NORTHWESTERN UNIVERSITY

(Not) Working to Sleep: Employment's Contribution to Gender and Socioeconomic Sleep Differences

A DISSERTATION

SUBMITTED TO THE GRADUATE SCHOOL
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

for the degree

DOCTOR OF PHILOSOPHY

Field of Sociology

By

Jess M. Meyer

EVANSTON, ILLINOIS

March 2019

Abstract

Sleep is affected by social relationships and institutions, but much research has studied sleep within an individualized framework. In this dissertation, I analyze sleep in a series of specific social contexts to examine how these contexts shape gender and socioeconomic differences in sleep. Given prior findings suggesting the importance of employment schedules for sleep, I pay particular attention to variation in employment and employment policy contexts. My first empirical chapter uses data from the Statistics Canada General Social Survey to test whether gender differences in parents' sleep narrowed after a change in macro-level employment policy—specifically, after introduction of dedicated paternity leave in the Canadian province of Quebec. My second analysis situates sleep at the intersection of work and family, using Multinational Time Use Study data to examine gender differences in how the time people start working, the time their partners start working, and the time their children start school associate with when they wake up in the morning. Finally, my third study focuses on life course context, examining whether educational differences in sleep duration vary over age and by retirement status in samples from the American Time Use Survey. In each of these studies I construct sleep measures from time diary data and carry out analysis using descriptive statistics and multivariate regression. Findings reinforce the idea that employment is an important determinant of sleep duration and that employment context shapes several gender and socioeconomic differences in sleep. More broadly, this research highlights the importance of not only examining how social structures, relationships, and inequalities impact sleep, but also of considering what sleep as a social activity reveals about our social lives.

Acknowledgements

I appreciate my dissertation committee's support and guidance regarding this project, as well as in many other scholarly endeavors. I am grateful to committee chair Jeremy Freese for being the fearless leader of "team Jess," even as he transitioned to a new institution, and for providing thoughtful feedback, carefully walking through the logic motivating my dissertation analyses. I thank committee member Christine Percheski for providing smart, strategic advice on a variety of fronts and for mentoring me through the process of writing and publishing. I am thankful to committee member Thom McDade for providing opportunities to work on innovative, interdisciplinary research, helping tie my interest in health to an understanding of biological processes. I extend thanks to committee member Sarah Burgard for providing insightful expertise on the sociological study of sleep and guidance regarding the dissertation-writing process. Finally, I recognize all of the above committee members' helpful feedback on this dissertation manuscript.

A variety of workshops and organizations on Northwestern University's campus have contributed to this research and to my development as a scholar. In particular, the Society, Biology, and Health Cluster (SBH), Cells to Society: The Center on Social Disparities and Health (C2S), and the Institute for Policy Research (IPR) at Northwestern University have provided engaging intellectual communities over the past several years. I acknowledge comments from the SBH summer writing group on my dissertation writing and from C2S workshop attendees on my second chapter's analysis. I have also been a participant in the Applied Quantitative Methods Workshop at Northwestern University and thank its attendees for useful feedback on multiple analyses contained in this dissertation. I have gratefully participated in the Dissertation Boot Camp held by the Graduate School and the Graduate Writing Place and thank the Boot Camp organizer, Elizabeth Lenaghan, for providing helpful feedback on my dissertation chapters and on the writing process. I acknowledge useful suggestions for my conclusion chapter from Graduate Writing Fellow Jessica Biddlestone.

My empirical chapters have also improved based on feedback received at multiple national conferences. Chapter 2 analyses were presented in the "Marriage, Families, Households, and Unions 2; Gender, Race, and Ethnicity" poster session at the 2018 Annual Meeting of the Population Association of America, and I thank poster session attendees who stopped to discuss my research. I also acknowledge attendees of the 2017 Fall Research Conference of the Association for Public Policy Analysis & Management who provided feedback on a research project closely related to Chapter 2. In particular, I acknowledge helpful comments from Ankita Patnaik, who developed the quasi-experimental research design I draw on in my second chapter. Research from Chapter 4 was presented at the 2018 Annual Meeting of the American Sociological Association, in the Section on Sociology of Population's session "Trends and Disparities in American Health and Mortality." I acknowledge the feedback of session attendees and extend particular thanks to Jenjira Yahirun for her comments as session discussant. I also acknowledge feedback from attendees of the 2018 Time Use Across the Life Course conference (at the University of Maryland) who provided feedback on a project related to (though not directly a part of) Chapter 4.

In addition to my dissertation committee members, several other individuals merit acknowledgement for their assistance and support of this project. Kristen Knutson provided a sleep expert's perspective on various aspects of my research and helped orient me to the sleep literature as I embarked on this project. Maria Stanfors shared her expert perspective on time use research, as well as paternity leave. Stefan Vogler and Stephanie Levy offered assistance in thinking through dissertation structure, particularly the table of contents. Stefan Vogler, along with Vincent Yung, also provided key support as Northwestern Sociology cohort members. Amelia Branigan offered feedback on my second chapter, and also provided more general guidance contributing to the success of this dissertation and to my scholarly practice as a whole.

As the first chapter to be fully drafted, Chapter 2 has had more time to benefit from the input of multiple individuals. Andrew Owen and anonymous reviewers provided comments on an earlier version of this chapter. Statistics Canada staff members helpfully thought of techniques to integrate different types of bootstrap replicate weights across survey years for supplementary analysis. I also acknowledge assistance from Yu-Han Jao with code for producing graphs and Dylan Doppelt with checking the accuracy of references in this chapter (references which are also used in other places throughout this dissertation).

Various sources of funding helped me successfully complete this dissertation and my doctoral program overall. I am thankful for financial support provided by the SBH Cluster Fellowship earlier in my graduate career, as well as research assistantship opportunities available through IPR. I am particularly grateful for the efforts of various faculty members who helped secure funding for an IPR position in my final year of graduate study. The University Fellowship from Northwestern University provided time to write my dissertation, and The Graduate School Conference Travel Grant supported my attendance at conferences to receive feedback on dissertation-related research. A travel grant from the University of Maryland assisted my travel to the 2018 Time Use Across the Life Course conference. The Applied Quantitative Research Fellowship at Northwestern University has supported my development as a quantitative researcher in multiple domains.

Several people and institutions helped lead me to graduate school and prepared me for success while here. I am grateful to Brian Powell and Bernice Pescosolido for introducing me to the sociological study of some of my most abiding research interests: gender, families, and health. These two individuals also both opened doors for me as a sociologist, pointing me toward opportunities of interest. The Wells Scholars Program at Indiana University not only provided a financial foundation that facilitated pursuit of a Ph.D., but also an intellectual home, and participating in the Program contributed to my confidence that I could apply for and complete a doctoral program.

A multitude of friends and family members have supported me during the process of finishing this dissertation. I thank Joyce Wells, John Meyer, Jenn Rogers, Brian Wells, and Susan Meyer for the many forms of support they have provided—collectively, so many forms of support that I do not have sufficient space to address them all here. I am grateful to Nick Wallace and Maria Zacapa Reaves for being members of my “chosen family” and for believing in my ability to successfully complete this project. There are many other dear friends—especially who live or have lived in Chicago—who I would like to thank for their support, but they are too numerous to name individually, so I issue a collective “Thank you!” to them all. Finally, I thank Alvaro Villagran for being the best possible partner I ever could have imagined. I acknowledge his help with dissertation-related matters—particularly in confirming my understanding of Spanish-language material related to Chapter 3’s analysis of Spain. More important, however, is the stable foundation of instrumental and emotional support he has provided, allowing me to dedicate a substantial amount of energy to finishing this project. It also turns out that our shared abnormal sleeping habits have contributed to something positive: this dissertation.

Table of Contents

List of Tables and Figures

Chapter 1: Introduction

> Matthew Walker: "The human brain is not capable of getting back all of the sleep that it has lost. So, sleep in this regard is not like the bank; you can't accumulate a debt and then pay it off at some later point in time. There isn't a credit system in the brain or the body…"
>
> Shankar Vedantam: "…The right analogy to sleep might not be eating but breathing. You can't say, 'I'll skip today and catch up on my breathing tomorrow.'"
>
> —*Hidden Brain*, National Public Radio podcast hosted by Shankar Vedantam

Sleep is important—biologically, temporally, and socially. First, sleep affects multiple biological processes and thus has health implications (Cappuccio et al. 2010; Hale, Peppard, and Young 2007; Irwin 2015; Knutson 2013)—implications so important that Vedantam compares sleep to breathing in the above quote (Boyle et al. 2018). Second, sleep comprises a substantial portion of our time use; on average, people spend nearly one third of their lives sleeping (estimates among working-age adults in the United States, from Hale (2005)). The conclusion that sleep is socially important follows from the first two points: if sleep affects our health, as well as the composition of our daily time use, then sleep shapes our social interactions—their valence (via psychological well-being) and their schedules (as other time demands compete with sleep). Moreover, sleep is a social activity, even when we sleep alone. For example, sleep timing is informed by culture (Fernández-Crehuet Santos 2016), and poor sleep quality is associated with social stressors such as perceived racial discrimination (Grandner et al. 2012) and financial difficulties (Hall et al. 2009).

Until relatively recently, sleep remained understudied by social scientists (Hale 2005); around only a decade ago, Hale et al. (2007) noted that little research had examined social variation in sleep. However, a number of studies analyzing social differences in sleep have been published since the early 2000's (e.g. see reviews in Grandner et al. (2016); Knutson (2013)).

Still, much research conceives of sleep as an individual, as opposed to socially-embedded, activity (Burgard and Ailshire 2013; Troxel 2010). In this dissertation, I socially situate sleep—within families, in specific policy contexts, and across the life course. In so doing, I not only examine how social factors affect sleep, but also explore what sleep patterns reveal about social expectations, structures, and inequalities.

Given the relevance of work schedules and family responsibilities for structuring our daily time use, including sleep (Burgard and Ailshire 2013; Moen et al. 2011), my overarching focus lies at the nexus of work and family. I pay particular attention to gender and socioeconomic differences in sleep-related time use, putting sleep in dialogue with two major questions in contemporary sociology: 1) Now that women have entered the workforce in larger numbers compared to the mid-20th century (e.g. see Roantree and Vira (2018) regarding women's employment in the U.K. or Mosisa and Hipple (2006) for U.S. statistics), how have gender differences in time use changed, if at all? (Winship (2009) discusses research on this question in the context of a broader discussion about time) and 2) How does the current context of high socioeconomic inequality in the United States shape health disparities? This context includes large income disparities (Autor 2014; Piketty and Saez 2014; Valletta 2015), as well as growing socioeconomic differences in work hours (Aguiar and Hurst 2007), and thus has potential implications for socioeconomic differences in sleep duration (Basner et al. 2007; Basner, Spaeth, and Dinges 2014; Krueger and Friedman 2009).

The first social question with which I dialogue addresses gendered divisions of paid and unpaid labor. This question centers on the idea that although women have increased participation in the labor force, they are still expected to carry out a greater share of domestic labor than men are, performing what Hochschild (1989) refers to as a "second shift" of domestic labor after their first shift of paid employment ends. Although the amount of time men spend in housework has increased since the 1960's, women still spend a greater number of hours in housework than men do in the contemporary U.S. (Bianchi et al. 2000, 2012).

Sociologists studying sleep have recently proposed that the care work provided during hours typically used for sleep comprises a "fourth shift" of labor, one that is gendered in ways similar to the "second shift"; that is, women more often perform this labor than men (Venn et al. 2008). Venn et al. (2008) conceive of the "third shift" as the emotional care thought that people engage in—for example, worrying about their children's well-being—during their first and second shifts (p. 81).[1] "Fourth shift" labor, then, is care work and other domestic labor provided at night. This labor could entail tasks that are also performed during the second or third shifts, such as feeding or worrying about a child, but only when these tasks occur at hours during which most people sleep. (The authors also include nighttime "first shift"-type labor in their full definition of the "fourth shift," but focus on care work and "emotional consciousness" (p. 81) as sources of gender differences in the fourth shift). My dissertation addresses the debate regarding gendered divisions of labor and time use by examining gender differences in this "fourth shift" of labor and in time dedicated to sleep. In addition, I extend beyond more traditional approaches to gender differences in time use, concerned primarily with gender differences in the frequency

[1] This is a broader definition of the "third shift" than Hochschild's (1997) conceptualization of it, which more directly connects the third shift of emotional care work and concern for other family members to consequences of the work-family imbalance between the first and second shifts. Hochschild (1997) writes that the third shift entails, "noticing, understanding, and coping with the emotional consequences of the compressed second shift" (p. 215).

and duration of time spent in specific activities (Winship 2009), to consider gender differences in the timing of activities—and the determinants of this timing.

The second social question with which I engage, though on a more limited basis than the first, stems from the rising levels of social inequality in the contemporary United States. Income inequality has increased in the U.S. in recent decades (Piketty and Saez 2014), and income disparities by educational attainment have also increased (Autor 2014; Valletta 2015). Inequalities in many health outcomes have widened, as well, with rising educational disparities in mortality (Meara, Richards, and Cutler 2008) likely driven by more recent birth cohorts (Masters, Hummer, and Powers 2012). Evidence also suggests that in the U.S., educational differences in work hours grew in the last few decades of the 20^{th} century (Aguiar and Hurst 2007), such that the contemporary U.S. labor market is “bifurcated” (Jacobs and Gerson 2004) and on average, men and women with higher levels of education work longer hours (Jacobs and Gerson 2004).

Given that both employment schedules and health are associated with sleep duration (Basner et al. 2007, 2014; Magee et al. 2013), it is unsurprising that sleep duration differs by education in the contemporary U.S. context (Basner et al. 2014). Evidence suggests that in this context, less-educated individuals are generally more likely to obtain non-optimal amounts of sleep, including sleep that is either shorter or longer than the recommended duration (Basner et al. 2014; Hale 2005). However, much remains to be understood regarding how educational differences in sleep duration are produced and whether they are uniform across all population subgroups. To better understand educational differences in sleep duration in the U.S., I apply a focus on work, informed by a life course perspective, to this issue. Specifically, given age-related differences in paid labor involvement, I examine whether educational differences in sleep duration vary over age, and whether work aspects related to the “bifurcated” (Jacobs and Gerson 2004) labor market contribute to this variation.

This focus on labor and employment serves as the common thread linking the two social questions addressed above, as well as the thread connecting each chapter of this dissertation. As a whole, this project explores how variation in employment status, employment schedules, and employment policy structures social differences in sleep. Each chapter focuses on an aspect of sleep (or multiple aspects of sleep) as the outcome of interest, examining how social variation in employment-related factors might produce social variation in sleep.

Employment and Sleep

There are many ways in which employment context might impact sleep. Perhaps the most basic connection between employment and sleep derives from what Winship (2009) refers to as the “time-budget perspective” (p. 502) which focuses on how quantities of time are allocated to certain activities. Particularly when examining work and sleep, the two activities of interest are mutually exclusive: if a person is working, they are not sleeping, and vice versa. Prior research supports this connection between employment and sleep, finding that time spent working is the daily activity most associated with a change in sleep duration (Basner et al. 2007).

Another way in which employment might impact sleep relates to timing (see discussion of timing in Winship (2009)): even holding constant the number of hours a person works, the timing of their work might affect their sleep. Sleep does not occur in a vacuum; it is situated within daily circadian rhythms and social schedules. For example, as discussed in greater detail in Chapter 3, working an eight-hour shift beginning at 4:00 a.m. likely affects a person’s sleep schedule more than working the same amount of time, but starting at 9:00 a.m., due to the work shift’s timing in relationship to circadian rhythms and more common schedules of social activity.

Employment might also affect sleep if employed individuals attempt to obtain high-quality sleep and optimal sleep duration in order to maintain or enhance their performance in the workplace (Gay, Lee, and Lee 2004; Venn et al. 2008) (this idea is discussed in Chapter 2). As an example, in Venn et al.'s (2008) study of “the fourth shift,” a non-employed mother with an employed partner commented, “We did talk about it [who wakes up to care for children at night] and came to a joint decision that it was accepted he [the male partner] is the one that works all day, so he is the one that needs his sleep at night” (p. 93). This example shows how perceived sleep needs relative to employment might affect how individuals and couples structure their sleep schedules. This example also shows how examining social variation in sleep can inform our understanding of broader social dynamics surrounding employment and the household division of labor—in this case, as related to gender differences in care work.

An additional mechanism through which employment might affect sleep connects individual behaviors with macro-level social norms. Specifically, societal norms and expectations surrounding employment likely affect social variation in sleep. For example, in countries where women’s labor force participation rates are high and social policies support women’s employment, social expectations surrounding “the fourth shift” (Venn et al. 2008) might be more gender egalitarian. This idea extends from research suggesting that countries with more gender-egalitarian employment policies and labor force participation have more gender-egalitarian distributions of domestic labor (Fuwa and Cohen 2007; Hook 2006). I explicitly test whether a social policy aimed to increase gender equality in parental leave-taking produces gender-equalizing effects on parents’ sleep in Chapter 2.

Many other possible connections exist between sleep and employment but are less related to temporal dimensions of sleep and employment schedules. For example, perceived work conditions might affect sleep quality (Åkerstedt et al. 2015), but sleep quality is not a major focus of this dissertation. My primary focus is on time-related sleep outcomes.

In each analysis of this dissertation, I use time diaries to construct measures of sleep outcomes. Although I analyze a different dataset in each chapter, all of the datasets I examine include time diaries from thousands of respondents. In each of these datasets, the included time diaries were collected over 24-hour periods. Thus, the time diaries allow me to measure time spent in non-sleep activities—in particular, time spent in paid employment.

Conceptual Framework for Sleep

The temporal focus of this dissertation often allows me to use units of time as common metrics connecting employment and sleep. For example, I investigate how the number of time units dedicated to employment relates to the number of time units dedicated to sleep. Within this temporal framework, the importance of sleep follows from the "time-budget perspective" (Winship 2009) described above: time is a limited resource, and people budget a substantial amount of this resource to sleep.

However, this temporal framework is only one of many ways to understand the importance of sleep in our daily lives, and it intersects with several other perspectives that inform my conceptualization of sleep. In particular, I conceive of sleep as a bio-social phenomenon that both affects and is affected by biology and social experience. I outline this bio-social model below and then discuss sleep's connection to health within this framework.

Bio-Social Model of Sleep

Figure 1.1 presents a schematic representation of the bio-social model I use to conceptualize sleep. Time is a contextual factor present in all the relationships depicted in Figure 1.1, but is not shown in this figure for the sake of simplicity; the depicted relationships operate on multiple time scales and represent different types of temporal associations. The arrows connecting sleep with social factors and biological processes run in both directions, representing the fact that sleep outcomes can both shape and be shaped by biological and social elements. Moreover, arrows connecting social factors to biological processes also run in both directions, given that social factors can affect biology, as well as vice versa. I discuss the connections of social factors and biology with sleep in greater detail below.

After discussing social and biological connections to sleep, I also highlight the role of environmental cues, depicted on the left-hand side of Figure 1.1, in this bio-social model. In Figure 1.1, arrows extending out from environmental cues denote the fact that external environmental cues can indirectly affect sleep by setting rhythms of social activity and biological processes. In addition, social and biological rhythms can affect environmental exposures, as represented by the arrows running toward environmental cues.

Social Factors and Sleep

The social factors that can affect and be affected by sleep range from micro to macro levels and span various arenas of social life. As a micro-level example in the arena of family and romantic partnership, evidence from a study of co-sleeping, different-sex couples suggests that the quality of partners' interactions (as rated by female partners) is associated with the subsequent sleep quality of both couple members (Hasler and Troxel 2010). Evidence also suggests that for men, better sleep quality is associated with less negative partner interactions the next day (Hasler and Troxel 2010).

As a more macro-level example of the connection between social factors and sleep, societal policies and norms regarding daily schedules, such as time zones and typical work hours, might affect the timing of sleep (e.g. see Fernández-Crehuet Santos (2016) for a discussion of time zone, work hours, and sleep schedules in Spain or Kantermann et al. (2007) regarding daylight savings time and sleep). Sleep needs, on the other hand, might affect societal work schedule norms. For example, sleep requirements limit the number of hours humans can work each day.

In the bio-social model of sleep depicted in Figure 1.1, I distinguish "Sleep" from "Social Factors" primarily for heuristic purposes. Not only does sleep affect social life (and vice versa), but I argue that for most people in contemporary societies, sleep itself is an activity that falls within the social realm, linking social rhythms and relationships to biological processes. For romantic partners who share a bed, for instance, sleep is clearly not an individual activity, and how bed partners negotiate issues such as sleep timing and bed position reveals underlying social dynamics surrounding gendered partnership expectations (Hislop 2007). Even the sleep behavior of individuals who sleep alone fits into the broader panorama of societal social rhythms. For example, evidence suggests that relatively socially-determined schedules, such as television programming schedules, can affect sleep timing (Hamermesh, Myers, and Pocock 2008). At the same time, societal sleep timing likely affects television programming schedules. For instance, basic cable television programming at 3:00 a.m. is plausibly less captivating than that of prime time.

Biological Processes and Sleep

As discussed above, sleep has bi-directional relationships with multiple dimensions of social life. Similarly, as represented in Figure 1.1, sleep both affects and is affected by biological processes, processes which span a variety of body systems. Moreover, sleep itself is a complex phenomenon that encompasses several different physiological states.

Sleep is rhythmic, both in terms of its role in our overarching daily schedules, as well as internally, in terms of the physiological processes of which it is comprised. The pattern of distinct stages internal to sleep is referred to as “sleep architecture” (Committee on Sleep Medicine and Research 2006). A full sleep cycle contains both rapid eye movement, or REM, and non-rapid eye movement, or NREM, sleep, and can last around 90-100 minutes (Lockley 2010:10). In addition, within NREM sleep, three distinct sleep stages are observed: Stage 1, Stage 2, and Stage 3 (National Institute of Neurological Disorders and Stroke 2019). Sleep stages can be distinguished by specific patterns of brain waves, using electroencephalogram, or EEG (Irwin 2015; Lockley 2010). These patterns of brain waves demonstrate how sleep itself is a biological phenomenon. However, as with the separation of “Sleep” from “Social Factors,” in Figure 1.1, I separate “Sleep” from “Biological Processes” to enhance clarity in this heuristic model.

Given the multi-dimensional nature of sleep, different sleep aspects often affect different biological processes. For instance, evidence suggests that growth hormone is secreted more during slow-wave sleep than other sleep stages (Lockley 2010; Morris, Aeschbach, and Scheer 2012). Thus, some aspects of sleep have different health implications than others. Below, I discuss health connections to sleep at greater length. However, before proceeding to this discussion, I address the role of environmental cues in the bio-social model of sleep I propose in Figure 1.1.

Environmental Cues and Sleep

The conceptual model of sleep displayed in Figure 1.1 accounts for the role of environmental cues in structuring rhythms of sleep-affecting social activities and biological processes. Circadian rhythms related to earth's 24-hour cycle of light and darkness are a particularly clear example of the indirect ways in which environmental cues affect sleep via biological rhythms. For instance, light exposure (which can be affected by earth's 24-hour rotation cycle) can suppress secretion of melatonin (Dijk and Lockley 2002; Lockley 2010), a hormone which evidence suggests can help support sleep (Morris et al. 2012). Weather is an example of how environmental cues can shape social activities, with possible implications for sleep. For instance, large amounts of snow might prompt school officials to cancel classes. Given evidence that school start times impact children's sleep duration (Dunster et al. 2018), it is plausible that children sleep longer on snow days (assuming that they know about the cancellation of classes prior to waking up on snow days).

Environmental cues might also be affected by social factors, as depicted in Figure 1.1. As an example of social activity affecting environmental cues, earth's weather is affected by human-created climate change (Karl, Melillo, and Peterson 2009). Moreover, many environmental cues in contemporary contexts are man-made, such as cues derived from artificial lighting and indoor heating and air conditioning. The types of man-made environments we encounter can be determined by a myriad of social factors, such as socioeconomic status and cultural norms.

In general, biological processes might have less striking or less direct effects on environmental cues than social factors do. However, biological processes can affect our exposure to environmental cues, which is the primary reason for including the arrow running from "Biological Processes" to "Environmental Cues" in Figure 1.1. Particularly relevant in the present context is the fact that eyes are generally closed during sleep, which limits exposure to light in the surrounding environment (Dijk and Lockley 2002).

It is important to note that the bio-social model depicted in Figure 1.1 is an oversimplification meant to facilitate conceptual understanding. To provide one example of how this model oversimplifies reality, the distinction between “Social Factors” and “Environmental Cues” is less defined in real life scenarios. For instance: is a roommate’s loud music, which wakes someone up, an environmental cue or a social factor? Moreover, the model in Figure 1.1 oversimplifies the relationship between biological and social processes. As Harris and McDade (2018) contend, “A biosocial perspective… conceptualizes the biological and the social as mutually constituting forces, and blurs boundaries between phenomena inside the body and outside of the body” (3). Thus, while sleep, social factors, and biological processes are clearly separated for the purposes of visual and conceptual clarity, in reality, I argue that sleep represents both a social and a biological phenomenon.

Sleep and Health

Sleep is connected to health through its links with biological processes. Sleep can also form indirect connections to health via social mediators. That is, sleep might affect or be affected by social relationships and experiences that, in turn, affect or are affected by health.

As noted above, different dimensions of sleep have different relationships with health. Given my focus on temporal dimensions of overall sleep (as opposed to temporal dimensions of internal sleep architecture, for example), in this discussion I pay particular attention to the potential connections between health and sleep duration (and to a lesser extent, sleep timing), as opposed to other sleep dimensions, such as sleep quality or internal sleep architecture. (Although

I examine sleep interruption in Chapter 2, sleep duration and timing receive greater attention in this dissertation overall.)

Research finds that both short and long sleep durations are associated with worse health outcomes, including lower self-rated health (Shankar, Charumathi, and Kalidindi 2011) and increased risk of mortality (Cappuccio et al. 2010). However, although non-optimal sleep duration might lead to worse health, it is also possible that worse health could contribute to non-optimal sleep duration (Hale et al. 2007). Thus, causality can be difficult to establish in cross-sectional associations between sleep duration and health.

Compared to long-duration sleep, evidence is stronger that short-duration sleep negatively affects health (Knutson and Turek 2006). One study, for example, examined several biomarkers in a sample of healthy men after six nights of short (i.e., maximum of four hours) sleep duration compared to those same biomarkers, in the same sample, after six nights of sleep limited to a maximum of 12 hours (Van Cauter and Spiegel 1999). Results of this experiment showed that glucose tolerance was lower and afternoon-to-evening cortisol levels were higher after sleep deprivation (Van Cauter and Spiegel 1999). These findings point to potential causal pathways linking short-duration sleep to worse health outcomes (Van Cauter and Spiegel 1999). Knutson (2013) reviews additional experimental studies documenting plausibly causal links between short-duration sleep and worse cardiometabolic outcomes, as well as non-experimental research that finds associations between short-duration sleep and health outcomes such as hypertension, obesity, and diabetes.

Evidence is less clear that long-duration sleep causes poor health (Knutson and Turek 2006). Reverse causality might produce associations between long-duration sleep and health, if underlying health problems increase the probability of long-duration sleep (Hale et al. 2007). In addition, sleep problems such as sleep apnea might contribute to both longer sleep duration and worse health outcomes, potentially confounding the association between long-duration sleep and health (Hale et al. 2007). Furthermore, other health problems might confound the association between sleep and mortality (Patel et al. 2006). In particular, depressive symptoms are associated with higher likelihood of long-duration sleep (Patel et al. 2006). One possibility is that depression serves as a mediator linking long-duration sleep to mortality; another possibility, however, is that depression confounds the relationship between long-duration sleep and mortality (Knutson and Turek 2006; Patel et al. 2006).

Compared to sleep duration, the implications of sleep timing for health are somewhat less clear. Evidence suggests that relatively extreme deviations of sleep timing from more typical circadian rhythms can lead to higher blood pressure and inflammation levels (C. J. Morris et al. 2016). However, the health implications of smaller differences in sleep timing—for instance, waking up a few minutes earlier each morning—are not as obvious.

In addition to the relationship between sleep timing and circadian rhythms, another potential pathway through which sleep timing could affect health is via sleep duration. For instance, the later wake times associated with delayed school start times contribute to longer sleep duration (Dunster et al. 2018). For people who would otherwise obtain inadequate amounts of sleep, delayed wake times, then, might improve health outcomes.

Dissertation Organization

The research core of this dissertation is organized into three empirical chapters (Chapters 2, 3, and 4), with each chapter situating the intersection of work and sleep in a slightly different life course context. Chapter 2 focuses on parents of young children. Chapter 3 focuses on working-age adults, but models differences between households with no children, households with younger children, and households with older children. Chapter 4 focuses on adults 25 years of age and older, but examines differences by age and retirement status. Given that the overarching dissertation project's focus lies at the intersection of work, family, and health, this attention to life course context is essential, as work commitments, family responsibilities, and health status often vary by life course stage.

In the following paragraphs, I outline the analytical focus of each of this dissertation's chapters. Although the chapters are broadly similar in their methods (i.e., analysis of time diaries) and research themes (i.e., social variation in sleep viewed through the lens of employment and employment policy), they differ in their specific methods and research questions. Moreover, the thematic focus of the dissertation shifts somewhat between Chapters 3 and 4. Chapters 2 and 3 focus on sleep differences by gender, whereas Chapter 4 pays greater attention to sleep differences by education (while also being attentive to possible gendered variation in sleep).

In Chapter 2, I examine how the introduction of a work-family policy affected parents' sleep. Building on a quasi-experimental research design developed by Patnaik (2016), I use time diaries from the Canadian General Social Survey (GSS) to analyze whether implementation of parental leave time dedicated specifically to fathers, through the Quebec Parental Insurance Plan (QPIP), decreased gender differences in sleep among parents of young children. Prior research suggests that parenthood of young children is a life course stage in which gender differences in sleep are particularly large, especially with regard to the probability of interrupting sleep to care for other household members (Burgard 2011; Burgard and Ailshire 2013). Among parents of young children, mothers obtain more sleep than fathers, on average, but are also more likely to interrupt their sleep to provide care for other household members (Burgard 2011; Burgard and Ailshire 2013). Given evidence that dedicated paternity leave introduction can lead to more gender-equal divisions of labor in certain domains, such as domestic labor (Kotsadam and Finseraas 2011; Patnaik 2016), I test whether gender differences in sleep decreased under QPIP, due to an increase in fathers' sleep duration and probability of interrupting their own sleep to provide childcare. Results suggest that post-QPIP implementation, fathers' sleep duration did increase, but gender differences in "fourth shift" (Venn et al. 2008) labor did not diminish.

Chapter 3 continues the focus on gender differences in sleep but examines wake time as the sleep outcome of interest, as opposed to sleep duration or interruption. In this chapter, I use the concept of "temporal anchoring" to describe the possible ways in which morning activities structure wake time. I examine gender differences in temporal anchors relative to wake time—specifically: the time a person starts working; the time their partner starts working; and the time their children start school. I am able to situate work, school, and sleep schedules in the household context by leveraging samples from Spain and the United Kingdom in the Multinational Time Use Study (MTUS) (Fisher et al. 2018); these data include time diaries for multiple members of the same household. Given gendered dynamics surrounding work and family responsibilities, I hypothesize that women's wake time is more anchored in partner's and children's schedules than men's wake time is, and that men's wake time is more anchored in their own work schedules. Contrary to expectations, I generally do not find evidence that the association between partner's work start time and wake time significantly differs by gender. In contrast, results are consistent with my hypothesis that own work start time is a stronger temporal anchor (relative to wake time) for men. I find mixed and weak support for my hypothesis regarding the temporal anchoring of parents' wake time by children's school schedules: the gender difference in Spain is in the expected direction, but is not statistically significant, and the gender difference in the U.K. is not in the expected direction (though also not statistically significant).

With Chapter 4, I transition from an emphasis on gender differences in sleep to a focus on socioeconomic differences in sleep, while maintaining attention to gender. In this chapter, I use data from the American Time Use Survey (ATUS) (Hofferth, Flood, and Sobek 2015, 2017) to examine how educational differences in sleep duration vary over age. Given differences by age and gender in the amount of time spent in paid employment (Basner et al. 2007), I examine whether educational differences in sleep duration narrow from middle to late adulthood, and whether this pattern of narrowing is stronger for men than women. Overall, I find greater evidence of convergence than divergence in educational sleep duration differences from middle to late adulthood. However, specific patterns of age-related variation in educational sleep duration differences differ by the sleep duration outcome examined, by the type of day (i.e., weekday versus weekend or holiday), and by gender. Contrary to expectations, patterns of sleep-duration convergence are not clearly stronger for men than women.

The final chapter, Chapter 5, concludes the dissertation, providing an overview of the key findings from each of the studies included in this project. Chapter 5 puts these findings in conversation with one another and discusses their implications with regard to health, work, and gendered time use. Chapter 5 also addresses limitations of the present work and suggests potentially fruitful directions for future research.

To further address the motivations for the present project, I conclude this introduction by noting that sleep and circadian rhythms have recently occupied positions of prominence in various scientific communities, and scholars from a wide range of fields have demonstrated an appreciation for the importance of these processes in our daily lives. One of most internationallyvisible examples of this is the awarding of the 2017 Nobel Prize in Physiology or Medicine to Jeffrey C. Hall, Michael Rosbash, and Michael W. Young for their work on genes that help regulate our circadian rhythms (Nobelförsamlingen 2017). As scientific knowledge regarding sleep and related biological rhythms advances, it is important for sociology to have a seat at the proverbial table of sleep research, to address how social institutions help structure biological processes of interest. The present research contributes to a growing number of studies (e.g. Burgard and Ailshire 2013; Maume, Sebastian, and Bardo 2009; Venn et al. 2008) that employ a sociological perspective to engage with sleep and situate sleep in social context.

Chapter 2: Gender Differences in Sleep among Parents of Young Children after Dedicated Paternity Leave Implementation[2]

Introduction

How long and how steadily we sleep are associated with health and well-being (Montgomery-Downs, Stremler, and Insana 2013; Shankar et al. 2011), and sleep patterns differ by gender. Women report spending more time sleeping than men, particularly during life course stages that involve partnership or parenting young children (Burgard and Ailshire 2013). However, women are more likely to interrupt their sleep to provide care for household members, particularly among parents of young children (Burgard 2011). As a mother in Hislop and Arber's (2003) study reports, "My husband never woke up when they [our children] were little and I would be up far quicker than he was" (p. 701).

The present research examines how gender differences in sleep change after implementation of an employment policy related to family responsibilities, exploring macro-level social policy as a contextual cause of gendered health differences. In particular, evidence suggests that policies promoting paternal leave-taking can shift gendered distributions of labor and time use between parents (Kotsadam and Finseraas 2011; Patnaik 2016). I examine whether gender-equalizing effects of dedicated paternity leave extend to parents' sleep. Prior research suggests that U.S. fathers who take at least two weeks of parental leave are more likely to

---

[2] This analysis is based on the Statistics Canada General Social Survey: Time Use 2005, the Statistics Canada General Social Survey: Time Stress and Well-being 2010, and the Statistics Canada General Social Survey, Cycle 29: Time Use, 2015. All computations, use and interpretation of these data are entirely that of Jessica Meyer.

interrupt their sleep to provide child care, but these results could be due to selection regarding which fathers take leave (Nepomnyaschy and Waldfogel 2007).

In the present research, I enhance causal inference by building on and modifying a quasi-experimental research design developed by Patnaik (2016) to analyze whether introduction of a dedicated paternity leave policy in the Canadian province of Quebec was associated with changes to gender differences in parents' sleep duration and interruption. Additionally, to my knowledge, I present the first estimates of Canadian parents' sleep interruption using large-scale time diary data. Research on paternity leave and sleep is restricted by the number of datasets that measure sleep interruption, the proportion of respondents in nationally-representative samples that are eligible for paternity leave, and, in the United States, the limited implementation of paternity leave. I use the Statistics Canada General Social Survey to help address these issues, as it provides a measure of sleep interruption among fathers who were likely eligible for paternity leave. My results expand existing insight into gendered divisions of labor and time use, as well as inform understanding of how employment and macro-level social policies affect sleep.

Background

Gender Differences in Sleep among Parents of Young Children: Prior Findings

The present study focuses on two sleep dimensions: sleep duration and sleep interruption**.** These sleep dimensions are particularly relevant for parents of young children. Evidence suggests that sleep interruption increases across the transition to parenthood (Doan et al. 2014; Gay et al. 2004) and short sleep durations are more likely among people who live with young children (Krueger and Friedman 2009).

Gender differences in sleep duration have been observed in both the United States (Burgard and Ailshire 2013) and Canada (Brochu, Armstrong, and Morin 2012; Michelson 2014; Robinson and Michelson 2010). An analysis of working-age U.S. adults suggests that among partnered parents of young children, mothers sleep over 26 more minutes per day, on average, than fathers (Burgard and Ailshire 2013). In addition, in models adjusting for sociodemographic characteristics, parenthood of young children (compared to being single, childless, and under 40 years old) is associated with shorter sleep duration among men, but longer sleep duration among women (Burgard and Ailshire 2013).

Gender differences in the likelihood of interrupting sleep to provide care to other household members are greatest among parents of young children (Burgard 2011; Burgard and Ailshire 2013). Burgard (2011) shows that among U.S. parents of children less than one year old, 25% of mothers interrupted sleep, whereas less than 10% of fathers did so (p. 1197). Given their greater number of sleep interruptions and possibly poorer sleep quality (Arber and Meadows 2011; Burgard 2011—also see review in Knutson (2013)), it is unclear if women's longer sleep duration represents a true sleep advantage, or a compensatory mechanism for worse-quality sleep (Burgard and Ailshire 2013).

Gender Differences in Sleep among Parents of Young Children: Theoretical Perspectives

In social science literature, two theories best explain gender differences in sleep: the compositional explanation and the gendered expectations explanation (Burgard 2011:1192).

The compositional explanation suggests that differences between men and women in demographic characteristics and social positions contribute to gendered sleep variation (Burgard 2011; Burgard and Ailshire 2013; Maume et al. 2009). For example, one of the compositional factors that most consistently explains gender differences in sleep duration is employment. People who work longer hours in paid employment tend to sleep less, and women generally spend less time in paid employment (Basner et al. 2007). Among married parents, gender differences in the amount of time spent in paid employment are larger among those with young children (Milkie, Raley, and Bianchi 2009).

Employment might also contribute to the gender gap in sleep interruption, in addition to gender differences in sleep duration. Engaging in paid work limits opportunities for napping, a sleep strategy that might be used to help ameliorate effects of nighttime sleep interruption (Burgard and Ailshire 2013; Gay et al. 2004). Additionally, employed individuals might wish to preserve uninterrupted sleep in order to avoid fatigue at work (Gay et al. 2004; Venn et al. 2008). However, in general, compositional differences explain more of the variation in sleep duration (Burgard and Ailshire 2013; Robinson and Michelson 2010), and gendered expectations, discussed below, better explain differences in sleep interruption (Burgard 2011; Maume et al. 2009).

In contrast to a focus on compositional differences, such as employment, the gendered expectations explanation posits that even if men and women shared the same demographic characteristics and social positions, expectations for their behavior would differ due to gendered social norms (Burgard 2011; Burgard and Ailshire 2013; Maume et al. 2009). Venn et al. (2008) propose that instrumental and emotional care provided during typical sleep hours constitute a "fourth shift" of labor, and this "fourth shift" that is frequently perceived as women's responsibility (Hislop and Arber 2003; Maume, Sebastian, and Bardo 2010), particularly when it involves care of young children (Venn et al. 2008). For example, in a family where both the mother and father work 40 hours per week, the mother might provide a majority of nighttime care to their infant due to gendered parenting norms, even though both parents have equal employment responsibilities.

Alternatively, certain sex-linked biological differences, such as the ability to give birth (and physical recovery needs related to childbirth) might contribute to gender differences in sleep. Gender differences in sleep arising from sex-linked biological differences might be less susceptible to policy change. In particular, among parents of very young children, breastfeeding might contribute to sleep interruption, raising the question of how interchangeable mothers and fathers are as caretakers (Burgard 2011; Doucet 2009). However, evidence leads to somewhat mixed expectations regarding whether breastfeeding contributes to gender differences in sleep interruption (Burgard 2011; Insana, Garfield, and Montgomery-Downs 2014; Nepomnyaschy and Waldfogel 2007). Additionally, gender differences in sleep interruption are found among parents of older children (who are unlikely to be breastfeeding), as well as childless adults (Burgard 2011). Thus, even if breastfeeding contributes to gender differences in sleep interruption, gendered expectations likely contribute to these differences, as well.

Gendered variation in attitudes toward sleep as a health behavior (Burgard and Ailshire 2013; Meadows et al. 2008) or in dimensions of health, such as depression (Kessler 2003; Patel et al. 2006), might also contribute to gender differences in sleep. Moreover, many aspects of biology might differ between men and women due to social causes, such as differences in employment. For instance, if men arise earlier to accommodate full-time work schedules, this might affect their circadian rhythm. Thus, many biological explanations interconnect with social theories of sleep difference and embodiment of gendered parenting expectations (Doucet 2009).

Paternity Leave Policies Shift Gendered Divisions of Labor and Time Use

When mothers and fathers share access to parental leave time, many fathers do not take leave, including in Canada (Marshall 2008; O'Brien 2009; Patnaik 2016). Fathers are more likely to take leave and take longer leaves when wage replacement rates are relatively high and leave time is reserved specifically for fathers, time known as a "daddy quota" (Cools, Fiva, and Kirkebøen 2015; Ekberg, Eriksson, and Friebel 2013; Geisler and Kreyenfeld 2012; Kotsadam and Finseraas 2011; O'Brien 2009). Such leave policies could plausibly affect gender differences in sleep by changing compositional differences between mothers and fathers, or by shifting gendered expectations surrounding care labor and sleep.

Employment is a compositional factor that could link paternity leave to fathers' sleep duration. Fathers currently on leave from work might have the opportunity to sleep longer than other fathers. If leave-taking fathers become accustomed to sleeping longer, this behavior could persist even after leaves end. It is also possible that paternity leaves impact fathers' employment after leave termination, though findings are somewhat inconclusive on this point (Bünning 2015; Ekberg et al. 2013; Kluve and Tamm 2009). Patnaik's (2016) study of the Quebec Parental Insurance Plan (QPIP), the policy examined in the present analysis, does not show significant changes in fathers' average weekly employment hours or employment status after paternity leave introduction (Patnaik 2016). However, analysis of time diaries suggests that QPIP was associated with a decrease the amount of time that fathers spent in paid employment, past the immediate leave period (Patnaik 2016). Given that employment hours predict sleep duration, it is possible that QPIP implementation was associated with an increase in fathers' sleep duration. This leads to my first hypothesis:

> Hypothesis 1: QPIP implementation was associated with a narrowing of the gender gap in sleep duration between mothers and fathers of young children.

There are several reasons to expect that dedicated paternity leave might also reduce gender differences in parental sleep interruption. Evidence that fathers working fewer hours in paid employment have higher likelihoods of interrupting their sleep to provide infant care (Tanaka and Waldfogel 2007) suggests a possible compositional explanation for why fathers' sleep interruption might increase after "daddy quota" implementation. Regarding shifts in gendered expectations, research suggests that macro-level policies, such as parental leave, can affect micro-level gendered dynamics regarding division of labor (Fuwa and Cohen 2007) (though a quasi-experimental study finds that a Norwegian "daddy quota" did not substantially change gender ideology at the individual level (Kotsadam and Finseraas 2011)). If parental leave policy does affect gender norms, this might also shift the gender gap in parents' sleep interruption.

Sleep habits from the immediate leave period might persist and affect longer-term sleep outcomes (see discussion in Burgard (2011), p. 1209). In addition to impacting fathers' habitus (Doucet 2009) and understanding of parenting responsibility (Rehel 2014), leave time might also provide fathers the opportunity to develop child care skills (Rehel 2014), such as soothing a child back to sleep. Possible enduring changes to father's sleep interruption lead to my second hypothesis:

> Hypothesis 2: QPIP implementation was associated with decreased gender differences between mothers and fathers in the probability of interrupting sleep to provide child care.

The Quebec Parental Insurance Plan

The Quebec Parental Insurance Plan was implemented January 1, 2006, in the Canadian province of Quebec (Marshall 2008). Prior to QPIP establishment, residents of Quebec had access to the Canadian Employment Insurance (EI) program, which provided 35 weeks of parental leave shared between mothers and fathers, in addition to 15 weeks of leave time reserved mothers only (Heymann, Gerecke, and Chaussard 2010; Marshall 2008). Under both QPIP and the EI program, mothers and fathers can receive parental leave benefits at the same time (Ministère du Travail 2017; Patnaik 2016). QPIP introduced five weeks of dedicated paternity leave, and increased wage replacement rates from 55% to 70% of average income[3] during all paternity leave, all maternity leave, and a portion of the shared parental leave time (Marshall 2008; Ministère du Travail 2017). Research suggests that these changes increased fathers' leave rates and extended the average duration of fathers' leaves (Marshall 2008; Patnaik 2016).

In addition to paternity leave changes, QPIP shortened the amount of shared parental leave by three weeks, but increased maternity leave by the same amount (Marshall 2008; Ministère du Travail 2017). The following changes also occurred under QPIP: elimination of a two-week waiting period for maternity leave; increase in the income replacement cap; transition from employment hours-based eligibility (minimum 600 hours in last year) to earnings-based (minimum $2,000 in last year); and inclusion of self-employed parents (Marshall 2008; McKay, Mathieu, and Doucet 2016). Evidence suggests that QPIP increased mothers' use of leave, but

[3] 70% is the rate provided in QPIP's "basic plan." Parents can also opt for a higher wage replacement rate (75%) disbursed over a shorter amount of time. In this "special plan," maternity leave is offered for only 15 weeks, paternity leave for three weeks, and shared parental leave for 25 weeks (Marshall 2008; Ministère du Travail 2017).

that effects were much more substantial for fathers, particularly given their low leave rates before QPIP implementation (Patnaik 2016).

Prior research has established the validity of treating QPIP introduction as a quasi-experiment, in terms of causal inference for paternity leave outcomes and gender differences in parents' time use (Patnaik 2016). Although the socio-demographic makeup of Quebec differed somewhat between the years leading up to and following QPIP introduction (Patnaik 2016), differences are not substantial, generally do not produce clear expectations regarding how this might affect results, and can be addressed using control covariates in multivariate regression models. In addition, evidence suggests that the 2008 recession did not disproportionately affect the unemployment rates of Quebec residents (Hoffmann and Lemieux 2016).

Methods

Data

This analysis uses data from the Public Use Microdata Files of Cycles 19 and 24 of the Statistics Canada General Social Survey (GSS), collected in 2005 and 2010, respectively. When weighted, these cross-sectional data represent the non-institutionalized Canadian population at least 15 years old living outside of Yukon, Nunavut, and the Northwest Territories (Béchard 2015). Cycles 19 and 24 of the GSS fielded time diaries covering respondents' activities from 4am of the diary day to 4am the following day (Béchard 2015; Béchard and Marchand 2006). Unfortunately, the Statistics Canada GSS only collects time diaries every five-to-seven years (Statistics Canada 2017c), so comparable data is not available for years immediately prior to or following 2005 or 2010.

I limit my sample to partnered (i.e., married or living in a common-law union) parents aged 18-49 whose youngest child is 14 years old or younger. I further restrict the sample to respondents who reported living with a different-sex partner. Given gendered family dynamics surrounding division of labor, time use, and sleep, QPIP effects might differ for single parents or parents in same-sex couples.) The GSS data I use only contain the age of the respondent's youngest child for children residing in the respondent's household. Thus, my sample is restricted to parents that reside with at least one of their children, and when I refer to the respondent's "youngest child," I specifically mean the respondent's youngest child living in the respondent's household. Because QPIP was implemented on January 1, 2006 (Marshall 2008), Quebecois parents whose youngest children are 4 years old in 2010 may or may not have been eligible for QPIP. Given the uncertainty regarding QPIP eligibility, I omit parents whose youngest child is 4 years old from my sample.[4]

My primary sample includes 2,986 mothers and 2,414 fathers. Table 2.1 displays sample sizes for parents whose youngest children are zero-to-three years old, broken down by year and province (i.e., Quebec or non-Quebec). My primary sample includes 80 fathers and 99 mothers who were likely eligible[5] for QPIP, as they lived in Quebec in 2010. In supplementary analysis

---

[4] Unfortunately, I cannot determine the exact ages of all of the respondents' children in the sample I use. In addition, GSS differences between 2005 and 2010 limit my ability to separate parents whose youngest child is zero years old from parents whose youngest child is one year old.

[5] I refer to "QPIP eligibility" henceforth for simplicity, but it is important to note that this is inferred eligibility only. I cannot determine whether parents have recently moved to Quebec and

of parents living with children zero-to-two years old, I include an additional wave of GSS data from 2015, raising the number of eligible parents to 146 fathers and 167 mothers. (Given that Quebecois partnered parents of children aged 0-14 comprise less than five percent of Canada's total population at least 15 years of age (Statistics Canada 2017b, 2017a) and paternity leave policies only affect parents of quite young children, the number of QPIP-eligible parents is expected to be small relative to the national population.)

Measures

Sleep duration measures the number of hours respondents spent in "essential sleep" during their diary day (it does not include napping). Because the time diary starts at 4am and ends at 4am the following day, this sleep duration measure captures total sleep over a 24-hour period, as opposed to total sleep over one night.

A time diary episode of child care (Supplementary Table 2.1 in the Appendix outlines the Statistics Canada GSS activity codes that qualify as child care) is coded as a sleep interruption if the respondent slept less than 20 hours during the diary day, and the episode meets the following criteria: the child care episode began at the same time that a sleep episode ended; the parent went back to sleep within two hours of interrupting sleep to provide child care; and the sleep episode following child care was longer than 20 minutes. I also code child care activities that interrupt the respondent's final sleep episode as sleep interruptions if: the respondent's final sleep episode began at 9pm or later; the respondent's activities from the sleep interruption until

---

thus not been eligible for QPIP. However, as discussed in Patnaik (2016), the Quebecois rates of in- and out-migration are fairly low, and should conservatively bias estimates, if anything.

diary end (at 4am) all involved child care; and the respondent did not report working irregular hours for their main job. Finally, I code child care episodes as sleep interruptions if: the child care episode was the first activity of the time diary; the respondent began a sleep episode at or before 6am; the respondent's first recorded sleep episode ended before 10am; the duration of the respondent's first sleep episode was 20 minutes or greater; and the respondent did not report working irregular hours in their main job. (For respondents that did not report working irregular hours, I do not consider a care episode a sleep interruption if it occurred between 12:01pm and 7:59pm.) From the continuous measure of sleep interruptions, I construct I dichotomous indicator of whether respondents experienced any sleep interruption during the diary day.

Employment hours are the number of hours that the respondent spent in employment-related activities during the diary day. This time use category includes activities such as paid work, as well as commuting to work and performing unpaid labor for a family business.

Covariates include a categorical age measure that indicates if the respondent is 18-29 years old, 30-34 years old, 35-39 years old, or 40 years old or greater. Dummy variables indicate the province in which the respondent lives and the year in which the respondent was interviewed. Dummy variables also indicate: whether the respondent is married, whether the respondent holds a college degree, whether the respondent was born outside of Canada, whether the time diary day was on a weekend, and whether the respondent reported a physical or mental disability. Additionally, a dichotomous variable indicates whether the respondent resides with more than one of their own children (including step-children) under the age of 15. Age of the respondent's youngest child captures the age of the youngest of the respondent's unmarried children (including step-children) living in the respondent's household. A dichotomous variable indicates whether the respondent reported spending any time napping or lying down in their time diary.

Analysis

Building from methods used in Patnaik (2016), I employ difference-in-difference models to I compare how sleep patterns changed from 2005 to 2010 among Quebecois parents to how sleep patterns changed for parents living in other Canadian provinces during the same time period. For these analyses, I limit my sample to parents whose youngest child is zero-to-three years old. Using this age band (as opposed to a narrower one) not only increases the number of QPIP-eligible parents in my sample, but also allows me to examine effects that extend beyond the immediate leave period.

Similar to Patnaik (2016), I use triple-differencing to examine whether results from difference-in-difference models might be due to Quebec-specific trends unrelated to QPIP. I compare difference-in-differences related to time (i.e., pre-QPIP versus post-QPIP) and province (i.e., Quebec or not Quebec) between parents whose youngest children are zero-to-three years old (who would likely have been eligible for QPIP if they lived in Quebec in 2010) and parents whose youngest children are five-to-14 years old (who would not have been eligible for QPIP, even if they lived in Quebec in 2010). I use this triple-differencing technique for analysis of sleep duration only; the smaller number of sleep interruptions among parents of older children (Burgard 2011) makes the triple-differencing method inappropriate for analysis of this outcome.

I first examine descriptive (weighted) statistics for sleep outcomes and use Wald tests to determine statistical significance of differences. I then use multivariate regression to analyze difference-in-difference and triple-differencing, following similar procedures to those outlined in Patnaik (2016). Difference-in-difference analyses are run only among parents whose youngest children are aged zero-to-three, and are represented in Eq. 1 below:

$$Y_i = B_0 + B_1 \text{Quebec}_i \times 2010_i + B_2 \text{Quebec}_i + B_3 2010_i + \sum_{p=4}^{11} B_p \text{Province}_{pi} + \sum_{c=12}^{C} B_c X_{ci} + \varepsilon_i \quad (1)$$

In this model, Y_i is the outcome (e.g., sleep duration) of individual i, and B_1 is the association of QPIP eligibility with the outcome of interest. The B_p coefficients represent fixed effects for province. X_{ci} represents control covariate c for individual i.

I run triple-differencing models using my full sample. These models are represented in Eq. 2 and, as in Eq. 1, roughly follow (Patnaik 2016):

$$Y_i = B_0 + B_1 \text{Quebec}_i \times 2010_i \times \text{Child0to3}_i + B_2 \text{Quebec}_i \times 2010_i + B_3 \text{Child0to3}_i \times 2010_i + B_4 \text{Quebec}_i \times \text{Child0to3}_i + B_5 \text{Quebec}_i + B_6 2010_i + B_7 \text{Child0to3}_i + \sum_{p=8}^{15} B_p \text{Province}_{pi} + \sum_{c=16}^{C} B_c X_{ci} + \varepsilon_i \quad (2)$$

Triple-differencing models include the same fixed effects for province and control covariates as the difference-in-difference models. In these models, B_1 represents the association of QPIP eligibility with sleep duration.

In Model 1 of difference-in-difference analyses, I include demographic covariates, as well as an indicator of whether the diary day was on a weekend. In Model 2, I add employment hours. In Model 3, I add an indicator of whether the respondent napped on the diary day (in sleep duration analysis, I also include an indicator of whether the respondent interrupted sleep to provide child care), exploring sleep-related mechanisms that might explain associations between QPIP eligibility and sleep duration. For example, if fathers work more variable employment schedules post-QPIP introduction, they might be more likely to nap during the day, and thus spend less time sleeping at night. Models 4, 5, and 6 of triple-differencing analyses use the same covariates as Models 1, 2, and 3, respectively.

I predict parents' sleep duration using ordinary least squares regression models, run separately for mothers and fathers. (The distribution of sleep duration deviates somewhat from normal, but is closer to normal than many other time-use variables. OLS regression models are often used to estimate continuous measures of sleep duration (e.g. Basner et al. 2014; Burgard and Ailshire 2013) and even used to predict time use measures that are much less normally distributed (e.g. Passias et al. 2016).) Logistic regression is not feasible for the analysis of sleep interruption probability, because living in Quebec in 2005 perfectly predicts having no sleep interruption for fathers. Thus, I use linear probability models.

I conduct all analyses in Stata/SE 14.2. In primary analysis I use weighting procedures recommended by Gagné et al. (2014), which includes calculation of standard errors using bootstrap replicate weights. I exclude cases with missing data on any of the variables used in main analyses, given that multiple imputation of missing data is incompatible with use of the bootstrap replicate weights recommended by Statistics Canada. Over 97% of mothers and fathers meeting sample inclusion criteria had no missing data on the variables used in this analysis.

Results

Table 2.1 shows descriptive statistics for my difference-in-difference sample, broken down by province, year, and gender. (Supplementary Table 2.2 of the Appendix contains descriptive statistics for parents of older children, used in the triple-differencing analysis.) Of note, across years and provinces, mothers worked fewer hours than fathers. The change in the difference between mothers' and fathers' employment hours from 2005 to 2010 differed between

Quebec and non-Quebec provinces; as might be expected given prior findings (Patnaik 2016), the gender difference in hours worked decreased from 2005 to 2010 in Quebec. However, this difference-in-difference in the gender difference is not statistically significant by conventional standards (p=.11).

Sleep Duration

Descriptive statistics in Figure 2.1 show how parents' sleep duration changed from 2005 (pre-QPIP) to 2010 (post-QPIP), in Quebec compared to the rest of Canada. (Supplementary Table 2.3 of the Appendix displays tabular representations of these statistics.) Prior to QPIP implementation, among Quebecois parents of young children, fathers slept over 48 minutes less than mothers (p<.001). However, among non-Quebecois parents of young children, the gender difference in sleep duration was less than 10 minutes in 2005.[6] Post-QPIP establishment, these patterns shifted. Under QPIP, fathers of young children slept around 18 minutes less per day than mothers, on average. Among their non-Quebecois counterparts in 2010, fathers spent around 38 fewer minutes per day sleeping than mothers (p<.001). Parents whose youngest child is five-to-14 years old do not show a similar pattern, suggesting that the post-QPIP changes among parents of young children were not due to spurious factors influencing the sleep of all Quebecois parents.

To adjust for non-QPIP variables that might influence results, I run a series of regression models. As shown in Table 2.2, regardless of which covariates I include, I do not find large (or

[6] Unfortunately, in additional analyses (not shown) I am unable to explain a majority of this initial difference between non-Quebecois and Quebecois parents in the gender sleep duration gap or change in this gender difference from 2005 to 2010 among non-Quebecois parents.

statistically significant) associations between QPIP eligibility variables and mothers' sleep duration, consistent with descriptive results from Figure 2.1. Regression results for fathers' sleep duration (displayed in Table 2.3) are also consistent with conclusions from Figure 2.1. Model 1 of the difference-in-difference analysis suggests that exposure to QPIP is associated with a 0.93-hour (nearly 56-minute) increase in fathers' sleep duration. Including a variable for fathers' employment hours (Model 2) diminishes the magnitude of the QPIP eligibility coefficient, but it remains statistically significant. Adding covariates for napping and sleep interruption (Model 3) does not substantially reduce the magnitude of the QPIP eligibility coefficient. Triple-differencing results for fathers' sleep duration (Models 4-6) are generally consistent with these findings.

Models interacting gender with QPIP eligibility provide an assessment of whether the post-QPIP decrease in sleep duration difference by gender is statistically significant. Results from these models show that interactions between gender and QPIP eligibility are consistently positive. The interaction between QPIP eligibility and male gender is statistically significant in Model 1 of the difference-in-difference model (shown in Supplementary Table 2.4, Appendix) and Model 4 of the triple-differencing model (shown in Supplementary Table 2.5, Appendix). The statistical significance of these terms diminishes when employment hours are added to the regression models; the coefficients for the interaction terms are still relatively large, but so are standard errors.

