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Explaining sleep time – Hungarian evidences

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Abstract

We spend about one-third of our life sleeping, which is essential for our physical and mental health. Research verified that both too much and too little sleep is associated with poor health, while the "golden mean" seems to be ideal. In general, sleep time forms a U-shaped curve over the life span. In our busy lifestyle, we can observe the conversion of sleep time to waking activities. In addition, some dimensions of social inequality may influence sleeping habits. At the same time, sleeping has a relation with families' lifecycles, with working time, and with income, as well. In this paper we focus on the relationship between sleep and work-related time. Studies of sleep time are based on two types of theoretical traditions, one of which relies on rational choice theory, while the other emphasizes the role of the social structural elements. We argue that the two theoretical frameworks do not contradict. Our results, that based on the Hungarian Time Use Survey, reveal that rational calculation is determinant, but we also found evidences of structural effects.Our main finding is that sleep time is strongly linked to the degree of integration in the labour market.

JEL-Codes: I1, J1, J2, Z1

Keywords: Health, time allocation, sleeping time, labour market, family, gender, childcare

1 Introduction

It is an unquestionable fact – everyday experience and research show – that sleep is essential for physical and mental health (Kripke et al. 2002, Metlaine et al. 2005) as well as for productivity at workplace (Metlaine et al. 2005, Hale 2005, Hurst 2008, Hale and Hale 2010). In this study our aim is to examine the social aspects of inequality in the duration of sleep. Our question is that the time spent sleep is some kind of resource that is expendable on other, more lucrative activities, or we would rather regard sleeping as something valuable in itself, something that one can maximalize and thus it is a new dimension of social inequalities.

The duration of sleep is associated with physical and mental health: both too long (more than 8 hours) and too short (much less than 7 hours) sleep is related to the poor health status. The ideal sleep duration is somewhere in the middle range (Basner et al. 2007). Beside duration, the quality of sleep is also decisive, and in addition to that, it seems the latter is at least as important as the former. While the duration of sleep can be measured easily in time use surveys, its quality cannot. Mostly the interruption of sleep can be grasped (Burgard 2011), and recently some time use data collections also recorded the subjective value of the action judged by the respondent (Ricroch 2011). However, these solutions do not reflect insomnia, though it is a quite common phenomenon (Leger et al. 2000). Insomnia is not equal to short sleep. Often people with insomnia lie in bed without sleeping. This activity is recorded mostly as sleeping in time use diaries. This is one of the reasons why time use surveys overestimate the time spent on real sleeping. Metlaine et al. (2005) discuss the possible and empirically proven socio-economic consequences of insomnia in detail.

Although the length of sleep is mostly biologically determined, it is remarkable that some effect of certain social factors is detectable. Following Jeffrey Alexander's (1987) meta-theoretical concept[1] there are two theoretical traditions in the research on sleep time. One of them is rational (methodological) individualism (i.e. voluntarism) and the other is methodological collectivism. Some of the research studies emphasize that people do their best to exploit individual opportunities, and the management of time plays an important role in this process. Other studies address the restrictive aspects of social structures.

First, we review authors who can be classified under the approach of methodological individualism or (social) exchange theory. Biddle and Hamermesh (1990) studied the relationship

[1] According to Alexander (1987), different ideological orientations, general assumptions about reality are in the background of these theories. The different theoretical traditions are mediated by these a priori elements. Two dimensions appear particularly important for Alexander; these are the assumptions about the issues of social action and order. In the case of the first, we may either believe that people are basically rational (or if you like selfish), or we may think that they are irrational (normatively or affectively oriented, idealists). The second assumption refers to whether the actions of actors create and shape social institutions (methodological individualism), or if it is social institutions that define actions, which can only reinforce already existing structures (methodological collectivism).

