Sleep: Erosion or Compression in the Computer Age?

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Abstract

Time-use data presented to IATUR 2005 in Halifax on the duration of nighttime sleep in Canada from 1986-1998 addressed the popular assertion that people are increasingly sleeping less. While sleep was not found to have eroded by as much as a minute during that period, it was systematically compressed among certain segments of the population, heavily related to socio-economic and demographic aspects of the population - particularly to intensive participation in the labor force. The use of computers to continue occupational activities at home after conventional working hours appeared statistically as the most salient aspect of the occupational context regarding sleep compression. However, the rapidly-growing wave of computer ownership and use after 1998 raised the desirability of examining more recent data on the trends and dynamics of Canadian sleep duration in the following decade.

This paper examines sleep erosion and compression through time-use data from Statistics Canada's General Social Survey 19, gathered during 2005 with 19,597 respondents, extending the trends from similar studies in 1986, 1992, and 1998. Mean duration of nighttime sleep in Canada no longer remains static. Contrary to public opinion, the average night's sleep *increased* by fourteen minutes in 2005. Nonetheless, factors explaining sleep compression among certain segments of the population remain potent, suggesting that sleep loss is not mythical among these visible and vocal groups. Analyses of the 2005 data set examine the degree, nature, and subjective impacts of sleep compression, including as possible the place of computer usage to sleep duration.

1. Sleep: Erosion and Compression

Sleep is a highly tangible, universal phenomenon. It is a biological necessity that takes up about a third of most people's days. Gershuny (2000) notes a paradox about amounts of sleep. On the one hand, he finds that "time devoted to sleep, washing, and dressing remains remarkably constant over time…" (p. 116) Changes from 1961 to 1983-84 that he presents in these activities are minimal, from 562 to 572 minutes a day (p. 224-225). Yet, citing earlier research by Alexander Szalai, he suggests that "sleep is compressible" under specific external circumstances such as distance to work. On two consecutive pages, Robinson, Converse, and Szalai (1972) state that for an aggregate the amount of sleep is relatively inelastic, while individuals can compress it on working days and extend it on days off (pp. 128-129). Time-use data from the Multinational Comparative Time-Budget Study (Szalai, 1972) showed few major differences in sleep between the twelve countries compared, but nonetheless that people of higher incomes sleep less and those who are older, more, i.e. compression according to societal segmentation.

A selection of studies supports Gershuny's observation that amounts of sleep do not change much over time. Robinson and Godbey (1997) showed from American time-use studies in 1965, 1975, and 1985 that changes in sleep were minor and inconclusive as a whole. Yet, they note that employed persons sleep less than those without jobs, that sleep varies inversely with income, and that older people sleep more (especially when naps are included). Rydenstam uses Swedish data from 1990-91 to 2000-2001 showing that while time spent eating meals increased in duration, sleeping time did not (2002). Vaage found the time devoted to sleep in Norway was unchanged from 1971 to 2000, while finding also that Norwegian men sleep less than Norwegian women and that both young and older women there sleep the most (2002).

More recently, Szalontai and Wittenberg (2004) stressed the variation by individuals in sleep duration, calling it a "consumer's choice" (p. 26). People are said to cut back on sleep when other uses of time are more economically attractive. If you earn more by working longer and sleeping less, you will do so according to this set of economic assumptions. This is said to explain why people sleep less in nations in which economic opportunities are markedly better than in others. Stalker's research (2004) suggests that those fortunate enough to have good jobs are working more, even if this is not a phenomenon spread throughout society. Jacobs and Gerson (2004b) emphasize from their analyses that the expansion or contraction of work time is not found in lock step within society. "Instead, it is more useful to see time as a new form of social inequality that is dividing a number of groups in our society – the overworked and the underemployed, men and women, and parents and nonparents, to mention a few." (p. 26)

This position was supported in an analysis of sleep presented recently to IATUR (Michelson and Frederick, 2005). Tracing the mean durations of nighttime sleep from Statistics Canada's general social surveys in 1986, 1992, and 1998, no erosion of sleep was found. Nonetheless, significant sleep compression was found related to socio-economic status, gender, age, household activity, and amount of daily travel. Aspects of labor force participation were statistically paramount in explaining sleep duration, within which the ability to extend the work day made possible by computers appeared to impact in the direction of compressing sleep duration. Nonetheless, other factors significantly impacted on sleep duration.

Fuchs Epstein and Kalleberg (2004) highlight how "Jacobs and Gerson's analysis points to the need to abandon the search for one overarching trend in favor of theoretical explanations that examine how economic transformations have created varied time constraints and dilemmas for workers and their families." (p. 7) Our data suggest that this conclusion flows through to an understanding of erosion and compression regarding sleep, an application that they did not pursue.

Although controversy once raged over the issue of whether people *in general* are working more and more (Schor, 1991) or whether the *average* person increasingly enjoys more leisure (Robinson & Godbey, 1997), there is relative unanimity both about the stability of sleep duration over time in nations and about characteristic ways in which individuals differ from each other regarding sleep. Nonetheless, there has been a wave of hyperbole from North American popular culture in recent years that most people are increasingly cutting into their sleep, becoming exhausted and haggard. For example, a Toronto radio news station spoke earnestly about an increasingly "nagging lack of proper sleep" in a "sleep deprived run and gun society" (680 News, 2005). Soon afterwards, the daily newspaper carried research results from a study showing greater incidence of clinically identified insomnia, interpreting this to mean the same thing (Carey, 2005). Popular culture has fixated on the notion that sleep has eroded as part of societal developments making work and leisure alike increasingly portable and without previous time limitations. The very people who may be working longer hours possess a digital tool that not only engages them, but allows them to continue their professional work during the evening and night without the external constraints of the workplace. Our previous paper did not find the expected general erosion of sleep as of 1998, though it did find sleep compression that logically appeared to flow from computer use in the performance of paid work. Nonetheless, the flow of sleep deprivation hyperbole appears to have accelerated after the 1998 data that we analyzed in 2005. This made it of considerable interest to replicate the previous analyses with more recent data. These were gathered by Statistics Canada throughout 2005 and made available late in 2006.

