T.R.

GEBZE TECHNICAL UNIVERSITY

SOCIAL SCIENCES INSTITUTE

THE RELATIONSHIP BETWEEN WORKING HOURS AND SLEEP IN THE UNITED STATES

Sevgi BİTER

MASTER THESIS

DEPARTMENT OF ECONOMICS

GEBZE

2021

T.R.

GEBZE TECHNICAL UNIVERSITY

SOCIAL SCIENCES INSTITUTE

THE RELATIONSHIP BETWEEN WORKING HOURS AND SLEEP IN THE UNITED STATES

Sevgi BİTER

MASTER THESIS

DEPARTMENT OF ECONOMICS

Thesis Advisor

PROF. Dr. Murat Anıl MERCAN

GEBZE

2021

GEBZE TEKNİK ÜNİVERSİTESİ	**YÜKSEK LİSANS JÜRİ ONAY FORMU**

GTÜ Sosyal Bilimler Enstitüsü Yönetim Kurulu'nun 15/06/2021 tarih ve ..……/……..… sayılı kararıyla oluşturulan jüri tarafından 30/06/2021 tarihinde tez savunma sınavı yapılan Sevgi BİTER'ın tez çalışması İKTİSAT Anabilim Dalında YÜKSEK LİSANS tezi olarak kabul edilmiştir.

JÜRİ

ÜYE
(TEZ DANIŞMANI) :Pro. Dr. Murat Anıl MERCAN

ÜYE : Dr. Öğr. Üyesi Hande BARLIN

ÜYE : Doç. Dr. Mesut KARAKAŞ

ONAY

Gebze Teknik Üniversitesi Fen Bilimleri Enstitüsü Yönetim Kurulu'nun ...…/……/…… tarih ve ……/…..... sayılı kararı.

ÖZET

Uyku, sürekli çalışan insan vücudunun işlevlerini sağlıklı bir şekilde yerine getirebilmesi için vücudun ihtiyaç duyduğu dinlenme aşaması olarak yaşamın doğal ve vazgeçilmez bir parçasıdır.

Uyku ve çalışma saatleri ile ilgili akademik çalışmalar, veri kısıtlamaları nedeniyle genellikle belirli bir meslek grubuna odaklanmaktadır. Ayrıca uyku ve çalışma saatleri ile ilgili çeşitli çalışmalar olmasına rağmen, ulusal bir veri seti ile uyku ve çalışma saatleri arasındaki ilişkiyi inceleyen bir çalışma bulunmamaktadır. Bu nedenle ulusal bir veri seti ve tüm meslekleri kapsayan bir analiz akademik literatürde önemli bir boşluğu dolduracaktır.

Bu çalışmada, Amerika Birleşik Devletleri'ndeki Michigan Üniversitesi tarafından hazırlanan, 15.000'den fazla kişi için yaklaşık 500 değişken içeren boylamsal bir panel veri seti olan Sağlık ve Emeklilik Çalışması (HRS) veri seti kullanılmıştır. HRS'den elde edilen veriler öncelikle Cox regresyon analizi, panel veri analizi ve çeşitli ekonometrik yöntemlerle analiz edilmektedir. Bu çalışmada, ekonometrik analiz için saat kukla değişkenleri (35-40 saat, 41-48 saat, 49-54 saat ve 55 saat ve üzeri) oluşturulmuş ve uyku bozukluğu olasılığını incelemek için bunlar 35 saat ve daha az çalışan bireylerle karşılaştırılmaktadır.

Ekonometrik analizler sonucunda, uzun çalışma saatlerinin uyku sırasında huzursuzluk yaşama olasılığını azalttığı bulunmuştur. Bulunan sonuçlar sıklıkla kullanılan istatistiksel anlamlılık seviyelerinde anlamlıdır.

Anahtar Kelimeler: Çalışma Saatleri, Uyku, Ulusal

SUMMARY

Sleep is a natural and indispensable part of life as the resting stage that the body needs in order for the constantly working human body to perform its functions in a healthy way.

Academic studies on sleep and working hours usually focus on a certain occupational group due to data constraints. In addition, although there are various studies on sleep and working hours, there is no study examining the relationship between sleep and working hours with a national data set. Therefore, a national data set and an analysis covering all professions will fill an important gap in the academic literature.

In this study, the Health and Retirement Study (HRS) data set, a longitudinal panel data set containing approximately 500 variables for more than 15,000 individuals, prepared by the University of Michigan in the United States, is used. The data obtained from HRS are analyzed firstly by Cox regression analysis, panel data analysis, and various econometric methods.

In this study, hour dummy variables (35-40 hours, 41-48 hours, 49-54 hours, and 55 hours and above) were created for econometric analysis and compared them with individuals who worked 35 hours or less to examine the probability of sleep disturbance. As a result of econometric analyses, it was found that long working hours reduce the possibility of experiencing restlessness during sleep. The results found are meaningful at the statistical significance levels that are frequently used.

Key words: Working hours, Sleep, National

ACKNOWLEDGEMENTS

I would like to thank Prof. Dr. Murat Anıl Mercan for his valuable comments, support, guidance, and encouragements throughout this study.

I thank my uncle Mehmet Biter for his endless support in all part of my life.

I also thank to my beloved friends Ramazan Eren and Derya Demir for their belief in myself to keep this study going and their significant support throughout this study.

Finally, I dedicate this thesis to my beloved mother Selma Ekinci, who always believed in me and taught me the importance of education and being a strong woman.

İstanbul, Mayıs, 2021

Sevgi Biter

TABLE OF CONTENTS

LIST OF ABBREVIATIONS

Abbreviations	Explanations
ADAMS	: Aging, Demographics, and Memory Study
AHEAD	: Asset and Health Dynamics of the Oldest Old
ATUS	: The American Time Use Survey
BLS	: The Bureau of Labor Statistics
BLUE	: Best Linear Unlimited Estimator
BMI	: Body Mass Index
CAMS	: Consumption and Activities Mail Survey
CDC	: The US Centers for Disease Control and Prevention
CODA	: The Children Of the Depression Age
EBB	: Early Baby Boomers
ESS	: Explained Sum of Squares
EU	: The European Union
GDP	: Gross Domestic Product
GLS	: Generalized Least Squares
HR	: The Hazard Ratios
HRS	: Health and Retriement Study
ILO	: International Labor Organization
MMSE	: The Mini Mental State Examination
NHIS	: The National Health Interview Survey-Sample Adult Files
NHIS	: The National Health Interview Survey

Abbreviations	**Explanations**
NSF	: The National Sleep Foundation
OLS	: Ordinary Least Square
OR	: The Odds Ratio
RR	: The Relative Risk
RSS	: Residuals Sum of Squares
TSS	: Total Sum of Squares
US	: The United States
WB	: The War Baby
WLS	: The Weighted Least Squares Method

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

With the effect of the industrial revolution, critical changes have occurred in the labor market. During the industrial revolution, the two important factors that brought us to today's working conditions were the industrial revolution and the technology that was constantly developing at an extraordinary rate. The R&D studies of international giant companies that emerged after the industrial revolution contributed greatly to the advancement of technology. In today's modern world, there is a large production cycle to meet human needs. Although there are advanced technology and various factors that facilitate production in every sense, human labor is still the most important factor for production.

In addition, working is an indispensable cycle of life for the individuals to earn income for their welfare and good living conditions. On the other hand, besides the advantages of working life, it also has negative effects on the life of the individual. The most important effects are related to working hours, which cover a large part of human life on a daily, weekly, monthly, and annual basis. Most countries set weekly or monthly working hours limits in their laws and protect worker health and safety through various labor laws. In these laws, the forms of work are also addressed, and different forms of work such as full-time, part-time, and remote work come to the fore.

In the globalizing world where rapid population growth forces people to work intensively in the fields of production and consumption, the effects of working hours on human life have become a remarkable phenomenon. For this reason, working hours, which are remarkable for the improvement and sustainability of human health and welfare, have been the subject of many researches since the end of the 19th century. As a result, it has been understood that working hours have a variety of effects on human life, including both physical and mental human health, occupational and employee health/performance, social and economic functions, and workplace productivity.

Sleep is one of the basic human needs and is at the bottom of the pyramidal table called "Maslow's Hierarchy of Basic Needs." People usually sleep one-third of the 24 hours a day. The resting, recovery, and regeneration process, which is

necessary for the mental and physical health of the human body, mostly takes place during sleep. Therefore, research has often been conducted through empirical data sets containing self-reported statements and objective techniques that show various degrees of sleep. As a result, sleep has gained an important scientific literature thanks to the studies focused on it. On the other hand, research on sleep health as a prominent issue tends to increase. In order to understand the importance of sleep health, it is very important to know its meaning. In this context, Buysse states that

"Sleep health is a multidimensional sleep-wake model that supports physical and mental well-being, adapted to individual, social and environmental demands. Good sleep health is characterized by subjective satisfaction, appropriate timing, adequate duration, high productivity, and sustained alertness during waking hours" (Buysse, 2014).

These two indispensable phenomena, sleep and working hours, and the relationship between them, due to their important existence in human life, has become an inevitable research topic for studies. In the light of research, countries carry out policies that will provide optimum benefits not only for public health and welfare but also for the welfare of the country.

In addition, there are studies examining the relationship of long working hours, which are generally thought to be more than 50 or 64 hours, with sleep disorders. As can be seen in our literature review, studies are generally related to the working hours of an occupational group or a business line and the sleep quality of the members of that group.

There are also similar studies in studies conducted for the United States. The need for a national data set for more comprehensive research results creates an important gap in the literature. Therefore, our study is very important as it is the first study in the United States to investigate the relationship between working hours and sleep with a national data set. Under the guidance of many studies on the relationships between sleep and working hours, we focused on this significant relationship and its results in our study.

Accordingly, in the following parts of the study, issues related to various variables such as income level and social status, education level, social and physical

environment, individual health and nutrition, gender, and psycho-social factors are discussed in the light of a comprehensive literature.

In the other sections, in-depth information about the data set and methods used in the study and the results of the empirical analysis made in the light of this information are included.

2. LITERATURE REVIEW

Many countries back studies up to carry out investigations to shed light on policies that will maximize the welfare of the country from past to present. In addition, scientists and researchers have done and continue to do many studies that take into account public health and well-being. Under the guidance of many studies related to relationships between sleep and working hours, we also focused on this significant correlation and its conclusions in our study.

Working hours and sleep and relationship among them have become the subjects of researches in many countries including Japan, the United States (US), the European Union (EU), England, Finland, Canada, France, Portugal and Korea. Furthermore, most of the studies were conducted in the light of the datas obtained from these countries due to the longitudinal data sets that aforementioned countries have in this fields and also the long-term survey studies which are also conducted by them. Since panel data sets increase the reliability of the study in terms of observe the changes in sleep and working hours.

In our study, we examined the relationship between sleep and working hours in terms of America but differently from other studies we investigated this correlation with national representative data set. Even though, no researches investigated this relationship through a national representative database for America until present, there are various studies that examined the relationship between working hours and sleep. In this respect, as the first attempt to examine the correlation between working hours and sleep regard to individuals in the United States with a national representative data set (HRS), differently, our study has scientific importance in terms of conducting such a comprehensive examination.

If we look at the explanations for working and sleep hours in the world. In 2007 International Labor Organization (ILO) suggested that the number of employees working more than 48 hours (long working hours defined as more than 48 hours) are approximately 22.0% , or an study indicated that over 600 million workers have excessive working hours (Messenger et al., 2007). Generally, many studies have stated short sleep duration as less than 7 hours and reported that the risk of short

sleep duration and related sleep impairments have a tendecy to increase. And working hours have expressed one of the most likelihood reasons for sleep restriction.

To clearly identified the importance sleep in terms of human life, we firstly gathered some conclusions of studies that have examined various effect of sleep on mental and physcial health alongside employee health/performance and work related issues.

2.1. Effects of Sleep Duration on Human Life

In many studies have proven that sleep and social and economic factors have associated. Moreover, health related impairments could have outcome as a result of duraation of sleep. Furthermore, thanks to the many studies we know that duration of sleep and sleep quality have a significantly consistent effects on physical and mental health impairments. To understand and prove how much is sleep important on account of healt and human well-being? Firstly we mentioned some studies that have examined relation among health problems and sleep.

In this regard, Cappuccio reported that short sleep duration give rise to an increase in the risk of obesity (Cappuccio et al., 2008). This meta-analysis study concluded that the odds ratio for obesity and short sleep duration was 1.55 in adults and there was consistent and remarkable inverse correlation between short sleep period and obesity. Datas have gathered from cross-sectional studies of 604,509 adults and 30,002 children around the world, including women, men, girls and boys. And adult participants were between 15 and 102 years old from the USA, Norway, Canada, France, Brazil, Switzerland, Hong Kong, Japan, Finland, England, Sweden and Spain. Furthermore, study also have stated the odds ratio 1.89 in children for relation between shortened sleep duration and obesity. Children were from China, Canada, Portugal, USA, Taiwan, Germany, Japan, Brazil, France aged from 2 to 20 years. In addition, the Body Mass Index(BMI) was used as constant variable in this systematic review of cross-sectional analysis.

In 2003, Ayas analyzed the relationship between the duration of sleep and coronary heart disease, using data from women in the US. By observing the datas (given by Nurses who did not enrty Coronary heart disease before) during 1986-

1996 and follow up, study concluded that 5 hours and less sleep period caused 39% rise in the risk of Coronary hearth disease whereas this ratio was 18% for sleeping 6 hours (Ayas et al.,2003). Study also indicated that duration of sleep associated with diabetes. Datas were collected from self-reports of 71617 healthcare professionals, aged 45-65 who did not initially report coronary heart disease, were followed. Between 1986 and 1996, respondents' notifications were tracked via a mailed survey. It was stated that survey was include questions about to identify participants daily duration of their sleep.

