

## RESEARCH REPORT

# Psychosocial determinants of premature cardiovascular mortality differences within Hungary

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**Objectives:** The life expectancy gap between Central-Eastern European (CEE) countries, including Hungary, and Western Europe (WE) is mainly attributable to excess cardiovascular (CV) mortality in midlife. This study explores the contribution of socioeconomic, work related, psychosocial, and behavioural variables to explaining variations of middle aged male and female CV mortality across 150 sub-regions in Hungary.

**Design:** Cross sectional, ecological analyses.

**Setting:** 150 sub-regions of Hungary.

**Participants and methods:** 12 643 people were interviewed in Hungarostudy 2002 survey, representing the Hungarian population according to sex, age, and sub-regions. Independent variables were income, education, control in work, job insecurity, weekend working hours, social support, depression, hostility, anomie, smoking, body mass index, and alcohol misuse.

**Main outcome measures:** Gender specific standardised premature (45-64 years) total CV, ischaemic heart disease, and cerebrovascular mortality rates in 150 sub-regions of Hungary.

**Results:** Low education and income were the most important determinants of mid-aged CV mortality differences across sub-regions. High weekend workload, low social support at work, and low control at work account for a large part of variation in male premature CV mortality rates, whereas job insecurity, high weekend workload, and low control at work contribute most noticeably to variations in premature CV mortality rates among women. Low social support from friends, depression, anomie, hostility, alcohol misuse and cigarette smoking can also explain a considerable part of variations of premature CV mortality differences.

**Conclusion:** Variations in middle aged CV mortality rates in a rapidly changing society in CEE are largely accounted for by distinct unfavourable working and other psychosocial stress conditions.

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The gap in life expectancy between Central-Eastern European (CEE) and Western Europe (WE) continues to be an important public health problem.<sup>1 2</sup> This gap increased most dramatically over the past three decades and it is largely attributable to excess cardiovascular (CV) mortality in midlife, and particularly among men. Up to the end of the 1970s, mortality rates in Hungary were lower than those found in Great Britain or Austria. Subsequently, mortality rates declined in WE. But in Hungary and in other CEE countries this trend was reversed, especially among middle aged men. In the 1990, the mortality rates among 45-64 year old men in Hungary rose to and remained at levels that were higher than they were in the 1930s.<sup>2</sup> In 1999 the standardised death rates attributable to diseases of the circulatory system were three times higher among Hungarian men and women than the European average, but were 2.8 times higher among men than among women.<sup>3</sup> Besides health damaging behaviours, socio economic and psychosocial factors might contribute to this health deterioration in a substantial way.<sup>4</sup> Although poverty is a powerful determinant of population health it is unlikely that it provides an important explanation of this change. This is obvious, among others, from the Hungarian case, where the increase of premature mortality occurred at a time when average living standards were raising, and when health care delivery was improved.<sup>5</sup> Between 1970 and 1990 an almost threefold increase of gross domestic product was witnessed in Hungary and at the same time, mortality rates increased from 12.5 to 15.5 per thousand in men and from 10.8 to 12.8 in women.<sup>2</sup>

It may be that the dynamics of sudden socioeconomic changes affect health by less obvious threats and challenges to people's everyday lives, such as the experience of increasing social disparities,<sup>6 7</sup> or the weakening and breakdown of sociocultural assets, social networks, and social capital.<sup>8 9</sup> The transformation in CEE countries created conditions of loss of control over life, economic deprivation, and social isolation that might undermine the health status of the population. This disproportionately affects the working age population because their work and family support roles rendered them more vulnerable to socioeconomic disruption, which, in the CEE countries, were not buffered by a well functioning civic society.<sup>4 8</sup> The factors that might undermine health may differ according to gender and socioeconomic status. Differences in gender roles may make different aspects of life more or less important, or there may be differences in meaningfulness of different factors of the socioeconomic and psychosocial environment.<sup>4 10</sup> Working conditions may play an important part in this regard, given the centrality of work as a risk factor in midlife.<sup>11 13</sup>