An excellent, recent sociological analysis of sleep by Simon Williams (2005) not only points to evidence of sleep erosion in a longer historical period and to dysfunctions arising from insufficient amounts of sleep but also to a variety of specific contexts in which sleep is characteristically compressed.

Therefore, the current paper focuses on evidence from 2005 in Canada on 1) whether sleep duration has eroded or remained inelastic in recent years, 2) the extent, nature, and explanation of sleep compression in society, and 3) in what respect, if at all, sleep compression is associated with negative outcomes.

2. Methodology

The analyses that follow are mainly based on time-use and related data collected in Statistics Canada's General Social survey 19, carried out from January through to early December, 2005. The completed sample size was 19,597 persons, one person in a household selected according to randomizing procedures. The main dependent variable is the duration of nighttime (more generally, the respondent's *essential* sleep of significant duration, even if not always during the night).

Consistent with previous time-use studies conducted by Statistics Canada, the day for which time-use data were gathered was deemed to start at 4 a.m. and to end at 3:59 the next morning. This would include the full course of most activities people conduct throughout the day. But it raises some questions about measuring sleep. The start time was chosen partly on the rationale that people are sleeping then, not embarked on any other activity of interest. The finding that virtually all people start a period of sleep at 4 a.m. is solely an artifact of the methodology. For that reason, our analysis of when people go to sleep omitted any episode of it found to start at 4 a.m. Nonetheless, Statistics Canada's main measurement of the duration of sleep for the 24 hour period studied started with the total minutes recorded from 4 a.m. until the respondent awoke and then included the usually longer episode of sleep from the time respondents went to bed the following evening or night until 3:59 a.m. Hence, the value for duration of nighttime sleep is derived from two nights. Stylized questions about when respondents went to bed on "Day -1" and when they arose on "Day 2" enabled two supplementary measures of nighttime sleep, though not listed as activity variables in the 24-hour time-use array. The mean durations of the three measures of nighttime sleep are close but not identical. Analysis of the pattern of discrepancies will be reserved to another paper. I continue to use the Statistics Canada's main measure as reflecting the same 24 hour period as for all other activities and to be consistent with previous analyses on sleep I have conducted with the same measurement.

Some consideration is given also to periods of incidental sleep (e.g. naps), so as to observe its amount and distribution in the population.

General Social Survey 19 approximates a representative sample of Canadians. But due to such factors as sampling frames with varying degrees of saturation and refusals, the raw data are not fully representative. For this reason, Statistics Canada provides weights for individual respondent data and urges their use. Nonetheless, as weightings are meaningless for a number of the analyses presented here, they were not employed in some situations and ignored in others. The main dependent variable of mean duration of nighttime sleep differs by only a minute between weighted and unweighted samples or about two-tenths of a percent. Use of the unweighted values also makes this presentation of the 2005 results compatible with our results from previous surveys.

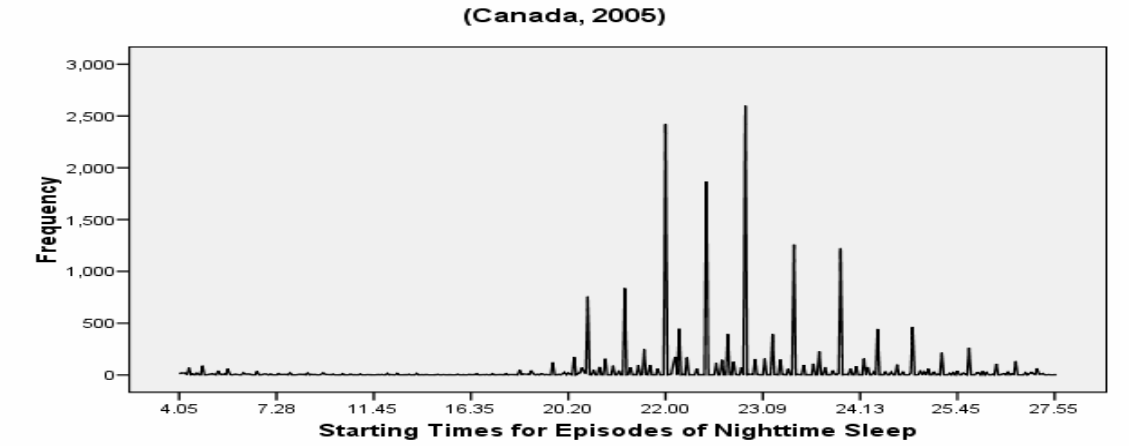
3. Elasticity over time: Erosion?

In the previous analysis, based on data from 1986, 1992, and 1998, mean duration of nighttime sleep was 483 minutes a night at all three time points. It did not change by as much as a minute over twelve year period. It was as inelastic as found from the other studies cited, despite the extent of change in technology during this period.

Nonetheless, there was reason to expect that the impact of technology in this regard might lag and therefore become evident within the seven years between 1998 and 2005. Has the duration of sleep eroded during this period? In short, no. To the contrary, the mean duration of nighttime sleep *increased* by **14** minutes to 497 minutes a night from the 1998 sample to the 2005 sample.