between working time and sleep time, and they were the first who indicated that men with higher income sleep less. Studying this relationship among women showed a weaker effect. The negative relationship between sleep time and education as well as income was studied later by others, too (Szalontai 2006). These studies assume that time is a resource of limited availability, so its management can be described on the basis of the rational choice theory (Becker 1965, Robinson 1987). According to this school of thought, the duration of sleep is influenced by monetary incentives. If the marginal cost of sleep is high enough, people will choose to be awake, or precisely, an income-generating activity instead of sleeping. However, this is limited by the fact that sleeping is essential for the production of energy required for waking activities. Thus, people cannot exploit themselves infinitely because there is a threshold, and over that, productivity will decline. This concept of sleep can explain many relationships found earlier, e. g. why sleep time by age shows a U-shaped curve or why women sleep slightly more than men in most countries, while they also have lower mean wages. Dinges et al. (2005) examined the annual data of 2003 of the American Time Use Survey to see which other activities sleep time is the most reciprocally related to. According to them, sleep is regarded as a flexible temporal commodity which can be converted to other waking activities. The results show that sleep time had the strongest reciprocal relation with working time, and the next two most powerful factors were travel time and time spent on housework. An extended version of the same research was published by Basner et al. (2007).

Unlike the previously discussed authors, Hale and Hale (2010) highlight the social structural determination of poor sleep beside the individual (biological or behavioural) reasons. The lack of autonomy converts social inequities to health inequality through the mechanism of poor sleep. In this concept, sleep quality is also an indicator of health status. The authors argue that limited autonomy (or lack of autonomy), which can be identified at least roughly as low-level positions in social inequality (e.g. poor housing, low educational level, unemployment), leads to poor sleep. At a first glance, this seems to contradict the previously described negative association between education (or income) and sleep duration. However, poor sleep does not necessarily imply a short sleep. As earlier studies demonstrated, the relationship between sleep and health is not linear, but rather U or even more J-shaped. The duration of sleep is acceptable in a relatively wide range, and a too long (more than 8 hours) sleep has even stronger associations with health problems than a too short (less than 7 hours) one (Kripke et al. 2002). In this concept, the unemployment resulting from low education, or even the voluntarily chosen inactivity – which is caused by the poor income opportunities – are structural constraints and not the results of freely chosen factors, leading to passivity and ultimately to a deterioration of health status. This deterioration is accelerated in the case of insomnia by disfunctional answers, e. g. alcohol-use, tv-watching and sleeping pills (Metlaine et al. 2005). Burgard and Ailshire (2009) investigated the impact of social stratification on sleep through bad work conditions (low control, perceived job insecurity and feeling upset on job). According to their results, being bothered or upset at work is one of the three factors that mostly impair the quality of sleep.

However, the quality and quantity of sleep can be examined not only as response variables. Deterioration in the quality of sleep may cause the decline of productivity at work (Metlaine 2005). Therefore, the relationship between work and sleep is circular in nature. Poor working conditions (shift work, night work, work-related stress) can result in poor sleep, while in the long run, lack of sleep will cause weak job performances, higher rates of absenteeism, and will increase the risk of accidents.

2 The current study

On the basis of the two theoretical traditions described, we wish to examine whether the management of time in the individual's life or the structural theory is more closely supported by the data of the Hungarian Time Use Survey 2009-10.

On the one hand, based on the economic theory of sleep we expect that a higher level of education and a stronger embeddedness in the labour market reduce the time spent on sleep. This is presumed to be a linear relationship. This theory suggests that as the presence of women in the labour market is smaller, they sleep slightly more than men. At the same time, based on this theory, we would expect that young and older people, the age-groups outside active age, sleep more than those who are economically active.

On the other hand, based on the structural theory we expect that the social groups with a lack of autonomy (or with a low autonomy) have less freedom for this transaction. Typically, these groups consist of people with low levels of education, poor housing conditions, and economically inactive or unemployed statuses. Moreover, their timetable is constrained by family life. However, a lack of autonomy may result in less sleep or more sleep, depending on the type of the restrictive mechanism. Certain factors, like family life, generate activities which compete with work, while other factors directly affect the sleep-work exchange. Based on structural theory, we would expect that married people and people with young children sleep less; at the same time, we would also expect that poor housing conditions and the occurrence of chronic diseases increase the duration of sleep.