Hungary has witnessed an important change in the labour market since 1970. Until the mid-1970s everybody had to have one working place and there was no possibility for more jobs. Afterwards the first development of the "new economic mechanism" was the initiation of the so called second or third economy, which meant the possibility of better economic situation by accepting or creating second or third

**Abbreviations:** CEE, Central-Eastern European; WE, Western Europe; CV, cardiovascular; BMI, body mass index

jobs by the expenses of considerable overwork. These developments were more frequent among groups in lower socioeconomic strata, as shown by lower educational degree or lower income, because they often dispose of fewer choices of alternatives. It went along with high degree of job instability and associated loss of control.<sup>7</sup>

This paper aims at exploring the role of adverse working and other psychosocial conditions in association with midlife CV mortality in Hungarian men and women in the frame of an ecological analysis. The mortality rates are available only on ecological level, therefore the relative importance of risk factors can be analysed only on aggregate level.

The relative importance of work related conditions in comparison with other established or hypothesised psychosocial and behavioural risk factors were also analysed, separately among men and women. It is worthwhile to hypothesise that the established psychosocial and behavioural risk factors, such as depression,<sup>14</sup> health damaging behaviour, in particular cigarette smoking,<sup>15</sup> body mass index (BMI),<sup>15</sup> and alcohol misuse,<sup>16</sup> hostility,<sup>17</sup> and social support from family and friends<sup>18</sup> all contribute to the explanation of regional differences in premature mortality. Additionally, a distinct psychosocial variable, the anomie score<sup>19</sup> was included, because in a suddenly changing society the inability of long term planning might contribute substantially to health deterioration.

Adverse working conditions were shown to predict an increased risk of a variety of stress related disease conditions. Up to now, most robust evidence concerns CV morbidity and mortality.<sup>12 20-25</sup>

Gender differences in association with work and midlife CV mortality are also explored. This question is important in view of the well reported gender gap in midlife CV morbidity and mortality<sup>1-3 26</sup> (table 1). Yet, given the fact that the overall CV mortality rates in Hungary are three times higher than the average in WE countries among women as well,<sup>3</sup> an

exploration of the high burden of premature CV mortality in Hungarian women is also needed, especially so as larger female CV mortality differences across 150 sub-regions are reported than among men<sup>26</sup> (table 1). As a substantial proportion of women take part in the labour market in Hungary, it is of interest to analyse to what extent adverse working conditions are associated with midlife mortality in women.

**METHODS**

The Hungarostudy 2002 is a national cross sectional survey representing the adult Hungarian population according to sex, age, and according to 150 sub-regions.<sup>10 27</sup> The sampling methods were described in detail elsewhere.<sup>10 27 28</sup> Altogether 12 643 persons were interviewed in their homes. The sample represented 0.16% of the population above age 18. The refusal rate was 17.7%.

**Standardised mortality data**

Age standardised midlife (45–64 years) male and female mortality rates for the main causes of death for 10 000 persons in the same sex and age group were computed by the Central Statistical Office of Hungary for each of the 150 Hungarian sub-regions for the past available years, between 2001 and 2003.<sup>26</sup> The standardised premature (45–64 years) total CV (ICD 10, I00–I99), IHD (ICD 10, I20–I25), and cerebrovascular (ICD 10, I60–I69) mortality rates were included as outcome measures in these analyses.

**Measures**

**Work stress**

*Control at work* was assessed by Likert scaled answers (0 to 3) to the item “How much can you influence what happens in your working group?” *Social support at work* was measured by answers (0–3) to the item “How much help do you receive from coworkers?”<sup>17 27</sup> The *number of working hours per week days*

**Table 1** Descriptives of the variables of the study for the 150 sub-regions of Hungary. Standardised CV\* middle aged (45–64 years) mortality rates and average values for the 150 sub-regions of Hungary from Hungarostudy 2002 (n = 150)

