Adverse conditions at the workplace are associated with increased suicide risk

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Abstract

Objective: The present study addressed potential harms of a negative working environment for employed subjects. The main aim was to evaluate if adverse working conditions and job strain are related to an increase in suicide mortality. *Methods:* The study population consisted of 6,817 participants drawn from the MONICA/KORA Augsburg, Germany, surveys conducted in 1984-1995, being employed at baseline examination and followed up on average for 12.6 years. Adverse working conditions were assessed by an instrument of 16 items about chronobiological, physical and psychosocial conditions at the workplace, job strain was assessed as defined by Karasek. Suicide risks were estimated by Cox regression adjusted for suicide-related risk factors. *Results:* A number of 28 suicide cases were observed within follow-up. High levels of adversity in chronobiological/physical working conditions significantly increased the risk for suicide mortality (HR 3.28, 95% CI 1.43-7.54) compared to low/intermediate levels in a model adjusted for age, sex and survey (p value 0.005). Additional adjustment for living alone, low educational level, smoking, high alcohol consumption, obesity and depressed mood attenuated this effect (HR 2.73) but significance remained (p value 0.022). Adverse psychosocial working conditions and job strain, in contrast, had no impact on subsequent suicide mortality risk (p values > 0.200). *Conclusions:* A negative working environment concerning chronobiological or physical conditions at the workplace had an unfavourable impact on suicide mortality risk, even after controlling for relevant suicide-related risk factors. Employer interventions aimed to improve workplace conditions might be considered as a suitable means to prevent suicides among employees.

Keywords: Working conditions, Job strain, Suicide, General population, Cohort study

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Since the outbreak of the current economic crisis in Europe, an increase of suicidal events were observed especially in countries which were particularly struck by the crisis (Stuckler et al., 2011; Economou et al., 2011; Chang et al., 2013).This phenomenon gained large public attention and was described by some media as "suicide by economic crisis" (New York Times, 2012). Moreover, suicide clusters were noticed in various companies across Europe which has raised the question about the potential harm of adverse working conditions. In a French company, for instance, after the third suicide occurred at one of the company's plants within four months "a prosecutor has opened an inquiry into working conditions" (The Guardian, 2007).

For preventive measurements, investigations about the relationship between negative working conditions and suicide mortality are crucial and need to consider suicide-related risk factors as well. Suicide mortality is elevated especially in individuals suffering from affective disorders or schizophrenia (Harris and Barraclough, 1997; Osby et al., 2001; Arsenault-Lapierre et al., 2004). Additionally, epidemiological studies revealed male sex, living alone, low educational level, smoking, high alcohol consumption and lower BMI as main risk factors for suicide mortality in the general population (Qin et al., 2003; Magnusson et al., 2006; Mukamal et al., 2010; Schneider et al., 2011; Li et al., 2012; Lukaschek et al., 2012; Schneider et al., 2014). High suicide risks were also observed in case of unemployment, especially during financial crises (Barr et al., 2012). It is well documented that adverse working conditions and work stress in particular are strongly related to indicators of depression (Bonde, 2008; Wieclaw et al., 2008; Netterstrom et al., 2008; Wang et al., 2012). This could be due to a mechanism linking working conditions with severe outcomes such as suicide. In the working population, however, evidence on a possible association between working conditions

and suicide risk is sparse and inconclusive so far. Three studies using occupational- or population-based samples assessed the impact of job strain on suicide mortality and reported inconsistent findings (Feskanich et al., 2002;Tsutsumi et al., 2007;Ostry et al., 2007). Feskanich et al. revealed a rather U shaped relationship between work-related stress and suicide mortality (Feskanich et al., 2002). Ostry et al found an increased suicide risk in case of low psychological job demands but not for low job control (Ostry et al., 2007). In contrast, Tsutsumi et al., estimated higher suicide risks for subjects with high job control but not for low job demand (Tsutsumi et al., 2007).