Sleep Interruption

Turning to sleep interruption, Figure 2.2 displays the proportion of mothers and fathers that interrupted their sleep to provide child care, broken down by province and year. This analysis is restricted to parents whose youngest child is zero-to-three years old. Prior to QPIP implementation, both in and outside of Quebec, mothers were more likely to interrupt their sleep to provide child care. In pre-QPIP Quebec, around 11% of mothers interrupted their sleep on the diary day, but no fathers did. In non-Quebec provinces, nearly 16% of mothers interrupted their diary day sleep in 2005, compared to about 2% of fathers.

These gender differences did not narrow in 2010. The proportion of Quebecois fathers interrupting their sleep increased during this time period, but also rose among non-Quebecois fathers, suggesting that the trend was not related to QPIP. The increases are also only marginally statistically significant ($p<.10$ for both Quebec and non-Quebec fathers). Additionally, the proportion of mothers with interrupted sleep increased over this time period, though the increase is only statistically significant in Quebec. Thus, mothers were still more likely than fathers to interrupt their sleep in 2010. Post-QPIP implementation, nearly 22% of Quebecois mothers interrupted their sleep on the diary day, compared to less than 4% of Quebecois fathers.

Table 2.4 displays results of linear regression models predicting the probability that parents interrupted their sleep to provide child care on the diary day. These results are largely consistent with Figure 2.2. QPIP eligibility has a positive, marginally statistically significant association with mothers' likelihood of sleep interruption when employment hours are included in the analysis. In analyses interacting male gender with QPIP eligibility (results not shown), the interaction term is negative, but fails to reach statistical significance (its lowest p-value, $p=.11$, is observed in Model 2).

Supplementary Analysis

Parents Whose Youngest Children Are Zero-to-Two Years Old

Prior research suggests that the probability of sleep interruption is highest among parents who co-reside with children less than a year old and generally falls as children age (Burgard 2011). The probability of breastfeeding also decreases as young children grow older (Baker and Milligan 2008; Millar and Maclean 2005). Thus, the effects of QPIP on sleep interruption might differ between parents of very young children and parents of preschoolers.

In my primary sample, the number of QPIP-eligible parents is too small to restrict analysis to parents of very young children. In supplementary analysis, I address this limitation by adding data from Cycle 29 of the Statistics Canada GSS, for which interviews were conducted primarily in 2015 (with some interviews completed in 2016). Even when restricting the sample to parents whose youngest household child is zero-to-two years old,[7] using these data increases the number of QPIP-eligible parents compared to what is available in the main analysis. However, given that the age "cutoff" of QPIP eligibility is older in the 2015 survey than in the 2010 survey (age 11 as compared to age 4), using the 2015 data is less desirable for a triple-differencing analysis.[8]

---

[7] I am unable to restrict the sample to even younger ages, as there would be too few pre-QPIP parents available for comparison.

[8] Reasons for not incorporating the 2015 data into main analyses include the fact that the activity coding structure of sleep changed in 2015, such that "essential sleep" was no longer separated from napping. The Cycle 29 Public Use Microdata File also does not provide the exact age of the respondent's youngest child in the household (or as granular detail on the age of the respondent). Parents included in the supplementary analysis are those aged 15-54 whose youngest child in the

Supplementary Figures 2.1 and 2.2 display results from analysis of the 2015 GSS sample, restricted to parents whose youngest household child is zero-to-two years old. These results generally parallel those derived in the main analysis. Results from regression analysis with this sample (not shown) also mirror those of the main analysis. For mothers, the association between QPIP introduction and probability of sleep interruption gained statistical significance in this supplementary analysis.

Sleep Interruption and Breastfeeding

The lack of substantial change in fathers' sleep interruption under QPIP could be related to limited caregiving interchangeability for parents whose children breastfeed. Unfortunately, neither the 2005 nor the 2010 GSS include activity codes for breastfeeding specifically. However, the 2010 GSS does distinguish general feeding from other forms of child care. To examine possible contributions of feeding activities to sleep interruption, I analyze the proportion of sleep interruptions that involved feeding in 2010, among mothers (whose youngest child is zero-to-three years old) that experienced sleep interruption. (Unfortunately, the number of fathers interrupting their sleep is too small to separately analyze this group.) Feeding represents a substantial percentage of child care activities that interrupt sleep—around 59% for mothers with interrupted sleep.

Parents on Leave

Main results from regression models in Tables 1.2, 1.3, and 1.4 do not produce different overarching conclusions when I exclude parents who reported being on maternity or paternity

---

household is under five years old and whose youngest household member is two years old or younger.

leave in the week prior to their interview.[9] This suggests that my findings are not driven by parents currently on leave. Unfortunately, too few parents report being on leave at the time of the GSS survey to examine how QPIP introduction associates with sleep outcomes among these parents only.

Combining provinces and years, I am able to examine how sleep interruption differs between mothers currently on leave and mothers not currently on leave. Among mothers with children zero-to-three years old, over 40% of those on leave interrupted their sleep, whereas only around 16% of those not on leave interrupted their sleep. However, it is difficult to discern how much of this difference is due to mothers' leave itself or due to the younger age of children among mothers on leave.

Robustness Checks

I combine nap and essential sleep time to examine whether total sleep duration changes under QPIP. I also run regression models predicting sleep duration using a measure that is top-coded at the 95th-percentile of the full GSS distribution, a procedure used to handle possible outlier influence (Burgard and Ailshire 2013). Main results do not substantially change using either of these specifications, though QPIP eligibility coefficients for fathers slightly decrease in magnitude and statistical significance, generally speaking.

In addition, main regression results do not substantially change when using a categorical measure of employment hours, as opposed to a continuous one. Main results are also robust to using an alternative marital status covariate in which Quebecois common-law unions are

---

[9] The one potentially notable difference is that QPIP treatment is no longer a marginally significant (or significant) predictor of maternal sleep interruption in Model 3.

considered “married,” a strategy motivated by differences in the meaning and prevalence of common-law union in Quebec compared to the rest of Canada (Kerr, Moyser, and Beaujot 2006).

Discussion

Macro-level work-family policy has the potential to impact sleep, which influences health and well-being. This study investigated how mothers’ and fathers’ sleep patterns shifted after implementation of a dedicated paternity leave policy. Prior to policy implementation, the gender differences I found in Canadian parents’ sleep generally mirror estimates from the U.S., where partnered mothers of young children sleep longer than partnered fathers (Burgard and Ailshire 2013) and are more likely to interrupt their sleep to provide care (Burgard 2011).

Consistent with my first hypothesis, after implementation of the Quebec Parental Insurance Plan, fathers spent more time sleeping, reducing the gender gap in sleep duration. Results suggest that a reduction in fathers’ employment hours might explain a portion of QPIP’s positive association with fathers’ sleep duration, which would align with the idea that compositional differences contribute to gender variation in sleep duration. An increase in fathers’ sleep duration might help explain findings connecting paternity leave use with better health outcomes (Månsdotter, Lindholm, and Winkvist 2007; Månsdotter and Lundin 2010).

In contrast, gender differences in sleep interruption did not narrow under QPIP. This could be related to the fact that even after QPIP introduction, women take substantially longer parental leaves than men do—on average, around 40 weeks longer (Patnaik 2016). Additionally, mothers of young children worked fewer hours than fathers, even after QPIP implementation. Still, my results raise the possibility that gender differences in sleep interruption expanded after QPIP implementation (including in models that control for employment hours), supporting the idea that compositional differences have less explanatory power for gender differences in sleep interruption than sleep duration.

If QPIP implementation did lead to an increase in mothers' probability of sleep interruption, one possible explanation for this finding is policy effects on breastfeeding. Though QPIP introduction was associated with substantially larger changes in fathers' leave-taking, evidence suggests that it did increase the likelihood that mothers take leave (Patnaik 2016). Expansions in maternity leave benefits and higher levels of paternal leave use are both associated with higher rates of breastfeeding (Baker and Milligan 2008; Flacking, Dykes, and Ewald 2010). Consistent with findings from a U.S. study of 21 couples with newborn children (Insana et al. 2014), feeding comprises a substantial portion of sleep-interrupting activities among mothers with young children in my sample, lending plausibility to the idea that breastfeeding might contribute to sleep interruption.

However, research regarding how breastfeeding affects mothers' sleep is somewhat inconclusive (Hunter, Rychnovsky, and Yount 2009). Breastfeeding likely affects sleep in multiple ways, apart from the mere act of waking up for nighttime feedings. Some scholars suggest that hormonal changes associated with breastfeeding affect the architecture of mothers' sleep (Blyton, Sullivan, and Edwards 2002; Nishihara et al. 2004). Additionally, sleep strategies such as co-sleeping might modify mothers' sleep architecture (McKenna, Ball, and Gettler 2007) and change the effects of nighttime feedings on sleep outcomes (Quillin and Glenn 2004). Future research exploring connections between breastfeeding and mothers' sleep (e.g. Blyton et al. 2002; Doan et al. 2014; Nishihara et al. 2004) would benefit from using larger and more generalizable samples; additional study is needed to better understand how biological mechanisms and gendered expectations surrounding breastfeeding might contribute to gender differences in sleep interruption. Moreover, breastfeeding confers certain health benefits to mothers and children (Victora et al. 2016), so even if nighttime sleep interruptions for breastfeeding did negatively impact women's health, mothers might decide this tradeoff is worthwhile.

Fathers could bottle-feed children at night, but prior research leads to mixed expectations as to whether this would improve mothers' sleep overall (Doan et al. 2014; Gay et al. 2004; Hunter et al. 2009; Montgomery-Downs, Clawges, and Santy 2010). Importantly, although feeding comprised a sizable portion of sleep interruptions, for mothers with interrupted sleep, over 40% of sleep-interrupting activities did not involve feeding. This suggests there is potentially "parent-interchangeable" care for which fathers could increase their responsibility at night.

The issue of QPIP's effects on mothers' leave-taking (and possibly, breastfeeding) raises causal inference limitations of this study. I am not able to exactly disentangle which aspects of QPIP are responsible for the sleep changes I observe. In addition, though the quasi-experimental methods I use enhance causal inference, it is still possible that unmeasured factors unrelated to QPIP affected results. Furthermore, I am unable to bolster causal inference through the use of triple-differencing in analysis of sleep interruption.

Another limitation of this study is its inability to compare results between parents who are currently on leave and parents of older children; QPIP's effects on parents' sleep might differ over the immediate, intermediate, and long term. Additionally, QPIP introduced a specific model of paternity leave, implemented in a certain socio-cultural context. Slightly different leave policies or the same policy in a different context might affect parents' sleep differently.

The time diary measurement of sleep represents both a strength and a limitation of this study. In general, time diaries generate relatively high-quality estimates of time use (Juster, Ono, and Stafford 2003; Robinson and Godbey 1999), but polysomnography and actigraphy can more closely capture when respondents are truly sleeping, as opposed to just resting in bed, for example. My method of determining sleep interruption might be conservative, underestimating its frequency (Lichstein et al. 2006).

The national representation of Statistics Canada's GSS provides a strength with regard to causal inference: the ability to compare Quebec-specific trends to the rest of Canada. At the same time, the GSS's national focus limits the number of parents eligible for QPIP. Standard errors in my analysis are higher than ideal, most likely due to the relatively small number of QPIP-eligible parents. Thus, estimates of QPIP-associated changes in parents' sleep should be treated with a degree of caution.

Though my findings suggest that QPIP did not directly affect mothers' sleep duration, changes in fathers' sleep duration under QPIP might indirectly affect mothers' well-being. Evidence suggests that longer sleep duration is associated with lower perceived work-to-family conflict and less perceived inadequacy of time with children (Lee et al. 2017). The work-to-family conflict that a mother's partner reports and that she perceives of her partner might, in turn, affect her well-being (Bakker, Demerouti, and Dollard 2008; Young, Schieman, and Milkie 2014). To the extent that the increase in fathers' sleep duration under QPIP produces psychosocial benefits for fathers, these positive effects could spill over to fathers' partners or children.

Still, my results suggest that the gender-equalizing effects of "daddy quotas" on the distribution of household labor do not extend to sleep-interrupting child care. QPIP implementation was associated with increased sleep time for fathers, but not with increases in fathers' sleep interruption. Recent research suggests that a parental accommodation policy designed to decrease gender disparity in faculty tenure outcomes might actually increase it (Antecol, Bedard, and Stearns 2016). In a similar vein, if additional sleep time is helpful and sleep interruption "costly," fathers might be reaping sleep benefits under QPIP while not paying the "costs" of sleep interruption. Further research is needed to better assess whether mothers' sleep interruption generates "costs" in terms of long-term gender inequality in labor market, health, or other outcomes. Such research is particularly important given evidence from the present study that although employment and family policies have the potential to impact gender differences in sleep duration, gender differences in sleep interruption are more likely to endure.

Chapter 3: Who and What Set the Alarm Clock? Gendered Temporal Anchors Relative to Wake Time among Partnered, Employed Adults

Introduction

When do we wake up in the morning, and why do we wake up at that time? Some of us might be woken up by light streaming through the window, others by a crying child, and many by an alarm clock. For people in co-residential romantic partnerships, romantic partners, as well as gendered expectations surrounding romantic relationships, might affect when they wake up. As an example, the web television series "The Marvelous Mrs. Maisel" depicts its protagonist as a 1950's housewife who wakes up before her husband's alarm clock goes off every morning in order to put on make-up and do her hair before he arises. Although this example might seem extreme and outdated today, it invites two questions that remain unanswered in a contemporary context: how do partners impact each other's wake time, and does this differ by gender?

Gender differences in daily schedules have been studied a great deal. However, much of the research on gender differences in time use has focused on the duration of time spent in specific activities, such as housework and care work (e.g. Bianchi et al. 2012; Hook 2006, 2010), as opposed to the timing of those activities (see discussion in Winship (2009) on the importance of considering timing in addition to duration). Recently, research from a variety of fields has paid greater attention to timing, examining temporal dimensions such as activity sequences (e.g. Flood, Hill, and Genadek 2018; Lesnard 2008), as well as schedule coordination within couples (e.g. Hamermesh 2002; Klaveren, van den Brink, and van Praag 2013), in societies (e.g. Young and Lim 2014), and across time zones (e.g. Hamermesh et al. 2008). In the present paper, I draw on existing theory regarding the social structuring of time (e.g. Moen et al. 2011; Orlikowski and Yates 2002) to develop the concept of "temporal anchors," which consist of events, activities, and processes that structure the timing of other events, activities, and processes. For example, in the present case of wake time, the time an employed person starts working might serve as a temporal anchor for the time they wake up (Basner and Dinges 2009; Basner et al. 2014). As a social phenomenon, wake time provides an opportunity to explore gender differences in work- and family-related temporal anchors affecting when people start their day.

Which institutions and people structure our daily schedules reflects underlying social expectations and power dynamics (Winship 2009). Thus, how family members adjust their schedules to accommodate other family members' activities might reflect within-family power distributions, as well as gendered partnership and family expectations. Moreover, which institutions—such as work or school (Basner and Dinges 2009; Basner et al. 2014; Owens, Belon, and Moss 2010)—affect our wake time reflects the power of these institutions to shape our daily schedules. However, as will be discussed in greater detail below, a challenge in studying how family members affect each other's wake time is determining whether one person adjusted their wake time to accommodate another person's schedule.

In the present study, I leverage daily time diaries from multiple members of the same household to address this challenge. Unfortunately, few surveys conducted in the contemporary United States include time diaries for multiple members of the same household.[10] Thus, I use

[10] The last American Heritage Time Use Study (AHTUS) to include time diaries for multiple respondents per household was conducted in 1985 (Minnesota Population Center N.d.), and social patterning of wake time might differ for more contemporary samples. Some more contemporary U.S. studies do include time diaries for multiple members of the same household,

Multinational Time Use Study (MTUS) (Fisher et al. 2018) samples from the United Kingdom (years 2000-2001 and 2014-2015) and Spain (years 2002-2003 and 2009-2010) that include 24-hour time diaries from adults and children living in the same household. These time diaries allow me to explore how partner's and children's daily schedules relate to the wake time of other family members. In particular, I examine how the time someone starts working associates with their own and their partner's wake time, and whether this association differs by gender. I also analyze how children's school start time associates with their parents' wake time, and whether this association differs by parents' gender. Analyzing both U.K and. Spanish samples allows me to examine whether patterns of gender difference and similarity hold across two countries with distinct temporal rhythms of social life (Fernández-Crehuet Santos 2016). This research introduces temporal anchors to the debate regarding whether the gender revolution is "stalled" (Hochschild 1989) in the " 'personal' realm" (England 2010:155) of time use.

Background

Temporal Anchors: Zeitgebers as a Motivating Example

Sleep timing, including wake time, generally follows a circadian rhythm (Panda, Hogenesch, and Kay 2002; Roenneberg, Wirz-Justice, and Merrow 2003). Circadian rhythms, in turn, are shaped by biological processes, such as hormone secretion (Cajochen, Kräuchi, and Wirz-Justice 2003), as well as environmental factors, such as light exposure (Fabbian et al. 2016). Indeed, environmental and biological factors often work in tandem, with environmental

---

but only sample respondents at a particular stage in the life course (e.g. the Panel Study of Income Dynamics (PSID) Disability and Use of Time Supplement).

cues structuring the timing of circadian biological processes (e.g. see Roenneberg and Merrow (2005)).

The environmental cues prompting alignment of our circadian rhythms with the earth's 24-hour rotation cycle are referred to as "zeitgebers," or "time givers" (Aschoff 1965; Grandin, Alloy, and Abramson 2006). Variation in light exposure due to earth's position relative to the sun is a particularly important zeitgeber (Panda et al. 2002; Roenneberg, Kumar, and Merrow 2007). However, research also suggests that relatively socially-determined schedules, such as the timing of exercise (Yamanaka et al. 2006) and team sports training (Kunorozva, Rae, and Roden 2017 examine the specific case of rugby) can affect circadian rhythms. Particularly relevant to the present study, romantic partners might affect each other's circadian rhythms (Ehlers, Frank, and Kupfer 1988; Leonhard and Randler 2009). For example, Yamazaki (2007) uses the term "family synchronizers" to refer to family members' behaviors and needs that affect mothers' sleep rhythms.

Zeitgebers act as temporal anchors relative to circadian rhythms in that they structure the timing of circadian rhythm processes. However, not all temporal anchors could be considered zeitgebers. Some temporal anchors might act against temporal alignment with the earth's 24-hour rotation cycle. Ehlers et al. (1993) refer to this type of environmental cue as a "zeitstörer," or "time disturber" (p. 289), and discuss shift work as an example of this phenomenon.[11] In

---

[11] Although I follow this distinction between "zeitgebers" and "zeitstörers," the term "zeitgeber" is sometimes employed more loosely to refer to something that affects circadian rhythms broadly conceived, but not necessarily in alignment with earth's light/dark cycles (e.g. see Basner and Dinges (2009) regarding television viewing as a zeitgeber).

addition, temporal anchors might or might not substantially affect biological processes. Temporal anchors also might not occur in rhythmic fashion or induce rhythmic processes. Finally, temporal anchors might not operate on a time scale that relates to earth's 24-hour and annual light/dark cycles. As an example extending beyond the realm of sleep, for an engaged couple wanting to conceive their first and only child immediately after getting married, their wedding date might serve as a temporal anchor relative to stopping contraception use (see Orlikowski and Yates (2002) p. 690 for a discussion contrasting the temporality of weddings to other types of events). This example also shows how temporal anchors can be one-time events.

The concept of temporal anchoring bridges the realm of zeitgebers—focused on circadian rhythms—and the sociological literature on timing, particularly timing in work and family contexts. As temporal anchors, zeitgebers include both "natural" and social phenomena that structure our time. Social perspectives on time provide a framework for understanding this structuring process. As Moen et al. (2011) (grounded in Sewell's (1992) perspective on structure) argue regarding work schedules:

> Sociologists can promote understanding of something as taken for granted as the time and timing of work by showing these socially constructed temporal structures are, in fact, verbs as well as nouns (e.g. Sewell 1992), structuring the lives—including health-related behaviors—of individuals in profound ways. (P. 404-5)

Similar arguments regarding the power of daily activities and social institutions to structure the timing of other activities have been made in studies focused on organizational operations (Orlikowski and Yates 2002), as well as family members' time together (Lesnard 2008).

The use of circadian rhythm concepts to help describe time dynamics surrounding social phenomena is not new. Kelly and McGrath (1985), for example, conceive of "social entrainment" as comparable with the entrainment of biological processes to circadian rhythms, but applied to social phenomena. Darnley (1981) discusses both social and biological rhythms in the context of families, noting, for example, how parents' and children's' circadian rhythms might conflict.

The concept of "temporal anchoring" builds on existing literature through its ability to shift focus from social rhythms or the overarching social structures described by Moen et al. (2011) to specific events located within those rhythms and structures. In the particular case I examine, work start time sits within the overarching work schedule structure and acts as a temporal anchor by structuring the timing of sleep, a circadian rhythm-related health behavior, in the manner described by Moen et al. (2011). In addition, the connection between zeitgebers and wake time provides an example of how temporal anchors extend beyond a more narrow focus on social structures to encompass biological phenomena, as well as rhythms related to "astronomical time" (Sorokin and Merton 1937), such as the sunrise. In turn, sociological perspectives on time lend a critical eye to the research on circadian rhythms, for instance, by asking which people and what institutions have the power to structure the timing of activities that might affect these rhythms (see Winship's (2009) discussion of how power determines which actors set schedules).

Structuring of Time within Families: Linked Lives, Linked Schedules, Linked Sleep?

The life course perspective of "linked lives" (Elder 1995) provides useful terminology for describing the fact that individual lives are not lived in a social vacuum and thus are inherently connected to other individual lives. Family members' schedules are one of many domains in which lives are linked. For example, research suggests that co-residential romantic partners without children attempt to work at similar times, likely to increase the amount of non-work time when they can enjoy each other's company (Jenkins and Osberg 2004; van Klaveren et al. 2013).

Scholars have noted a dearth of empirical research that situates sleep in the couple context (Meadows et al. 2009), arguing that many existing studies conceive of sleep as an individual activity (Troxel 2010). However, research has recently started to pay more attention to the interpersonal dynamics of sleep within couples (Troxel 2010) and families (e.g. Leonhard and Randler 2009; Yamazaki 2007). In addition to research examining how partners affect each other's sleep quality (see review of relevant literature in Troxel et al. (2007)), multiple studies have analyzed concordance in partners' sleep timing (e.g. Chen 2018; Gunn et al. 2017; Hasler and Troxel 2010)).

Results from studies of sleep concordance are consistent with the idea that spouses influence each other's sleep timing. For example, one U.S. study finds that spouses are more similar in their sleep timing than we would expect by chance and that spouses wake times (and bed times) are positively correlated (Gunn et al. 2015). Another U.S. study examines how similar spouses' wake times and bed times are in a sample of older adults, finding that over 10% of husbands and wives wake up less than 20 minutes before or after the time their spouse wakes up (Chen 2018). However, this finding highlights one of the issues facing research on partners' sleep concordance: if two spouses wake up around the same time, how would we know that one spouse's morning activities have affected the wake time of the other spouse (see discussion in Gunn et al. (2017):8)? For example, a wife could have woken up when her husband's alarm clock sounded, or vice versa. Alternatively, an external factor, such as a car alarm, could have woken both spouses up at the same time.

In the present study, I address this issue by examining another dimension of partners' daily schedules: work timing. Specifically, I examine how the time one partner starts work associates with the time the other partner wakes up. My focus on work start time as a temporal anchor distinguishes this research from studies of sleep concordance between partners. For example, if a wife consistently wakes up two hours prior to the time her husband starts work in order to prepare breakfast for him, then the husband's work start time operates as a temporal anchor relative to the wife's wake time. However, the wife and husband may or may not wake up at the same time in this scenario; thus, the wife and husband might have low sleep concordance, even though the husband's work start time structures the wife's wake time.

Still, concordance between partner's and own wake time would likely produce an association between partner's work start time and own wake time, if partner's work start time affects partner's wake time. In these cases, examining partner's and own work start time helps me address the following question: who accommodates to or is affected by whose schedule? For example, does one partner adjust their schedule to start their day closer to the other partner's wake time, or do both partners try to "meet in the middle?"

Own Work Start Time and Partner's Work Start Time as Temporal Anchors Relative to Wake Time: Differences by Gender?

I focus on work and school start times as temporal anchors relative to wake time because of previous research suggesting that work and school schedules affect sleep duration and wake time (Basner and Dinges 2009; Basner et al. 2014; Dunster et al. 2018; Knutson and Lauderdale 2009; Moen et al. 2011). I discuss work start time in this section, using it as a motivating example for further developing the concept of temporal anchors and showing why the influence of temporal anchors might differ by social characteristics, such as gender. I address the reasons why we might expect gender differences in the extent to which partner's and own work start time structure wake time, and I outline hypotheses regarding the direction of these gender differences.

In the next section, I apply the temporal anchor concepts I develop below to a second example: school start time.

The influence of partner's and own work start time as a temporal anchor relative to wake time might differ by gender due to three potential mechanisms: 1) gender differences in schedule composition—in this case, the number of hours worked each week; 2) gender differences in the temporal proximity of work start time to wake time; and 3) holding constant the number of hours worked and the time the work day starts, gender differences in the (conditional) temporal association[12] between work start and wake time. These three mechanisms help determine the temporal weight of a temporal anchor relative to a specific event—i.e., the power of a temporal anchor to structure the timing of this event. Empirically, the three mechanisms can be difficult to tease apart; for example, in reality, the temporal association between work start time and wake time might affect the temporal proximity of work start time to wake time. However, conceptually, separating these three mechanisms helps elucidate the distinct reasons why the temporal weight of work start time relative to wake time might vary. The third mechanism—the temporal association—is the primary focus of the present study. However, I also address elements of the first two mechanisms in my analysis. Thus, I discuss each of these three mechanisms below.

---

[12] I use the term "temporal association" as opposed to "conditional temporal association" throughout this paper for simplicity, but it is important to remember that this represents the temporal association *conditional* on number of hours worked (schedule composition) and work start time (temporal proximity).

The first potential mechanism producing gender differences in the effects of work start time on wake time derives from the idea that differences in schedule composition produce differences in the importance of a given temporal anchor relative to the event, activity, or process under examination. In this case, gender differences in labor force participation or the number of hours worked each day likely produce gender differences in the importance of partner's and own work start time for own wake time. This mechanism follows a somewhat obvious logic: for example, if a person is not employed, their schedule is composed of zero work hours, and own work start time cannot be a determinant of wake time because that person does not start work on any given day. If a person's partner is not employed, then their partner does not have a work start time. Among the employed, working fewer hours might mean that work has less of an impact on the schedules of other activities, all else equal, and might leave more room for a partner's work schedule to influence the timing of daily activities.

Prior research suggests that women are less likely to be employed in both the U.K. and Spain (Carrasco and Recio 2001; Instituto Nacional de Estadistica 2018; Office for National Statistics 2018b). In addition, employed women work fewer hours than employed men in both the U.K. and Spain, on average (Eurostat 2004, 2018). Thus, considering this first mechanism only—i.e., gender differences in schedule composition—we might expect own work start time to be a more important determinant of wake time for men than women, ceteris paribus, in both the U.K. and Spain.

The second possible mechanism generating gender differences in the association of wake time with partner's and own work start time is temporal proximity. If a temporal anchor occurs chronologically closer to a given event, the importance of that temporal anchor relative to the event of interest might increase. In the case of wake time, this mechanism would operate if, conditional on working a certain number of hours, the chronological proximity of work activities relative to wake time differed by gender. For example, starting work at 6:00 a.m. would likely have a greater impact on own wake time than starting work at 10:00 a.m. The temporal proximity mechanism could operate at the individual level—for instance, if an individual shifts their work start time from 6:00 a.m. to 10:00 a.m. This mechanism could also operate at the couple level, reflecting within-couple differences in work start time. For example, within a couple, the partner who starts work first could be more likely to wake up first. The first riser within a couple might wake up their sleeping partner, but the sleeping partner is unlikely to have woken up the first riser (unless the sleeping partner engages in behavior, such as snoring, that could wake a person up).

I am not aware of research that analyzes gender differences in work start time in either the U.K. or Spain, though research does examine gender differences in non-standard work schedules. In the European Union overall, employed men are more likely than employed women to work evening or night shifts (Burchell et al. 2007). A study of working-age adults in the U.K. finds that men are more likely to usually work evening, night, or rotating shifts (Presser, Gornick, and Parashar 2008). In Spain, a "split-shift" schedule is often observed, in which workers take an extended break from work in the middle of the day (Fernández-Crehuet Santos 2016; Gracia and Kalmijn 2016).[13] In a study of married and cohabiting Spanish parents, among those who were employed, men were more likely to work this "split-shift" schedule, though not

[13] This extended break relates to the Spanish tradition of the siesta (Gracia and Kalmijn 2016), though evidence suggests a majority of contemporary Spaniards do not take a siesta (Simple Lógica 2016).

more likely to work an evening shift (Gracia and Kalmijn 2016). However, examination of non-standard work schedules provides only a portion of the broader picture of gender differences in work timing. Given that among the employed, men work a higher number of hours than women and are more likely to work full-time (Eurostat 2004, 2018; Morley et al. 2010), men on standard work schedules might start work earlier than women to accommodate longer work hours. Arguably, however, this would reflect a difference in schedule composition (that affects temporal proximity of work start time to wake time), rather than a difference in temporal proximity alone. Taken together, this evidence does not produce clear expectations regarding gender differences in work start time and its temporal proximity to wake time.

The third mechanism potentially generating gender differences in the impact of work schedules on wake time is the main focus of this study: differences in the temporal association of a temporal anchor with an event of interest. This mechanism refers to the idea that conditional on a given schedule composition and temporal proximity to the event of interest, a temporal anchor might have more or less influence on this event, and this influence could operate in a positive or negative direction. In the case I study, even if a man and a woman worked the same number of hours and started work at the same time, the anchoring "pull" of work start time on wake time could change according to gendered social factors—such as power dynamics within families or gendered social expectations.

Although, to the best of my knowledge, no prior research has addressed this topic specifically, existing research helps establish a set of expectations regarding gender differences in the temporal association between work start time and wake time. Relevant to how partners' work start time might affect own wake time, evidence from the U.K. and U.S. suggests that women are more likely to interrupt their sleep to provide care to other family members (Burgard

2011; Venn et al. 2008).[14] Interviews from the U.K. suggest that women's sleep is often viewed as more expendable than men's and as secondary to their responsibilities as caretakers of children and partners (Hislop and Arber 2003; Venn et al. 2008). Thus, we might expect that women are likely to structure their wake time around their partners' schedules, in order to provide morning instrumental care or emotional support to their partners. This leads to the following hypothesis:

Hypothesis 1: Among couples in which both partners are employed, the association between partner's work start time and wake time is greater for women than men.

I specifically address dual-employed couples, because in single-employed couples, only one partner would have a work start time, so I would not be able to examine how each partner's work start time affects the other partner's wake time. In addition, focusing on dual-employed couples helps diminish (though certainly not eliminate) schedule composition differences between partners.

In addition to caretaking expectations, gendered power differentials might also make women more likely to structure their wake time around their partners' schedules. Research suggests that partners' decisions about sleep routines—such as whether to sleep in the same room—are enmeshed in power dynamics, as well as gendered partnership norms (Hislop 2007; Hislop and Arber 2003). If men have greater power in different-sex couples—for example, due to their higher relative earnings or traditional gender norms (see discussion in Bittman et al.

---

[14] In Chapter 2, I also find that among Canadian parents of young children, women are more likely to interrupt their sleep to care for children.

(2003)), then this power might translate into the ability to affect the schedules (Winship 2009) and sleep behaviors (Hislop 2007; Hislop and Arber 2003) of other family members.

Prior research also suggests that when partners' sleep schedules are more dissimilar, women are more likely to suffer negative consequences. For example, greater sleep schedule similarity between partners is associated with lower systolic blood pressure (Gunn et al. 2017) and higher perceived relationship quality among women (Hasler and Troxel 2010), but not men. The psychosocial and physiological consequences of sleep dissimilarity might provide a higher incentive for women to structure their sleep around partners' schedules.

Alternatively, literature addressing sleep as a health behavior might lead to somewhat different expectations regarding the relationship between partner's work start time and wake time. A recent analysis of 38 different-sex, co-residential partners in the U.S. found that daily variation in women's sleep duration was more predictive of their male partners' sleep duration than vice versa, when controlling for potentially sleep-affecting covariates (Lee et al. 2018). The authors note this pattern could be a result of women's greater propensity to socially control (Umberson 1992) their partners' health behaviors (Lee et al. 2018:202, 207). However, it is not immediately apparent how social control of health behaviors would apply to wake time. On the one hand, if women are more likely to set other family members' sleep schedules, we might expect women's work start time to have a greater impact on their male partner's sleep than vice versa. On the other hand, if women are more concerned about promoting other family members' positive health behaviors, we might expect women to avoid waking other family members up in the morning, in order to help preserve uninterrupted sleep and extend sleep duration (Hislop and Arber 2003).

If family members' schedules do influence women's wake time more than men's, then there might be less room for women's own work start time to influence their own wake time. Thus, I hypothesize that:

> Hypothesis 2: Among couples in which both partners are employed, the association between own work start time and wake time is greater for men than women.

Own work start time also might be more predictive of men's wake time due to gendered norms surrounding the importance of employment for setting daily schedules and gender differences in the approach to sleep as a health behavior. Meadows et al. (2008) find that English men they interview consider sleep needs in relationship to what sleep will help them accomplish in the workplace, among other factors. If the need for longer sleep duration conflicts with the need to arrive to work earlier in the morning, men might be more likely to favor an earlier workplace arrival to a longer sleep duration, leading work to be a more important determinant of when they wake up.

A U.S. study suggests that gender differences in sleep duration vary over the life course, according to partnership and parenthood status (Burgard and Ailshire 2013). The schedules of work and family demands vary according life course stage, as well. Evidence suggests that couples with young children have less synchronous work schedules than other couples, perhaps in order to facilitate childcare needs (van Klaveren et al. 2013). In addition, people (especially women) living with young children are particularly likely to interrupt their sleep to provide care for another household member (Burgard 2011), possibly affecting the association of wake time with own and partner's work start time. This leads to my third hypothesis:

Hypothesis 3: Gender differences in the association of wake time with partner's work start time and in the association of wake time with own work start time will differ by presence and age of household children.

I do not hypothesize specific differences between Spain and the U.K. regarding the relationships of wake time with own work start time and partner's work start time, or regarding how gender differences in these relationships might differ between the U.K. and Spain However, work, family, and sleep contexts differ between the U.K. and Spain. In particular, compared to the U.K. (and many other Western European countries) Spain has relatively late bedtimes and long mid-afternoon work breaks (Fernández-Crehuet Santos 2016). Evidence also suggests that Spain and the U.K. differ in terms of gender-relevant policies and gender differences in household labor, with Spain following more traditional gender norms (Altintas and Sullivan 2016; Fuwa and Cohen 2007). Thus, I separately test hypotheses within each country. Examining countries with distinct gender-norm contexts and such different daily schedules helps provide a sense of how broadly applicable any gender differences I find might be.

Children's School Start Time as a Temporal Anchor Relative to Parents' Wake Time: Differences by Gender?

As with work start time, in my analysis of children's school start time, I focus on gender differences in temporal association as a mechanism producing gender differences in the importance of the temporal anchor of interest (children's school start time) relative to parental wake time. Because I examine partners who live in the same household, I eliminate the possibility that gender differences in the probability of living with children or in the timing of children's school start produce gender differences in the weight of children's school start time as a temporal anchor relative to parents' wake time. Thus, I reduce the potential effects of gender differences in schedule composition (given that some parents might not live with their children) or temporal proximity (given that partners in my sample will have the same schedules for household children) on the weight of children's school start time as a temporal anchor relative to household parents' wake time.

Prior research suggests that children's schedules and needs have a particularly large impact on mothers' sleep. Research suggests that sleep duration is more highly correlated between mothers and children than between fathers and children, and that children's sleep problems are more highly correlated with maternal than paternal levels of sleepiness during the day[15] (Boergers et al. 2007). In addition, as discussed above, women are more likely to interrupt their sleep to care for other family members, including children, at night (Burgard 2011; Venn et al. 2008).

Children's school start times have been shown to affect children's sleep duration and wake time (Basner et al. 2014; Dunster et al. 2018; Knutson and Lauderdale 2009). Given the possibility that mothers are more likely to wake up in the morning to care for children, children's school schedules (which help determine children's wake time) might have a larger impact on mothers' than fathers' wake time. Thus, I hypothesize the following:

[15] This research examined a sample of families seeking treatment for children's sleep disorders, so generalizability might be limited (Boergers et al. 2007). In addition, mothers reported children's sleep information, which could potentially bias results (Boergers et al. 2007).

Hypothesis 4: Among couples in which both partners are employed, the association between children's school start time and wake time will be larger for mothers than fathers.

Gender Differences in Circadian Rhythms

In addition to gendered social expectations, power distributions, and approaches to health behavior, gender differences in circadian rhythms could theoretically contribute to gender differences in the weight of certain temporal anchors relative to wake time. Research on Western European individuals suggests that in early-to-middle adulthood, women have earlier chronotypes than men, on average (Roenneberg et al. 2004, 2003; Roenneberg et al. 2007). Chronotype refers to the timing of daily circadian processes, as reflected in the extent to which someone is a "morning" or "evening" person (Fischer et al. 2017; Roenneberg and Merrow 2005); in the cited studies of Western European populations, women's earlier chronotype is inferred from the fact that women's sleep cycle mid-point occurs earlier, on average (Roenneberg et al. 2004, 2003; Roenneberg et al. 2007). These studies examine sleep on "free" (Roenneberg et al. 2003:82) days to help reduce the possible influence of work and social schedules on sleep timing (Roenneberg et al. 2004, 2003; Roenneberg et al. 2007).

If women tend to have earlier chronotypes, we might think this could have implications for gender differences in temporal anchors relative to wake time. For example, a person might argue that social temporal anchors relative to wake time could have less weight among women if earlier average chronotype causes women to wake up prior to the start of social activities. In addition, one U.S. study suggests that chronotype is correlated with wake time among women, but not men (Gunn et al. 2015), raising the possibility that circadian rhythm processes carry more temporal weight relative to women's wake time.

However, chronotype does not translate directly into actual wake times, particularly for workday sleep (Roenneberg et al. 2003), which is the focus of the present study. Even on non-workdays, analysis of a U.S. sample suggests that women do not consistently wake up earlier than men across all races and ethnicities, supporting the idea that social factors shape gender differences in actual wake times (National Sleep Foundation N.d.). Moreover, research on another U.S. sample also does not find significant gender differences in wake time (Thomas et al. 2014).

In addition, although gender differences in dimensions of circadian rhythms, such as chronotype, could be related to sex-linked hormone variation, they might also be caused by environmental—including social—contexts (Fischer et al. 2017; Roenneberg et al. 2007). Indeed, gender differences in chronotype among individuals in middle-to-late adulthood have been found to differ between U.S. and Western European samples, suggesting that certain gender differences in chronotype are not universal across human populations (Fischer et al. 2017; Roenneberg et al. 2004). Moreover, Leonhard and Randler (2009) find evidence that on "free" days mothers have earlier sleep rhythms than women without children and propose that mothers might experience diminished alignment between chronotype and actual sleep behavior, due to morning childcare responsibilities (p. 521). Taken together, then, the evidence regarding gender differences in circadian rhythms does not point to clear implications for the hypotheses I outline above.

Methods

Data

I use a Multinational Time Use Study (MTUS) dataset generated by the IPUMS (Integrated Public Use Microdata Series) extract system (Fisher et al. 2018). This dataset includes samples from the United Kingdom and Spain. U.K. data were collected in 2001-2001 and 2014-2015 as part of the U.K. Time Use Survey. Spanish data were collected in 2002-2003 and 2009-2010 as part of the Spanish Time Use Survey (Encuesta de Empleo del Tiempo) run by the Spanish National Statistical Agency (Instituto Nacional de Estadistica) (Centre for Time Use Research N.d.a, N.d.b, Instituto Nacional de Estadistica 2004, 2011). With appropriate weighting, each sample represents the national population of its respective country (Instituto Nacional de Estadistica 2004, 2011; S. Morris et al. 2016; Short 2006).

Following Harmonised European Time Use Survey (HETUS) guidelines, both U.K. and Spanish surveys included time diaries that asked respondents about their time use during each 10-minute period of their assigned diary day (Centre for Time Use Research N.d.c; European Communities 2004; Instituto Nacional de Estadistica 2004, 2011; S. Morris et al. 2016). Diaries began at 4:00 a.m. in the U.K. and 6:00 a.m. in Spain. Respondents in the U.K. completed two time diaries (one weekend and one weekday), whereas Spanish respondents completed only one time diary (Centre for Time Use Research N.d.a, N.d.b, N.d.d; Short 2006). Data were harmonized across surveys following MTUS procedures outlined in Fisher, Gershuny, and Gauthier (2015).

In each country, household members at or above a certain age cutoff were invited to complete a time diary. In Spain, household members at least 10 years of age were asked to complete time diaries (Centre for Time Use Research N.d.a, N.d.b). The age cutoff was younger in the U.K., where household members at least 8 years of age were asked to complete time diaries (Centre for Time Use Research N.d.c, N.d.d). HETUS guidelines specify that household members should be assigned the same diary day (European Communities 2004). Of respondents in these samples whose co-residential partners also completed a time diary, only around .22% completed their time diary on a different day of the week or different month than their partners did.[16]

My analysis examines weekday time diaries, to focus on days in which respondents are more likely to work and to diminish possible effects of chronotype on wake time (Roenneberg et al. 2003). I limit my primary analytic sample to respondents in cohabiting or marital co-residential, different-sex romantic partnerships whose partners also completed time diaries. My hypotheses focus primarily on different-sex couples, with the idea that differences in gendered expectations for each partner might produce gender differences in temporal anchors relative to wake time. Although a comparative study of same-sex couples would likely be illuminating, due to their small number in each sample, I do not include same-sex couples in this analysis. My primary sample includes 2,358 individual U.K. respondents (comprising 1,179 couples) and 3,692 individual Spanish respondents (comprising 1,846 couples). I include couples in which

---

[16] Unfortunately, given that exact interview dates are not provided, it is possible that additional respondents were not interviewed on the same calendar date as their partners were. This might conservatively bias my results regarding the relationship between partner's work start time and own wake time. Similarly, if children were not interviewed on the same calendar date as parents, this might conservatively bias estimates of the association between children's school start time and parent's wake time.

both partners are 18 to 64 years of age. I exclude couples in which partners were not interviewed on a matching day of the week or diary month. I also exclude couples in which either partner is missing data on variables used in this analysis[17] or has been assigned a "0" weight by the MTUS, as is done for diaries considered to be low quality (Fisher et al. 2015).

To limit gender differences in employment status and work start time, I restrict my sample to couples in which both partners are employed and started work activities prior to 12:00 p.m. on the diary day. This also helps eliminate noise surrounding work start times that are less likely to be associated with wake time. I further limit my sample to couples in which neither partner was engaged in work activities (including commuting) before they woke up, to ensure I observe a wake time that precedes work start time. In addition, in order to be included in my sample, both partners had to have a valid wake time (defined below) on the diary day. In Spain, 22.4% of otherwise sample-eligible couples were eliminated because at least one member was engaged in work activities prior to their wake time and/or did not have a valid wake time on the diary day, whereas this was only true of 6.4% of U.K. couples. Although evidence suggests that Spanish residents generally have later wake times and work start times than U.K. residents (Fernández-Crehuet Santos 2016), time diaries started two hours later in Spain than in the

---

[17] Approximately 3.9% of couples meeting other inclusion criteria are excluded from the main sample due to missing data. In all but one couple, the missing information is for education.

U.K.—6:00 a.m. versus 4:00 a.m. Likely as a result, the (unweighted) proportion of respondents awake at the time diary start was significantly higher in Spain.[18]

In a subsample of respondents, I analyze the association between the earliest school start time of respondents' children and the time that respondents wake up. This subsample is comprised of couples from my main analytic sample whose children completed a time diary on the same day of the week and month as their parents did. I include couples in this subsample if each household child who has completed a time diary identifies the couple members as their parents, to eliminate possible gender differences in the extent to which household children correspond to each couple member's own children. This subsample includes 396 U.K. individuals (comprising 198 couples) and 468 Spanish individuals (comprising 234 couples). I exclude couples who live with children younger than the time diary age-eligibility cutoff in each country (eight years old in the U.K. and 10 years old in Spain), as these couples might have children with earlier school start times not captured in the time diaries. I also exclude couples who completed time diaries in July or August, given seasonal differences in children's school attendance. Finally, couples are included in this subsample only if one of their children reported starting school prior to 12:00 p.m. on their diary day; later school start times likely have more limited associations with child and parental wake time.

Measures

---

[18] Among respondents who meet all sample inclusion criteria besides wake time validity and not working prior to wake time, 16.1% of Spanish men and 10.6% of Spanish women were awake at the diary start, compared to 4.8% of U.K. men and 1.9% of U.K. women.

Wake time is defined as the end of the first sleep episode that terminates prior to 12pm after which the respondent is awake for at least two hours. This coding is a more conservative version of procedures used in Basner and Dinges (2009). Wake time is measured in number of hours past midnight, such that a wake time of 8:00 a.m. is measured as eight hours. However, for ease of interpretability, many descriptive statistics and coefficients related to wake time and other time variables are given in alternate units—specifically, in minutes or in clock time. In these cases, I specify the specific units I use.

Work start time is the time when the first episode of work activities in a respondent's time diary begins, measured in hours past midnight. Work includes activities such as working from home, looking for work, and work travel, as well as commuting to or from work. Including commute time is particularly important in the U.K., where evidence suggests that commute duration differs by gender (Office for National Statistics 2018c, 2018a), so excluding commuting in the definition of work activities could provide an inaccurate picture of gender differences in how the start of work activities associates with wake time. (Evidence suggests that gender differences in commute time might be smaller in Spain, but likely differ according to life course stage (OECD Family Database 2016; Olmo Sánchez and Maeso González 2014).) I use the phrase "work start time" for simplicity throughout this paper, but it is important to remember that this measure captures the start time of all work activities—including commuting.

For each respondent, there are two relevant measures of work start time: own work start time, which refers to the time that this respondent starts work, and partner's work start time, the time that the respondent's partner starts work. In regression analysis, own and partner's work start time are centered at the within-country mean of work start time. For descriptive analysis, I use own and partner's work start time to construct a dichotomous variable indicating whether the respondent started work before their partner did.

Work hours represent the total number of hours that a respondent spent in work activities (including commuting) on the diary day. In regression analysis, work hours are centered at the within-country mean.

Drawing from categorization used in Burgard and Ailshire (2013), presence of household children is divided into the following three categories: households in which the youngest child is under six years old (referred to as "young children" households); households in which the youngest child is between six and 17 years old (referred to as "older children" households); and households in which no children under the age of 18 years old live (referred to as "childless" households). Children living in the household may or not be respondents' biological children.

Age is measured in decades (i.e., original age values divided by ten) and is also centered at the within-country mean in regression analysis. Age squared is the squared value of this age measure. Education is a categorical measure indicating whether the respondent completed less than a secondary education, a secondary education, or a more than a secondary education. Year is a categorical measure of the survey year in which the interview was conducted. Survey years are combined into the following categories: 2000-2001 (U.K.), 2002-2003 (Spain), 2009-2010 (Spain), and 2014-2015 (U.K.). Season is a categorical variable capturing whether the interview was conducted in winter (December through February), spring (March through May), summer (June through August), or fall (September through November). Day of the week indicates whether the interview took place on Monday, Tuesday, Wednesday, Thursday, or Friday.

For the children's school start time subsample, children's school start time is defined as the earliest school start time among all of respondents' children who completed a time diary and reported a school start time prior to 12:00 p.m. This variable is measured in hours past midnight and is centered at the within-country mean in regression analysis.

Analysis

Descriptive statistics for individual-level variables (e.g. age) are generated using recommended MTUS weights (Fisher et al. 2015). Given the unavailability of harmonized household-level weights in the MTUS, descriptive statistics for couple-level variables (e.g. season) are unweighted. Histogram values are also unweighted. Wald tests are used to determine statistical significance of differences in descriptive statistics. The “mlincom” command (Long and Freese 2014) is used to test statistical significance of differences in marginal effects.

Regression analysis is conducted using mixed-effects regression models (also known as multilevel regression models or hierarchical linear models). To account for the fact that individual respondents (level 1) are nested within couples (level 2), random effects are modeled for each couple in predicting the intercept. Level-1 residuals are estimated separately for men and women. Because harmonized MTUS weights would weight results at the individual, as opposed to household level, I do not use survey weights in mixed-effect regression analysis. Following procedures similar to those used in prior analysis of the MTUS (Hook (2006), who draws from the work of Winship and Radbill (1994)), rather than weighting multivariate regression analyses, I control for age and the day of the week (in addition to limiting my sample to employed individuals).

In addition to age and interview day, all regression models control for age squared, education, season of interview, and year of interview. All models also control for presence of household children, with the exception of the children’s school start time analysis, given that all couples in this subsample live with older children. Regression analyses are conducted separately for Spain and the U.K., given that time diaries started at different times in each country and that relationships between key independent variables and wake time might differ by country, as well.

My first regression analysis set examines the association of own work start time with wake time and the association of partner's work start time with wake time. Model 1 examines own work start time and the interaction of own work start time with gender. Model 2 adds partner's work start time and its interaction with gender. Unfortunately, due to multicollinearity concerns, I was not able to include the indicator that the respondent started work before their partner in regression analysis (the multicollinearity concerns are related to the fact that this indicator is derived from partners' and own work start time).

My second regression analysis set examines whether gender differences in the associations of wake time with partner's and own work start time vary over three categories of children's presence in the respondents' household: young children present, older children present, or no children present. This analysis includes all covariates from the first analysis set and adds three-way interactions between gender, presence of household children, and each of the work start time variables (partner's and own work start time), separately. Corresponding lower-order interactions are also included. To facilitate interpretation of interaction terms, I graph marginal effects of partner's and own work start time on wake time. Marginal effects of partner's and own work start time on wake time are generated using the "mgen" command in Stata (Long and Freese 2014).

My third regression analysis set analyzes the children's school start time subsample to examine how the earliest school start time of respondents' children associates with respondents' wake time. I include an interaction between respondents' gender and children's school start time to test whether this association differs by gender. This analysis also controls for partner's and own work start time and includes interactions of the two work start time variables with respondents' gender.

A supplementary analysis addresses the possibility that the associations of wake time with partner's and own work start times differ by the number of hours worked on the diary day. In this analysis, I include the measure of diary day work hours, as well as three-way interactions between work hours, gender, and work start time variables (both partner's and own work start time, separately). The model also includes lower-order interactions corresponding to these three-way interactions—for instance, the two-way interaction between work hours and own work start time. This analysis allows me to observe whether any gender differences in associations of wake time with partner's and own work start time diminish when accounting for work hours and its potential interactions with gender and work start time variables.

Results

To enhance clarity, when results from Spain and the United Kingdom do not lead to substantively different conclusions regarding core research questions, I focus the presentation of findings on the United Kingdom. In these cases, results from Spain are available in the Appendix. When Spanish results do lead to substantively different conclusions, I present them along with the U.K. results in the main text, tables, and figures. I use the U.K. as the focal example instead of Spain due to the earlier time diary start in the U.K., which likely produces fewer unobserved wake times.

Table 3.1 provides descriptive statistics for the main analytic sample from the U.K. (Supplementary Table 3.1, available in the Appendix, presents these statistics for Spain.) Results show that wake time and work start time differ by gender, with men waking up around eight minutes earlier than women, on average. The gender difference in work start time is larger, with men starting work activities around 36 minutes earlier than women, on average. A histogram of own work start time, displayed in Figure 3.1, shows the distribution of own work start times, disaggregated by gender. (Supplementary Figure 3.1 of the Appendix presents this histogram for Spain.) This histogram shows that in general, larger percentages of men have work start times prior to 8:00 a.m., whereas larger percentages of women have work start times after 8:00 a.m.

In addition to having earlier average work start times at the national level, within couples, men are also more likely than women to start work activities before their partners do (descriptive statistics available in Table 3.1). More than half of all men started work before their partners did on the diary day, compared to less than one-third of women. Men also work longer hours than women, spending over one-and-a-half more hours working (including commuting) on their diary day.

Figure 3.2 presents a histogram of the within-couple difference between the male partner's wake time and the female partner's wake time within each couple. (Supplementary Figure 3.2 presents this histogram for Spain, in the Appendix.) Negative values mean that the male partner woke up first (and positive values vice versa); thus, negative values represent the number of hours earlier that a male partner woke up (and vice versa for positive values). The histogram bin centered at 0 includes the largest percentage of couples and represents 10 or fewer minutes of difference in partners' wake times (with either the male or female partner waking up first). However, a majority of couples do not fall into this bin, suggesting that partners often differ in their wake times. The distribution is slightly asymmetric and suggests that men more frequently wake up before their partners.

Figure 3.3 displays a histogram of the difference between the time each respondent wakes up and the time they start work, broken down by gender. (Supplementary Figure 3.3 presents this histogram for Spain, in the Appendix.) These results suggest that compared to women, less time passes between men's wake time and their own work start time. The distance between wake time and work start time also varies less among men.

Do the Associations of Own Work Start Time with Wake Time and Partner's Work Start Time with Wake Time Differ by Gender?

Table 3.2 displays results of mixed-effects regression models predicting wake time. (Supplementary Table 3.2, presented in the Appendix, presents these results for Spain.) Model 1 examines how own work start time associates with wake time and whether this association differs by gender. Model 2 adds partner's work start time and the interaction between partner's work start time and gender.

As hypothesized, own work start time is more predictive of men's than women's wake time. Model 1 shows that starting work one hour later is associated with waking up around 36 minutes later for men and 21 minutes later for women. These results do not change much when partner's work start time is added in Model 2.

Model 2 indicates that partner's work start time is positively associated with wake time. However, own work start time is substantially more predictive of wake time than partner's work start time is. For example, for each hour advance in the time that their partners start working, men wake up around six minutes later—compared to 36 minutes later for a one-hour advance in their own work start time. Contrary to my first hypothesis, the association between partner's work start time and wake time does not significantly differ by gender.

Differences by Presence and Ages of Household Children

The next analysis examines whether gender differences in the associations of wake time with partner's and own work start time vary by the presence (and age) of children in the couple’s household. Full mixed-effects regression results are presented in Supplementary Table 3.3 of the Appendix. Figures 3.4 and 3.5 display marginal effects for partner’s and own work start time, respectively, calculated from the mixed-effects regression results. (The corresponding graphs for Spain are available in the Appendix as Supplementary Figures 3.4 and 3.5.) These Figures compare respondents living in three types of households: households with young children, households with older children, and households with no children.

Figure 3.4 displays the marginal effects of partner’s work start time on wake time, broken down by country, presence of children in the couple’s household, and gender. Gender differences in the association between partner’s work start time and wake time do not significantly differ between couples living with older children and couples living with no children (the reference category in regression models). Among both of these groups, there is no significant gender difference in the marginal effects of partner’s work start time on wake time.

However, gender differences in the association between partner’s work start time and wake time do differ between couples in childless households and couples living with young children. This difference is suggested by the marginally statistically significant, three-way interaction between living with young children, gender, and partner’s work start time in regression models (see Supplementary Table 3.3, Appendix). As observed in Figure 3.4, among couples living with young children, the marginal effects of partner’s work start time on wake time are greater for men than for women, a pattern that differs from results observed for couples living in other types of households. However, the gender difference in the marginal effects of partner's work start time on wake time is only marginally statistically significant in the U.K. and lacks statistical significance in Spain.

Figure 3.5 presents the marginal effects of own work start time on wake time, broken down by country, presence of household children, and gender. Own work start time is more predictive of men's (versus women's) wake time in each of the three types of households. However, gender differences in the association between own work start time and wake time are significantly larger among couples living with older children compared to childless couples. In the U.K., gender differences in this association are also significantly larger for couples living with young children, compared to childless couples; this is not the case in Spain.

Does the Association of Children's School Start Time with Parents' Wake Time Differ by Gender?

Finally, I examine how children's school start time associates with parents' wake time, and whether this association differs by parents' gender. This analysis is limited to respondents whose children live in their household, completed a time diary, and reported an eligible school start time on the diary day. Supplementary Table 3.4 (Appendix) provides descriptive statistics for the subsample of respondents included in this analysis. Figures 3.6 and 3.7 present histograms of children's school start time for U.K. and Spanish couples, respectively. These histograms suggest that there is more variation in school start times for Spanish children, compared to U.K. children.

Table 3.3 presents results of within-country mixed-effects regression models using the first school start time of respondents' co-residential children to predict respondents' wake time. I present Spanish results in this table, because they differ from U.K. findings. These models control for partner's and own work start time. Models also include two-way interactions of gender with the following variables (separately): partner's work start time, own work start time, and children's school start time.

Spanish and U.K. results produce substantively different conclusions regarding hypothesized gender differences in the association between children's school start time and parents' wake time. In Spain, children's school start time significantly predicts mothers', but not fathers' wake time. However, the gender difference in the association between children's school start time and wake time is not statistically significant. In contrast, in the U.K., children's school start time predicts fathers', but not mothers' wake time. However, this gender difference is also not statistically significant.

Interestingly, in both countries, partner's work start time is predictive of women's, but not men's, wake time. However, gender differences in the association between partner's work start time and wake time do not achieve statistical significance in either country. As in analysis of the main sample above, own work start time is significantly more predictive of men's wake time. The gender difference in the association between own work start time and wake time is particularly large among U.K. respondents in this subsample.

Supplementary Analysis: Work Hours

Gender variation in schedule composition might contribute to gender differences in the weight of own work start time as a temporal anchor relative to wake time. In particular, work start time might be a more important temporal anchor for men's wake time because men work longer hours (see Table 3.1), leaving less room for other activities. For example, perhaps people who work longer hours are less likely to have time to exercise before work in the morning, making work start time more closely linked to wake time. Thus, gender differences in the association between own work start time and wake time might be explained by gender variation in the number of hours worked per day.

Supplementary Table 3.5, available in the Appendix, examines whether accounting for work hours diminishes gender differences in the association between own work start time and wake time. Model 2 of Supplementary Table 5 re-presents results from Model 2 of main analyses (shown in Table 3.2 for the U.K. and Supplementary Table 3.2 for Spain) in order to provide a baseline for comparison. Model 3 of Supplementary Table 3.5 adds work-hour variables, including three-way interaction terms (and their corresponding lower-order interactions) between gender, work hours, and work start time (both partner's and own, separately).

Results suggest that work hours moderate the association between own work start time and wake time in both countries. Work hours and own work start time positively interact in both Spain and the U.K., suggesting that the association of wake time with own work start time is greater for respondents who work longer hours. In both countries there is also a positive three-way interaction between work hours, female gender, and own work start time, such that working longer hours is associated with a larger increase in the association between own work start time and wake time for women (compared to men).

Gender differences in the association between own work start time and wake time diminish somewhat in Model 3, suggesting that accounting for work hours explains a portion of the gender differences observed in the baseline model. However, although diminished, significant gender differences in association between own work start time and wake time are still observed in Model 3.

Similar to results from main models, partner's work start time has a relatively small association with wake time in this supplementary analysis. Moreover, as in main results, the association between partner's work start time and wake time does not significantly differ by gender. In the U.K., work hours moderate the association between partner's work start time and wake time, such that men who work longer hours have a diminished association between partner's work start time and wake time. (Work hours do not significantly moderate the association between partner's work start time and wake time for U.K. women, but the gender difference in the interaction between partner's work start time and work hours falls short of statistical significance.)