Descriptive statistics	Minimum	Maximum	Mean	SE
Male total CV* mortality	408.00	939.80	636.69	9.85
Male IHD† mortality	91.40	541.40	319.81	6.38
Male cerebrovascular mortality	48.30	316.80	160.83	4.07
Female CV* mortality	81.50	371.50	222.31	4.89
Female IHD† mortality	18.00	198.50	96.96	2.89
Female cerebrovascular diseases	18.00	160.80	67.99	2.22
Control at work	0.28	1.91	1.12	2.69E-02
Social support at work	0.50	2.00	1.23	2.07E-02
Job security	0.47	1.82	1.35	1.91E-02
Week day work hours	5.57	9.76	7.71	6.05E-02
Weekend work hours	4.00	8.68	6.09	6.77E-02
Personal income	1.11	1.94	1.44	1.40E-02
Education	2.50	4.21	3.46	3.61E-02
Subjective social status	2.73	4.69	3.81	3.27E-02
Unemployment rate	1.60	20.7	5.92	0.30
Shift work (%)	0.00	37.2	13.5	5.21E-03
Beck depression score	2.74	14.17	8.37	0.17
Hostility score	2.26	6.40	4.01	5.89E-02
Anomie score	2.49	7.28	5.08	6.33E-02
Social support from friends	1.10	2.40	1.73	1.96E-02
Social support from parents	1.00	2.65	1.77	2.85E-02
Social support from partner	1.35	3.00	2.27	1.87E-02
Social support from civic organisations	0.00	1.11	0.45	1.29E-02
Pack/year cigarettes	25.85	148.05	83.48	1.97
Non-stop drinking	0.00	0.36	3.67E-02	4.72E-03
Morning drinking	0.00	0.30	3.97E-02	4.69E-03
Self blame because of drinking	0.00	0.32	5.59E-02	4.64E-03
Spirit consumption (0.5 dl)	0.00	1.10	0.35	1.43E-02
BMI	24.6	28.5	26.2	6.48E-02

\*CV, total cardiovascular mortality rates (ICD 10.I00–I99). †IHD, ischaemic heart disease mortality (ICD 10. I20–I25). Cerebrovascular diseases (ICD 10.I60–I69).

and on weekend days were recorded. Job security was assessed by Likert scaled answers (0 to 2) to the item "I am happy with my level of job security".<sup>29</sup> Unemployment rates and shift work were also recorded.

### Socioeconomic and further psychosocial variables

Education was measured by the highest education grade on a six level score, personal income was assessed as average of personal income on the basis of eight income categories. Subjective social status<sup>10</sup> was measured by a 10 rung scale.

To measure the presence and severity of depressive symptoms the shortened Beck depression inventory (BDI) was applied.<sup>5, 7, 27</sup> The BDI is a validated and reliable screening instrument for assessing the severity of depression in population surveys.

Social support outside work was assessed by answers to items on perceived support from partners, parents, friends, and civic or religious organisations separately.<sup>7, 27</sup> To measure hostility a shortened version of the Cook-Medley scale was used.<sup>7</sup>

Anomie was assessed by the four item shortened anomie questionnaire of the Eurobarometer survey.<sup>19</sup> The anomie values increased significantly in the past decades in Hungary, and this measure can be an important determinant of health deterioration.<sup>19</sup>

Information on health damaging behaviour was measured by cigarette smoking (smoking status and average number of pack years per person). BMI was measured on the basis of reported height and weight of the respondents. Alcohol misuse was measured by the AUDIT alcohol abuse score.<sup>30</sup> From these score three items seem to be most informative: During the past year how often: (1) have you found that you were not able to stop drinking once you had started? (2) have you needed a first drink in the morning? (3) have you had a feeling of guilt or remorse after drinking? The quantity of alcohol consumption was also recorded.

All analyses were performed based on the SPSS Base 9 programme.

The study was approved by the ethics committee of the Semmelweis University and conforms to the principles embodied in the declaration of Helsinki.

