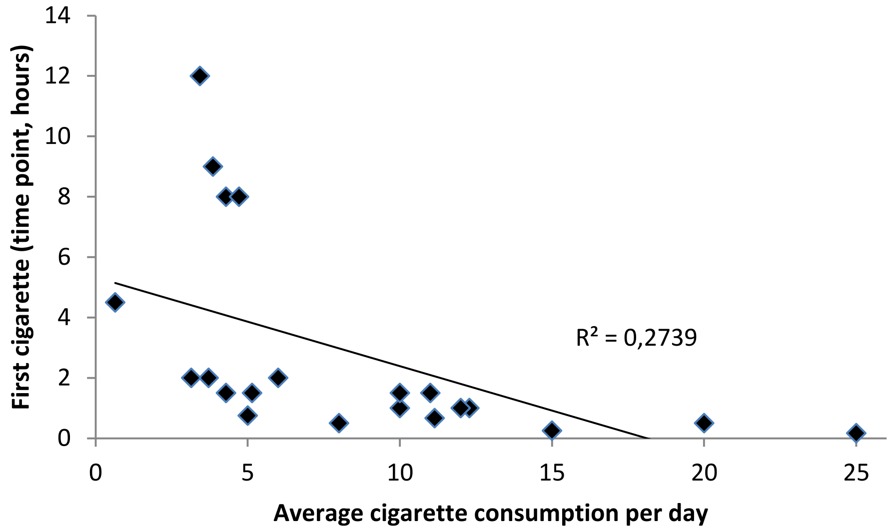

Figure 8: The relationship between average cigarette consumption per day and the time between getting up and smoking the first cigarette.

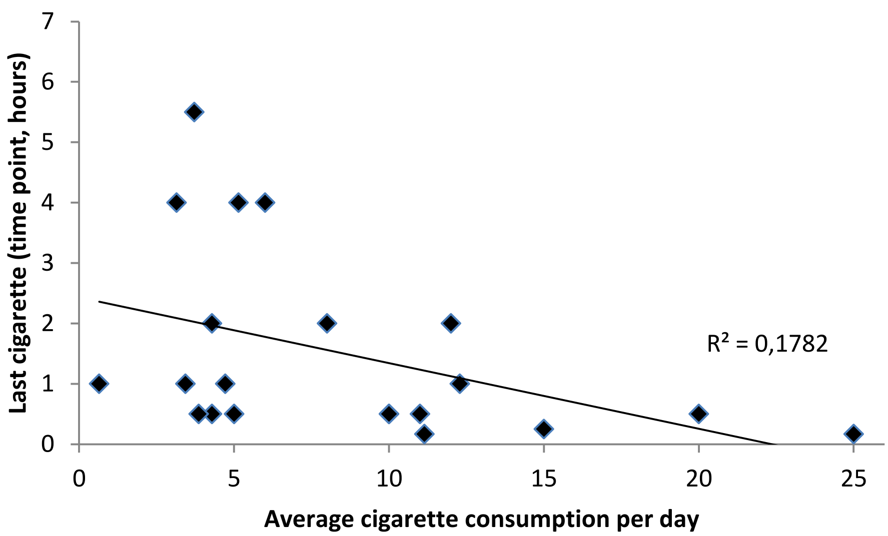

Figure 9: The relationship between average cigarette consumption per day and the time between smoking the last cigarette and going to sleep.

The internal time of smoking was calculated as the biological time point of the consumption of the cigarette in relation to chronotype. The group with high social jetlag showed a significantly earlier internal time of the last cigarette on workdays (p=0,020) and a trend towards a later internal time of the first cigarette on freedays (p=0,051) in comparison with the group with a small social jetlag. Spearman rho analysis showed that social jetlag correlated with a later time of the first cigarette on freedays(p=0,005;r=0,593) (Fig. 10) and an earlier internal time of the last cigarette on workdays (p=0,012;r=-0,539) (Fig. 11). Both social jetlag groups did not differ with regard to the internal time of the first cigarette on workdays (p=0,557), and the internal time of the last cigarette on freedays (p=0,114). Late and early chronotypes did not differ with respect to the internal time of the first cigarette on workdays (p=0,512) and on freedays (p=0,863),and to the internal time of the last cigarette on workdays (p=0,349) and freedays (p=0,426).

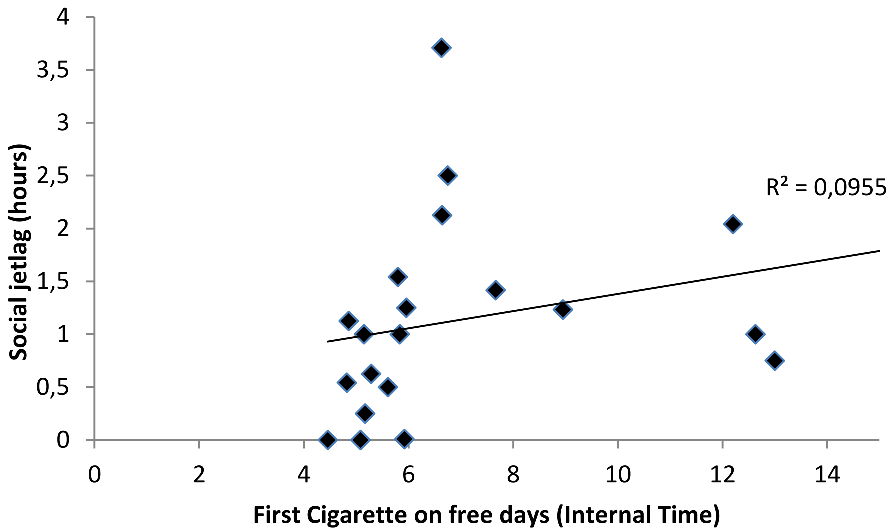

Figure 10: The relationship between the internal time of the first cigarette on freedays and social jetlag.