In 2006, Yaggi investigated the association between the duration of sleep and diabetes. It was concluded that the relative risks of testesteron decreased 29% who has sleep duration 5 hours and less and 11% was who has sleep duration more than 8 hours while these rates were 14% and 3% respectively for cortisol (Yaggi et al.2006).The study examined the effect of sleep duration on diabetes with testosterone level and cortisol variables. In a prospective cohort study involving 1,709 men, participants who reported more than 8 hours of sleep as long duration of sleep and 6 hours to 5 hours or less as shortened duration of sleep. Those who slept 7 hours per night were taken as the reference group. Participants were taken from the Massachusetts Male Aging Study from 1987 to 1989 who had not reported diabetes at baseline. They were between the ages of 40 and 60 and have been followed until 2004. Finally, study reported that short duration of sleep and long duration of sleep are significant factors to rise diabetes risk.

Another study found that those with short sleep period had a 15% higher risk of cardiovascular diseases than those with normal sleep period. In addition to this, compared to those who have both normal sleep period and good sleep quality, those who have low sleep quality besides to short sleep duration have a 63% higher risk of cardiovascular diseases (Hoevenaar-Bloom et al., 2011). Study also reported that these relative risks for the incidence of coronary hearth disease was respectively 23% for short sleepers and 79% in those who have shortened sleep duration with low sleep quality. However, the study concluded that there was no association between prolonged sleep and the incidence of cardiovascular diseases. Participants were selected from The MORGEN Study (Monitoring Project on Risk

Factors and Chronic Diseases in the Netherlands) from 1993 to 1997. Subjects were 11,215 female and 9,217 male without having kardiovascular illneses at baseline.

In another research, the correlation among duration of sleep and hypertension was analyzed. According to conclusions of a research which is investigated the effect of sleep duration on hypertension, there is significantly consistent correlation between the hours of sleep and hypertension (Gangwisch et al., 2006). It was also stated that long duration of sleep could cause risk of hypertension with rise blood pressure , as short duration of sleep . Gangwisch analyzied the datas from the National Health and Nutrition Examination Survey I, conducted among 1982 and 1992. By carry out longitudinal analysis, study reported that the duration of sleep rise the risk for hypertension. These coclusion was for partcipants whose amond 32-59 ages.

The other study have analyzed the correlation amon duraiton of sleep and stroke. According to conclusions of study, short duration of sleep and long duration of sleep are both increases stroke risk, hazard ratios(HR) were 1.13 and 1.40, respectively (Ge B. & Guo X., 2015). Additionally, the odds ratio (OR) for duration of long sleep have reported as 2•12, while it was 1•71 for short duration of sleep. Researches that contained analysis which are examine correlation between duration of sleep and risk of stroke were investigated, with research on MEDLINE and EMBASE. These analyzes were consist of cross-sectional (to identify odds ratio (OR) or cohort (to identify relative risk (RR) or hazard ratio (HR) studies. Consequently, duration of sleep was significantly associated with risk of stroke on account of both long duration of sleep and short duration of sleep.

In the other hand, there is found correlation between mortality and duration of sleep in a community based prolonged cohort study across 22 years and follow up. Hublin reported that shortened sleep duration and prolonged sleep duration are caused an augment for risk of mortality about 26% and 24% respectively in male, whereas these ratios are found 21% for duration of short sleep and 17% for duration of long sleep in female. Study also demonstrated that augment of mortality expanded from 1.24 to 2.17 in female when reduced long sleep hours to short sleep. These conclusions are found similar for the results of the male participants as well (Hublin et al., 2007). This study is a prospective cohort analysis.

Participants were from The Finnish Twin Cohort, and to collect datas, study used two survey through mail way in 1975 and 1981. Reports of 21,268 twins 18 years old and older were recorded. These surveys were answered by 89% in 1975, while it was 84% in 1981.

Hall carried out a study to examine association among duration of sleep and metabolic syndrome. According to conclusions, when compared to 7 to 8 sleep hours in night, the prospect of having metabolic syndrome have seen over 45% for paticipants whose have short duration of sleep and long sleep hours (Hall et al., 2008). The analysis were conducted over 1214 American adults between ages 30 and 54. The American Heart Association/National Heart Lung and Blood Institute's criteria were used to characterize metabolic sendrome. Subjects were from Adult Health and Behavior Project registry between 30 and 54 ages. By Aiming to investigate the effect of sleep duration on metabolic syndrome, study conducted cross-sectional analysis. Metabolic syndrome rate was reported 22% in analysis. As a result it was also demonstrated in the research that there is individually correlation between boosted fasting glucose, diabetes, hypertriglyceridemia and duration of sleep.

In 2004, Van Dongen mentioned links between sleep deficiency and neurobehavioral impairments. Study have aimed to expose interindividual distinctions in case of any connection. İnvestigation have conducted under laboratory conditions. As a result of observations, study found out significant correlation between duration of sleep and neurobehavioral performance impairments (Van Dongen et al., 2004). In addition to this, it was demonstrated that due to the sleep deprivation, neurobehavioral impairments diversified considerably within individuals and consistent. Paticipants were 21 adults without any health problems and between 21-38 years old.

Another prospective cohort study have conducted to examine the association between sleep and cognitive functions. Study stated that those with short sleep hours have been reported to have more low cognitive functions than those with normal sleep hours (Ferrie et al., 2011). Moreover, when the sleep hours of those who have long or normal sleep duration are reduced, it has been found that cognitive functions are become poorer. Based on conclusions from Whitehall II

study, 6 tests were conducted in the study including verbal meaning (Mill Hill), verbal memory, the Mini Mental State Examination (MMSE), inductive reasoning (Alice Heim 4-I), phonemic and semantic fluency, to tested cognitive function. Examining the datas of 3972 male and 1459 female participants between the ages of 45 and 69, the study have indicated results for individuals in the middle age group. As a result of study, association among duration of sleep and cognitive function was found.

Baglioni reported that poor sleep quality is associated with depression. As a result of insomia records, which is one of the sleep deprivation problems, it has been stated that people who had no symptoms of depression but has insomnia were twice as prone to depression risk compared to non-insomnia subjects (Baglioni et al., 2011). In this meta-analysis study with databases which are longitudinal epidemiological studies about depression and insomniac informations has been observed datas between 1980 and 2010. Longitudinal studies on insomnia and depression disorders between 1990 and 2010 were investigated using Medline, PsycArticles, PsycInfo and PubMed. In the study where meta-analytical studies including effects of fixed as well as effects of random were collected to evaluate compatibility, for insomnia predicting depression odds ratios were 2.10 and 2.60, respectively, in the effects fixed and random.

On the contrary, there are some studies that found that depression is association with excessive sleep hours. And in various studies, sleep deprivation has been correlated to many other mental health factors such as anxiety, undecided moods, alcohol misuse, dementia and suicidial ideation. Sleep is also associated with employee health and performance as well as work-related difficulties and human safety as well. We also have mentioned some studies that had analyzed this correlation in terms of various factors.

In other study, Lombardi found that reduced self usual reported sleep per day give rise to an increase in work-related accidents (Lombardi et al., 2010). Work-related accidents in terms of sleep duration were recorded by 544 employees. In accordance daily self usual reported sleep , with redused duration of daily sleep bring about rise the crude prediction accident indicence per year/ 100 employees. These ratios were 4.72 for more than 10 hours sleep, 7.89 for less than 5 hours

sleep, 5.21 for duration of sleep between 5 and 5.9 hours and 3.62 for duration of sleep between 6 and 6.6 hours. The reference group was duration of 7-7.9 sleep hours. When compared to reference, the odds ratio for employees whose have less than 5 hours sleep per day were reported 2.65, while the odds ratio for duration of more that 10 hours sleep were 1.82 as. Consequently, study observed that the duration of short sleep and prolonged sleep give rise to increase work-related accidents. Additionally, it was stated that similar effects on work-related accidents were also observed for excessive working hours. Data were gathered with household survey from the National Health Interview Survey (NHIS) throughout 2004 and 2008. 177,576 induvidual between aged 18 and 74 have reported survey. Responses of 74,415 adults, which are consist of 98.3% of 75,718 participants whose randomly selected to report their sleep duration per day, were analyzed.

Another one have found an important correlation between duration of sleep and traffic incidents. The study was consist of 544 participants, including emergency conveyance, truck and taxi drives. But only 275 of cases were included in the analysis since they had complaints fo sleep and sleep irregularity. From these cases 50.9% drives were reported daily 6 hours of sleep and less with also reporting sleep related disorders during the latest three months, and 49.1% drives record inadequate sleep hours which were refered to duration of short sleep. For the lastest three months, whose expose to very poor duration of sleep have tend to 3.35 times to rise traffic incidents risk , and whose have 6 hours or less duration of sleep have tendecy to increase 1.69 times risk of accidents (Philip et al., 2014). In this population-based study, for examine all variables, multivariate logistic regression were used. Datas of subjects have collected through a survey which carried out by clinical searh assitant. Survey have conducted by telephone or face-to-face.

In the following section, we did literature research for studies which have found an important links between sleep and working hours. These studies were also important in terms of our study topic and they were shed light on the hypotheses we have formed.

2.2. The Intercorrelation Between Sleep and Working Hours

Working hours and sleep, these two phenomena covering the long period of human life and their reciprocal relationship have been the subject of many studies. The following, we have included brief summaries of some of these studies. First of all, we have mentioned studies that examining these two phenomena (sleep and working hours) and their relationship on behalf of population of United States. But before that, we briefly have mentioned about working hours, sleep and sleep-related problems, as well as economic cost of sleep-related problems in the United States.

When we look at the working hours in the United States, accordance to the Bureau of Labor Statistics (BLS) 2019 data, the average daily working hours of Americans are 8.5 hours , while the average working hours are 34.4 hours per week. However, it would not be wrong to say that these rates are much higher than they recorded, by taking advantage of the studies on this subject, and with regard of enormous economic size of counrty in 7/24 hours working modern societies.

In respect of sleep in America, accordance to the data of the US Centers for Disease Control and Prevention (CDC) in 2008, the ratio of those who sleep fewer than 6 hours in a 24-hours augmented for both male and female from 1985 to 2006. Colten noted that approximately between 50 and 70 million of the US underwent to sleep related disorders (Colten, 2006 book). In 2009, the National Sleep Foundation (NSF) reported that work schedule of 25% of employees in the America prevented them from obtaining necessary sleep. The National Health Interview Survey (NHIS), in 2013, stated that the ratio of those who slept fewer than 6 hours a night increased 6.9% in the period among 1985 and 2012, while the self usual reported habitual sleep duration decreased 10-15 minutes.

Additionally, Sheehan analyzed data from the National Health Interview Survey (NHIS) from 2004 to 2017 for adults in the United States, conducted study in 2019. It was demonstrated that in the proportion of those who slept 6 hours or fewer (defined as short sleep duration) had increase 15% (Sheehan et al., 2019). In addition, the study, which examines racial and ethnic aspects, indicated that while

this increase was profound among mostly black and Hispanic adults, negative health outcomes in society were associated with short sleep periods.

Investigating the economic cost of insatisfactory sleep for 5 different OECD countries (US, Canada, Japan, Germany, U.K), Hafner found that the economic cost of sleep and sleep related disorders for the United States was $ 411 billion to 2.28% GDP (Hafner et al., 2017). Besides, a higher risk of mortality was correlated deprivation of sleep. And also study reported that the loss due to deprivation of sleep in the United States is equivalent to 1.23 million working days.

Accordance to another study which conducted in 2019, , the prevalence of short duration of sleep increased significantly 4.7% for adult emloyees in the 9-year period from 2010 to 2018 (Khubchandani & Price, 2020). The study defined short duration of sleep as fewer that 7 hours, analyzed the prevalence of the tendency for duration of short sleep accordance to employment and demographic characteristics for employees of American. By comparing the datas from 2010 to 2018, study found that the prevalence of duration of short sleep in 2018 was higher in terms of demographic characteristics including race, education level, marital status, age, gender, region of residence and the number of children in the household, employment characteristics as well. Datas have obtained from the NHIS which are conducted between 2010 and 2018.

According to another study, while there has been a decrease in duraition of sleep recently, there is a light augment in the prevalence of sleep difficulties (Hisler et al., 2019). Study concluded that;

"*From 2013 to 2017, the prevalence of reporting any days with difficulty falling asleep (B ¼ .01, p <.01), trouble staying asleep (B ¼ .02, p <.001), increased, yet waking feeling rested also increased (B ¼ .01, p ¼ .004), while average sleep duration decreased (B ¼ -.02, p <.001)." Data were from the yearly National Health Interview Survey from 2013 to 2017.* "

Surveys were including self usual report of sleep impairments of 164,696 adults whose American. By using a multistage probability design, study analyzed difficulty falling asleep, take of sleeping pills, duration of sleep, difficulty stay of asleep and senses of restorative sleep.

On the other hand, Basner conducted an study to identify seculer tendecy of duration of sleep over the U.S population between 2003 and 2016. Study concluded that there is an increase in duration of sleep, in reverse of studies that found a decrease in sleep duration (Basner & Dinges, 2018). Accordance to study, throughout the 14-year period, an augment, was observed in sleep period on weekdays +1.40 min and on weekends +0.83 min. And it has stated that these increase were seen for students, retirees and workers. While there was no such tendency in those who were not working or in labor force, the change in the average sleep period of those who sleeping 7 hours or fewer was found to be -0.44%. It has demonstrated that the augment in duration of sleep is not due to working hours, but that the U.S population prefers sleep rather than waking activities. Besides, study reported that online chances such as shopping, learning, banking, and working feed the duration allocated to sleep. Additionally, the main reason for this increase were given as early retirement at night and waking up late in the morning. In the study, data on duration of sleep and 40 waking activities reported by 181,335 subjects participating in The American Time Use Survey (ATUS) of USA aged 15 and over were examined.

Biddle and Hamermesh concluded that *"[t]ime spent sleeping is inversely related to both the wage and time spent in the labor market. In short, sleep is subject to consumer choice and is affected by the same economic variables that affect choices about other uses of time*."(Biddle & Hamermesh, 1990). The study, which analyzed with multivariate linear regression models, demonstrated that any additional hour of work decreased duration of sleep by almost 10 minutes. Study conducted based on the time use data sampled in a study on 1519 American households from 1975 to 1976.