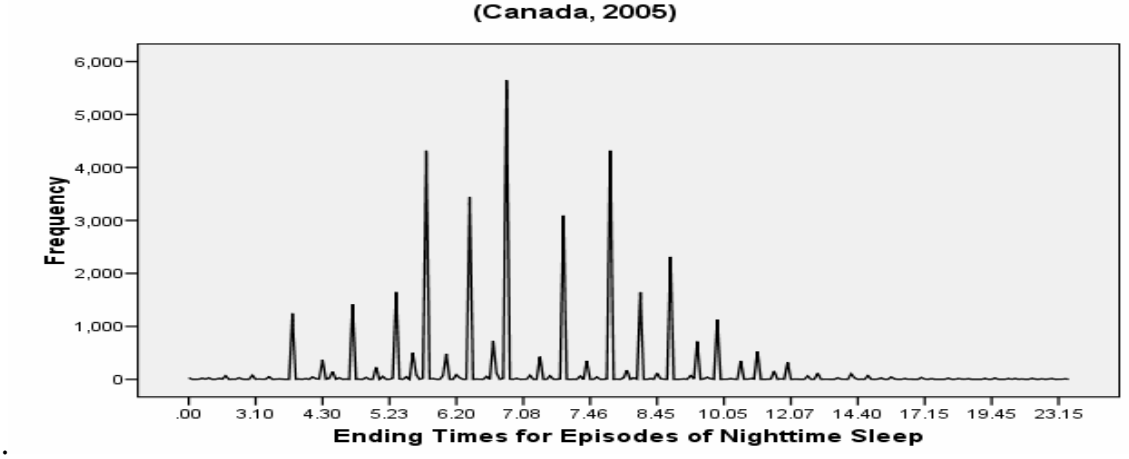
The media suggest that people go to bed later than before, contributing to a reduction in sleep. When do people go to bed, and has this changed? A plot showing the frequency of times at which people started episodes of sleep showed a relatively normal distribution around the mode of 11 p.m. in all three previous surveys. Figure 1 shows this distribution for the 2005 sample. While 11 p.m. remains the modal start time, nearly as many people retire now at 10 p.m., and a much higher percentage of respondents goes to bed at 10:30 p.m. than at either 11:30 or midnight. The shape of the distribution is no longer as normal, reflecting earlier bedtimes, enough so as to generate the increase in mean sleep duration.

Figure 1. Distribution of Starting Times for Nighttime Sleep



In contrast, Figure 2 shows a distribution of when respondents get up that is much more normal in shape. Not surprisingly the mode is at 7 a.m., but about the same number arise at 6 a.m. and 8 a.m., not to speak of balance at the half hour points before and after these times. It is easy to see from the comparison of Figures 2 and 3 how the mean duration of sleep has to exceed eight hours by more than the previous three minutes.

Figure 2. Distribution of Ending times for Nighttime Sleep



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Thus, the aggregate amount and timing of sleep appear to have changed between 1998 and 2005, but in the opposite direction from what might have been expected. While 14 minutes is not very large, it still represents a clear difference that is supported by the change in the timing of bedtimes. Nonetheless, it is still difficult to say whether, in the long run, this will represent elasticity in sleep duration. But it certainly does not reflect erosion.

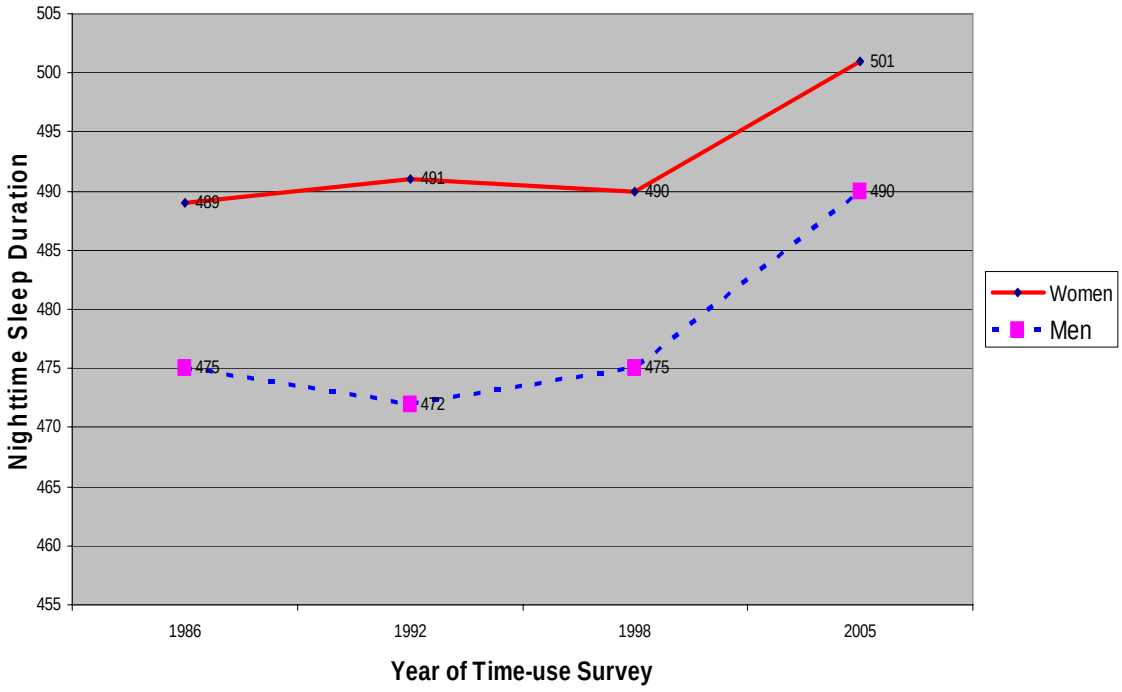
4. Compression by Subpopulation Differences

The second analytic focus is on the extent that the duration of sleep is particularly compressed within certain segments of the population in comparison to others, regardless of elasticity or inelasticity in the general sample. Consistent with the literature, the previous analysis found substantial differences in sleep duration according to gender, age, and aspects of socio-economic status, particularly work status. To what extent are these sources of sleep compression found in 2005, and do they impact sleep as before?