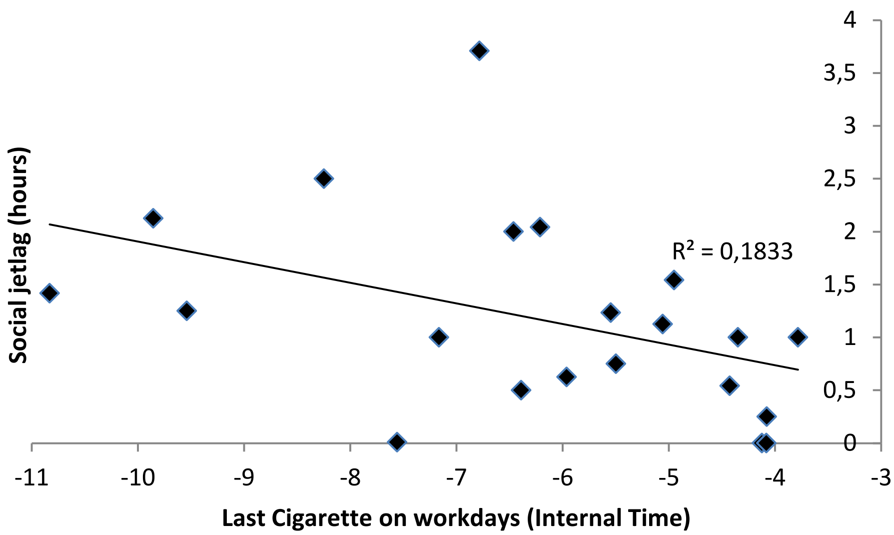

Figure 11: The relationship between the internal timing of the last cigarette on workdays and social jetlag.

Discussion

Recently, Wittmann and colleagues found a relationship between social jetlag and the chance of being a smoker (Wittmann et al. 2006). In my pilot-study I investigated the relationship between smoking behaviour and social jetlag in further detail. For this purpose we investigated sleep timing and smoking behaviour in twenty-one volunteers by a MCTQ and a general questionnaire.

Both social jetlag and sleep duration on freedays decreased significantly with age. Cigarette consumption was not affected by sleep behaviour. Cigarette consumption increased with smoking duration. Higher average cigarette consumption correlated with a shorter time between getting up and smoking the first cigarette, and with a shorter time between smoking the last cigarette and going to sleep. Larger social jetlag correlated with a later internal time of the first cigarette on freedays and an earlier time of the last cigarette on workdays.

Social jetlag and sleep duration on freedays decreased with age, while MSF became earlier with age, in my sample. This decrease in social jetlag with age is in accordance with the fact that especially teenagers and young adults have higher social jetlag (Carskadon et al. 1999; Giannotti et al. 2002; Roenneberg et al. 2003b). However, there was no correlation between age and chronotype (MSF_{sc}), in contrast to earlier findings showing that chronotype becomes earlier with age (Roenneberg et al. 2007a). Chronotype was not correlated with social jetlag and sleep loss in my sample. This is not in agreement with the findings that especially later chronotypes are most affected by social jetlag and also built up a bigger sleep debt on workdays (Carskadon et al. 1999; Giannotti et al. 2002; Roenneberg et al. 2003b, Wittmann et al. 2006). No correlation was found between average daylight exposure on the one hand and chronotype and social jetlag on the other hand. This is in contrast to earlier studies showing that daylight exposure advances chronotype (Roenneberg et al. 2003b, 2007b, 2012; Wright et al. 2013).

Average cigarette consumption per day only correlated with years being a smoker and not with chronotype, social jetlag, sleep loss and the average sleep duration. This indicates that addiction worsens with a longer smoking duration. These findings are also in accordance with earlier findings suggesting a correlation between social jetlag and chronotype and the chance of being a smoker but not with cigarette consumption (Wittmann et al. 2006). Wittmann and colleagues concluded that it might be that social jetlag and chronotype affect the chance of becoming a smoker positively or weaken the chance to quit smoking successfully. The lack of a correlation between cigarette consumption and sleep timing in my study might also be explained by the variation added by duration of smoking. However, including duration of smoking as a covariate did not substantially alter the findings. Mann-Whitney U tests did not reveal differences between both cigarette consumption groups except a smaller time in between getting up and smoking the first cigarette, and a smaller time between smoking the last cigarette and going to sleep. However, because of the small sample size it cannot be excluded that participants with smaller cigarette consumption weakened the correlations.