Compared with job strain, relationships between specific working conditions and suicide have been even more seldom studied. Strain can be induced by a variety of adverse conditions in the workplace mainly consisting of chronobiological (e.g. overtime, night or shift work), physical (e.g. noise or pollutants) or psychosocial (e.g. demand-control, strong competition) components (Woo and Postolache, 2008). An autopsy study from Japan, for instance, identified long working hours as a common condition for the majority of the 22 investigated suicide cases (Amagasa et al., 2005). Overall, the evidence for an impact of high job strain and adverse working conditions on the risk of suicide mortality remains poor, especially in a population-based, prospective context. Therefore, the present study was carried out to evaluate associations between adverse working conditions and job strain on suicide mortality risk in a representative working population in a region located in Southern Germany using a prospective study design.

1. Materials and methods

1.1. Study design

The data of the present study was drawn from three population-based MONICA/KORA Augsburg surveys (S1, S2, S3) conducted between 1984 and 1995 in the region of Augsburg, southern Germany, and followed-up within the KORA research platform (Holle et al., 2005). The MONICA Augsburg project was part of the multinational WHO MONICA project aimed to estimate the prevalence and distribution of cardiovascular risk factors among men and women aged 25–64 (S1) or 25–74 years (S2, S3) (WHO MONICA Project Principal Investigators, 1988). All procedures were subjected to constant quality assessment. The study was approved by the local authorities and followed the declaration of Helsinki. Written informed consent was obtained from all participants.

1.2. Study population

Altogether, 13,427 participants (6,725 men, 6,702 women, response rate 77%) aged 25–74 years, randomly drawn from the general population, participated in one of three cross-sectional surveys. In a subsample of 12,888 subjects, a psychodiagnostic assessment was obtained through self-administered questionnaires that followed the WHO MONICA psychosocial optional study recommendations (WHO MONICA Project Principal Investigators, 1989). A total of 7,466 subjects (57.9%) reported to be currently employed at the baseline examination representing the working population of the underlying general population. After excluding 649 participants with missing information on either of the two exposures, 'job strain' and 'adverse working conditions' or on follow-up status, the study population of the present analyses consisted of 6,817 employed subjects (4,269 men and 2,548 women) with a mean age of 42.2 years (standard deviation 10.4).

Some subjects were recruited for more than one survey by chance. In this case, only the risk factor assessment at the first survey was included in the present analysis.

1.3. Assessment of adverse working conditions and job strain

Information on working conditions and work-related stress were assessed at the baseline examination by the German version of a self-administered questionnaire following the recommendations of the MONICA psychosocial optional study (WHO MONICA Project Principal Investigators, 1989). This data set included a variety of work-related instruments, which were used to define the following three exposures:

a) 'Adverse chronobiological/physical working conditions' were assessed by an instrument comprising 11 items which measured chronobiological (overtime, shift work, night shifts, taskwork, assembly-line work) and physical (screen handling work, physically challenging work, dangerous work, noise, pollutants, radioactive radiation) working conditions. Summing up these 11 three-scaled single items (coded as 1='never, 2='sometimes', 3='frequently') gave a score ranging from 11 to 28 in the present study population. The exposure 'adverse chronobiological/physical working conditions' was defined by classifying this score into a 'low/intermediate' and a 'high' group using the upper tertile as a cut-off point (< 16, ≥ 16).

b) 'Adverse psychosocial working conditions' were assessed by an instrument comprising five items concerning psychological and social components (disturbances and interruptions, urge for fast decisions, high responsibility for people, high responsibility for machines, strong competition). Summing up these five three-scaled single items (coded as 1='never', 2='sometimes', 3='frequently') gave a score ranging from 5 to 15 in the present study population. The exposure 'adverse psychosocial

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working conditions' was defined by classifying this score into a 'low/intermediate' and a 'high' group using the upper tertile as a cut-off point (< 10, ≥ 10).

c) 'Job strain' was assessed by the well-characterised Job Content Questionnaire (JCO) which included five items concerning demands, four items concerning skills and two items concerning decision authority (Karasek et al., 1998). First, scores of job demand and job control were created by summing up the respective single four-scaled items. Then, the job strain score was calculated by dividing the job demand score by the job control score leading to a continuous variable ranging from 0.21 to 2.83 in the present study population. The exposure 'job strain' was then defined by classifying the score into groups of 'low/intermediate' and 'high' job strain using the upper tertile as a cut-off point (< 0.778, ≥ 0.778).

The upper tertiles of the score distributions were chosen a priori (before the analyses) as cut-off points. This choice was driven by the assumption that essentially high levels of adverse working conditions or job strain might have an impact on suicide mortality in contrast to low or intermediate levels. Analyses using three categories (upper versus intermediate versus low third) could not be performed with sufficient validity due to the low number of suicide cases especially in the lower third of the chronobiological/physical working conditions score.