In the further part of the study we will try to answer the question whether the sleep-work tradeoff or rather structural factors influence the sleep duration. As the results show, we can find evidences for both theory, but we can argue more persuasive for one side. In the third part of this paper we briefly describe the background of the analysis, which is Hungarian Time Use Survey, while the fourth part includes the descriptive statistics for the variables used in the analysis. Then in the fifth section regression models based on the theoretical question and the results of the multivariate analysis are described. Finally, conclusions are drawn from the results.

3 The Hungarian time use survey – The data

Time use surveys in Hungary have a relatively long tradition. The first national data collection was implemented by the Hungarian Central Statistical Office (HCSO) in 1963. The first time use research conducted within the framework of an international cooperation was headed by Hungarian sociologist Sándor Szalai between 1965-1966 (Szalai 1972, 1984) and HCSO also had an important role in this. After this starting point, HCSO organised time use data collection and provided a descriptive analysis on a regular basis (Falussy and Zoltánka 1995, Harcsa and Sebők 2002).

Time use diary data have a privileged place in social statistics, since researchers try to grasp the full spectrum of lifestyle with these. There are many fields which could only be examined by special surveys in the absence of time use surveys.

Nevertheless, the overall nature of the survey also has disadvantages, which may cause some limitations for this study. Such a drawback in connection with our current issue is that only the length of sleep can be examined, while its quality cannot, (although it has become possible recently with the development of time-use survey techniques; Ricroch 2011)). Another disadvantage is that the estimation of the amount of time spent on certain activities is based on self-reporting. It should be noted that there is some difference between data gained from objective observation and those derived from self-reporting (Lauderdale et al. 2008); namely, compared to health or medical data collections, the real time spent sleeping is usually overestimated by time use surveys. The reason for this is that actual sleep is not distinguished from the time spent in bed with insomnia or from intervals of falling asleep or awakening. This is caused by the fact that the details of diary entries as well as the activity codelists are limited (Dinges 2005).

Time use surveys in Hungary are conducted by the HCSO broadly every 10 years. The last survey spanned the period between October 2009 and September 2010; it covered a full 12 months period, i.e. 365 consecutive days. The survey, which was based on a multistage clustered sample, covered the population aged 10–84 years, and a total of 8391 people were interviewed using paper-based questionnaires. Its methodology corresponded to the relevant EU recommendations although only one person in a household had to fill in a questionnaire with the exception of households with a child under the age of 15. The response rate was 75% compared to the primary sample frame, but considering the extended sample framework with extra addresses, it was 54%. To eliminate a systematic error caused by non-response, the attributes of non-response were monitored, and the people who refused to answer were superseded with new addresses from a second (backup) sample. After data collection, weighting was assigned based on region, gender and age-groups. The analysed subsample was constricted to 5451 people aged 25-64. In this study unweighted data and one diary per respondent are used, because only a small subsample provides diaries for two days.