Hale's, with title of "Who has time to sleep?", analyzed the correlation between sleep and sociodemographic characteristics such as marital status and education. Study concluded that those who work 50 hours per week are more likely to have a short duration of sleep, compared to those who work fewer than 35 hours (Hale, 2005). Quantitatively, study reported that the odds ratio for risk of short duration of sleep for who working more than 50 hours a week have an augmented 1.45, contrast to the who working 35 and fewer hours a week. Similarly, the odds

ratio was reported as 0.75 in the comparison made for the probability of long sleep duration risk. What' more, it was indicated tha being unemployed and retiring also increased the probability of longer sleep. The article published in 2005. Study analyzed the time use data of over 7000 people between the ages of 25 and 64. In the study, in which the subset of the cross-sectional time-use studies conducted in 1965, 1975, 1985 and 1999 was followed, the multinomial logistic regression equation was calculated for the amount of sleep reported in 24 hours..

Basner investigated the relationship between sleep duration and other wakening activities.The study, which handled the 24-hours time use data of the subjects, stated that working hours associated with sleep duration. Consequently, the fewer sleep duration has found (7.87 ± 0.03 years) in subjects aged 45-54 with the longer working hours, while the longer sleep duration was observed (8.98 ± 0.05 h)for over 75 years old (Basner et al., 2007). Moreover the lowest sleep hours were observed in men, and the lowest sleep hours were observed with the highest working hours. By using cross-sectional data of N= 47,731 participants over the age of 14, analysis have collected data from the database of the ATUS in 2003, 2004 and 2005. Study have conducted multiple linear regression models.

In the US population-based cross-sectional analysis in 2009, sleep duration were analyzed. Working 41 hours and more was found to be associated with a shortened sleep time, and long sleep hours were associated with not working (Kreuger & Friedman, 2009). As a result of study, subject who has 41 and more working hours were indicated 40% more likely sleeping 5 and less hours, compared to who has 34 and less working hours. Additionally study reported that the rate of adult subjects those sleeping 6 and less hours was 28,3%, while this rate was 8.5% for whose sleeping 9 and more hours. The 2004-2007 NHIS-SAF data were taken to examine sleep time through the National Health Interview Survey-Sample Adult Files, which provides national representative data for 110,441 non-institutionalized US adults aged 18 and over. In the annual cross-sectional surveys, where the response rate was 81%, behavioral, socio-demographic and socioeconomic characteristics were asked in personal interviews in English and Spanish to monitor the health of the population. Multinomial logistic regression analysis was used to examine the relationship between long and short sleep times with variables of

health behavior, education, socioeconomic status, family structure and demographic status. Consequently, long working times were associated with short sleep times.

A subsequent study examined how Americans sleep duraiton has changed over the past 31 years. Study defined duration of short sleep as 5 hours and e fewer, 6 hours and fewer. In study, it was indicated that those who stated less than 6 hours of sleep per night were those who had long working hours. Study reported that compared to other employments (part-time employees, the unemployed, retired or housemakers), full-time employees are 50% more likely to have short duration of sleep (Knutson et al., 2010). Moreover, the increased odds ratio of shortened sleep was remarked 1.19 for full-time employees throughout 31 years. Additionally, study carried out the analysis of 8 national studies including American's Use Of Time Series 1975, 1985, and 1998, 1999 , the Environmental Protection Agency time use study from 1993 to 1994, as well as 2003, 2004, 2005, 2006 American Time Use Survey. And the subjects were between aged 18 and 65 years old.

According to the study, long working hours are related to shorter duration of sleep , while short sleep duration are associated with work disorders and %37 participants had been graded as at risk in terms of sleep disorders (Swanson et al., 2011). Furthermore, subjects those recorded quality of poor sleep were increased more likely odds ratios of impatience, poor concentration, difficulty with organization, problems with organization, avoiding interactions with co-workers , boredom, decreased productivity and missed work time because of sleepiness, falling asleep at work. Study suggested that long working hours may in turn rised work-related disruptions by contributing chronic sleep loss. In study, data of 17% of the 1000 Americans aged 18 years or older and working 30 hours or more per day were used thanks to the National Sleep Foundation's (NSF) 2008 Sleep in American Poll.

Yong carried out a study to examine sleep disturbances in American population. Duration of short sleep handled as less than 7 hours. As a result of multivariate logistic regression analysis performed with calculated prevalence rates, compared to long sleepers who sleep more than 7 hours, short sleepers who sleep fewer than 7 hours were found

more likely tend to have impaired activities daily living, insomnia and poor quality of sleep (Yong et al., 2017). Moreover having 48 and more working hours were associated with higher prevalance of duration of short sleep, insomnia and poor quality of sleep. With standing for 54.1 millon Americans workers, the prevalence of duration of short sleep was reported 37.6% among all employees. Besides, data were collected from a survey of National Health and Nutrition Examination, which is a continuous series of cross-sectional analyzes and obtained with 2-year cycles. Moreover, responses of 6338 workers aged 18 and over in 2005-2006 and 2007-2008 were were analyzed. These responses were about sleep-related problems and sleep habits, and short sleep hours.

In a study conducted in Australia shows that the probability of reporting 6 hours of sleep (OR = 1.17) is highest for those who work more than 40 hours a week and 16.6% of adults whose data were analyzed reported short duration of sleep. As a result of analyzed cross-sectional data from the self-report survey, the odds ratio (OR) for the association of long working hours and short sleep duration was found to be 1.17 (Magee et al., 2009). In the study, which examined the data of the participants between the ages of 45 and 65, the full data of 49.405 subjects were observed for this study and became the subject of examination. However 62.317 subjects were included in the dataset for this ages. For review, the study handled data between 2006 and 2008 from the Study 45 and Up (New South Wales [NSW]), a survey study of adult Australians aged 45 and over. Consequently, as the study stated that short and long sleep times were common in Austrian adults.

The other study conducted in the United Kingdom in 2009 was examined correletaion between sleep deprivation and families responsiblities, occupational conditions In study, it was found an inverse relationship between long working hours and sleep duration (Chatzitheochari & Arber, 2009). Study demonstrated that the subjects those who work more than 10 hours a week, the rate of being short sleepers has increased. Moreover, ıt was indicated that 21% male and 22% female recorded sleeping less than 6.5 hours. Furthermore, the odds ratio for the risk of sleeping fewer than 6.5 hours was observed 3.5 for male and 1.79 for female those who working more than 10 hours a day, compared to those working up to 8 hours a day. This study examined time use data from the United Kingdom Time Use Survey

2000 (UKTUS) for employees, a subset of employees aged from 20 to 60 account of 2882 subjects.

Another study, using The Jenkins (26) scale and a 2009 study of Whitehall II's British civil servants, have examined the relationships between working of long hours and sleep related problems including short sleep, waking up without refreshing, frequent waking up, early awakening and difficulty falling asleep. Described as the first prospective cohort study to examine the relationship between re-exposure to long working hours and sleep disorders independent of known risk factors. This study supported the idea that prolonged working hours are seen as an independent risk factor for the development of sleep disorders (Virtanen et al., 2009). The study reported that the odds ratio short hours of sleep, which defined as fewer than 7 hours per day, for those who working more than 55 hours a week was 1.98 times higher in comparision to those who work 35-40 hours a week. Moreover repated exposure to long working hours was correlated to more than 3.24 odds ratio for short duration of sleep.

Similarly a study in Japan showed that quality of poor sleep was associated with hours of long work in a dose-response manner (Nakashima et al., 2011). After adjustment for entire confounding, the odds ratio of short duration of sleep, which increases in dose response with overtime, was reported 1.43 for working 26 and more hours but less than 40 hours, 1.51 for working 40 and more hours but less than 50 hours, 1.75 for working 50 and more hours but less tthan 63 hours, 3.68 for working 63 and more hours. The study examined sleep status for 1510 male white-collar workers among aged 18 and 59 working in a light metal products factory,according to components of the Pittsburgh Sleep Quality Index. Adjustmented for confounding factors, while reference group taken as work fewer than 26hours , the odds ratio for working less than 63 but 50 and more hours was 1.67 ,and for workers with more than 63 hours was 1.87.The PSQI was Japanese version.

In another study, Otshu examined the relationship between sleep and working hours for Japan working population (Otshu et al., 2013). With the approval of the Epidemiological Studies Ethics Committee of Nihon University Faculty of Medicine, 4,000 households were selected throughout the country. It was

demonstrated that the odds ratio for short duration of sleep in male subjects those who work 10 and more hours a day was 8.62 compared to reference which consist of male subjects those who work 7 and more hours but less than 9 hours a day. Moreover, compared to non-overtime work among male, the odds ratio for hours of overtime in men was 3.59 for hours of 3 and more but less than 4 hours. And during the one-month survey, were reached 2,206 adults at their homes, and the data of 662 currently workers participating in the survey were analyzed.Study have examined hours of long work as exceed 40 hours a week. To analyzed the correlation between duration of sleep and working hours in logistic regression analysis "*sleep duration <6 hours per day*" were used as dependent variant.

In 2013, a cross-sectional study conducted in Hokkaido Prefecture, Japan, on public junior high school teachers. It was stated that there is a significant link between sleep and working hours. An increase in the risk of sleep problems was found when those who worked more than 60 hours a week compared to those who worked for 40 hours or fewer , but this was statistically significant for male teachers (Bannai et al., 2015). In the study, sleep impairments were recorded in 41.5% of 335 men and 44.4% of 180 women.The prevalence of sleep impairments in men working more than 60 hours a week was the highest with 47.4%, while this rate was reported 34.0% for those working 40 hours or less, and it was determined to increase depending on working hours. In the study, which examined the relationship between working hours and sleep for school teachers for the first time , responded to 558 (44.8%) of the surveys delivered to 1,245 teachers were analyzed. Responses to working hours and responses given accordace to the Pittsburgh Sleep Quality Index were examined separately by gender with multiple regression analyzsis.

Another study examined by Bo Hwan Kim & Hye-Eun in 2005, suggested that long working hours may have a risk effect on sleep related disorders. For female employees, it was indicated 1.9% for those who worked among 40 and 48 hours a week ,and was 2.7% for employees with more than 60 hours per week. In terms of occupation, sleep disorders was reported 2.4% in female working manually while this was 2.2% for male , and 3.0% in male those who non-manually workers while this was 2.1% in female those who worked non-manually (Kim&Lee., 2015). As a

result of the study in which working hours were examined as <40, 40-48, 49-60 and > 60 hours a week, the prevalence of sleep disturbance in the male group working between 40 and 48 hours a week was 1.9%, while it was the highest with 4.2% in male those who working more than 60 hours. The study obtained data from the third Korean Working Conditions Survey (KWCS) which conducted by the Korean Occupational Safety and Health Agency in 2011. The 3 KWCS were including information about the social and occupational health reports of employees aged 15 and 65. And the subjects were 34,783.

Another study investigated qualityof sleep, recovery and working hours in an expert study using data from members of the Finnish Business School Alumni Association and members of an international information technology (IT) company in 2018. As a result, almost half of the sample covering the 19-62 ages range reported that hours of long work frequently or somewhat affected quality of sleep, recovery, and wakefulness. The day-to-day ratings of sleep, wakefulness, recovery and detachment rates were corperated with longer working hours the next day as well as long hours of working the previous day. Longer working hours following day are corporated with moderate to fair sleep or wakefulness, and the odds ratio was 1.07 (Ropponen et al., 2018). In the app, a survey method based on sleep quality and wakefulness questions from the Pittsburgh Sleep Diary and the recovery and detachment questions in the Healing Experience Questionnaire were used. Although 1544 employees have installed and approved the application, 218 of the 651 employees, whose time use was recorded, responded to the survey and it was observed that a total of 307 employees responded to the survey. Data of 154 employees who took part in knowledge-intensive expertise studies were analyzed. Cross-sectional design was used to examine the relationship between mobile application data and survey data in statistical analysis. Multiple logistic regression analysis was used to calculate the odds ratios (OR) and a general equation estimation model for 95% confidence intervals (CI).

Afonso examined the effects of long working hours on depression and anxiety symptoms and sleep quality with a survey prepared for all graduates of the Portuguese AESE-Business school. Afonso identified long working hours more than 48 and examined white-collar participants. In a analysis, the 479 subjects were observed including the normal working hours group (RWHG), n = 223, 47% of all subjects and the longer working hours group (LWHG), n=256, 53% of all subjects. A statistically significant positive correlation was detected. An It has been stated that

long working hours have a significant effect on the increase of anxiety and depression symptoms as well as reducing duration of sleep and causing an increase in sleep disorders (Afonso et al., 2017). Furthermore statistically significant negative correlation ($P < 0.05$) was found between weekly working hours and sleep duration. LWHG (mean 6.4 hours, SD 0.9; $P < 0.001$) found significantly less sleep hours compared to the normal working hours group (mean 6.7 hours, SD 0.8). In the survey have been created to obtain study characteristics and demographic data, the Pittsburgh Sleep Quality Index (PSQI) was used to evaluate sleep quality and sleep types, and the Hospital Anxiety and Depression Scale (HADS) was used to reveal depression and anxiety symptoms.

In his 2017 study, Schiller stated that a 25% decrease in weekly working hours had a positive effect on sleep and stress, and an increase in sleep duration on working days (Schiller et al., 2017). A total of 33 workplaces with 919 employeees were included in a longitudinally controlled intervention study conducted by The Swedish National Institute of Working Life between 2005 and 2006. This study, which handled the data of 590 employees, has seen an increase in sleep duration by 23 minutes throughout the entire 18-month period in the working days of full-time employees, due to a 25% decrease in working hours. In addition, the study found that the reduction in working hours caused less stress and apprehensive when going to bed, and less sleepiness and stress perception.