Discussion

These results provide proof of concept for the idea of temporal anchoring, demonstrating its ability to enrich time use analysis by focusing attention on which activities structure events of interest. The present study examines the particular case of temporal anchors relative to what time we wake up in the morning. Empirically, I find evidence supporting the idea that the time people start work, the time their partners start work, and the time their children start school can serve as temporal anchors relative to wake time, though evidence is strongest with regard to people's own work start time.

My findings are consistent with the idea that the weight of a specific temporal anchor can vary according to social characteristics—in this case, gender. In particular, I find support for my hypothesis that among dual-employed couples, the association between own work start time and wake time is greater among men than women. Men have a closer average temporal proximity of own work start time to wake time, which might help explain this finding. I find evidence of gender differences in the association between own work start time and wake time in both Spain and the U.K., two countries with different work and sleep schedules (Fernández-Crehuet Santos 2016). This invites the question of whether these patterns might be found in other European countries, or perhaps even more broadly, to countries such as the United States.

I did not find the expected gender difference for partner's work start time. In general, partner's work start time was not more predictive of women's wake time, in either Spain or the U.K. This finding adds nuance to scholarly understanding of how time use is gendered. Studies examining gender differences in the duration of time spent in specific activities show that although some gender differences have diminished in recent years, relatively large differences remain in the amount of time men and women spend in domestic labor activities (e.g. Bianchi et al. 2000, 2012; Eurostat 2004; Gonalons-Pons 2015). Such studies suggest that the gender revolution might be "stalled" (Hochschild 1989) with regard to gender differences in household divisions of labor, though this is a subject of ongoing debate (e.g. see Altintas and Sullivan (2016)). Regarding sleep in particular, although on average women spend more time sleeping than men (at least, in the United States), a portion of gender differences in sleep duration is explained by compositional differences in social factors such as employment (Burgard and Ailshire 2013). In addition, women are more likely to interrupt their sleep to provide care to other family members (Burgard 2011; Venn et al. 2008). In contrast to lingering gender inequalities in housework or gender disparities in sleep interruption, I do not find gender differences with respect to how partner's work start time temporally anchors wake time among the dual-employed couples in my sample.

I find little support for the hypothesis that children's school start time is more predictive of mothers' than fathers' wake time. Gender differences in the association between children's school start time and wake time are not significant in either Spain or the U.K. However, Spanish results are arguably more consistent with my hypothesis, whereas U.K. results are highly inconsistent with my hypothesis. In Spain, although the gender difference in the association between children's school start time and wake time is not statistically significant, children's school start time predicts mothers', but not fathers', wake time. The gender difference in the association between children's school start time and wake time also fails to achieve statistical significance in the U.K.; however, this gender difference (even if not statistically significant) has a different pattern. In the U.K., children's school start time is predictive of wake time for fathers, but not for mothers. The potentially (though not conclusively) more gender-traditional pattern in Spain could be related to the differing gender contexts of the two countries. In addition, the age cut-offs for children completing time diaries differed slightly between the two countries, though it is not clear how this might affect results, if at all.

Still, in both countries, children's school start time is associated with wake time for one set of parents. In Spain, each hour later that the first household child starts school is associated with a nearly ten-minute increase in maternal wake time. In the U.K., a one-hour increase in children's school start time is associated with an approximately 15-minute increase in paternal wake time. These results suggest that changes in children's school start times might affect parents' sleep, in addition to children's sleep duration (Adam, Snell, and Pendry 2007; Basner et al. 2014; Dunster et al. 2018; Knutson and Lauderdale 2009).

I find some support for the hypothesis that gender differences in temporal anchors relative to wake time differ by the presence of household children. The marginal effects of own work start time and wake time are greater for men in all three types of households examined: households with young children, households with older children, and households with no children. However, this gender difference is greatest in households with older children, followed by households with younger children (though the difference in this gender difference between households with young children and childless households was only significant in the U.K.).

Compared to own work start time, for partner's work start time, variation across household types in how its marginal effects differ by gender is somewhat less straightforward to interpret. The marginal effects of partner's work start time on wake time are greater for men in households with young children, but greater for women in other households. However, it is difficult to discern if the difference in findings for couples living with young children is substantively very meaningful, given that gender differences in the marginal effects of partner's work start time fail to reach (conventional measures of) statistical significance in all households. Additional research is needed to help clarify the meaning of these results. The lack of difference between couples living with older children and couples in childless households resonates with Gunn et al.'s (2015) finding that partners' similarity in sleep schedules is not correlated with parenthood status.

The finding that own work start time more strongly predicts wake time than partner's work start time could be related to the intuitive idea that our own work schedules are the best predictor of our own sleep schedules. However, this finding could also be related to the fact that partner's work start time might not affect wake time when it occurs after own work start time. To address this possibility, I generated a variable measuring how many minutes before own work start time a partner started work. Specifically, I created a measure representing own work start time minus partner's work start time and set this measure to zero when partner's work start time occurred after own work start time. Unfortunately, given that this measure is derived from both partner's and own work start time, including this measure in regression models produced multicollinearity concerns. Examining raw values of partner's work start time instead of a measure that accounts for whether a partner started work before the respondent might paint a more conservative picture of gender differences in the association between partner's work start time and wake time, given that women are more likely to have partners that start work before they do.

Results suggest that own work start time carries heavier weight as a temporal anchor relative to wake time when people work longer hours. This finding is consistent with the idea that schedule composition affects temporal anchors' weight. However, partner's work start time only appears to be a "lighter" temporal anchor relative to wake time for U.K. men working longer hours (and not for Spanish respondents or U.K. women working longer hours).

Given my focus on morning wake times and work start times, my findings do not generalize to people who keep nonstandard work or sleep schedules or whose partners keep nonstandard work or sleep schedules. My primary focus is on gender differences in the importance of own work start time and partner's work start time as temporal anchors relative to wake time. For people working or sleeping during nonstandard hours, own work start time and partner's work start time might not act as temporal anchors relative to wake time, or might affect wake time in a different way than for people keeping more standard schedules. Thus, including people with nonstandard schedules might add noise and introduce inaccuracies into the present analysis. However, this population might be of interest for future study on the relationship of wake time to work and family schedules.

Importantly, my findings also do not generalize to unpartnered individuals. Given my focus on partner's work start time as a temporal anchor relative to wake time, I only examine individuals in co-residential couples. In my analysis of children's school start time, this means that results do not generalize to single parents. Future research might examine how children's school start time and own work start time temporally anchor wake time for unpartnered individuals.

A further limitation of this study is my inability to directly disentangle the mechanisms connecting partner's work start time and children's school start time with wake time. For example, partner's work start time might be associated with the respondent's wake time for a variety of reasons. The time that a respondent's partner starts work could affect the time the partner sets their alarm clock for—and this alarm clock might happen to wake up the respondent. Alternatively, the time a respondent's partner starts working might be associated with the respondent's wake time if the respondent and partner make an effort to eat breakfast together before they both leave for work in the morning. The time diaries I analyze do not include sufficient detail to distinguish with certainty whether one household member wakes up another or capture specific interpersonal dynamics regarding why partners' wake times might be similar.

Analysis of a single time diary also places limitations on the present study. Such analysis does not allow me to examine whether partner's work start time might affect rhythmic circadian processes, as opposed to a single day's wake time. In addition, the time diaries I analyze only measure the actual time a respondent started working, and would not be able to reveal, for instance, if a respondent with some schedule flexibility moved their work start time to be closer to their partner's work start time. In the future, qualitative research might help elucidate the processes surrounding how couples negotiate morning routines.

In addition, evidence that women's perceptions of relationship quality are associated with the degree of similarity between their own and their male partner's bed time (though not wake time) (Hasler and Troxel 2010) suggests that couples' bedtime negotiations might be a particularly important area for future research. Indeed, a recent study of older U.S. adults finds that spouses might be more similar in bed times than wake times (Chen 2018). Future research might examine gender differences in temporal anchors relative to bed time, such as television viewing (Basner and Dinges 2009).

It is important to contextualize my results within the broader picture of gender differences in time use and employment within couples. Given my present research focus, I limit my analytic sample to dual-employed couples, which are only a subset of all couples. It would be interesting to examine temporal anchors relative to wake time among single-employed couples—in particular, to analyze gender differences in how the work start time of the employed partner associates with the wake time of the partner who is not employed. Even if there were no gender differences in this temporal association, among such couples, gender differences in schedule composition could produce gender differences in the overall weight of partner's work start time as a temporal anchor, given that women are less likely to be the employed partner.[19]

This research demonstrates the utility of the temporal anchor concept for research examining how institutions—and individuals embedded in those institutions—shape our daily schedules. In particular, my findings suggest the potential for social factors to contribute to differences in temporal anchors' weight relative to the events whose timing they structure. Ferree's (2010) review of research on gender in family contexts advocates for a "…definition of gender as a relationship of power connected to institutional processes organizing—and changing—families" (p. 423) and notes that, "A more generalized view of time as a circuit

---

[19] For different-sex couples in which only one partner is employed in the full U.K. and Spanish MTUS samples, the employed partner is more likely to be a man.

connecting gender relations among institutions and over the life course awaits development" (p. 432). In the present research, I contribute to scholarly understanding of time by examining how gender shapes which institutions and people have the power to structure family members' schedules—in particular, who and what structure the start of the waking day. In addition, this research's focus on sleep shows how social scholarship on time "circuits" (Ferree 2010) can be expanded to not only encompass connections between social institutions, but also connections of social institutions with biological processes.

Chapter 4: Do Educational Differences in Sleep Duration Converge at Older Ages?

Introduction

Prior research has established that, in the United States, less-educated individuals sleep longer than the more highly educated, on average (Basner et al. 2014). Lower levels of education are generally associated with higher probabilities of long-duration sleep (Krueger and Friedman 2009), but also perhaps a higher likelihood of less-than-optimal amounts of sleep (Hale 2005). Several mechanisms likely explain some portion of the association between education and sleep duration, including differences in employment hours and schedules (Basner et al. 2007; Givens et al. 2015; Jacobs and Gerson 2004), as well as variation in health (Krueger and Friedman 2009; Stamatakis, Kaplan, and Roberts 2007). Given that some of these mechanisms change over the life course (Basner et al. 2007; Ross and Wu 1996), it is plausible that the association between education and sleep duration changes over the life course as well.

In the present study, I use time diary data from the American Time Use Survey (ATUS) to examine whether educational differences in sleep duration narrow or widen at older ages (in the United States). Doing so introduces sleep duration to the body of literature examining whether socioeconomic differences in health outcomes converge or diverge as people age (e.g. Kim and Durden 2007; Lynch 2003). Similarly, by testing for interactions between education and age in predicting sleep duration, the study follows a vein of research examining whether age-related trajectories of health outcomes differ by education (e.g. Ross and Wu 1996). I also examine the extent to which employment-related mechanisms explain the patterns of sleep duration difference I observe, contributing to scholarly understanding of the relationship between employment and sleep.

Background

Educational Differences in Sleep Duration

Although studies have occasionally produced conflicting results (e.g. Moore et al. 2002), in general, evidence suggests that in the United States, lower levels of education are associated with longer sleep duration, for both weekdays and weekends/holidays (Basner et al. 2014). However, some research suggests that the association between education and sleep duration is not linear, such that less-educated individuals are more likely to obtain both short and long amounts of sleep (Hale 2005). Research findings regarding the probability of long-duration sleep are fairly consistent: in general, less-educated individuals are more likely to sleep for long durations (Basner et al. 2014; Krueger and Friedman 2009; Whinnery et al. 2014), though specific associations might differ by type of day (i.e., weekend versus weekday) or particular sleep categories examined (Basner et al. 2014; Hale 2005; Krueger and Friedman 2009; Whinnery et al. 2014).

Some research suggests a positive association between lower levels of education and probability of short-duration sleep (Hale 2005; Krueger and Friedman 2009). Other studies, however, find less uniform associations between education and the probability of short-duration sleep (e.g. Whinnery et al. 2014). In an analysis of ATUS time diaries, those with moderate education—in this case, a high school degree—were more likely than those with either higher or lower education to sleep six hours or less on weekends and holidays (Basner et al. 2014). Another time diary study found that people with moderate education—in this case, some college—were more likely than those with higher or lower education to obtain six hours of sleep or less, using models that adjust for sociodemographic characteristics, including employment status (Knutson et al. 2010). Differences in findings could be due to differences in the educational and sleep category cutoffs used, the samples analyzed, or the covariates included in models. Yet such methodological differences also exist in analyses of long sleep duration, and conclusions regarding its association with education are more consistent.

Educational Differences in Sleep Duration: Changes with Age?

Prior Empirical Findings

Few studies examine heterogeneity in the association between education and sleep duration by age. One notable exception is Basner et al. (2014), who present a heat map that combines education and age categories, comparing the odds of short (or long) sleep duration of individuals in each age/education category to the odds of short (or long) sleep duration in the rest of the sample. This heat map suggests that educational differences in the odds of short sleep duration on weekdays narrow at ages 65 and above (Basner et al. 2014), though this is difficult to discern with certainty via visual inspection of the map. Variation in educational differences by age is less clear for weekends/holidays and long-duration sleep (Basner et al. 2014). These findings might lead us to expect convergence in weekday short-duration sleep at older ages. Perspectives from social epidemiological theory, outlined below, provide insight for developing additional (and alternative) expectations.

Convergence Hypotheses

The age-as-leveler hypothesis posits that socioeconomic disparities in health diminish at older ages, particularly from middle to late adulthood (see discussion in Kim and Durden (2007)). Scholars have proposed various mechanisms to explain this pattern, such as the idea that later in life, the association of increased age with worse health is so strong that there is little health variation left to explain when controlling for age (Lynch 2003:313). Considering the u-shaped associations previously found between sleep duration and age (Basner et al. 2007), we might hypothesize that education explains less of the variation in sleep duration in early and late adulthood, compared to middle adulthood. Some research has found a similar pattern of divergence (from early to middle adulthood) and later convergence (from middle to late adulthood) in certain health outcomes, such as physical limitations (House et al. 1994). These health outcomes might, in turn, affect sleep duration (e.g. see Shandra et al. (2014)). In addition, it is possible that sleep duration has a lower natural "ceiling" at older ages (Klerman and Dijk 2008), potentially allowing for less variation at the high end of the sleep duration distribution.

Changing socioeconomic differences in psychosocial context and health behaviors might explain a portion of the observed pattern of divergence, then convergence, in physical limitation differences by education (House et al. 1994). Similarly, educational differences in certain factors affecting sleep might vary with age, producing divergence and later convergence in sleep duration at older ages. In particular, time spent in employment activities represents a sleep-affecting factor (Biddle and Hamermesh 1990) whose importance for determining sleep duration appears to increase from early to middle adulthood, then decrease from middle to late adulthood (Basner et al. 2007).

In the U.S., higher levels of education are associated with greater probability of holding multiple jobs (Kimmel and Powell 2001; Marucci-Wellman et al. 2014) and longer hours spent working (Aguiar and Hurst 2009; Jacobs and Gerson 2004). In particular, individuals with less than a high school education work fewer hours, on average, than their more highly-educated counterparts (Jacobs and Gerson 2004). People working multiple jobs or long hours are more likely to sleep six or less hours (Basner et al. 2014; Luckhaupt, Tak, and Calvert 2010), and time spent in paid employment is negatively associated with sleep duration (Basner et al. 2007).

Educational differences in the probability of holding multiple jobs and in the time people dedicate to employment might lead us to expect less-educated individuals to have a lower likelihood of short sleep. Consideration of other employment aspects—specifically, shift timing—might lead to different expectations. Among the employed, those with less education are more likely to work nonstandard hours (Enchautegui 2013) and be employed in shift work (Givens et al. 2015). Evidence suggests that shift work is associated with higher probability of both long (Patel et al. 2006—though this study examines women only) and short (Givens et al. 2015) sleep duration. Certain industries and occupations demonstrate particularly high rates of short sleep duration, a phenomenon possibly related to shift work, at least in part (Luckhaupt et al. 2010). However, research has found differences by race/ethnicity and immigrant status in the association between occupational category and probability of short sleep duration (Jackson et al. 2014).

Prior research has established an accelerating decrease in employment hours from middle to late adulthood (Basner et al. 2007), and by 65 years of age (specifically, 62 years of age for women and 64 years of age for men), most U.S. residents no longer participate in the labor force (Munnell 2015). Regardless of the direction of educational sleep duration differences, the probable role of employment in generating these differences, as well as the decreasing salience of employment from middle to late adulthood, lead to the following hypothesis:

> Hypothesis 1: Educational differences in sleep duration increasingly diminish from middle to late adulthood.

If Hypothesis 1 holds, we might expect to see significant interactions between education variables and age squared in predicting sleep duration, in the opposite direction of the baseline associations between education and sleep duration (though various combinations of interaction terms between age and education might represent some form of convergence). Importantly, higher levels of education are associated with later retirement ages (Burtless 2013; Hayward and Grady 1990), which might mean that convergence in educational sleep duration differences is not visible until quite late in adulthood.

Hypothesis 1 centers on the idea that educational differences in sleep duration are greater at ages when people are more likely to work in paid employment. The particular time use importance of employment on weekdays leads to the following corollary hypothesis:

> Hypothesis 1A: If Hypothesis 1 holds, the pattern outlined in Hypothesis 1 will be stronger for weekday, as compared to weekend/holiday, sleep.

A prior study found that being retired was associated with higher odds of long sleep duration on weekdays and lower odds of short sleep duration on weekends, but the latter association was only marginally statistically significant (Hale 2005).

On average, men spend more time in employment activities than women, and at most ages, the association between employment hours and sleep duration is greater among men (Basner et al. 2007). Men's higher average rate of participation in paid employment likely contributes to gender differences in associations of sleep duration with age and education. This suggests a potential addendum to Hypothesis 1:

> Hypothesis 1B: If Hypothesis 1 holds, the pattern outlined in Hypothesis 1 will be stronger for men than women.

A study of US and UK adults suggests that the odds of obtaining less than six hours of average weeknight sleep diminish at older ages for men, but not women (though this trend was only statistically significant by conventional standards in the US) (Stranges et al. 2008). The same study finds that the probability of reporting long average weeknight sleep duration is higher for

U.S. respondents over 60 years old than respondents 50 years old or younger, and this difference is greater among men than among women (Stranges et al. 2008).

While the discussion of the age-as-leveler perspective hypothesis has thus far focused on employment (and retirement), a separate phenomenon might also be consistent with sleep duration convergence from middle to late adulthood: selective mortality. Given that less educated individuals die at an increasingly faster rate than the more highly educated as they age (Lauderdale 2001), health differences between these two groups might move toward convergence at older ages, as only the healthiest members of the least-educated groups remain alive (see discussion in Lynch (2003)). Evidence suggests that sleep duration predicts mortality (Cappuccio et al. 2010), so if only "healthier" sleepers survive to older ages, this might generate sleep duration convergence later in the life course.

Another perspective, called the rising importance hypothesis, posits that the effects of education on health outcomes have risen over time and are larger in more recent birth cohorts (Mirowsky and Ross 2008). Indeed, evidence suggests that educational disparities in certain health outcomes, such as self-rated health, are larger in more recent cohorts (Mirowsky and Ross 2008). This phenomenon can lead to the appearance of late-life convergence in health outcomes, if scholars are unable to disentangle age from cohort effects (Lynch 2003; Mirowsky and Ross 2008). Any health aspects that affect sleep duration and are more unequal (by education) in more recent cohorts could produce a similar pattern for sleep duration. (Lower self-rated health is positively associated with short-duration and long-duration sleep (Shankar et al. 2011), but questions remain as to why, causally, health is related to sleep duration—particularly long sleep duration (Jike et al. 2018; Knutson and Turek 2006)).

In addition, several of the proposed causes of widening educational disparities in other health outcomes in more recent birth cohorts and recent periods are potentially applicable to sleep duration, as well. In particular, rising educational inequalities in income and dimensions of paid employment (Aguiar and Hurst 2007; Autor 2014; Lynch 2006; Valletta 2015; also see discussion in Goesling (2007):1622-1623) could possibly affect educational differences in sleep duration, potentially increasing these differences in more recent birth cohorts. Evidence from the U.S. suggests that higher income is associated with shorter total sleep duration (Basner et al. 2014), lower odds of long-duration sleep (Basner et al. 2014), and possibly lower odds short-duration sleep (Krueger and Friedman 2009) (though results are less consistent on this point—see Basner et al. (2014)). In addition, as mentioned above, work hours, which have become increasingly longer among the more highly-educated relative to their less-educated counterparts (Aguiar and Hurst 2007), are negatively associated with sleep duration (Basner et al. 2007). Thus, to the extent that increases in educational inequalities related to income and work represent cohort-level—and not just period-level—phenomena, we might expect educational differences in sleep duration to diminish at older ages in a cross-sectional sample.

However, it is possible that recent rises in income- and work-related differences by education represent more period-level than cohort trends (e.g. see Osberg (2003), Table 3 for evidence of rising intra-cohort income inequality in more recent U.S. periods). In data taken from the same time frame, period-level trends would not produce apparent late-life convergence in health outcomes in the way that cohort differences might. In addition, at older ages, many individuals no longer participate in the labor force. If few older adults are working, any potential cohort differences in work hours or current work-related earnings might have less of an impact on sleep or other health outcomes at older ages. Therefore, it is difficult to say with certainty that recent trends in income- and work-related differences by education would contribute to a "rising importance" of education as a determinant of sleep duration in more recent cohorts.

Divergence Hypotheses

The major perspective competing with convergence hypotheses is that of cumulative advantage, the idea that socioeconomic disparities accumulate over the life course, leading to widening health inequalities at older ages (Ross and Wu 1996). Some evidence suggests that educational disparities in particular health outcomes associated with sleep duration, such as depressive symptoms (Patel et al. 2006—though this is an all-women sample), increase with age (Miech and Shanahan 2000), leading to the following hypothesis:

Hypothesis 2: Educational differences in sleep duration linearly increase from middle to late adulthood.

Other educational disparities in health outcomes associated with sleep, such as physical limitations (Shandra et al. 2014), might expand at an increasing rate with age (Ross and Wu 1996) (though this is debated, and findings from other studies differ—e.g. House et al. 1994), leading to a slightly different hypothesis:

Hypothesis 3: Educational differences in sleep duration increasingly expand from middle to late adulthood.

Generally speaking, Hypothesis 2 would be supported if education significantly interacts with age, but not age squared, such that educational differences in sleep duration increase at a linear rate. Hypothesis 3 would find support if divergence is observed and education significantly interacts with age squared. Notably, interactions between age and education that run in the opposite direction of baseline associations could represent evidence of initial convergence, but later divergence if educational groups' sleep outcomes cross each other at older ages.

Additional Factors

There are additional reasons to expect that educational differences in sleep duration might differ by age. One such reason relates to poor sleep quality. Higher probability of frequent sleep complaints is associated with both short and long sleep durations (Grandner and Kripke 2004). Evidence suggests that on the whole, higher socioeconomic status is associated with better sleep quality (see review in Knutson 2013).[20] One study suggests that the association between sleep problems and socioeconomic status might diminish after 45 years of age (Hunt, McEwen, and McKenna 1985), though cell sizes of several gender/age/social class combinations are small ("cell sizes" refers to sample sizes within specific "cells" representing combinations of categories to which respondents belong). If socioeconomic differences in sleep quality do decrease at older ages, this might contribute to decreasing educational differences in sleep duration in late adulthood.

Methods

Data

[20] However, evidence also suggests that race and ethnicity moderate associations between education and particular sleep quality indicators (Grandner, Patel, et al. 2010; Lauderdale et al. 2006). Additionally, some research finds non-linear relationships between education and certain sleep quality measures (Grandner et al. 2013).

I use the 2003-2016 samples of the American Time Use Survey (ATUS), a cross-sectional data source whose respondents are subsampled from the Current Population Survey (CPS) (U.S. Bureau of Labor Statistics 2019). The dataset I use was generated by the ATUS Extract Builder (Hofferth et al. 2015, 2017). ATUS data are nationally representative of the non-institutionalized, civilian U.S. population aged 15 and above (U.S. Bureau of Labor Statistics 2019). ATUS includes time diaries administered to respondents across all days of the week; diaries began at 4am the day prior to the interview and ended at 4am the day of the interview (U.S. Bureau of Labor Statistics 2019).

I include ATUS respondents ages 25 and above in my analytic sample. I omit individuals younger than 25 years old because many of them will not yet have completed their education, the measure of socioeconomic status used in this analysis. I also omit respondents older than 79 years of age; due to top-coding, I am unable to discern the exact age of older respondents.[21] I exclude respondents that are missing information for any of the variables examined in this analysis; only .17% of ATUS respondents meeting sample inclusion criteria are excluded for this reason.[22] Descriptive statistics for my sample (N= 153,241), disaggregated by gender and education, are available in Supplementary Table 4.1 (Appendix), and sample cell sizes for

---

[21] In 2003 and 2004, age was top-coded at 80 years old. Since 2005, age was top-coded at 85, and respondents 80-84 years old were coded as 80 years old (Minnesota Population Center 2017).

[22] I do not impute missing data due to the incompatibility of multiple imputation with successive difference replicate weights.

combinations of diary day, gender, education, and age are shown Supplementary Tables 4.2A, 4.2B, 4.2C, and 4.2D (Appendix).

Measures

Total sleep duration is the number of hours the respondent spent sleeping on the diary day, including time spent napping. Because time diaries ran from 4am to 4am, this measure does not capture one continuous night of sleep, but rather the total amount of sleep the respondent obtained during a 24-hour period. I define short-duration sleep as less than six hours of sleep recorded in a respondent's time diary, following coding procedures similar to those used in other studies of time diary sleep (Basner et al. 2014; Knutson et al. 2010).[23] I define long-duration sleep as 10 or more hours of diary day sleep. Although many studies define long sleep as nine or more hours (e.g. Whinnery et al. 2014), the ATUS likely overestimates actual sleep duration (Basner et al. 2007), so I use more conservative criteria.

Education is measured using the following categories: less than high school; high school (includes respondents with a GED); some college or associate's degree; and college or advanced degree. In supplementary analyses, I use a gender and cohort-specific relative education measure to address rising levels of educational attainment in more recent birth cohorts.

For descriptive analysis, I use a categorical age measure that is broken down into 5-year increments. In regression analysis, I use a continuous measure of age centered at 48.69, the mean age (unweighted) of respondents that meet age-related sample inclusion criteria (i.e., are more

[23] Although Basner et al. (2014) code six hours of sleep as "short," Knutson et al. (2010) only consider sleep durations lasting *less* than six hours as "short."

than 25 and less than 80 years old). I also include a measure of age squared that is the square of this centered age variable.

Covariates include variables indicating: the region in which the respondent lives (Northeast, Midwest, South, or West), the season in which the time diary was completed (winter, spring, summer, or fall), and whether the interview took place after 2008 (when the U.S. experienced an economic recession, which evidence suggests affected sleep duration (Aguiar, Hurst, and Karabarbounis 2013)). I also use a variable indicating gender (man or woman), as well as an indicator of the specific day of the week for which the time diary was completed. Consistent with prior sleep research using time diaries (Basner et al. 2014), holidays are treated as a distinct type of day (for instance, if a diary day falls on a Monday that is also a holiday, it will be coded as "holiday," not "Monday"). (See Minnesota Population Center's (2017) documentation for a list of days coded as "holidays.") When breaking analysis down by type of day, Friday is considered a weekday, and Sunday is considered a part of the weekend. (Hale's (2005) analysis of time diary sleep did not find substantial differences in results when omitting Fridays and Sundays. Additionally, to help account for possible sleep differences on Friday and Sunday nights, I include controls for day of week in regression analyses.) Sociodemographic covariates include: a measure of the respondents' race/ethnicity (non-Hispanic white, non-Hispanic black, Hispanic, or other) (e.g. see Lauderdale et al. (2006) regarding sleep duration differences by race), an indicator of whether the respondent was born outside of the U.S. (which evidence suggests can affect both sleep quality (Grandner et al. 2013; Hale et al. 2014) and quantity (Seicean et al. 2011)), a categorical measure of the number of children living in the respondent's household (zero, one, two, or three or more), and a measure of the respondent's partnership status (living with a spouse, cohabiting with a partner, or not living with a spouse or partner).

Employment hours represents the number of hours the respondent spent working and in work-related activities on the diary day. This measure encompasses ATUS activity codes under the major category “05” (see U.S. Bureau of Labor Statistics N.d.) and does not specifically include time spent commuting. I use time diaries to construct a dichotomous indicator of whether respondents worked non-standard hours on the diary day. Combining the evening and night shifts identified by Wight et al. (2008), I code a respondent as having worked non-standard hours on the diary day if the amount of time they spent in work activities prior to 8am and after 4pm exceeds the amount of time they spent in work activities between 8am and 4pm. (Respondents that do not work on the diary day are coded as not having worked non-standard hours.) Respondents who held more than one job in the week prior to the ATUS interview and who did not report being absent from work for the full week prior to the ATUS interview were coded as having multiple jobs. Respondents are considered retired if they reported being absent from the labor force due to retirement at the time of the CPS interview (this does not include respondents absent from the labor force due to disability) and reported still being retired at the time of the ATUS interview two to five months later (Minnesota Population Center 2017).

Analysis

I graph descriptive statistics for each sleep outcome and use Wald tests to assess the statistical significance of certain sleep duration differences by education. I break statistics down by gender and type of day (weekday or weekend/holiday). I also use multivariate regression models to predict sleep duration, allowing me to statistically test interactions between education and age variables, as well as to control for covariates. Given the u-shaped association previously found between age and sleep duration (Basner et al. 2007), I include a squared age (centered) term in all models. In the baseline set of models, I include covariates that control for region, season, day of the week, and whether the interview took place after 2008. In additional models, I include sociodemographic and employment characteristics, analyzing whether they might explain differences in the association between education and sleep duration by age.

Prior research suggests that employment status among "retirement-age" adults is associated with differences in sleep duration (Flood and Moen 2015). To examine whether retirement might contribute to age-related changes in educational sleep duration differences, I run regression models paralleling the baseline models described above, in which I replace the interactions between education and age variables with interactions between education and retirement status. I restrict these models to respondents 60 to 69 years of age, to mitigate the collinearity of age and retirement status.

To address the possibility that cohort differences in the distribution of education levels might explain my results, I run supplementary models using a relative education measure generated within genders and birth cohorts. I also examine descriptive statistics among a single 10-year birth cohort to help distinguish age variation from cohort differences.

I use linear regression to predict total sleep duration and multinomial logistic regression to predict the odds of short or long (compared to moderate) sleep duration. For both descriptive and regression analyses, I use ATUS probability weights. To account for survey design in calculating standard errors, I use successive difference replicate weights (U.S. Bureau of Labor Statistics 2019; U.S. Census Bureau 2006), except in multinomial logistic regression models, in which the use of successive difference replicate weights produced model convergence issues. All analyses are conducted in Stata/SE 14.2.

Results

Do Educational Differences in Sleep Duration Converge or Diverge?

I discuss results for each of the three sleep outcomes examined separately below. In general, for each sleep outcome, I first present descriptive statistics, then review results from multivariate regression models.

Total Sleep Duration

To examine whether educational differences in total sleep duration converge or diverge with age, Figures 4.1A and 4.1B present descriptive statistics for this outcome, broken down by type of day (i.e., weekday or weekend/holiday) and gender. In general, individuals with lower levels of education spend more time sleeping, and differences are most striking between respondents with less than a high school degree and more highly-educated respondents. Results suggest that certain sleep duration differences expand from early to middle adulthood and contract from middle to late adulthood. For example, at ages 25-29, college-educated men slept an average of 37 minutes less on weekdays than did men with less than a high school education ($p<0.001$). This difference expands to around one hour at ages 45-49 ($p<0.001$) and contracts to 27 minutes at ages 75-79 ($p<0.05$). Women also display a pattern of expansion and contraction in differences. Overall, Figures 4.1A and 4.1B show greater evidence of convergence than divergence in total sleep duration.

Multivariate regression results for total sleep duration, presented in Table 4.1, also provide more support for convergence than divergence in educational sleep duration differences.

(Graphical representations of predicted total sleep duration from these models are available in Supplementary Figures 4.1A, 4.1B, 4.1C, and 4.1D of the Appendix.) For example, among both men and women, age squared negatively interacts with holding less than a high school degree on weekdays, confirming that the average weekday sleep duration difference between college-educated respondents and respondents with less than a high school degree increasingly diminishes from middle to late adulthood.

Regarding differences between weekdays and weekends/holidays, for weekdays, graphed results suggest that more-educated respondents display a higher rate of increase in total sleep duration at older ages, relative to respondents with less than a high school degree—particularly among men. On weekends, a mirror trend is observed: in general, less-educated groups show a faster decrease in total sleep duration at older ages, compared to college-educated respondents. Thus, although age variation in total sleep duration differs between weekdays and weekends/holidays, convergence in educational differences is not clearly stronger on weekdays, compared to weekends.

Turning to differences by gender, the pattern of late-life convergence in weekday total sleep duration is more visually striking (in graphs) among men, and several interactions between age and education variables differ in statistical significance between men and women. However, overall, patterns of convergence in total sleep duration are not clearly stronger among men.

Short-Duration Sleep

Descriptive statistics for the probability of weekday short-duration sleep, graphed in Figure 4.2A, also suggest that individuals with less than a high school education display some of the greatest sleep duration differences from other education categories. However, these and other educational differences in short sleep duration do not show the same pattern of convergence observed for total sleep duration. In particular, differences in the probability of weekday short-duration sleep between men with less than a high school degree and more educated men appear to converge, but then diverge at some of the oldest ages in my sample.

Results from multinomial logistic regression models predicting odds of short (or long), compared to moderate, sleep duration parallel the descriptive statistics' finding of late-life divergence in weekday short-duration sleep between men with less than a high school degree and college-educated men (Table 4.2). (Predicted probabilities of short-duration sleep, calculated from these regression models, are shown in Supplementary Figures 4.2A, 4.2B, 4.2C, and 4.2D of the Appendix.) On weekdays, middle-aged men with less than a high school degree are less likely than college-educated men to experience short-duration sleep, but this difference reverses in direction at the oldest ages in this sample. Additional evidence for late-life divergence in weekday short-duration sleep is observed for men with a high school degree. Compared to their college-educated counterparts, men with a high school degree do not have significantly higher odds of short weekday sleep duration in middle age, but the difference increasingly grows in late adulthood.

Although men's weekday short-duration sleep shows some evidence of divergence, similar patterns are generally not found for women or for men on weekends and holidays (descriptive statistics shown in Figure 4.2B). Indeed, short-duration sleep shows some evidence of convergence for women on weekdays and men on weekends. The difference in odds of weekday short-duration sleep between college-educated women and women with some college education or an associate's degree shows a marginally significant ($p<0.10$) decrease at older ages. The difference between men with a high school education and their college-educated counterparts in the odds of weekend/holiday short-duration sleep increasingly diminishes with age. Thus, patterns of convergence in short-duration sleep are not stronger on weekdays, nor are they clearly more visible among men than women.

Long-Duration Sleep

Figures 4.3A and 4.3B display descriptive statistics for the probability of long-duration sleep on weekdays and weekends, respectively. Although variation in long-duration sleep does not exactly match variation in total sleep duration, long-duration sleep more closely parallels patterns of difference in total sleep duration than short-duration sleep does. Multinomial logistic regression results (Table 4.2) confirm this. (Predicted probabilities of long-duration sleep, derived from the baseline model, are graphed in Supplementary Figures 4.3A, 4.3B, 4.3C, and 4.3D of the Appendix.) For both weekday and weekend/holiday sleep, I find that in middle adulthood, less educated individuals are more likely to sleep for long durations, compared to the college-educated. In general, results suggest that many educational differences in the probability of long-duration sleep converge from middle to late adulthood, with several significant interactions between educational categories and age squared. Contrary to my corollary hypotheses, patterns of convergence in long-duration sleep were not stronger among men (versus women) or on weekdays (compared to weekends and holidays).

Possible Confounding of Education and Sociodemographic Characteristics?

To address the possibility that other sociodemographic characteristics—such as race and ethnicity—confound results, I examine whether controlling for a series of sociodemographic characteristics alters the results presented in Tables 4.1 and 4.2 (results available in Supplementary Tables 4.3 and 4.4 of the Appendix for total and categorical sleep duration measures, respectively). In models that adjust for sociodemographic characteristics, educational differences in total sleep duration in middle adulthood generally decrease in magnitude, suggesting that sociodemographic differences explain a portion of educational differences in sleep duration. Additionally, several interactions between education and age variables diminish in statistical significance in these models. Results from these models are more consistent with the idea that educational differences in sleep duration converge at older ages, compared to the idea that they diverge, with the exceptions for men's weekday short-duration sleep found in baseline models above. Some patterns of convergence become more linear when controlling for sociodemographic characteristics—for instance, having less than a high school degree negatively interacts with age, but not age squared (at least, not statistically significantly so), in predicting women's weekend/holiday total sleep duration.

Do Employment-Related Mechanisms Play a Role?

Employment Schedule and Multiple Job-Holding

Hypothesis 1 centers on the role of employment in generating educational differences in sleep duration. To analyze whether variation in potentially sleep-affecting dimensions of employment contribute to the patterns of sleep duration convergence I observe, I add employment characteristics, in addition to sociodemographic controls, to the main regression models presented above (results available in Supplementary Tables 4.5 and 4.6 of the Appendix). Educational differences in weekday total sleep duration in middle adulthood further diminish in these models. Compared to models including only sociodemographic controls, one of the most substantial changes in this set of models is in the prediction of men's weekday total sleep duration; here, the interaction of age squared with holding less than a high school degree diminishes in magnitude and statistical significance. This result suggests that aspects of employment explain a substantial portion of the accelerating decrease in weekday total sleep duration differences between men with less than a high school degree and those with a college degree.

Retirement

I next examine whether retirement might contribute to late-life convergence in educational sleep duration differences. I run regression models paralleling the main analyses above, interacting education with retirement status instead of with age and age squared (results available in Supplementary Tables 4.7 and 4.8 of the Appendix). Given the collinearity of age and retirement status in my full sample, I restrict the sample for this analysis to individuals aged 60 to 69 years old.

Figure 4.4 shows the predicted difference in total sleep duration between each of the education categories displayed and college-educated respondents, broken down by gender, type of day, and retirement status. No educational differences in total sleep duration are larger among the retired, and many are significantly smaller, particularly for men on weekdays. Educational differences in the odds of weekday long-duration sleep are also smaller among the retired, particularly when comparing college-educated men and women's weekday sleep to that of their counterparts with less than a high school education.

In contrast, for men on weekdays, educational differences in the odds of short-duration sleep are larger in retirement, significantly so for men with less than a high school education, compared to men with a college degree. Retirement status positively interacts with lower levels of education in several other instances in models predicting short-duration sleep, though these interactions do not meet conventional standards of statistical significance. Notably, even in cases where educational differences in the probability of short-duration sleep are larger in retirement, differences between college-educated and less educated respondents never exceed five percentage points.

Supplementary Analysis and Robustness Checks

Cohort-Specific Education Distribution

The probability and meaning of obtaining a particular level of education varies by birth cohort, which might contribute to variation in the association between education and sleep duration by age (given the collinearity of age and birth cohort in my sample). In my sample, the percentage of women with less than a high school education falls from 24.14% in the oldest birth cohort to 7.86% in the youngest birth cohort (the corresponding percentages for men are 24.60% and 8.73%). Conversely, obtaining a college degree is more common in more recent birth cohorts, particularly for women. If the differing meaning and distribution of educational categories across birth cohorts affected my results, we might expect this phenomenon to bias results toward late-life divergence when comparing college-educated to less-educated respondents, given that college education represents a higher relative position in the education distribution of older birth cohorts, compared to more recent ones. In contrast, late-life convergence might be expected for comparisons of respondents with less than a high school degree to more-educated respondents; less than a high school level of education represents a lower relative position in the education distribution of more recent birth cohorts. Thus, changing education distributions might affect my results in a variety of ways.

To address this possibility, in supplementary analysis I use a measure of education that identifies each respondent's position in their 10-year birth cohort's[24] education distribution, broken down by gender. Though I am unable to exactly match distributional break-downs across years, I am roughly able to divide respondents into the bottom 10%, middle 50%, and top 40% of their respective gender-specific, within-cohort education distributions. I use this distributional grouping because I am able to generally approximate it across years, and because it roughly corresponds to the distributional break-down of the following categories in the most recent birth cohort in my sample: less than high school (bottom 10%); high school, some college, or associate's degree (middle 50%); and college or advanced degree[25] (top 40%).

I run regression models paralleling main analyses, using the cohort-specific education percentile measure. Descriptive sleep statistics broken down by this cohort-specific measure are graphed in the Appendix (Supplementary Figures 4.4A, 4.4B, 4.5A, 4.5B, 4.6A, and 4.6B), as are predicted values (for total sleep duration—see Supplementary Figures 4.7A, 4.7B, 4.7C, and 4.7D) and probabilities (for short-duration sleep—Supplementary Figures 4.8A, 4.8B, 4.8C, 4.8D—and long-duration sleep—Supplementary Figures 4.9A, 4.9B, 4.9C, 4.9D).

---

[24] Birth cohorts are approximate—birth year is coded as the year in which the respondent was interviewed minus the respondent's age. The first birth cohort category spans only nine years, given the ages of respondents in my sample.

[25] For women in the most recent birth cohort, 39.24% of my sample has a college or advanced degree. For men, I must include respondents with four years of college education (but no college degree) to approximate the top 40% of the education distribution about this closely.

Evidence for convergence in total and long-duration sleep is weaker in this analysis, though some patterns of convergence are visible, such as for women's long-duration sleep on weekends.

These results do not lead to a clear conclusion regarding whether differences in education distribution by birth cohort produce the patterns I observe in the main models above. Although findings differ between these supplementary models and my main results, the educational break-downs I use only roughly approximate distributional cutoffs, possibly generating noise in my results. In addition, it is possible that the credentials offered by certain discrete educational categories—such as a high school degree—matter just as much (or more) as position within an education distribution for determining sleep duration outcomes (e.g. see discussion in Hayward et al. (2015) regarding the changing importance of credentials for mortality risk). If this were the case, we would not expect to see the same results when using the distributional measure as when using the four-category education variable above.

Age Versus Cohort

To help tease out whether observed patterns of convergence in educational sleep duration differences from middle to late adulthood are due to age (i.e., age-as-leveler perspective) or cohort (i.e., rising importance perspective), I generate supplementary descriptive statistics, restricting my sample to a single 10-year birth cohort, born from 1939 to 1948 (results available Supplementary Figure 4.10 of the Appendix). Though imperfect, limiting analysis to one birth cohort helps control for potential cohort differences in the association between education and sleep duration. Given small cell sizes for older ages in this birth cohort, I restrict this supplementary sample to respondents under 75 years of age and only examine total sleep duration. (Sample sizes for the cases I analyze, broken down by gender, type of diary day, age, and education, are shown in Supplementary Tables 4.9A, 4.9B, 4.9C, and 4.9D of the Appendix.)

Standard errors in regression analyses limited to this cohort were too large to be confident in results (thus, regression results are not presented), and caution should be exercised in interpreting descriptive statistics.

Results suggest that certain patterns of convergence hold when examining this birth cohort. However, convergence is more clearly observed for men, particularly on weekdays. Some trends suggest educational differences in total sleep duration might diverge among women, but it is difficult to discern patterns with certainty given the limited size and age range of this sample. Thus, these results do not produce firm conclusions regarding whether the patterns of convergence I find above are due to changes with age—for instance, per the age-as-leveler hypothesis—or caused by differences between birth cohorts—such as in the rising importance explanation. Still, at the least, results from the 1939-1948 birth cohort provide a small boost in confidence that the observed convergence in men's weekday total sleep duration is related to change over age.

Discussion

This study uses data from the American Time Use Survey to estimate how educational differences in sleep duration vary over age, accounting for possible moderation by gender and day of sleep. In middle adulthood, lower levels of education are associated with longer total sleep duration (in hours) and higher probability of sleeping 10 or more hours, on both weekdays and weekends/holidays. Many of the educational differences in total sleep duration and the probability of long-duration sleep converge at an accelerating rate from middle to late adulthood.

However, analysis of short-duration sleep provides less clear support for the hypothesis that educational differences in sleep duration converge from middle to late adulthood. Consistent with prior findings, the association between education and sleep duration is not entirely linear in my sample. For instance, in middle adulthood, less-educated respondents are more likely to sleep for either long or short durations on weekends/holidays, compared to respondents with a college degree. Results suggest educational differences in the odds of short-duration sleep might diverge in some cases, at the oldest ages in my sample. The finding that patterns of convergence/divergence differ between long and short sleep duration is consistent with research suggesting that long and short sleep durations reflect different dimensions of sleep health (see discussion in Knutson and Turek (2006)). The inconsistency of these results with expectations of late-adulthood convergence in weekday short-duration sleep, derived from Basner et al. (2014), could be due to the fact that I stratified analyses by gender, while Basner et al. (2014) did not. In addition, I operationalized education slightly differently than Basner et al. (2014).

I do not find clear support for the hypothesis that patterns of convergence in educational sleep duration differences are stronger among men than women. However, results do suggest that potentially sleep-affecting aspects of employment are more important for explaining certain patterns of late-adulthood sleep duration convergence among men than among women. In particular, retirement is associated with a more substantial reduction in weekday total sleep duration differences for men than for women. Additionally, results suggest that time spent in employment activities, along with other employment characteristics, play a role in explaining differences in weekday total sleep duration between men with a college degree and men with less than a high school education, but a similar pattern is not observed for women.

In general, I find only limited support for the idea that variation in employment schedules and holding multiple jobs explains a substantial portion of the accelerating decline in educational sleep duration differences at older ages. Still, these results suggest that dimensions of employment play some role in generating certain patterns of convergence in educational sleep duration differences. For men in particular, retirement status might have a greater capacity to explain late-life convergence in educational sleep duration differences than the other employment dimensions examined. Interestingly, I did not find clear support for my corollary expectation that patterns of convergence in educational sleep duration differences from middle to late adulthood would be stronger for weekday, as compared to weekend or holiday, sleep. However, when examining the specific life course stage of retirement, I did find evidence that the reduction of differences in total sleep duration associated with retirement is greater for weekday than weekend/holiday sleep—at least among men.

This analysis suggests that age-related trajectories of sleep duration vary by education. For instance, the association between age and weekday total sleep duration appears to be flatter among respondents with less than a high school education than among more highly-educated respondents. In addition, results suggest that the association of retirement status with sleep duration differs by education. For weekday sleep, the largest increases in total sleep duration associated with retirement status are observed for college-educated respondents. Indeed, for men with less than a high school education, being retired is associated with a decrease in weekday total sleep duration and an increase in the probability of sleeping less than six hours on weekdays. These results help contextualize recent findings regarding post-retirement changes in sleep duration (Hagen et al. 2016), suggesting that these changes might differ by socioeconomic status.

However, given the cross-sectional nature of this analysis, it is difficult to be certain that the effects I find are causal—that is, that the transition to retirement causes educational sleep duration differences to widen or narrow. Health declines are associated with greater likelihood of retirement (Bound et al. 1999), and several measures of poor health are associated with higher probability of both short and long sleep durations (Krueger and Friedman 2009). If retired individuals are more similar in health status than individuals still in the labor force, due to less-healthy individuals selecting into retirement, this might lead educational sleep duration differences to be smaller among the retired.

I find many more cases of convergence, as opposed to divergence, in educational differences in sleep duration from middle to late adulthood. If accumulating educational differences in health status were the only driver of age variation in sleep duration differences by education, we might expect the opposite pattern, when adjusting for selective mortality. However, given my inability to account for selective mortality, my results do not necessarily reject the hypothesis that accumulating educational health disparities account for the patterns I observe. Additionally, health is a multi-dimensional construct, and though disparities in many health outcomes increase with age (Ross and Wu 1996), educational differences in other health dimensions, such as sleep problems (Hunt et al. 1985), might show distinct patterns. A limitation of the present research is its inability to control for health status; though certain ATUS samples include health information, using only those samples would further decrease cell sizes of educational and other categorical combinations, which are already limited by the numerous ways in which I disaggregate analyses (i.e., by gender, type of time diary day, and age).

Another limitation of this research is my inability to analyze sleep quality with ATUS data. The ATUS includes a time diary measure of the number of minutes respondents spent in sleeplessness on the diary day, but this variable captures a limited amount of information related to sleep quality. In supplementary analysis (results not shown), including this measure did not substantially change main results. An additional limitation is that I do not explore heterogeneity in observed sleep duration patterns by race or ethnicity (doing so would further limit cell sizes).

I am furthermore unable to distinguish age from birth cohort. To help address this issue, in supplementary analysis I restrict my sample to one 10-year birth cohort. However, relatively high standard errors (likely related to sample size) limit my ability to make firm conclusions with this restricted sample. Using longitudinal panel data would allow for tracking of a single birth cohort over time; however, I know of no panel studies with sufficient sample size for this analysis that include measurement of sleep duration in both middle and late adulthood.

Limitations notwithstanding, the present study represents a step forward in our understanding of how the social determinants of sleep vary by age. These findings point to the potential importance of retirement as a life course stage at which educational differences in sleep duration shift. The collection of detailed sleep information in longitudinal panel studies of older adults would help ascertain with certainty whether the patterns of sleep duration convergence and divergence I observe among the retired are due to changes brought about by this life course stage. In addition, given that I find age-related variation in associations between education and sleep duration, a potentially fruitful question for future research to explore in greater detail is whether changing educational differences in sleep duration at older ages contribute to, attenuate, or reflect widening disparities in other health outcomes at these ages. Panel study collection of health and sleep information would also help address this question with greater certainty.

Chapter 5: Conclusion

In this dissertation, I situate sleep in a variety of social environments—including distinct policy, family, and life course contexts—to examine how social structures and expectations affect social variation in sleep. I also explore what social variation in sleep reveals about the social dynamics that shape it. Given the likely importance of employment schedules for sleep duration and timing (Basner et al. 2007, 2014; Basner and Dinges 2009), in each of the specific social contexts I study, I view social sleep differences through the lens of employment, paying particular attention to how employment and employment policy might affect gender (Chapters 2 and 3) and socioeconomic (Chapter 4) differences in sleep.

Although my focus is not primarily comparative in the sense of concentrating on cross-national differences, my interest in socially situating sleep leads me to analyze data from four different countries: Canada, Spain, the United Kingdom, and the United States. Studying these distinct countries allows me to examine sleep in specific social contexts with different work-family policies and norms. For example, in Chapter 2, I examine the effects of a dedicated paternity leave policy on gender differences in parents' sleep. In addition to time-use data availability, the presence of a dedicated paternity leave policy in Quebec makes this analysis possible in Canada, whereas many other countries lack dedicated paternity leave policies.

In addition, each country's time use data present unique advantages and disadvantages. For instance, the American Time Use Survey (ATUS) provides a relatively large sample size, allowing me to disaggregate Chapter 4 analyses by multiple sociodemographic characteristics while separating weekday sleep from sleep on weekends and holidays. On the other hand, the Spanish and U.K. surveys available in the Multinational Time Use Study each include fewer contemporary respondents than the ATUS (when considering all surveys since the year 2000) but allow me to examine multiple members of the same household, which is not possible with the ATUS.

To analyze social variation in sleep, each of the empirical chapters in this dissertation (i.e., Chapters 2-4) uses time diaries to construct measures of sleep outcomes. The specific sleep outcomes analyzed differ somewhat between chapters. Chapter 2 examines gender differences in sleep interruption and total sleep duration, whereas Chapter 3 examines wake time and its determinants. Chapter 4 returns to the outcome of sleep duration, modeling both long-duration and short-duration sleep, in addition to total sleep duration. Despite their differences in the exact sleep outcomes examined, each chapter employs time diary measures to connect social context to sleep. Although I am unable to directly observe biological phenomena in the body via time diaries, sleep operates at the intersection of biology and social experience, connecting social activities (such as time spent in paid employment) to sleep-related biological processes.

Overview of Findings

In Chapter 2, I situate gender differences in sleep within a specific policy context. I investigate whether implementation of a new work-family policy in the Canadian province of Quebec affected sleep among parents of young children. Specifically, I examine how mothers' and fathers' sleep changed after the introduction of five weeks of dedicated paternity leave under the Quebec Parental Insurance Plan (QPIP). I find evidence suggesting that fathers' sleep duration increased after QPIP introduction, narrowing gender differences in sleep duration. However, I do not find that fathers' probability of interrupting to sleep to care for children increased after QPIP introduction. If anything, gender differences in sleep interruption might have widened after QPIP was implemented.

In Chapter 3, I situate gender differences in sleep within couples and families by investigating whether the time a person's partner starts working and the time their children start school serve as temporal anchors relative to the time that person wakes up in the morning. I use the term temporal anchors to refer to events that structure the timing of other activities, building on sociological theory regarding time (e.g. Moen et al. 2011) and connecting it to literature on environmental structuring of circadian rhythms, including sleep timing (e.g. Roenneberg, Kumar, and Merrow 2007). In addition, I analyze gender differences in the extent to which a person's own work start time temporally anchors their wake time. In general, evidence supports my hypothesis that own work start time is a stronger predictor of men's wake time, but does not support my hypothesis that partner's work start time is a stronger predictor of women's wake time. I find very limited support for my hypothesis that children's school start time has a larger association with women's wake time. In Spain, children's school start time does predict women's, but not men's, wake time. However, this pattern is reversed in the U.K., and neither of these gender differences in the association between children's school start time and wake time reach statistical significance.

In Chapter 4, I situate educational differences in sleep within the context of the life course. I analyze how educational differences in sleep duration vary over age and investigate whether such variation might be related to retirement. Educational differences in long-duration sleep and total sleep duration sleep generally converge more than diverge from middle to late adulthood, among both men and women. However, results for educational differences in short-duration sleep are more mixed, showing patterns of both convergence and divergence. Results suggest that retirement might play a role in the convergence patterns I do observe, particularly for men's weekday sleep. In addition, although convergence in educational sleep duration differences was observed just as clearly among women as among men, in several cases, employment-related measures did a better job of accounting for educational sleep duration differences among men, consistent with the idea that employment is a more important factor in the production of men's educational differences in sleep duration.

Limitations

Time-Diary Measurement of Sleep

Although each chapter of this dissertation analyzes a different dataset, all chapters use time diaries that run over a 24-hour period. In each dataset analyzed, the time diaries start early in the morning—before, presumably, most respondents have woken up—and end 24 hours later—after, presumably, most respondents have gone to sleep. (With the exception of Spain, all time diaries begin and end at 4:00 a.m.) Because of this design, time diaries do not capture one full night of sleep, but rather the amount of sleep an individual obtains in one 24-hour period. This design limits my ability to measure certain aspects of sleep. For instance, in the Chapter 3 analysis of wake time, I cannot analyze how bed times on one weekday evening associate with wake times the following weekday morning, because I only observe bed times that occur after wake times, on the same diary day (unless a respondent has an irregular sleep schedule). Collection of time diaries over multiple, consecutive weekdays and weekend days would help scholars observe full nights of sleep, as opposed to one morning and one evening of sleep.

Unfortunately, in the surveys I analyze, time diaries are collected on one day only (or one weekday only, in the case of the U.K.). Sleep duration can vary a great deal from day to day (Knutson et al. 2007), suggesting that the single-day time diary measures I analyze present only a portion of the full picture regarding social variation in sleep. For example, in Chapter 4 I find that middle-aged men with some college education or an associate's degree are more likely to obtain both short and long sleep durations, compared to their college-educated counterparts. With multiple days of time diaries, I could examine whether these differences exist because these men consistently sleep for only short or only long durations every day—or because these men are more likely to move back and forth between short and long sleep durations from day to day. Indeed, analysis of Belgian (specifically, Flemish) time use data suggests that work hours and education levels are associated with degree of sleep schedule regularity across days (van Tienoven, Glorieux, and Minnen 2014). Thus, large-scale samples of U.S. time diaries collected across multiple, consecutive days would not only help scholars observe full nights of sleep, but would also allow us to test whether similar findings regarding sleep schedule regularity are observed in the U.S. context.

Several time diary studies, such as the ATUS, collect information on who respondents are with when they complete certain activities, but do not collect this information for times when the respondents are sleeping. Information about where and with whom people sleep would be particularly helpful for studying sleep within family contexts. For example, it might be interesting to examine whether the effects of dedicated paternity leave on parents' sleep interruption (Chapter 2) differ between parents who sleep in the same room as their young children and parents who do not. Future time diaries might collect such contextual information to help socially situate sleep.

Prior research suggests that time diaries overestimate sleep duration (Basner et al. 2014; Knutson et al. 2010). Time diaries might also fail to capture certain forms of sleep interruption (Lichstein et al. 2006). Nevertheless, the benefits of time diaries outweigh their disadvantages in the particular contexts I study. Sleep duration measures derived from logs or diaries likely produce more accurate estimates of sleep than stylized, self-reported measures of sleep duration (Lauderdale 2015; Lauderdale et al. 2008, 2016; Miller et al. 2015). In addition, compared to more intensive measurement procedures such as actigraphy or polysomnography, time diaries facilitate larger sample sizes. Larger samples can be particularly advantageous in analysis of specific combinations of social characteristics. For instance, in Chapter 4 I break down sleep duration by multiple sociodemographic characteristics, necessitating sample sizes large enough to ensure sufficient cases in each combination of gender, education, and age I examine. Furthermore, as discussed in the introduction to this dissertation, daily time diaries allow me to contextualize sleep with regard to non-sleep activities, such as work—something that's more difficult with actigraphy, polysomnography, or diaries that focus on sleep outcomes alone.

Same-Sex Couples

In my examination of gender differences in sleep among partnered men and women, I focus on different-sex couples. In Chapters 2 and 3, my ability to examine same-sex couples is limited by the relatively small number of respondents in same-sex partnerships in the samples I analyze. Regarding Chapter 2's focus, it would be interesting to analyze whether QPIP's effects on sleep differ between parents in same-sex and different-sex couples, but a larger number of same-sex couples would be necessary in order to carry out this analysis. Regarding Chapter 3, if gendered expectations (e.g. see discussion in Burgard (2011)) produce sleep differences between men and women, then we might expect partners' sleep differences to be smaller among same-sex couples. Analysis testing this expectation would also benefit from samples that include a larger number of same-sex couples. Future time diary collection efforts might oversample same-sex couples to enhance researchers' ability to study these families.

Race and Ethnicity

The present dissertation focuses on gender and, to a lesser extent, socioeconomic variation in sleep. However, prior research has also found racial and ethnic differences in various aspects of sleep, such as duration (Basner et al. 2014) and efficiency (Lauderdale et al. 2006). Moreover, employment might play a role in shaping sleep differences by race and ethnicity. For example, prior research suggests that work schedule differences explain a portion of racial and ethnic disparities in sleep duration among a sample of U.S. health care workers (Ertel, Berkman, and Buxton 2011). Future research could build on analyses contained in this dissertation to potentially enhance understanding of how employment contributes to racial and ethnic differences in sleep. In particular, future study might parallel Chapter 4's analysis of how social differences in sleep vary over age, replacing education with race and ethnicity to examine how racial and ethnic differences in sleep vary over the life course.

In addition, future research might examine whether race and ethnicity moderate some of the sleep differences I find, particularly with regard to educational differences in sleep duration. In Chapter 4's analysis, I am limited in my ability to examine such moderation. Although I have a relatively large sample size, I disaggregate analyses by gender, type of day (i.e., weekday versus weekends and holidays), education, and age. Further breaking down results by race and ethnicity would lead to restricted cell sizes—that is, small numbers of cases reflecting each combination of gender, type of day, education, age and race or ethnicity. Future research might investigate whether alternative sources of sleep data have sufficient sample sizes to accommodate this type of analysis.