Cigarette consumption on workdays and freedays also increased with smoking duration. Higher cigarette consumption on workdays was correlated with a later MSW. However, it remains to be shown in future studies why cigarette consumption on freedays did not correlate with MSF, or why average cigarette consumption did not correlate with MSF_{sc}. The cigarette consumption on workdays and freedays did not correlate with any other parameter assessed. Because average cigarette consumption per day is calculated from workday consumption and free day cigarette consumption, it is likely that no significant correlations were found because of the same reasons as for average cigarette consumption per day.

The more cigarettes participants smoked the earlier the first cigarette is consumed after getting up, and the later the last cigarette is consumed before going to sleep. Assuming that the number of cigarettes is an indicator of addiction, this finding here suggests that the timing of the first and last cigarette were mainly determined by the strength of addiction. There might be a couple of reasons for the lack of correlations between the timing of the first and last cigarette and the sleep variables. Timing of both the first and last cigarette might be more variable on a day-to-day basis than suggested by a single measurement. Furthermore, the complete cigarette consumption over the day might be more important than only the timing of the first and last cigarette. Last, the participants might have interpreted the questions differently. Some participants might have confused waking up with getting up, and also falling asleep with going to sleep.

The larger the social jetlag, the later the internal time of the first cigarette on freedays. This was in accordance with our expectations. However, no relationship between social jetlag and internal time of the first cigarette on workdays was found. Also no relationship between chronotype and internal time of the first cigarette on both workdays and freedays was found. These findings are in contrast with the idea that the first cigarette might affect the circadian clock and indirectly also social jetlag. Larger social jetlag also correlated with an earlier internal time of the last cigarette on workdays but not on freedays. This was in contrast to our expectations, but a couple of reasons might explain these results. The internal time of smoking was an indirect measurement calculated from the difference between getting up and smoking the first cigarette, smoking the last cigarette and going to sleep, the time point of getting up/going to sleep and the MSF_{sc}. The data might be influenced by social jetlag due to the calculations, as the timing of the first and last cigarette was not measured for workdays and freedays separately. The larger the social jetlag, the earlier was the internal time of both the first and last cigarette on workdays. This might explain the correlation between an earlier internal time of the last cigarette on workdays and a larger social jetlag. However, it does not explain the correlation between a later time of the first cigarette on freedays and a larger social jetlag. Also the daily variation in timing of sleep and smoking was not captured in the questionnaires. Therefore, it is likely that the circadian clock is not only affected by the first and last cigarette on the day, but also by the other consumed cigarettes.

This study also has some limitations. Our sample of twenty-one participants was small so that it is better to replicate this study in a larger sample. That I did not replicate the earlier correlation between chronotype and other parameters might be related to the small sample size. In addition, chronotype was also not normally distributed, suggesting that our sample does not reflect the general population (Roenneberg et al. 2007a). For example, to find a relationship between cigarette consumption on the one hand and both social jetlag and chronotype one would need a sample size of 300 participants (calculated by GPower 3.1.9.2). Although Mann-Whitney U-test did not find a difference between the low and high cigarette consumption group, it cannot be excluded that participants who smoked less cigarettes weakened the correlations. For a follow-up study it is better to include only smokers with a minimum amount of cigarette consumption per day, and a non-smoker control group. The reliability of our sample might also be restricted because of the heterogeneity in age and years being a smoker. Because years being a smoker might affect cigarette consumption and is also positively related with age, while social jetlag decreases with age, this might have interfered with other correlations, especially the relationship between social jetlag and cigarette consumption. Furthermore, the fact that we also included young adult students with probably a more flexible work schedule than employees might also weaken the correlations between chronotype and social jetlag and sleep loss. Measurements might be more reliable when the population is split up in different age categories or is only investigated in a certain narrow age range. Our questionnaires only provided rough estimates of the measured parameters as it sleep timing and behaviour might vary on a daily basis and also with season. In addition, also the cigarette consumption pattern might vary on a daily basis. To capture these daily variations it might be useful to replicate this research in a prospective study on a daily basis. Because this study used retrospective questionnaires this automatically creates response and memory bias. The duration of sleep inertia and latency might be difficult to estimate as people are less conscious during this period between waking and sleeping. Also the time in between getting up and smoking the first cigarette, and the time between smoking the last cigarette and going to sleep might not be precise estimations, as participants might have confused getting up with waking up, and also might confuse going to sleep with falling asleep. It might be useful to measure the whole daily cigarette consumption, as the biological clock might not only be affected by the first and the last cigarette. Daily measurements of cigarette consumption will provide a more reliable measurement of the internal timing of cigarette consumption than the calculation used in this study.

Conclusions

The strength of addiction was not affected by chronotype, social jetlag or any of the other sleeping parameters I assessed. Daylight exposure did not influence chronotype or social jetlag. The timing of both the first and last cigarette was mainly affected by the amount of addiction. An earlier internal time of the last cigarette on workdays and a later internal time of the first cigarette on freedays were correlated with higher social jetlag. These relationships might indicate an effect of cigarette consumption on social jetlag. For a follow-up study I recommend to investigate a larger sample size, restricted to a certain age category and a minimal amount of cigarette consumption. A follow-up study could be performed with a prospective set-up with measurements on a daily basis. Furthermore, it will also proof efficient to investigate the complete cigarette consumption across full days.