### RESULTS

Table 1 shows the descriptive statistics for the variables included into the analyses. There are considerable variations in different forms of premature CV mortality differences and also in work related, other psychosocial and socioeconomic conditions, and behavioural variables among 150 sub-regions.

Table 2 shows correlations of the four clusters of variables (work related variables; additional psychosocial risk factors; socioeconomic factors; behavioural variables) with premature male and female CV mortality rates, and separately with ischaemic heart disease and cerebrovascular mortality rates. Concerning adverse psychosocial work environment, low control and low social support at work were strongly associated with premature CV mortality rates in both sexes, although there were gender differences. Weekend workload was most closely connected with male, while job insecurity was most closely associated with female CV mortality.

As anticipated, strong associations of measures of SE status with mortality rates were seen, first of all between low education and premature CV mortality, but low personal income and unemployment rates were also closely connected with CV mortality rates. Moreover, the additional psychosocial risk factors explored in this study showed substantial correlations with mortality rates, in particular lack of social support from friends, anomie, depression, and hostility. Associations with social support from parents, partners, civic and religious organisations were much weaker. The correlation coefficients with cigarette smoking, BMI, and three items of alcohol misuse were significantly connected with premature CV mortality rates, but the reported quantity of

**Table 2** Correlation coefficients of associations between work related, other psychosocial, socio-economic, and behavioural variables and standardised midlife (45–64 years) male and female CV\* mortality rates in 2001–2003 in 150 Hungarian sub-regions (n = 150) (data weighted according to sample size in the sub-regions)

	Male CV*	Male IHD†	Male cerebrovascular	Female CV*	Female IHD†	Female cerebrovascular diseases
<b>Work related variables:</b>						
Control at work	-0.255***	-0.193*	-0.249**	-0.275**	-0.334***	-0.188*
Social support at work	-0.197*	-0.213**		-0.179*	-0.236**	
Job security	-0.220**		-0.193*	-0.304***	-0.273**	-0.234**
Weekend work hours	0.344***	0.205*	0.350***	0.225**		0.200*
Week day work hours			0.182*			
Shift work					0.171*	
<b>Significant further psychosocial variables:</b>						
Hostility	0.257**		0.278**	0.229**	0.211**	0.205**
Depression	0.352***	0.198*	0.364***	0.331***	0.274**	0.280**
Anomie	0.340***	0.183*	0.333***	0.287***	0.225**	0.171*
Social support from parents				-0.222	-0.236**	
Social support from friends	-0.372***	-0.285***	-0.363***	-0.345***	-0.360***	-0.287***
<b>SE variables</b>						
Education	-0.599***	-0.385***	-0.592***	-0.527***	-0.409***	-0.460***
Subjective social status	-0.353***	-0.226**	-0.336***	-0.303***	-0.301***	-0.173*
Personal income	-0.512***	-0.372***	-0.474***	-0.402***	-0.369***	-0.324***
Unemployment rate	0.465***	0.296***	0.491***	0.378***	0.373***	0.271**
<b>Behavioural variables:</b>						
Pack/year cigarettes	0.188*		0.162*	0.151*	0.153*	
Non-stop alcohol	0.288***	0.206*	0.283***	0.313***	0.276**	0.268**
Morning alcohol	0.266**	0.165*	0.287***	0.224**	0.229**	0.223**
Self blame because of alcohol	0.250**	0.189*	-0.228**			0.188
BMI	0.192*	NS	0.195*	0.205*	NS	0.241**

\*CV, total cardiovascular mortality rates (ICD 10.I00–I99). †IHD, ischaemic heart disease mortality (ICD 10. I20–I25). \*p<0.05; \*\*p<0.01; \*\*\*p<0.001.