4.1. Gender

The absolute amounts of sleep and the differences by gender were virtually unchanged from 1986 to 1998. Canadian women slept about 15 minutes longer on the days recorded by the time-use surveys than did men, 490 minutes to 475 minutes. Figure 3 show that both men and women have increased sleep duration in 2005. The men increased sleep duration by 15 minutes, compared to 11 for the women. This tended to narrow the gender differences to somewhat less than was the case in previous surveys.

Figure 3. Mean Nighttime Sleep Duration by Gender and Year

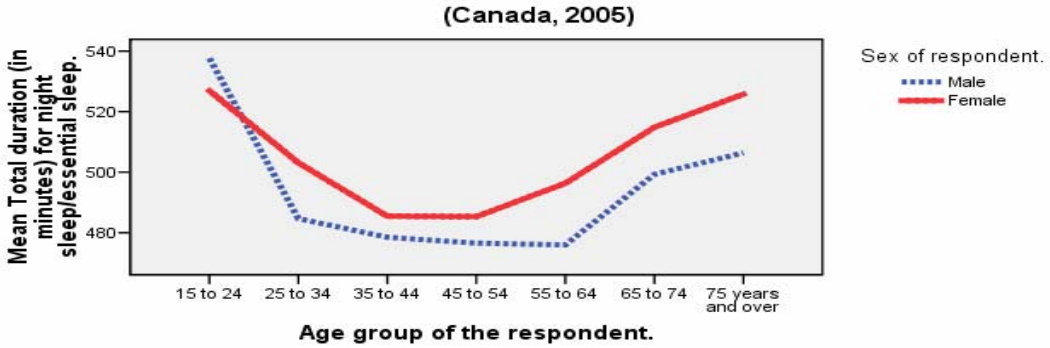


4.2. Age

Sleep forms a U-shaped curve: higher before and after the prime employment years and lower during the years when employment is most likely. Figure 4 shows this pattern, broken down by gender. The gender difference in sleep duration holds within every ten-year age category except among the 15-24 year olds, where males sleep longer than females.

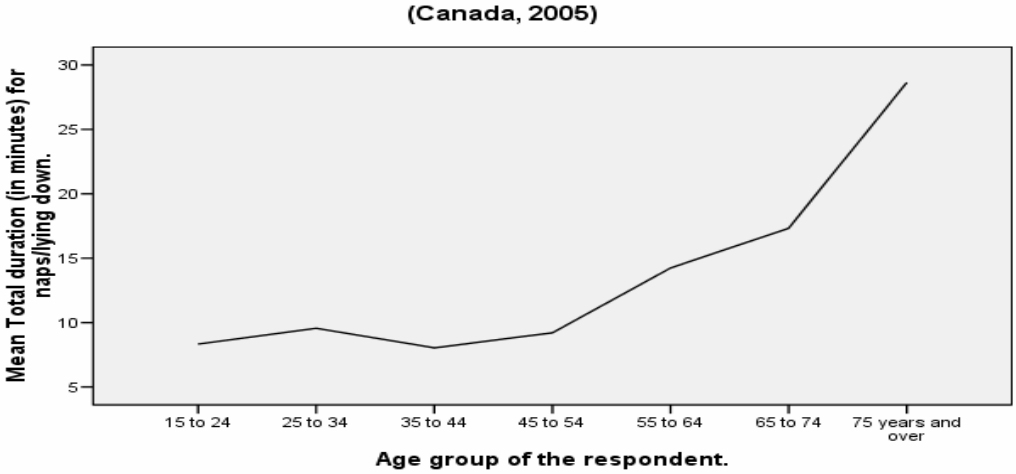
This pattern differs somewhat from the 1998 findings, in which there was equality by gender within the youngest age category, rather than the current reversal of the otherwise prevalent gender difference. Furthermore there is more convergence in gender now by gender during the peak employment years than afterwards, which is the reverse of gender convergence in sleep by age in 1998.

Figure 4. Mean Nighttime Sleep by Age and Sex of Respondent



In comparison, relatively little time is taken in incidental episodes of sleep, naps for example. Only about 10 minutes a day are accounted for by such incidental slap until after age 55, when the amount changes rises by each succeeding age cohort as might be expected. What Figure 5 shows is that time spent on incidental sleep is greatest among the segment of the population that is already getting the most nighttime sleep as well. The distribution of incidental sleep is unchanged from 1998.