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Supplemental material

Recruitment letter

De effecten van stoppen met roken op de timing van slaap

Proefpersoon informatie
Voordat u beslist om deel te nemen nodigen wij u uit om deze informatie te lezen zodat u weet wat meedoen met dit onderzoek voor u betekent en u een weloverwogen besluit kunt nemen. Lees deze informatie goed door. Als u nog vragen hebt dan kunt u die altijd stellen aan de onderzoeker (contact informatie vindt u aan het eind van deze brief).

Wie zijn wij?
Wij zijn een team van onderzoekers van de Rijksuniversiteit Groningen (RuG), het UMC Groningen en de Ludwig-Maximilians Universiteit (LMU) München. De hoofdonderzoekers zijn Dr. Thomas Kantermann (RuG), Assistant Prof. Dr. Janwillem Kocks (UMCG), Prof. Dr. Till Roenneberg (LMU), Giulia Zerbini (RuG) en Arjan de Boer (RuG). Ons team heeft veel ervaring met het doen van onderzoek op het gebied van slaap en fysiologie, zowel in het laboratorium als in de wereld daarbuiten.

Wat is het doel van het onderzoek?
Veel rokers hebben last van slaapproblemen, en mensen die stoppen met roken merken verbeteringen van deze slaapproblemen. De timing van slaap is belangrijk voor goede slaap. Mensen die op verschillende tijden slapen op werkdagen en vrije dagen hebben meestal last van slaap problemen. Daarbij komt dat mensen die op verschillende tijden slapen op werkdagen en vrije dagen meer kans hebben om te roken. In dit onderzoek willen we het verband tussen onregelmatige slaaptijden en de kans om te roken verder onderzoeken.

Komt u in aanmerking voor deelname aan dit onderzoek?
Er kunnen aan dit onderzoek alleen mannen en vrouwen in de leeftijd van 18 jaar en ouder deelnemen.

Als één of meerdere van de onderstaande zaken op u van toepassing zijn, kunt u **NIET** meedoen:

- U heeft gereisd over 2 tijdzones of meer in de maand voorafgaand aan de studie
- U werkt of heeft in ploegendienst gewerkt in de 2 jaren voorafgaand aan de studie
- U gebruikt veel alcohol, drugs of cafeïne bevattende drankjes (ter beoordeling van de onderzoeker)
- U bent chronisch ziek (ter beoordeling van de onderzoeker)

Bent u verplicht om deel te nemen aan dit onderzoek?
U beslist zelf of u meedoet aan het onderzoek. Deelname is geheel vrijwillig. Als u wel meedoet, kunt u zich altijd bedenken en toch nog stoppen. Als u besluit niet mee te doen, hoeft u verder niets te doen. U hoeft niets te tekenen. U hoeft ook niet te zeggen waarom u niet wilt meedoen. Als u wel beslist om mee te doen kunt u deze informatie bewaren.
We zullen u vragen om een toestemmingsformulier te tekenen waarmee u aangeeft toe te stemmen in deelname aan de studie. U blijft de vrijheid behouden om wegens voor u relevante redenen uw medewerking te stoppen.

Wat gebeurt er als u beslist om deel te nemen?
Als u toestemt om mee te doen aan deze studie, zult u onze enquêtes krijgen via uw de UMC huisartsenpraktijk of per post. De enquêtes kunt u terugsturen naar de UMC Groningen huisartspraktijk.

De deelnemers vragenlijst
Bij het begin van de studie zal u een vragenlijst worden voorgelegd voor het vastleggen van enige persoonlijke gegevens (zoals leeftijd, geslacht, lengte en gewicht), uw persoonlijke slaapgewoontes, uw algehele gezondheid, uw rookgewoontes en uw werktijden. Verder zullen we u eenmalig vragen een vragenlijst in te vullen naar uw slaapgewoontes (de Munich ChronoType Questionnaire). Aan het eind van de studie ontvangt u van ons een evaluatie van uw slaap tijden. Daarmee zult u veel over u zelf en uw slaapgedrag leren. Tevens zal uw deelname van grote waarde zijn voor het verkrijgen van nieuwe wetenschappelijke inzichten in het dagelijkse slaappatroon van mensen.

Mogelijke bijwerkingen
Er zijn geen risico's aan dit onderzoek verbonden. Mochten er zich gezondheidsproblemen voordoen tijdens het onderzoek die een medische beoordeling of behandeling noodzakelijk maken dan overleggen wij met u over passende zorg. In principe is uw eigen huisarts de verantwoordelijke. Er zijn geen risico's bij het voortijdig stoppen met deelname aan de studie.

Wat gebeurt er met uw gegevens?
De gegevens die worden verzameld worden gecodeerd opgeslagen bij de Rijksuniversiteit Groningen. De lijst waarop uw naam en de bijbehorende code staat wordt gescheiden van uw gegevens bewaard. De coderingssleutel is niet buiten het onderzoeksteam bekend. De resultaten van de studie kunnen worden gepubliceerd, maar altijd zonder het gebruik van uw naam en adres gegevens. De wijze waarop uw onderzoeksgegevens worden bewaard en opgeslagen is in overeenstemming met de Wet bescherming persoonsgegevens. Eventueel kan de toetsingscommissie en de Inspectie voor de Gezondheidszorg inzage vragen om te zien of we het onderzoek volgens de regels uitvoeren.