Table 2.1.: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Cappuccio et al. (2008)	UK	Cross-sectional studies of 19 studies in Child and 26 studies in adults were analyzed thanks to the Medline (1996-2007 week 40), EMBASE (from 1988), AMED (from 1985), CINAHL (from 1982) Psychinfo (from 1985)	1992-2007	634,511 Subjects	Obesity	Short Sleep Duration	Age,gender,child indicators, adults indicators	Breslow-Day test, Cochran-Mantel-Haenszel test, the Mantel-Haenszel	There is negative correlation between obesity and duration of short sleep for both of adults and childdren.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Ayas et al.(2003)	US	The Nurses' Health Study	1986-1996	71,617 US female	Coronary Heart Disease	Sleep Duration	Age, smoking statu,BMI, alcohol consumption, physical activity,menopausal status,depressed mood,aspirin use,parental history,history of hypercholesterolemia	Multivariate Logistic Regression	Statistically significant and positive.
Yaggie et al. (2006)	US	The Massachusetts Male Aging Study	1987–1989	1,564 male without baseline diabetes	Diabetes	Sleep Duration	Age, education, annual household income, marital statues, cigarette smoking, current employment status, alcohol, hypertension, heart disease, kilocalories expended in leisure and work activities, inches, cancer, caloric self-rated health.	$\chi 2$ tests	Statistically not significant. Sleep deficiency and surplus are associated with improved risk for Diabetes in men.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Hoevenaar-Bloom et al.(2011)	Netherlands	Dutch community-based cohort study	1993-1997	20,432 male and female aged 20-65 years without history of CVD.	Cardiovascular Disease Incidence	Sleep duration and quality of sleep	Age, sex, educational level, lifestyle factors, subjective health Sleep quality, general health(BMI, Overweight, obesity, total cholesterol, glucose, systolic blood pressure, hypertension Self-reported CVD risk factor medication , diabetes mellitus type 2, cardiovascular events	Cox (proportional hazards) models	Statistically significant and positive for shortduration of sleep but not sginficant for long duration of sleep.
Gangwisch et al. (2006)	US	National Health and Nutrition Examination Survey I	1982-1992	N=4810	Hypertension	Short sleep duration	Age, physical activity, salt consumption, diabetes, pulse rate, daytime sleepiness,, smoking, alcohol consumption, education, ethnicity, gender, depression.	Cox proportional hazards models	Statistically significant. Short duration of sleep is associated with risk of hypertension.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Contro V.	Statistical Methods	Results
Ge B. & Guo X. (2015)	China	12 cohort studies and 6 cross-sectional studies	1997-2013	-	Risk of stroke	Sleep Duration	.	Meta-analysis	Statistically significant and positive. There is correlation between risk of stroke and sleep duration.
Hublin et al. (2007)	Finland	The Finnish Twin Cohort	1982-2003	21,268 twins aged ≥18	Mortality	Sleep	Married, social class, education, working status, BMI, smoking status, binge drinking, grams of alcohol consumed daily, conditioning physical activity, and life satisfaction	Cox proportional hazard models	Statistically significant.Sleep durations are associated with increased risk of mortality.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Hall et al. (2008)	U.S.	The University of Pittsburgh's Adult Health and Behavior (AHAB)	2008	1240 subjects aged 30 to 54 years	Metabolic Syndrome	Self-reported sleep duration	Age, sex, race, smoker status, physical activity, educational attainment, fasting LDL-cholesterol level, and symptoms of depression.	Multivariable logistic regression	Statistically significant for associaton between short duration of sleep and Mtabolic syndrome but not for long duration of sleep.
Ferrie et al. (2011)	U.K. (London)	The Whitehall II study	1997-1999, 2003-2004	1459 female and 3972 male (aged 45-69)	cognitive function	Sleep duration	Age, gender, education and occupational position.	Prospective cohort.	Changes in duration of sleep are correlated with poor cognitive function.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Van Dongen et al. (2004)	US	The General Clinical Research Center of the Hospital of the University of Pennsylvania (labaratory environment)	7 days	21 healthy adults, 12 men and 9 women (aged 21–38 years)	Interindividual differences (in neurobehavioral deficit)	Sleep loss	Age, sex, BMI, handedness, self-reported habitual sleep duration, prestudy overall sleepiness , pre-study sleep quality, circadian preference, core body temperature (circadian rhythm) .	Stepwise linear regression , Wald Z test	Statistically significant. Neurobehavioral deficiencies that occur due to sleep deprivation vary among individuals.
Baglioni et al. (2011)	Germany	Longitudinal studies from PubMed, Medline, PsycInfo, and PsycArticles databases	1980-2010	-	Depression	Insomnia	Age, sex, publication year, number of follow-up evaluations.	Meta-analytic models (fixed- and random-effects)	Statistically significant. Poor sleep quality is associated with depression.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Lombardi et al. (2010)	USA	National Health Interview Survey (NHIS)	2004–2008	177,576 subjects aged 18–74	Work-related injury	self-reported sleep duration and working hours (weekly)	Age, sex, ethnicity, BMI, education, industry and occupation, type of pay.	Multiple logistic regression	Statistically significant and positeve. Sleep duration is correlated with work-related injury.
Philip et al.,2014	French	2 French agglomerations (Bordeaux, 750,000 inhabitants) and (Libourne, 30,000 inhabitants)	2011(June) and 2012 (October)	272 control drivers	Traffic accidents	Sleep duration	Age, sex and marital status, driving variables (holding a driving license, type of road, kilometers driven per year) , legal drug consumption (medications in the last 24 h).	Multivariate logistic regression	There is a significant association among sleep duration and traffic accidents.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Sheehan et al. (2019)	US	National Health Interview Survey (NHIS)	2004-2017	398 382 adults (aged 18-84)	Age-adjusted sleep duration	Age, race/etnicity	Age, sex, race/ethnicity, number of children, region of residence, marital status, alcohol consumption, smoking status, body mass index, Self-Reported Health, educational attainment, Kessler-6 scale, hours worked per week and household Income.	Multinomial logistic regression	Statistically significant. The ratio of short sleepers (<6 h) increased % 15 from 2004 to 2017.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Khubchandani & Price, (2020)	US	National Health Interview Survey (NHIS)	2010-2018	158,468 individuals	Sleep duration	Working adults	Age, race, gender, ethnicity, education, number of children, , legal marital status, birthplace , and region of residence.	Multinomial logistic regression	Statistically significant. There is linear trends for increase in duration of short sleep.
Hisler et al. (2019)	US	National Health Interview Survey	2013-2017	164,696 adults	Sleep difficulties	Age	Age, sex, ethnicity, all difficulty of sleep variables	Logistic models	Statistically significant. However a decrease observed in duration of sleep, light increase observed in the prevalence of sleep difficulties.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Basner & Dinges, (2018)	USA	American Time Use Survey (ATUS)	2003-2016	181,335 subjects	Sleep duration	Time use	Age, race/ethnicity, gender, educational attainment, presence of spouse, marital status, number of children, employment category, family income, multiple job status, survey day, survey season and region.	Balaced repeated replication metod	Statistically significant. Thre is an increase in sleep duration from 2003 to 2016.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Biddle & Hamermesh, (1990)	US	Aggregated data for 12 countries (Belgium, Bulgaria, Czechoslovakia, France, two from the Federal Republic of Germany, the German Democratic Republic, Hungary, Peru, Poland, two from the United States, the Soviet Union, and two from Yugoslavia.)	1975-1980	-	Allocation of Time	Sleep duration	Age, marital status, gender, work time.	Multivariate linear regression models	Statistically significant and positive.Additional working hour is decreased duration of sleep.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Hale, (2005)	USA	American Use of Time Studies (1965, 1975, 1985, 1999)	1965-1999	Over 7000 individuals (ages 25–64)	Sleep duration	Self-report of time-use (Sociodemographic factors)	Age, sex, marital status, educational status, employment status, minutes/day watching TV.	Multivariate linear regression models	Working 50 hours a week causes a decrease duration of sleep, compared to working 35 hours a week.
Basner et al., (2007)	USA	American Use of Time Studies (2003, 2004, 2005)	2003-2005	N=47,731 respondents (>14 aged)	Sleep duration	Self-report of time-use (Waking activities)	Age, gender, race, weekly pay, educational status, children in household, spouse or partner present.	Multivariate linear regression models	Working hours are associated with duration of sleep.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Kreuger & Friedman, (2009)	US	National Health Interview Survey-Sample Adult Files (NHIS-SAF)	2004-2007	N =110,441 (aged 18 and over9	Self-reported Sleep Hours	Demographic status	Demographic status, family stracture, socioeconomic status, health behaviors and status, education.	Multinomial logistic regression models	Working 41 hours are associated with short duration of sleep and long sleep hours associated with non working.
Knutson et al. (2010)	US	Americans' Use of Time Series (1975, 1985, and 1998-99), Anvironmental Protection Agency Time Use Study (1992-94), American Time Use Survey (2003, 2004, 2005, 2006)	1975-2006	adults ≥ 18 years	Short sleeper	Time diary	Age, gender, education, employment, race, income, daily activities and day of week, marital status.	Logistic regression model	Unadjusted percentages of those who short sleepers ranged from 7.6% to 9.3% for 1975 and 2006 respectively.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Swanson et al. (2011)	U.S	National Sleep Foundation (NSF)	2008	1000 residents (18 y and older)	Work performanc e	Sleep disorders	Age, gender, race, marital status, occupational classification, annual household income	Logistic regressions	Long working hours are associated with duration of short sleep and work-related impairments.
Yong et al. (2017)	U.S.	National Health and Nutrition Examination Survey (NHANES)	2005–2006 and 2007-2008	6338 employeers (aged ≥18 years)	Sleep disorders	Sleep duration	Age, sex, etnicity/race, educational level, marital status, health factors, lifestyle factors, job charecteristic, occupation categories, Sleep characteristics.	Logistic regression analysis	Those who sleep fewer than 7 hours are more likely have poor quality of sleep and and impaired activities.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Magee et al., (2009)	Australia	45 and Up Study	2006-2008	49,405 Australian adults (ages 45-65)	Socio-demographic and health-related functions	Short and long sleep	Gender, age, country of birth, smoking status, description of residence, alcohol consumption, education level, body weight status, paid work hours treatment for chronic disease, marital status and self-rated health.	multinomial logistic regression	Working more than 40 hours are associated with short sleep duration.And short and long duration of sleep are correlated with health-related impairments.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Chatzitheochari & Arber, (2009)	UK	2000 UK Time Use Survey (UKTUS)	June 2000 and September 2001	N = 2882 (aged 20–60 years)	İnsufficient daily sleep time	Working hours	Age, social class, occupational class, time spent commuting, undertaking housework, time spent in childcare, shift work.	Nested logistic regression model	Statistically significant and negative.
Virtanen et al. (2009)	UK	The Whitehall II study of British civil servants.	1991-2004	N= 937–1594 (Phases 5 and 7), N = 886–1510 (phases 3, 5, and 7)	Sleep disturbances	Long working hours	Gender, age, marital status, occupational grade level, physical disease, BMI, alcohol consumption, exercise level, job demands.	$\chi 2$ tests, Binary logistic regression, Multiple multivariate imputation.	Statistically significant and positive. There is a positive corralation amond sleep disturnace and long work time.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Nakashima et al. (2011)	Japan	The white-collar workers (a light metal products company)	2004	1510 men full-time employees	Sleep Problems	Working hours	Age, occupational category, sickness absence, family or partner, bedtime, Leisure time physical activity, drinking habit before bedtime.	Multiple logistic regression	Statistically not significant. Long hours of working are correlated with poor quality of sleep.
Otshu et al. (2013)	Japan	4,000 households across country	November 2009	662 subjects (372 men; 290 women)	Sleep duration	Working hours	Sex, age, city of residence, working hours/ overtime, years of schooling completed , hours per weekday, sleep duration per day (workdays) and holidays.	Univariate logistic regression	Statistically significant. Working 10 hours and more per day are associated with short duration of sleep compared to working between 9 and 7 hours.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Bannai et al. (2015)	Japan	High school teachers in Hokkaido Prefecture	2003	515 teachers	Sleep problems	Working hours	Age, marital status, educational status, employment status,children living at home, classes in the school, work experience(in the current school), subjects led and exercise habits.	Multiple logistic regression analysis	Statistically significant for men but not for women. Working 60 hours per week are more likely increse risk of sleep-related impairments , compared working 40 hours a week.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Kim & Lee. (2015)	Korea	The third Korean Working Conditions Survey	2013	50 032 employees, 34 783 salaried contract employees	Sleep Disturbances	Working hours	Age, sex, marital status, occupation status, educational status, self-related health, shift work and working hours.	Multiple logistic regression	Statistically significant for male but not significant for female. Working hours are related to sleep-related disturbances.
Ropponen et al. (2018)	Finland	The Finnish Business School Graduates and workers of an information technology (IT)		154 employees	sleep, alertness and wellbeing	Time use	Age, gender	Multi-level logistic regression	Statistically significant and possitive. Long working hours are affected quality of sleep.

Table 2.1. Continued: Literature Review

Study	Country	Dataset	Time Period	Sample Size	Dependent V.	Independent V.	Control V.	Statistical Methods	Results
Afonso et al.(2017)	Portugal	Portuguese AESE-Business School	2017	479 alumni	Sleep and mental health	Working hours	Age, gender, civil status, children, corporate position, educational status, holidays, weekly working days, taking work home, shift work.	χ2 tests	Statistically significant and negative in terms of the association between hours of sleep and working hours.
Schiller et al. (2017)	Sweden	Swedish National Institute of Working Life	2005-2006	workers	Sleep and stress	Worktime	Gender, educational level, having child living at home, working area, age, work demands.	Multilevel mixed model	%25 decrease in working hours per week have an positive influnce on sleep and stress.

3. DATA SET AND METODOLOGY

3.1. Data Set Selection

Thanks to the technological developments, large databases are increased , and consequently the number of data storaged in these databases has remarkably increased. In this increasing data stack, it is considerable to correctly select and analyze the dataset, which is crucial for the authenticity of the study. There is three distinct data set methods that used in econometric analysis. After choose data set method from these three data set methods, containing time series and cross-section data, either panel data comprise to combination of these two datasets, the empirical analysis and model scheme are decided.