Figure 5. Mean Minutes of Incidental Sleep by Age group of respondent



4.3. Socio-Economic Status

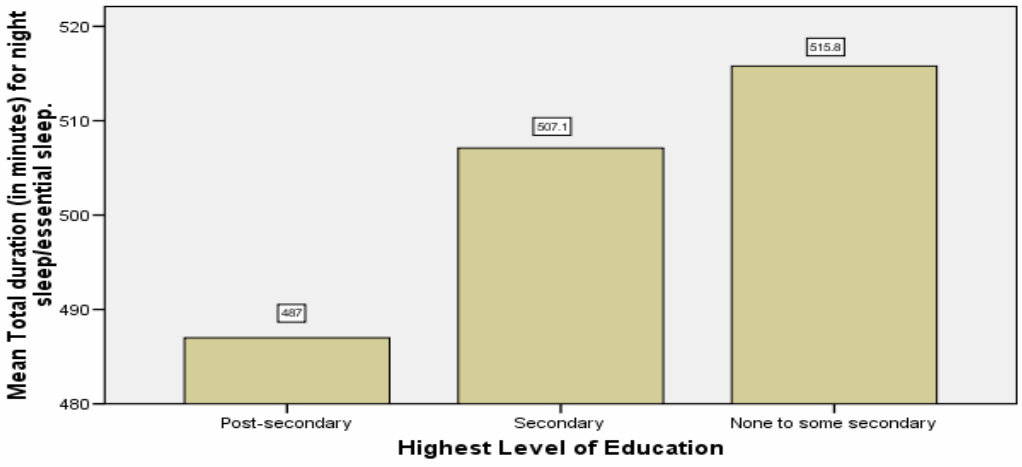
The components of socio-economic status have been found related to sleep duration, typically inversely. This is confirmed in all the Canadian analyses since 1986, the current one included.

4.3.1 Education

Figure 6 shows that those with higher levels of education sleep significantly less (F = 100.117, sig. = .000). This represents no change.

Figure 6. Mean Minutes of Sleep by Highest Level of Education

(Canada, 2005)



4.3.2. Income

As assumed by economics-informed research, Canadian respondents traded off sleep for income – to an extent. The Pearson correlation coefficient between sleep duration and personal income in 2005 is -.142. This, in itself, is not a particularly high level of association, but in an effective sample of 14,452 for this pair of variables, the chance that the two variables are unrelated is extremely remote (<.000). Controlling this association by gender reduces it only very marginally, to -.135, without affecting the level of significance. Once again, this relationship is essentially unchanged from that of 1998.

4.3.3. Work Status

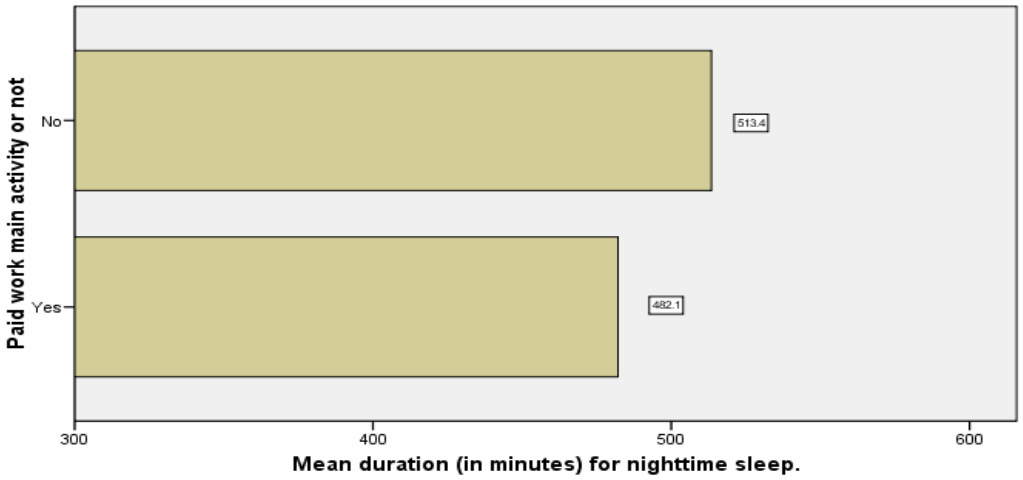
The main influences from work status on sleep duration are, first, being in the active work force, and then, the amount of time spent in the day on various paid work activities.

Figure 7 examines sleep duration with respect to the main activity in the past week. There are only two bars on the chart, because those whose main activity is reported as anything other than working at a paid job or business slept considerably

longer did those with paid employment. There was a clear dichotomy between those currently employed and all others. The difference in mean sleep duration is more than half an hour, 482.1 for those in the work force and 513.4 for all others (F=322.924, sig. = .000).

Figure 7. Sleep duration by whether or not paid work is main activity of past 7 days

(Canada, 2005)



The simple Pearson Correlation coefficient showing the association between total minutes of paid work activities and minutes of nighttime sleep is strongly negative and significant: -.309.

These findings are once again consistent with the literature and with our previous analyses of earlier surveys of time-use by Statistics Canada.

Our previous analysis of the 1998 data set indicated that computer use is an important aspect of paid work time. Work-related use of computers amounted to 80 per cent of all time spent with computers. And the variable of time spent on computers for paid work purposes correlated almost entirely with that for time spent in paid work. Indeed, those in the labor force found to bring home their main work on a regular basis were also found to spend more time doing work-related computation – and they slept less. In a multiple regression on mean sleep duration, it was computer time for work purposes that explained the most, removing most of the explanatory power from duration of work in general. While the former is an aspect of the latter in the closest possible relationship, the analysis suggested that being able to use the computer at home for purposes of work without artificial time boundaries is a potent factor in explaining work-based compression of sleep.

In the current analysis with data from 2005, it is still possible to observe a significant effect of carrying out main paid work at home on sleeplessness. Those bringing home their work have a mean of 474 minutes of nighttime sleep, compared to 486 minutes among people with paid employment who do not (F = 16.827, sig. = .000).