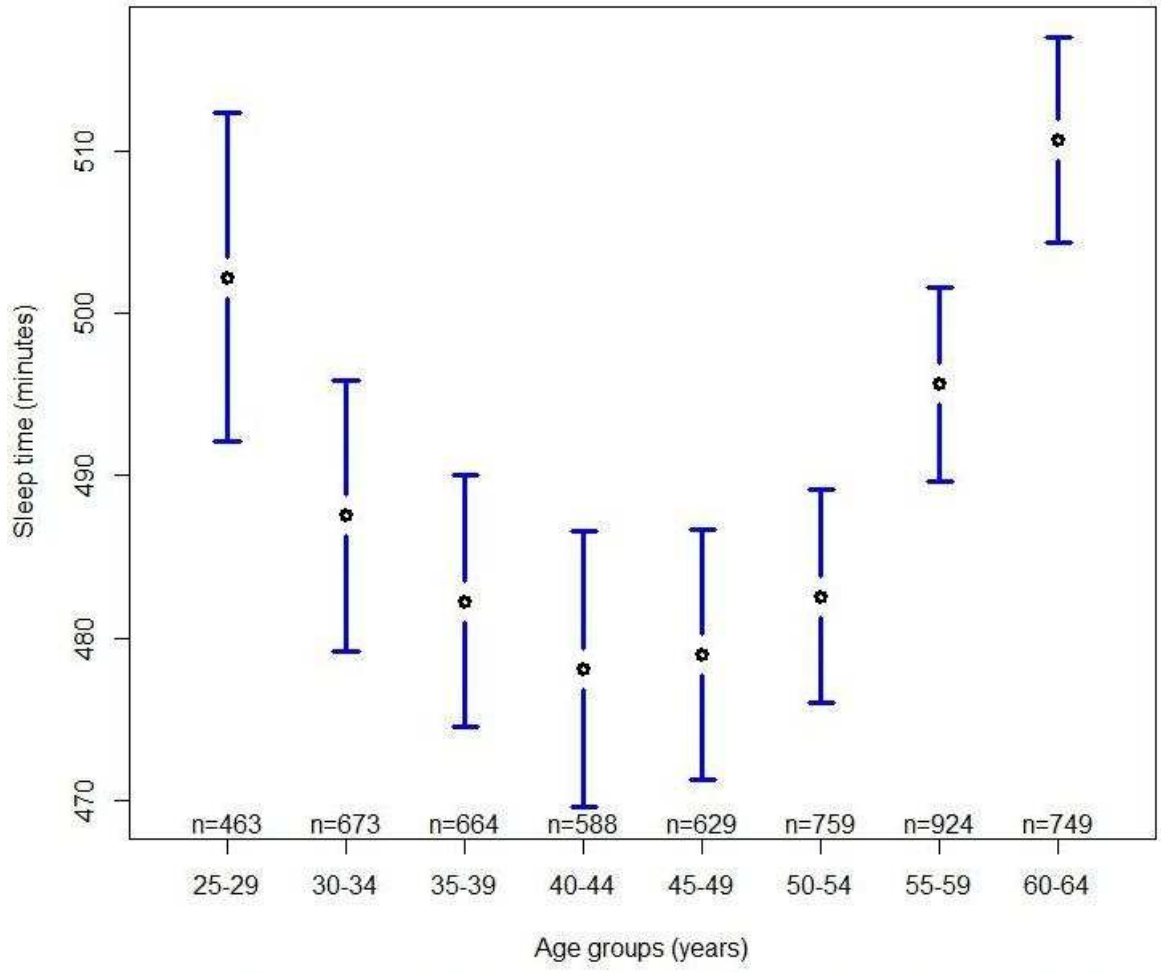
In the coding process of the time use diaries, a detailed activity coding list was applied consisting of 548 primary activities. In the analysis, we used the primary category of sleeping without

relaxation, but we added all the sleeping activities which occurred during the day. The explanatory variables were derived from the household and personal questionnaires, with the exception of working time, which was also a diary-based activity. This work activity encompasses all the earning activities that were carried out by a respondent.

4 Descriptive results

The analysis was restricted to the 25-64 year-old population. This is the economically active age (or working age) population, which – although it is still a broad category – is a relatively homogeneous group from the viewpoint of the lifestyle. The tradeoff between work and sleep in this agegroup is a relevant question. Based on the results collected in Hungary, sleep time by age is characterised by a moderately U-shaped curve (Figure 1).