Wat als u wilt stoppen met deelname of als u een klacht heeft
Als u meedoet aan het onderzoek kunt u zich altijd bedenken en toch nog stoppen. U hoeft hiervoor geen reden op te geven. U kunt mondeling, telefonisch of via email laten weten dat u niet meer mee wilt doen. De verzamelde informatie van deelnemers die

tussentijds stoppen zal alleen worden gebruikt als hier toestemming voor is gegeven. Als u een klacht heeft over enig onderdeel van de studie gebruik dan s.v.p. de contact informatie onderaan deze brief.

Welke medisch-ethische toetsingscommissie heeft dit onderzoek goedgekeurd?
De Medisch Ethische Toetstingscommissie (METc) van het Universitair Medisch Centrum Groningen heeft het onderzoek goedgekeurd.

Bent u verzekerd wanneer u aan het onderzoek meedoet?
Aangezien deelname aan dit onderzoek geen risico’s met zich meebrengt is er door de Medisch Ethische Toetsingscommissie ontheffing van de verzekeringsplicht verleend.

Tenslotte
Het onderzoeksteam zal u met alle plezier te woord staan bij eventuele vragen met betrekking tot de studie. Mocht u na het lezen van de brief, voor of tijdens de studie nog nadere informatie willen ontvangen of komen er nog vragen bij u op dan kunt u altijd contact opnemen met de onderzoeker Dr. Thomas Kantermann.

Als u beslist om mee te doen aan dit onderzoek, ondertekent u dan het bijgevoegde toestemmingsformulier en geef het af aan of stuur het op naar het onderzoeksteam. De onderzoeker zal het formulier eveneens ondertekenen en bevestigt dat hij/zij u heeft geïnformeerd over het onderzoek, deze informatiebrief heeft overhandigd en bereid is om waar mogelijk in te gaan op nog opkomende vragen.

Hartelijk dank voor het lezen van deze informatie.

Met vriendelijke groet namens het onderzoeksteam,

Dr. Thomas Kantermann

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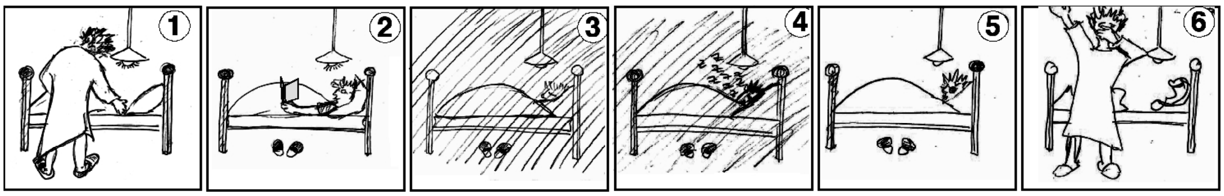
Munich Chronotype Questionnaire (MCTQ)

Heeft u vaste werktijden (b.v. betaald of vrijwilligers werk, maar ook "huisman" of "huisvrouw")?

☐ **JA** ☐ **NEE**

Indien "JA":
Op hoeveel dagen per week heeft u vaste werktijden? 1☐ 2☐ 3☐ 4☐ 5☐ 6☐ 7☐



Gebruik a.u.b. de 24u-tijdschaal: bijvoorbeeld, 17:00 en *NIET* 5 pm!!!

Werkdagen (inclusief de nacht voor de eerste werkdag)

Cartoon 1: Ik ga naar bed om _________ uur.

Cartoon 2: **Bedenk dat sommigen een tijd wakker kunnen blijven na het naar**
bed gaan!

Cartoon 3: Om _________ uur besluit ik te gaan slapen (dwz doe ik mijn ogen
dicht).

Cartoon 4: Ik heb _________ minuten nodig om in slaap te vallen.

Cartoon 5: Ik word wakker om _________ uur.

☐ met wekker

☐ zonder wekker

Cartoon 6: Na_________ minuten sta ik ook echt op.

Vrije Dagen (inclusief de nacht voor de eerste vrije dag)

Cartoon 1: Ik ga naar bed om _________ uur.

Cartoon 2: **Bedenk dat sommigen een tijd wakker kunnen blijven na het naar**
bed gaan!

Cartoon 3: Om _________ uur besluit ik te gaan slapen (dwz doe ik mijn ogen
dicht).

Cartoon 4: Ik heb _________ minuten nodig om in slaap te vallen.

Cartoon 5: Ik word wakker om _________ uur.

☐ met wekker

☐ zonder wekker

Cartoon 6: Na_________ minuten sta ik ook echt op.

Noteer s.v.p. of u momenteel NIET vrij bent in het kiezen van uw slaaptijden (b.v. vanwege huisdier(en), kind(eren) etc.):

____

General Questionnaire

Deelnemersenquête

Beste deelnemer, wees ervan verzekerd dat alle informatie uit deze enquête gecodeerd en anoniem geanalyseerd worden, gescheiden van uw naam en adres. Alle data is aan strikte geheimhouding onderworpen, en zal niet aan derden doorgegeven worden.