**Table 3** Results of multivariable linear regression analysis of work related variables (control at work, social support at work, job security, weekend work hours, and week day work hours) in explaining differences in midlife (45–64 years) male and female total CV\*, IHD†, and cerebrovascular disease mortality (those variables which entered into the models)

	Standardised $\beta$	t Value	Significance	Adjusted R <sup>2</sup> for the final model
<b>Total male CV* mortality</b>				
Weekend work hours	0.346	4.58	<0.000	0.112
Social support at work	-0.201	-2.66	<0.000	0.147
<b>Total female CV* mortality</b>				
Job security	-0.271	-3.44	<0.000	0.087
Weekend work hours	0.172	2.23	<0.000	0.109
<b>Male IHD† mortality</b>				
Social support at work	-0.215	-2.78	<0.007	0.039
Weekend work hours	0.207	2.68	<0.009	0.076
<b>Female IHD† mortality</b>				
Control at work	-0.334	-4.31	<0.000	0.106
<b>Male cerebrovascular mortality</b>				
Weekend work hours	0.312	4.09	<0.000	0.117
Control at work	-0.184	-2.38	<0.019	0.144
<b>Female cerebrovascular mortality</b>				
Job security	-0.263	-3.29	<0.001	0.048
Week day work hours	0.175	2.33	<0.030	0.072

\*CV, total cardiovascular mortality rates (ICD 10.I00–I99). †IHD, ischaemic heart disease mortality (ICD 10. I20–I25).

spirit consumption showed no significant correlation with CV mortality.

Education and income were significantly and in decreasing order associated with control at work, weekend working hours, job security, social support from friends, depression, anomie, BMI, social support from coworkers, hostility, pack cigarettes per year, and alcohol misuse. Week day working hours were shorter only among the more educated people, but they were not significantly connected with income. Week day and weekend work hours were significantly interrelated ( $r = 0.608$ ,  $p = 0.000$ ), which means overwork among the same persons not only at weekends but during the weekdays as well. Shift work correlated with week day working hours, but not with weekend working hours.

Finally, multivariable linear regression analyses were conducted with all those variables that reported significant associations with premature CV mortality rates in bivariate analyses. Because of the high level of colinearity of the variables, there was a need for three separate models. In the first model, the five variables measuring an adverse psychosocial work environment were included and their combined effects were analysed. Among men weekend work hours and low social support from coworkers explained 14.7%, among women low job security and weekend work hours explained 10.9% of the total premature CV mortality variations among sub-regions. In the case of male cerebrovascular mortality 14.4% of variance could be explained by work related factors such as by weekend work hours and by low control at work. It is important to note that the list of variables entering the models differed between men and women (table 3).

Model 2 includes depression, social support from friends, anomie, and hostility. Although depression and hostility showed significant correlations with premature mortality rates, in the multiple regression models low social support from friends and in the case of total CV mortality high anomie entered significantly into the models. These two variables explained 18.4% among the male and 15.1% among the female total CV mortality rates. Low social support from

friends alone explained 12.4% of female ischaemic heart disease variations and 19% of male cerebrovascular mortality differences (table 4).

Next, in view of substantial colinearity between socioeconomic and other psychosocial factors, the independent associations of income, education, subjective social status, unemployment, smoking, and alcohol misuse with premature CV mortality were analysed. In agreement with the literature<sup>1 2 5 7</sup> the explanatory power of these variables was comparatively strongest, 31.6% of the total male and 25.3% of the total female CV mortality variations could be explained. In both sexes alcohol misuse (not able to stop drinking after started) was a highly significant determinant of total, ischaemic heart disease, and cerebrovascular mortality differences. In regression models unemployment rate explained significantly the female ischaemic and male cerebrovascular mortality variations. According to causes of death these factors were in the closest connection with cerebrovascular mortality differences—that is they explained 31.5% of variance (table 5).