1.4. Assessment of suicide mortality

The study endpoint was death from suicide. The duration of the follow-up was calculated as the interval between the baseline examination and death or the date of the last available follow-up. Death certificates were obtained from the local health departments and were coded for the underlying cause of death using the 9th and 10th Revision of the International Classification of Diseases (ICD). Deaths were

classified as deaths from suicide (E950 – E959 using ICD-9 or X60 – 84 using ICD-10) or deaths from other causes. The vital status of all participants sampled in the three surveys was assessed by the population registries in 2002. The last possible observation date was December 31, 2002, leading to a mean follow-up time of 12.6 years (standard deviation 4.2). By December 31, 2002, a total of 28 participants (26 men, 2 women) had died by suicide.

1.5. Assessment of confounding risk factors

Based on previous studies, we chose a variety of suicide-related risk factors which might confound the association of adverse working conditions and job strain with suicide mortality. Information on these confounding risk factors was assessed by standardized personal interviews, medical examinations or a self-administered questionnaire:

'Living alone' was assessed by asking the participants about their family status and defining subjects not living in a partnership as living alone. 'Low educational level' was defined as having less than 12 years of schooling. 'Smoking' was defined as reporting smoking regularly and at least one cigarette per day on average. 'High alcohol consumption' was defined as an average daily alcohol intake of at least 40 g per day for women and 60 g per day for men based on self-report. 'Obesity' was defined as having a body mass index $\geq$ 30 kg/m^2 assessed by clinical examinations. 'Depressed mood' was examined by the "Depression and Exhaustion" (DEEX) scale consisting of eight items drawn from the von Zerssen affective symptom check list (Ladwig et al., 2004) and using the upper tertile as cut-off point (< 10, $\geq$ 10).

1.6. Statistical analyses

Associations of categorical variables were assessed by the χ^2 test; for group differences in continuous variables, the 2-sided *t* test was applied. To assess the suicide mortality risk of adverse chronobiological/physical and psychosocial working conditions as well as of job strain, Cox proportional hazards regression was applied calculating a first 'crude' model adjusted for age, sex and survey (model 1) and a second 'fully-adjusted' model additionally adjusted for living alone, low educational level, smoking, high alcohol consumption, obesity, and depressed mood (model 2). The relative risk for suicide mortality is presented as hazard ratio (HR) with 95% confidence interval (95% CI) and p value. Missing values were included in the regression analyses as own category.

For all statistical analysis, a p value less than 0˙05 was considered to be statistically significant. The evaluations were performed with the statistical software package SAS (Version 9.1, SAS Institute Inc., Cary, North Carolina, USA). The study design, data collection and statistical analyses in the present manuscript follow the STROBE guidelines for cohort studies.

2. Results

2.1. Descriptive analyses

The associations of suicide-related risk factors with adverse chronobiological/physical and psychosocial working conditions as well as with job strain are shown in Table 1. Participants with high adverse working conditions, both chronobiological/physical and psychosocial, were significantly younger and more often male than participants in the low or intermediate group; the opposite was observed for job strain with a higher mean age and a lower percentage of men in the high compared to the low/intermediate group. Additionally, low educational level and

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smoking were significantly associated with all three exposures. Smoking was more pronounced in the respective high than in the low or intermediate group.

2.2. Association of adverse working conditions and job strain with suicide mortality risk

Cox regression revealed that a high adversity of chronobiological or physical working conditions significantly increased the risk for suicide mortality (HR 3.28, 95% CI 1.43-7.54) compared to the low or intermediate adversity group in the model adjusted for age, sex and survey (p value 0.005). Additional adjustment for living alone, low educational level, smoking, high alcohol consumption, obesity and depressed mood attenuated this effect to 2.73 (95% CI 1.16-6.42) but significance remained (p value 0.022).

In contrast to these significant findings, adverse psychosocial working conditions and job strain were not associated with suicide mortality, not even in the models adjusted for age, sex and survey (HR 1.63, 95% CI 0.75-3.53, p value = 0.22 and HR 0.99, 95% CI 0.45-2.20, p value 0.987).