But we cannot view the extent that this reflects work-related computing. Unfortunately, procedural differences with the 2005 data set by Statistics Canada resulted in no reporting of the total minutes spent on the computer for work purposes. In both 1998 and 2005, episodes of time spent on the computer were transferred into the category of main paid work (code 011), as well as to other work variables that combined diverse work activities. In 1998, the amounts of time spent on work related computing were also reported independently in a different series of special interest totals in the main file. In 2005, it was not. In contrast, however, several leisure-related uses of computers were incorporated in 2005 as regular activity variables. I have combined these for the analyses in section 5. Thus, work-related computing is passively included in our analyses as an unobservable component of paid work time, while leisure-related computing, the least amount of computer time, is an explicit leisure activity.

It is not coincidental for the differential duration of sleep by gender that men report 90 minutes more time in paid work activities than do women. But, on the other hand, there are many more activities requiring time in the day, many of them at home, so that the tradeoff between paid work activities and sleep does not occur in a vacuum and is hence not necessarily determinative. Domestic activities are important in the understanding of how all everyday activities fit together.

4.3.4. Household structure and Activity

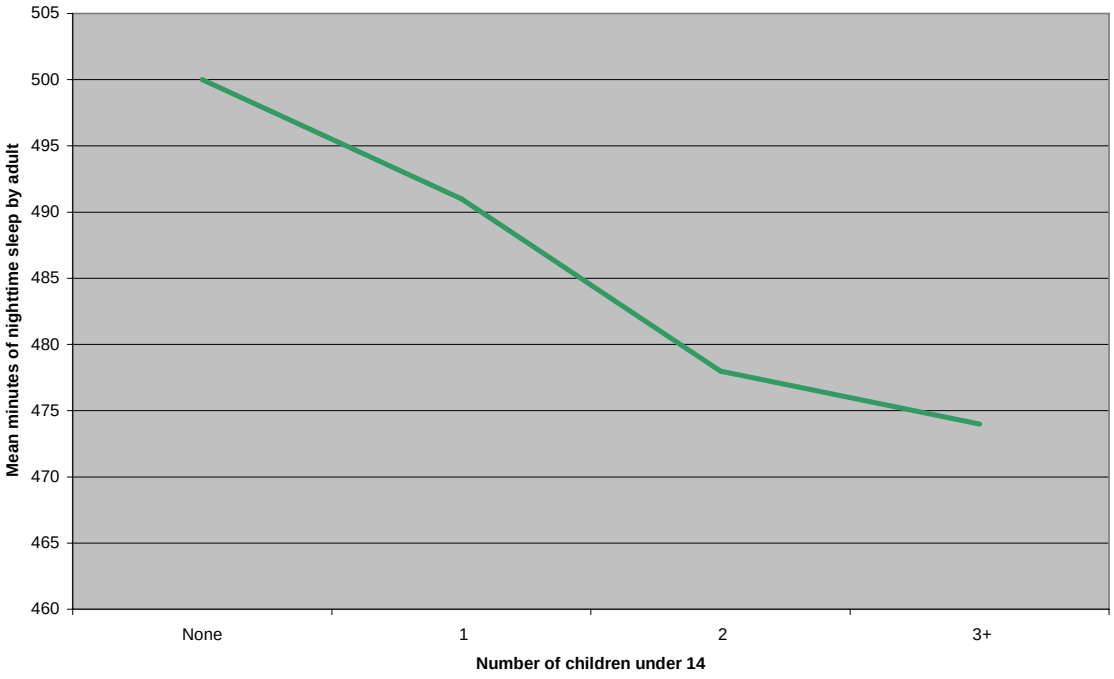
A great deal of attention in the literature is paid to the presumed tradeoffs between time devoted to work and time for what were considered as important alternatives: leisure time, family time, and the like (Schor, 1991; Presser, 2003; Robinson & Godbey, 1997; Bianchi, et al., 2000; Fuchs Epstein & Kalleberg, 2004, Jacobs & Gerson, 2004a). This matching of variables fits well growing feminist interest in the daily activity contexts of increasing numbers of women with both households and paid employment (Friberg, 1993; Hochschild, 1989). The perspective of work-family balance has become prominent. A focus on division of labor within the household, as related to both gender roles and external paid work commitments, has become a vital link between time-use analysis and women's studies.

In that regard, it is surprising that research focusing on the balance between work and family life has so seldom extended to a logical outcome of dual demands, sleep compression. This might be understood in those analyses, indeed some of those contributing most powerfully to the debate, which were based entirely on stylized questions, which do not assess the minutia of diverse activities making up the day. But in studies based on systematic time-use data, sleep has been under analyzed in its logical connection with household structure and activity.

Research has indicated clearly how families with children, particularly young children, spend much time in household activity within the 24-hour day (e.g. Mattingly & Bianchi, 2003; Gunthorpe, 2003). Does this have a bearing on sleep? According to the current analysis of 2005 data in Canada, adults in households without children sleep a mean of nearly twenty minutes longer than do those in households without children (502 to 484 minutes). The greater the number of children under 14 years of age in a family,

the greater the compression on sleep occurs. Figure 8 shows the steady compression of sleep duration from 501 minutes among adults in families with no children under 14, to 474 minutes among those with three or more children.

Figure 8. Duration of Adult Nighttime Sleep by Number of Children in Household Under 14



However clear this relationship might appear, it doesn't stand alone. Age enters the interpretation of these data, too, in that persons beyond the childbearing years sleep much longer as a consequence of age and more likely labor force retirement.

The bivariate association between sleep and time devoted to domestic work of all kinds is negative as expected but relatively weak (r = -.028). The Pearson correlation between sleep duration and child care is statistically significant and in the negative direction but still relatively low, -.060. In contrast, the amount of time spent watching television is positive (r=+.051), though not of greater strength.