Discussion

This research uses a focus on employment to connect the study of sleep to literatures surrounding health and health disparities, social policy, and gendered divisions of labor and time use. I address each one of these research areas in the discussion of my findings below. However, I first begin this section with a discussion of what my findings reveal about the connections between employment and sleep. I end this section with a broader discussion regarding the social study of sleep.

The Role of Employment in Producing Sleep Variation

Taken together, the findings in this dissertation suggest that employment shapes social variation in sleep. As a corollary, findings also provide support for the idea that employment schedules are an important determinant of sleep outcomes. These findings align with prior research showing that people who spend more time sleeping spend less time in paid employment (Basner et al. 2007, 2014) and that earlier work start times are associated with shorter sleep durations (Basner et al. 2014).

However, employment might be a stronger determinant of some sleep outcomes than others. Support for the idea that employment and employment policy shape sleep outcomes was greatest in analysis of sleep duration and wake time. In contrast, evidence was relatively less clear that employment policy affected sleep interruption among parents of young children. It is possible that the structure of sleep timing is more responsive to changes in employment schedules and policies, whereas sleep-interrupting care provision might be more responsive to changes in societal expectations regarding parenthood and gendered responsibilities during the "fourth shift" (Venn et al. 2008).

My findings reveal how employment likely plays a role in shaping gender and socioeconomic sleep differences in particular. For example, in Chapter 4 I find that among men aged 60-69 years old in the United States, educational differences in total sleep duration on weekdays are smaller among those who are retired. This result suggests that in the contemporary U.S. context of a "bifurcated" labor market (Jacobs and Gerson 2004), educational differences in temporal employment dimensions might contribute to educational differences in sleep.

Each chapter of this dissertation examines particular facets of employment schedules—for example, Chapter 3 examines the time of day that people start working, and Chapter 4 examines the amount of time people spend working, among other employment aspects. Although outside the scope of the present study, such employment dimensions are likely shaped by the occupations people hold. Thus, future research might more explicitly examine how occupation affects some of my findings, given that occupation could structure many of the employment dimensions I study.

Health Implications

Sleep is connected to a wide range of health outcomes (Cappuccio et al. 2010; Grandner, Hale, et al. 2010; Knutson 2013; Shankar et al. 2011). However, as discussed in Chapter 1, health implications might be more obvious for some aspects of sleep than others. For instance, short sleep duration is associated with poorer health outcomes (Grandner, Hale, et al. 2010), whereas it is not immediately apparent whether a five-minute change in wake time would have deleterious effects on health. For this reason, frequently in this dissertation I refer to social variation in sleep using that phrase or the term "sleep differences," as opposed to "sleep disparities" or "sleep inequalities"—because it is not fully obvious whether certain differences in sleep represent true inequalities—or just differences. In addition, as covered in Chapter 1, even in the case of sleep duration, it is not entirely clear to what extent non-optimal sleep durations (especially long sleep duration) cause or merely reflect poor health (Hale et al. 2007; Knutson and Leproult 2010).

Due to such varied and multi-directional relationships between sleep and health, it is difficult to draw definitive, overarching conclusions regarding the implications of my results for population health or health disparities. Many implications of my results would depend on the specific sleep context under examination. For example, if, as suggested by my Chapter 2 results, dedicated paternity leave introduction was associated with a roughly one-hour increase in Quebecois fathers' sleep duration, this sleep increase would likely have more beneficial effects for fathers who otherwise would have obtained short amounts of sleep than for fathers who would have otherwise slept eight hours.

Nevertheless, several results lay informative groundwork for future research to offer more definitive conclusions regarding connections between employment, sleep, and health. For example, Chapter 4 shows that educational differences in sleep duration vary over age. This finding highlights the potential importance of examining how connections between socioeconomic health disparities and sleep vary over the life course. In addition, perhaps the most overarching conclusion that can be drawn from the present research is support for the existing idea that employment hours and schedules matter for social variation in sleep, as discussed above. A recent review by Knutson (2013) on social differences in "sleep deficiency" calls for additional research examining the mechanisms producing disparities in this outcome (p. 7). My findings lend weight to the idea that such research would do well to consider the possible role of employment in generating connections between sleep, health, and social inequalities.

Policy Implications

This research contributes to a growing body of literature showing that work-related policies can affect sleep (e.g. Moen, Fan, and Kelly 2013; Olson et al. 2015). Much of the existing literature in this area focuses on the organizational level, examining policies within specific workplaces, as opposed to more macro-level social policy—for instance, at the state or national level. In Chapter 2, I find evidence consistent with the idea that macro-level social policies—in this case, dedicated paternity leave—have the capacity to affect sleep. Several contemporary U.S. proposals to change employment policy—for instance, to provide paid family leave or raise the minimum wage—might provide fertile ground for studying how employment and employment policy affect sleep.

In addition, Chapter 3 demonstrates the importance of socially situating sleep in the family context when considering possible effects of policies on sleep. A recent study by McHale et al. (2015) shows a workplace intervention that increased employees' control over their work schedules and locations (among several other changes) (Kelly et al. 2014) also improved the sleep of employees' children. Looking at how children's daily schedules might affect parents' sleep, results from Chapter 3 provide suggestive support for the idea that children's school start times affect some parents' wake times. Future research regarding the effects of school start times on sleep might pay greater attention to how delayed school start times impact parents' sleep.

Gendered Divisions of Labor and Time Use

Overall, results provide mixed evidence for the idea that the gender revolution is "stalled" (Hochschild 1989) with regard to gendered organization of time. For example, consistent with a narrative of enduring gender differences, I find that own work start time is a better predictor of wake time for men than women. However, contrary to this narrative, partner's work start time is generally not a better predictor of wake time for women than men. The question remains as to how results might change when studying countries with different labor-market, employment-schedule, and gender-norm contexts.

Connecting a focus on gendered divisions of labor to the discussion of policy implications, this research contributes to scholarly understanding of whether parental leave policies—dedicated paternity leave policies in particular—shift gender differences in the time use and division of labor between family members. My results suggest that fathers' probability of sleep interruption for childcare did not increase after introduction of dedicated paternity leave. However, as discussed in Chapter 2, this result could be related to the specific context in which I examine parental leave, a context in which mothers still take substantially longer leaves (Patnaik 2016).

In addition to empirical results regarding gender differences in time use, this study contributes to the theoretical toolkit of time use research, including research at the intersection of work and family. The concept of temporal anchors, introduced in Chapter 3, could be used in future studies of how family members, more extended social networks, institutions, and policies structure our schedules. Although I study temporal anchors within the context of daily schedules, the concept could apply to any time horizon at which we might expect one event to affect the timing of another.

It is important to contextualize my findings regarding gender differences in sleep and employment within the broader time use context, as sleep and employment are only two of the many activities that comprise daily schedules. Of particular interest, research has also found gender differences in housework, childcare, and leisure time. On average, women spend more time than men in housework and childcare, and this pattern has been found in all of the countries studied in this dissertation: Canada (Hook 2010; Sayer, Gauthier, and Furstenberg 2004), Spain (Gonalons-Pons 2015; Gutiérrez-Doménech 2010), the U.K. (Gimenez-Nadal and Molina 2013; Hook 2010), and the U.S. (Bianchi et al. 2012, 2000). In addition, research has found that men dedicate more time to leisure activities (Burgard and Ailshire 2013; Gimenez-Nadal and Sevilla-Sanz 2011; Nomaguchi and Bianchi 2004). Burgard and Ailshire (2013) note that in their U.S. sample, although women spend more time sleeping at several stages in the life course, men spend more time in leisure at all life course stages (p. 65).

In addition, it is important to recognize possible within-gender heterogeneity in time use. For example, Passias, Sayer, and Pepin (2016) find that the quality of mothers' leisure time varies by marital status. In Chapter 4, I examine within-gender heterogeneity in sleep by education and age. In other chapters, I focus primarily on between-gender differences in sleep. Future research might pay further attention to within-gender sleep heterogeneity and its connections to employment—for example, heterogeneity in the effects of dedicated paternity leave on fathers' sleep.

Sleep as a Bio-Social Phenomenon

In this dissertation, I argue for the importance of socially situating sleep, contributing to a growing literature challenging individualistic conceptions of sleep (e.g. Troxel 2010). In my three empirical chapters, I link sleep to specific policy contexts, social institutions, and family relationships, and find support for the idea that examining the social context of sleep enhances understanding of sleep variation. In particular, my findings point to the importance of employment and employment policy for shaping social variation in sleep.

Given sleep's connection to biology, my results also contribute to evidence regarding the potential for social structures and relationships to affect biological processes and rhythms. Unfortunately, many of the data sources I analyze contain limited direct measures of biology or health. I plan to more explicitly analyze how sleep might connect social experiences to biology and health in future research.

At the same time, this dissertation's findings show how sleep is a social activity that deserves to be studied in its own right—aside from its direct impact on biology or health implications (even though these are also quite important). For example, women's higher rates of sleep interruption for care work (Chapter 2) represent an important dimension of gendered household labor divisions. How partners affect each other's wake time (Chapter 3) informs our understanding of household schedule setting and negotiation. And educational differences in sleep duration (Chapter 4) comprise one form of socioeconomic differences in time use. Social scientists, then, should do more to incorporate sleep into our study of social life.

Tables and Figures

Figure 1.1 Conceptual Model of Sleep as a Bio-Social Phenomenon

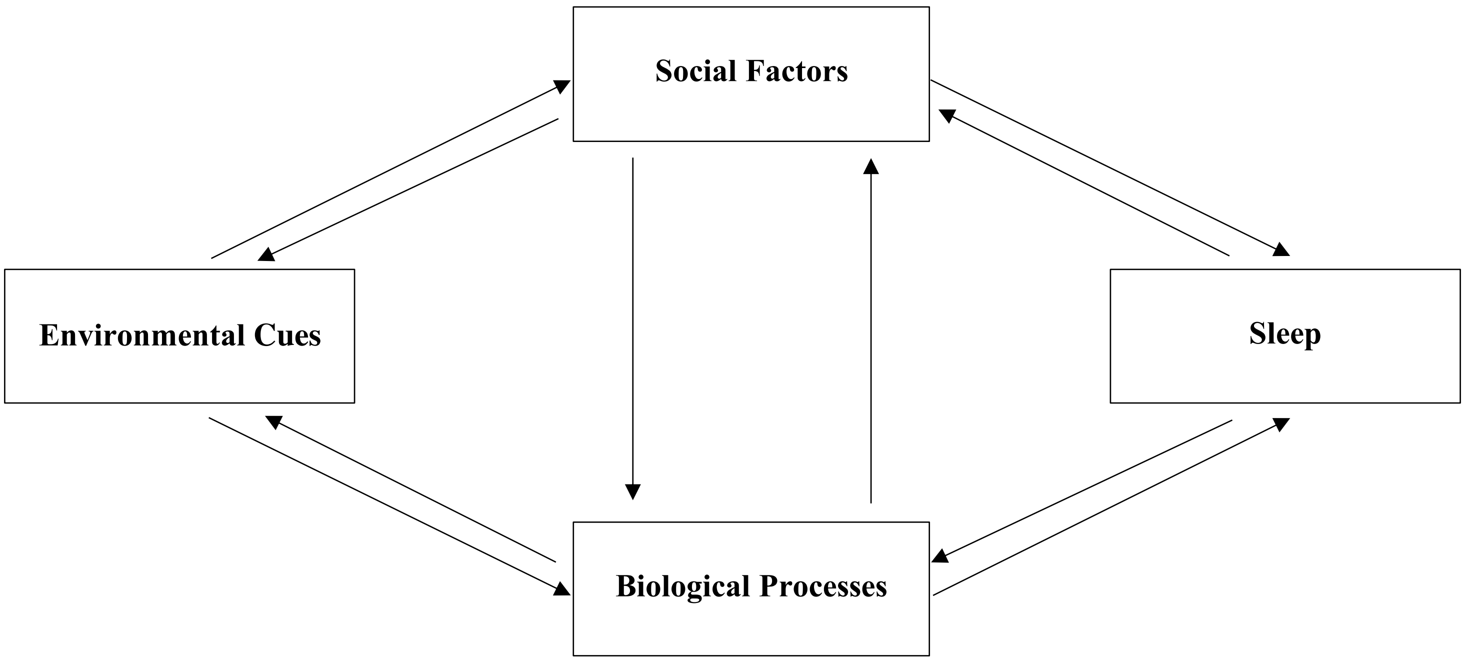
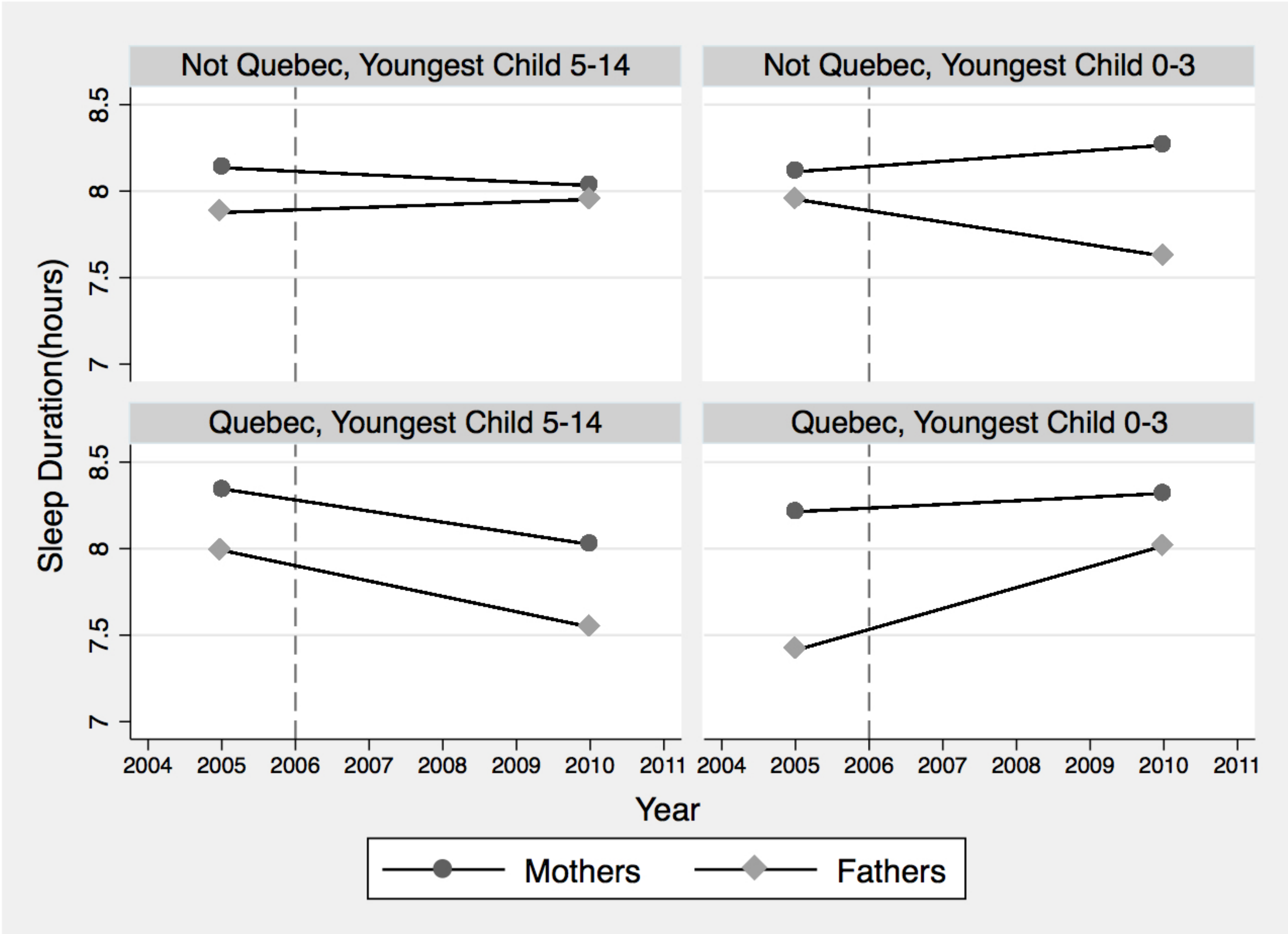


Table 2.1 Descriptive Statistics of Independent Variables for Partnered Parents Whose Youngest Child Is Zero-to-Three Years Old, by Province, Year, and Gender

	Non-Quebec Provinces				Quebec			
	2005		2010		2005		2010	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Age category (%)								
18-29 years old	28.7**	20.0	29.1**	20.0	35.1	26.7	36.8**	19.5
30-34 years old	37.5*	31.8	35.7	32.6	35.9	28.2	30.5	35.1
35-39 years old	25.3	27.5	27.9	29.2	21.5†	30.6	27.2	29.6
40 years old or more	8.4***	20.7	7.3***	18.3	7.4†	14.5	5.5*	15.8
Married (%)	89.8	89.1	86.7	84.7	45.9	48.7	45.3	49.2
Born outside of Canada (%)	25.3	24.0	28.5	23.8	15.8	17.1	15.3	24.9
> one child in household (%)	60.3	63.0	60.1	62.8	50.0*	63.8	62.1	58.8
Weekend diary day (%)	28.8	27.9	23.0†	29.3	24.2	34.0	29.5	35.3
Holds a college degree (%)	38.9	35.9	43.3*	34.7	33.9	27.6	38.9	40.4
Reports a disability (%)	21.2	19.9	25.0	24.9	30.5**	14.1	26.6*	12.4
Employment hours (on diary day)[a]	2.5***	6.7	2.5***	6.5	2.3***	7.0	2.9**	5.6
	(4.6)	(5.3)	(3.8)	(4.4)	(3.7)	(4.4)	(3.0)	(3.5)
Napped on diary day (%)	12.5***	6.0	9.2**	4.2	14.2**	4.5	7.8*	1.6
N	527	514	482	418	147	94	99	80

†p<.10; * p<.05; ** p<.01; *** p<.001 (refers to gender difference within year and province category)
Source: Statistics Canada General Social Survey, 2005 and 2010.
Note: Standard deviations in parentheses.
[a] Difference-in-difference has p=0.11, the lowest difference-in-difference p-value of this table. This represents the difference between Quebec and non-Quebec provinces in the difference between 2005 and 2010 in gender difference.

Figure 2.1 Partnered Mothers' and Fathers' Average Sleep Duration by Province, Year, and Youngest Child's Age



Source: Statistics Canada General Social Survey, 2005 and 2010.
Note: Results based on weighted data. N=2,548 for Not Quebec, Youngest Child 5-14; N=1,941 for Not Quebec, Youngest Child 0-3; N=491 for Quebec, Youngest Child 5-14; and N=420 for Quebec, Youngest Child 0-3.

Table 2.2 Coefficients from OLS Regression Models Predicting Partnered Mothers' Essential Sleep Duration

	Difference in Difference			Triple Difference		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Quebec x 2010	-0.06	0.01	0.10	-0.20	-0.15	-0.12
	(0.29)	(0.29)	(0.29)	(0.24)	(0.23)	(0.23)
Quebec	0.04	0.03	-0.07	0.15	0.14	0.12
	(0.19)	(0.19)	(0.19)	(0.15)	(0.14)	(0.14)
2010	0.18	0.17	0.18	-0.10	-0.11	-0.11
	(0.12)	(0.12)	(0.11)	(0.10)	(0.10)	(0.10)
Quebec x 2010 x Youngest Child 0-3				0.10	0.14	0.19
				(0.37)	(0.37)	(0.37)
Youngest Child 0-3 Years Old				-0.11	-0.20†	-0.08
				(0.12)	(0.12)	(0.12)
Quebec x Youngest Child 0-3				-0.09	-0.12	-0.17
				(0.20)	(0.20)	(0.19)
2010 x Youngest Child 0-3				0.29†	0.28†	0.29†
				(0.16)	(0.15)	(0.15)
Employment hours (on diary day)		-0.08***	-0.11***		-0.09***	-0.10***
		(0.01)	(0.01)		(0.01)	(0.01)
Napped			-0.43*			-0.32*
			(0.19)			(0.14)
Sleep interruption			-0.94***			-0.87***
			(0.16)			(0.15)
Constant	8.09***	8.38***	8.78***	8.08***	8.59***	8.72***
	(0.24)	(0.24)	(0.24)	(0.17)	(0.18)	(0.18)
N	1,255	1,255	1,255	2,986	2,986	2,986
R-squared	.07	.10	.14	.06	.10	.12

†p<.10; * p<.05; ** p<.01; *** p<.001

Source: Statistics Canada General Social Survey, 2005 and 2010. Note: Standard errors in parentheses, calculated using bootstrap replicate weights. Models control for province, whether the diary day was on a weekend, whether the respondent was born outside of Canada, the respondent's age (a categorical measure), whether more than one child lives in the household, marital status, whether the respondent holds a college degree, and whether the respondent has a disability.

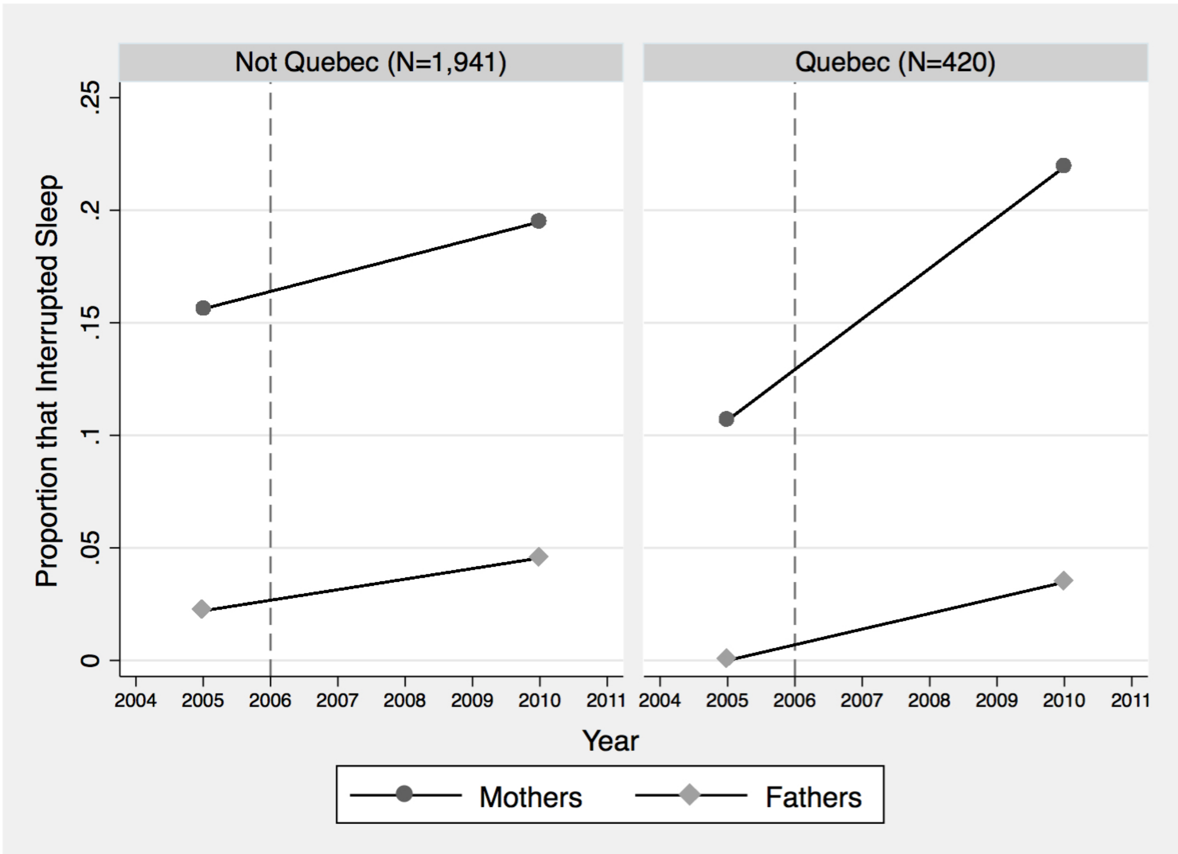
Table 2.3 Coefficients from OLS Regression Models Predicting Partnered Fathers' Essential Sleep Duration

	Difference in Difference			Triple Difference		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Quebec x 2010	0.93**	0.75**	0.73**	-0.44	-0.23	-0.20
	(0.29)	(0.27)	(0.27)	(0.32)	(0.31)	(0.30)
Quebec	-0.53*	-0.38†	-0.40†	0.13	0.03	0.03
	(0.23)	(0.23)	(0.23)	(0.17)	(0.16)	(0.16)
2010	-0.33*	-0.36*	-0.37*	-0.01	-0.13	-0.17
	(0.16)	(0.15)	(0.15)	(0.13)	(0.13)	(0.13)
Quebec x 2010 x Youngest Child 0-3				1.37**	1.00*	0.95*
				(0.44)	(0.42)	(0.41)
Youngest Child 0-3 Years Old				-0.13	-0.14	-0.14
				(0.14)	(0.14)	(0.13)
Quebec x Youngest Child 0-3				-0.80**	-0.59*	-0.60*
				(0.27)	(0.25)	(0.26)
2010 x Youngest Child 0-3				-0.34†	-0.24	-0.21
				(0.20)	(0.19)	(0.19)
Employment hours (on diary day)		-0.16***	-0.17***		-0.14***	-0.14***
		(0.02)	(0.02)		(0.01)	(0.01)
Napped			-0.86**			-0.85**
			(0.32)			(0.31)
Sleep interruption to Provide Care			-0.10			-0.11
			(0.32)			(0.32)
Constant	7.51***	8.88***	8.99***	7.89***	9.07***	9.15***
	(0.25)	(0.30)	(0.30)	(0.17)	(0.20)	(0.20)
N	1,106	1,106	1,106	2,414	2,414	2,414
R-squared	.06	.19	.20	.06	.17	.17

†p<.10; * p<.05; ** p<.01; *** p<.001

Source: Statistics Canada General Social Survey, 2005 and 2010. Note: Standard errors in parentheses, calculated using bootstrap replicate weights. Models control for province, whether the diary day was on a weekend, whether the respondent was born outside of Canada, the respondent's age (a categorical measure), whether more than one child lives in the household, marital status, whether the respondent holds a college degree, and whether the respondent has a disability.

Figure 2.2 Proportion of Partnered Parents with Youngest Child Zero-to-Three Years Old that Interrupted Sleep to Care for Child on Diary Day, by Province and Year



Source: Statistics Canada General Social Survey, 2005 and 2010.
Note: Results based on weighted data.

Table 2.4 Coefficients from Linear Probability Models Predicting Probability of Interrupting Sleep to Provide Child Care among Partnered Parents Whose Youngest Child Is Zero-to-Three Years Old

	Fathers			Mothers		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Quebec x 2010	0.01	0.01	0.01	0.09	0.10†	0.10†
	(0.02)	(0.02)	(0.02)	(0.06)	(0.05)	(0.05)
Quebec	-0.04*	-0.04*	-0.04*	-0.10*	-0.10**	-0.10**
	(0.01)	(0.01)	(0.02)	(0.04)	(0.04)	(0.04)
2010	0.02†	0.02†	0.02†	0.03	0.03	0.03
	(0.01)	(0.01)	(0.01)	(0.03)	(0.03)	(0.03)
Employment hours (on diary day)		0.00	0.00		-0.02***	-0.02***
		(0.00)	(0.00)		(0.00)	(0.00)
Napped			-0.01			0.09*
			(0.02)			(0.05)
Constant	0.05*	0.06*	0.06*	0.27***	0.33***	0.31***
	(0.02)	(0.02)	(0.02)	(0.05)	(0.05)	(0.05)
N	1,106	1,106	1,106	1,255	1,255	1,255
R-squared	.02	.02	.02	.04	.08	.08

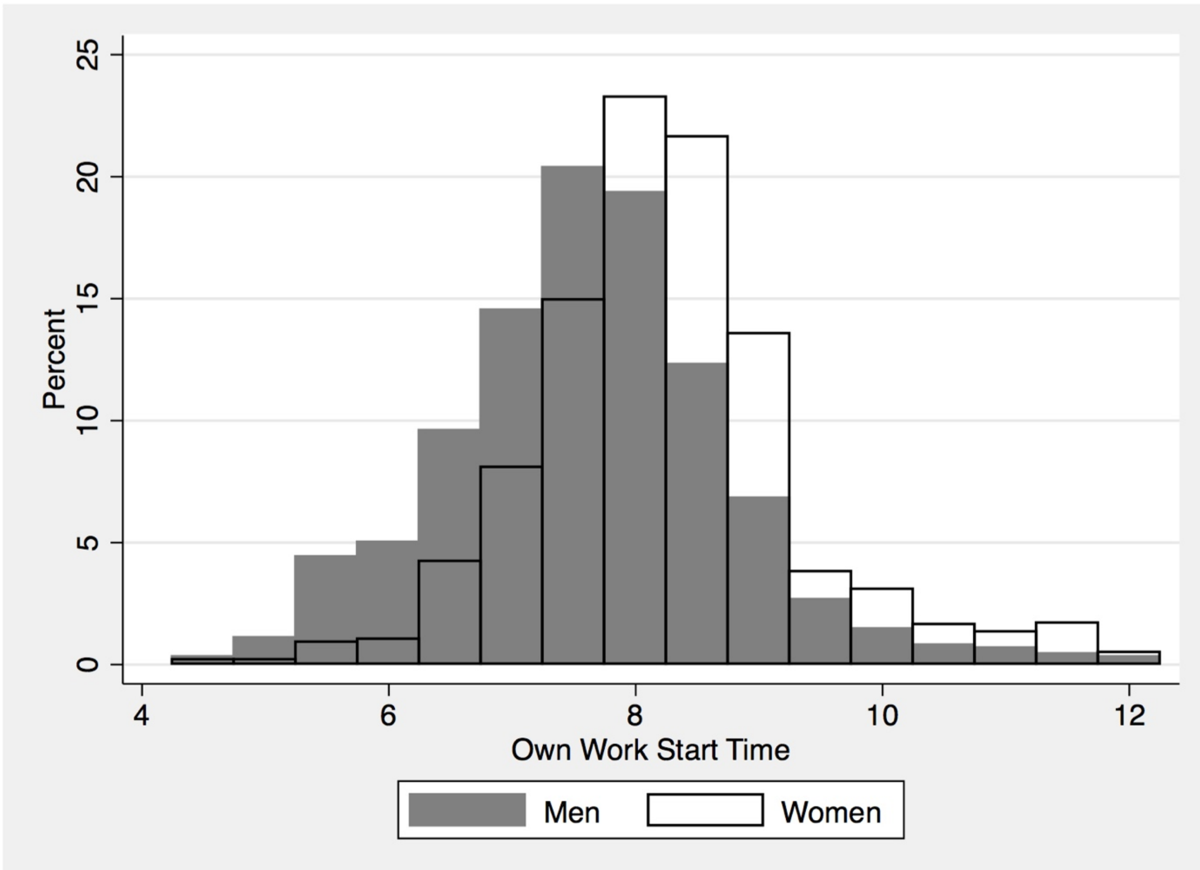
†p<.10; * p<.05; ** p<.01; *** p<.001
Source: Statistics Canada General Social Survey, 2005 and 2010.
Note: Standard errors in parentheses, calculated using bootstrap replicate weights. Models control for province, whether the diary day was on a weekend, whether the respondent was born outside of Canada, the respondent's age (a categorical measure), whether more than one child lives in the household, marital status, whether the respondent holds a college degree, and whether the respondent has a disability.

Table 3.1 Descriptive Statistics for Wake Time, Work Start Time, Sociodemographic Characteristics, and Interview Timing in the United Kingdom, by Gender

	Men	Women	Difference (Men - Women)	
Panel A: Individual-Level Variables				
Own Wake Time (clock time)	6:38	6:46	-0:08	***
(SD in minutes)	(50.3)	(42.2)		
Own Work Start Time (clock time)	7:38	8:14	-0:36	***
(SD in minutes)	(62.8)	(61.8)		
Started Work First (%)	62.3	29.5	32.8	***
Work Hours (in hours)	9.4	7.8	1.6	***
(SD in hours)	(2.0)	(2.4)		
Age (in years)	42.9	40.9	2.0	***
	(9.3)	(9.4)		
Education (%)				
Less than Secondary	20.2	16.3	3.8	**
Secondary	36.6	36.3	0.3	
Post-Secondary	43.3	47.4	-4.1	**
N	1,179	1,179		
Panel B: Couple-Level Variables				
Presence of Household Children (%)				
Young Children	16.8			
Older Children	33.1			
Childless	50.1			
Interview Year (%)				
2000-2001	59.8			
2014-2015	40.2			
Interview Season (%)				
Winter	22.6			
Spring	22.6			
Summer	28.2			
Fall	26.5			
Interview Day (%)				
Monday	18.1			
Tuesday	20.7			
Wednesday	20.4			
Thursday	20.1			
Friday	20.7			
N	2,358			

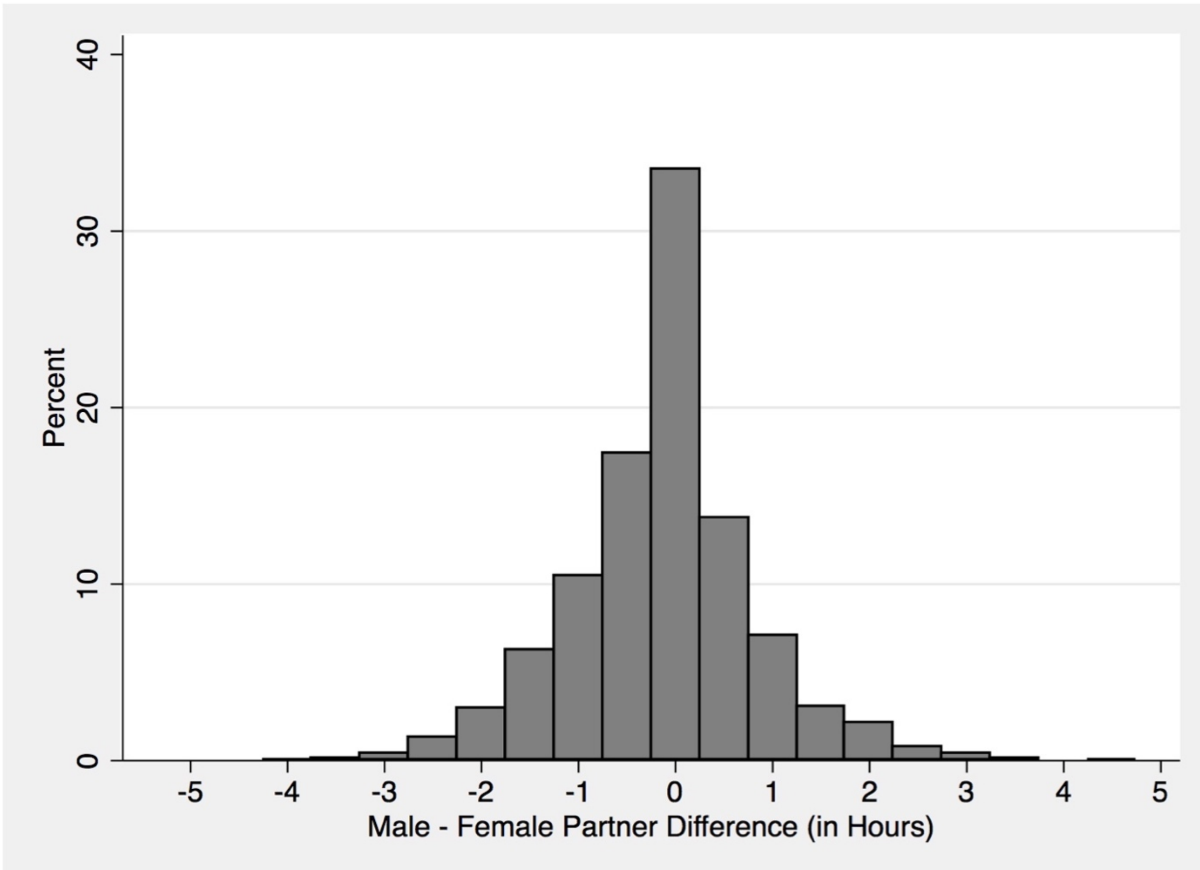
†p<.10; * p<.05; ** p<.01; *** p<.001. Source: Multinational Time Use Study, 2000-2001 and 2014-2015. Note: MTUS probability weights used in calculating descriptive statistics for individual-level variables. SD = standard deviation. Standard deviations provided in parentheses for continuous variables.

Figure 3.1 Histogram of Own Work Start Time among Respondents in the United Kingdom, by Gender



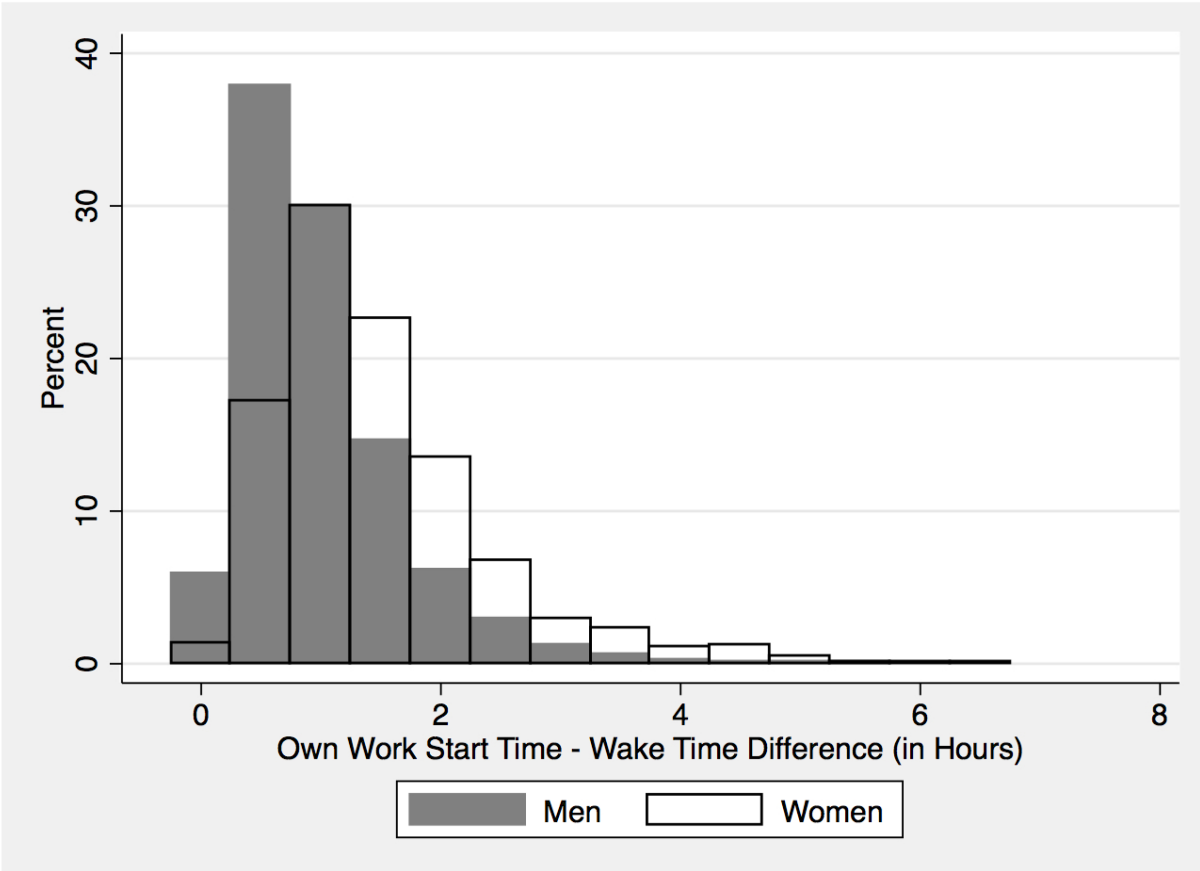
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: These statistics are not weighted.

Figure 3.2 Histogram of the Difference (Male - Female) in Wake Time between Partners in the United Kingdom



Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: These statistics are not weighted. The x-axis represents the male partner's wake time minus the female partner's wake time. In couples to the left of 0, the male partner woke up earlier than the female partner, and in couples to the right of 0, the female partner woke up earlier than the male partner.

Figure 3.3 Histogram of the Difference between Own Work Start Time and Wake Time among Respondents in the United Kingdom, by Gender



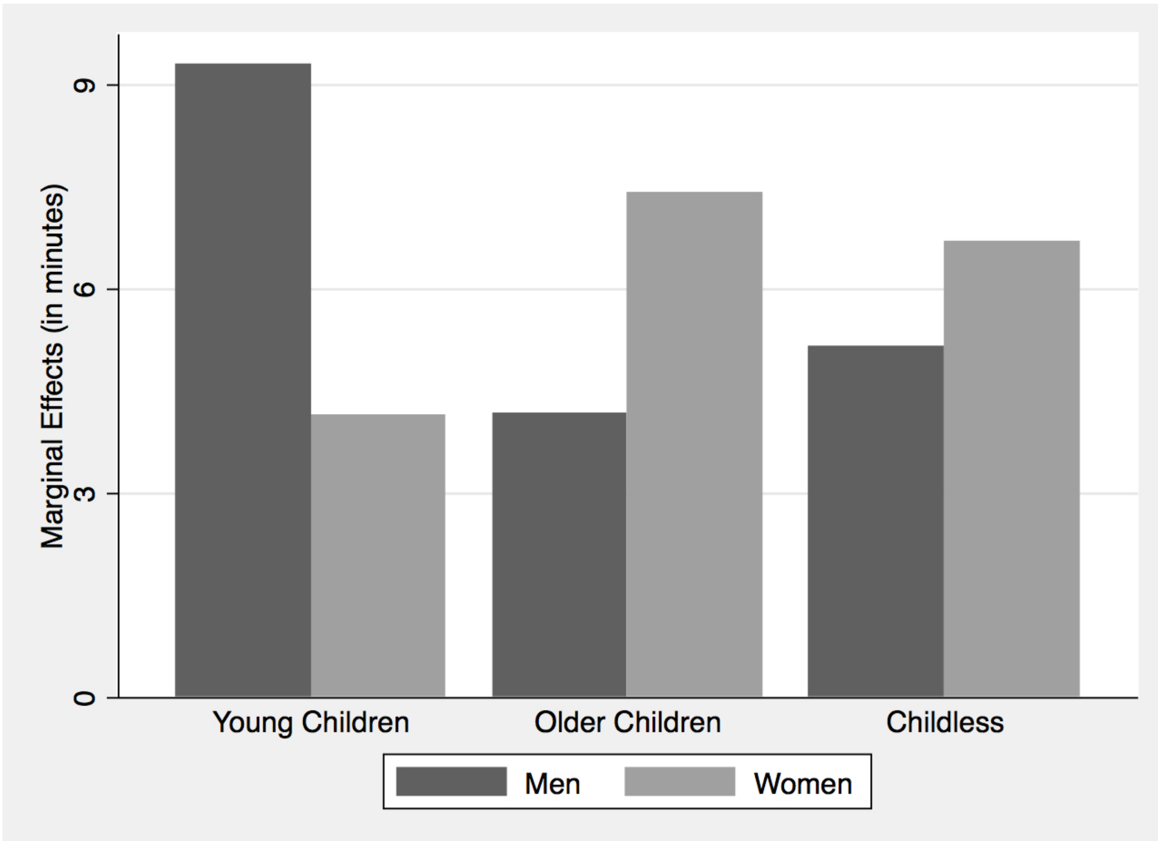
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: These statistics are not weighted. The x-axis represents own work start time minus own wake time.

Table 3.2 Mixed-Effects Regression Coefficients Predicting Wake Time among Working-Age, Partnered Adults in the United Kingdom

	Model 1			Model 2		
	Men (N=1,179)	Women (N=1,179)	Difference	Men (N=1,179)	Women (N=1,179)	Difference
Own Work Start Time (in minutes)	36.25***	21.31***	14.94***	37.66***	22.71***	14.95***
	(0.81)	(0.96)	(1.25)	(0.83)	(0.98)	(1.30)
Partner's Work Start Time (in minutes)				5.58***	6.78***	-1.20
				(0.88)	(0.93)	(1.28)
Constant (in clock time)	6:52***	6:41***	0:11***	6:51***	6:42***	0:09***
	(0:03)	(0:03)	(0:01)	(0:03)	(0:03)	(0:01)

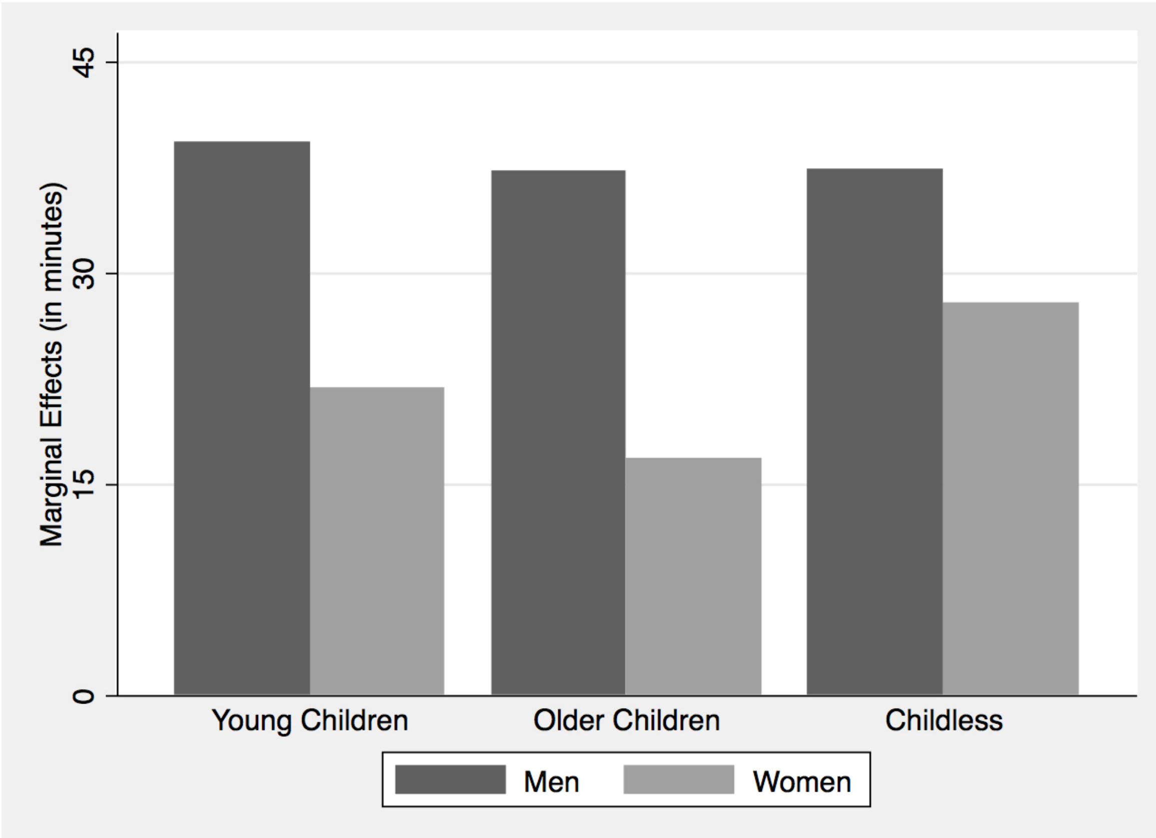
†p<.10; * p<.05; ** p<.01; *** p<.001.
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: Difference represents men's minus women's coefficients. Standard errors in parentheses. Models include covariates for presence of household children, education, age, and age squared, as well as year, season, and day of interview. Partner's and own work start times are centered at the average within each country. Models include a random effect for each couple. Men and women were included in the same regression models, but coefficients are separated by gender to enhance interpretability.

Figure 3.4 Marginal Effects of Partner's Work Start Time on Wake Time in the United Kingdom, by Presence of Household Children and Gender



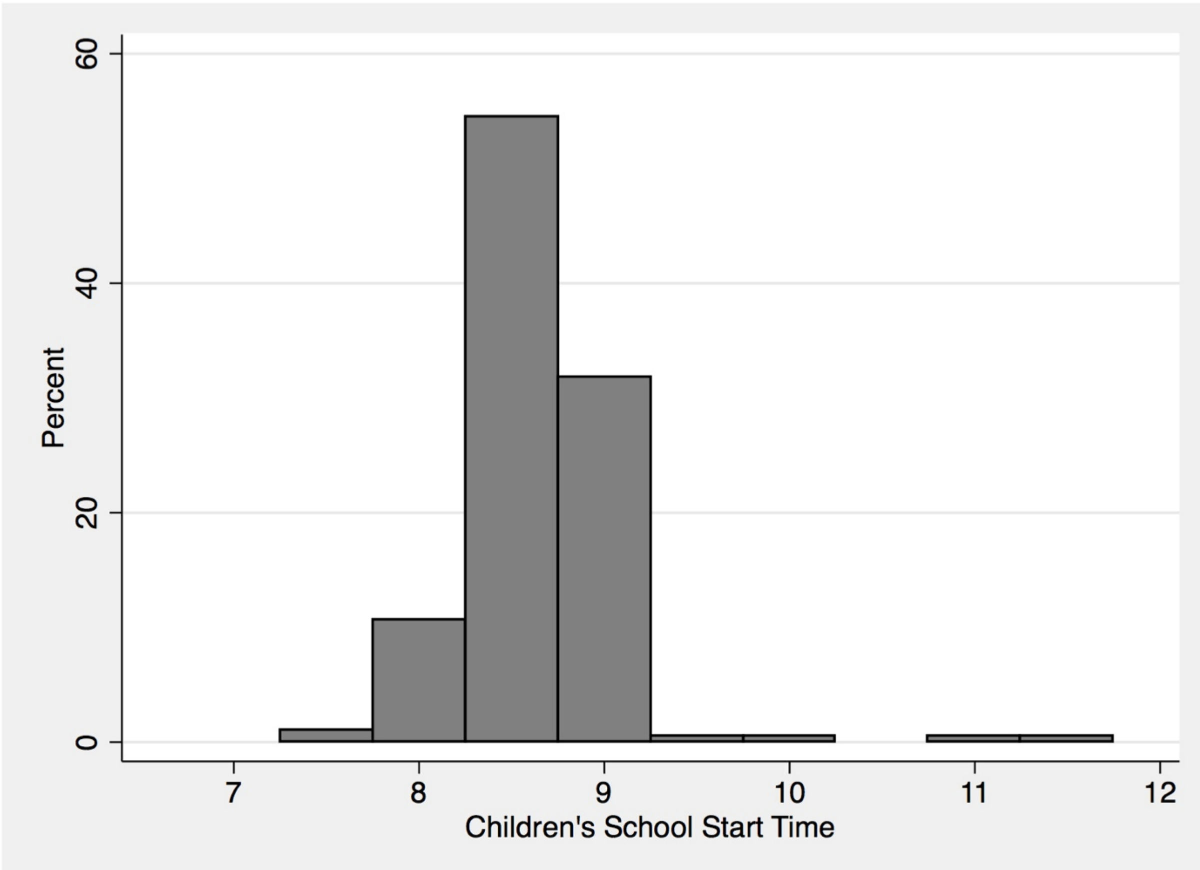
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: Marginal effects generated from country-specific mixed-effects models displayed in Supplementary Table 3.

Figure 3.5 Marginal Effects of Own Work Start Time on Wake Time in the United Kingdom, by Presence of Household Children and Gender



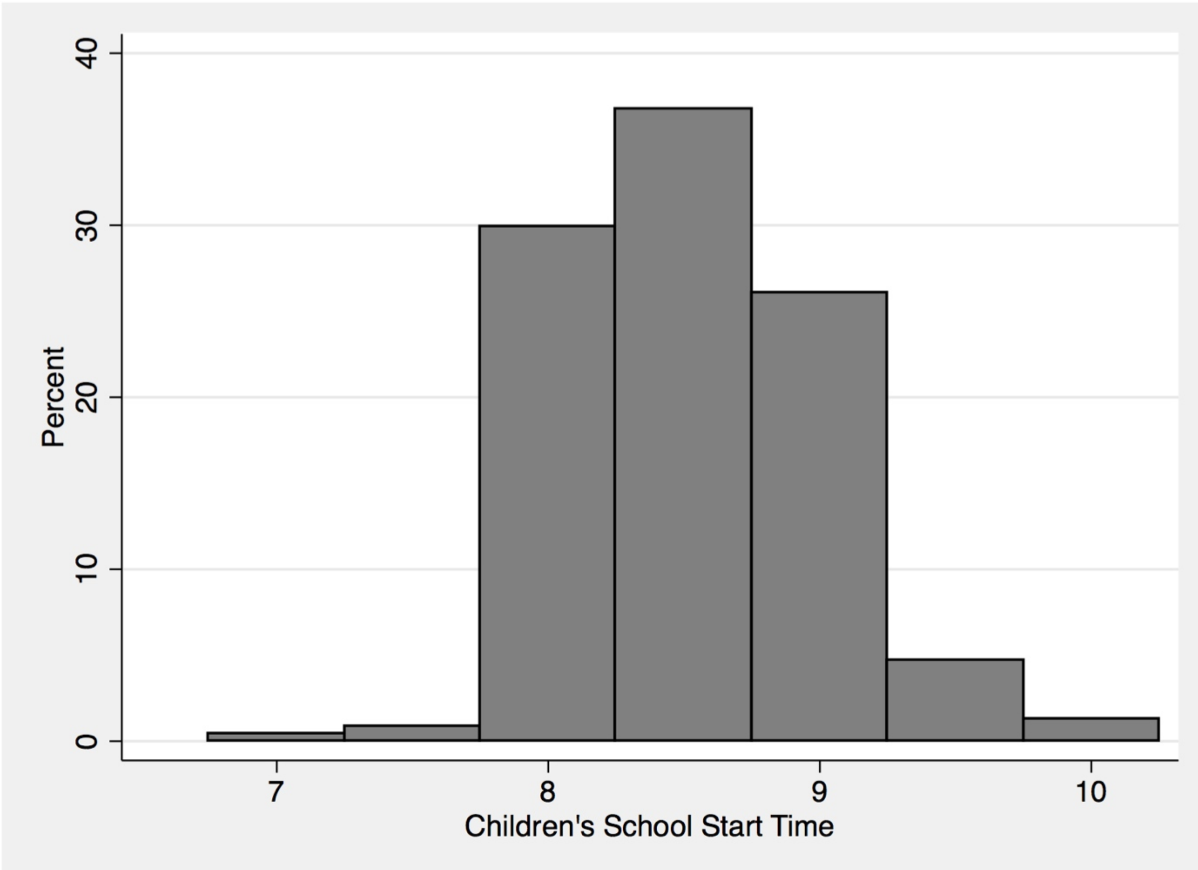
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: Marginal effects generated from country-specific mixed-effects models displayed in Supplementary Table 3.

Figure 3.6 Histogram of Children's School Start Time among Respondents in the United Kingdom



Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: These statistics are not weighted.

Figure 3.7 Histogram of Children's School Start Time among Respondents in Spain



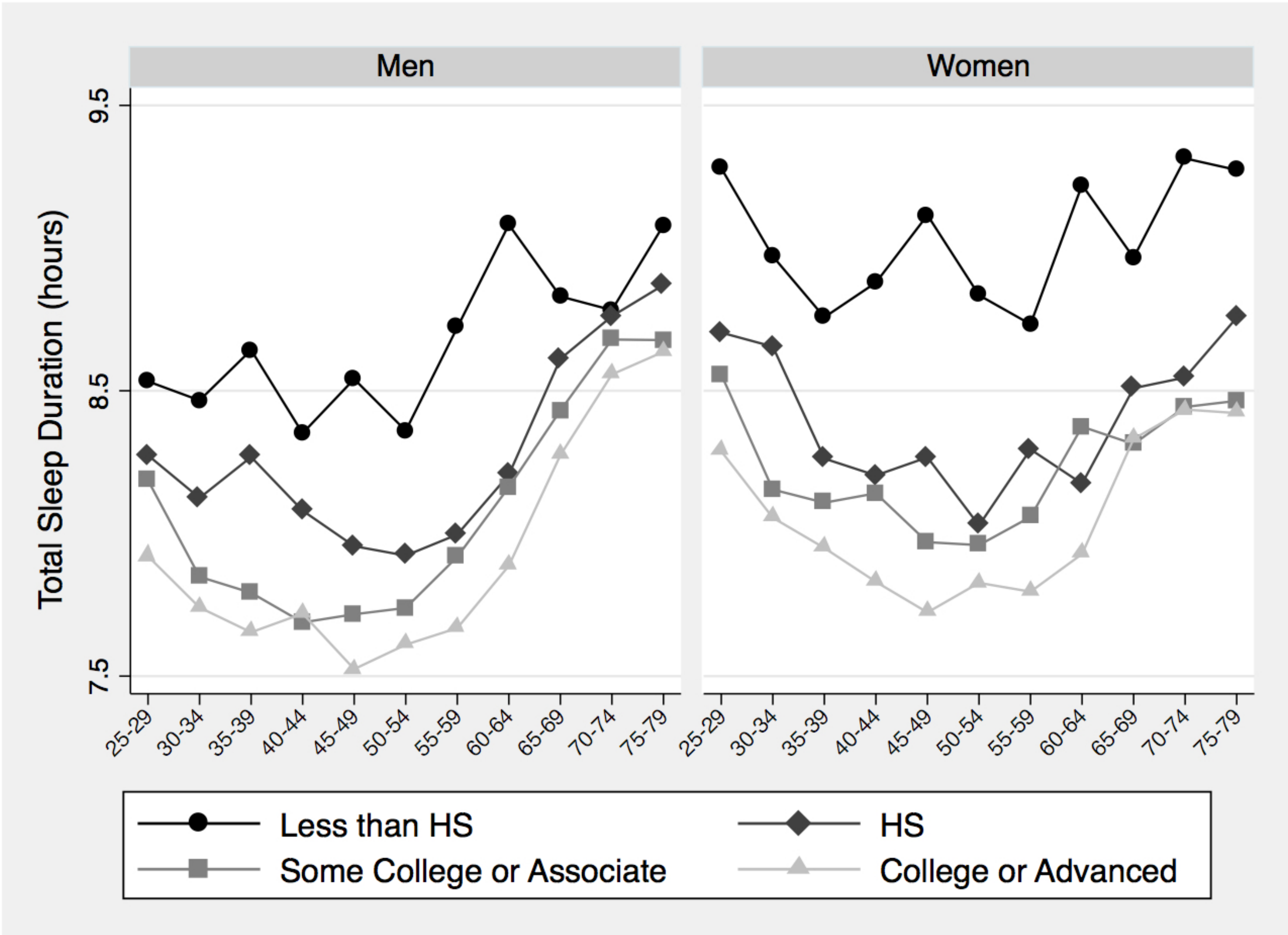
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: These statistics are not weighted.