Table 1
Mean sleep time by age-groups with standard errors

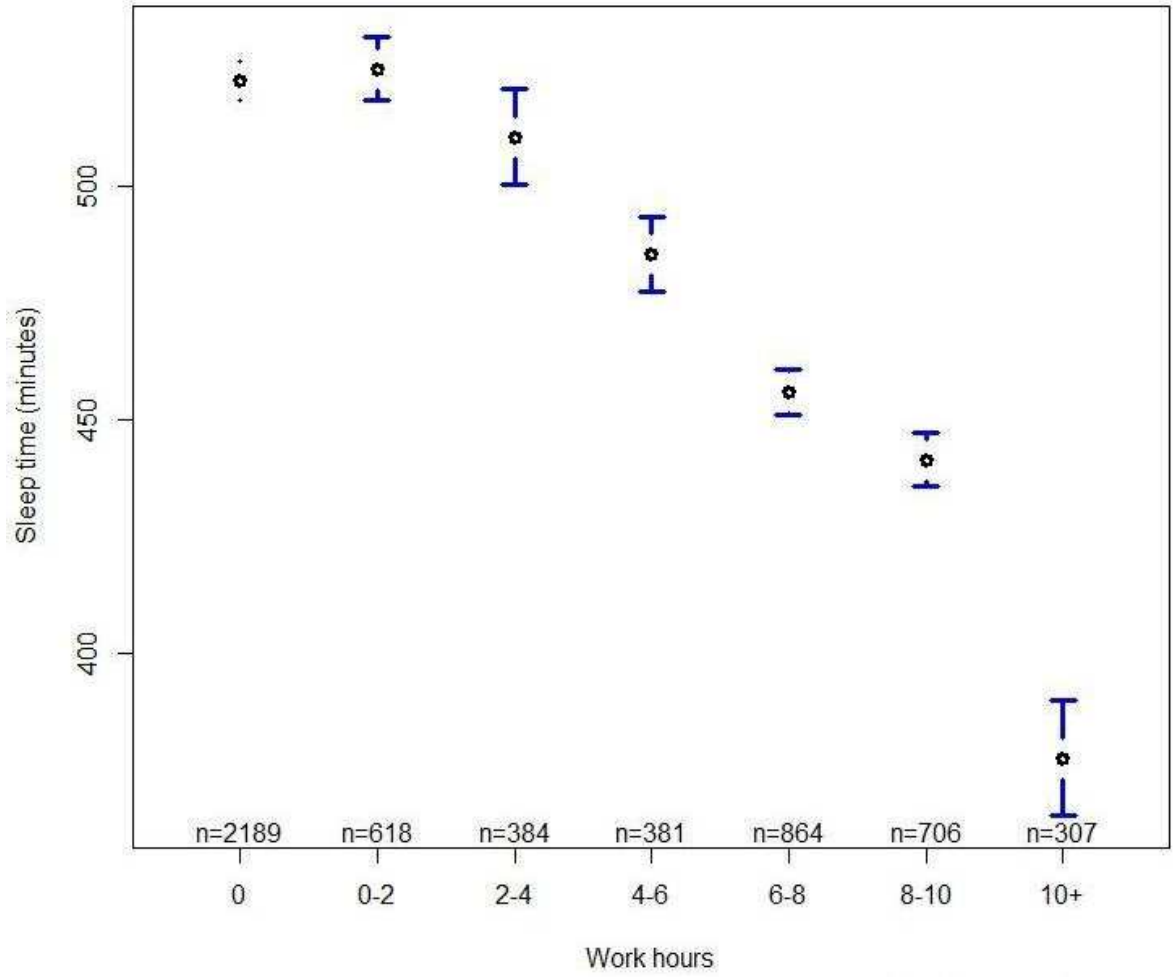


Source: Hungarian Time Use Survey 2009-2010, own illustration.

Thus younger and older people tend to spend more time with this basic activity, while the middle generation spends less time on it. The difference is significant between the terminals and the mid age-groups, but it is not between the groups next to each other.

Figure 2 shows that there is an inverse relationship between the time spent working and the time spent sleeping. People who work a lot sleep definitely less than those who do not work or work for just a few hours (2 hours at the most). As figure 2 indicates, there is no difference between the group without work and those who work only a few hours per day, mostly as part time workers.