3.1.1. The Time Series Data

The time series data, which is frequently used in empirical analysis, is a metod that enables to analysis of time-dependent alterations of a variable. This method allows to forecast the further value of the variable by measuring the historical values of the variable. Therefore, the method has unique emphasis. These data can be gathered at regular time intervals like daily, weekly, monthly, yearly, once in five years and once in ten years. Thanks to the developing information systems, it is no longer hard to obtain these data in real time and faster.

3.1.2. Cross-sectional data

In Cross-sectional data , time is constant, but there are different units monitored at constant time. This data set contains data collected from different units at given fixed time frame.

3.1.3. Longitudinal Data

Longitudinal data, sometimes named panel data, is the gathering of cross-sectional surveillances of individuals, countries, firms and also households etc. in a particular period of time. It can also considered as a combination of the time series analysis and the cross-sectional data group.

The panel data helps to make and test more complex behavioral models than time series data analysis and cross-sectional data. When compared to time series and cross-sectional analysis with panel data, the panel data analysis allows

researcher to work with a wider set of data. Thanks to this data, results contains higher authenticity parameter estimates, higher degree of independence as well as lower multiple linear connection among explanatory variables, consequently in more efficient econometric estimates. Additionally, in the analysis by using panel data, the error term is correlated with the explanatory variables due to the ignored (excluded) factors, and deviations occur in the parameter estimates. Also, using panel data allows us to overcome this problem because the source of the correlation is known. Therefore, in this study, we will use (HRS) panel data set , which is carried out by Michigan University since 1992.

3.2. Health and Retriement Study (HRS)

HRS is a nationally representative and also longitudinal dataset that comprices American 50 and older ages and provides detailed information about their economical status, work, health status, family ties, and more. Each of these survey studies conducted in every two years is considered as a data wave. There are thirteen key data waves from 1992 to 2016, and every data wave has 18-23,000 participants. Study follows the participants from the moment they take the questionnaire to death. It was started as a survey study in 1992 by the Institute of Social Research of Michigan University.

The aging and retirement studies are examined by social scientists around a wide range of disciplines containing psychology, management, sociology and also economics (Gwenith and Lindsay, 2018). Since then, it has become one of the most comprehensive data sets, with the addition of genetic and psychosocial content.

It is predicted that the increasing retired population in the US will cause problems in the labor market in the medium and long term. The ultimate goal of HRS is to overcome this problem and contribute to the creation of new policies for the future by providing detailed information about the retirement or retirement of the elderly population. HRS creates and continues to provide an enormous collection of data on aging.

3.2.1. Income And Wealth

The detailed distribution of house-hold income and wealth in the course of time is a distinctive features of HRS. Although such personal informations are

difficult to obtain, thanks to the innovative data-set methods used by HRS, it has handle many traditional survey barriers and keep going provide in-depth and credible measures.

3.2.2. Health and Use Of Health Service

Examining the process of chronic illness and development of functional capacities, HRS adopts a multi-dimensional approach to health studying. One of the most remarkable characteristic of the HRS is straight evaluation of cognitive skills and alterations that they show with age. The health insurance, medicinal care, as well as links between health and employment and economic sources are important for understanding health.

3.2.3. Employment

Although retirement does not seem to make sense at first glance for people who start working at a young age, it is quite noteworthy at the phase of transition to a non-employment stage after many years of full-time working life. HRS addresses people's pension or non-pension choices in all aspects by linking their health status, family status, job types, pension and health insurance coverage. Thanks to these data, it is quite valuable to observe the impact of recent policies to encourage people working more. The study is a unique resource not also for researchers, but also for policy makers.

3.2.4. Family

The development of structure of the family is effective in shaping people health and economic conditions about life, with its effect from past to present. Understanding the economic, emotional and physical connections of family members to each other and the process of change of these connections with age has been an important point since the design of HRS.

3.2.5. Creating a Biosocial Survey

Health and Retiremen Study initiated a recently evolved face-to-face interview (EFTF) in 2016. This new interview expands the scope of the study by including collection of dried blood stains for clinical biomarkers , a wide range of physical function measurements, salivary DNA. In this way, it aims to reflect the alterations in cardiovascular and metabolic functions as well as organ reserve and

inflammation grades in age-dependent HRS through biomarkers such as glycolysed hemoglobin, cholesterol level, blood pressure. As a result of integrated biology, Health and Retirement Study gains importance for biosocial investigations in terms of aging.

3.2.6. Psychosocial and Lifestyle Factors

This section is part of the EFTF interview. Self-administered questionnaire comprises questions about the participants' individuality, well-being, beliefs, relationships with spouce, experiences at work and varied sources of stress.

Well-being	**Lifestyle**	**Social relationships**
Satisfaction of life	Activities in life	Spouse/child/relative/friends
Satisfaction of domain	Neighbourhood evaluaiton	Positive backing
Depression	Religiosity	Negative backing
Positive/negative affect	Discrimination	Closeness
Hedonic well-being	Lifetime traumas	Loneliness
Purpose in lifetime	Early life experiences	Beforetime parental relationships
Personal development	Stressful life events	Friend relation
Financial strain	Ongoing stress	Child relation
Personality	**Work**	**Self-related Beliefs**
Agreeableness	Work stress	Personal mastery
Neuroticism	Work discrimination	Sensed constraints
Openness	Capacity to working	Optimism
Conscientiousness	Effort-reward balance	Subjective age
Extraversion	Working support	Perceptions of aging
Cynical hostility	Work/family preferences	Subjective social status
Anxiety	Work/life balance	Hopelessness
Anger		Pessimism

Figure 3.1: Synopsis of HRS psychosocial content for 2010

3.2.7. Groups Represented in HRS and Their Characteristics

The original HRS court commenced in 1992 as a longitudinal analysis for those who born between 1931 and 1941.This study includes pre-pension cohort of individuals whose residing in households in the contiguous United States, and their partners regardless of date of birth. In 1992, while 15,497 people were found appropriate for the study in terms of data collection, interviews were made with 12,652 participants (7,704 households), which constitutes 81.6% of the total response rate.

In 1993, the study of Asset and Health Dynamics of the Oldest Old (AHEAD) was throwed in study. The cohort sample was generated from individuals who born before 1924 (age 70 or older in 1993) and their partners regardless of date of birth. During the interviews with 6,046 different households, 8,222 participants who constitute 80.4% of the sample response, were interviewed. In 1994 and 1996, re-interviews were carried out with the 1992 cohort participants, merged with the 1993 cohort.

In addition to these, two new cohorts were added in 1998. One of new sample was the Children Of the Depression Age (CODA) (consist of persons who born among 1924-1930 years).The other was the War Baby (WB) (consist of those who born among 1942-1947 years). In 1998, basic response rates were 72.5% for the Children of the Depression Age and 70% for the War Baby .These recent cohorts constitute of a national likelihood sample of persons aged 51 or older (i.e. born before 1947) in 1998. As a result, HRS has ceased to be a study for a specific group, and has turned into a stable state pattern for persons over the age of 50 and living in the US.

In 2004, individuals those who born between 1948 and 1953 were included as a recent sample cohort. Additionally, sample of the Early Baby Boomers (EBB) ,which acquired from 38,385 households with screening, was included in Health and Retiremen Study in 2004. In interviews, there were recorded 3,330 individuals with corresponding to 75.3% r answer rate and 2,154 households with corresponding to 78.2% answer rate.

Furthermore, in 2010, sample cohort of individuals who born between 1954 and 1959 was added in study with the title of the Mid Baby Boomers cohort. Lastly, the Late Baby Boomers is being added to HRS Study in 2016.

The overall sample dimension for Health and Retiremen Study is the consequence of the decision based upon the budget constraint and the extent of the survey to meet the data demands of various pension aging. The age range of the elected sample is important for the authenticity of the data. However, choosing an age range before pension but also not too far from retirement causes problems. Moreover, while collecting comprehensive data before pension is important, collecting long-term data incurs huge costs. On the grounds that private pension

provides a strong pension incentive and the common age range is 51-61, after lengthy discussions in the NIA Data Monitoring Committee and the Steering Committee, the working groups decided on the age range 51 and 61.

In addition, both committees stated that the factors that influence Black pension decisions is diverse and far more different from Whites, so Blacks need to deal with more for pension study to be successful. Examples of these differences are that Blacks have extended family relationships and fewer economic sources, less likely to receive personal pension, and lesser potential to marry than Whites. Moreover, the fact that some ilnesses and functional limitations are more prevalent among Blacks, constitutes a different reason for the health conditions.

In terms of region, dense places with more elderly population were taken into consideration more. And the sample was mostly created from such places. Florida is an example for such places.

Another issue is that previous pensio studies do not include women. In addition, although both of the couple work, pension has not been analyzed as a common decision. However, after the last major pension study in 1970, the developing economy brought differences with it. Therefore, study decided to contain persons with their spouses regardless of age. The following figure is indicated the longitudinal cohort sample design of HRS from past to 2016.

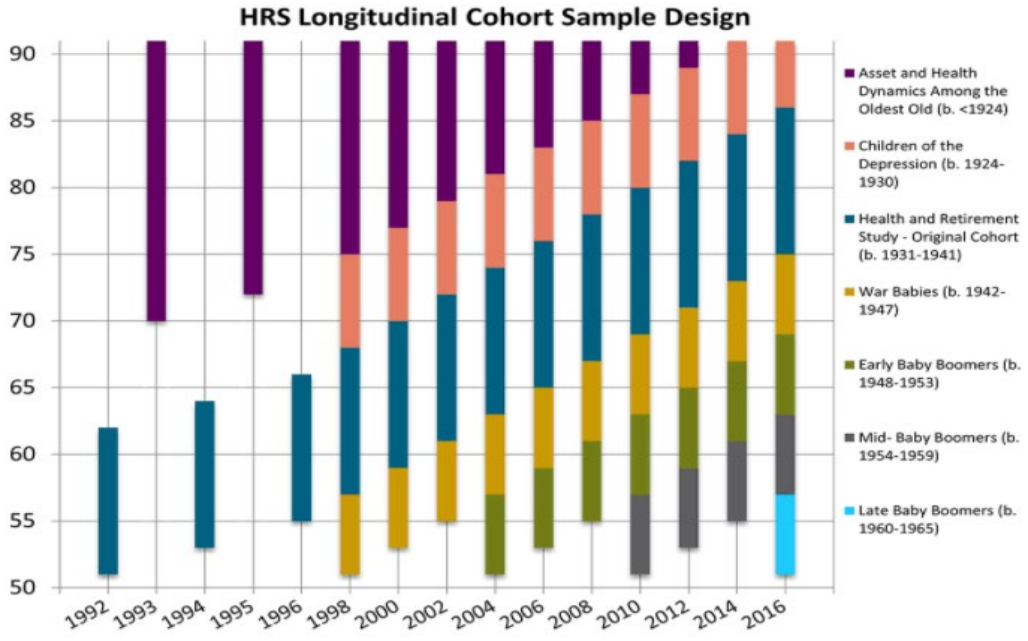

Figure 3.2: The Longitudinal Cohort Sample Design of HRS

3.2.8. HRS Survey Content and Experimental Modules

Survey is designed to reflect the political and analytical benefits of those doing research on pension and aging. In addition including a number of empirical modules from an analytical perspective, study covers the best policy issues in the field of pension and aging. Moreover, it contains key thinking elements related to modeling pension and aging processes. Experimental modules as well as the questionnaire sections are listed below with abstracts. Unless otherwise stated, the sections are inquired people in the household those who are couples. Here is HRS content:

Core interview:The core questionnaire occurs every two years. İt makes up 1½- to 3-hour interview. The core interview is the main part of the data. The sample size recently ranges from 18,000 to 23,000 any given wave.

Experimental modules: This section takes place at end of core interview.Each wave is about ten modules. The sample magnitude is around 1,500. Additionally interview consists of 3 minutes on varied topics and topics do not in core.

Enhanced Face-to-Face: Genetics, physical measurements, biomarkers, furthermore, psychosocial knowledges acquired as section of the enlarged face-to-face survey that givens on a random half of core each 2 years. Psychosocial topics occur from physical measures, saliva sample(DNA), blood sample (biomarker), psychosocial questionnaire (mail back).

Supplemental studies: Studies on a variety of matters that happen in the "off year." Section is connected to core study. And sample sizes are around 3,000-7,000. Studies contain Aging, Demographics, and Memory Study(ADAMS), diabetes care, prescription drugs, consumption and activies, subjective well-being, human capital investments for children and internet survey.

Administrative data: This part is linked to core interview at individual level. Additionally, it confirms self-reported data and puts in new information. Furthermore, it comprises social security earnings and advantages, medicare claims, public death index, the administration of Veteran and employer supplied retirement plans. Also, HRS core study are linkaged to varied resources of administrative data.

Survey sections;

HRS 2020 core;

Coverscreen: This section consists of household knowledge, marital status, interview knowledge, living arrangements, participant information.

Demography: Section includes questionnaires of age, birthplace, region of residence, language, race/etnicity, religion, marital status and education status of parents.

Physical Health and Functionality: Consist of questions related to basic activities of daily living, life quality, history of illness, use of health services, current treatment, depression scales and high grade physical functioning.

Cognition: This section is a part of interview with aim to record store and mental processing, depressive symptoms, self-rated meta-store, Proxy cognition.

Family Structure: In this section the questions are about family moves and closeness, the structure of extended family connections, as well as the transfer of money, time and housing to children and from children.

Parents/Couple and Sibling Decisions: Related to Marriage, parents assistance, parents demographics, neighbors, sibling demographics.

Housing and Mobility: This section, which is asked to only financially informed participants, is related to housing spending and value, residence loan and loan limits, deed, value, taxes, pension services, mobility plans, home facilities/modifications and neighbourhood adaptations, farm or ranch, second house ownership, mobile house, rent, primary and second mortgage, duty status.

Current Job: This section is about job requirements, main job, income, self-employment dates and hours of working, earnings, former-employer, other job, firm dimesion, early pension window, retirement plans.