## DISCUSSION

This study found strong associations of variables defining an adverse psychosocial work environment and other socioeconomic and psychosocial variables with variations of premature CV mortality rates by 150 sub-regions among middle aged men and women in Hungary. Although based on ecological analysis, results are of interest in view of a substantial increase in premature male and female CV mortality in recent years in Hungary and in view of sudden socioeconomic changes. Hungary had witnessed higher income inequality during these years compared with neighbouring CEE countries.<sup>4</sup> This means stronger socioeconomic deprivation in lower socioeconomic strata. During the past decades there was a considerable decrease in perceived control in work and in perceived social support from coworkers and friends, more so in the lowest socioeconomic strata of the society.<sup>7</sup> According to these results adverse working conditions, low social support from friends, depression, hostility, anomie,

**Table 4** Results of multivariable linear regression analysis of other psychosocial variables (depression, hostility, anomie, social support from friends) in explaining differences in midlife (45–64 years) male and female total CV\*, IHD†, cerebrovascular and other heart disease mortality (n = 150) (those variables that entered in to the models)

	Standardised $\beta$	t Value	Significance	Adjusted R <sup>2</sup> for the final model
<b>Total male CV* mortality</b>				
Social support from friends	-0.307	-4.05	<0.000	0.190
Anomie	0.264	3.48	<0.001	0.184
<b>Total female CV* mortality</b>				
Social support from friends	-0.292	-3.75	<0.000	0.113
Anomie	0.216	2.77	<0.006	0.151
<b>Male IHD† mortality</b>				
Social support from friends	-0.285	-3.62	<0.000	0.075
<b>Female IHD† mortality</b>				
Social support from friends	-0.360	-4.69	<0.000	0.124
<b>Male cerebrovascular mortality</b>				
Social support from friends	-0.299	-3.92	<0.000	0.190
<b>Female cerebrovascular mortality</b>				
Social support from friends	-0.204	-2.35	<0.020	0.076
Depression	0.190	2.20	<0.029	0.100

\*CV, total cardiovascular mortality rates (ICD 10.I00–I99). †IHD, ischaemic heart disease mortality (ICD 10. I20–I25).

smoking, BMI, and alcohol misuse were significantly connected with low education and income.

In the middle aged population work and working conditions are central in determining health.<sup>31</sup> An independent predictive role of work stress on male and female CV mortality, based on individual level data, was found in a recent prospective epidemiological investigation in Finland.<sup>23</sup> Similarly, incident fatal and non-fatal coronary heart disease, the major contributor to CV mortality, was predicted by work

related stress in other epidemiological studies.<sup>22</sup> These results are interpreted as support of an important role of long term psychosocial stress in the development of CV diseases.<sup>5 31–33</sup>

In this study associations of work related stress with variation in CV mortality were found for both sexes although the contribution of single components differed by gender. Although weekend workload seems to be an important risk factor in both sexes, the pressure to work on the weekends without pause, matters more for Hungarian men,<sup>10</sup> while low

**Table 5** Results of multi-variable linear regression analysis of education, personal income, unemployment rate, smoking, and alcohol misuse in explaining differences in midlife (45–64 years) male and female total CV\*, IHD†, cerebrovascular and other heart disease mortality (those variables that entered into the models)

	Standardised $\beta$	t Value	Significance	Adjusted R <sup>2</sup> for the final model
<b>Total male CV* mortality</b>				
Income	-0.301	-2.87	<0.005	0.257
Non-stop drinking	0.192	2.77	<0.006	0.297
Education	-0.237	-2.23	<0.027	0.316
<b>Total female CV* mortality</b>				
Education	-0.415	-5.74	<0.000	0.209
Non-stop drinking	0.226	3.18	<0.002	0.253
<b>Male IHD† mortality</b>				
Income	-0.348	-4.55	<0.000	0.132
Non-stop drinking	0.153	2.00	<0.047	0.149
<b>Female IHD† mortality</b>				
Education	-0.219	-2.30	<0.023	0.142
Non-stop alcohol	0.193	2.56	<0.011	0.177
Unemployment	0.199	2.14	<0.037	0.196
<b>Male cerebrovascular mortality</b>				
Education	-0.289	-2.68	<0.001	0.245
Unemployment rate	0.277	2.60	<0.002	0.292
Non-stop drinking	0.170	2.45	<0.015	0.315
<b>Female cerebrovascular mortality</b>				
Education	-0.349	-4.60	<0.000	0.146
Non-stop drinking	0.195	2.60	<0.011	0.177

\*CV, total cardiovascular mortality rates (ICD 10.I00–I99). †IHD, ischaemic heart disease mortality (ICD 10. I20–I25).