Figure 1
Mean sleep time by working time categories with standard errors



Source: Hungarian Time Use Survey 2009-2010, own illustration.

In Table 1 we summarized the descriptive statistics of sleep time broken down by categorized explanatory variables. This shows that women sleep slightly more than men. It is well known from other studies, and it is also confirmed by our data that the surplus in women's sleep disappeares in old age. Women's sleep surplus in the population aged 25-64 was altogether 8 minutes (their total sleep length was 8 hours 14 minutes). According to marital status, married persons spend less amount of time sleeping than unmarried people; the difference was 15 minutes.

Table 2
Descriptive statistics of sleep time by categorized explanatory variables and one-way anovas by single variables (unweighted sample, population aged 25-64)

Variables	Categories	N	Min	Max	Mean	Median	Std dev.	F-value	P-value
Gender	Male	2473	15.0	1110.0	485.7	480.0	107.3	8.44	0.004
	Female	2976	5.0	945.0	493.6	490.0	92.5		
Marital status	Not married	2224	5	945.0	497.1	495.0	105.0	19,37	0.000
	Married	3225	10	1110.0	485.1	480.0	95.3		
Education	Below lower secondary education	117	165.0	810.0	524.2	540.0	109.2	8.90	0.000
	Lower secondary education	915	5.0	875.0	499.2	505.0	100.7		
	Upper secondary education	3338	10.0	1110.0	488.2	480.0	101.2		
	Tertiary education	1079	60.0	810.0	484.1	480.0	90.7		
Chronic diseases	Without chronic illness	3398	5.0	1110.0	483.1	480.0	99.8	43.06	0.000
	With chronic illness	2051	60.0	910.0	501.3	500.0	98.0		
Child under 7 years	Has no children	4326	10.0	1110.0	490.2	480.0	98.4	0.05	0.815
	Has children	1123	5.0	920.0	489.4	480.0	103.6		
Quality of housing	Standard or higher	5071	10.0	1110.0	489.1	480.0	98.7	5.61	0.018
	Sub standard	378	5.0	945.0	501.7	495.0	109.7		

Source: Hungarian Time Use Survey 2009-2010, own calculations.

Mean sleep time changes in the reverse direction by educational attainment. People belonging to the lowest category of educational attainment (Below lower secondary education) sleep 40 minutes longer than the most educated (tertiary education). The biggest difference between the averages of sleep time was at lower secondary education and below this level. The presence of a child seemingly does not have a remarkable impact on the duration of sleep in the total population (we will see from the multivariate analysis that in the case of women it is not true). People who have children under 7 years sleep only 1 minute less than those who do not have children, and this difference was not significant. Among people living under unfavourable housing conditions[2] (which can be regarded as an indicator of living standards), we found an average of 13 minutes longer sleep. The average daily sleep time of those suffering from a chronic (outstanding for at least 6 months) disease is 18 minutes longer than that of the healthier majority.

To sum it up, data support the exchange-theory hypothesis of sleep time being converted to activities pursued awake (namely to work), but also allow the existence of other (structural) mechanisms.

Multivariate methodology and regression results Source: Hungarian Time Use Survey 2009-2010.

5 Multivariate methodology and regression results

We tested our hypotheses with three models. The first one is a simple demographic model (model 1), which examines the impact of age, age-square and gender on sleep. The second one is an exchange-theoretical model, which in addition to the previous factors, also includes the impact of the working time and the level of education. In the third (full) model, we have combined the former demographic and exchange-theoretical effects with structural factors which are marital status, presence of a child under 7, occurrence of chronic diseases, and quality of housing. Thus our models were as follows:

1. Basic demographic model (Model 1)

(1) $$\text{Sleep time} = f\left(\text{age}, \text{age}^2, \text{gender}\right)$$

2. Exchange model (Model 2)

(2) $$\text{Sleep time} = f\left(\text{age}, \text{age}^2, \text{gender}, \text{working time}, \text{education}\right)$$

[2] According to the definition of HCSO, substandard dwellings are apartments without kitchen and of a full size of less than 50 sq. metres or if one of the following characteristics is true: lack of toilet; lack of bathroom; lack of waste-water drain channel; lack of groundwork and the walls were built of adobe.