Job History and Work History: This section comprises the questions about dates, earnings, hours, early retirement window, retirement plans. (only asked participants who skipped the present job because they are not now working).

Disability: Consist of questions of benefits , disability screening inquiries, pre- and post-disability job attributes, impairment history, injuries at work and attendance in the workforce, employer disability conformations.

Health and Life Insurance: This section is recording measures about health providers such as dentist and doctor, financial support, hospitalization, drugs, insurance of health, health insurance of goverment, in-home care/private facilities, outpatient surgery, long-time care insurance, Medicaid, home for the aged knowledge, Medicare.

Expectations: This section consists of subjective expectancies of case possibility and risk tolerance.

Assets and Income: The questions are about assets, income, charges, federal tax return, lump sum payments.

Asset Change: This section includes questions about business purchased and sold, real estate-purchased, house member appendix assets/debts, stocks, self house, major house advancement, real estate-sold and housing bought or sold.

Widowhood and Divorce: The questions are about death, earnings/work alter, divorce, insurance change of life and health, social security, and pension.

Wills, Insurance and Trusts: Will provisions, insurance of life, beneficiaries and property disposal (Exit) are quetioned in this section.

Internet Use and Social Security Permission: This section examines the internet use and social safety permissions.

Psycho-Social (Participant Lifestyle Leave-Behind Questionnaire): This section is related to questions about psycho-social and respondent lifestyle.

Covid-19: This new part is about to learn the impacts of Covid-19.(2020)

3.2.8.1.Experimental Modules

Experimental modules are composed of specific questions besides being part of Health and Retiremen Study. At the end of the interview, a few additional questions are asked in each module to randomly elected subsamples of around 1500 respondents. Before each wave, modules are requested from the research group through the HRS website.

HRS 2018 core:

Module A: Finansal Decisions Making and Coping

Two issues are handled in this section. One of them is about participators daily financial decisions. The aim is to learn participators experiences when they give money decisions such as assurance, worry, conflict and anxiety. The other is related to the way participators handling various situations. The second section is about to know what are participator concerns about the way they are sensed in day-to-day cases. Moreover, the section asks participators if they have any concern or lack related to matters such as sex, religion, age, financial standing, nationality and race.

Module 2: Understanding Debt

Respondent's current depts are interviewed in this section. The questions are about previous planning for current level of debt, unpaid students debts, medicinal

loan and any contact with loan collection agents. In the last question, participators are asked for their initial opinions on the course of loan interest ratios over time.

Module 3: Dental Health and Dental Health Services

Participator's dental health are being examined by this section. Firstly, general dental status of participant are inquired as well as the existence of denture. Later, the middle section, which is longest one, focuses on effect of dental issues over participator's quality of life. This last section deals with the participator's use of dental services, including the frequency of seeing a dentist, the types of dental facilities R uses, and the types of treatment needed.

Module 4: Attitude Toward and Use of Marijuana (Cannabis) in Older Americans.

This section are about using Marijuana in older Americans. At the outset, section examines the forms of use of hashish and marijuana for past and present besides whether a prescription has been given to the participator by the doctor before and if so for what condition. Later, the present attitudes of participators about hashish and marijuana are inquired.

Module 5: Entrepeneurship

Information about involvement of participators in business ownership is examined in this module. In the first part, questions are asked about whether the participant's have ever been owns a business and in the process of managing. In one of two parts related to the answers, if the participator has been the business owner, the effect of business activities on the motivation of being an entrepreneur and the total quality of life is examined. Respondents, who wanted to join a business but didn't execute, are asked what the obstacles were in their way. Additionally, the other focus is on what the motivation was that had an impact on their willingness to still running this business.The module is rather short in cases where the participators weren't involved in running any work and didn't consider it.

Module 6: Perceived Effects of Behaviors and Conditions on Longevity

Section aims to learn the perceptions of respondent's that affect their longevity. First, the target age, at which participators can live based on their present age, was determined as 62. In another section, the respondents forecast about someone who looks exactly like them but unlike in some ways, whether or not they will live to the target age. Moreover, questions are asked to challenge the participant about the impact of smoking, diabetes and regular practice on life expectancy.

Module 7: Working Longer (Age < 65)

Based on the distinct characteristics of the job, the participator under the age of 65 is asked about what the chance of working in this job after the age of 70 in this module.There are three sections to select for participants those who working for an employer, who are now unemployed or self-employed.

Module 8: Overuse of Health Care

The respondents attitudes are asked in this section related to various medicinal tests and cure as well as their medicinal care experiences.The aim is to balance the tests they need for the participators and the potential damages they might have from doing these tests.

Module 9: End of Life Decisions

Respondents are asked their choices which they do for medicinal decisions in varied situations. In this module, questions are first asked participators about their preferred medicinal decision-making way for their own health.The module is being ended with a politely worded "thank you" because of answering to inquiries in such issues that is very difficult to share.

Module 10: HRS Adaptation of Patient Assessment of Care for Chronic Conditions

In this module, participators those who 65 and older are asked about medicinal care for chronic diseases. Module, in this respect, is complementary to the age group of the 7th module. Module 10 is done for participators when they do not have a chronic status that treated in 2 years.

3.2.9. Off-year and Supplemental Studies

These studies are included in sub-samples. These are web-based questionaries as well as paper and pencil questionaries sent by mail, or in-home assessments. Some of them are biennial studies that took place at different duration, others have only happened once. There are detail informaition about content of the Off-year and Suplemental studies and tables in below.

Aging, Demographics, and Memory Study (ADAMS): Years of 2001- 2009 and 2010-2011 (home clinical interviews).

Mail surveys:

- Human Capital and Educational Expenses Mail Survey (2001)
- Consumption and Activities Mail Survey (CAMS) (2001, 2003, 2005, 2007, 2009, 2011)
- Diabetes Study (2003) (sensitive health data)

- Prescription Drug Study (2005, 2007) (sensitive health data)
- Health and Well-being Study (2009) (sensitive health data)
- Health Care and Nutrition Study (2013)
- Health Care Mail Survey (2011)
- Disability Vignette Survey (2007)
- Life History Mail Survey (2015, 2017)

Internet surveys : 2003, 2006-2007, 2009, 2011, 2013.

Table 3.1: Health Studies

ADAMS	The Aging, Demographics, and Memory Study Wave A The Aging, Demographics, and Memory Study Wave B The Aging, Demographics, and Memory Study Wave C The Aging, Demographics, and Memory Study Wave D
Diabetes	2003 Diabetes Study
HCAP	2016 Harmonized Cognitive Assessment Protocol
HWB	2009 Health and Well-Being Study (English) 2009 Health and Well-Being Study (Spanish)
PDS	2005 Prescription Drug Study 2005 Prescription Drug Study 2007 Prescription Drug Study (Spanish)

Source: Health and Retirement Study Web Site 2020

These data are obtained as a result of studies created to obtain information about the health of individuals. HRS obtains the health data of individuals very carefully and does not compromise the confidentiality of these data. Health-related data are considered as one of the most sensitive issues of the study.

3.2.10.HRS and Collaborations

The Health and Retirement Study has been the model in order to evolving network of studies about longitudinal ageing around the world. These surveys offer the chance for cross-public comparisons besides ensure data for individual countries. HRS is carried out many research collaborations. Some collaborations aim to expand data gathering and analysis in innovative aspects with high impact , while the others improvement the accessibility of the data.

The International Sister Studies stand for a expanding network of longitudinal studies of ageing across the globe for which HRS is the model. The following HRS sister studies are listed in table.

Table 3.2: HRS Sister Studies

ELSI-BRASIL	Brazilian Longitudinal Aging Study
CRELES	Costa Rican Longevity and Healthy Aging Study
CHARLS	China Health and Retirement Longitudinal Study
ELSA	English Longitudinal Study of Ageing
SHARE	Survey of Health, Ageing and Retirement in Europe (Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Greece, Hungary, Israel, Italy, The Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and Switzerland)
LASI	Longitudinal Aging Study in India
IFLS	Indonesian Family Life Survey
Tilda	The Irish Longitudinal Study on Aging
JSTAR	Japanese Study of Aging and Retirement
KLoSA	Korean Longitudinal Study of Ageing
MARS	Malaysia Ageing and Retirement Study
MHAS	Mexican Health and Ageing Study
NIKOLA	Northern Ireland Cohort Study on Ageing
HAALSI	Health and Aging in Africa: Longitudinal Studies in Three INDEPTH Communities
HAGIS	Healthy Ageing In Scotland
HART	Panel Survey and Study on Health, Aging, and Retirement in Thailand
WHO	Study on Global Ageing and Adult Health

Source: Health and Retirement Study Web Site 2020

3.3. Methodology

In general terms, methodology is defined as a set of special techniques that applied for defining the information about the conducted study , selecting these defined knowledge, processing this knowledge selection, and deciding an analysis method to be used in the study. In this section, the information is given to the reader expresses what the general validity and reliability of the study is based on and allows the reader to evaluate the study.

In this section, a brief information are given about analysis methods, special techniques and concepts that applied in the study. In addition, this section contains explanatory information about the methods that used in measuring the effect of the independent variable on the dependent variable and the followed map in the study.

Stata program was preferred while performing regression analysis. For the analysis, it was preferred to use OLS, the least squares method (OLS-Ordinary Least Square). In addition, the time series analysis, hausman test, random effects and fixed effects models are used. Regression analysis is related to investigating the dependence of an independent variable on one or more variables (independent variables), in other words the effect of the independent variable on the dependent variable in order to predict and / or estimate the group mean or mean value of an independent variable (Damodar N Gujarati, 2004). Briefly, regression analysis is used to predict the extent of how a dependent variable is affected by another independent variable.

3.3.1. Linear Regression Model

This regression model includes dependent variable Y and more than one explanatory variables. In other words, it is used to analyze and make sense of the relationship between independent variables (X_1, X_2, X_3…, X_k) and the dependent variable Y. It is possible to define a linear regression form as follows.

$$Y = \delta_0 + \delta_1 X_1 + \delta_2 X_2 + \ldots + \delta_k X_k + u \qquad (3.1)$$

Y: Dependent variable

X: Independent, explanatory variables

u: Defined as error term that included in empirical analysis.

Moreover, it expresses measurement errors and the effect of any factors not included in the analysis.

$\delta_0, \delta_1, \delta_2, \ldots, \delta_k$: These values in the linear regression form are expressed as parameters. Considering that these values are coefficients of the independent variables, it shows the degree of influence of the dependent variable Y from X_j depending on these parameters.

δ_0: Expresses as the constant term of the regression.

δ_1: Expresses a parameter associated with independent variable X_{j1}

δ_2 : Expresses a parameter associated with independent variable X_{j2}.

δ_3 : Refers to a parameter associated with independent variable X_{j3}.

If the multiple linear regression model is desired to be generalized, the population regression function including dependent variable and k-1 independent variable is obtained.

$$Y_i = \delta_0 + \delta_1 X_{j1i} + \delta_2 X_{j2i} + \delta_3 X_{j3i} \ldots + \delta_k X_{j\,ki} + u_i \qquad (3.2)$$

i= 1,2,3, …, n means

From this expression, it is possible to understand that the equation (3.2) is a set of simultaneous equations and a shortened form of equation, represented below.

$$\left.\begin{aligned} Y_1 &= \delta_0 + \delta 1\, X_{j11} + \delta_2 X_{j21} + \delta_3 X_{j31} \ldots + \delta_k X_{jk1} + u_1 \\ Y_2 &= \delta_0 + \delta_1 X_{j12} + \delta_2 X_{j22} + \delta_3 X_{j32} \ldots + \delta_k X_{jk2} + u_2 \\ Y_3 &= \delta_0 + \delta_1 X_{j13} + \delta_2 X_{j23} + \delta_3 X_{j33} \ldots + \delta_k X_{jk3} + u_3 \\ &\vdots \\ Y_n &= \delta_0 + \delta_1 X_{j1n} + \delta_2 X_{j2n} + \delta_3 X_{j3n} \ldots + \delta_k X_{jkn} + u_n \end{aligned}\right\} \qquad (3.3)$$

The set of equations that expressed in equation (3.3) is indicated with the help of matrix form below.

$$\begin{bmatrix} Y_1 \\ Y_2 \\ \vdots \\ Y_n \end{bmatrix} = \begin{bmatrix} 1 & X_{j11} & X_{j21} & \cdots & X_{jk1} \\ 1 & X_{j12} & X_{j22} & \cdots & X_{jk2} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & X_{j1n} & X_{j2n} & \cdots & X_{jkn} \end{bmatrix} \begin{bmatrix} \delta_0 \\ \delta_1 \\ \vdots \\ \delta_k \end{bmatrix} + \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix} \qquad (3.4)$$

$$Y = X_j \delta + u$$

Here;

Y = The n x 1 column vector of observations on the dependent variable Y,

Χ = Giving n observations on k -1 variable (from $Χ_1$ to $Χ_k$). The 1's in the first column show the term of the breakpoint. This matrix is also known as data matrix.

δ = Unknown parameters of independent variables Χ ($δ_0$, $δ_1$,…, $δ_k$) on k x 1 column vector,

u = The n × 1 column vector of error terms (u_i)

As a result of these representations, a classical linear regression model is shown with the help of matrices and vectors in the form below:

$$Y = Χδ + u \quad (3.5)$$

3.3.1.1. Hypothesis of the Classical Linear Regression Model

1. Linearity

Linear regression model has been specified in equation (3.1) in previous sections. To remind this model;

$$Y_i = δ_0 + \sum_{i=1}^{k} δiΧi + u \quad (3.6)$$

In here, e includes unobservable variables that are not included in the analysis, and the model also describes a linear relationship between dependent variables and explanatory variables.

2. Absence of complete multi-linearity

There is no linear relationship between the independent variables in the model. Also, any of the independent variables cannot be constant. This assumption is valid for the estimation of the coefficients in the model. This baseline assumption is only related to the multiple regression model as it is related to the relationship between independent variables (Poole & O'Farrell, 1971).