Geboortedatum ____/____/______ (dag /maand /jaar) **Datum van vandaag** ____________

Geslacht: Vrouw ☐ Man ☐

Dominante hand ________ Lichaamslengte (cm) ________ Gewicht (kg) ________

Tailleomvang (cm) ________ Heupomvang (cm) ________

Naar mijn werk reis ik meestal (a.u.b. maar één antwoord kiezen) …

a) … in een gesloten voertuig (bijv. auto, bus, trein) ☐

b) … niet in een gesloten voertuig (bijv. te voet, met de fiets) ☐

c) Ik werk thuis. ☐

Voor de heenweg naar mijn werk heb ik dagelijks nodig: ___ uur en ___ minuten

Voor de terugweg van mijn werk naar huis heb ik dagelijks nodig: ___ uur en ___ minuten

Gemiddeld breng ik zo veel tijd buiten door (zonder dak boven mijn hoofd):

Op werkdagen: ______ uur ______ minuten

Op vrije dagen: ______ uur ______ minuten

Mijn laatste reis met 2 of meer uren tijdsverschil eindigde op: ____/____/______
(dag/maand/jaar)

Zo word ik doorgaans wakker:

	Werkdag	**Vrije dag/weekend**
Door het afgaan van de wekker	☐	☐
Uit mezelf en voor de wekker aan	☐	☐
Door andere personen (bijv. partner)	☐	☐
Door mijn huisdier(en)	☐	☐
Door lawaai (bijv. autoverkeer)	☐	☐

Mijn slaapkamer en bed (a.u.b. aankruisen wat van toepassing is):

a) Ik heb ____ (aantal) vensters in mijn slaapkamer.

b) Ik verduister deze (meestal) met: gordijnen ☐ jaloezieën ☐ anders, n.l.: _____ ☐ niets ☐

c) Ik slaap (meestal) met een slaapmasker op: ja ☐ nee ☐

d) Als ik **'s nachts** wakker word, is het in mijn slaapkamer licht genoeg (meerdere antwoorden mogelijk):

d.1) om de hand voor het gezicht te zien ja ☐ nee ☐

d.2) om het voeteneinde van het bed te zien ja ☐ nee ☐

d.3) om de hele kamer te kunnen zien ja ☐ nee ☐

d.4) om comfortabel een krant te lezen ja ☐ nee ☐

e) Ik slaap (meestal) met het licht aan/licht van de overloop aan: altijd ☐ zelden ☐ nooit ☐

f) Licht van buiten (maan/straatlantaarn/etc.) valt **'s nachts** op mijn gezicht: ja ☐ nee ☐

g) Het eerste zonlicht **'s morgens** schijnt vaak op mijn gezicht: ja ☐ nee ☐

h) Het venster /de vensters van mijn slaapkamer zijn georiënteerd op het (noorden/zuiden/oosten/westen) ________________

h.1) met enkele beglazing ☐ dubbele beglazing ☐ driedubbele beglazing ☐

i) De afmetingen van mijn slaapkamerraam zijn ____ (cm hoogte) en ____ (cm breedte)

g.1) andere vensters (indien voorhanden): ____ (cm hoogte) en ____ (cm breedte)

j) Het hoofdeind van mijn bed is ____ centimeter van het dichtstbijzijnde venster verwijderd.

k) Mijn slaapkamer is ______m^2 groot.

Consumptie (a.u.b. gemiddelde waarden aangeven!) **per → dag / week / maand**

a) Ik rook _____ sigaretten ... ☐ ☐ ☐

b) Ik drink _____ glazen bier ... ☐ ☐ ☐

c) Ik drink ______ glazen wijn … ☐ ☐ ☐

d) Ik drink ______ glazen sterke drank (jenever/whisky/wodka/etc.) … ☐ ☐ ☐

e) Ik drink ______ koppen koffie … ☐ ☐ ☐

f) Ik drink ______ koppen zwarte thee ... ☐ ☐ ☐

g) Ik drink ______ blikjes cafeïne houdende frisdrank … ☐ ☐ ☐

h) Ik neem slaap bevorderende medicamenten ______ maal in ... ☐ ☐ ☐

Mijn rookgedrag

a) Ik was ______ jaar oud toen ik begon met roken.

b) Ik rook al ______ jaar lang.

c) Ik heb ______ keer eerder geprobeerd te stoppen met roken.

d) Ik rook ______ sigaretten op een werkdag. (a.u.b. gemiddelde waarden aangeven!)

e) Ik rook ______ sigaretten op een vrije dag. (a.u.b. gemiddelde waarden aangeven!)

f) Ik rook mijn eerste sigaret circa ______ uur en ______ minuten nadat ik wakker wordt.

g) Ik rook mijn laatste sigaret circa ______ uur en ______ minuten voordat ik ga slapen.

h) Meestal rook ik…(bepaald moment van de dag, bepaalde situaties etc.): ______________________

In de afgelopen 12 maanden heb ik regelmatig de volgende medicamenten ingenomen

(Dit zijn tabletten, crèmes/zalven, injecties of alles waarvoor u een recept van uw arts nodig heeft)

	Naam/type	Dosis	Wanneer genomen	Hoeveel genomen	Commentaar
a					
b					

c					
d					
e					
F					
g					
h					

Bedankt voor het invullen

Reply letter

Groningen, [datum]

Beste deelnemer,

Hartelijk bedankt voor uw deelname in onze studie naar het verband tussen roken en slaaptijden. In deze brief vindt u de resultaten van onze studie en ook de gegevens die we van u verzameld hebben. Voordat we u over uw gegevens vertellen willen we u eerst meer vertellen over het onderzoeksgebied zelf.