How do we account for the much publicized "double day" of the employed woman with a family, in which the responsibilities of paid work and gender role related domestic work are said to be additive (c.f. Hochschild, 1989)? Does not this double burden necessarily cut into sleep? Analyzing only women in the labor force, the Pearson correlation coefficient linking time devoted to domestic activities with sleep duration is *positive*, though not significant - +.024 (sig. = .086). The impact of paid work hours on sleep in the double day is surely strong and negative, but it does not appear that time devoted to domestic activities exacerbates that situation.

We do, however, continue to assess the relative impact of domestic and child care activities in a more integrated framework in Section 5.

5. Relative Impact of Factors on Duration of Nighttime Sleep

Section 4 presents an array of factors that are logically and statistically significant as explanations of sleep compression. For example, the mean duration of nighttime sleep is compressed among adults is the prime working years, among those actually in the labor force, and among those with children at home. Do any one or more of these factors, or indeed others as well, take precedence in explaining sleep compression? Do some factors lose their explanatory significance was controlled by others?

For this reason, several versions of linear regression analysis were computed, with very similar results. Table 1 shows the results of the stepwise method, which lists factors in order or explanatory power and, at the end, excludes factors found not significant in view of the others. A number of factors were constructed for analysis, to reflect the independent factors identified in Section 4. These are:

- Total duration (in minutes during the day) for paid work
- Total travel time
- Total duration of domestic work activity codes
- Total duration for watching television
- Age group of the respondent
- Total duration for child care by the adult respondent
- Total computer usage for leisure purposes
- Highest level of education
- Total household income
- Total income of the respondent
- Hours in the week worked at home
- Sex of respondent

Coefficients

Variables	B	Std. Error	Beta	t	Sig.
(Constant)	**605.333**	**5.159**		**117.343**	**.000**
Minutes of paid work	**-.206**	**.004**	**-.456**	**-49.276**	**.000**
Minutes of travel time	**-.357**	**.012**	**-.241**	**-29.279**	**.000**
Domestic work activity	**-.165**	**.007**	**-.198**	**-22.681**	**.000**
Minutes watching TV	**-.094**	**.008**	**-.107**	**-12.235**	**.000**
Age of respondent	**-7.688**	**.613**	**-.106**	**-12.547**	**.000**
Minutes giving child care	**-.153**	**.013**	**-.097**	**-11.991**	**.000**
Computer usage - leisure	**-.209**	**.021**	**-.079**	**-10.005**	**.000**
Highest education (inverse)	**5.884**	**1.284**	**.038**	**4.581**	**.000**
Total household income	**1.553**	**.371**	**.035**	**4.186**	**.000**

Dependent Variable: Total duration (in minutes) for nighttime sleep.

Table 1. Coefficients and Significance Levels for Factors Potentially Explaining Duration of Nighttime Sleep in Stepwise Linear Regression Analysis (Canada, 2005).

The single strongest variable in explaining sleep duration within the controlling restraints of the others is minutes devoted to paid work during the day, with a Beta of -.456. This, as noted, includes work-related computing but can not separately identify any particular effects of it. While this effect is substantial, other factors also are found to make major contributions. As in our analysis of the 1998 data, total time spent in travel has a strong inverse effect on sleep, with a Beta of -.241, and time spent in domestic work activity is nearly as strong (Beta = -.198)

Other factors having more modest but still statistically significant impacts on sleep are: minutes watching television, age, child care, leisure related computer usage, highest level of education, and total household income.

Three factors were excluded from the final explanatory model in Table 1 because they were found insignificantly associated with sleep duration in the stepwise regression iterations. These are the number of hours in the week worked at home in answer to a stylized question, the annual personal income of the respondent, and, perhaps surprisingly, the sex of the respondent. The extent that factors that appeared significant in bivariate analyses are found to be better explained by other, sometimes more specific factors is illustrated clearly by the sex factor. In this subset of factors, it is not being a woman that has a bearing on more or less sleep but rather being a person spending greater or lesser amounts of time on paid employment, daily travel, household work, child care, and more that impacts on the amount of sleep. The use of linear regression to show the relevant effects on sleep of factors once controlled by each other changes our impressions of the relationship of income and sleep. Whereas personal income was more closely related to sleep than was household income when viewed in bivariate analysis, it is the reverse after the controls in the regression analysis, where household income is significant and personal income is not. Furthermore, the direction of the relationship is changed to a positive one; all things considered, adults in households with greater incomes get more sleep.

The R^2 for the final model, excluding the three insignificant factors, is .186, adjusted to .185.

As much as the findings establish the relative strength of several explanatory factors vis á vis the others, they also show that explaining sleep compression is not a simplistic matter, reflecting a single cause and effect. Paid work can take a big chunk out of your day, potentially lessening time available for sleep, but it does not do so without interaction with a large number of other factors also present in peoples' days and lives.

A residual question awaits. Does it matter how much sleep people get?