3. Full model, that is the exchange with structural constraints (Model 3)

$$\text{Sleep time} = f\left(\begin{array}{l}\text{age, age}^2\text{, gender,working time, education, marital status,}\\ \text{presence of child under 7, occurrence of chronic diseases,}\\ \text{quality of housing}\end{array}\right) \quad (3)$$

The income variable has been excluded from the models because of the poor quality, whereas it is obvious that is has a great importance from both theoretical and empirical aspects. However there is a strong relationship between the level of education and income in Hungary (Kézdi 2005), so the level of education as a proxy variable could be used. Beside this the quality of housing was also used as an indicator of living conditions or risk of poverty.

Obviously, a multivariate analysis may exhibit a more accurate picture. As a starting point we applied OLS regression on the subpopulation aged 25-64 to examine the relationships between sleep time and (its) covariates. We excluded two individuals with no sleep time. The dependent variable was mean sleep time per day based on the time use diary, measured in minutes. Predictor variables were the following: age, age-square, gender, working time (mean working time per day, based on the diary, measured in minutes), education, marital status (married, not married), presence of a child under 7, occurrence of chronic diseases, quality of housing. Level of education was introduced as a categorical variable.

Linear regression makes strong assumptions, but often these requirements do not hold (Fox 2008). In our model, the variance of errors was not identically distributed, they are heteroskedastic, as it was revealed by the employed Breusch-Pagan test (Breusch-Pagan 1979) and White test, as well (White 1980). As a consequence, the OLS estimator is still unbiased and consistent, but it is no longer efficient (Baum 2006: 146). Depending on the nature of heteroscedasticity, standard errors of the estimates are biased, and they can be too high or too low. The "Huber-White Sandwich Estimator" providesrobust standard errors and hence accurate p-. Analyses were performed by using the respective Stata software.

It should be mentioned that the OLS standard errors were considerably smaller, thus biased downward, relative to the robust estimates. Here we show only the robust regression coefficients (Table 2). In the first model (basic demographic model), we could see the significant effect of age, age-square and gender. Besides these variables, the second (exchange theory) model confirms the effect of work on sleeping, and the impact of education is demonstrable. People with the highest educational level (tertiary education) sleep 19 minutes less than those with the lowest educational level (below lower secondary education). In the third (full) model, the effect of education is not significant, but the effect of marital status, the presence of children and chronic diseases shows up, the latter two with weak significance levels. We tested the model separately for females and males, as well, and we found significant differences between men and women in the mechanisms affecting sleep. The model for females reveals that married life and the presence of a child under 7 years decrease sleep duration, while in case of males the role of education is more decisive besides work.

Table 3
Sleep duration – Estimated coefficients and standard errors (in brackets) from robust regression models

				Model 3 separated for gender	
	Model 1	**Model 2**	**Model 3**	**Female**	**Male**
R^2	0.015	0.192	0.194	0.162	0.229
DF	5445	5441	5437	2965	2462
Age	-8.32***	-2.71*	-2.39*	-2.55†	-3.10*
	(1.13)	(1.04)	(1.05)	(1.37)	(1.61)
Age^2	0.10***	0.03*	0.02*	0.02	0.03†
	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Female	7.37**	6.14*	6.66*	–	–
	(2.72)	(2.51)	(2.51)		
Work		-0.18***	-0.18***	-0.17***	-0.20***
		(0.01)	(0.01)	(0.01)	(0.01)
Lower secondary education[a]		-11.33	-10.27	0.81	-25.61
		(10.57)	(10.79)	(13.29)	(18.06)
Upper secondary education[a]		-15.10	-13.22	-1.32	-30.14†
		(10.24)	(10.62)	(13.12)	(17.69)
Tertiary education		-18.54†	-16.03	-5.97	-31.45†
		(10.43)	(10.83)	(13.39)	(18.03)
Married			-6.48*	-9.31**	-1.46
			(2.56)	(3.24)	(4.38)
Child under 7 years			-6.14†	-14.90***	4.30
			(3.36)	(4.35)	(5.19)
Chronic diseases			5.17†	5.33	4.83
			(2.75)	(3.49)	(4.38)
Substandard housing			-2.03	7.69	-3.23
			(5.62)	(7.51)	(8.40)