De biologische klok

Chronobiologie houdt zich bezig met (dagelijkse) ritmes in levende wezens. Om ons gedrag en ons lichaam aan te passen op het dag- en nachtritme hebben vrijwel alle organismes een biologische klok. Bij mensen bevind de biologische klok zich in de hersenen. De biologische klok ontvangt lichtsignalen via de ogen en wordt daardoor aangepast op de licht-donker cyclus. Hierdoor blijft de biologische klok gelijk lopen met het dag-nacht ritme van onze omgeving. Onze biologische klok stoomt ons lichaam 's ochtends klaar om wakker te worden en geeft 's avonds signalen die ons voorbereiden om te gaan slapen.

In onze huidige 24-uurs maatschappij staat ons natuurlijke ritme onder druk. Dit komt vooral door de uitvinding van kunstlicht en doordat we steeds meer binnen leven. Hierdoor krijgen we overdag minder zonlicht. Daarnaast moeten de meeste mensen hun natuurlijk ritme aanpassen op hun werktijden. Veel mensen staan eerder op en gaan eerder naar bed op werkdagen dan op vrije dagen. Dit verschijnsel wordt sociale jetlag genoemd. Sociale jetlag heeft echter wel gevolgen. Het wordt bijvoorbeeld in verband gebracht met obesitas, een groter risico voor hartklachten, depressieve klachten en slechtere schoolprestaties. Verder is er een sterk verband tussen een grotere sociale jetlag en een grotere kans om te roken. Een grotere sociale jetlag zou de kans kunnen vergroten om te gaan roken. Omgekeerd is het ook bekend dat nicotine, de werkzame stof in tabak, de biologische klok en ook slaap beïnvloed.

Doel van het onderzoek

In dit onderzoek wilden wij het verband tussen sociale jetlag en de kans om te roken verder onderzoeken. Hierbij hebben we gekeken naar uw slaaptijden en de gegevens uit de algemene vragenlijst: de hoeveelheid zonlicht per dag en uw rookgedrag. Aangezien zonlicht een belangrijk signaal is voor de biologische klok, verwachtten we dat een grotere hoeveelheid zonlicht per dag samenhangt met een vroeger chronotype en een kleinere sociale jetlag. Uw chronotype geeft aan of u een ochtend- of een avondmens bent. We verwachtten dat groter aantal gerookte sigaretten samenhangt met een later chronotype en een grotere sociale jetlag. Daarnaast verwachtten we dat de eerste sigaret wordt gerookt om wakker te worden. De eerste sigaret zou dan eerder worden gerookt wanneer u meer slaap tekort komt en een langere slaapinertie heeft (de tijd tussen wakker worden en op staan). De laatste sigaret zou volgens ons slaapproblemen kunnen veroorzaken zoals een groter slaaptekort en een langere slaaplatentie (de tijd tussen besluiten te gaan slapen en werkelijk in slaap vallen). Nicotine beïnvloed het ritme van de biologische klok. In de ochtend vervroegt nicotine de biologische klok en in de avond zorgt nicotine er voor dat de biologische klok naar later verschuift. Daarom verwachtten we dat een latere timing van zowel de eerste als de laatste sigaret samenhangt met een later chronotype en een grotere sociale jetlag.