Table 3.3 Mixed-Effects Regression Coefficients Predicting Wake Time among Working-Age, Partnered Parents in Spain and the United Kingdom whose Children Reported an Eligible School Start Time

	United Kingdom			Spain		
	Men (N=198)	Women (N=198)	Difference	Men (N=234)	Women (N=234)	Difference
Children's School Start Time (in minutes)	14.53**	6.92	7.61	3.78	9.54**	-5.76
	(5.33)	(5.87)	(7.13)	(3.42)	(3.19)	(4.07)
Own Work Start Time (in minutes)	34.94***	9.23***	25.71***	36.61***	22.12***	14.49***
	(2.33)	(2.18)	(3.18)	(1.86)	(1.54)	(2.41)
Partner's Work Start Time (in minutes)	2.33	6.23*	-3.90	1.58	3.38*	-1.80
	(2.01)	(2.53)	(3.21)	(1.67)	(1.72)	(2.39)
Constant (in clock time)	6:49***	6:41***	0:08*	7:23***	7:11***	0:12***
	(0:06)	(0:06)	(0:03)	(0:04)	(0:04)	(0:02)

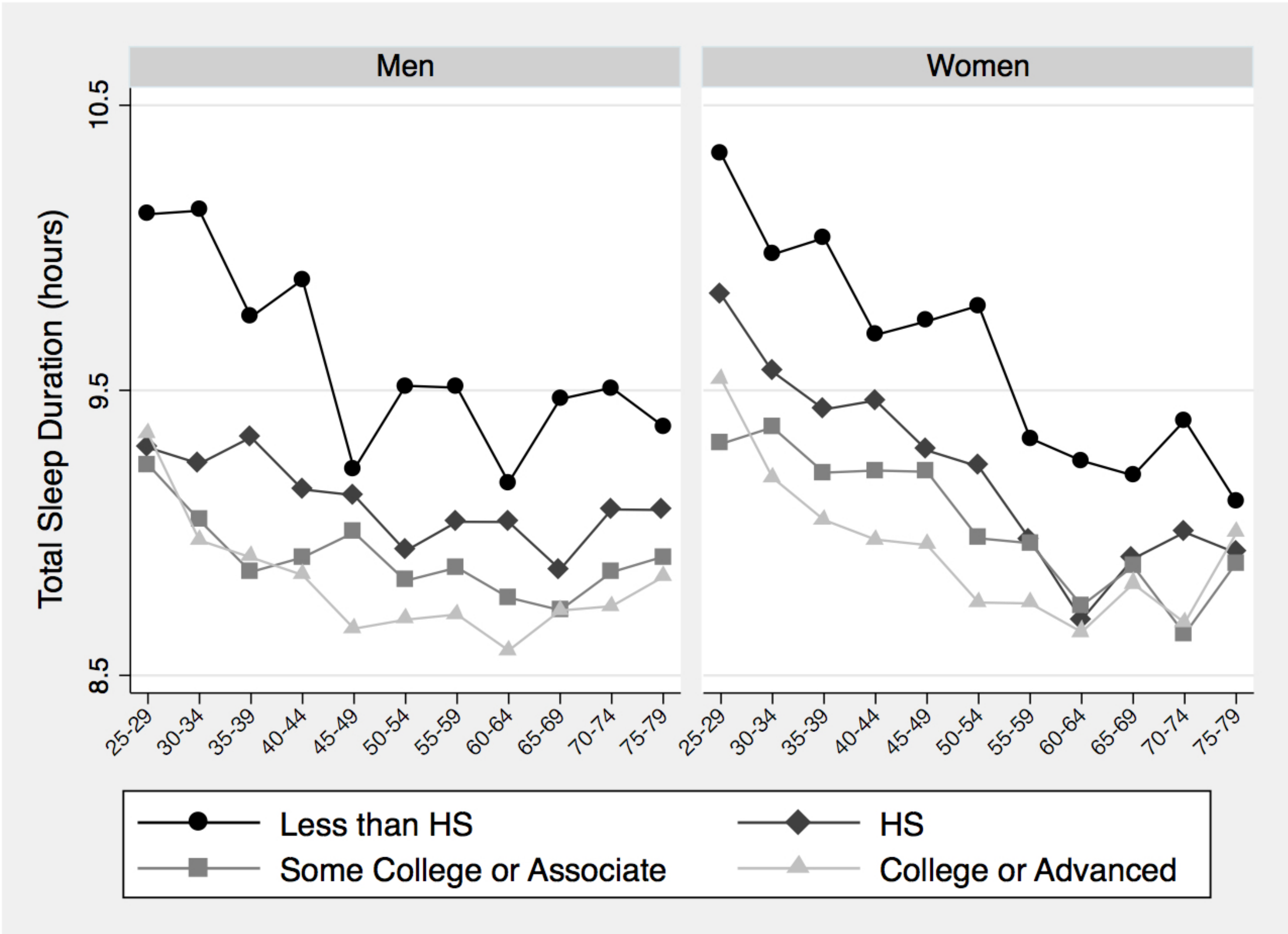
†p<.10; * p<.05; ** p<.01; *** p<.001.
Source: Multinational Time Use Study, 2000-2001, 2002-2003, 2009-2010, and 2014-2015.
Note: Difference represents men's minus women's coefficients. Standard errors in parentheses. Models include covariates for education, age, and age squared, as well as year, season, and day of interview. Partner's and own work start times are centered at the average within each country, as is children's school start time. Models include a random effect for each couple. Men and women were included in the same regression models, but coefficients are separated by gender to enhance interpretability.

Figure 4.1A Average Weekday Total Sleep Duration by Gender, Education, and Age



Source: American Time Use Survey, 2003-2016.
Note: These descriptive statistics are weighted.

Figure 4.1B Average Weekend/Holiday Total Sleep Duration by Gender, Education, and Age



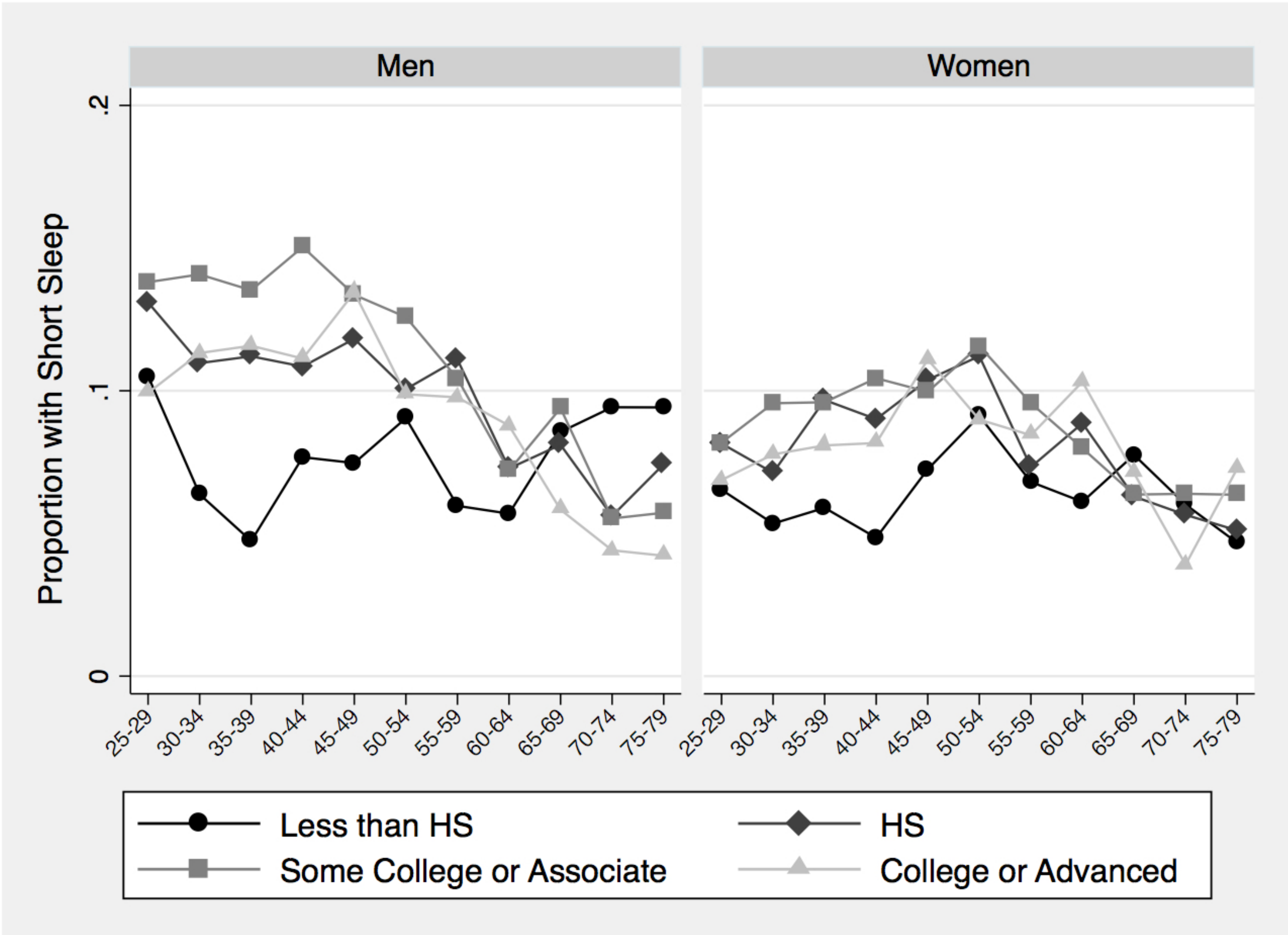
Source: American Time Use Survey, 2003-2016.
Note: These descriptive statistics are weighted.

Table 4.1 Coefficients from OLS Regression Models Predicting Total Sleep Duration (in Hours)

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Education (Reference=College or Advanced Degree)				
Less than High School	0.94***	0.80***	1.09***	0.83***
	(0.06)	(0.09)	(0.07)	(0.07)
High School	0.40***	0.38***	0.41***	0.37***
	(0.04)	(0.05)	(0.04)	(0.05)
Some College or Associate's	0.14***	0.17**	0.25***	0.26***
	(0.04)	(0.05)	(0.04)	(0.04)
Age (centered, in 10 years)	0.09***	-0.13***	0.00	-0.16***
	(0.01)	(0.02)	(0.01)	(0.02)
Education x Age (centered, in 10 years)				
Less than High School x Age	0.01	-0.07	0.00	-0.08**
	(0.03)	(0.04)	(0.04)	(0.03)
High School x Age	-0.03	0.05	-0.05**	-0.06**
	(0.02)	(0.03)	(0.02)	(0.02)
Some College or Associate's x Age	0.00	0.05†	-0.02	0.02
	(0.03)	(0.03)	(0.02)	(0.02)
Age (centered, in 10 years) Squared	0.12***	0.07***	0.11***	0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	-0.08***	0.00	-0.04**	-0.05**
	(0.02)	(0.03)	(0.02)	(0.02)
High School x Age Squared	-0.01	-0.04**	-0.01	-0.03†
	(0.02)	(0.02)	(0.01)	(0.02)
Some College or Associate's x Age Squared	0.01	-0.04**	-0.02†	-0.07***
	(0.02)	(0.02)	(0.01)	(0.02)
Constant	7.64***	8.34***	7.74***	8.57***
	(0.05)	(0.05)	(0.05)	(0.05)
N	33,018	34,083	42,150	43,990
R-squared	.04	.04	.04	.04

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001 Source: American Time Use Survey, 2003-2016. Note: All models include variables indicating region, season, day of week, whether the interview year was post-2008 recession.

Figure 4.2A Proportion of Weekday Respondents with Short-Duration Sleep by Gender, Education, and Age



Source: American Time Use Survey, 2003-2016.
Note: These descriptive statistics are weighted.

Table 4.2 Coefficients from Multinomial Logistic Regression Models Predicting Sleep Duration Category

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Short Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	-0.38**	0.62***	-0.08	0.49***
	(0.12)	(0.14)	(0.12)	(0.14)
High School	0.02	0.52***	0.11	0.43***
	(0.08)	(0.09)	(0.08)	(0.10)
Some College or Associate's	0.19**	0.42***	0.15**	0.29**
	(0.07)	(0.09)	(0.07)	(0.09)
Age (centered, in 10 years)	-0.14***	-0.10**	0.01	-0.01
	(0.03)	(0.04)	(0.03)	(0.04)
Education x Age (centered, in 10 years)				
Less than High School x Age	0.14**	-0.03	0.01	0.10
	(0.07)	(0.07)	(0.07)	(0.07)
High School x Age	0.01	-0.05	-0.08†	0.01
	(0.05)	(0.06)	(0.04)	(0.05)
Some College or Associate's x Age	-0.04	-0.08	-0.07†	-0.07
	(0.05)	(0.05)	(0.04)	(0.05)
Age (centered, in 10 years) Squared	-0.09***	-0.02	-0.06**	-0.02
	(0.02)	(0.02)	(0.02)	(0.03)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	0.17***	-0.05	0.03	-0.02
	(0.04)	(0.05)	(0.04)	(0.04)
High School x Age Squared	0.09**	-0.08**	0.00	-0.02
	(0.03)	(0.04)	(0.03)	(0.03)
Some College or Associate's x Age Squared	0.05	0.00	0.00	0.01
	(0.03)	(0.04)	(0.03)	(0.04)
Constant	-2.14***	-2.23***	-2.20***	-2.40***
	(0.09)	(0.10)	(0.09)	(0.10)
Long Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	1.38***	0.96***	1.48***	0.99***

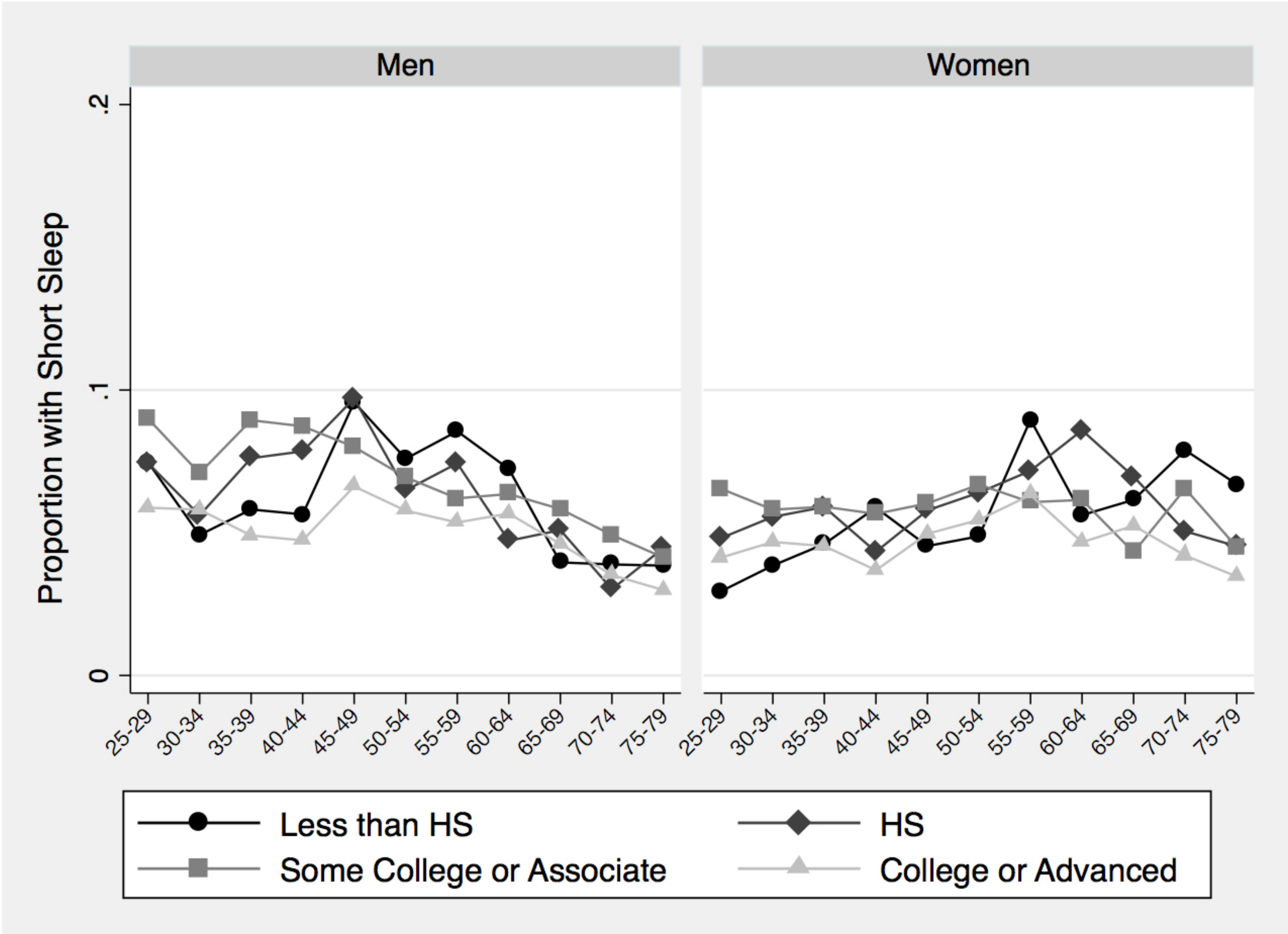
	(0.09)	(0.07)	(0.08)	(0.07)
High School	0.89***	0.64***	0.85***	0.54***
	(0.07)	(0.05)	(0.07)	(0.05)
Some College or Associate's	0.60***	0.37***	0.59***	0.34***
	(0.08)	(0.05)	(0.07)	(0.05)
Age (centered, in 10 years)	0.08**	-0.18***	-0.01	-0.19***
	(0.03)	(0.02)	(0.02)	(0.02)
Education x Age (centered, in 10 years)				
Less than High School x Age	-0.01	-0.01	0.01	-0.02
	(0.04)	(0.04)	(0.04)	(0.03)
High School x Age	-0.09**	0.04	-0.07**	-0.03
	(0.04)	(0.03)	(0.03)	(0.02)
Some College or Associate's x Age	-0.06	0.03	-0.05	-0.01
	(0.04)	(0.03)	(0.03)	(0.02)
Age (centered, in 10 years) Squared	0.15***	0.08***	0.14***	0.06***
	(0.02)	(0.01)	(0.02)	(0.01)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	-0.07**	-0.05**	-0.08**	-0.06**
	(0.03)	(0.02)	(0.02)	(0.02)
High School x Age Squared	-0.03	-0.09***	-0.05**	-0.04**
	(0.02)	(0.02)	(0.02)	(0.02)
Some College or Associate's x Age Squared	-0.02	-0.04†	-0.06**	-0.05**
	(0.03)	(0.02)	(0.02)	(0.02)
Constant	-2.52***	-1.38***	-2.41***	-1.23***
	(0.08)	(0.06)	(0.07)	(0.05)
N	33,018	34,083	42,150	43,990

†p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001

Source: American Time Use Survey, 2003-2016.

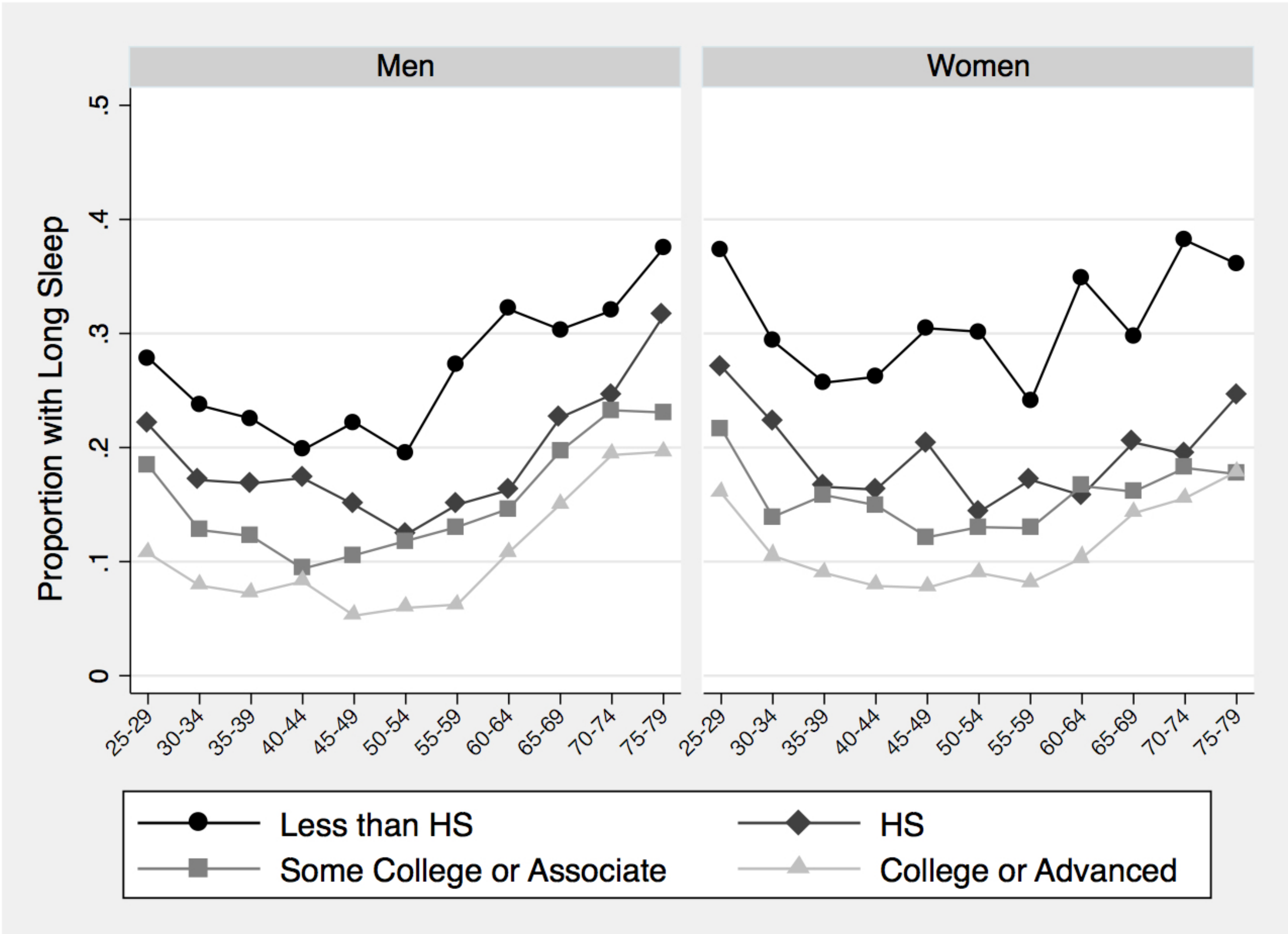
Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

Figure 4.2B Proportion of Weekend/Holiday Respondents with Short-Duration Sleep by Gender, Education, and Age



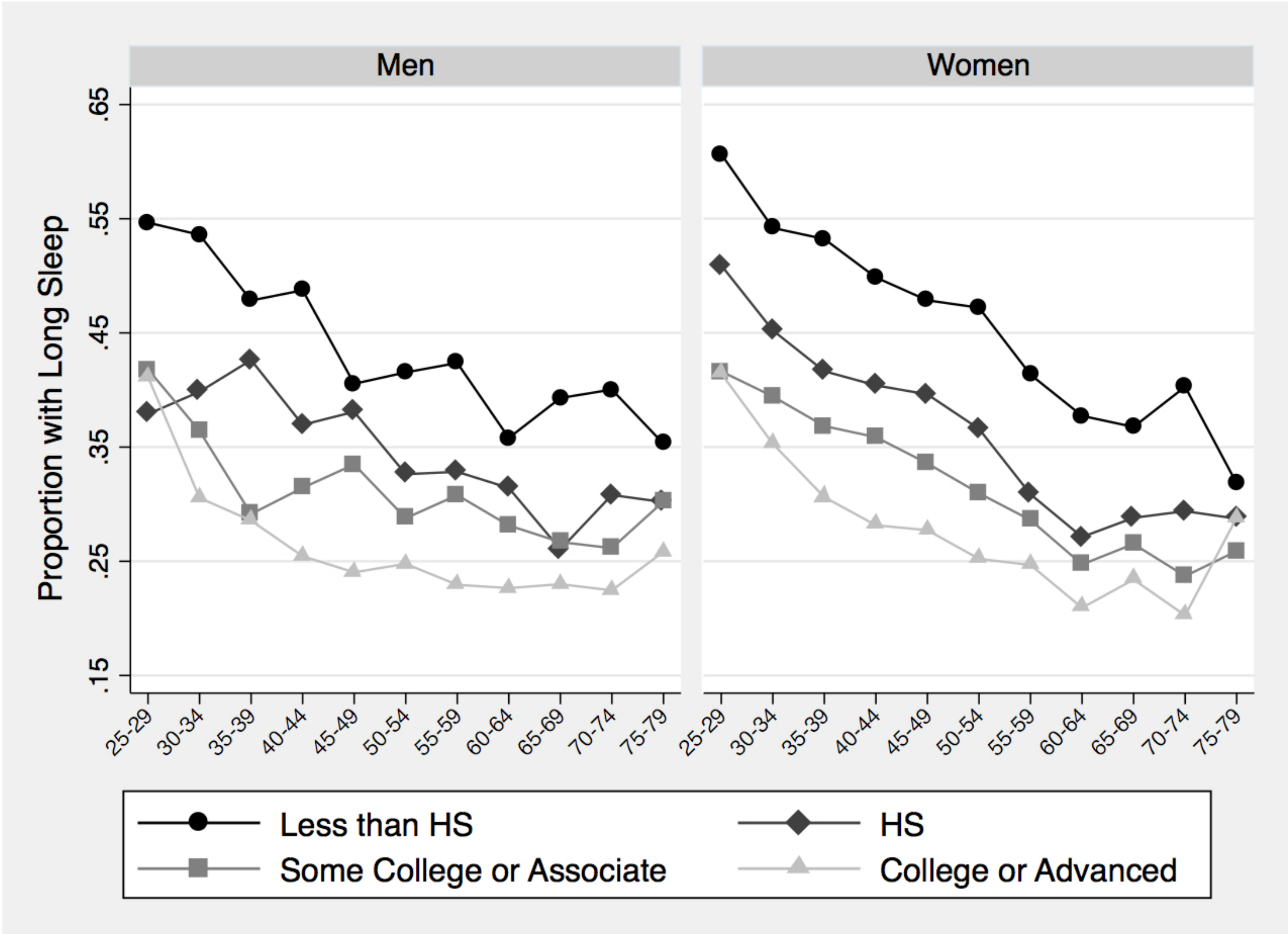
Source: American Time Use Survey, 2003-2016.
Note: These descriptive statistics are weighted.

Figure 4.3A Proportion of Weekday Respondents with Long-Duration Sleep by Gender, Education, and Age



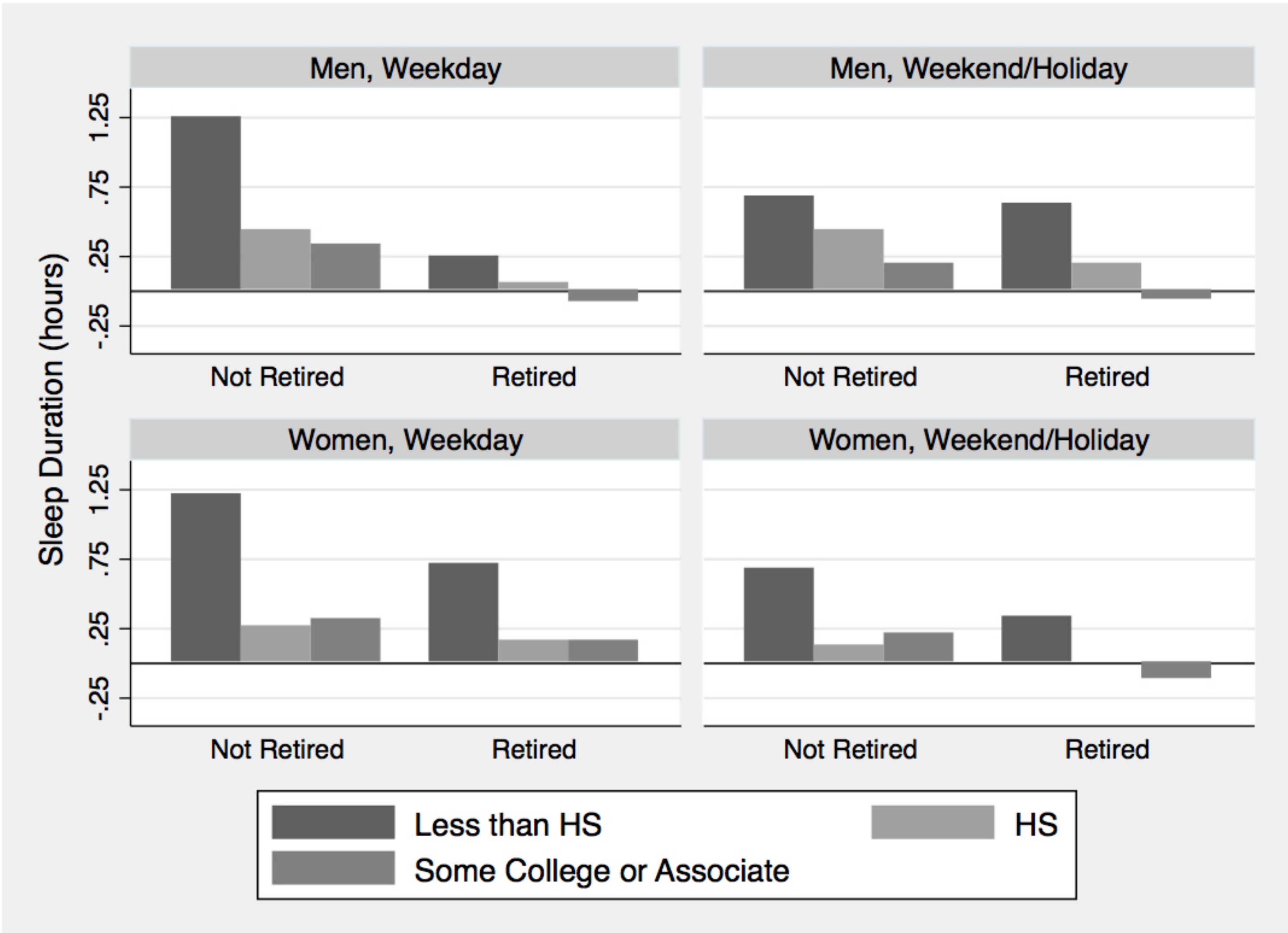
Source: American Time Use Survey, 2003-2016.
Note: These descriptive statistics are weighted.

Figure 4.3B Proportion of Weekend/Holiday Respondents with Long-Duration Sleep by Gender, Education, and Age



Source: American Time Use Survey, 2003-2016.
Note: These descriptive statistics are weighted.

Figure 4.4 Predicted Difference from College-Educated Respondents in Total Sleep Duration by Gender, Type of Day, and Retirement Status, among ATUS Respondents 60-69 Years Old



Source: American Time Use Survey, 2003-2016.
Note: All models hold the following covariates at their means: age, age squared, region, season, day of week, and whether the interview year was post-2008 recession.

References

Adam, Emma K., Emily K. Snell, and Patricia Pendry. 2007. "Sleep Timing and Quantity in Ecological and Family Context: A Nationally Representative Time-Diary Study." *Journal of Family Psychology* 21(1):4–19.

Aguiar, Mark and Erik Hurst. 2007. "Measuring Trends in Leisure: The Allocation of Time Over Five Decades." *The Quarterly Journal of Economics* 122(3):969–1006.

Aguiar, Mark and Erik Hurst. 2009. *The Increase in Leisure Inequality,1965-2005*. Washington, D.C.: The AEI Press.

Aguiar, Mark, Erik Hurst, and Loukas Karabarbounis. 2013. "Time Use During the Great Recession." *The American Economic Review* 103(5):1664–96.

Åkerstedt, Torbjörn, Johanna Garefelt, Anne Richter, Hugo Westerlund, Linda L. Magnusson Hanson, Magnus Sverke, and Göran Kecklund. 2015. "Work and Sleep—A Prospective Study of Psychosocial Work Factors, Physical Work Factors, and Work Scheduling." *Sleep* 38(7):1129–36.

Altintas, Evrim and Oriel Sullivan. 2016. "Fifty Years of Change Updated: Cross-National Gender Convergence in Housework." *Demographic Research* 35:455–70. Retrieved (http://www.demographic-research.org/Volumes/Vol35/16/).

Antecol, Heather, Kelly Bedard, and Jenna Stearns. 2016. "Equal but Inequitable: Who Benefits from Gender-Neutral Tenure Clock Stopping Policies?" IZA DP NO. 9904, Institue of Labor Economics.

Arber, Sara and Robert Meadows. 2011. "Social and Health Patterning of Sleep Quality and Duration." Pp. 87–98 in *Understanding Society: Early Findings from the First Wave of the UK's Household Longitudinal Study*, edited by S. L. McFall and C. Garrington. Colchester:

Institute for Social and Economic Research, University of Essex.

Aschoff, Jürgen. 1965. "Circadian Rhythms in Man." *Science* 148(3676):1427–32.

Autor, David H. 2014. "Skills, Education, and the Rise of Earnings Inequality among the 'Other 99 Percent.'" *Science* 344(6186):843–51.

Baker, Michael and Kevin Milligan. 2008. "Maternal Employment, Breastfeeding, and Health: Evidence from Maternity Leave Mandates." *Journal of Health Economics* 27(4):871–87.

Bakker, Arnold B., Evangelia Demerouti, and Maureen F. Dollard. 2008. "How Job Demands Affect Partners' Experience of Exhaustion: Integrating Work-Family Conflict and Crossover Theory." *Journal of Applied Psychology* 93(4):901–11.

Basner, Mathias, Kenneth M. Fomberstein, Farid M. Razavi, Siobhan Banks, Jeffrey H. William, Roger R. Rosa, and David F. Dinges. 2007. "American Time Use Survey: Sleep Time and Its Relationship to Waking Activities." *Sleep* 30(9):1085–95.

Basner, Mathias and David F. Dinges. 2009. "Dubious Bargain: Trading Sleep for Leno and Letterman." *Sleep* 32(6):747–52.

Basner, Mathias, Andrea M. Spaeth, and David F. Dinges. 2014. "Sociodemographic Characteristics and Waking Activities and Their Role in the Timing and Duration of Sleep." *Sleep* 37(12):1889–1906.

Béchard, Marcel. 2015. *General Social Survey Cycle 24: Time-Stress and Well-Being Public Use Microdata File Documentation and User's Guide*. Statistics Canada. Statistics Canada Catalogue No. 12M0024X.

Béchard, Marcel and Isabelle Marchand. 2006. *General Social Survey Cycle 19: Time Use (2005) User's Guide to the Public Use Microdata File*. Statistics Canada. Statistics Canada Catalogue No. 12M0019GPE.

Bianchi, Suzanne M., Melissa A. Milkie, Liana C. Sayer, and John P. Robinson. 2000. "Is Anyone Doing the Housework? Trends in the Gender Division of Household Labor." *Social Forces* 79(1):191–228.

Bianchi, Suzanne M., Liana C. Sayer, Melissa A. Milkie, and John P. Robinson. 2012. "Housework: Who Did, Does or Will Do It, and How Much Does It Matter?" *Social Forces* 91(1):55–63.

Biddle, Jeff E. and Daniel S. Hamermesh. 1990. "Sleep and the Allocation of Time." *Journal of Political Economy* 98(5):922–43.

Bittman, Michael, Paula England, Liana Sayer, Nancy Folbre, and George Matheson. 2003. "When Does Gender Trump Money? Bargaining and Time in Household Work." *American Journal of Sociology* 109(1):186–214.

Blyton, Diane M., C. E. Sullivan, and N. Edwards. 2002. "Lactation Is Associated with an Increase in Slow-Wave Sleep in Women." *Journal of Sleep Research* 11(4):297–303.

Boergers, Julie, Chantelle Hart, Judith A. Owens, Randi Streisand, and Anthony Spirito. 2007. "Child Sleep Disorders: Associations with Parental Sleep Duration and Daytime Sleepiness." *Journal of Family Psychology* 21(1):88–94.

Bound, John, Michael Schoenbaum, Todd R. Stinebrickner, and Timothy Waidmann. 1999. "The Dynamic Effects of Health on the Labor Force Transitions of Older Workers." *Labour Economics* 6(2):179–202.

Boyle, Tara, Jennifer Schmidt, Rhaina Cohen, Parth Shah, Thomas Lu, Laura Kwerel, and Camila Vargas Restrepo [Producers]. 2018. "Radio Replay: Eyes Wide Open." *Hidden Brain* podcast. Retrieved March 8, 2019 (https://www.npr.org/2018/09/20/650114225/radio-replay-eyes-wide-open).

Brochu, Pierre, Catherine Deri Armstrong, and Louis-Philippe Morin. 2012. "The 'trendiness' of Sleep: An Empirical Investigation into the Cyclical Nature of Sleep Time." *Empirical Economics* 43(2):891–913.

Bünning, Mareike. 2015. "What Happens after the 'Daddy Months'? Fathers' Involvement in Paid Work, Childcare, and Housework after Taking Parental Leave in Germany." *European Sociological Review* 31(6):738–48.

Burchell, Brendan, Colette Fagan, Catherine O'Brien, and Mark Smith. 2007. *Working Conditions in the European Union: The Gender Perspective*. Luxembourg: Office for Official Publications of the European Communities.

Burgard, Sarah A. 2011. "The Needs of Others: Gender and Sleep Interruptions for Caregivers." *Social Forces* 89(4):1189–1215.

Burgard, Sarah A. and Jennifer A. Ailshire. 2013. "Gender and Time for Sleep among U.S. Adults." *American Sociological Review* 78(1):51–69.

Burtless, Gary. 2013. "The Impact of Population Aging and Delayed Retirement on Workforce Productivity." Working Paper No. 2013-11, Center for Retirement Reseach at Boston College, Chestnut Hill, MA.

Cajochen, C., K. Kräuchi, and A. Wirz-Justice. 2003. "Role of Melatonin in the Regulation of Human Circadian Rhythms and Sleep." *Journal of Neuroendocrinology* 15(4):432–37.

Cappuccio, Francesco P., Lanfranco D'Elia, Pasquale Strazzullo, and Michelle A. Miller. 2010. "Sleep Duration and All-Cause Mortality: A Systematic Review and Meta-Analysis of Prospective Studies." *Sleep* 33(5):585–92.

Carrasco, Cristina and Albert Recio. 2001. "Time, Work and Gender in Spain." *Time & Society* 10(2/3):277–301.

Centre for Time Use Research. N.d.a. “Spain 2002.” *IPUMS Time Use*. Minneapolis, MN: Minnesota Population Center, University of Minnesota. Retrieved February 2, 2019a (https://www.mtusdata.org/mtus/sp2002a.shtml).

Centre for Time Use Research. N.d.b. “Spain 2009.” *IPUMS Time Use*. Minneapolis, MN: Minnesota Population Center, University of Minnesota. Retrieved February 2, 2019b (https://www.mtusdata.org/mtus/sp2009a.shtml).

Centre for Time Use Research. N.d.c. “UK 2000.” *IPUMS Time Use*. Minneapolis, MN: Minnesota Population Center, University of Minnesota. Retrieved February 1, 2019c (https://www.mtusdata.org/mtus/uk2000a.shtml).

Centre for Time Use Research. N.d.d. “UK 2014-2015.” *IPUMS Time Use*. Minneapolis, MN: Minnesota Population Center, University of Minnesota. Retrieved February 1, 2019d (https://www.mtusdata.org/mtus/uk2014a.shtml).

Chen, Jen-Hao. 2018. “Couples’ Sleep and Psychological Distress: A Dyadic Perspective.” *Journals of Gerontology: Psychological Sciences* 73(1):30–39.

Cools, Sara, Jon H. Fiva, and Lars J. Kirkebøen. 2015. “Causal Effects of Paternity Leave on Children and Parents.” *The Scandinavian Journal of Economics* 117(3):801–28.

Committee on Sleep Medicine and Research. 2006. “Sleep Physiology.” Pp. 33–53 in *Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem*, edited by H. R. Colten and B. M. Altevogt. Institute of Medicine of the National Academies. Washington, D.C.: The National Academies Press. doi:10.17226/11617.

Darnley, Fred. 1981. “Periodicity in the Family: What Is It and How Does It Work?” *Family Relations* 30(1):31–37.

Dijk, Derk-Jan and Steven W. Lockley. 2002. “Invited Review: Integration of Human Sleep-

Wake Regulation and Circadian Rhythmicity." *Journal of Applied Physiology* 92(2):852–862.

Doan, Therese, Caryl L. Gay, Holly P. Kennedy, Jack Newman, and Kathryn A. Lee. 2014. "Nighttime Breastfeeding Behavior Is Associated with More Nocturnal Sleep among First-Time Mothers at One Month Postpartum." *Journal of Clinical Sleep Medicine* 10(3):313–19.

Doucet, Andrea. 2009. "Dad and Baby in the First Year: Gendered Responsibilities and Embodiment." *The ANNALS of the American Academy of Political and Social Science* 624(1):78–98.

Dunster, Gideon P., Luciano de la Iglesia, Miriam Ben-Hamo, Claire Nave, Jason G. Fleischer, Satchidanada Panda, and Horacio O. de la Iglesia. 2018. "Sleepmore in Seattle: Later School Start Times Are Associated with More Sleep and Better Performance in High School Students." *Science Advances* 4(12):eaau6200.

Ehlers, Cindy L., Ellen Frank, and David J. Kupfer. 1988. "Social Zeitgebers and Biological Rhythms." *Archives of General Psychiatry* 45:948–52.

Ehlers, Cindy L., David J. Kupfer, Ellen Frank, and Timothy H. Monk. 1993. "Biological Rhythms and Depression: The Role of Zeitgebers and Zeitstörers." *Depression* 1(6):285–93.

Ekberg, John, Rickard Eriksson, and Guido Friebel. 2013. "Parental Leave — A Policy Evaluation of the Swedish 'Daddy-Month' Reform." *Journal of Public Economics* 97:131–43.

Elder, Glen H., Jr. 1995. "The Life Course Paradigm: Social Change and Individual Development." Pp. 101–39 in *Examining Lives in Context: Perspectives on the Ecology of Human Development*, edited by P. Moen, G. H. Elder, Jr., and K. Lüscher. Washington, DC: American Psychological Association.

Enchautegui, María E. 2013. "Nonstandard Work Schedules and the Well-Being of Low-Income Families." Washington, D.C.: Urban Institute.

England, Paula. 2010. "The Gender Revolution: Uneven and Stalled." *Gender & Society* 24(2):149–66.

Ertel, Karen A., Lisa F. Berkman, and Orfeu M. Buxton. 2011. "Socioeconomic Status, Occupational Characteristics, and Sleep Duration in African/Caribbean Immigrants and US White Health Care Workers." *Sleep* 34(4):509–18.

European Communities. 2004. *Guidelines on Harmonised European Time Use Surveys*. Luxembourg: Office for Official Publications of the European Communities.

Eurostat. 2018. "Average Number of Usual Weekly Hours of Work in Main Job, by Sex, Professional Status, Full-Time/Part-Time and Economic Activity (from 2008 Onwards, NACE Rev. 2) - Hours." Retrieved February 2, 2019 (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=lfsa_ewhun2&lang=en).

Eurostat. 2004. *How Europeans Spend Their Time: Everyday Life of Women and Men: Data 1998-2002*. Luxembourg: Office for Official Publications of the European Communities.

Fabbian, Fabio, Beatrice Zucchi, Alfredo De Giorgi, Ruana Tiseo, Benedetta Boari, Raffaella Salmi, Rosaria Cappadona, Gloria Gianesini, Erika Bassi, Fulvia Signani, Valeria Raparelli, Stefania Basili, and Roberto Manfredini. 2016. "Chronotype, Gender and General Health." *Chronobiology International* 33(7):863–82.

Fernández-Crehuet Santos, José María. 2016. *La Conciliación de La Vida Profesional, Familiar y Personal: España En El Contexto Europeo*. Madrid: Ediciones Pirámide.

Ferree, Myra Marx. 2010. "Filling the Glass: Gender Perspectives on Families." *Journal of*

Marriage and Family 72(3):420–39.

Fischer, Dorothee, David A. Lombardi, Helen Marucci-Wellman, and Till Roenneberg. 2017. "Chronotypes in the US – Influence of Age and Sex." *PLoS ONE* 12(6):e0178782. doi:10.1371/journal.pone.0178782.

Fisher, Kimberly, Jonathan Gershuny, Sarah M. Flood, Joan Garcia Roman, and Sandra L. Hofferth. 2018. "Multinational Time Use Study Extract System: Version 1.2 [Dataset]." Minneapolis, MN: University of Minnesota. doi:10.18128/D062.V1.2.

Fisher, Kimberly, Jonathan Gershuny, and Anne H. Gauthier. 2015. "MTUS Coding Procedures: Harmonised Episode (HEF), Aggregate (HAF), and Simple Files (HSF) (Release 2)." Oxford, U.K.: Centre for Time Use Research, University of Oxford. Retrieved March 8, 2019 (https://www.mtusdata.org/mtus/resources/linked_docs/mtus_coding_procedures.pdf).

Flacking, Renée, Fiona Dykes, and Uwe Ewald. 2010. "The Influence of Fathers' Socioeconomic Status and Paternity Leave on Breastfeeding Duration: A Population-Based Cohort Study." *Scandinavian Journal of Public Health* 38(4):337–43.

Flood, Sarah M., Rachelle Hill, and Katie R. Genadek. 2018. "Daily Temporal Pathways: A Latent Class Approach to Time Diary Data." *Social Indicators Research* 135(1):117–42.

Flood, Sarah M. and Phyllis Moen. 2015. "Healthy Time Use in the Encore Years: Do Work, Resources, Relations, and Gender Matter?" *Journal of Health and Social Behavior* 56(1):74–97.

Fuwa, Makiko and Philip N. Cohen. 2007. "Housework and Social Policy." *Social Science Research* 36(2):512–30.

Gagné, Christian, Georgia Roberts, and Leslie-Anne Keown. 2014. "Weighted Estimation and Bootstrap Variance Estimation for Analyzing Survey Data: How to Implement in Selected

Software.” Statistics Canada Catalogue No. 12-002-X. *The Research Data Centres Information and Technical Bulletin* 6(1).

Gay, Caryl L., Kathryn A. Lee, and Shih-Yu Lee. 2004. “Sleep Patterns and Fatigue in New Mothers and Fathers.” *Biological Research For Nursing* 5(4):311–18.

Geisler, Esther and Michaela Kreyenfeld. 2012. “How Policy Matters: Germany’s Parental Leave Benefit Reform and Fathers’ Behavior 1999-2009.” Working Paper WP 2012-021, Max Planck Institute for Demographic Resarch, Rostock, Germany.

Gimenez-Nadal, J. Ignacio and Jose Alberto Molina. 2013. “Parents’ Education as a Determinant of Educational Childcare Time.” *Journal of Population Economics* 26(2):719–49.

Gimenez-Nadal, Jose Ignacio and Almudena Sevilla-Sanz. 2011. “The Time-Crunch Paradox.” *Social Indicators Research* 102(2):181–96.

Givens, Marjory L. Kristen C. Malecki, Paul E. Peppard, Mari Palta, Adnan Said, Corinne D. Engelman, Matthew C. Walsh, and F. Javier Nieto. 2015. “Shiftwork, Sleep Habits, and Metabolic Disparities: Results from the Survey of the Health of Wisconsin.” *Sleep Health* 1(2):115–20.

Goesling, Brian. 2007. “The Rising Significance of Education for Health?” *Social Forces* 85(4):1621–44.

Gonalons-Pons, Pilar. 2015. “Gender and Class Housework Inequalities in the Era of Outsourcing Hiring Domestic Work in Spain.” *Social Science Research* 52:208–18.

Gracia, Pablo and Matthijs Kalmijn. 2016. “Parents’ Family Time and Work Schedules: The Split-Shift Schedule in Spain.” *Journal of Marriage and Family* 78(2):401–15.

Grandin, Louisa D., Lauren B. Alloy, and Lyn Y. Abramson. 2006. “The Social Zeitgeber Theory, Circadian Rhythms, and Mood Disorders: Review and Evaluation.” *Clinical*

Psychology Review 26(6):679–94.

Grandner, Michael A., Lauren Hale, Nicholas Jackson, Nirav P. Patel, Nalaka Gooneratne, and Wendy M. Troxel. 2012. "Perceived Racial Discrimination as an Independent Predictor of Sleep Disturbance and Daytime Fatigue." *Behavioral Sleep Medicine* 10(4):235–49.

Grandner, Michael A., Megan E. Ruiter Petrov, Pinyo Rattanaumpawan, Nicholas Jackson, Alec Platt, and Nirav P. Patel. 2013. "Sleep Symptoms, Race/Ethnicity, and Socioeconomic Position." *Journal of Clinical Sleep Medicine* 9(9):897–905.

Grandner, Michael A., Nirav P. Patel, Philip R. Gehrman, Dawei Xie, Daohang Sha, Terri Weaver, and Nalaka Gooneratne. 2010. "Who Gets the Best Sleep? Ethnic and Socioeconomic Factors Related to Sleep Complaints." *Sleep Medicine* 11(5):470–78.

Grandner, Michael A., Lauren Hale, Melisa Moore, and Nirav P. Patel. 2010. "Mortality Associated with Short Sleep Duration: The Evidence, the Possible Mechanisms, and the Future." *Sleep Medicine Reviews* 14(3):191–203.

Grandner, Michael A. and Daniel F. Kripke. 2004. "Self-Reported Sleep Complaints with Long and Short Sleep: A Nationally Representative Sample." *Psychosomatic Medicine* 66(2):239–41.

Grandner, Michael A., Natasha J. Williams, Kristen L. Knutson, Dorothy Roberts, and Girardin Jean-Louis. 2016. "Sleep Disparity, Race/Ethnicity, and Socioeconomic Position." *Sleep Medicine* 18:7–18.

Gunn, Heather E., Daniel J. Buysse, Karen A. Matthews, Christopher E. Kline, Matthew R. Cribbet, and Wendy M. Troxel. 2017. "Sleep–Wake Concordance in Couples Is Inversely Associated With Cardiovascular Disease Risk Markers." *Sleep* 40(1):zsw028.

Gunn, Heather E., Daniel J. Buysse, Brant P. Hasler, Amy Begley, and Wendy M. Troxel. 2015.

"Sleep Concordance in Couples Is Associated with Relationship Characteristics." *Sleep* 38(6):933–39.

Gutiérrez-Doménech, Maria. 2010. "Parental Employment and Time with Children in Spain." *Review of Economics of the Household* 8(3):371–91.

Hagen, Erika W., Jodi H. Barnet, Lauren Hale, and Paul E. Peppard. 2016. "Changes in Sleep Duration and Sleep Timing Associated with Retirement Transitions." *Sleep* 39(3):665–73.

Hale, Lauren. 2005. "Who Has Time to Sleep?" *Journal of Public Health* 27(2):205–11.

Hale, Lauren, Paul E. Peppard, and Terry Young. 2007. "Does the Demography of Sleep Contribute to Health Disparities?" Pp. 1–17 in *Sleep Disorders: Their Impact on Public Health*, edited by S. R. Pandi-Perumal and D. Léger. U.K.: Informa Health Care.

Hale, Lauren, Wendy M. Troxel, Howard M. Kravitz, Martica H. Hall, and Karen A. Matthews. 2014. "Acculturation and Sleep among a Multiethnic Sample of Women: The Study of Women's Health Across the Nation (SWAN)." *Sleep* 37(2):309–17.

Hall, Martica H., Karen A. Matthews, Howard M. Kravitz, Ellen B. Gold, Daniel J. Buysse, Joyce T. Bromberger, Jane F. Owens, and MaryFran Sowers. 2009. "Race and Financial Strain Are Independent Correlates of Sleep in Midlife Women: The SWAN Sleep Study." *Sleep* 32(1):73–82.

Hamermesh, Daniel S. 2002. "Timing, Togetherness and Time Windfalls." *Journal of Population Economics* 15(4):601–23.

Hamermesh, Daniel S., Caitlin Knowles Myers, and Mark L. Pocock. 2008. "Cues for Timing and Coordination: Latitude, Letterman, and Longitude." *Journal of Labor Economics* 26(2):223–46.

Harris, Kathleen Mullan and Thomas W. McDade. 2018. "The Biosocial Approach to Human

Development, Behavior, and Health Across the Life Course." *RSF: The Russell Sage Foundation Journal of the Social Sciences* 4(4):2–26.

Hasler, Brant P. and Wendy M. Troxel. 2010. "Couples' Nighttime Sleep Efficiency and Concordance: Evidence for Bidirectional Associations with Daytime Relationship Functioning." *Psychosomatic Medicine* 72(8):794–801.

Hayward, Mark D. and William R. Grady. 1990. "Work and Retirement Among a Cohort of Older Men in the United States, 1966-1983." *Demography* 27(August):337–56.

Hayward, Mark D., Robert A. Hummer, and Isaac Sasson. 2015. "Trends and Group Differences in the Association between Educational Attainment and U.S. Adult Mortality: Implications for Understanding Education's Causal Influence." *Social Science & Medicine* 127:8–18.

Heymann, S. Jody, Megan Gerecke, and Martine Chaussard. 2010. "Paid Health and Family Leave: The Canadian Experience in the Global Context." *Canadian Journal of Public Health* 101(Suppl. 1):S9–15.

Hislop, Jenny. 2007. "A Bed of Roses or a Bed of Thorns? Negotiating the Couple Relationship Through Sleep." *Sociological Research Online* 12(5):2. Retrieved February 3, 2019 (http://www.socresonline.org.uk/12/5/2.html).

Hislop, Jenny and Sara Arber. 2003. "Sleepers Wake! The Gendered Nature of Sleep Disruption among Mid-Life Women." *Sociology* 37(4):695–711.

Hochschild, Arlie (with Anne Machung). 1989. *The Second Shift: Working Parents and the Revolution at Home*. New York, New York: Viking.

Hochschild, Arlie Russell. 1997. *The Time Bind: When Work Becomes Home and Home Becomes Work*. New York: Henry Holt and Company.

Hofferth, Sandra L., Sarah M. Flood, and Matthew Sobek. 2017. "American Time Use Survey

Data Extract Builder: Version 2.6 [Dataset].” College Park, MD: University of Maryland and Minneapolis, MN: University of Minnesota. doi:10.18128/D060.V2.6.

Hofferth, Sandra L., Sarah M. Flood, and Matthew Sobek. 2015. “American Time Use Survey Data Extract Builder: Version 2.5 [Dataset].” College Park, MD: University of Maryland and Minneapolis, MN: University of Minnesota. doi:10.18128/D060.V2.5.

Hoffmann, Florian and Thomas Lemieux. 2016. “Unemployment in the Great Recession: A Comparison of Germany, Canada, and the United States.” *Journal of Labor Economics* 34(S1):S95–139.

Hook, Jennifer L. 2006. “Care in Context: Men’s Unpaid Work in 20 Countries, 1965-2003.” *American Sociological Review* 71(4):639–60.

Hook, Jennifer L. 2010. “Gender Inequality in the Welfare State: Sex Segregation in Housework, 1965-2003.” *American Journal of Sociology* 115(5):1480–1523.

House, James S., James M. Lepkowski, Ann M. Kinney, Richard P. Mero, Ronald C. Kessler, and A. Regula Herzog, 1994. “The Social Stratification of Aging and Health.” *Journal of Health and Social Behavior* 35(3):213–34.

Hunt, Sonja M., James McEwen, and S. P. McKenna. 1985. “Social Inequalities and Perceived Health.” *Effective Health Care* 2(4):151–60.

Hunter, Lauren P., Jacqueline D. Rychnovsky, and Susan M. Yount. 2009. “A Selective Review of Maternal Sleep Characteristics in the Postpartum Period.” *Journal of Obstetric, Gynecologic, and Neonatal Nursing* 38(1):60–68.

Insana, Salvatore P., Craig F. Garfield, and Hawley E. Montgomery-Downs. 2014. “A Mixed-Method Examination of Maternal and Paternal Nocturnal Caregiving.” 28(4):313–21.

Instituto Nacional de Estadística. 2004. “Encuesta de Empleo del Tiempo 2002-2003: Tomo I.

Metodología y Resultados Nacionales." Madrid: Instituto Nacional de Estadística. Retrieved October 29, 2018 (https://www.mtusdata.org/mtus/resources/linked_docs/international/sp_0203_methodology.pdf).

Instituto Nacional de Estadística. 2011. "Encuesta de Empleo Del Tiempo 2009-2010: Metodología." Instituto Nacional de Estadística. Retrieved October 29, 2018 (https://www.mtusdata.org/mtus/resources/linked_docs/international/sp_0910_methodology.pdf).

Instituto Nacional de Estadistica. 2018. "Tasas de Empleo Por Distintos Grupos de Edad, Sexo y Comunidad Autónoma." Retrieved December 5, 2018 (http://www.ine.es/jaxiT3/Tabla.htm?t=4942).

Irwin, Michael R. 2015. "Why Sleep Is Important for Health: A Psychoneuroimmunology Perspective." *Annual Review of Psychology* 66:143–72.

Jackson, Chandra L., Frank B. Hu, Susan Redline, David R. Williams, Josiemer Mattei, and Ichiro Kawachi. 2014. "Racial/Ethnic Disparities in Short Sleep Duration by Occupation: The Contribution of Immigrant Status." *Social Science & Medicine* 118:71–79.

Jacobs, Jerry A. and Kathleen Gerson. 2004. *The Time Divide: Work, Family, and Gender Inequality*. Cambridge, MA: Harvard University Press.

Jenkins, Stephen P. and Lars Osberg. 2004. "Nobody to Play with? The Implications of Leisure Coordination." Pp. 113–45 in *The Economics of Time Use*, edited by D. S. Hamermesh and G. A. Pfann. Elsevier.

Jike, Maki, Osamu Itani, Norio Watanabe, Daniel J. Buysse, and Yoshitaka Kaneita. 2018. "Long Sleep Duration and Health Outcomes: A Systematic Review, Meta-Analysis and

Meta-Regression." *Sleep Medicine Reviews* 39:25–36.

Juster, F. Thomas, Hiromi Ono, and Frank P. Stafford. 2003. "An Assessment of Alternative Measures of Time Use." *Sociological Methodology* 33(1):19–54.

Kantermann, Thomas, Myriam Juda, Martha Merrow, and Till Roenneberg. 2007. "The Human Circadian Clock's Seasonal Adjustment Is Disrupted by Daylight Saving Time." *Current Biology* 17(22):1996–2000.

Karl, Thomas R., Jerry M. Melillo, and Thomas C. Peterson, eds. 2009. *Global Climate Change Impacts in the United States*. New York: Cambridge University Press. Retrieved March 6, 2019 (https://downloads.globalchange.gov/usimpacts/pdfs/climate-impacts-report.pdf).

Kelly, Erin L., Phyllis Moen, J. Michael Oakes, Wen Fan, Cassandra Okechukwu, Kelly D. Davis, Leslie B. Hammer, Ellen Ernst Kossek, Rosalind Berkowitz King, Ginger C. Hanson, Frank Mierzwa, and Lynne M. Casper. 2014. "Changing Work and Work-Family Conflict: Evidence from the Work, Family, and Health Network." *American Sociological Review* 79(3):485–516.

Kelly, Janice R. and Joseph E. McGrath. 1985. "Effects of Time Limits and Task Types on Task Performance and Interaction of Four-Person Groups." *Journal of Personality and Social Psychology* 49(2):395–407.

Kerr, Don, Melissa Moyser, and Roderic Beaujot. 2006. "Marriage and Cohabitation: Demographic and Socioeconomic Differences in Quebec and Canada." *Canadian Studies in Population* 33(1):83–117.