2.3. Sensitivity analyses

We performed a variety of sensitivity analyses to assess the robustness of our findings.

First, we repeated the Cox regression analyses by restricting mortality within ten years leading to 24 suicide cases. These analyses revealed comparable findings: For adverse chronobiological/physical working conditions, the model adjusted for suicide-related factors estimated a HR of 3.38 (95% CI 1.29-8.84, p value 0.013).

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Second, a Cox regression only in participants aged < 65 years at baseline (n=6,772) was performed with restricting suicide mortality before the age of 65 years (n=25 cases). These analyses revealed a slightly more pronounced impact of adverse chronobiological/physical working conditions on suicide mortality than the main analyses; the hazard ratio in the model adjusted for suicide-related risk factors were estimated as 3.22 (95% CI 1.24-8.36, p value 0.016). No significant effect on suicide mortality was found for adverse psychosocial working conditions and job strain in both sensitivity analyses.

Third, we performed separate analyses for the chronobiological and physical working conditions using the respective upper tertiles as cut-off points. These analyses showed similar but less strong effects for both working conditions with hazard ratios of 2.56 (95% CI 1.12-5.87, p value 0.027) in model 1 and 2.32 (95% 1.01-5.35, p value 0.048) in model 2 for chronobiological and 2.22 (95% 1.00-4.94, p value 0.051) in model 1 and 1.83 (95% CI 0.80-4.18, p value 0.152) in model 2 for physical working conditions. These estimates may indicate that the effect of the combined conditions was more driven by the chronobiological than by the physical working conditions. However, as shown in the main analyses, the suicide risk was substantially increased in participants with a high compared to a low or intermediate level of the combined score, i.e. regardless of the type of condition. This was confirmed by further Cox regression analyses estimating the suicide risk for participants with a high compared to a low/intermediate level for both conditions. These analyses revealed a hazard ratio of 7.15 (95% 1.59-32.30, p value 0.011) in model 1 and 5.58 (95% 1.22-25.60, p value 0.027) in model 2.

Fourth, use of the median-split instead of classifying by the upper tertile showed results comparable to the main analyses. Higher levels of adverse chronobiological/physical working conditions remained significantly associated with increased suicide risk in both models (p values 0.005 and 0.010). Regarding adverse psychosocial working conditions and job strain, no significant associations with suicide mortality were found (p values 0.369 and 0.631 in the model adjusted for age, sex and survey). Moreover, using the scores as linear exposures led also to a significant association for adverse chronobiological/physical working conditions and to no significant associations for adverse psychosocial working conditions and job strain.

Fifth, analysing job demand and job control separately using the tertiles as cut-off points found also no significant association with suicide mortality (p values 0.614 and 0.865 in the models adjusted for age, sex and survey).

3. Discussion

3.1. Overall

Being employed is an important resource and could improve mental well-being (Woo and Postolache, 2008). However, on the other hand, being employed can also be a source of dissatisfaction and sustained stress. A number of studies have shown associations of elevated work-related psychosocial stress with increased risk for cardiovascular diseases (Kivimaki et al., 2012; Emeny et al., 2013). In the worst case, it can act as a life-threatening source of stress and lead to suicide mortality (Woo and Postolache, 2008).

The present study of a representative working population indicated an elevated suicide mortality risk for participants with a high level of adverse chronobiological or physical working conditions compared to low or intermediate levels. This association was independent of classical suicide-related risk factors and hold also when suicide mortality was restricted to occurring within ten years or before the age of 65 years after baseline. In contrast to these findings, a significantly increased suicide risk could not be observed for high levels of adverse psychosocial working conditions or high job strain compared to low or intermediate levels.

3.2. Adverse working conditions

In the present study population, participants who reported high adverse chronobiological or physical working conditions had a more than two-fold increased risk of a suicidal fatality within the follow-up period compared to those reporting only low or intermediate adverse working conditions. Potential underlying mechanisms explaining this association are rather unclear and can only be speculated.

A variety of potential adverse circumstances at the workplace can affect the worker persistently during working hours. It should be kept in mind that employed subjects spend most of their time at the workplace and therefore, subjects might be consistently exposed to these adverse conditions. Additionally, adverse working conditions might also have an impact on one's life outside the workplace; especially overtime, shift work or night shifts can affect the social environment and potentially contribute to increased isolation and feelings of loneliness. Moreover, it might be assumed that the association of high levels of adverse chronobiological or physical conditions at the workplace are mediated by sleeping disorders; insomnia has been shown to be an independent risk factor for suicide (McCall and Black, 2013).