### What is already known about this topic

- Low education and low income are important determinants of CV mortality
- Adverse working conditions predict an increased risk of CV morbidity and mortality
- Low social support, depression, hostility, alcohol misuse, and cigarette smoking are cardiovascular risk factors

### What this study adds

- High weekend workload, low social support at work, and low control at work account for a large part of variation in male premature CV mortality rates
- Job insecurity, high weekend workload, and low control at work contribute considerably to variations in premature CV mortality rates among women
- Low social support from friends, depression, anomie, hostility, alcohol misuse, and cigarette smoking can explain a considerable part of variations of premature CV mortality differences within Hungary

### Policy implications

- In the population of CEE countries exposed to far reaching socioeconomic changes a cluster of stressful, work related, and other psychosocial conditions accounts for substantially increased premature CV morbidity and mortality rates.
- An integrated public health approach is needed to identify and reduce the impact of adverse bio-psycho-social conditions on premature CV mortality.
- Given gender differences in psychosocial stress at work, preventive programmes should take these into account.
- Improved occupational mental health services are needed to prevent a growing health burden in CEE countries.

job security seems to be more important for women. Although these gender specific constellations might reflect the particularly stressful situation of the rapid socioeconomic changes that occurred in CEE it should be mentioned that considerable inconsistency exists in international research on gender variation in associations between psychosocial stress at work and CV morbidity or mortality.<sup>34 35</sup>

An additional research question concerns the relative importance of work related conditions, compared with other psychosocial variables, in accounting for CV mortality differences. Social support outside work, depression and hostility are three well established psychosocial factors explaining increased CV morbidity and mortality.<sup>36</sup> In our study anomie, the inability for long term planning in combination with feelings of societal demoralisation seems to be an important CV risk factor as well. In bivariate analysis, each one of these factors exhibits strong associations with mortality variation across sub-regions. This

finding is consistent with a growing body of evidence linking depression to CV morbidity and mortality.<sup>5 14</sup> Given close associations between socioeconomic, work related, and additional psychosocial factors, it is tempting to hypothesise that these latter conditions act as mediators of the link between low socioeconomic status and premature CV mortality. It is through high effort—that is, overwork at the weekends as well—low personal income and low job security, low social support from coworkers and friends, low control at work, anomie, and hostility that low socioeconomic status, as measured by education, exerts its “toxic” effects on health. These conditions go along with depressive symptoms that aggravate the health burden of chronic psychosocial stress.<sup>5</sup>

Among established behavioural risk factors alcohol misuse, cigarette smoking, and BMI were significantly associated with premature CV mortality variations in our study as well. In agreement with the literature,<sup>2</sup> the reported quantity of alcohol consumption was not significantly associated with premature CV mortality. Inability to stop drinking after starting, as a measure of alcohol misuse, seems to be particularly relevant in our sample. Alcohol misuse is a highly prevalent public health problem in Hungary. The alcohol related hepatic cirrhosis mortality rates increased dramatically in the past decades in Hungary, and it is currently the highest one in Europe.<sup>37</sup>

While smoking and alcohol misuse are established CV risk factors,<sup>38</sup> their valid and specific measurement is still debated. More elaborate individual data based analyses might also find that an adverse psychosocial work environment results in an increase of unhealthy behaviours, and that both direct and indirect effects on CV morbidity and mortality are expected.<sup>36 38 39</sup> A recent prospective study showed that effort-reward imbalance at work predicts alcohol dependence in men.<sup>40</sup>

Despite the limitations of the ecological study of a population exposed to far reaching socioeconomic change we show that a cluster of stressful, work related, and other psychosocial conditions account for a substantial part of variation in middle aged male and female premature CV mortality differences across Hungarian sub-regions. An integrated public health approach is needed to understand and prevent the bio-psycho-social determinants of premature mortality crisis in CEE.

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