3. 0 conditional average

The conditional expected value of the error term is expected to be 0 at each measurement. Because this means that the independent variables will not carry useful information for the prediction of u.

$$E(ui \mid Xj1, Xj2, \ldots, Xjk) = 0 \quad (3.7)$$

$$i = 1,2,3 \ldots, n$$

$$j = 1,2,3 \ldots, n$$

4. Homoscedasticity

Each error term (u_i) has the same finite variance (σ^2). This assumption means that the variance of the dependent variable in the equation is not affected by the values of the independent variables in the model.

$$Var (ui \mid Xj1, Xj2, \ldots, Xjk) = \sigma 2 \quad (3.8)$$

$$i = 1,2,3 \ldots, n$$

5. Lack of autocorrelation

It expresses that the error terms are independent from each other. So covariances of error terms are equal to zero.

$$Cov (ui, uj \mid Xj1, Xj2, \ldots, Xjk; Xi1, Xj2, \ldots, Xik) = 0 \quad (3.9)$$

$$i \neq j$$

6. Externally generated data

The data in the independent variables (X_{jk}; X_{i1}, X_{j2},…, X_{ik}) can appear as any mixture or ratio of constant parameters and random variables in the model. However, th process that creates the data is a situation that developed outside of the model's assumptions and independently from the model**.**

7. Normal distribution

It is based on the assumption that the error terms are normally distributed with a mean of 0 and a fixed variance value.

$$u \mid X_1, X_2, \ldots, X_k \sim N (0, \sigma^2) \quad (3.10)$$

3.3.2. Ordinary Least Squares (SEKK-OLS) Method

Ordinary Least Squares (OLS) method is the most preferred linear model analysis in social sciences (Pohlman & Leitner, 2003). The purpose of performing regression analysis is to provide the most accurate and optimum calculation of the Population Regression Function (PRF) that tried to be predicted within the

framework of the Sample Regression Function (SRF). Ordinary least squares method and Maximum Likelihood method are commonly preferred to make this estimation (Gujarati, 2009). As mentioned in the previous sections, the methods used outside of OLS include methods that are a derivative of OLS.

However, due to different practical and theoretical reasons, the widely method used is the Ordinary Least Squares method. Even when another method of estimation is used, the Least Squares estimator method remains a benchmark approach. Moreover, the method used is expressed as a result of a change in least squares. (William H Greene, 2003).

The use of the sample regression function is preferred because it is impossible to observe all of them directly in the population regression function. The sample regression function is shown as;

$$\hat{Y}_i = \delta_0 + \delta_1 X_1 + \delta_2 X_2 + \ldots + \delta_k X_k \qquad (3.11)$$

$\hat{Y}i$: the estimated value of the dependent variable Y,

δ_0: Breakpoint estimator, sort of constant term

$\delta_1, \delta_2, \ldots, \delta_k$: Refers to the coefficient estimators of the independent variables.

It is possible to obtain a population regression function using equation (3.11). The error term or residuals (residuals – $\hat{u}_i$) can be obtained with the help of this function.

$$Y_i = \hat{y}_i + \hat{u}_i \qquad (3.12)$$

$$\hat{u}_i = Y_i - \hat{y}_i \qquad (3.13)$$

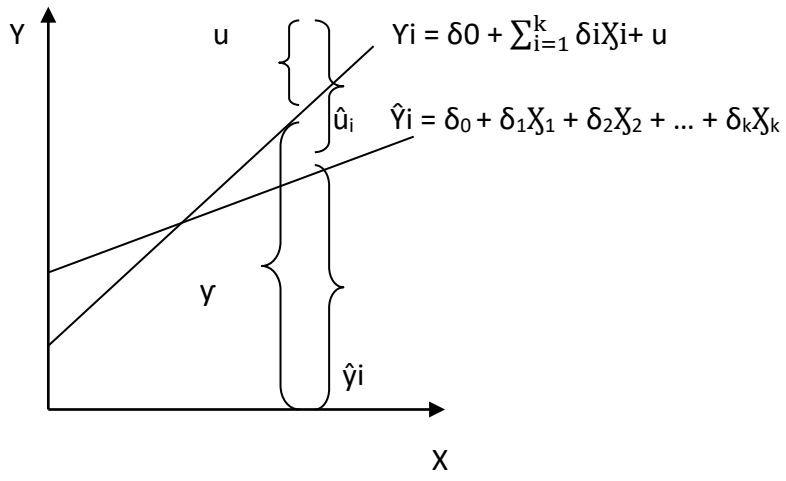

Figure 3.3: Population and Sample Regression Function

Ordinary Least Squares are based on the hypothesis that the sum of the residual squares converges to 0. The reason for choosing the error term or the sum of the squares of the residues is because of the presence of negative values that the residuals can take even if they are spread along the sample regression function, and the concern about their sum being zero by eradicating each other.

$$\sum \hat{u}_i^2 = \sum(y_i - \hat{y}_i)^2 = \sum(y_i - \delta_0 - \delta_1 x_{1i} - \delta_2 x_{2i} - \cdots - \delta_k x_{ki})^2 \qquad (3.14)$$

3.3.2.1. Derivation of OLS Estimators

In order to find ordinary least squares estimators, the residual sum of squares shown above should be first-order derivative with respect to each δ_i value in equation (3.14). The resulting equations at the end of this process are set to 0.

$$\frac{\partial \sum \hat{u}_i^2}{\partial \delta_0} = 2\sum(y_i - \delta_0 - \delta_1 x_{1i} - \delta_2 x_{2i} - \cdots - \delta_k x_{ki})(-1) = 0 \qquad (3.15)$$

$$\frac{\partial \sum \hat{u}_i^2}{\partial \delta_1} = 2\sum(y_i - \delta_0 - \delta_1 x_{1i} - \delta_2 x_{2i} - \cdots - \delta_k x_{ki})(-x_{1i}) = 0 \qquad (3.16)$$

$$\frac{\partial \sum \hat{u}_i^2}{\partial \delta_2} = 2\sum(y_i - \delta_0 - \delta_1 x_{1i} - \delta_2 x_{2i} - \cdots - \delta_k x_{ki})(-x_{2i}) = 0 \qquad (3.17)$$

$$\vdots$$

$$\frac{\partial \sum \hat{u}_i^2}{\partial \delta_k} = 2\sum(y_i - \delta_0 - \delta_1 x_{1i} - \delta_2 x_{2i} - \cdots - \delta_k x_{ki})(-x_{ki}) = 0 \qquad (3.18)$$

3.3.2.2 Interpreting Ordinary Least Squares Regression (OLS)

The δ_0 value, which was expressed as a constant term in the previous chapters, determines the predicted value of the dependent variable Y when other explanatory variables are equal to zero. Parameter estimators (δ_1, δ_2,…, δ_k) reveal the power of the effects of independent variables on the estimated value ($\hat{y}$). Equality that derived from the sample regression function equation is expressed in equation (3.19) below.

$$\Delta\hat{y} = \delta_1\Delta x_1 + \delta_2\Delta x_2 + \ldots + \delta_k\Delta x_k \quad (3.19)$$

A sample regression function with k variables is in a form that shows the changes on the equation. The equation aims to measure the estimated value of $\hat{y}$, which is the dependent variable and is also desired to be predicted, taking into account the changes in the explanatory variables. In other words, it aims to explain the effect of the independent variable on the dependent variable. The absence of δ_0 value can be interpreted as not having any relationship with the changes on the dependent variable.In addition, it reveals the fact that the amount of change in the dependent variable will be as much as one unit of change that will occur in the independent variable coefficient specified as x_1, provided that all other variables are constant.

3.3.2.3. SEKK Estimated Value (Fitted Value) and Residuals

In ordinary least squares regression, the estimated value for observation (i) is calculated with the help of the following equation.

$$\hat{y}_i = \delta_0 + \delta_1 x_{1i} + \delta_2 x_{2i} + \ldots + \delta_k x_{ki} \quad (3.20)$$

The above equation is intended to be used to express the estimated value of the dependent variable for the observation i, when the values of the explanatory variables are replaced. In other words, it is used to express the estimated value of $\hat{y}_i$ that is desired to be calculated. There is no equality between the true value y_i and the predicted value $\hat{y}_i$ of any observation i. The reason for this is that each observation has its own residue, in other words the error term. In order to overcome this situation and measure the residue, the most accurate method is take account the difference between the true value y_i and the predicted value $\hat{y}_i$ of the observation i. OLS estimated value and properties of residual terms are as follows;

• The mean of the sample of residual terms must be 0,

• The sample covariance between each independent variable and residual term is 0, that is, they do not have a connection between themselves.Therefore, the sample covariance between the predicted value and residual terms is also 0.

• Each of the observed points must be located on the optimum line that determined by the least squares regression.

3.3.2.4. Goodness of Fit and Coefficient of Determination (R-square)

The concept of Goodness of Fit reveals how well the observed set of independent variables explains the dependent variable $\hat{y}_i$ which is desired to be predicted and calculated. It means that there is a perfect fit when the observations mentioned in the predictive value properties are located on the optimum line, determined by the regression. However, it is not common to find such a harmony in empirical studies. Some methods are used to interpret the regression taken into consideration and to understand how important the concept of determination coefficient is for this interpretation. Accordingly, the Total Sum of Squares (TSS), Explained Sum of Squares (ESS) and Residuals Sum of Squares (RSS) include the methods used in regression interpretation.

- Total Sum of Squares- SST

$$\mathrm{TSS} = \sum_{i=1}^{n} (y_i - \bar{y})^2 \qquad (3.21)$$

- Explained Sum of Squares- SSE

$$\mathrm{ESS} = \sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2 \qquad (3.22)$$

- Residuals Sum of Squares- SSR

$$RSS = \sum_{i=1}^{n} \hat{u}_i^2 \qquad (3.23)$$

Considering that other variables are known here;

$\bar{y}$: It is expressed as the average value of the dependent variable in the regression. In addition, this value is calculated with the help of the following equation:

$$\bar{y} = \sum y_i / n \qquad (3.24)$$

The value of n in equation (3.24) indicates the number of dependent variables in the regression.

From the index of equations above, it is possible to write the equation below.

$$TSS = ESS + RSS \qquad (3.25)$$

The determination coefficient (R^2) is a term used in understanding to what extent the independent variables explain the total changes that will occur on the dependent variable and a guide for the analysis of goodness of fit. This term is expressed below in the light of the sums defined in the previous equations.

$$R^2 = \frac{ESS}{TSS} = 1 - \frac{RSS}{TSS} \qquad (3.26)$$

As an alternative to the above equation, the coefficient of determination is equal to the square of the correlation coefficient between the real value of the observation and its predicted value. Also, the equation (3.27) expresses this equation.

$$R^2 = \frac{\left[\sum_{i=1}^{n}(y_i - \bar{y})(\hat{y}_i - \bar{\hat{y}})\right]^2}{[\sum_{i=1}^{n}(y_i - \bar{y})^2]\left[\sum_{i=1}^{n}(\hat{y}_i - \bar{\hat{y}})^2\right]} \qquad (3.27)$$

The value of R^2, which is the determination coefficient, cannot be considered to have a negative value below zero under any circumstances. It consists of the values that will take in the range of $0 \leq R^2 \leq 1$. When the determination coefficient takes the value of 1, it means that the independent variables explain the dependent variable with a perfect fit in terms of the concept of goodness of fit. On the other hand, if this value is zero, it means that there is no harmony and relationship between the observed explanatory variables and the dependent variable. In this

direction, it is possible to deduce that the increase in the determination coefficient value means that the ratio of the independent variables in the regression form taken into consideration to explain the dependent variable increases.

Several problems are encountered in the use of R^2, which is a guiding term in the goodness of fit analysis. One of the problems encountered is that another variable added to the regression never causes a decrease in the R^2 value, but rather an increase. This means that even if an independent variable not associated with the dependent variable in the evaluated regression is added, there will be an unrelated R^2 increase. In order to eliminate this problem, a method called improved R^2 ($\overline{R}^2$) is used. This method avoids the confusion that may occur in the interpretation of the model by penalizing and excluding the independent variables that are added to the regression model and are meaningless, ineffective, and unrelated for the dependent variable. Thus, the corrected R^2 initiates a healthier, not confusing and understandable empirical analysis for the good of fit. The following equation is used to find the corrected R^2.

$$\overline{R}^2 = 1 - (1 - R^2)\frac{n-1}{n-p-1} \qquad (3.28)$$

Here;

n: Observation size included in the regression,

p: Expresses the amount of explanatory variables in the regression.

3.3.2.5. Gauss-Markov Theorem

As stated before, when the assumptions of the classical linear regression model are taken into account, the least squares estimator must have optimum properties. These optimum properties encompass the theorem known as Gauss-Markov. The theorem states that the optimum linear estimation can be achieved when the assumptions of the classical linear regression model are valid. When the assumptions of the classical linear regression model are taken into account, least squares estimators in the group of unbiased linear estimators have a minimum variance. By the neutrality specified here, it is meant that the average or expected value of the estimated " δ " should be equal to the true " δ " value. The dependent variable Y in the regression model is a linear function of a random variable and this emphasizes the concept of linearity. If these assumptions are valid, it is concluded

that the OLS estimator "δ" is the Best Linear Unlimited Estimator (BLUE) of the actual value of "δ". However, the Gauss-Markov theorem is remarkable because it contains no assumptions about the probability distribution of the residual variable e_i and the dependent variable Y_i (Gujarati, 2009).

3.3.2.6. Variance of Least Squares Estimators

Unlike the search for minimum variance in the previous section, it is important in here that the variance of the OLS estimators is large. This is related to the sensitivity of the estimators, and the higher the size, the less sensitive. As a natural consequence of this, wider confidence intervals and less accurate hypothesis tests occur inevitably. The variance of the estimators can be formulated in the light of the assumptions stated in the Gauss-Markov theorem. The constant variance assumption is not valid to obtain an OLS without deviation, but this assumption is needed to determine the variance of the predictors. These are calculated with the help of the variance formula as follows.

$$\mathrm{Var}(\delta_j) = \frac{\sigma^2}{\mathrm{TSS}(1 - R_j^2)} \qquad (3.29)$$

j: It refers to any of the observed explanatory variables.