To the best of our knowledge, the present study is the first population-based, prospective investigation analysing the impact of adverse working conditions on suicide mortality. Regarding the single items, an autopsy study from Japan identified long working hours ("karojisatsu") as a common condition for the majority of the 22 investigated suicide cases (Amagasa et al., 2005).

The deteriorating impact of a hostile working environment and its association with mental disorders and their worst outcome – suicide - was outlined before (Woo and Postolache, 2008). Therefore, our findings indicate that improvements in circumstances of daily work, especially regarding chronobiological or physical conditions, might be an appropriate and worthwhile strategy to reduce the number of suicides in the working population.

3.3. Job strain

Three previous prospective studies examined whether job strain might lead to an increased suicide mortality risk and reported inconsistent findings (Feskanich et al., 2002; Tsutsumi et al., 2007; Ostry et al., 2007). In a large sample from the Nurse's Health Study, a U shaped relation between self-reported home- or work-related stress and suicide mortality could be observed with higher risks in the minimal/severe compared to the group perceiving light or moderate work stress. However this relation was not significant for work-related stress after adjustment for suicide-related risk factors (Feskanich et al., 2002). A further large occupational-based study found an increased risk for completed suicides when workers experienced low psychological 'job demands' (risk ratio ~ 25%) but not for low job control (Ostry et al., 2007). In contrast, a population-based study of Japanese men showed a strong increase in suicide mortality risk for subjects with low job control versus high job

control (risk ratio 4.10) but not for low job demand (Tsutsumi et al., 2007). In the autopsy study from Japan mentioned above, most of the suicide victims had suffered from high psychological demand and low decision attitude, additionally reinforced by low social support (Amagasa et al., 2005). The inconsistent findings regarding the job strain-suicide association might be explained by different social and cultural backgrounds.

3.4. Job strain versus adverse working conditions

The non-associations of high job strain with suicide mortality in contrast to the increase in suicide risk by high adverse chronobiological/physical working conditions in our study population is remarkable and needs further thoughts. Job strain assessment as well as the items regarding psychosocial working conditions are based rather on 'subjective' attitudes and depend strongly on the perception of each individual. Adverse working conditions with respect to chronobiological or physical issues, however, are based more on 'objective' items addressing unfavourable conditions in the working environment. Permanent job strain can induce cardiovascular diseases which has been shown recently in a large meta-analysis (Kivimaki et al., 2012), but might not lead to suicidal tendencies. The burden of permanent adverse working conditions regarding chronobiological or physical issues, however, might promote feelings of hopelessness leading to an attitude of giving up and potentially to a suicidal event in the long run. Adverse psychosocial working conditions showed no significant association with suicide mortality in the present study population with 28 suicide cases; though the hazard ratio of 1.67 in the fully-adjusted model may indicate a tendency towards an increased suicide risk for participants with a high compared to a low or intermediate level and held an

intermediate position in relation to the effects of job strain and adverse chronobiological/physical working conditions.

Nevertheless, the different findings in the association of job strain and working conditions with suicide mortality remains unclear and should be addressed in future studies.

3.5. Limitations and strengths

The assessment of suicide mortality was based on death certificates. Therefore, miss-classifications in the assignment of death causes cannot be excluded. It can not be completely ruled out that among cases with other causes of death, suicide cases may be hidden and thus lead to an underestimation of the true number of suicides. However, all death certificates were carefully inspected and validated by physicians of the KORA study center. Therefore, we consider the number of miss-classifications as low. A further limitation concerns the low number of suicide cases included in the present study which does not allow more detailed analyses, especially interaction analyses, with sufficient validity. Moreover, our study population was restricted to subjects aged 25 years or older; therefore, potential associations between adverse working conditions and suicide risk in working adolescents and younger adults remain unclear. Adverse working conditions and job strain were only assessed once at baseline examination; potential changes of these conditions over the follow-up period could not be taken into account. Finally, in contrast to job strain which is based on a well-established instrument, the validity and reliability of the instrument assessing adverse working conditions has not been assessed so far.