Kessler, Ronald C. 2003. "Epidemiology of Women and Depression." *Journal of Affective Disorders* 74(1):5–13.

Kim, Jinyoung and Emily Durden. 2007. "Socioeconomic Status and Age Trajectories of

Health." *Social Science & Medicine* 65(12):2489–2502.

Kimmel, Jean and Lisa M. Powell. 2001. "A Comparative Analysis of Moonlighting in Canada and the United States." Pp. 293–325 in *Working Time in Comparative Perspective: Life-Cycle Working Time and Nonstandard Work*, Vol. 2, edited by S. Houseman and A. Nakamura. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research.

Klerman, Elizabeth B. and Derk-Jan Dijk. 2008. "Age-Related Reduction in the Maximal Capacity for Sleep—Implications for Insomnia." *Current Biology* 18(15):1118–23.

Kluve, Jochen and Marcus Tamm. 2009. "Now Daddy's Changing Diapers and Mommy's Making Her Career : Evaluating a Generous Parental Leave Regulation Using a Natural Experiment." IZA Discussion Papers No. 4500, Institute of Labor Economics.

Knutson, Kristen L. 2013. "Sociodemographic and Cultural Determinants of Sleep Deficiency: Implications for Cardiometabolic Disease Risk." *Social Science & Medicine* 79:7–15.

Knutson, Kristen L., Eve Van Cauter, Paul J. Rathouz, Thomas DeLeire, and Diane S. Lauderdale. 2010. "Trends in the Prevalence of Short Sleepers in the USA: 1975-2006." *Sleep* 33(1):37–45.

Knutson, Kristen L. and Diane S. Lauderdale. 2009. "Sociodemographic and Behavioral Predictors of Bed Time and Wake Time among US Adolescents Aged 15 to 17 Years." *The Journal of Pediatrics* 154(3):426–430.e1.

Knutson, Kristen L. and Rachel Leproult. 2010. "Apples to Oranges: Comparing Long Sleep to Short Sleep." *Journal of Sleep Research* 19(1–Part–I):118.

Knutson, Kristen L., Paul J. Rathouz, Lijing L. Yan, Kiang Liu, and Diane S. Lauderdale. 2007. "Intra-Individual Daily and Yearly Variability in Actigraphically Recorded Sleep Measures: The CARDIA Study." *Sleep* 30(6):793–96.

Knutson, Kristen L. and Fred W. Turek. 2006. "The U-Shaped Association between Sleep and Health: The 2 Peaks Do Not Mean the Same Thing." *Sleep* 29(7):878–79.

Kotsadam, Andreas and Henning Finseraas. 2011. "The State Intervenes in the Battle of the Sexes: Causal Effects of Paternity Leave." *Social Science Research* 40(6):1611–22.

Krueger, Patrick M. and Elliot M. Friedman. 2009. "Sleep Duration in the United States: A Cross-Sectional Population-Based Study." *American Journal of Epidemiology* 169(9):1052–63.

Kunorozva, Lovemore, Dale E. Rae, and Laura C. Roden. 2017. "Chronotype Distribution in Professional Rugby Players: Evidence for the Environment Hypothesis?" *Chronobiology International* 34(6):762–72.

Lauderdale, Diane S. 2015. "Commentary on 'Agreement between Simple Questions about Sleep Duration and Sleep Diaries in a Large Online Survey.'" *Sleep Health* 1(2):138–39.

Lauderdale, Diane S. 2001. "Education and Survival: Birth Cohort, Period, and Age Effects." *Demography* 38(4):551–61.

Lauderdale, Diane S., Kristen L. Knutson, Lijing L. Yan, Paul J. Rathouz, Stephen B. Hulley, Steve Sidney, and Kiang Liu. 2006. "Objectively Measured Sleep Characteristics among Early-Middle-Aged Adults: The CARDIA Study." *American Journal of Epidemiology* 164(1):5–16.

Lauderdale, Diane S., Jen-Hao Chen, Lianne M. Kurina, Linda J. Waite, and Ronald A. Thisted. 2016. "Sleep Duration and Health among Older Adults: Associations Vary by How Sleep Is Measured." *Journal of Epidemiology and Community Health* 70(4):361–66.

Lauderdale, Diane S., Kristen L. Knutson, Lijing L. Yan, Kiang Liu, and Paul J. Rathouz. 2008. "Sleep Duration: How Well Do Self-Reports Reflect Objective Measures? The CARDIA

Sleep Study." *Epidemiology* 19(6):838–45.

Lee, Soomi, Lynn M. Martire, Sarah A. Damaske, Jacqueline A. Mogle, Ruixue Zhaoyang, David M. Almeida, and Orfeu M. Buxton. 2018. "Covariation in Couples' Nightly Sleep and Gender Differences." *Sleep Health* 4(2):201–8.

Lee, Soomi, Tori L. Crain, Susan M. McHale, David M. Almeida, and Orfeu M. Buxton. 2017. "Daily Antecedents and Consequences of Nightly Sleep." *Journal of Sleep Research* 26(4):498–509.

Leonhard, Catherine and Christoph Randler. 2009. "In Sync with the Family: Children and Partners Influence the Sleep-Wake Circadian Rhythm and Social Habits of Women." *Chronobiology International* 26(3):510–25.

Lesnard, Laurent. 2008. "Off-Scheduling within Dual-Earner Couples: An Unequal and Negative Externality for Family Time." *American Journal of Sociology* 114(2):447–90.

Lichstein, Kenneth L., Kristen C. Stone, James Donaldson, Sidney D. Nau, James P. Soeffing, David Murray, Kristen W. Lester, and R. Neal Aguillard. 2006. "Actigraphy Validation with Insomnia." *Sleep* 29(2):232–39.

Lockley, S. W. 2010. "Principles of Sleep-Wake Regulation." Pp. 9–34 in *Sleep, Health, and Society: From Aetiology to Public Health*, edited by F. P. Cappuccio, M. A. Miller, and S. W. Lockley. New York: Oxford University Press.

Long, J. Scott and Jeremy Freese. 2014. *Regression Models for Categorical Dependent Variables Using Stata*. 3rd ed. College Station, TX: Stata Press.

Luckhaupt, Sara E., SangWoo Tak, and Geoffrey M. Calvert. 2010. "The Prevalence of Short Sleep Duration by Industry and Occupation in the National Health Interview Survey." *Sleep* 33(2):149–59.

Lynch, Scott M. 2003. “Cohort and Life-Course Patterns in the Relationship between Education and Health: A Hierarchical Approach.” *Demography* 40(2):309–31.

Lynch, Scott M. 2006. “Explaining Life Course and Cohort Variation in the Relationship between Education and Health: The Role of Income.” *Journal of Health and Social Behavior* 47(4):324–38.

Magee, Christopher A., Elizabeth G. Holliday, John Attia, Leonard Kritharides, and Emily Banks. 2013. “Investigation of the Relationship between Sleep Duration, All-Cause Mortality, and Preexisting Disease.” *Sleep Medicine* 14(7):591–96.

Månsdotter, Anna, Lars Lindholm, and Anna Winkvist. 2007. “Paternity Leave in Sweden—Costs, Savings and Health Gains.” *Health Policy* 82(1):102–15.

Månsdotter, Anna and Andreas Lundin. 2010. “How Do Masculinity, Paternity Leave, and Mortality Associate? —A Study of Fathers in the Swedish Parental & Child Cohort of 1988/89.” *Social Science & Medicine* 71(3):576–83.

Marshall, Katherine. 2008. “Fathers’ Use of Paid Parental Leave.” Statistics Canada Catalogue No. 75-001-X.

Marucci-Wellman, Helen R., Tin-Chi Lin, Joanna L. Willetts, Melanye J. Brennan, and Santosh K. Verma. 2014. “Differences in Time Use and Activity Patterns When Adding a Second Job: Implications for Health and Safety in the United States.” *American Journal of Public Health* 104(8):1488–1500.

Masters, Ryan K., Robert A. Hummer, and Daniel A. Powers. 2012. “Educational Differences in U.S. Adult Mortality: A Cohort Perspective.” *American Sociological Review* 77(4):548–72.

Maume, David J., Rachel A. Sebastian, and Anthony R. Bardo. 2010. “Gender, Work-Family Responsibilities, and Sleep.” *Gender & Society* 24(6):746–68.

Maume, David J., Rachel A. Sebastian, and Anthony R. Bardo. 2009. "Gender Differences in Sleep Disruption among Retail Food Workers." *American Sociological Review* 74(6):989–1007.

McHale, Susan M., Katie M. Lawson, Kelly D. Davis, Lynne Casper, Erin L. Kelly, and Orfeu Buxton. 2015. "Effects of a Workplace Intervention on Sleep in Employees' Children." 56(6):672–77.

McKay, Lindsey, Sophie Mathieu, and Andrea Doucet. 2016. "Parental-Leave Rich and Parental-Leave Poor: Inequality in Canadian Labour Market Based Leave Policies." *Journal of Industrial Relations* 58(4):543–62.

McKenna, James J., Helen L. Ball, and Lee T. Gettler. 2007. "Mother–Infant Cosleeping, Breastfeeding and Sudden Infant Death Syndrome: What Biological Anthropology Has Discovered about Normal Infant Sleep and Pediatric Sleep Medicine." *American Journal of Physical Anthropology* 134(S45):133–61.

Meadows, Robert, Sara Arber, Susan Venn, and Jenny Hislop. 2008. "Engaging with Sleep: Male Definitions, Understandings and Attitudes." *Sociology of Health & Illness* 30(5):696–710.

Meadows, Robert, Sara Arber, Susan Venn, Jenny Hislop, and Neil Stanley. 2009. "Exploring the Interdependence of Couples' Rest-Wake Cycles: An Actigraphic Study." *Chronobiology International* 26(1):80–92.

Meara, Ellen R., Seth Richards, and David M. Cutler. 2008. "The Gap Gets Bigger: Changes in Mortality and Life Expectancy, by Education, 1981-2000." *Health Affairs* 27(2):350–60.

Michelson, William. 2014. "Unraveling the Mystery of Sleep Duration Dynamics – Sleep in the Objective and Subjective Lives of Employed Men and Women." *Electronic International*

Journal of Time Use Research 11(1):57–72. doi:10.13085/eIJTUR.11.1.57-72.

Miech, Richard Allen and Michael J. Shanahan. 2000. "Socioeconomic Status and Depression over the Life Course." *Journal of Health and Social Behavior* 41(2):162–76.

Milkie, Melissa A., Sara B. Raley, and Suzanne M. Bianchi. 2009. "Taking on the Second Shift: Time Allocations and Time Pressures of U.S. Parents with Preschoolers." *Social Forces* 88(2):487–517.

Millar, Wayne J. and Heather Maclean. 2005. "Breastfeeding Practices." Statistics Canada Catalogue No. 82-003. *Health Reports* 16(2):23–31.

Miller, Christopher B., Christopher J. Gordon, Leanne Toubia, Delwyn J. Bartlett, Ronald R. Grunstein, Angela L. D'Rozario, and Nathaniel S. Marshall. 2015. "Agreement between Simple Questions about Sleep Duration and Sleep Diaries in a Large Online Survey." *Sleep Health* 1(2):133–37.

Ministère du Travail, de l'Emploi et de la Solidarité sociale. 2017. "Parental Benefits." Ministère du Travail, de l'Emploi et de la Solidarité sociale. Retrieved September 11, 2017 (http://www.rqap.gouv.qc.ca/travailleur_salarie/types/parentales_en.asp).

Minnesota Population Center. N.d. "AHTUS Sample Characteristics." Minneapolis, MN: Minnesota Population Center. Retrieved February 3, 2019 (https://www.ahtusdata.org/ahtus/samples.shtml).

Minnesota Population Center. 2017. *Codebook for an ATUS Data Extract*. Minneapolis, MN: Minnesota Population Center.

Mirowsky, John and Catherine E. Ross. 2008. "Education and Self-Rated Health: Cumulative Advantage and Its Rising Importance." *Research on Aging* 30(1):93–122.

Moen, Phyllis, Wen Fan, and Erin L. Kelly. 2013. "Team-Level Flexibility, Work-Home

Spillover, and Health Behavior." *Social Science & Medicine* 84:69–79.

Moen, Phyllis, Erin L. Kelly, Eric Tranby, and Qinlei Huang. 2011. "Changing Work, Changing Health: Can Real Work-Time Flexibility Promote Health Behaviors and Well-Being?" *Journal of Health and Social Behavior* 52(4):404–29.

Montgomery-Downs, Hawley E., Heather M. Clawges, and Eleanor E. Santy. 2010. "Infant Feeding Methods and Maternal Sleep and Daytime Functioning." *Pediatrics* 126(6):e1562–68.

Montgomery-Downs, Hawley E., Robyn Stremler, and Salvatore P. Insana. 2013. "Postpartum Sleep in New Mothers and Fathers." *The Open Sleep Journal* 6:87–97.

Moore, Philip J., Nancy E. Adler, David R. Williams, and James S. Jackson. 2002. "Socioeconomic Status and Health: The Role of Sleep." *Psychosomatic Medicine* 64(2):337–44.

Morley, John, Fadila Sanoussi, Isabella Biletta, and Felix Wolf. 2010. *Comparative Analysis of Working Time in the European Union*. Dublin, Ireland. European Foundation for the Improvement of Living and Working Conditions. Retrieved March 8, 2019 (https://www.eurofound.europa.eu/sites/default/files/ef_files/docs/ewco/tn0803046s/tn0803046s.pdf).

Morris, Christopher J., Daniel Aeschbach, and Frank A. J. L. Scheer. 2012. "Circadian System, Sleep and Endocrinology." *Molecular and Cellular Endocrinology* 349(1):91–104.

Morris, Christopher J., Taylor E. Purvis, Kun Hu, and Frank A. J. L. Scheer. 2016. "Circadian Misalignment Increases Cardiovascular Disease Risk Factors in Humans." *Proceedings of the National Academy of Sciences* 113(10):E1402-1411.

Morris, Sarah, Alun Humphrey, Pablo Cabrera Alvarez, and Olivia D'Lima. 2016. "The UK

Time Diary Study 2014 - 2015: Technical Report." NatCen Social Research. Retrieved (http://doc.ukdataservice.ac.uk/doc/8128/mrdoc/pdf/8128_natcen_reports.pdf).

Mosisa, Abraham and Steven Hipple. 2006. "Trends in Labor Force Participation in the United States." *Monthly Labor Review* 129(10):35–57.

Munnell, Alicia H. 2015. "The Average Retirement Age – an Update." IB No. 15-4, Center for Retirement Reseach at Boston College, Chestnut Hill, MA.

National Institute of Neurological Disorders and Stroke. 2019. "Brain Basics: Understanding Sleep." National Institute of Neurological Disorders and Stroke. Retrieved March 4, 2019 (https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Understanding-Sleep#10).

National Sleep Foundation. N.d. *2010 Sleep in America Poll: Summary of Findings*. Washington, D.C.: National Sleep Foundation.

Nepomnyaschy, Lenna and Jane Waldfogel. 2007. "Paternity Leave and Fathers' Involvement with Their Young Children." *Community, Work and Family* 10(4):427–53.

Nishihara, Kyoko, Shigeko Horiuchi, Hiromi Eto, Sunao Uchida, and Makoto Honda. 2004. "Delta and Theta Power Spectra of Night Sleep EEG Are Higher in Breast-Feeding Mothers than in Non-Pregnant Women." *Neuroscience Letters* 368(2):216–20.

Nobelförsamlingen. 2017. "The Nobel Assembly at Karolinska Institutet Has Today Decided to Award the 2017 Nobel Prize in Physiology or Medicine Jointly to Jeffrey C. Hall, Michael Rosbash and Michael W. Young for Their Discoveries of Molecular Mechanisms Controlling the Circadian Rhythm." Nobelförsamlingen, the Nobel Assembly at Karolinska Institutet. Retrieved February 3, 2019 (https://www.nobelprize.org/uploads/2018/06/press-39.pdf).

Nomaguchi, Kei M. and Suzanne M. Bianchi. 2004. "Exercise Time: Gender Differences in the Effects of Marriage, Parenthood, and Employment." *Journal of Marriage and Family* 66(2):413–30.

O'Brien, Margaret. 2009. "Fathers, Parental Leave Policies, and Infant Quality of Life: International Perspectives and Policy Impact." *The ANNALS of the American Academy of Political and Social Science* 624(1):190–213.

OECD Family Database. 2016. "Time Spent Travelling to and from Work." OECD – Social Policy Division. Retrieved March 8, 2019 (http://www.oecd.org/els/family/LMF2_6_Time_spent_travelling_to_and_from_work.pdf).

Office for National Statistics. 2018a. "Commuting to Work by Gender, UK Country and Region." Retrieved January 4, 2019 (https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/commutingtoworkbygenderukcountryandregion).

Office for National Statistics. 2018b. "Employment and Employee Types." Retrieved December 4, 2018 (https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes).

Office for National Statistics. 2018c. "The Commuting Gap: Men Account for 65% of Commutes Lasting More than an Hour." Retrieved January 3, 2019 (https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/articles/thecommutinggapmenaccountfor65ofcommuteslastingmorethananhour/2018-11-07).

Olmo Sánchez, Ma. Isabel and Elvira Maeso González. 2014. "Travel Patterns, Regarding

Different Activities: Work, Studies, Household Responsibilities and Leisure." *Transportation Research Procedia* 3:119–28.

Olson, Ryan, Tori L. Crain, Todd E. Bodner, Rosalind King, Leslie B. Hammer, Laura Cousino Klein, Leslie Erickson, Phyllis Moen, Lisa F. Berkman, and Orfeu M. Buxton . 2015. "A Workplace Intervention Improves Sleep: Results from the Randomized Controlled Work, Family, and Health Study." *Sleep Health* 1(1):55–65.

Orlikowski, Wanda J. and JoAnne Yates. 2002. "It's About Time: Temporal Structuring in Organizations." *Organization Science* 13(6):684–700.

Osberg, Lars. 2003. "Long Run Trends in Income Inequality in the United States, UK, Sweden, Germany and Canada: A Birth Cohort View." *Eastern Economic Journal* 29(1):121–41.

Owens, Judith A., Katherine Belon, and Patricia Moss. 2010. "Impact of Delaying School Start Time on Adolescent Sleep, Mood, and Behavior." *Archives of Pediatrics & Adolescent Medicine* 164(7):608–14.

Panda, Satchidananda, John B. Hogenesch, and Steve A. Kay. 2002. "Circadian Rhythms from Flies to Human." *Nature* 417:329–35.

Passias, Emily J., Liana Sayer, and Joanna R. Pepin. 2016. "Who Experiences Leisure Deficits? Mothers' Marital Status and Leisure Time." *Journal of Marriage and Family* 79(4):1001–1022.

Patel, Sanjay R., Atul Malhotra, Daniel J. Gottlieb, David P. White, and Frank B. Hu. 2006. "Correlates of Long Sleep Duration." *Sleep* 29(7):881–89.

Patnaik, Ankita. 2016. "Reserving Time for Daddy: The Short and Long-Run Consequences of Fathers' Quotas." Retrieved (http://papers.ssrn.com/abstract=2475970).

Piketty, Thomas and Emmanuel Saez. 2014. "Inequality in the Long Run." *Science*

344(6186):838–43.

Presser, Harriet B., Janet C. Gornick, and Sangeeta Parashar. 2008. “Gender and Nonstandard Work Hours in 12 European Countries.” *Monthly Labor Review* 131(2):83–103.

Quillin, Stephanie I. M. and L. Lee Glenn. 2004. “Interaction between Feeding Method and Co-sleeping on Maternal-Newborn Sleep.” *Journal of Obstetric, Gynecologic & Neonatal Nursing* 33(5):580–88.

Rehel, Erin M. 2014. “When Dad Stays Home Too: Paternity Leave, Gender, and Parenting.” *Gender & Society* 28(1):110–32.

Roantree, Barra and Kartik Vira. 2018. *The Rise and Rise of Women’ s Employment in the UK*. IFS Briefing Note BN234, Institute for Fiscal Studies. Retrieved March 8, 2019 (https://www.ifs.org.uk/uploads/BN234.pdf).

Robinson, John P. and Geoffrey Godbey. 1999. *Time for Life: The Surprising Ways Americans Use Their Time*. 2nd ed. University Park, PA: The Pennsylvania State University Press.

Robinson, John P. and William Michelson. 2010. “Sleep as a Victim of the ‘Time Crunch’ – A Multinational Analysis.” *Electronic International Journal of Time Use Research* 7(1):61–72. doi:10.13085/eIJTUR.7.1.61-72.

Roenneberg, Till, Tim Kuehnle, Myriam Juda, Thomas Kantermann, Karla Allebrandt, Marijke Gordijn, and Martha Merrow. 2007. “Epidemiology of the Human Circadian Clock.” *Sleep Medicine Reviews* 11(6):429–38.

Roenneberg, Till, Tim Kuehnle, Peter P. Pramstaller, Jan Ricken, Miriam Havel, Angelika Guth, and Martha Merrow. 2004. “A Marker for the End of Adolescence.” *Current Biology* 14(24):R1038-1039.

Roenneberg, Till, C. Jairaj Kumar, and Martha Merrow. 2007. “The Human Circadian Clock

Entrains to Sun Time." *Current Biology* 17(2):R44–45.

Roenneberg, Till and Martha Merrow. 2005. "Circadian Clocks — the Fall and Rise of Physiology." *Nature Reviews Molecular Cell Biology* 6:965–71.

Roenneberg, Till, Anna Wirz-Justice, and Martha Merrow. 2003. "Life between Clocks: Daily Temporal Patterns of Human Chronotypes." *Journal of Biological Rhythms* 18(1):80–90.

Ross, Catherine E. and Chia-Ling Wu. 1996. "Education, Age, and the Cumulative Advantage in Health." *Journal of Health and Social Behavior* 37(1):104–20.

Sayer, Liana C., Anne H. Gauthier, and Frank F. Furstenberg, Jr. 2004. "Educational Differences in Parents' Time With Children: Cross-National Variations." *Journal of Marriage and Family* 66(5):1152–69.

Seicean, Sinziana, Duncan Neuhauser, Kingman Strohl, and Susan Redline. 2011. "An Exploration of Differences in Sleep Characteristics between Mexico-Born US Immigrants and Other Americans to Address the Hispanic Paradox." *Sleep* 34(8):1021–31.

Sewell, William H., Jr. 1992. "A Theory of Structure: Duality, Agency, and Transformation." *American Journal of Sociology* 98(1):1–29.

Shandra, Carrie L., Allison Kruger, and Lauren Hale. 2014. "Disability and Sleep Duration: Evidence from the American Time Use Survey." *Disability and Health Journal* 7(3):325–34.

Shankar, Anoop, Sabanayagam Charumathi, and Sita Kalidindi. 2011. "Sleep Duration and Self-Rated Health: The National Health Interview Survey 2008." *Sleep* 34(9):1173–77.

Short, Sandra. 2006. "Review of the UK 2000 Time Use Survey." Office for National Statistics. Retrieved March 8, 2019 (http://timeuse-2009.nsms.ox.ac.uk/information/studies/data/downloads/uk/2000-

01/ReviewTimeUseSurvey2000.pdf).

Simple Lógica. 2016. "La Siesta Entre Los Españoles (Diciembre 2016)." Retrieved January 16, 2019 (http://www.simplelogica.com/en/la-siesta-entre-los-espanoles-diciembre-2016/#).

Sorokin, Pitirim A. and Robert K. Merton. 1937. "Social Time: A Methodological and Functional Analysis." *American Journal of Sociology* 42(5):615–29.

Stamatakis, Katherine A., George A. Kaplan, and Robert E. Roberts. 2007. "Short Sleep Duration Across Income, Education, and Race/Ethnic Groups: Population Prevalence and Growing Disparities During 34 Years of Follow-Up." *Annals of Epidemiology* 17(12):948–55.

Statistics Canada. 2017a. "Marital Status and Opposite- and Same-Sex Status by Sex for Persons Aged 15 and over Living in Private Households for Both Sexes, Total, Presence and Age of Children, 2016 Counts, Canada, Provinces and Territories, 2016 Census – 100% Data." *Families, Households and Marital Status Highlight Tables*. Retrieved August 29, 2018 (https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/fam/Table.cfm?Lang=E&T=11&Geo=00&SP=1&view=1&sex=1&presence=1).

Statistics Canada. 2017b. "Marital Status and Opposite- and Same-Sex Status by Sex for Persons Aged 15 and over Living in Private Households for Both Sexes, with at Least One Child Aged 0 to 14, 2016 Counts, Canada, Provinces and Territories, 2016 Census – 100% Data." *Families, Households and Marital Status Highlight Tables*. Retrieved August 17, 2018 (https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/fam/Table.cfm?Lang=E&T=11&Geo=00&SP=1&view=1&sex=1&presence=4).

Statistics Canada. 2017c. "The General Social Survey: An Overview." Statistics Canada. Retrieved February 21, 2018 (http://www.statcan.gc.ca/pub/89f0115x/89f0115x2013001-

eng.htm).

Stranges, Saverio, Joan M. Dorn, Martin J. Shipley, Ngianga-Bakwin Kandala, Maurizio Trevisan, Michelle A. Miller, Richard P. Donahue, Kathleen M. Hovey, Jane E. Ferrie, Michael G. Marmot, and Francesco P. Cappuccio. 2008. "Correlates of Short and Long Sleep Duration: A Cross-Cultural Comparison Between the United Kingdom and the United States." 168(12):1353–64.

Tanaka, Sakiko and Jane Waldfogel. 2007. "Effects of Parental Leave and Work Hours on Fathers' Involvement with Their Babies." *Community, Work and Family* 10(4):409–26.

Thomas, S. Justin, Kenneth L. Lichstein, Daniel J. Taylor, Brant W. Riedel, and Andrew J. Bush. 2014. "Epidemiology of Bedtime, Arising Time, and Time in Bed: Analysis of Age, Gender, and Ethnicity." *Behavioral Sleep Medicine* 12:169–82.

Troxel, Wendy M. 2010. "It's More than Sex: Exploring the Dyadic Nature of Sleep and Implications for Health." *Psychosomatic Medicine* 72(6):578–86.

Troxel, Wendy M., Theodore F. Robles, Martica Hall, and Daniel J. Buysse. 2007. "Marital Quality and the Marital Bed: Examining the Covariation between Relationship Quality and Sleep." *Sleep Medicine Reviews* 11(5):389–404.

U.S. Bureau of Labor Statistics. N.d. "American Time Use Survey Activity Lexicon 2003-2016." Retrieved March 1, 2019 (https://www.bls.gov/tus/lexiconnoex0316.pdf).

U.S. Bureau of Labor Statistics. 2019. *American Time Use Survey User's Guide: Understanding ATUS 2003 to 2017*. Retrieved March 1, 2019 (https://www.bls.gov/tus/atususersguide.pdf).

U.S. Census Bureau. 2006. "Current Population Survey: Design and Methodology." Technical Paper 66. Retrieved March 1, 2019 (https://www.census.gov/prod/2006pubs/tp-66.pdf).

Umberson, Debra. 1992. "Gender, Marital Status and the Social Control of Health Behavior."

Social Science & Medicine 34(8):907–17.

Valletta, Rob. 2015. “Higher Education, Wages, and Polarization.” *Federal Reserve Bank of San Francisco Economic Letter* 2015-2.

Van Cauter, Eve. and Karine Spiegel. 1999. “Sleep as a Mediator of the Relationship between Socioeconomic Status and Health: A Hypothesis.” *Annals of the New York Academy of Sciences* 896(1):254–61.

van Klaveren, Chris, Henriette Maassen van den Brink, and Bernard van Praag. 2013. “Intra-Household Work Timing : The Effect on Joint Activities and the Demand for Child Care.” 29(1):1–18.

van Tienoven, T. P., I. Glorieux, and J. Minnen. 2014. “The Impact of Work and Family Responsibilities on Healthy Sleep Habits.” *Time & Society* 23(2):235–57.

Venn, Susan, Sara Arber, Robert Meadows, and Jenny Hislop. 2008. “The Fourth Shift: Exploring the Gendered Nature of Sleep Disruption among Couples with Children.” *British Journal of Sociology* 59(1):79–97.

Victora, Cesar G., Rajiv Bahl, Aluísio J. D. Barros, Giovanny V. A. França, Susan Horton, Julia Krasevec, Simon Murch, Mari Jeeva Sankar, Neff Walker, and Nigel C. Rollins. 2016. “Breastfeeding in the 21st Century: Epidemiology, Mechanisms, and Lifelong Effect.” *The Lancet* 387(10017):475–90.

Whinnery, Julia, Nicholas Jackson, Pinyo Rattanaumpawan, and Michael A. Grandner. 2014. “Short and Long Sleep Duration Associated with Race/Ethnicity, Sociodemographics, and Socioeconomic Position.” *Sleep* 37(3):601–11.

Wight, Vanessa R., Sara B. Raley, and Suzanne M. Bianchi. 2008. “Time for Children, One’s Spouse and Oneself among Parents Who Work Nonstandard Hours.” *Social Forces*

87(1):243–71.

Winship, Christopher. 2009. "Time and Scheduling." Pp. 498–520 in *The Oxford Handbook of Analytical Sociology*, edited by P. Hedström and P. Bearman. New York: Oxford University Press.

Winship, Christopher and Larry Radbill. 1994. "Sampling Weights and Regression Analysis." *Sociological Methods & Research* 23(2):230–57.

Yamanaka, Yujiro, Ken-ichi Honma, Satoko Hashimoto, Nana Takasu, Toshihiko Miyazaki, and Sato Honma. 2006. "Effects of Physical Exercise on Human Circadian Rhythms." *Sleep and Biological Rhythms* 4(3):199–206.

Yamazaki, Akemi. 2007. "Family Synchronizers: Predictors of Sleep–Wake Rhythm for Japanese First-Time Mothers." *Sleep and Biological Rhythms* 5(3):218–25.

Young, Cristobal and Chaeyoon Lim. 2014. "Time as a Network Good: Evidence from Unemployment and the Standard Workweek." *Sociological Science* 1(2):10–27. doi:10.15195/v1.a2.

Young, Marisa, Scott Schieman, and Melissa A. Milkie. 2014. "Spouse's Work-to-Family Conflict, Family Stressors, and Mental Health among Dual-Earner Mothers and Fathers." *Society and Mental Health* 4(1):1–20.

Appendix. Supplementary Tables and Figures

Supplementary Table 2.1 List of Statistics Canada GSS Activity Codes Qualifying as Child Care

2005		2010	
Code	Description	Code	Description
200	Care for child 0-4 years old (includes feeding)	200.1	Care for child 0-4 years old
		202.2	Food preparation for child 0-4 years old
		200.3	Feeding child 0-4 years old
211	Putting child 5-14 years old to bed	211.0	Putting child 5-14 years old to bed
212	Preparing child 5-14 years old for school	212.0	Preparing child 5-14 years old for school
213	Personal care for household child 5-14 years old	213.0	Personal care for household child 5-14 years old
220	Helping, teaching, or reprimanding child	220.0	Helping, teaching, or reprimanding child
230	Reading or talking with child	230.1	Reading with child
		230.2	Talking with child
240	Playing with child	240.0	Playing with child
250	Providing medical care to household child	250.1	Providing medical care to household child
		250.2	Providing emotional care to household child
260	Babysitting household child without pay	260.0	Babysitting household child without pay
281	Providing other help or care to household child	281.1	Visiting child care provider or school of household child younger than 15 years old
		281.2	Communicating regarding child care or school of household child younger than 15 years old
		281.8	Providing other education-related assistance to household child younger than 15 years old
		281.9	Providing other assistance, not related to education, to household child younger than 15 years old
291	Travel related to personal care of household child younger than 15 years old.	291.0	Travel related to personal care of household child younger than 15 years old

Source: General Social Survey Cycle 19: Time Use (2005) User's Guide to the Public Use Microdata File (Béchard and Marchand 2006, p. 874-880); General Social Survey Cycle 24: Time-Stress and Well-being Public Use Microdata File Documentation and User's Guide (Béchard 2015, p. 178-187)

Note: The Statistics Canada GSS generally considers individuals younger than 15 years of age children.

Supplementary Table 2.2 Descriptive Statistics of Independent Variables for Partnered Parents Whose Youngest Child Is Five-to-14 Years Old, by Province, Year, and Gender

	Non-Quebec Provinces				Quebec			
	2005		2010		2005		2010	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Age category (%)								
18-29 years old	4.2*	1.9	2.6	3.3	4.5	1.5	1.4	3.0
30-34 years old	13.2***	7.6	12.0***	5.0	13.3*	7.4	16.0	9.6
35-39 years old	26.1	23.0	22.6	21.8	29.0*	20.7	27.2	26.6
40 years old or more	56.5***	67.5	62.8*	69.8	53.2***	70.4	55.4	60.9
Married (%)	93.4*	90.1	91.1	93.1	61.5	61.8	60.8	50.9
Born outside of Canada (%)[a]	25.0†	20.3	25.7	25.4	11.2	11.6	17.1*	6.6
> one child in household (%)	54.6	52.3	56.6	50.9	56.8	54.5	58.8	54.4
Weekend diary day (%)	27.7	25.2	29.0	33.5	32.8*	21.1	31.1*	18.3
Holds a college degree (%)	27.8	28.2	36.9	32.3	21.6	24.8	34.3	33.3
Reports a disability (%)[b]	25.6	28.7	34.6	31.1	27.5	27.6	24.8	35.4
Employment hours (on diary day)	4.0***	7.3	4.0***	5.9	3.8***	6.7	4.4***	7.6
	(4.9)	(5.0)	(4.2)	(4.4)	(4.4)	(4.5)	(3.4)	(2.9)
Napped on diary day (%)	8.4	5.8	7.2***	1.9	6.4	6.1	2.0	4.1
N	842	642	619	445	179	148	91	73

†p<.10; * p<.05; ** p<.01; *** p<.001 (refers to gender difference within year and province category)

Source: Statistics Canada General Social Survey, 2005 and 2010

[a] Difference-in-difference significant at p<0.05. This represents the difference between Quebec and non-Quebec provinces in the difference between 2005 and 2010 in gender difference.

[b] Difference-in-difference significant at p<0.1. This represents the difference between Quebec and non-Quebec provinces in the difference between 2005 and 2010 in gender difference.

Supplementary Table 2.3 Descriptive Statistics of Sleep Outcome Variables for Partnered Parents, by Province, Year, and Youngest Child's Age

	Non-Quebec Provinces				Quebec			
	2005		2010		2005		2010	
	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers	Mothers	Fathers
Youngest Child 0-3 Years Old								
Sleep duration (hours)[bc]	8.1	8.0[a]	8.3***	7.6	8.2***	7.4[a]	8.3	8.0
	(2.0)	(2.2)	(1.5)	(1.7)	(1.5)	(1.3)	(1.6)	(0.9)
Interrupted sleep (%)	15.6***	2.2	19.5***	4.6	10.7***[a]	0.0	21.9***	3.5
Youngest Child 5-14 Years Old								
Sleep duration (hours)	8.1*	7.9	8.0	8.0	8.3*	8.0	8.0†	7.5
	(1.9)	(1.8)	(1.6)	(1.5)	(1.3)	(1.3)	(1.4)	(1.2)

†p<.10; * p<.05; ** p<.01; *** p<.001 (refers to gender difference within year and province category)

Source: Statistics Canada General Social Survey, 2005 and 2010. Note: Change from 2005 to 2010 within gender and province category in the proportion of parents (whose youngest child is 0-3 years old) with interrupted sleep has p<0.1 for non-Quebec and Quebec fathers.

[a] Change from 2005 to 2010 within gender and province category significant at p<0.05.

[b] Difference-in-difference significant at p<0.05 among difference-in-difference sample. This represents the difference between Quebec and non-Quebec provinces in the difference between 2005 and 2010 in gender difference, among parents whose youngest child is 0-3 years old.

[c] Triple difference significant at p<0.05. This represents the difference between parents whose youngest child is 0-3 years old and parents whose youngest child is 5-14 years old in the difference-in-difference (i.e., by year and province) of gender difference. (This statistic is not available for sleep interruption.)

Supplementary Table 2.4 Coefficients from OLS Regression Models Predicting Difference-in-Difference of Gender Difference in Partnered Parents' Essential Sleep Duration

	Model 1	Model 2	Model 3
Quebec x 2010 x Male	1.06*	0.77†	0.68†
	(0.42)	(0.41)	(0.41)
Quebec	0.13	0.12	0.05
	(0.18)	(0.18)	(0.17)
2010	0.19	0.16	0.16
	(0.12)	(0.12)	(0.12)
Male	-0.10	0.41**	0.31*
	(0.14)	(0.16)	(0.15)
Quebec x Male	-0.71**	-0.58*	-0.56*
	(0.27)	(0.26)	(0.26)
2010 x Male	-0.54**	-0.52**	-0.52**
	(0.20)	(0.19)	(0.19)
Quebec x 2010	-0.11	0.03	0.10
	(0.30)	(0.30)	(0.30)
Employment hours (on diary day)		-0.13***	-0.14***
		(0.01)	(0.01)
Napped			-0.59***
			(0.15)
Sleep interruption			-0.83***
			(0.14)
Constant	7.81***	8.31***	8.63***
	(0.19)	(0.19)	(0.19)
N	2,361	2,361	2,361
R-squared	.06	.14	.16

†p<.10; * p<.05; ** p<.01; *** p<.001

Source: Statistics Canada General Social Survey, 2005 and 2010. Note: Standard errors in parentheses, calculated using bootstrap replicate weights. Models control for province, whether the diary day was on a weekend, whether the respondent was born outside of Canada, the respondent's age (a categorical measure), whether more than one child lives in the household, marital status, whether the respondent holds a college degree, and whether the respondent has a disability.

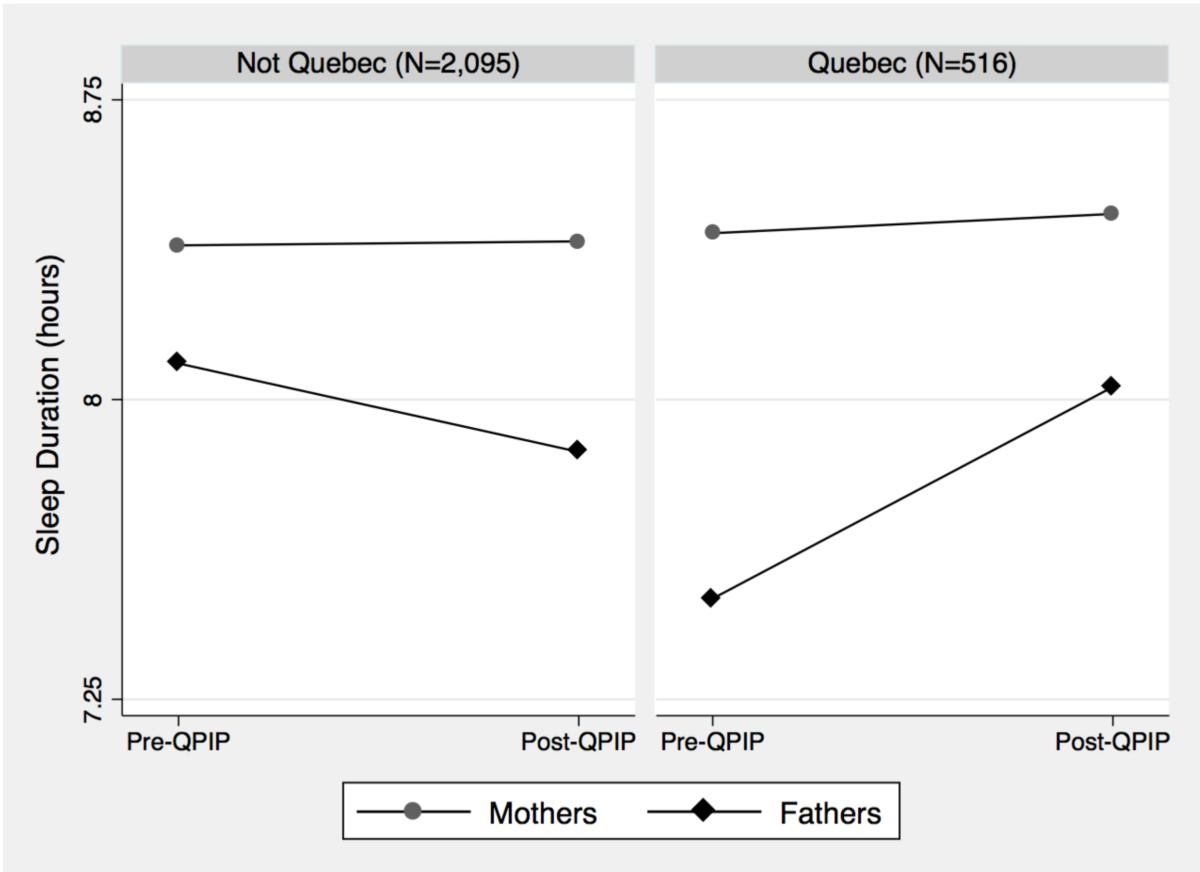
Supplementary Table 2.5 Coefficients from OLS Regression Models Predicting Triple Differences of Gender Difference in Partnered Parents' Essential Sleep Duration

	Model 4	Model 5	Model 6
Quebec x 2010 x Youngest Child 0-3 x Male	1.29*	0.89	0.82
	(0.59)	(0.57)	(0.56)
Youngest Child 0-3 Years Old	-0.18	-0.30**	-0.17
	(0.11)	(0.11)	(0.11)
Quebec x Youngest Child 0-3	-0.09	-0.14	-0.16
	(0.20)	(0.20)	(0.19)
2010 x Youngest Child 0-3	0.29†	0.26†	0.28†
	(0.16)	(0.16)	(0.15)
Quebec x 2010 x Youngest Child 0-3	0.09	0.17	0.20
	(0.37)	(0.37)	(0.37)
Youngest Child 0-3 Years Old x Male	0.11	0.22	0.11
	(0.17)	(0.17)	(0.17)
Quebec x Youngest Child 0-3 x Male	-0.69*	-0.48	-0.48
	(0.34)	(0.33)	(0.33)
2010 x Youngest Child 0-3 x Male	-0.64*	-0.52*	-0.50*
	(0.26)	(0.25)	(0.24)
Quebec x 2010 x Male	-0.24	-0.11	-0.11
	(0.40)	(0.39)	(0.39)
Quebec	0.15	0.15	0.13
	(0.14)	(0.13)	(0.13)
2010	-0.11	-0.11	-0.11
	(0.10)	(0.10)	(0.10)
Male	-0.22*	0.13	0.14
	(0.10)	(0.10)	(0.11)
Quebec x Male	-0.02	-0.11	-0.10
	(0.21)	(0.20)	(0.20)
2010 x Male	0.11	0.00	-0.03
	(0.17)	(0.16)	(0.16)
Quebec x 2010	-0.21	-0.15	-0.13
	(0.24)	(0.24)	(0.24)
Employment hours (on diary day)		-0.12***	-0.12***
		(0.01)	(0.01)
Napped			-0.53***
			(0.14)
Sleep interruption			-0.75***
			(0.14)
Constant	8.09***	8.72***	8.83***
	(0.13)	(0.13)	(0.14)
N	5,400	5,400	5,400
R-squared	.06	.14	.15

†p<.10; * p<.05; ** p<.01; *** p<.001
Source: Statistics Canada General Social Survey, 2005 and 2010. Note: Standard errors in parentheses, calculated using bootstrap replicate weights. Models control for

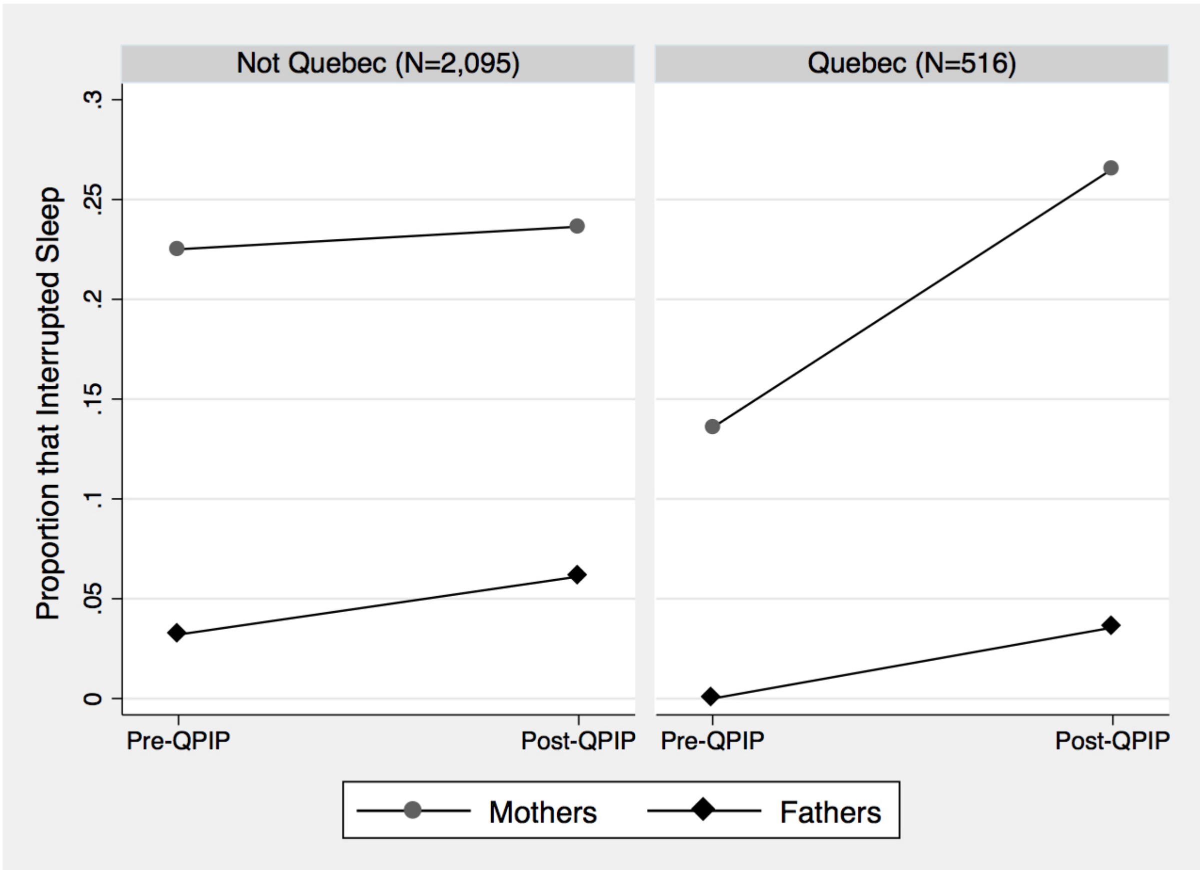
province, whether the diary day was on a weekend, whether the respondent was born outside of Canada, the respondent’s age (a categorical measure), whether more than one child lives in the household, marital status, whether the respondent holds a college degree, and whether the respondent has a disability.

Supplementary Figure 2.1 Average Sleep Duration of Partnered Mothers and Fathers Whose Youngest Child Is Zero-to-Two Years Old, by Province and Whether Interview Year is Post-QPIP Implementation



Source: Statistics Canada General Social Survey, 2005, 2010, and 2015-2016.
Note: Results based on weighted data.

Supplementary Figure 2.2 Proportion of Partnered Parents with Youngest Child Zero-to-Two Years Old that Interrupted Sleep to Care for Child on Diary Day, by Province and Year



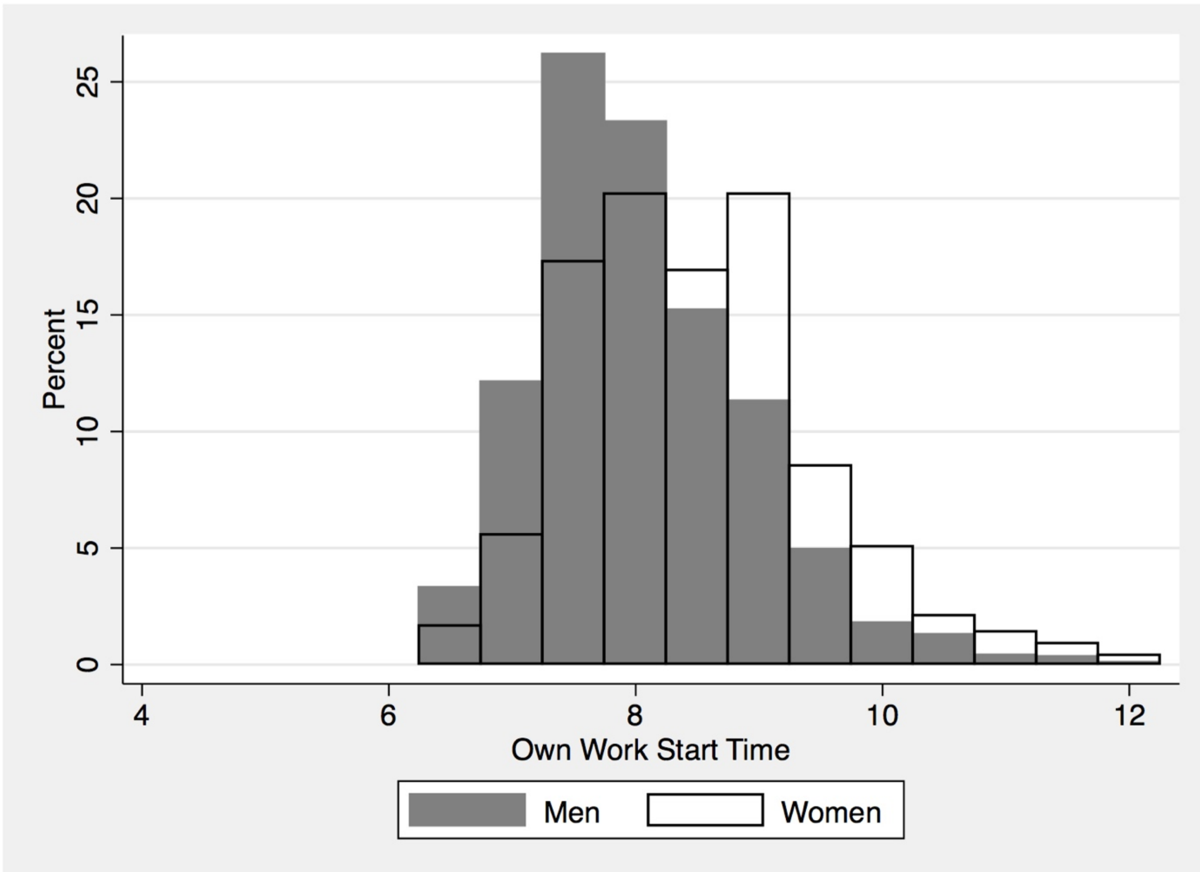
Source: Statistics Canada General Social Survey, 2005, 2010, and 2015-2016.
Note: Results based on weighted data.

Supplementary Table 3.1 Descriptive Statistics for Wake Time, Work Start Time, Sociodemographic Characteristics, and Interview Timing in Spain, by Gender

	Men	Women	Difference (Men - Women)	
Panel A: Individual-Level Variables				
Own Wake Time (clock time)	7:13	7:18	-0:05	***
(SD in minutes)	(40.9)	(42.2)		
Own Work Start Time (clock time)	8:02	8:29	-0:27	***
(SD in minutes)	(53.1)	(63.1)		
Started Work First (%)	57.2	27.2	29.9	***
Work Hours (in hours)	9.7	7.8	1.9	***
(SD in hours)	(2.2)	(2.5)		
Age (in years)	42.4	40.4	2.0	***
	(9.1)	(9.1)		
Education (%)				
Less than Secondary	10.7	9.8	1.0	
Secondary	39.5	37.9	1.6	
Post-Secondary	49.8	52.3	-2.5	*
N	1,846	1,846		
Panel B: Couple-Level Variables				
Presence of Household Children (%)				
Young Children	24.4			
Older Children	36.4			
Childless	39.2			
Interview Year (%)				
2002-2003	67.8			
2009-2010	32.2			
Interview Season (%)				
Winter	28.2			
Spring	28.5			
Summer	20.6			
Fall	22.8			
Interview Day (%)				
Monday	17.7			
Tuesday	17.3			
Wednesday	18.0			
Thursday	18.6			
Friday	28.4			
N	3,692			

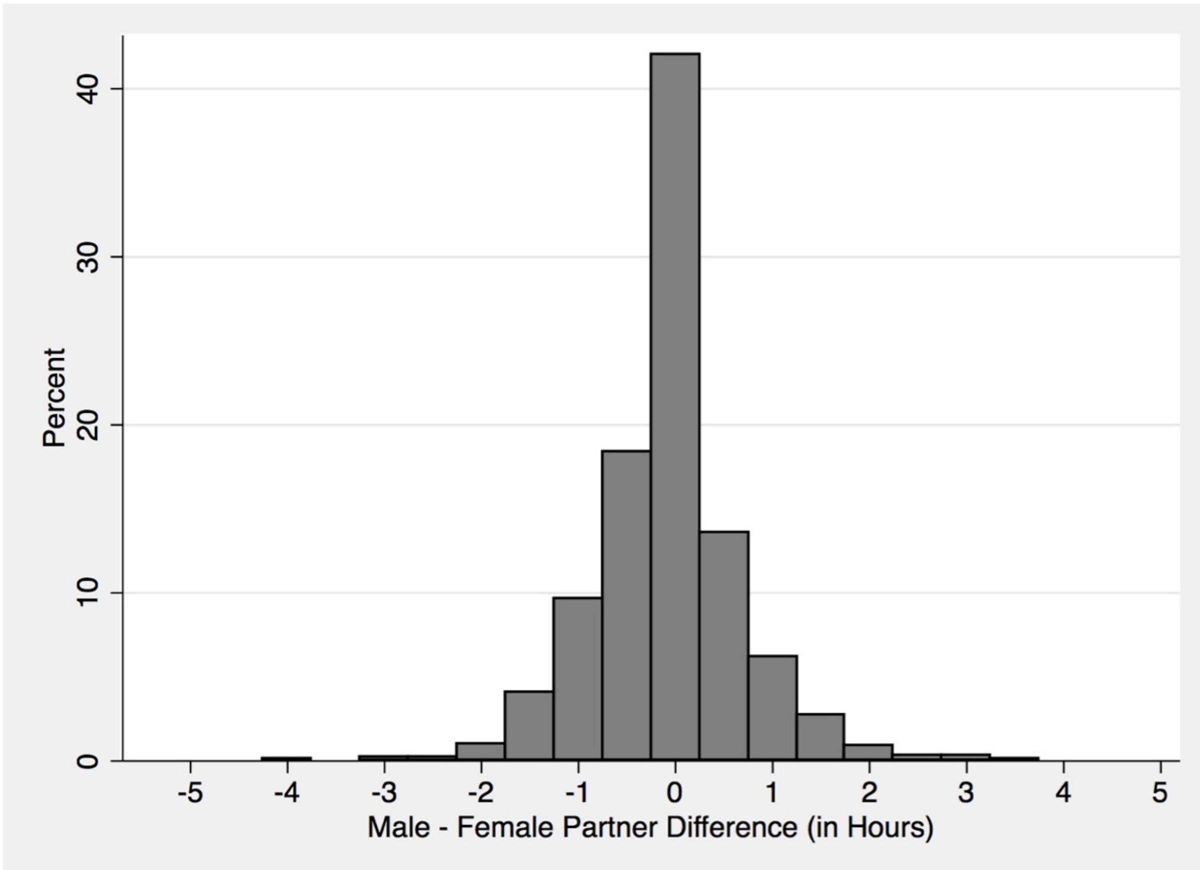
†p<.10; * p<.05; ** p<.01; *** p<.001. Source: Multinational Time Use Study, 2002-2003 and 2009-2010. Note: MTUS probability weights used in calculating descriptive statistics for individual-level variables. SD = standard deviation. Standard deviations provided in parentheses for continuous variables.

Supplementary Figure 3.1 Histogram of Own Work Start Time among Respondents in Spain, by Gender



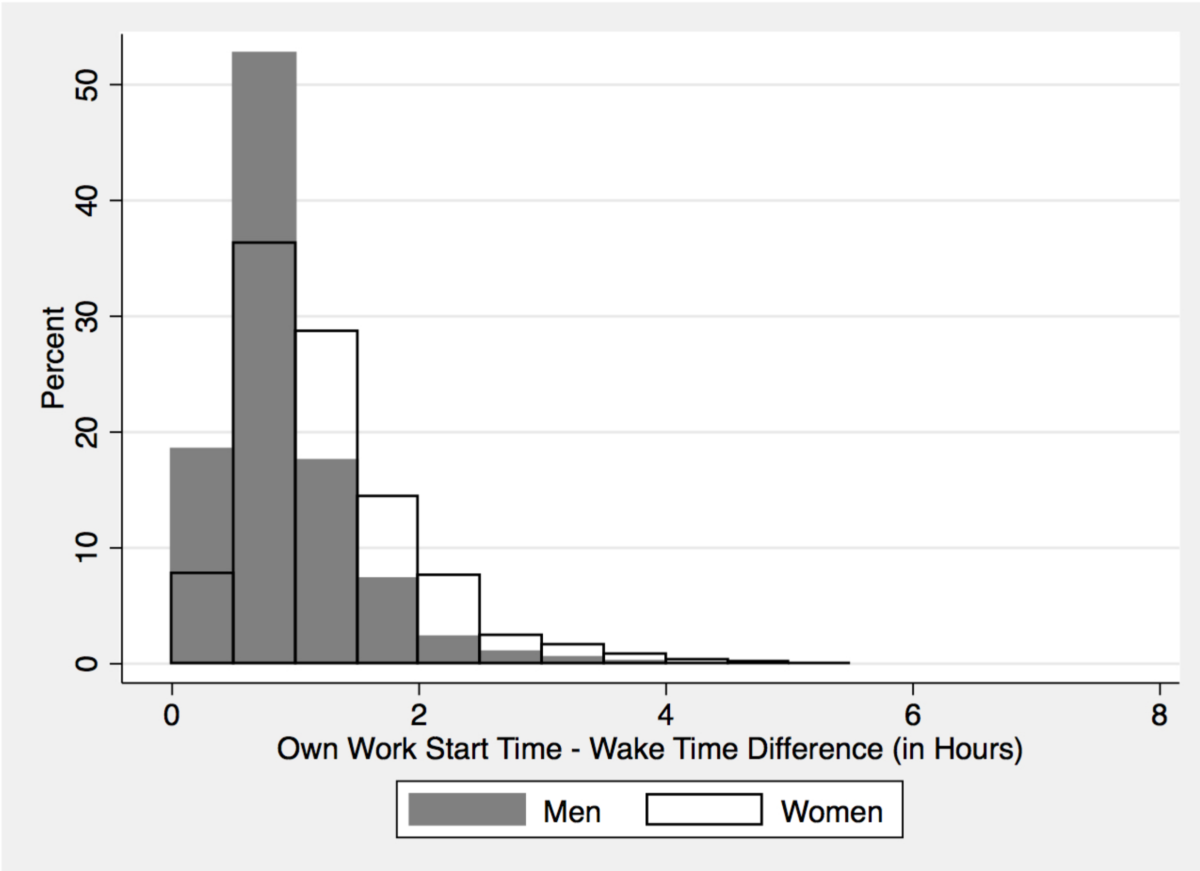
Source: Multinational Time Use Study, 2000-2001 and 2014-2015.
Note: These statistics are not weighted.