a: Below lower secondary education is the Reference category,
Significance codes: ***99.9%, **99%, *95%, †90%,
Source: Hungarian Time Use Survey 2009-2010, own calculations.

6 Conclusion

The tradeoff between sleep time and working time seems to be supported by the results. In addition, people with higher education appear to sleep significantly less than those with a lower one, which underpins even more the exchange theory's hypotheses.

According to all models, we can observe a U-shape association between sleep time and age. This association was also observed by Tune (1968) and by Basner et al. (2007), the latter study having been based on the data of the American Time Use Survey. However, this relationship

does not appear to be universal because Biddle and Hamermesh (1990) detected a different pattern for the two sexes: they found an inverse U-shaped (concave) relationship among men and a U-shaped (convex) one among women. These findings were based on data from the 1975-76 US Time Use Survey, which was conducted by the University of Michigan. In the full model separated for women, the U-shape relationship disappeared between age and sleeptime.

The impact of gender was only 8 minutes according to the descriptive data, and this gap between the two sexes was slightly smaller in the multivariate regression. At the same time, we observed different mechanisms for the two genders when we separated our model, which could be interpreted as a gendered trade-off. In the case of women, marriage and the presence of a child (under 7 years) are determining factors in sleep time beside work, while in case of men they are not. For men, the amount of sleep is primarily determined by the level of education and activity in the labour market. This difference can be explained by the well-known fact that in families, women typically reduce their paid work and do more unpaid work and child care, while men spend more time on paid work. This strong trade-off is the main finding of our study, which was verified by others earlier as well (Biddle and Hamermesh 1990, Szalontai 2006, Basner et al. 2007).

The results also exhibit an additional independent effect of chronic diseases on sleep-work transaction. Finally, substandard housing did not prove to be significant. Although it could be an appropriate indicator of deprivation, the level of education provides a much stronger prediction for the living conditions or even for the risk of poverty in the Hungarian social-economic environment (Kapitány – Spéder 2004, Kézdi 2005).

In the model separated for men, the role of education and the role of labour market participation seem to be priorities. Education decisively determines the chances of life. In the case of women, the increase in the level of education did not reduce significantly the time spent sleeping, but family life carries other determining factors in addition to age and work. The effect of family life can be interpreted as another trade-off between the sexes that is organically connected to the exchange between sleep and work. (Nevertheless, it could also be argued that family is a structural constraint, which basically determines the tradeoff between sleep and work.) This tradeoff between the sexes would require further investigation, but technically this could be tested properly on a time use dataset, which contains a household sample and both adult members of the household.

We have not examined the quality of sleep though it is likely that there is a stronger relationship between the sleep quality and the structural constraints (Burgard Ailshire 2009, Burgard 2011).

Our main result is that the duration of sleep is strongly linked to work. The contradiction between the two theories – methodological individualism vs. structuralism – appears to dissolve in the light of this empirical finding. Namely, the labour market participation has two side, a voluntaristic action side and a structuralistic one – regarding the fact that below a specific level of education the chance of integration in the labour market is very low. We can add to this

emipirical finding, that in Hungary the presence in the labour market – due to the low level of capital in the Hungarian population – has a great importance and the lifestyle of people who are integrated in this market is significantly different from those, who are unemployed. This can be seen well on sleep which is one of our basic physiological activity.

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