The strength of the study is its population-based setting and the prospective design of the investigation. Moreover, demographic and socioeconomic characteristics of the

study population roughly reflect those of the average middle European population in general. The observed number of suicide cases in the whole MONICA/KORA population with psychodiagnostic assessment was in the range of the expected suicide number in the general German population (standardized mortality ratio (SMR) for death from suicide: 1.10, 95% CI: 0.78-1.51) as shown in a previous study (Schneider et al., 2011). However, the generalisation of our findings to countries with different social, economic or cultural conditions may be questioned. A further strength of the study is the extended data set including a wide range of potential suicide risk factors. Finally, our study is one of the first investigations assessing the role of adverse working conditions – a stressor potentially amplified by economic crisis – on the risk of suicide mortality.

3.6. Conclusions

A negative working environment concerning chronobiological or physical conditions at the workplace had an unfavourable impact on suicide mortality risk, even after controlling for relevant suicide-related risk factors. These findings should be considered in measurements aimed to prevent suicidal events in the working population.

Employed subjects often spend more time at work than at home during the daytime which reinforces the need to tackle health problems at the workplace, regardless of whether these problems were caused by the workplace situation or otherwise (Woo and Postolache, 2008). Knowledge about adverse circumstances at the workplace which might contribute to mental disorders potentially leading to suicide as worst consequence is crucial to improve the worker's health. Therefore, employer

interventions aimed to improve workplace conditions might be considered and may be regarded as a suitable means to prevent suicides among employees.

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Table 1

Distribution of participant characteristics by job strain and adverse working conditions (n=6,817)

Characteristic	Adverse chronobiological/physical working conditions			Adverse psychosocial working conditions			Job strain		
	Low or intermediate (n=4,225)	High (n=2,592)	P value	Low or intermediate (n=4,028)	High (n=2,789)	P value	Low or intermediate (n=4,505)	High (n=2,312)	P value
Age (years)	42.4 (10.4)	41.8 (10.4)	0.015	42.5 (10.6)	41.8 (10.0)	0.012	41.8 (10.5)	43.1 (10.1)	< 0.001
Male sex	53.1	78.2	< 0.001	50.4	80.4	< 0.001	65.5	57.0	< 0.001
Living alone	21.2	20.3	0.375	21.9	19.4	0.012	20.0	22.6	0.014
Low educational level	60.8	74.7	< 0.001	73.8	54.9	< 0.001	59.1	79.6	< 0.001
Smoking	29.2	38.4	< 0.001	31.0	35.1	< 0.001	31.7	34.5	0.021
High alcohol consumption	8.6	14.9	< 0.001	9.3	13.4	< 0.001	11.1	10.6	0.508

Obesity	12.7	18.0	< 0.001	14.6	14.9	0.661	14.0	16.0	0.029
Depressed mood	40.6	40.5	0.949	39.3	42.2	0.020	35.9	49.7	< 0.001

Data is given as percentages; mean (standard deviation) is given for age. High alcohol consumption (n=5), obesity (n=52) and depressed mood (n=427) have missing values which are not shown and were not used for assessment of proportions and tests

Table 2

Association of job strain and adverse working conditions with suicide mortality assessed by Cox regression (n=6,817)

	Cases/ non-cases	Model 1 HR (95% CI) p value	Model 2 HR (95% CI) p value
<u>Adverse chronobiological/physical working conditions:</u>			
Low or intermediate	8/4,217	ref.	ref.
High	20/2,572	3.28 (1.43-7.54) 0.005	2.73 (1.16-6.42) 0.022
<u>Adverse psychosocial working conditions:</u>			
Low or intermediate	11/4,017	ref.	ref.
High	17/2,772	1.63 (0.75-3.53) 0.220	1.67 (0.76-3.68) 0.200
<u>Job strain:</u>			
Low or intermediate	19/4,486	ref.	ref.
High	9/2,303	0.99 (0.45-2.20) 0.987	0.82 (0.36-1.84) 0.624

Model 1: adjusted for age, sex and survey

Model 2: adjusted for age, sex, survey, living alone, low educational level, smoking, high alcohol consumption, obesity, and depressed mood

High alcohol consumption (n=5), obesity (n=52) and depressed mood (n=427) have missing values which were included as own category in the Cox regression, estimates not shown