Supplementary Figure 3.2 Histogram of the Difference (Male - Female) in Wake Time between Partners in Spain



Source: Multinational Time Use Study, 2002-2003 and 2009-2010.
Note: These statistics are not weighted. The x-axis represents the male partner's wake time minus the female partner's wake time. In couples to the left of 0, the male partner woke up earlier than the female partner, and in couples to the right of 0, the female partner woke up earlier than the male partner.

Supplementary Figure 3.3 Histogram of the Difference between Own Work Start Time and Wake Time among Respondents in Spain, by Gender



Source: Multinational Time Use Study, 2002-2003 and 2009-2010.
Note: These statistics are not weighted. The x-axis represents own work start time minus own wake time.

Supplementary Table 3.2 Mixed-Effects Regression Coefficients Predicting Wake Time among Working-Age, Partnered Adults in Spain

	Model 1			Model 2		
	Men (N=1,846)	Women (N=1,846)	Difference	Men (N=1,846)	Women (N=1,846)	Difference
Own Work Start Time (in minutes)	36.21***	26.95***	9.26***	36.70***	27.26***	9.60***
	(0.62)	(0.63)	(0.87)	(0.65)	(0.66)	(1.20)
Partner's Work Start Time (in minutes)				3.13***	4.56***	-1.43
				(0.57)	(0.74)	(0.96)
Constant (in clock time)	7:23***	7:13**	0:10***	7:23***	7:14***	0:09***
	(0:02)	(0:02)	(0:01)	(0:02)	(0:02)	(0:01)

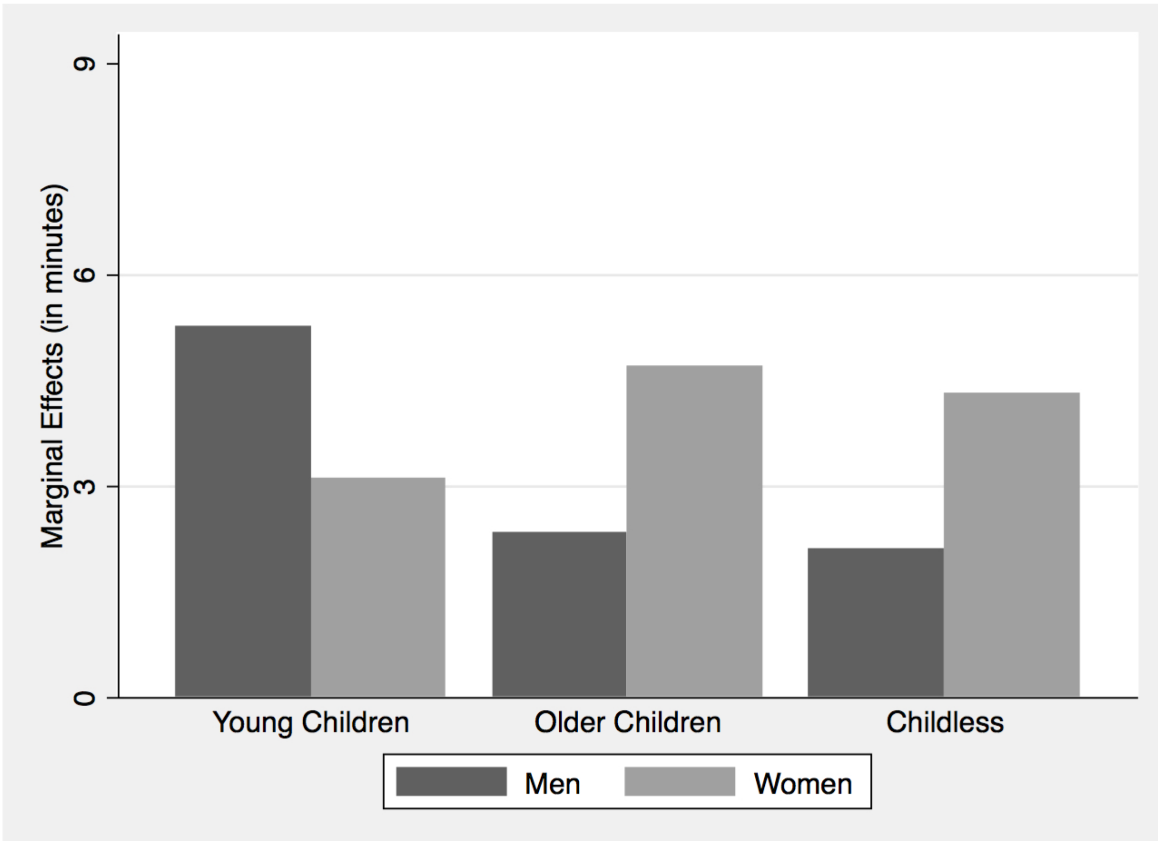
†p<.10; * p<.05; ** p<.01; *** p<.001.
Source: Multinational Time Use Study, 2002-2003 and 2009-2010.
Note: Difference represents men's minus women's coefficients. Standard errors in parentheses. Models include covariates for presence of household children, education, age, and age squared, as well as year, season, and day of interview. Partner's and own work start times are centered at the average within each country. Models include a random effect for each couple. Men and women were included in the same regression models, but coefficients are separated by gender to enhance interpretability.

Supplementary Table 3.3 Mixed-Effects Regression Coefficients Predicting Wake Time among Working-Age, Partnered Adults in Spain and the United Kingdom, Including Interactions with Presence of Household Children

	Spain	United Kingdom
Partner's Work Start Time (Partner's Start)	0.04**	0.09***
	(0.02)	(0.02)
Female	-0.10***	-0.11***
	(0.02)	(0.03)
Female X Partner's Start	0.04	0.03
	(0.03)	(0.03)
Own Work Start Time (Own Start)	0.65***	0.62***
	(0.02)	(0.02)
Female X Own Start	-0.11***	-0.16***
	(0.03)	(0.03)
Presence of Household Children (Reference=None)		
Young Children	-0.15***	-0.16**
	(0.03)	(0.05)
Older Children	-0.04	-0.01
	(0.02)	(0.04)
Young Children X Partner's Start	0.05**	0.07
	(0.02)	(0.04)
Older Children X Partner's Start	0.00	-0.02
	(0.02)	(0.03)
Young Children X Female	-0.03	-0.07
	(0.03)	(0.06)
Older Children X Female	-0.09**	-0.01
	(0.03)	(0.05)
Young Children X Female X Partner's Start	-0.07†	-0.11†
	(0.04)	(0.06)
Older Children X Female X Partner's Start	0.00	0.03
	(0.04)	(0.05)
Young Children X Own Start	-0.09**	0.03
	(0.03)	(0.04)
Older Children X Own Start	-0.04†	0.00
	(0.02)	(0.03)
Young Children X Female X Own Start	-0.03	-0.13**
	(0.04)	(0.06)
Older Children X Female X Own Start	-0.12***	-0.18***
	(0.04)	(0.05)
Constant	7.36***	6.84***
	(0.03)	(0.05)
N	3,692	2,358

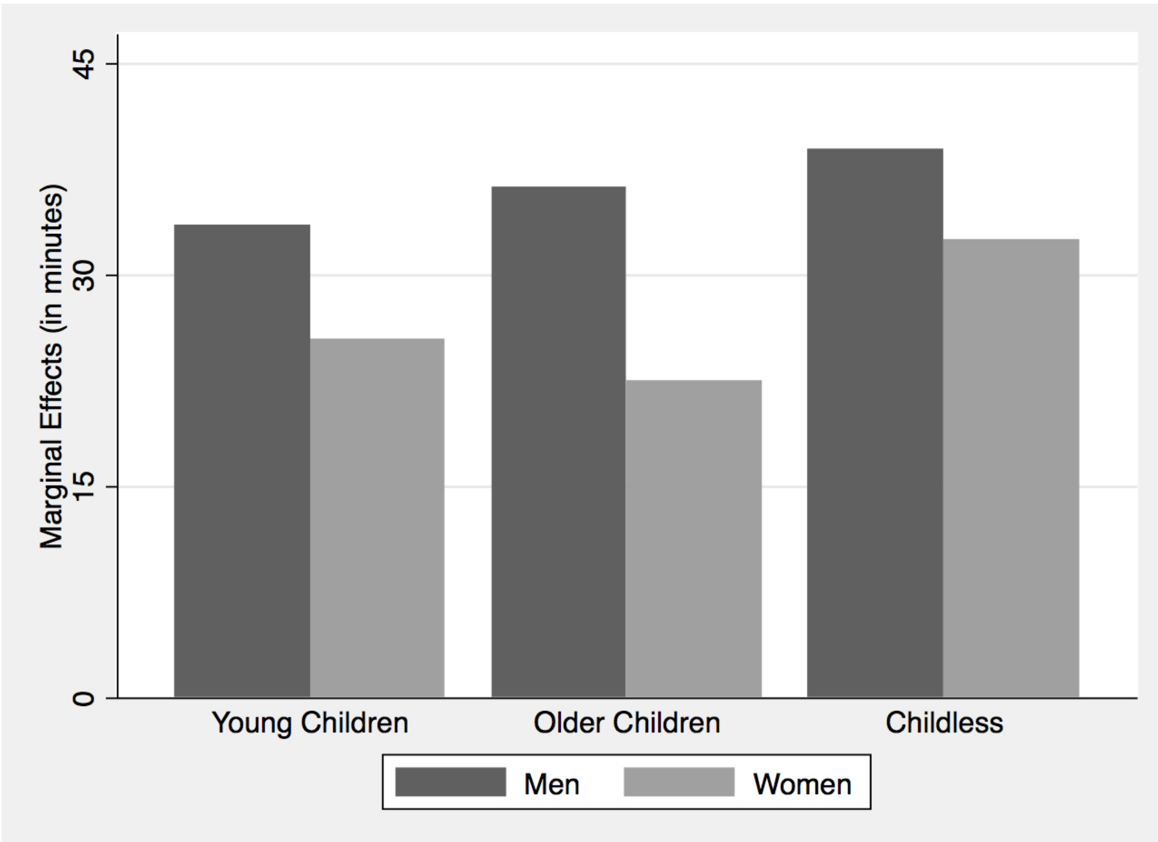
†p<.10; * p<.05; ** p<.01; *** p<.001. Source: MTUS, 2000-2001, 2002-2003, 2009-2010, and 2014-2015. Note: Coefficients in hours. Standard errors in parentheses. Includes random effect for couple and covariates for education, age, and age squared, as well as interview year, season, and day. Partner's and own work start times centered at within-country means.

Supplementary Figure 3.4 Marginal Effects of Partner's Work Start Time on Wake Time in Spain, by Presence of Household Children and Gender



Source: Multinational Time Use Study, 2002-2003 and 2009-2010.
Note: Marginal effects generated from country-specific mixed-effects models displayed in Supplementary Table 3.

Supplementary Figure 3.5 Marginal Effects of Own Work Start Time on Wake Time in Spain, by Presence of Household Children and Gender



Source: Multinational Time Use Study, 2002-2003 and 2009-2010.
Note: Marginal effects generated from country-specific mixed-effects models displayed in Supplementary Table 3.

Supplementary Table 3.4 Descriptive Statistics for Wake Time, Children's School Start Time, Work Start Time, Sociodemographic Characteristics, and Interview Timing among Parents with Eligible Children's School Start Time, by Country and Gender

	Spain			United Kingdom		
	Men	Women	Difference (Men - Women)	Men	Women	Difference (Men - Women)
Panel A: Individual-Level Variables						
Own Wake Time (clock time)	7:14	7:11	0:03	6:39	6:46	-0:07 *
(SD in minutes)	(39.1)	(30.9)		(45.9)	(36.4)	
Own Work Start Time (clock time)	8:04	8:20	-0:17 **	7:37	8:31	-0:54 ***
(SD in minutes)	(49.5)	(56.5)		(55.5)	(67.2)	
Started Work First (%)	52.4	31.7	20.7 ***	73.3	20.5	52.8 ***
Work Hours (in hours)	9.6	7.8	1.8 ***	9.2	7.2	2.0 ***
(SD in hours)	(2.1)	(2.0)		(2.0)	(2.4)	
Age (in years)	45.5	43.3	2.2 ***	45.5	43.4	2.1 ***
	(5.5)	(5.2)		(6.4)	(5.7)	
Education (%)						
Less than Secondary	11.7	11.7	0.0	23.7	22.1	1.6
Secondary	45.5	36.5	9.0 *	35.8	34.3	1.4
Post-Secondary	42.8	51.8	-8.9 **	40.5	43.6	-3.1
N	234	234		198	198	
Panel B: Couple-Level Variables						
Children's School Start Time (clock time)	8:31			8:38		
(SD in minutes)	(28.0)			(24.2)		
Interview Year (%)						
2000-2001	NA			67.7		
2002-2003	69.7			NA		
2009-2010	30.3			NA		
2014-2015	NA			32.3		

Interview Season (%)		
Winter	41.9	29.3
Spring	29.1	22.2
Summer	NA	16.2
Fall	29.1	32.3
Interview Day (%)		
Monday	17.9	15.7
Tuesday	19.2	21.2
Wednesday	12.8	17.7
Thursday	17.9	21.7
Friday	32.1	23.7
N	468	396

Gender difference within country significant at †$p<.10$; * $p<.05$; ** $p<.01$; *** $p<.001$.
Source: MTUS, 2000-2001, 2002-2003, 2009-2010, and 2014-2015.
Note: MTUS probability weights used in calculating descriptive statistics for individual-level variables (age, education, work start time, and wake time). Standard deviations provided in parentheses for continuous variables.

Supplementary Table 3.5 Mixed-Effects Regression Coefficients Predicting Wake Time among Working-Age, Partnered Adults in Spain and the United Kingdom, Including Interactions with Work Hours

	Spain		United Kingdom	
	Model 2	Model 3	Model 2	Model 3
Partner's Work Start Time	0.05***	0.04***	0.09***	0.10***
	(0.01)	(0.01)	(0.01)	(0.02)
Female	-0.14***	-0.11***	-0.14***	-0.11***
	(0.01)	(0.01)	(0.02)	(0.02)
Female X Partner's Start	0.02	0.02	0.02	0.00
	(0.02)	(0.02)	(0.02)	(0.02)
Own Work Start Time	0.61***	0.61***	0.63***	0.64***
	(0.01)	(0.01)	(0.01)	(0.01)
Female X Own Start	-0.16***	-0.10***	-0.25***	-0.17***
	(0.02)	(0.02)	(0.02)	(0.02)
Work Hours		0.01***		0.03***
		(0.00)		(0.01)
Work Hours X Partner's Start		0.00		-0.01**
		(0.00)		(0.01)
Work Hours X Female		-0.01		-0.04***
		(0.01)		(0.01)
Work Hours X Female X Partner's Start		-0.01		0.01
		(0.01)		(0.01)
Work Hours X Own Start		0.02***		0.03***
		(0.00)		(0.00)
Work Hours X Female X Own Start		0.02**		0.02**
		(0.01)		(0.01)
Constant	7.38***	7.37***	6.84***	6.85***
	(0.03)	(0.03)	(0.05)	(0.05)
N	3,692	3,692	2,358	2,358

†p<.10; * p<.05; ** p<.01; *** p<.001.
Source: MTUS, 2000-2001, 2002-2003, 2009-2010, and 2014-2015.
Note: Coefficients provided in hours. Standard errors in parentheses. "Partner's Start" refers to partner's work start time. "Own Start" refers to own work start time. Models include covariates for presence of household children, education, age, and age squared, as well as year, season, and day of interview. Partner's and own work start times are centered at the average within each country, as are work hours. Models include a random effect for each couple.

Supplementary Table 4.1 Descriptive Statistics of Respondents' Sleep Duration and Sociodemographic, Employment, and Diary Day Characteristics, by Gender and Education

	Less than High School	High School	Some College or Associate's	College or Advanced Degree
Men				
Age (in years)	49.4	48.5	47.0	47.4
	(14.1)	(12.9)	(14.4)	(14.6)
Sleep Duration (in hours)	8.9	8.5	8.3	8.1
	(2.3)	(2.1)	(2.3)	(1.9)
Sleep Duration Category (%)				
Short (<6 Hours)	7.3	9.3	10.7	8.6
Medium (6-9.99 Hours)	61.1	67.7	70.0	76.9
Long (10 or More Hours)	31.7	23.0	19.4	14.5
Race/Ethnicity (%)				
White	39.7	71.1	73.9	78.6
Hispanic	44.2	13.2	10.0	6.0
Black	13.2	12.7	11.7	6.7
Other	2.9	3.0	4.5	8.7
Born Outside U.S. (%)	41.8	12.9	10.0	15.9
Number of Household Children (%)				
Zero	58.0	66.0	64.6	63.2
One Child	14.4	14.2	14.1	13.8
Two Children	14.3	12.4	13.9	15.7
Three or More Children	13.4	7.4	7.4	7.3
Partnership Status (%)				
Lives with Spouse	62.1	62.9	64.4	71.8
Cohabiting	4.9	5.5	4.8	3.6
Does not Reside with Partner	33.0	31.6	30.7	24.5
Employment Hours	3.6	4.2	4.5	5.0
	(4.1)	(4.2)	(4.8)	(4.7)
Works Multiple Jobs (%)	2.8	5.4	7.6	9.1
Worked Non-Standard Hours (%)	7.4	9.9	11.1	9.5
Post-2008 Recession (%)	55.8	58.1	58.9	61.0
Region (%)				
Northeast	14.8	19.4	15.4	20.7
Midwest	17.1	27.0	25.6	22.6
South	43.9	36.3	33.9	33.3
West	24.2	17.3	25.1	23.4

Season (%)				
Spring	25.0	25.4	24.8	25.5
Summer	25.2	24.7	24.9	24.9
Fall	25.4	25.1	25.7	24.8
Winter	24.4	24.8	24.6	24.8
Day of Week (%)				
Monday	13.6	14.5	14.0	13.6
Tuesday	14.5	14.4	14.6	14.6
Wednesday	13.8	14.3	13.9	13.4
Thursday	13.8	14.3	14.0	14.0
Friday	13.6	13.2	13.7	14.6
Saturday	14.7	14.0	14.2	14.4
Sunday	14.3	13.7	13.8	13.8
Holiday	1.7	1.6	1.8	1.6
N	7,105	18,089	17,538	24,369
Women				
Age (in years)	51.6	51.8	48.0	45.5
	(16.9)	(14.9)	(16.0)	(15.0)
Sleep Duration (in hours)	9.2	8.6	8.5	8.3
	(2.6)	(2.2)	(2.4)	(2.1)
Sleep Duration Category (%)				
Short (<6 Hours)	6.1	7.6	8.2	7.2
Medium (6-9.99 Hours)	58.4	68.3	71.2	76.6
Long (10 or More Hours)	35.4	24.1	20.6	16.2
Race/Ethnicity (%)				
White	38.4	70.9	72.2	76.2
Hispanic	41.7	12.0	9.6	6.3
Black	15.8	13.3	13.5	9.0
Other	4.1	3.8	4.6	8.5
Born Outside U.S. (%)	40.4	13.3	10.7	15.0
Number of Household Children (%)				
Zero	54.4	64.7	59.2	58.5
One Child	15.1	14.9	16.7	16.7
Two Children	14.3	12.4	15.2	17.3
Three or More Children	16.3	8.0	8.8	7.4
Partnership Status (%)				

Lives with Spouse	52.2	60.6	59.2	66.6
Cohabiting	4.3	4.0	4.4	4.2
Does not Reside with Partner	43.6	35.4	36.5	29.2
Employment Hours	1.6	2.6	3.2	3.7
	(3.4)	(3.9)	(4.6)	(4.7)
Works Multiple Jobs (%)	1.7	3.6	6.1	7.9
Worked Non-Standard Hours (%)	5.0	6.5	6.8	8.2
Post-2008 Recession (%)	54.6	56.8	58.9	62.6
Region (%)				
Northeast	14.7	18.5	14.9	20.2
Midwest	17.5	26.3	25.4	22.8
South	42.3	38.6	35.8	34.2
West	25.4	16.6	23.9	22.8
Season (%)				
Spring	24.9	25.1	25.2	24.6
Summer	25.0	25.2	25.0	25.3
Fall	25.4	24.4	25.5	25.4
Winter	24.7	25.2	24.3	24.6
Day of Week (%)				
Monday	13.5	13.6	13.3	13.4
Tuesday	13.8	14.4	14.2	14.1
Wednesday	13.7	14.6	14.4	14.2
Thursday	14.2	14.0	13.8	14.5
Friday	14.4	14.2	14.4	14.1
Saturday	14.5	13.7	13.9	14.3
Sunday	14.3	14.1	14.3	13.7
Holiday	1.6	1.5	1.7	1.7
N	8,972	23,059	24,842	29,267

Source: American Time Use Survey, 2003-2016.
Note: Generated using probability weights. Standard deviations for continuous variables are shown in parentheses.

Supplementary Table 4.2A Sample Size for Men with Weekday Diary Day, by Age and Education

Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
25-29	254	702	755	800	2,511
30-34	307	814	904	1,327	3,352
35-39	327	987	1,051	1,630	3,995
40-44	317	1,116	1,097	1,706	4,236
45-49	325	1,126	1,021	1,503	3,975
50-54	336	1,022	1,004	1,327	3,689
55-59	344	903	952	1,070	3,269
60-64	322	772	735	951	2,780
65-69	349	683	554	738	2,324
70-74	293	500	313	534	1,640
75-79	237	372	230	408	1,247
Total	3,411	8,997	8,616	11,994	33,018

Supplementary Table 4.2B Sample Size for Women with Weekday Diary Day, by Age and Education

Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
25-29	304	844	1,167	1,249	3,564
30-34	398	981	1,419	1,874	4,672
35-39	375	1,037	1,432	2,233	5,077
40-44	340	1,076	1,388	2,099	4,903
45-49	338	1,116	1,394	1,652	4,500
50-54	368	1,167	1,237	1,432	4,204
55-59	404	1,165	1,183	1,237	3,989
60-64	400	1,139	1,045	994	3,578
65-69	443	1,090	802	775	3,110
70-74	451	928	582	477	2,438
75-79	448	836	475	356	2,115
Total	4,269	11,379	12,124	14,378	42,150

Supplementary Table 4.2C Sample Size for Men with Weekend/Holiday Diary Day, by Age and Education

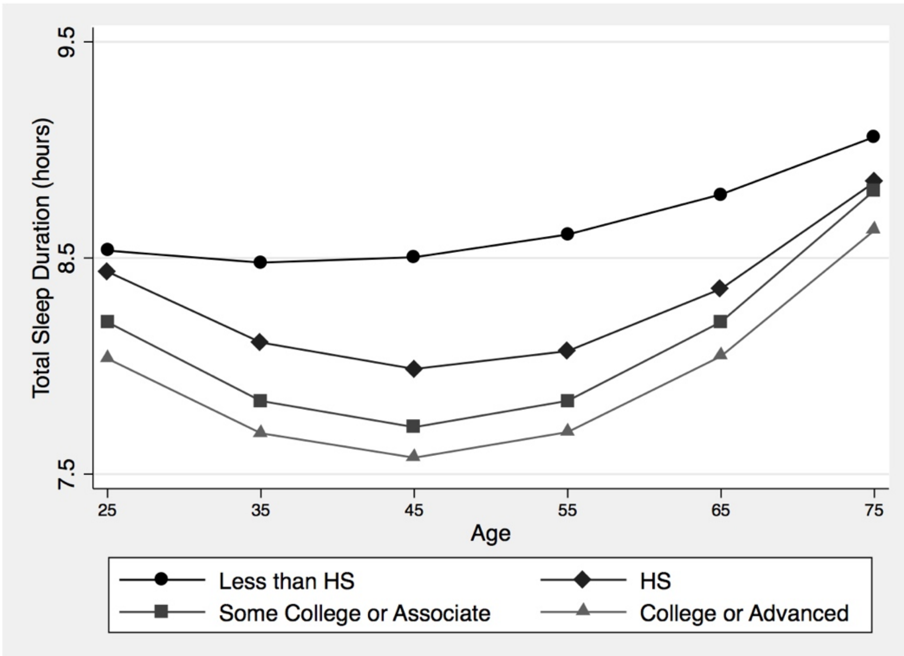
Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
25-29	281	693	758	888	2,620
30-34	384	901	1,017	1,414	3,716
35-39	365	1,003	1,082	1,688	4,138
40-44	384	1,110	1,181	1,812	4,487
45-49	367	1,117	1,050	1,537	4,071
50-54	341	1,077	1,019	1,336	3,773
55-59	327	945	919	1,136	3,327
60-64	330	746	726	965	2,767
65-69	348	640	566	751	2,305
70-74	309	481	348	464	1,602
75-79	258	379	256	384	1,277
Total	3,694	9,092	8,922	12,375	34,083

Supplementary Table 4.2D Sample Size for Women with Weekend/Holiday Diary Day, by Age and Education

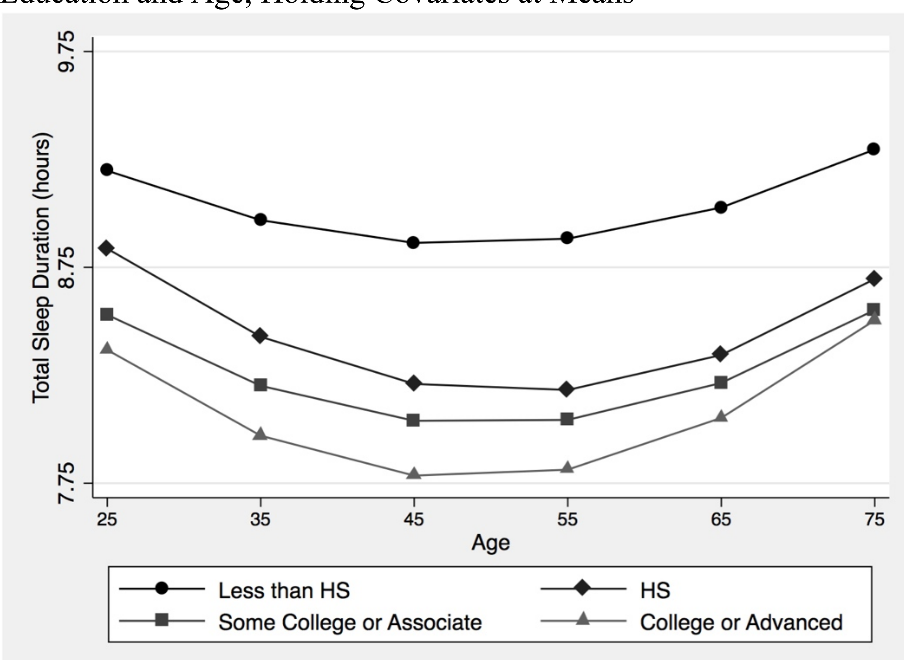
Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
25-29	400	900	1,271	1,303	3,874
30-34	433	1,048	1,544	2,050	5,075
35-39	405	1,094	1,431	2,260	5,190
40-44	373	1,143	1,468	2,239	5,223
45-49	388	1,214	1,419	1,787	4,808
50-54	390	1,201	1,306	1,435	4,332
55-59	431	1,168	1,254	1,254	4,107
60-64	455	1,148	1,074	929	3,606
65-69	502	1,035	823	765	3,125
70-74	474	927	636	501	2,538
75-79	452	802	492	366	2,112
Total	4,703	11,680	12,718	14,889	43,990

Source: American Time Use Survey, 2003-2016 (Supplementary Tables 4.2A through 4.2D).

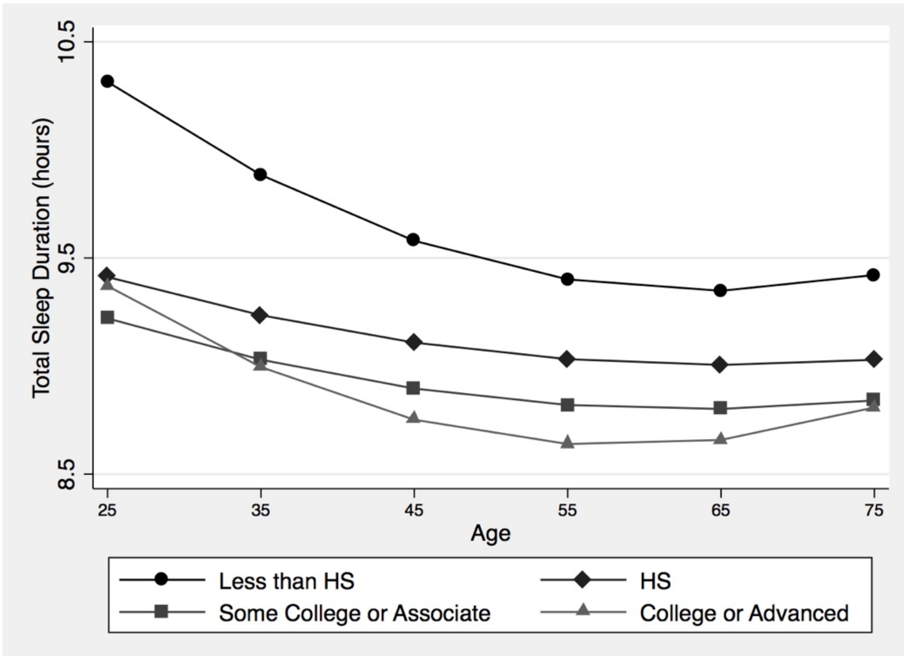
Supplementary Figure 4.1A Predicted Weekday Total Sleep Duration for Men, by Education and Age, Holding Covariates at Means



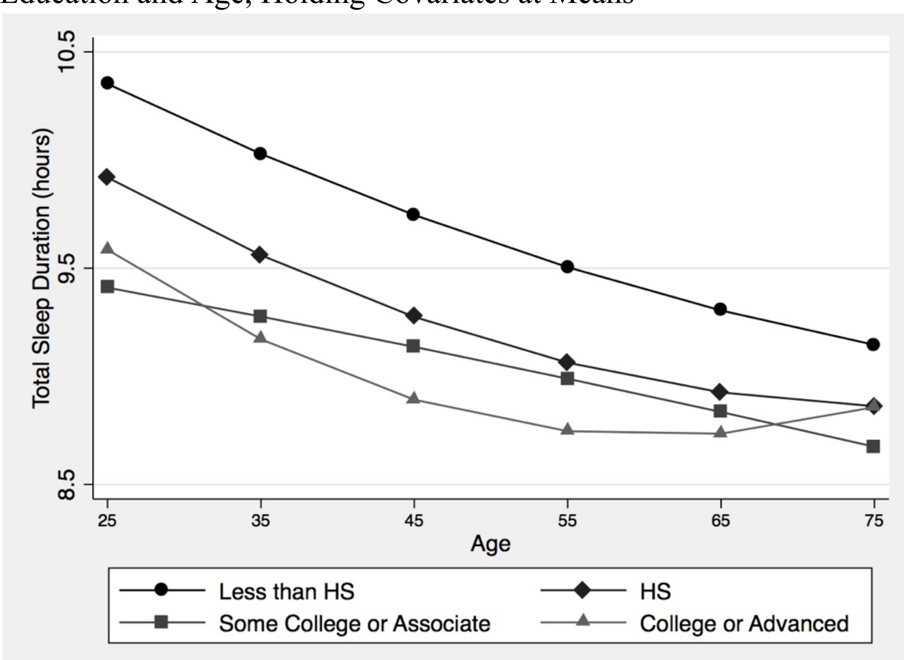
Supplementary Figure 4.1B Predicted Weekday Total Sleep Duration for Women, by Education and Age, Holding Covariates at Means



Supplementary Figure 4.1C Predicted Weekend/Holiday Total Sleep Duration for Men, by Education and Age, Holding Covariates at Means

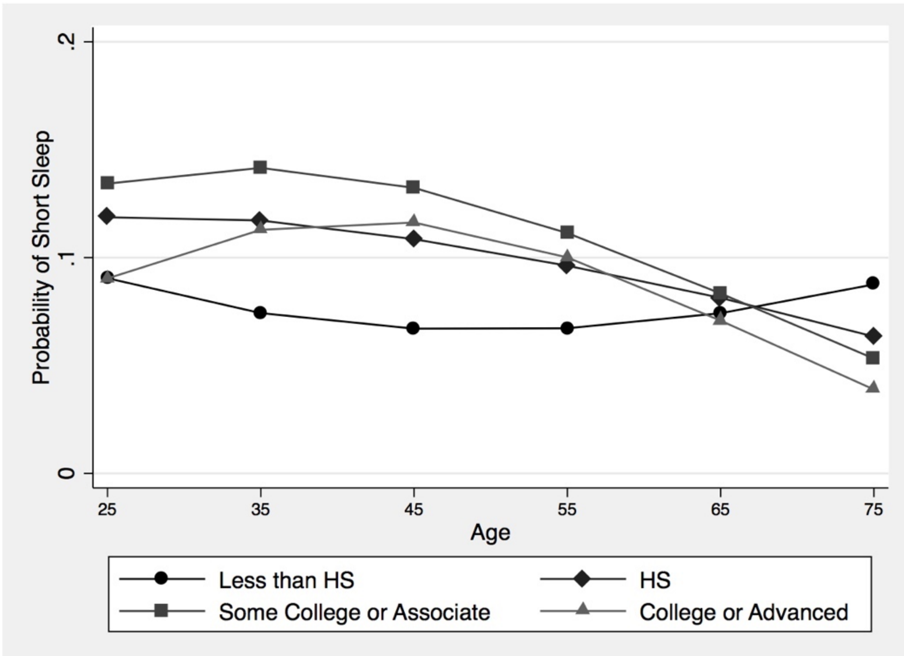


Supplementary Figure 4.1D Predicted Weekend/Holiday Total Sleep Duration for Women, by Education and Age, Holding Covariates at Means

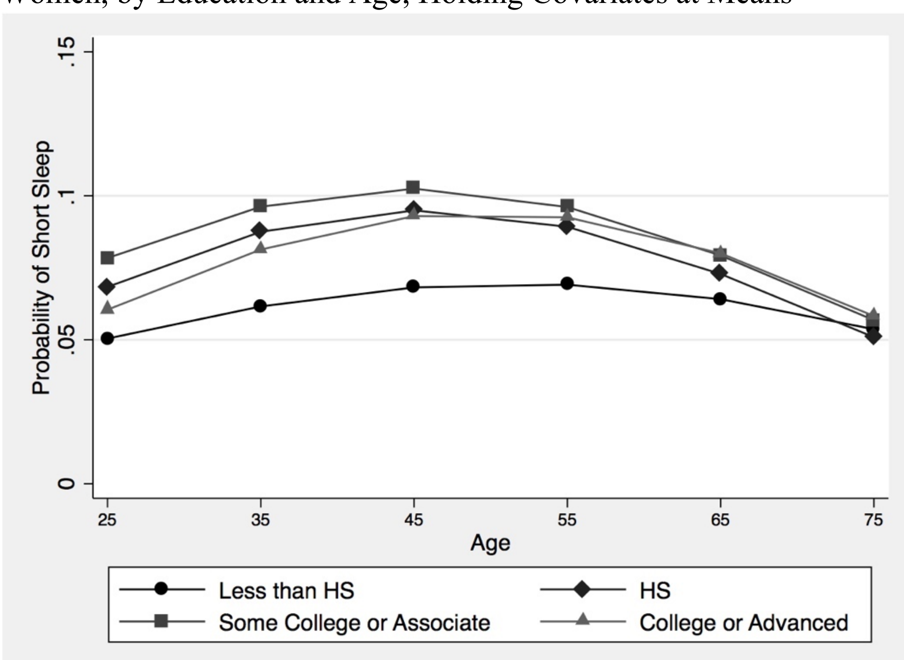


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.1A through 4.1D).
Note: Supplementary Figures 4.1A through 4.1D were generated from OLS regression models adjusted for region, season, day of week, and whether the interview year was post-2008 recession. Models include interactions of education variables with age and age squared.

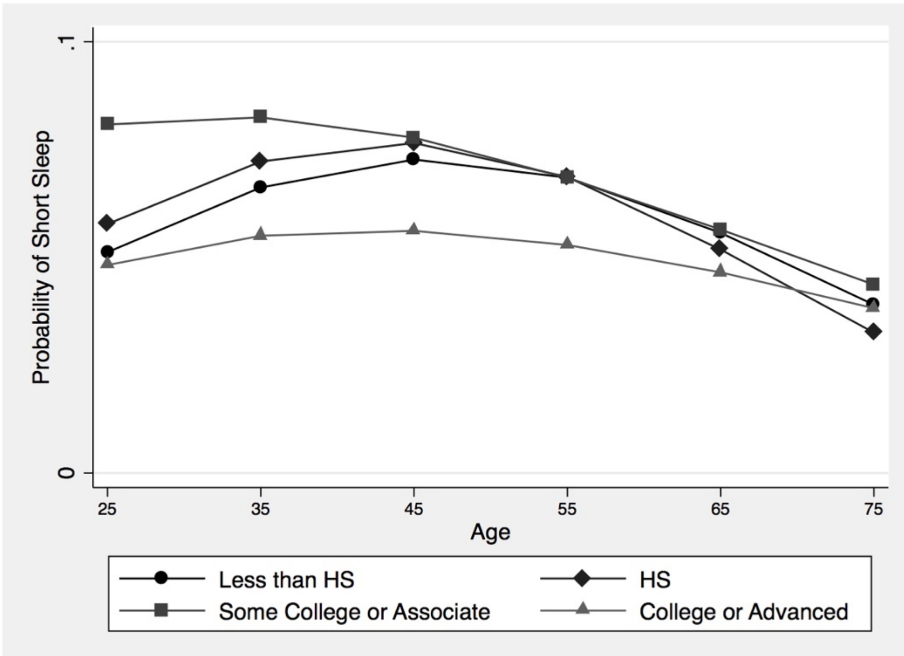
Supplementary Figure 4.2A Predicted Probability of Weekday Short-Duration Sleep for Men, by Education and Age, Holding Covariates at Means



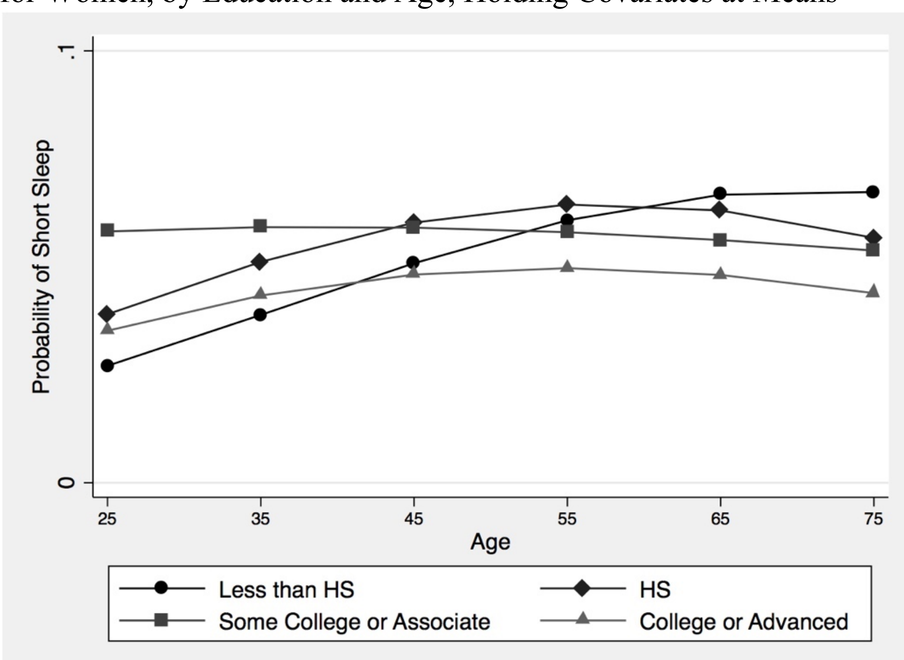
Supplementary Figure 4.2B Predicted Probability of Weekday Short-Duration Sleep for Women, by Education and Age, Holding Covariates at Means



Supplementary Figure 4.2C Predicted Probability of Weekend/Holiday Short-Duration Sleep for Men, by Education and Age, Holding Covariates at Means

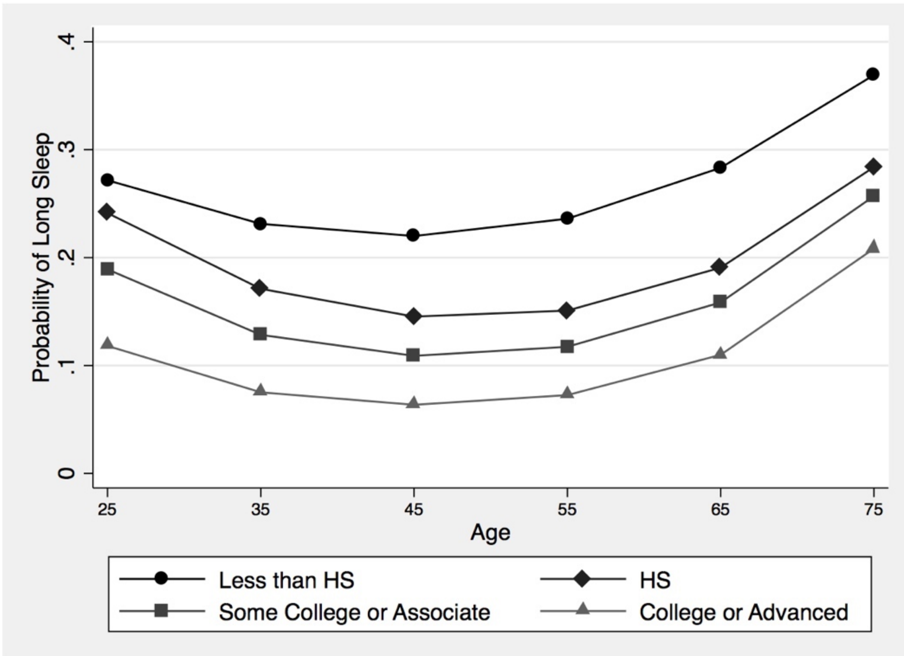


Supplementary Figure 4.2D Predicted Probability of Weekend/Holiday Short-Duration Sleep for Women, by Education and Age, Holding Covariates at Means

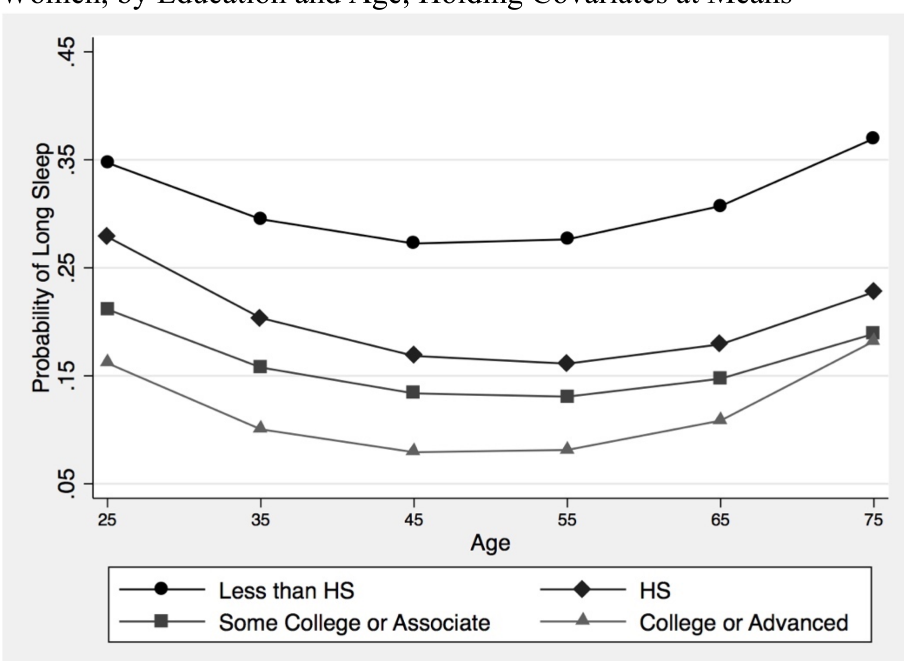


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.2A through 4.2D).
Note: Supplementary Figures 4.2A through 4.2D generated from multinomial logistic regression models adjusted for region, season, day of week, and whether the interview year was post-2008 recession. Models include interactions of education variables with age and age squared.

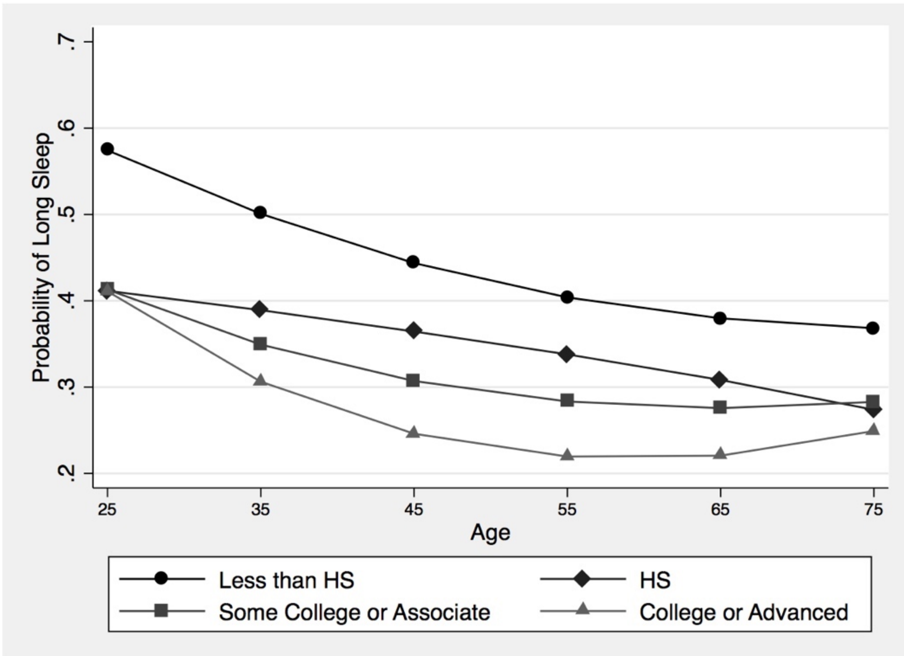
Supplementary Figure 4.3A Predicted Probability of Weekday Long-Duration Sleep for Men, by Education and Age, Holding Covariates at Means



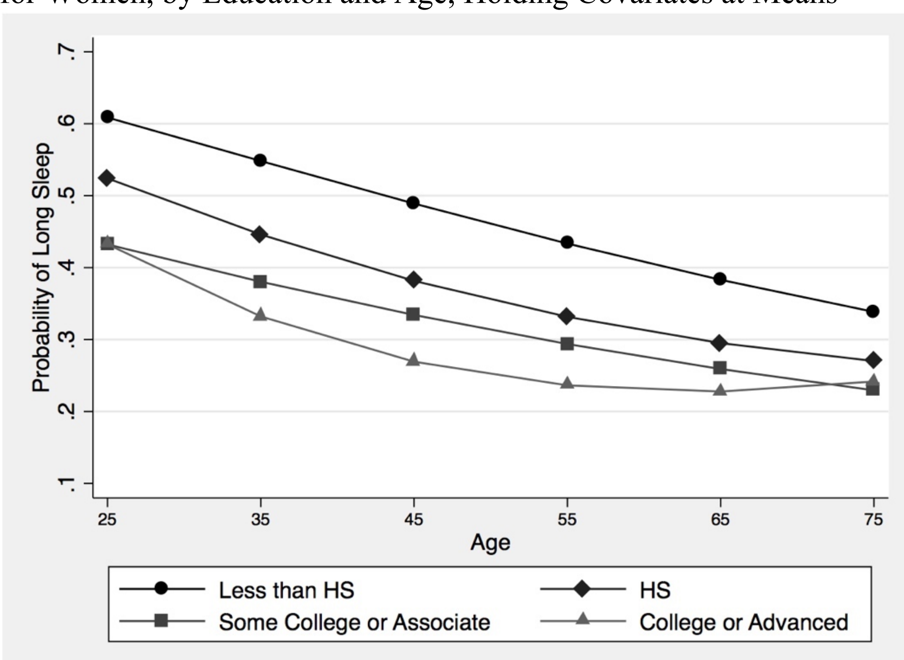
Supplementary Figure 4.3B Predicted Probability of Weekday Long-Duration Sleep for Women, by Education and Age, Holding Covariates at Means



Supplementary Figure 4.3C Predicted Probability of Weekend/Holiday Long-Duration Sleep for Men, by Education and Age, Holding Covariates at Means



Supplementary Figure 4.3D Predicted Probability of Weekend/Holiday Long-Duration Sleep for Women, by Education and Age, Holding Covariates at Means



Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.3A through 4.3D).
Note: Supplementary Figures 4.3A through 4.3D generated from multinomial logistic regression models, adjusted for region, season, day of week, and whether the interview year was post-2008 recession. Models include interactions of education variables with age and age squared.

Supplementary Table 4.3 Coefficients from OLS Regression Models Predicting Total Sleep Duration (in Hours), Adjusted for Sociodemographic Characteristics

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Education (Reference=College or Advanced Degree)				
Less than High School	0.79***	0.63***	1.00***	0.66***
	(0.06)	(0.09)	(0.07)	(0.08)
High School	0.34***	0.35***	0.36***	0.30***
	(0.04)	(0.05)	(0.04)	(0.05)
Some College or Associate's	0.11**	0.16**	0.22***	0.21***
	(0.04)	(0.05)	(0.04)	(0.04)
Age (centered, in 10 years)	0.10***	-0.12***	-0.02	-0.18***
	(0.01)	(0.02)	(0.01)	(0.02)
Education x Age (centered, in 10 years)				
Less than High School x Age	0.00	-0.05	-0.02	-0.10**
	(0.03)	(0.04)	(0.04)	(0.03)
High School x Age	-0.04	0.04	-0.07***	-0.07**
	(0.02)	(0.03)	(0.02)	(0.02)
Some College or Associate's x Age	0.00	0.04	-0.03	0.01
	(0.03)	(0.03)	(0.02)	(0.02)
Age (centered, in 10 years) Squared	0.10***	0.05***	0.09***	0.05***
	(0.01)	(0.01)	(0.01)	(0.01)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	-0.06***	0.01	-0.02	-0.02
	(0.02)	(0.03)	(0.02)	(0.02)
High School x Age Squared	0.00	-0.03†	0.01	-0.01
	(0.02)	(0.02)	(0.01)	(0.02)
Some College or Associate's x Age Squared	0.01	-0.03	-0.01	-0.06**
	(0.02)	(0.02)	(0.01)	(0.02)
Race/Ethnicity (Reference=Non-Hispanic White)				
Hispanic	0.07	0.10†	0.10**	0.20***
	(0.05)	(0.05)	(0.05)	(0.05)
Black	0.21***	0.00	0.21***	0.17***
	(0.06)	(0.06)	(0.05)	(0.05)

Other	-0.02	0.09	0.20**	-0.02
	(0.07)	(0.08)	(0.06)	(0.08)
Born Outside U.S.	0.28***	0.41***	0.12**	0.15***
	(0.05)	(0.05)	(0.04)	(0.04)
Number of Household Children (Reference=Zero)				
One Child	-0.08†	-0.07	-0.08**	-0.08†
	(0.04)	(0.04)	(0.04)	(0.04)
Two Children	-0.09**	-0.15**	-0.20***	-0.21***
	(0.04)	(0.05)	(0.04)	(0.05)
Three or More Children	-0.26***	-0.26***	-0.35***	-0.40***
	(0.05)	(0.06)	(0.04)	(0.05)
Partnership Status (Reference=Lives with Spouse)				
Cohabiting	0.17**	0.08	0.01	0.10
	(0.08)	(0.08)	(0.07)	(0.07)
Does not Reside with Partner	0.29***	0.19***	0.07**	0.18***
	(0.03)	(0.04)	(0.03)	(0.03)
Constant	7.58***	8.31***	7.75***	8.57***
	(0.05)	(0.06)	(0.05)	(0.05)
N	33,018	34,083	42,150	43,990
R-squared	.04	.05	.04	.04

†p < 0.10, *p < 0.05, **p < 0.01, ***p <0.001

Source: American Time Use Survey, 2003-2016.

Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

Supplementary Table 4.4 Coefficients from Multinomial Logistic Regression Models Predicting Sleep Duration Category, Adjusted for Sociodemographic Characteristics

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Short-Duration Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	-0.35**	0.50**	-0.07	0.34**
	(0.13)	(0.15)	(0.12)	(0.14)
High School	-0.03	0.44***	0.10	0.37***
	(0.08)	(0.10)	(0.08)	(0.10)
Some College or Associate's	0.13†	0.35***	0.11	0.24**
	(0.08)	(0.10)	(0.07)	(0.10)
Age (centered, in 10 years)	-0.11***	-0.07†	0.02	-0.01
	(0.03)	(0.04)	(0.03)	(0.04)
Education x Age (centered, in 10 years)				
Less than High School x Age	0.09	-0.07	-0.02	0.09
	(0.07)	(0.07)	(0.07)	(0.07)
High School x Age	0.00	-0.03	-0.06	0.02
	(0.05)	(0.06)	(0.04)	(0.05)
Some College or Associate's x Age	-0.05	-0.07	-0.06	-0.07
	(0.05)	(0.05)	(0.04)	(0.05)
Age (centered, in 10 years) Squared	-0.09***	-0.02	-0.07**	-0.03
	(0.02)	(0.03)	(0.02)	(0.03)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	0.16***	-0.05	0.03	-0.01
	(0.05)	(0.05)	(0.04)	(0.04)
High School x Age Squared	0.09**	-0.08**	0.00	-0.01
	(0.03)	(0.04)	(0.03)	(0.03)

Some College or Associate's x Age Squared	0.05	-0.01	0.00	0.02
	(0.03)	(0.04)	(0.03)	(0.04)
Race/Ethnicity (Reference=Non-Hispanic White)				
Hispanic	0.04	0.30**	-0.18†	0.14
	(0.08)	(0.11)	(0.09)	(0.10)
Black	0.62***	0.69***	0.47***	0.67***
	(0.07)	(0.08)	(0.06)	(0.07)
Other	0.33**	0.28†	0.11	0.48***
	(0.12)	(0.15)	(0.11)	(0.13)
Born Outside U.S.	-0.32***	-0.36***	-0.13	0.02
	(0.08)	(0.11)	(0.08)	(0.10)
Number of Household Children (Reference=Zero)				
One Child	0.08	0.08	0.09	-0.10
	(0.07)	(0.08)	(0.06)	(0.08)
Two Children	0.01	0.11	0.08	-0.18**
	(0.07)	(0.09)	(0.07)	(0.09)
Three or More Children	0.20**	0.10	0.18**	0.07
	(0.08)	(0.11)	(0.08)	(0.11)
Partnership Status (Reference=Lives with Spouse)				
Cohabiting	0.01	0.28**	0.06	0.19
	(0.12)	(0.13)	(0.13)	(0.16)
Does not Reside with Partner	0.12**	0.31***	0.35***	0.29***
	(0.06)	(0.07)	(0.05)	(0.06)
Constant	-2.27***	-2.44***	-2.42***	-2.60***
	(0.10)	(0.11)	(0.09)	(0.11)
Long-Duration Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	1.22***	0.77***	1.33***	0.76***
	(0.10)	(0.08)	(0.08)	(0.07)

High School	0.79***	0.60***	0.77***	0.46***
	(0.07)	(0.05)	(0.07)	(0.05)
Some College or Associate's	0.52***	0.34***	0.52***	0.28***
	(0.08)	(0.05)	(0.07)	(0.05)
Age (centered, in 10 years)	0.12***	-0.15***	-0.02	-0.21***
	(0.03)	(0.02)	(0.02)	(0.02)
Education x Age (centered, in 10 years)				
Less than High School x Age	-0.06	-0.01	-0.06	-0.04
	(0.05)	(0.04)	(0.04)	(0.03)
High School x Age	-0.11**	0.04	-0.10**	-0.04
	(0.04)	(0.03)	(0.03)	(0.03)
Some College or Associate's x Age	-0.08†	0.02	-0.06†	-0.02
	(0.04)	(0.03)	(0.03)	(0.02)
Age (centered, in 10 years) Squared	0.13***	0.06***	0.11***	0.04**
	(0.02)	(0.01)	(0.02)	(0.01)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	-0.04	-0.04	-0.04	-0.03
	(0.03)	(0.02)	(0.02)	(0.02)
High School x Age Squared	-0.01	-0.08***	-0.02	-0.02
	(0.02)	(0.02)	(0.02)	(0.02)
Some College or Associate's x Age Squared	-0.01	-0.03	-0.04†	-0.04**
	(0.03)	(0.02)	(0.02)	(0.02)
Race/Ethnicity (Reference=Non-Hispanic White)				
Hispanic	0.14†	0.15**	0.16**	0.27***
	(0.07)	(0.05)	(0.06)	(0.05)
Black	0.64***	0.21***	0.57***	0.34***
	(0.06)	(0.05)	(0.05)	(0.04)
Other	0.24**	0.19**	0.40***	0.08
	(0.10)	(0.08)	(0.08)	(0.07)

Born Outside U.S.	0.16**	0.34***	0.11†	0.21***
	(0.07)	(0.05)	(0.06)	(0.04)
Number of Household Children (Reference=Zero)				
One Child	-0.11†	-0.06	-0.08	-0.10**
	(0.06)	(0.05)	(0.05)	(0.04)
Two Children	-0.18**	-0.12**	-0.33***	-0.22***
	(0.07)	(0.05)	(0.06)	(0.04)
Three or More Children	-0.33***	-0.21***	-0.52***	-0.35***
	(0.09)	(0.06)	(0.07)	(0.05)
Partnership Status (Reference=Lives with Spouse)				
Cohabiting	0.26**	0.19**	0.13	0.19**
	(0.10)	(0.08)	(0.10)	(0.07)
Does not Reside with Partner	0.44***	0.27***	0.36***	0.25***
	(0.05)	(0.04)	(0.04)	(0.03)
Constant	-2.66***	-1.48***	-2.55***	-1.29***
	(0.09)	(0.06)	(0.08)	(0.05)
N	33,018	34,083	42,150	43,990

†$p < 0.10$, *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

Source: American Time Use Survey, 2003-2016.

Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

Supplementary Table 4.5 Coefficients from OLS Regression Models Predicting Total Sleep Duration (in Hours), Adjusted for Sociodemographic and Employment Characteristics

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Education (Reference=College or Advanced Degree)				
Less than High School	0.40***	0.57***	0.56***	0.59***
	(0.06)	(0.08)	(0.07)	(0.07)
High School	0.10**	0.35***	0.16***	0.28***
	(0.04)	(0.05)	(0.04)	(0.05)
Some College or Associate's	-0.02	0.21***	0.11**	0.21***
	(0.04)	(0.05)	(0.04)	(0.04)
Age (centered, in 10 years)	-0.08***	-0.16***	-0.16***	-0.21***
	(0.01)	(0.02)	(0.01)	(0.02)
Education x Age (centered, in 10 years)				
Less than High School x Age	-0.02	-0.07†	0.02	-0.12***
	(0.03)	(0.04)	(0.04)	(0.03)
High School x Age	-0.06**	0.01	-0.05**	-0.10***
	(0.02)	(0.03)	(0.02)	(0.02)
Some College or Associate's x Age	-0.01	0.00	-0.02	-0.03
	(0.02)	(0.03)	(0.02)	(0.02)
Age (centered, in 10 years) Squared	0.00	0.03**	0.01	0.03**
	(0.01)	(0.01)	(0.01)	(0.01)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	-0.01	0.01	0.02	-0.01
	(0.02)	(0.03)	(0.02)	(0.02)
High School x Age Squared	0.02	-0.03	0.02†	0.00
	(0.02)	(0.02)	(0.01)	(0.02)
Some College or Associate's x Age Squared	0.01	-0.03†	0.00	-0.05**
	(0.02)	(0.02)	(0.01)	(0.02)
Race/Ethnicity (Reference=Non-Hispanic White)				
Hispanic	0.02	0.11**	0.13**	0.19***
	(0.05)	(0.05)	(0.04)	(0.05)
Black	0.03	0.00	0.19***	0.18***
	(0.05)	(0.06)	(0.05)	(0.04)

Other	-0.12†	0.07	0.19**	-0.01
	(0.06)	(0.07)	(0.06)	(0.07)
Born Outside U.S.	0.40***	0.48***	0.09**	0.21***
	(0.05)	(0.05)	(0.04)	(0.04)
Number of Household Children (Reference=Zero)				
One Child	-0.06	-0.08†	-0.19***	-0.11**
	(0.04)	(0.04)	(0.03)	(0.04)
Two Children	-0.09**	-0.17***	-0.38***	-0.27***
	(0.04)	(0.05)	(0.04)	(0.04)
Three or More Children	-0.28***	-0.26***	-0.66***	-0.49***
	(0.05)	(0.06)	(0.04)	(0.05)
Partnership Status (Reference=Lives with Spouse)				
Cohabiting	0.08	0.10	0.13**	0.15**
	(0.07)	(0.08)	(0.06)	(0.07)
Does not Reside with Partner	0.15***	0.17***	0.16***	0.26***
	(0.03)	(0.04)	(0.03)	(0.03)
Employment Hours	-0.18***	-0.19***	-0.16***	-0.20***
	(0.00)	(0.00)	(0.00)	(0.01)
Works Multiple Jobs	-0.13**	-0.07	-0.11**	-0.05
	(0.05)	(0.06)	(0.05)	(0.06)
Works Non-Standard Hours	-0.17**	-0.16**	-0.08	-0.18***
	(0.05)	(0.05)	(0.05)	(0.05)
Constant	9.00***	8.72***	8.70***	8.84***
	(0.06)	(0.05)	(0.06)	(0.05)
N	33,018	34,083	42,150	43,990
R-squared	.17	.12	.13	.10

†p < 0.10, *p < 0.05, **p < 0.01, ***p <0.001
Source: American Time Use Survey, 2003-2016.
Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

Supplementary Table 4.6 Coefficients from Multinomial Logistic Regression Models Predicting Sleep Duration Category, Adjusted for Sociodemographic and Employment Characteristics

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Short-Duration Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	-0.20	0.56***	0.08	0.40**
	(0.13)	(0.16)	(0.13)	(0.15)
High School	0.04	0.40***	0.15**	0.35***
	(0.08)	(0.10)	(0.08)	(0.10)
Some College or Associate's	0.15**	0.27**	0.14†	0.21**
	(0.08)	(0.10)	(0.07)	(0.10)
Age (centered, in 10 years)	-0.02	-0.02	0.09**	0.03
	(0.03)	(0.04)	(0.03)	(0.04)
Education x Age (centered, in 10 years)				
Less than High School x Age	0.12†	-0.05	-0.02	0.12
	(0.07)	(0.08)	(0.07)	(0.08)
High School x Age	0.04	0.00	-0.05	0.06
	(0.05)	(0.06)	(0.04)	(0.05)
Some College or Associate's x Age	-0.02	-0.03	-0.05	-0.03
	(0.05)	(0.05)	(0.04)	(0.05)
Age (centered, in 10 years) Squared	-0.04	0.00	-0.03	-0.01
	(0.02)	(0.03)	(0.02)	(0.03)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	0.14**	-0.05	0.02	-0.02
	(0.05)	(0.05)	(0.04)	(0.04)
High School x Age Squared	0.08**	-0.08**	-0.01	-0.02
	(0.03)	(0.04)	(0.03)	(0.04)
Some College or Associate's x Age Squared	0.05	0.00	0.00	0.02
	(0.03)	(0.04)	(0.03)	(0.04)
Race/Ethnicity (Reference=Non-Hispanic White)				
Hispanic	0.07	0.29**	-0.18†	0.16
	(0.09)	(0.11)	(0.09)	(0.11)
Black	0.65***	0.70***	0.45***	0.65***

	(0.07)	(0.08)	(0.06)	(0.07)
Other	0.42***	0.32**	0.10	0.51***
	(0.12)	(0.15)	(0.11)	(0.13)
Born Outside U.S.	-0.43***	-0.51***	-0.16†	-0.09
	(0.08)	(0.11)	(0.08)	(0.10)
Number of Household Children (Reference=Zero)				
One Child	0.09	0.11	0.15**	-0.06
	(0.07)	(0.09)	(0.06)	(0.08)
Two Children	0.04	0.15†	0.18**	-0.10
	(0.07)	(0.09)	(0.07)	(0.09)
Three or More Children	0.25**	0.13	0.33***	0.18†
	(0.09)	(0.11)	(0.08)	(0.11)
Partnership Status (Reference=Lives with Spouse)				
Cohabiting	0.05	0.27**	-0.02	0.14
	(0.12)	(0.13)	(0.13)	(0.17)
Does not Reside with Partner	0.16**	0.33***	0.29***	0.20***
	(0.06)	(0.07)	(0.05)	(0.06)
Employment Hours	0.09***	0.11***	0.06***	0.12***
	(0.01)	(0.01)	(0.01)	(0.01)
Works Multiple Jobs	0.27***	0.11	0.27***	0.04
	(0.07)	(0.09)	(0.08)	(0.10)
Worked Non-Standard Hours	0.72***	0.31***	0.69***	0.25**
	(0.06)	(0.07)	(0.07)	(0.08)
Constant	-3.13***	-2.86***	-2.95***	-2.88***
	(0.12)	(0.11)	(0.11)	(0.12)
Long-Duration Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	0.83***	0.75***	0.90***	0.72***
	(0.10)	(0.08)	(0.09)	(0.07)
High School	0.48***	0.60***	0.56***	0.45***
	(0.08)	(0.06)	(0.07)	(0.05)
Some College or Associate's	0.32***	0.37***	0.42***	0.27***
	(0.08)	(0.06)	(0.07)	(0.05)
Age (centered, in 10 years)	-0.09**	-0.18***	-0.21***	-0.23***
	(0.03)	(0.02)	(0.03)	(0.02)

Education x Age (centered, in 10 years)				
Less than High School x Age	-0.07	-0.03	0.01	-0.06†
	(0.05)	(0.04)	(0.04)	(0.03)
High School x Age	-0.11**	0.02	-0.06†	-0.06**
	(0.04)	(0.03)	(0.03)	(0.03)
Some College or Associate's x Age	-0.04	0.00	-0.03	-0.04
	(0.04)	(0.03)	(0.03)	(0.03)
Age (centered, in 10 years) Squared	0.04**	0.05***	0.04**	0.03**
	(0.02)	(0.01)	(0.02)	(0.01)
Education x Age (centered, in 10 years) Squared				
Less than High School x Age Squared	0.01	-0.03	0.00	-0.02
	(0.03)	(0.02)	(0.03)	(0.02)
High School x Age Squared	0.03	-0.08***	-0.01	-0.01
	(0.03)	(0.02)	(0.02)	(0.02)
Some College or Associate's x Age Squared	0.00	-0.03	-0.04†	-0.03†
	(0.03)	(0.02)	(0.02)	(0.02)
Race/Ethnicity (Reference=Non-Hispanic White)				
Hispanic	0.12	0.16**	0.23***	0.27***
	(0.08)	(0.05)	(0.06)	(0.05)
Black	0.43***	0.21***	0.56***	0.35***
	(0.06)	(0.05)	(0.05)	(0.04)
Other	0.15	0.18**	0.37***	0.07
	(0.10)	(0.08)	(0.09)	(0.07)
Born Outside U.S.	0.38***	0.41***	0.09	0.25***
	(0.07)	(0.05)	(0.06)	(0.05)
Number of Household Children (Reference=Zero)				
One Child	-0.07	-0.07	-0.20***	-0.13***
	(0.07)	(0.05)	(0.05)	(0.04)
Two Children	-0.14†	-0.14**	-0.58***	-0.27***
	(0.07)	(0.05)	(0.06)	(0.04)
Three or More Children	-0.39***	-0.23***	-0.91***	-0.42***
	(0.09)	(0.06)	(0.08)	(0.05)
Partnership Status (Reference=Lives with Spouse)				
Cohabiting	0.18	0.20**	0.26**	0.24**
	(0.11)	(0.08)	(0.10)	(0.07)

Does not Reside with Partner	0.30***	0.25***	0.47***	0.31***
	(0.05)	(0.04)	(0.04)	(0.03)
Employment Hours	-0.24***	-0.17***	-0.24***	-0.17***
	(0.01)	(0.01)	(0.01)	(0.01)
Works Multiple Jobs	-0.10	-0.07	-0.04	-0.02
	(0.12)	(0.07)	(0.11)	(0.06)
Worked Non-Standard Hours	0.54***	-0.02	0.59***	-0.15**
	(0.08)	(0.06)	(0.08)	(0.06)
Constant	-1.31***	-1.24***	-1.62***	-1.13***
	(0.10)	(0.06)	(0.08)	(0.05)
N	33,018	34,083	42,150	43,990

†p < 0.10, *p < 0.05, **p < 0.01, ***p <0.001
Source: American Time Use Survey, 2003-2016.
Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

Supplementary Table 4.7 Coefficients from OLS Regression Models Predicting Total Sleep Duration (in Hours), among ATUS Respondents 60-69 Years Old

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Education (Reference=College or Advanced Degree)				
Less than High School	1.26***	0.68***	1.21***	0.68***
	(0.16)	(0.18)	(0.15)	(0.16)
High School	0.44***	0.43**	0.26**	0.12
	(0.11)	(0.14)	(0.08)	(0.11)
Some College or Associate's	0.33***	0.20†	0.32***	0.22†
	(0.10)	(0.11)	(0.09)	(0.11)
Retired	0.83***	0.16	0.54***	0.08
	(0.09)	(0.12)	(0.09)	(0.12)
Education x Retired				
Less than High School x Retired	-1.01***	-0.05	-0.50**	-0.36
	(0.29)	(0.22)	(0.22)	(0.25)
High School x Retired	-0.38**	-0.24	-0.10	-0.11
	(0.16)	(0.18)	(0.13)	(0.15)
Some College or Associate's x Retired	-0.42**	-0.26	-0.15	-0.33**
	(0.15)	(0.17)	(0.13)	(0.16)
Age (centered, in 10 years)	1.18	-0.53	0.44	-0.99
	(1.43)	(1.33)	(1.20)	(1.37)
Age (centered, in 10 years) Squared	-0.28	0.18	-0.11	0.33
	(0.46)	(0.42)	(0.38)	(0.43)
Constant	6.64***	8.86***	7.52***	9.40***
	(1.10)	(1.04)	(0.91)	(1.06)
N	5,104	5,072	6,688	6,731
R-squared	.05	.02	.04	.02

†p < 0.10, *p < 0.05, **p < 0.01, ***p <0.001
Source: American Time Use Survey, 2003-2016.
Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

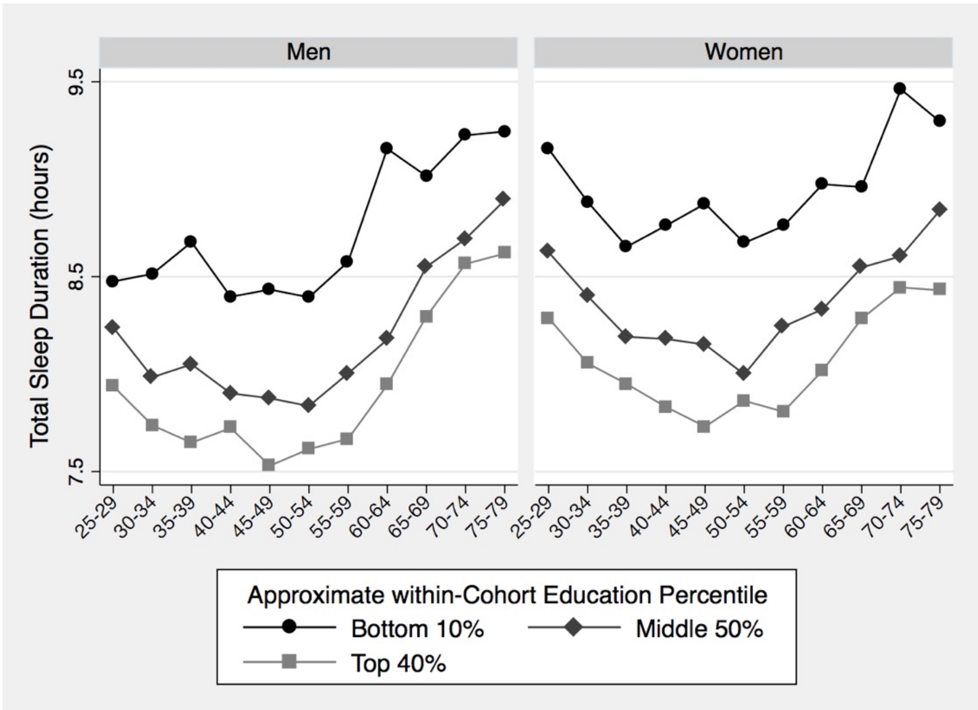
Supplementary Table 4.8 Coefficients from Multinomial Logistic Regression Models Predicting Sleep Duration Category, among ATUS Respondents 60-69 Years Old

	Men		Women	
	Weekday	Weekend/ Holiday	Weekday	Weekend/ Holiday
Short-Duration Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	-0.14	0.57***	0.07	-0.01
	(0.27)	(0.11)	(0.22)	(0.36)
High School	-0.04	0.42***	-0.09	0.68**
	(0.20)	(0.07)	(0.18)	(0.21)
Some College or Associate's	-0.03	0.43***	-0.08	0.13
	(0.19)	(0.07)	(0.18)	(0.23)
Retired	-0.63**	-0.24	-0.51**	-0.18
	(0.24)	(0.18)	(0.26)	(0.27)
Education x Retired				
Less than High School x Retired	0.94**	-0.31	-0.16	0.82†
	(0.44)	(0.28)	(0.43)	(0.47)
High School x Retired	0.56†	-0.20	0.13	-0.11
	(0.33)	(0.22)	(0.31)	(0.33)
Some College or Associate's x Retired	0.66†	0.09	-0.33	0.09
	(0.34)	(0.23)	(0.33)	(0.35)
Age (centered, in 10 years)	2.13	-0.10***	-0.39	1.47
	(2.80)	(0.02)	(2.36)	(2.69)
Age (centered, in 10 years) Squared	-0.63	-0.03	0.06	-0.44
	(0.89)	(0.02)	(0.75)	(0.86)
Constant	-3.93†	-2.19***	-1.66	-3.68†
	(2.14)	(0.09)	(1.81)	(2.07)
Long-Duration Sleep				
Education (Reference=College or Advanced Degree)				
Less than High School	1.55***	0.88***	1.61***	0.89***
	(0.19)	(0.05)	(0.17)	(0.15)
High School	0.70***	0.47***	0.55***	0.50***
	(0.17)	(0.04)	(0.16)	(0.13)
Some College or Associate's	0.45**	0.29***	0.56***	0.34**

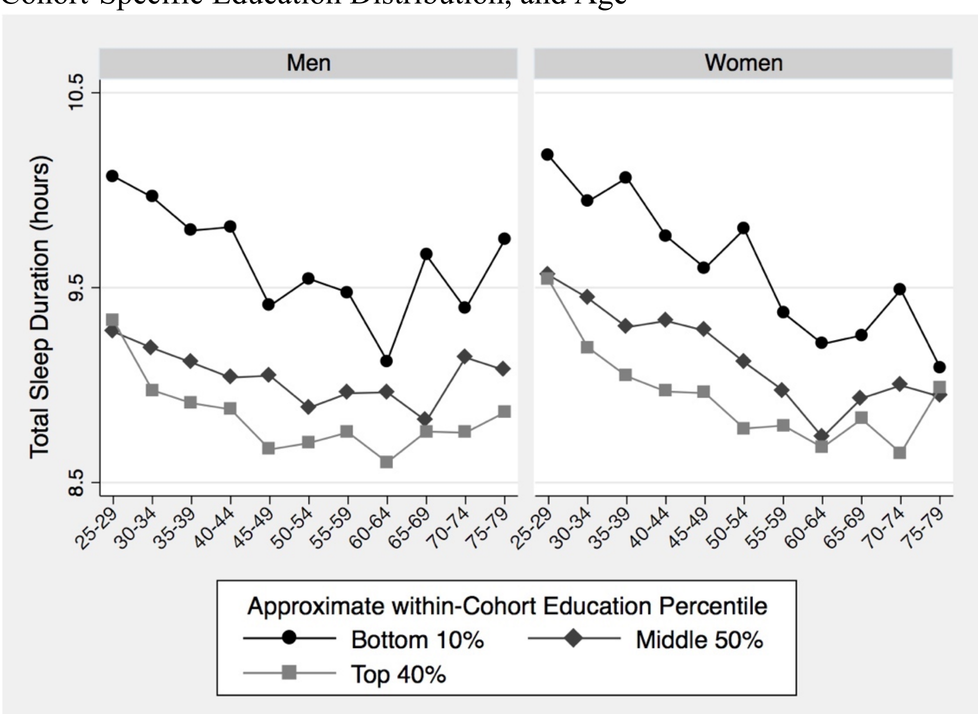
	(0.18)	(0.04)	(0.16)	(0.13)
Retired	0.84***	-0.11	0.57***	-0.02
	(0.18)	(0.09)	(0.17)	(0.15)
Education x Retired				
Less than High School x Retired	-0.90***	-0.19	-0.71**	-0.16
	(0.27)	(0.13)	(0.25)	(0.22)
High School x Retired	-0.42†	-0.14	-0.16	-0.23
	(0.23)	(0.11)	(0.21)	(0.18)
Some College or Associate's x Retired	-0.25	-0.10	-0.37†	-0.32†
	(0.25)	(0.12)	(0.22)	(0.19)
Age (centered, in 10 years)	1.57	-0.13***	2.26	-1.59
	(1.89)	(0.01)	(1.65)	(1.48)
Age (centered, in 10 years) Squared	-0.41	0.04***	-0.69	0.52
	(0.59)	(0.01)	(0.52)	(0.47)
Constant	-3.61**	-1.29***	-3.97**	-0.02
	(1.48)	(0.05)	(1.28)	(1.14)
N	5,104	5,072	6,688	6,731

†p < 0.10, *p < 0.05, **p < 0.01, ***p <0.001
Source: American Time Use Survey, 2003-2016.
Note: All models include variables indicating region, season, day of week, and whether the interview year was post-2008 recession.

Supplementary Figure 4.4A Average Weekday Total Sleep Duration by Gender, Cohort-Specific Education Distribution, and Age

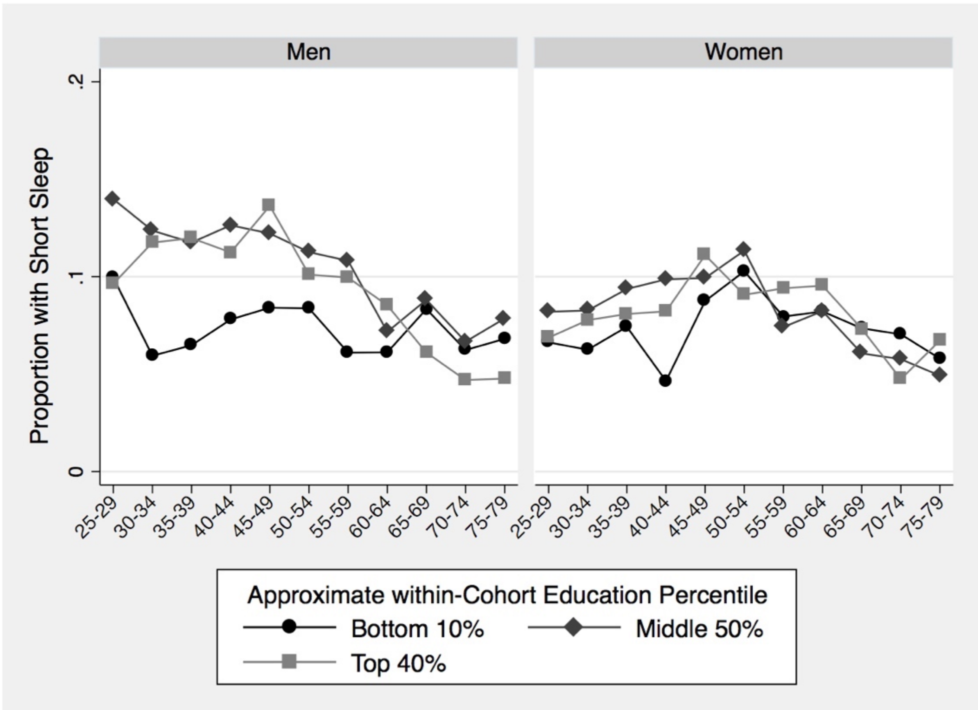


Supplementary Figure 4.4B Average Weekend/Holiday Total Sleep Duration by Gender, Cohort-Specific Education Distribution, and Age

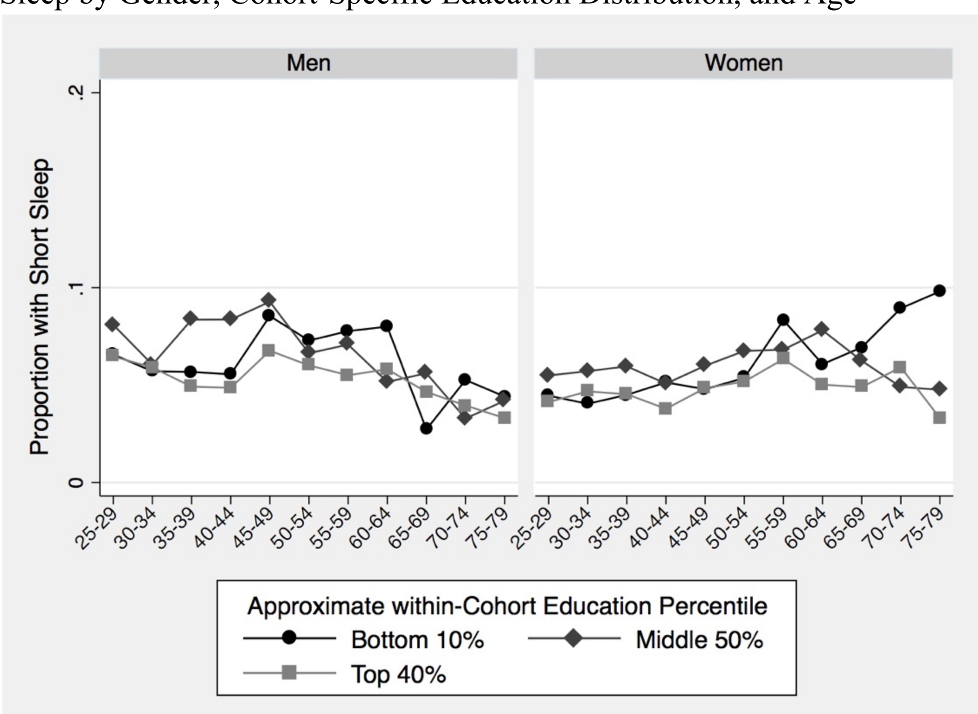


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.4A and 4.4B).
Note: These descriptive statistics are weighted (Supplementary Figures 4.4A and 4.4B).

Supplementary Figure 4.5A Proportion of Weekday Respondents with Short-Duration Sleep by Gender, Cohort-Specific Education Distribution, and Age

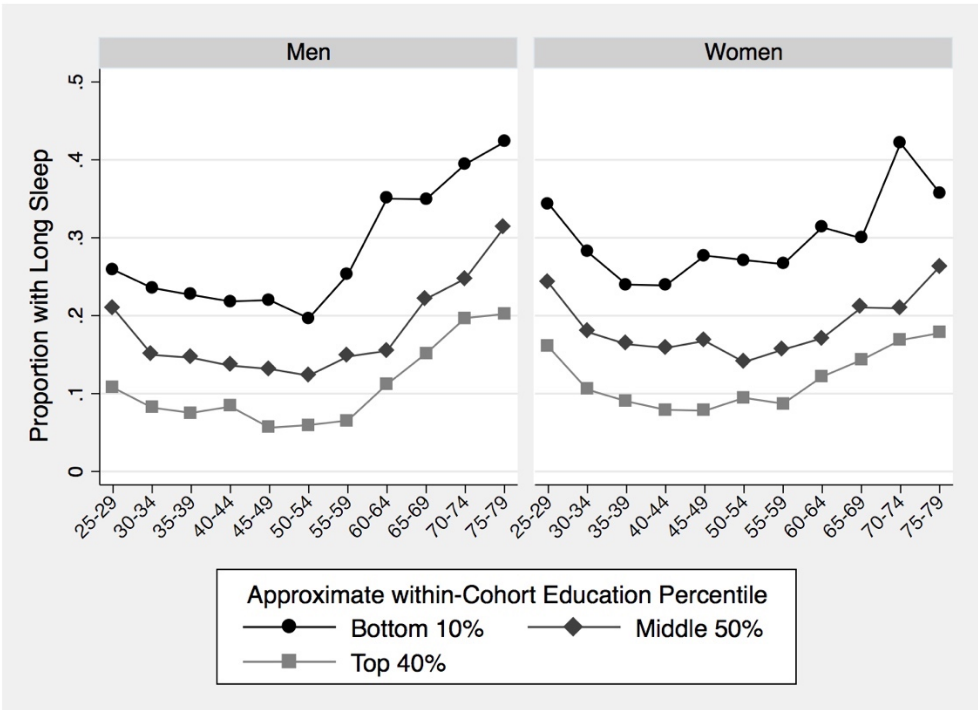


Supplementary Figure 4.5B Proportion of Weekend/Holiday Respondents with Short-Duration Sleep by Gender, Cohort-Specific Education Distribution, and Age

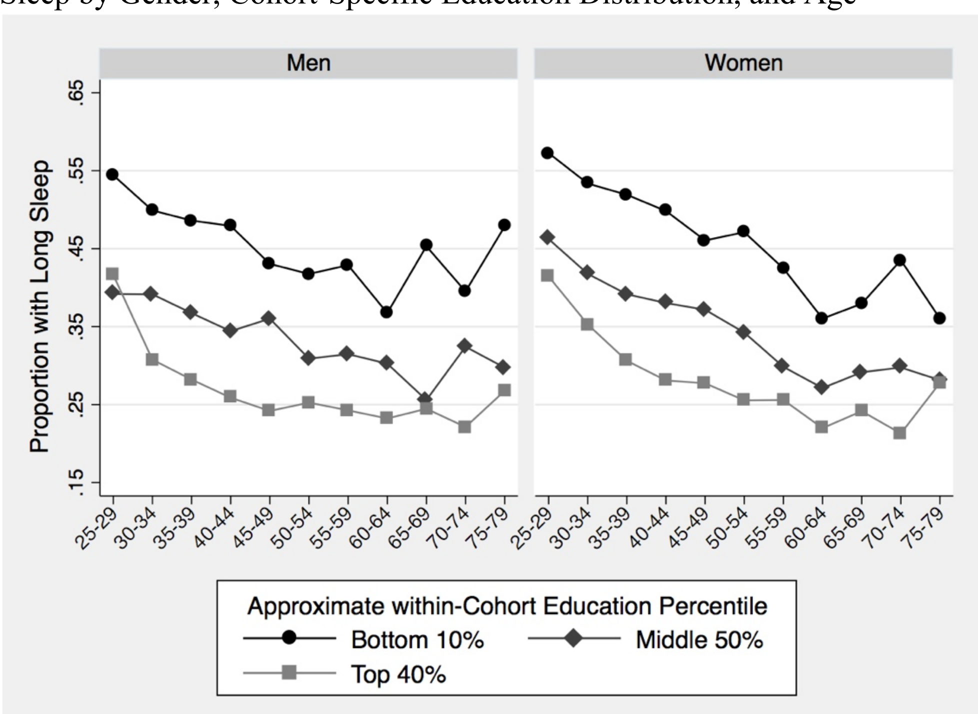


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.5A and 4.5B).
Note: These descriptive statistics are weighted (Supplementary Figures 4.5A and 4.5B).

Supplementary Figure 4.6A Proportion of Weekday Respondents with Long-Duration Sleep by Gender, Cohort-Specific Education Distribution, and Age

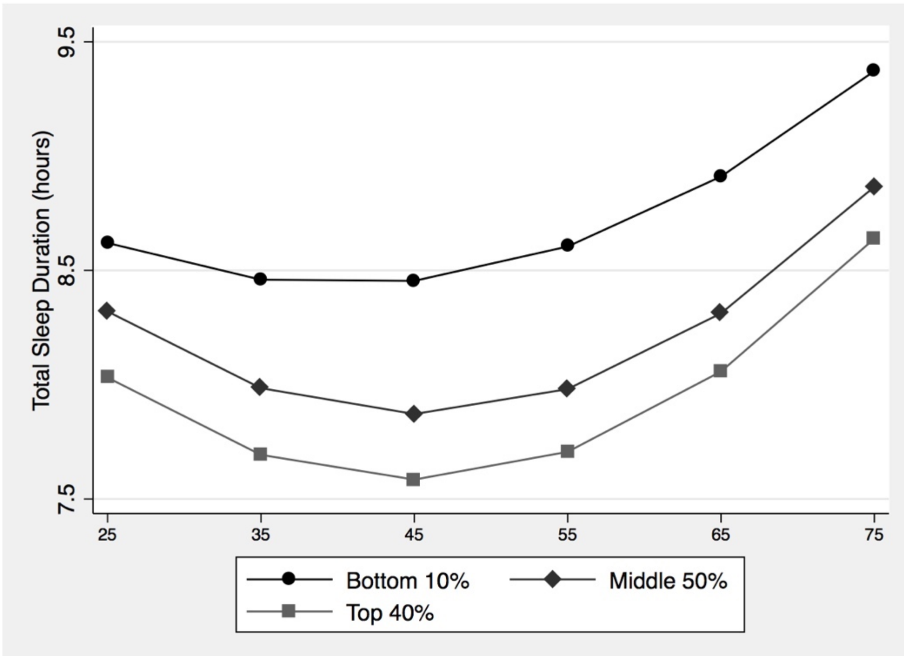


Supplementary Figure 4.6B Proportion of Weekend/Holiday Respondents with Long-Duration Sleep by Gender, Cohort-Specific Education Distribution, and Age

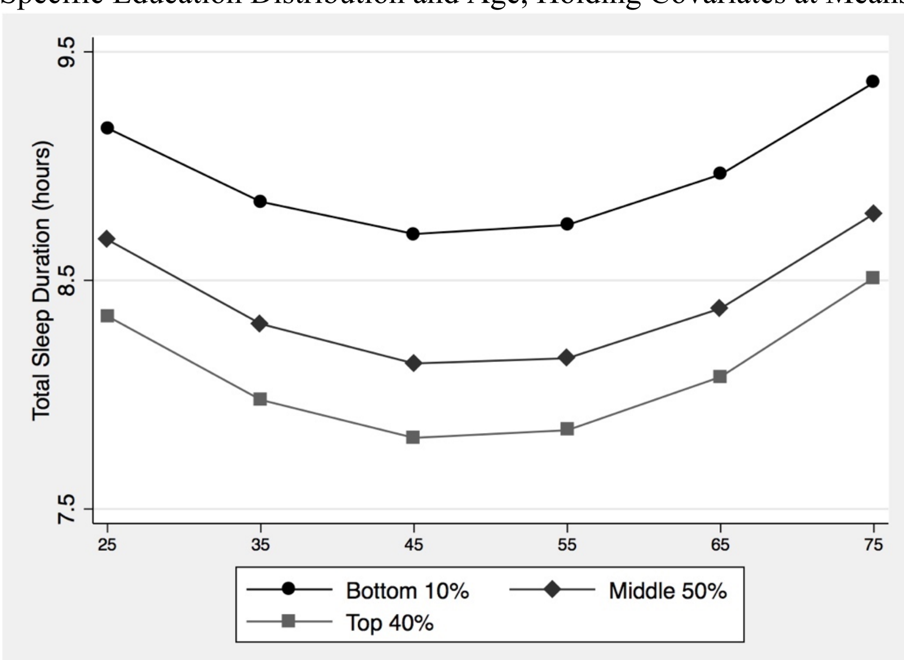


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.6A and 4.6B).
Note: These descriptive statistics are weighted (Supplementary Figures 4.6A and 4.6B).

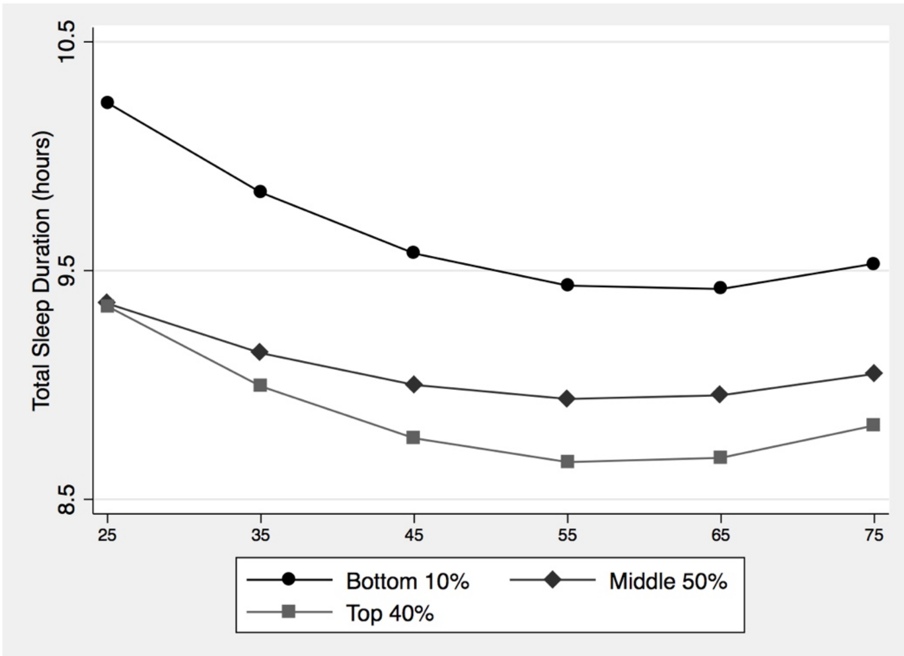
Supplementary Figure 4.7A Predicted Weekday Total Sleep Duration for Men, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



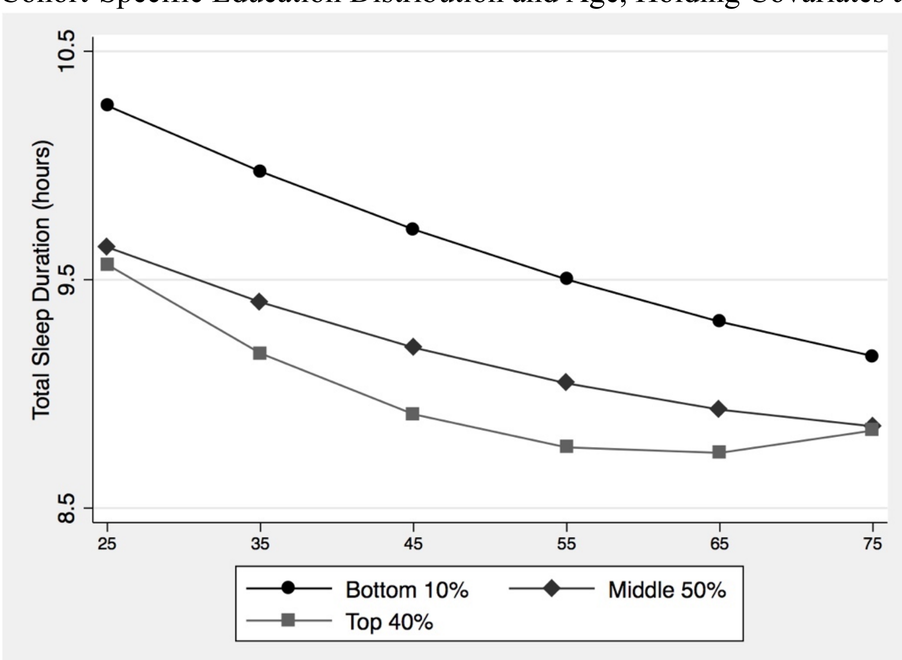
Supplementary Figure 4.7B Predicted Weekday Total Sleep Duration for Women, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



Supplementary Figure 4.7C Predicted Weekend/Holiday Total Sleep Duration for Men, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means

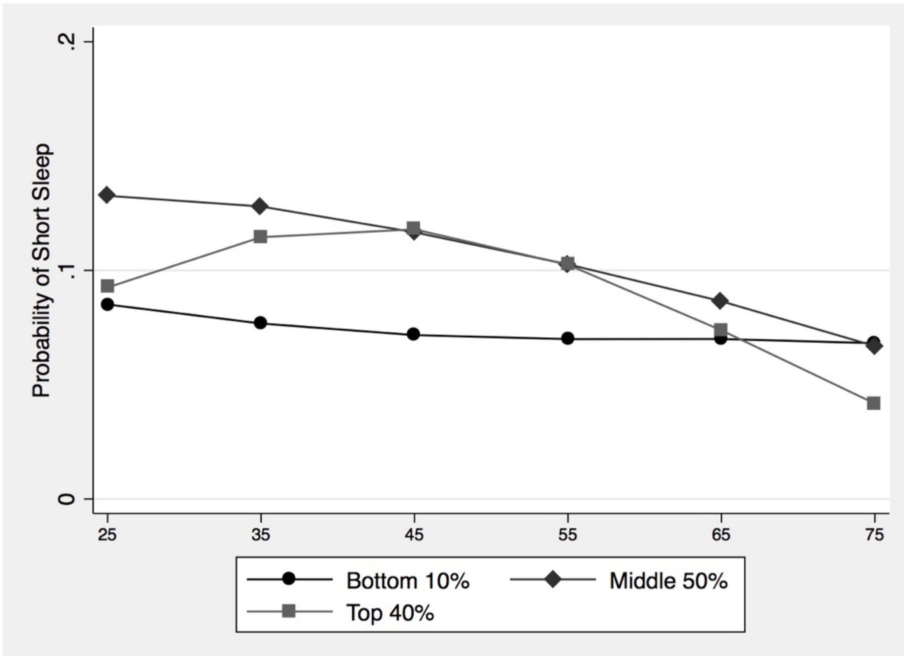


Supplementary Figure 4.7D Predicted Weekend/Holiday Total Sleep Duration for Women, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means

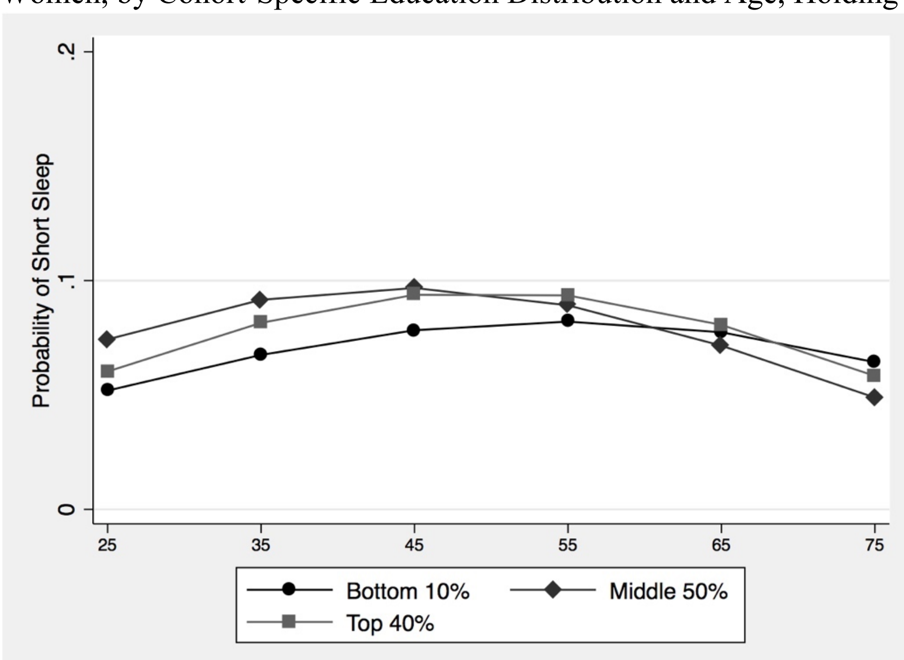


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.7A through 4.7D).
Note: Supplementary Figures 4.7A through 4.7D were generated from OLS regression models adjusted for region, season, day of week, and whether the interview year was post-2008 recession. Models include interactions of education variables with age and age squared.

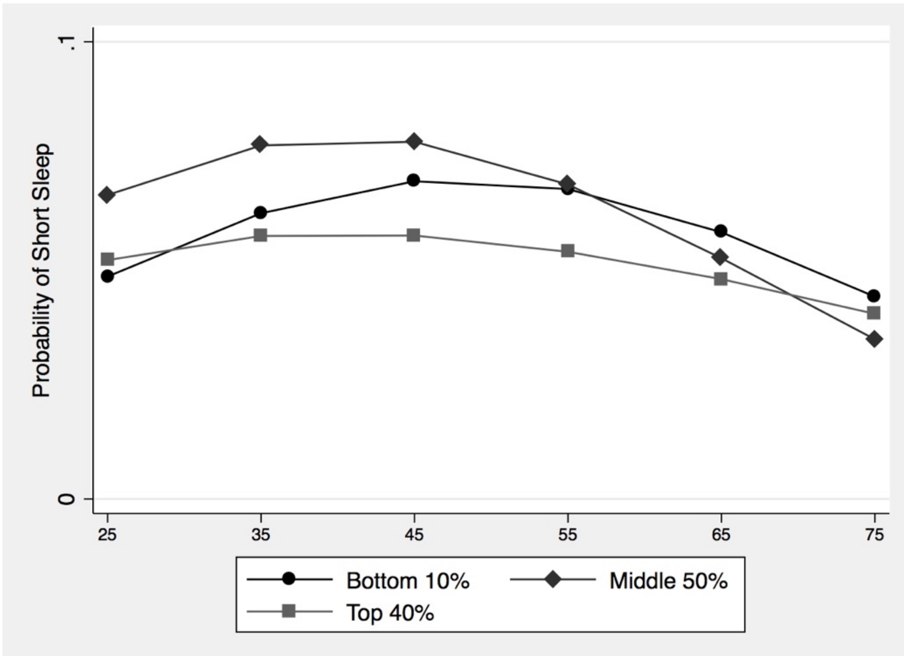
Supplementary Figure 4.8A Predicted Probability of Weekday Short-Duration Sleep for Men, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



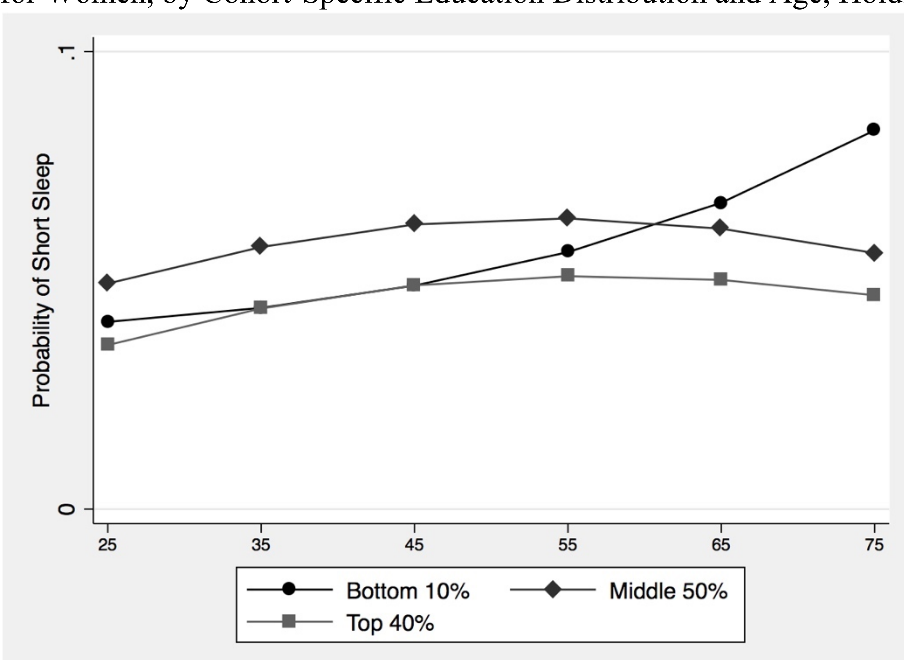
Supplementary Figure 4.8B Predicted Probability of Weekday Short-Duration Sleep for Women, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



Supplementary Figure 4.8C Predicted Probability of Weekend/Holiday Short-Duration Sleep for Men, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means

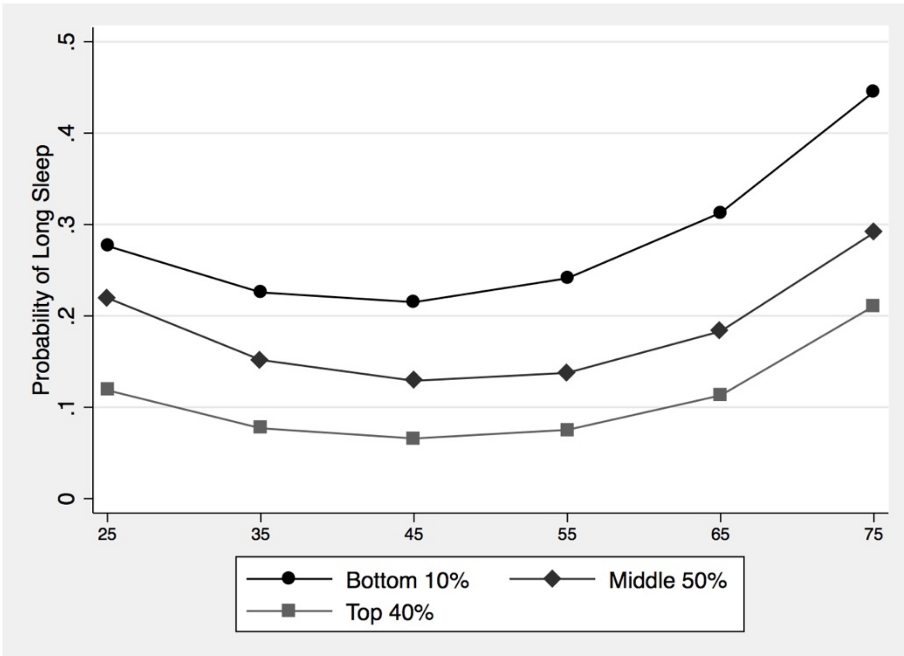


Supplementary Figure 4.8D Predicted Probability of Weekend/Holiday Short-Duration Sleep for Women, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means

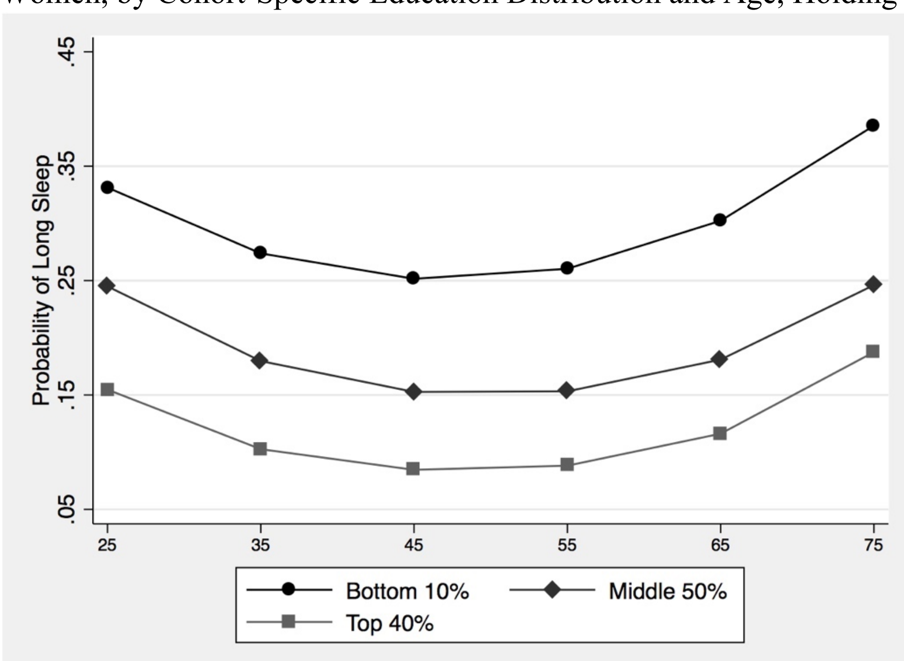


Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.8A through 4.8D).
Note: Supplementary Figures 4.8A through 4.8D generated from multinomial logistic regression models adjusted for region, season, day of week, and whether the interview year was post-2008 recession. Models include interactions of education variables with age and age squared.

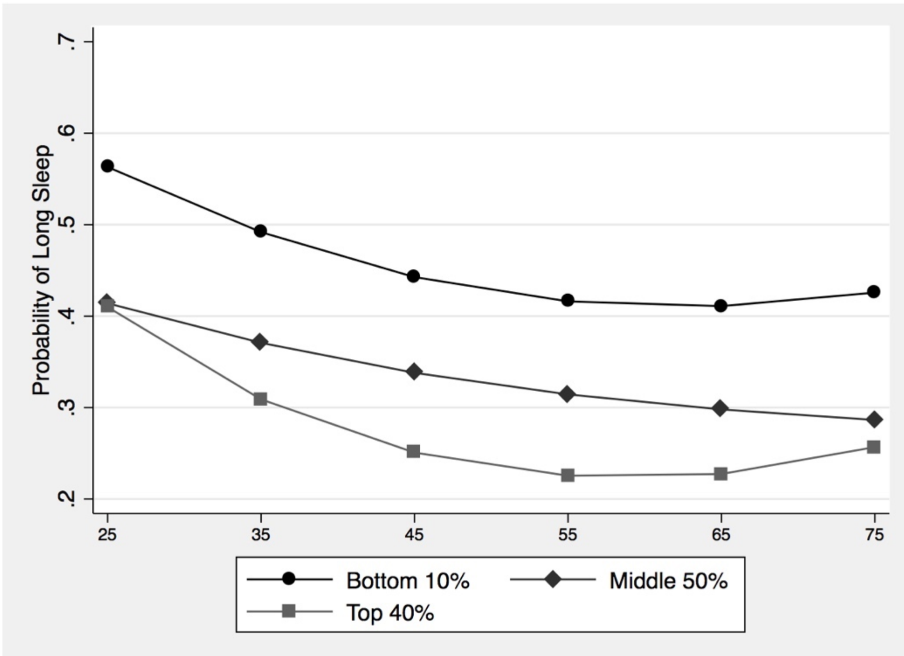
Supplementary Figure 4.9A Predicted Probability of Weekday Long-Duration Sleep for Men, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



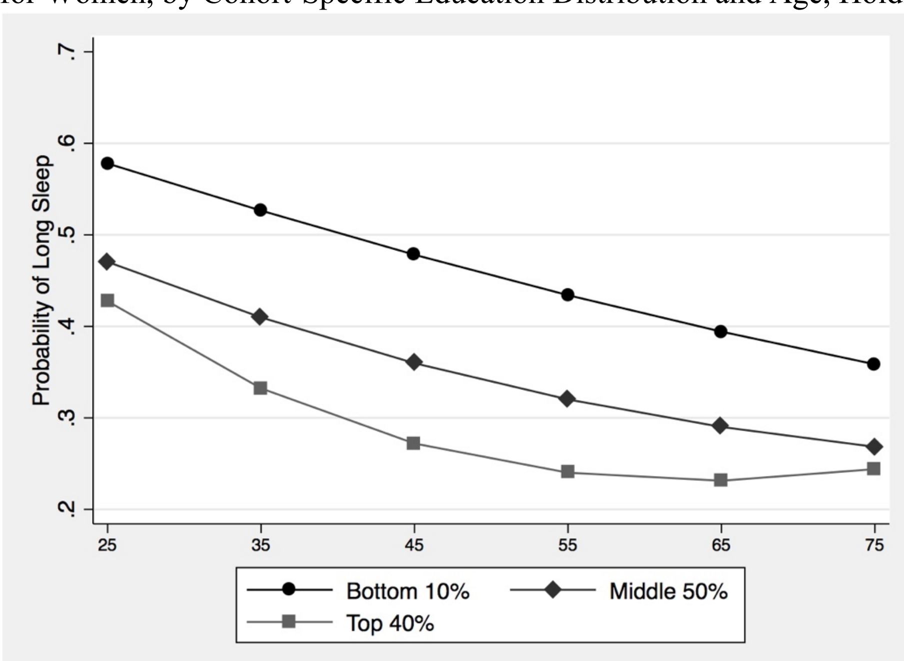
Supplementary Figure 4.9B Predicted Probability of Weekday Long-Duration Sleep for Women, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



Supplementary Figure 4.9C Predicted Probability of Weekend/Holiday Long-Duration Sleep for Men, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means

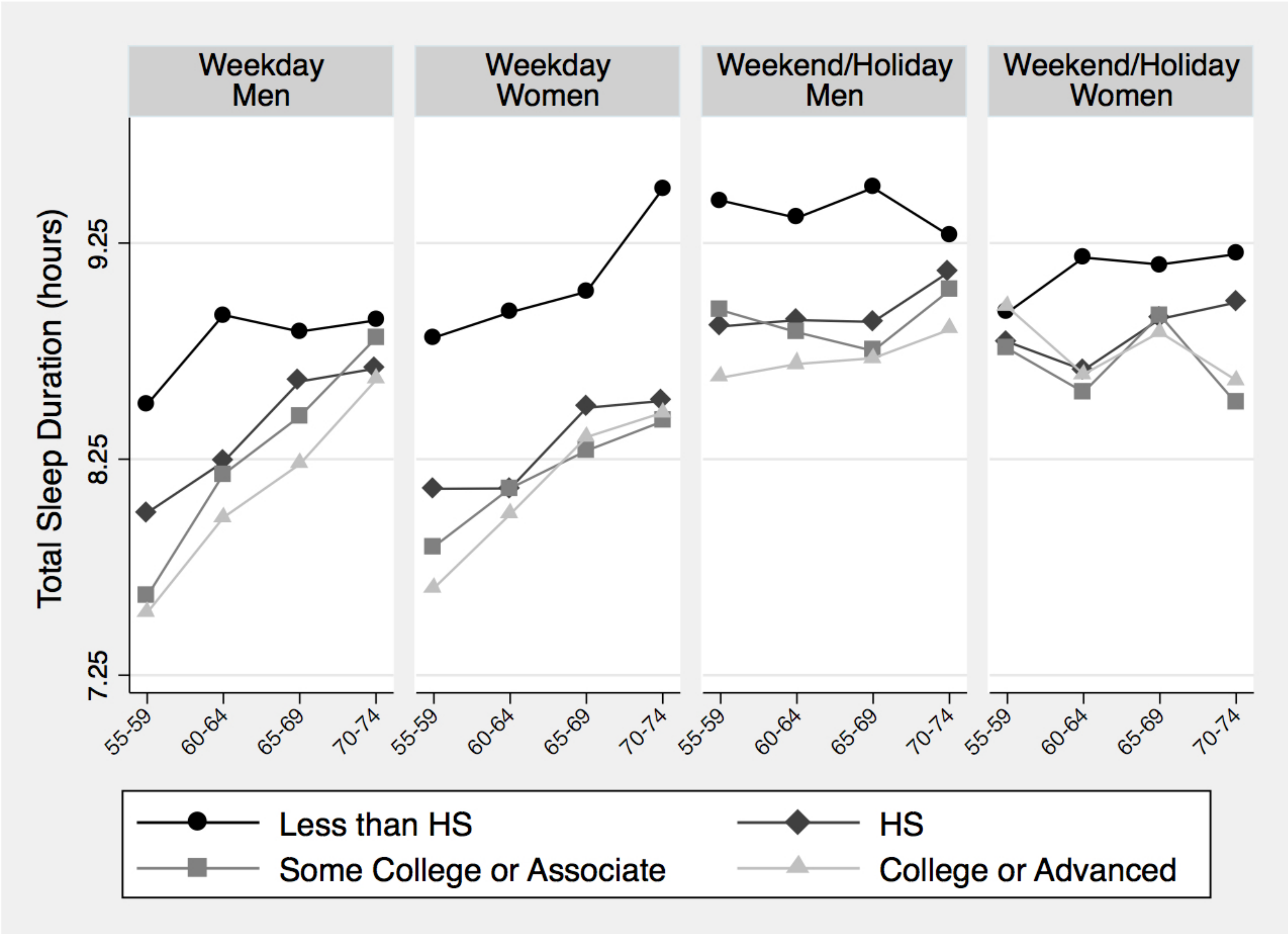


Supplementary Figure 4.9D Predicted Probability of Weekend/Holiday Long-Duration Sleep for Women, by Cohort-Specific Education Distribution and Age, Holding Covariates at Means



Source: American Time Use Survey, 2003-2016 (Supplementary Figures 4.9A through 4.9D).
Note: Supplementary Figures 4.9A through 4.9D generated from multinomial logistic regression models adjusted for region, season, day of week, and whether the interview year was post-2008 recession. Models include interactions of education variables with age and age squared.

Supplementary Figure 4.10 Average Total Sleep Duration by Type of Day, Gender, Education, and Age, in 1939-1948 Birth Cohort



Source: American Time Use Survey, 2003-2016. Note: These descriptive statistics are weighted

Supplementary Table 4.9A Sample Size for Men with Weekday Diary Day, by Age and Education, in 1939-1948 Birth Cohort

Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
55-59	81	226	204	285	796
60-64	194	435	377	542	1,548
65-69	228	462	365	502	1,557
70-74	91	210	154	246	701
Total	594	1,333	1,100	1,575	4,602

Supplementary Table 4.9B Sample Size for Women with Weekday Diary Day, by Age and Education, in 1939-1948 Birth Cohort

Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
55-59	115	309	291	286	1,001
60-64	265	686	554	515	2,020
65-69	282	735	559	569	2,145
70-74	145	370	266	267	1,048
Total	807	2,100	1,670	1,637	6,214

Supplementary Table 4.9C Sample Size for Men with Weekend/Holiday Diary Day, by Age and Education, in 1939-1948 Birth Cohort

Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
55-59	86	204	194	294	778
60-64	203	423	392	522	1,540
65-69	230	448	397	522	1,597
70-74	106	202	172	234	714
Total	625	1,277	1,155	1,572	4,629

Supplementary Table 4.9D Sample Size for Women with Weekend/Holiday Diary Day, by Age and Education, in 1939-1948 Birth Cohort

Age	Less than High School	High School	Some College or Associate's	College or Advanced Degree	Total
55-59	124	290	293	274	981
60-64	308	669	614	457	2,048
65-69	346	719	566	541	2,172
70-74	160	409	298	243	1,110
Total	938	2,087	1,771	1,515	6,311

Source: American Time Use Survey, 2003-2016 (Supplementary Tables 4.9A through 4.9D).