Uitkomst van het onderzoek

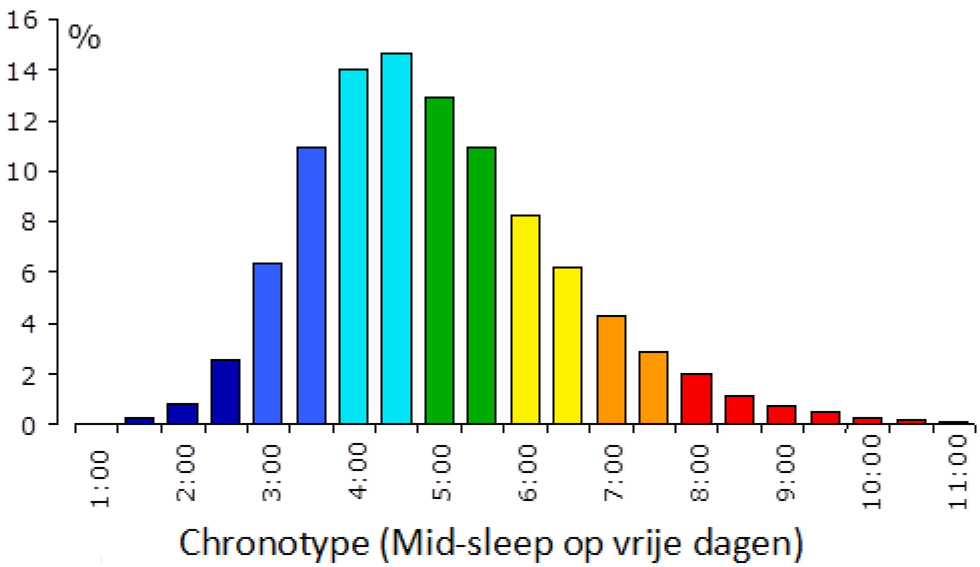
Uit dit onderzoek kwamen de volgende resultaten voort. Vanwege het kleine aantal deelnemers in dit onderzoek hoeven deze resultaten niet te gelden voor de algehele bevolking. Zowel sociale jetlag en de slaapduur op vrije dagen verminderde met leeftijd en ook verschoof het middelpunt van de slaaptijd op vrije dagen naar een eerder tijdstip met leeftijd. De hoeveelheid gerookte sigaretten per dag bleek echter niet samen te hangen met sociale jetlag, chronotype of ander slaapgedrag. De tijd tussen opstaan en het roken van de eerste sigaret, en de tijd tussen het roken van de laatste sigaret en het gaan slapen werd voornamelijk bepaald door de mate van verslaving. Hoe groter het aantal gerookte sigaretten per dag, hoe kleiner de tijd tussen het opstaan en de eerste sigaret en hoe kleiner de tijd tussen de laatste sigaret en het slapen gaan. Ten slotte bleek dat een eerdere timing van de laatste sigaret op werkdagen en een latere timing van de eerste sigaret op vrije dagen samenhing met een grotere sociale jetlag. Dit kan duiden op een effect van nicotine op de biologische klok en sociale jetlag, maar kan ook het gevolg zijn van de berekening die we gebruikten.

Uw gegevens

Aan de hand van uw gegevens hebben we een aantal zaken berekend. Uw slaaptekort hebben we bepaald aan de hand van de duur van uw slaap op werkdagen en vrije dagen. We hebben het middelpunt van uw slaap op werkdagen (MSW: Mid-sleep on workdays) en op vrije dagen (MSF: Mid-sleep on freedays) bepaald. We hebben uw chronotype bepaald door het middelpunt van uw slaap op vrije dagen te berekenen en te corrigeren voor slaaptekort (MSF_{sc}). Uw sociale jetlag is berekend door het verschil te berekenen tussen het middelpunt van uw slaap op vrije dagen (MSF) en op werkdagen (MSW). MSW, MSF en MSF_{sc} worden gemeten als tijdstippen.

	Persoonlijke gegevens	Gemiddelde groep
Gemiddelde slaapduur (h)		7:27
Slaaptekort (h)		1:10
Mid-Sleep op werkdagen		3:51
Mid-Sleep op vrije dagen		5:07
Chronotype		4:52
Social Jetlag (h)		1:10

Hieronder hebben we de spreiding van chronotypes weergeven. Van links naar rechts staat het tijdstip van de MSF_{sc} weergeven. Chronotypes zijn normaal verdeelt over de bevolking. Dat wil zeggen: er zijn veel gemiddelde chronotypes en minder extreem laat/vroege chronotypes. Een gemiddeld chronotype heeft het middelpunt van zijn slaap rond 4:00 uur ’s ochtends. Hij gaat bijvoorbeeld om 0:00 uur op bed en staat om 08:00 uur op, als hij geen verplichtingen heeft. Uw chronotype wordt hieronder weergeven met een rode pijl.



Figuur 12: De verspreiding van chronotypes. Op de x-as staat het tijdstip van de MSF_{sc} weergeven. Het middelpunt van uw slaap op vrije dagen gecorrigeerd voor slaaptekort. Op de y-as wordt het percentage van de bevolking per categorie weergeven.

Nogmaals bedankt voor uw deelname aan dit onderzoek!

Arjan de Boer, Giulia Zerbini en dr. Thomas Kantermann

Dankwoord

Graag willen wij hierbij de academische huisartsenpraktijk van het UMCG en Dr. Janwillem Kocks persoonlijk bedanken voor hun hulp bij het benaderen van deelnemers. Ook willen wij graag de huisartsenpraktijk Andeweg, en de bedrijven Sine Fuma en Medipro bedanken voor hun bijdrage aan dit onderzoek door het benaderen van deelnemers.

Wilt u meer weten over sociale jetlag en wat u er aan kunt doen? Of wilt u meer weten over de huisartsenpraktijken en bedrijven die dit onderzoek mogelijk maakten? Kijk dan op de volgende sites:

[1] www.ukrant.nl/magazine/fout-licht,
Een krantenartikel over het belang van een goed slaapritme.

[2] https://www.youtube.com/watch?v=iZ_VH2Zh1lU,
Een Engelstalig filmpje over sociale jetlag.

[3] https://www.umcg.nl/NL/UMCG/Afdelingen/Academische_Huisartsenpraktijk_Groningen/Pages/default.aspx,
De site van de academische huisartsenpraktijk van het UMCG.

[4] www.sinefuma.com/,
De site van het bedrijf Sine Fuma, dat rokers helpt om te stoppen met roken.

[5] www.medipro.nl/,
De site van het bedrijf Medipro, dat rokers helpt om te stoppen met roken.