6. Impacts of Compressed Sleep

It is one thing to address the stability and dynamics of sleep duration. It is another matter entirely to assess the extent that sleep duration *matters* beyond the obvious threshold for survival and reasonable health. Sleep standards have been established and widely known. Stanislav Strumilin, a Russian pioneer of time-use surveys, was adamant that the healthy balance of time-use in society included eight hours of sleep, to go along with eight hours or work and eight hours of leisure (Zuzanek, 1980). Various health groups establish desirable ranges, such as 7-9 hours a night. Nonetheless, other scientific voices claim

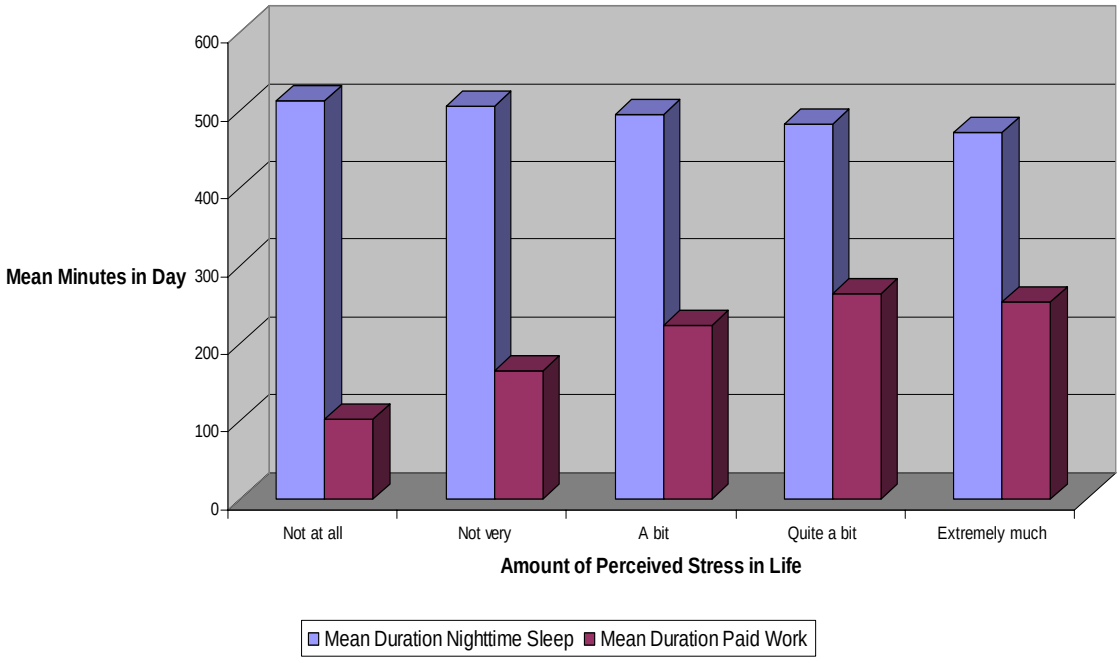
that the amount of sleep needed varies by the individual as the result of factors such as genetic makeup, gender, and more (BBC News, 2007).

What evidence is there of impacts of more or less sleep? Supplementary subjective questions in the time-use surveys help to examine this matter. They tap different types of outcomes, and they lead to different conclusions.

In some instances, sleep compression is associated with negative outcomes. For example reports of time pressure on Robinson's Time Crunch scale correlate inversely with sleep duration in the 2005 data. The correlation coefficient of -.09 (exactly the same as with similar data in 1998) is not great, but with the large sample is highly significant statistically ($p = .000$).

A stylized question asks respondents to rate the amount of perceived stress in their lives, from not at all to extremely much in five steps. Figure 9 show bars denoting the mean duration of paid work and the mean duration of nighttime sleep among those choosing each variant of perceived stress. Those answering no (stress) at all report the greatest amount of sleep and the least amount of paid work. Work increases and sleep decreases in a linear fashion with each increase in perceived stress level, until work time declines very marginally with the highest stress level. The relationship is statistically significant with stress for both nighttime sleep and paid work (sig. = .000)

Figure 9. Durations of Nighttime Sleep and Paid Work Work by Perceived Stress



Similarly, those with less sleep are more likely to be dissatisfied with their balance between home and work. Excluding those who are not employed, who get a lot of sleep, an average of 487 minutes of sleep is found among those satisfied with the

balance, while those who are dissatisfied show a mean of 474 minutes of sleep, a statistically significant difference (F=19.24, sig.= .000).

But not all such analyses indicate negative outcomes accompanying sleep compression. For example, the better that respondents judge their health, the less they sleep (F = 7.686, sig. = .000). It is arguable in this case that poor health both demands and allows for more sleep, not that more sleep somehow brings on poor health.

With respect to some other indicators of subjective outcomes such as "happiness" and "satisfaction with life as a whole", there is no observable relationship with amount of sleep on the day covered by the time-use survey.

These analyses suggest that outcome measures are differentially relevant to different contexts. Those measures relating to the specific aspects of the everyday context are more likely to reflect situational irritations or difficulties (i.e. bumps on the road to a desired destination), while outcome measures of a more general or longer term nature are not as likely to reflect the adverse aspects of particular days. Many people, for example, undertake long and demanding work days in order to enable longer term stability or even prosperity. Time-use and appropriate outcome measures can identify and illuminate dysfunctional elements in everyday life. But care must be taken to differentiate these from the longer term trajectory, which can just as easily involve both unhappy days but long term success as well as great moments amidst long-term misery.[1]

Conclusions

In short, time-use data in Canada over a period from 1986 extending now to 2005 provides no evidence of sleep *erosion* among adults in general, despite popular myths to the contrary. On the other hand, sleep *compression* continues significantly among a variety of types of population subgroups, of which the duration of time devoted to paid employment, travel, and domestic activities stand out as pre-eminent. Once several of the behavioral activities typically associated with gender are considered, gender itself is not a significant factor in sleep duration. Furthermore, while sleep compression in the immediate time frame studied is associated with feelings of time pressure and stress, it is not found associated with health and life satisfaction measures more broadly.

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[1] This theme has been developed by Daniel Kahneman, Princeton University, in his Lancet Lecture in 2005.

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