σ^2: To recall from the previous sections, it expresses the variance of the error term that found in the regression. There is a direct proportion between this term and the estimators, that is, as the error term variance increases, the variance of the estimators increases accordingly. Therefore, it becomes difficult to predict the effect of any observed explanatory variables on the dependent variable. The only way to overcome the increase in error term variance (σ^2) is the adding more explanatory variables to the evaluated regression model.

TSS_j: Based on its definition, it is possible to say that it defines the total sample variance. And also, the increase of this value means that the variance of the estimators decreases. In addition, the increase in the mentioned value increases the predictability of the analysis.

R_j^2: It means that there is a linear relation between the explanatory variables in the regression. This value means the increase of the linear relationship and also this value increases the variance of the estimators included in the evaluation.

The following equation is used to calculate the variance of the error term with an unbiased estimator in the scope of the multiple regression form.

$$\hat{\sigma}^2 = \frac{(\sum_{i=1}^{n} \hat{u}_i^2)}{(n-k-1)} = \frac{RSS}{(n-k-1)} \qquad (3.30)$$

The standard deviation (sd) of the estimators represents a necessary parameter in analysis, and this parameter is used to generate confidence intervals and hypothesis theses.The equation obtained from the square root of the variance of the OLS estimators is used to calculate the standard deviation of the estimators.

$$sd(\delta_j) = \frac{\sigma}{\sqrt{TSS_j\left(1-R_j^2\right)}} \qquad (3.31)$$

j = 1, 2, 3, …, k

The standard error of the estimators (standard error-se) is calculated by taking the estimator($\hat{\sigma}$) of σ due to the σ is unknown.

$$se(\delta_j) = \frac{\hat{\sigma}}{\sqrt{SST_j\left(1-R_j^2\right)}} \qquad (3.32)$$

j = 1, 2, 3, … ,k

3.3.3. Hypothesis Test

A hypothesis test consists of four basic steps. The first of these steps is to create a null hypothesis (H_0) about a phenomenon or parameter. This null hypothesis (H_0) is generally determined as the opposite of (H_1), which is the research hypothesis that the researcher really believes and wants to test. Research hypotheses can be deductively generated from a study of theoretical observations. As a second step, relevant data are typically collected through an experiment or sampling. Next, a statistical test of the null hypothesis producing the P-value is performed. Finally, the question of what this value means according to the null hypothesis is considered (Johnson, 1999). Following these steps, the research hypothesis (H_1), which is intended to be tested, gains significance depending on whether the null hypothesis (H_0) will be rejected or not. Accepting the null hypothesis means that the study is statistically insignificant, while rejecting it means that there is a statistically significant relationship. One hypothesis is shown as follows:

H_0: $\delta_j = 0$

$H_1: \delta_j \neq 0$

3.3.3.1. t-Test

The t-Test is defined as a type of statistical test which used to compare the means of two groups. The t-Test is also known as the Student's t-Test (Kim, 2015). A t test used to test only one of the independent variables that helps to understand the effects of the observed independent variable on the dependent variable. The t value is found with the help of the following equation.

$$t = \frac{\hat{\delta}_j - \delta_j}{se(\hat{\delta}_j)} \qquad (3.33)$$

$j = 1, 2, 3, \ldots, k$

H_1, expressed as the research hypothesis to be tested in the previous section, becomes meaningful depending on the value obtained from the equation above whether the null hypothesis H_0 will be rejected or not. First of all, a significance level should be determined, then the critical value (c) should be found by examining the table value of the significance level. The critical value found at the significance level determined is compared with the *t value* calculated from equation (3.33) above and the hypotheses are interpreted for the constraints given below.

- If the calculated t value is greater than the critical value, ie. $t > c$, H_0 should be rejected for right tail test.
- If the calculated t value is less than the critical value, ie. $t < c$, H_0 is rejected for the left tail test.
- Calculated t value as absolute value is greater than critical value ie. $| t | > c$, H0 is rejected for duplex test.

3.3.3.2. Test F

In the previous section, the t test used to test only one of the independent variables was mentioned. In this section, the F test, which is used to examine the effect of all observed independent variables on the dependent variable in a regression, and moreover, allows this effect to be statistically tested. Hypotheses in F test analyzes are written in the form stated below.

$H_0: \delta_1 = \delta_2 = \delta_3 \ldots = \delta_k = 0$

$H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \ldots \neq \delta_k \neq 0$

Except for cases where all parameters of independent variables in the model are excluded, there are also F tests that are created and applied by excluding a group of parameters. In the analysis called the Unrestricted F-Test, all parameters are included completely, while in the Restricted F-Test analysis, one group of parameters is excluded, in other words, there are fewer parameters compared to the other and statistically is being tested. Because ,while the parameters to be analyzed equal to zero belong to the null hypothesis (H_0), in the research hypothesis (H_1) the situation is that at least one of these observed parameters is different from zero. The way to reach a restricted model is to accept the null hypothesis. In cases where all observed parameters are not excluded from the model, hypotheses can be shown in different forms, examples of which are below.

$$H_0: \delta_1 = 0, \delta_3 = 0$$

$$H_1: \delta_1 \neq 0, \delta_3 \neq 0$$

How a constrained and unconstrained model is written for this null hypothesis (H0) and the research hypothesis (H1) are explained in detail below.

Constrained model;

$$y = \delta_0 + \delta_1 x_1 + \delta_2 x_2 + \delta_3 x_3 + \ldots + \delta_k x_k + u \qquad (3.34)$$

Unconstrained model;

$$y = \delta_0 + \delta_2 x_2 + \delta_4 x_4 + \ldots + \delta_k x_k + u \qquad (3.35)$$

Based on this, the F value is obtained with the help of the following equation.

$$F = \frac{(RSS_r - RSS_{ur})/q}{RSS_{ur}/(n-k-1)} \qquad (3.36)$$

Here;

RSS_r: Sum of squares of residues defined for the constrained model,

RSS_{ur}: Sum of squares of residues defined for the unconstrained model,

q: The total constraint amount obtained by taking the difference between the level of freedom of the unconstrained model and the level of freedom of the constrained model,

n: The amount of observations included in the model,

k: Refers to the amount of explanatory variable in the model.

In addition, the F value can be found with the help of determination coefficients.

$$F = \frac{(R_{ur}^2 - R_r^2)/q}{(1 - R_{ur}^2)/(n - k - 1)} \qquad (3.37)$$

Here;

R_{ur}^2: Determination coefficient defined for the constrained model,

R_r^2: It refers to the determination coefficient defined for the unconstrained model.

Whether the zero hypothesis (H_0) will be rejected or not becomes meaningful depending on the F value which obtained from the above equation. As in the t-test, a significance level should be determined first, and then the critical value (c) should be found by examining the table value of the significance level. The critical value depends on q and degrees of freedom in here, unlike the t-test. Hypotheses are interpreted by comparing the critical value found at the determined significance level with the F value that obtained from equation (3.36) or (3.37).

- If the calculated F value is greater than the critical value, ie. F > c, H_0 must be rejected.

3.3.4. Weighted Least Squares Method (AEKK - WLS)

In the previous sections, it was stated that the least squares method (OLS) analysis is used in cases where the constant variance (homoscedasticity) assumption is valid. However, if the assumption of constant variance is not available , in other words, if the existence of variance assumption (heteroscedasticity) is proven in the light of methods such as Breusch-Pagan or White Test, which includes different analysis methods, the Weighted Least Squares method (WLS) is preferred in terms of efficiency of the analysis , instead of the least squares method.

In the case where "x" in a linear regression form represents the observed explanatory variables and the following equation is assumed;

$$Var(u|x) = \sigma^2 h(x) \qquad (3.38)$$

h (x) in equation (3.38) expresses any function of the explanatory variable x in the regression and determines the changing variance (heteroscedasticity). For the "x" values included in the model, the fact that h (x) is greater than zero is due to the variance taking a positive value. Apart from this, according to the assumption, the value of h (x) in the equation is known, and it is claimed that the value of σ^2, whose value is unknown, is estimated from the sample.

In order to benefit from equation (3.38) in estimation of "δ" values, which express the coefficients of independent variables in the regression, some changes should be applied. First of all, the classical linear regression model to be discussed should include the assumption of variable variance of the variance of error terms.

$$y_i = \delta_0 + \delta_1 x_{i1} + \delta_2 x_{i2} + \dots + \delta_k x_{ik} + u_i \qquad (3.39)$$

The equation in (3.39), which expresses the most typical form of the classical linear regression model, should be transformed into a form containing the assumption of constant variance and the assumptions of the Gauss-Markov theorem mentioned in the previous topics. Since h_i contains a function of x_i which representing the independent variables, the conditional expected value of the value $u_i/\sqrt{h_i}$ with respect to x_i is equal to zero. However, starting from the equation $Var(u_i|x_i) = E(u_i^2|x_i) = \sigma^2 h_i$, the conditional variance of $u_i/\sqrt{h_i}$ according to x_i is also σ^2. To summarize, the following equation will explain these definitions.

$$E\left(\left(u_i/\sqrt{h_i}\right)^2\right) = E\left(u_i^2\right)/h_i = \left(\sigma^2 h_i\right)/h_i = \sigma^2 \qquad (3.40)$$

After this step, each term of a linear regression with variable nature of the variance of the error terms is divided to $\sqrt{h_i}$.

$$y_i/\sqrt{h_i} = \delta_0/\sqrt{h_i} + \delta_1(x_{i1}/\sqrt{h_i}) + \delta_2(x_{i2}/\sqrt{h_i}) + \dots + \delta_k(x_{ik}/\sqrt{h_i}) + (u_i/\sqrt{h_i}) \qquad (3.41)$$

Another representation rather than the complex image in Equation (3.41) is stated below;

$$y_i^* = \delta_0 x_{i0}^* + \delta_1 x_{i1}^* + \delta_2 x_{i2}^* + \dots + \delta_k x_{ik}^* + u_i^* \qquad (3.42)$$

The meaning of each star (*) specified here represents $1/\sqrt{h_i}$, in other words, it refers to the division of each x_i' to $\sqrt{h_i}$. In addition to having the conditional constant variance (σ^2) with respect to x^*, u_i^* also has normal distribution if u_i in the original equation has normal distribution. In addition, the above-mentioned equation maintains its linearity in terms of parameters and still includes the random sampling assumption. The δ values $(\delta_0^*, \delta_1^*, \dots, \delta_k^*)$ obtained as a result of this transformation applied to the regression form and called the Generalized Least Squares (GLS) method will give more reliable results than the least squares method to be used in the analysis.

The weighted least squares method is called a method used to solve the problems caused by the heteroscedasticity. The main reason for naming it this way is that the square of each of the residues in the model is weighted with $1/h_i$, so that the sum of the residual squares of the δ^* is reduced to the lowest level. While each observation that evaluated in the OLS method has the same weight, the observations with high residual variance in the WLS method have lower weights. This is because the best predictor with the lowest variance is obtained when the residual variance is the same in all the observed independent variables. An WLS estimator is shown below which consists of δ_j values that will make the equation minimum.

$$\sum_{i=1}^{n} (y_i - \delta_0 - \delta_1 x_{i1} - \delta_2 x_{i2} - \cdots - \delta_k x_{ik})^2 / h_i \qquad (3.43)$$

It is given in equation (3.44) that the sum of the squares of the weighted error terms is equal to the sum of the squares of the error terms in the transformed regression form when the square root of the expression $1/h_i$ is taken in equation (3.43) and replaced in the part indicated with parentheses.

$$\sum_{i=1}^{n} (y_i^* - \delta_0 x_{i0}^* - \delta_1 x_{i1}^* - \delta_2 x_{i2}^* - \cdots - \delta_k \delta_{ik}^*)^2 \qquad (3.44)$$

3.3.5. Hausman Test

Hausman test was developed to test identification error, but can be applied in different areas. Hausman test is generally defined as a preferred specification test in order to decide which of the fixed and random effects models will be used in panel data analysis. The basis of the Hausman test that used in the choice of fixed and random effects models is based on asymptotic covariance matrices that ignore constant terms corresponding to slopes in models (Greene, 2003). In the Hausman test application, the rejection of H_0 expresses the null hypothesis. İf H_0 ,that is, null hypotesis is accepted, random effects model should be choosed, however, accepted H_1 means fixed effects model should be selected. In another words, Random effects model gives more effective results if null hypotesis (H_0) is accepted while fixed effects model gives more effective results if H_0 rejected.

3.3.5.1. Hausman Test for Unidirectional Model

One of the most distinctive distinctions for fixed and random effects models is whether the direction and strength of the relationship between time effects and explanatory variables are the same. Based on this distinction, it is argued that if there is no relationship between time effects and explanatory variables in terms of relationship direction and strength, the most effective model to be preferred in the analysis is the random effects model. On the other hand, if there is a relationship between time effects and explanatory variables in terms of relationship direction and strength, it is stated that the most effective model to be preferred in the analysis is the fixed effects model.

The null hypothesis H_0, which expressed in the previous section, means that there is no relationship between time effects and explanatory variables in terms of the direction and strength of the relationship. Furthermore, if the zero hypothesis (H_0) is statistically significant, there is no difference between the two model estimators. However the absence of such a difference makes it more effective to choose the estimator of the random effects model. The research hypothesis H_1, which expressed in the same test, means that there is a relationship between time effects and explanatory variables in terms of the direction and strength of the relationship. Additionally, if the research hypothesis (H_1) is statistically significant, it requires the choice of fixed effects model unlike the random effects model.

In the Hausman test, the accuracy of the null hypothesis (H_0), which means that there is no relationship between time effects and explanatory variables in terms of relationship direction and strength and that the choice of random effects model estimators is effective, is tested in accordance with the analysis made by various statistical methods that are compatible with x^2 (chi-square) distribution which has k degrees of freedom.

When using Hausman test statistics, Hausman statistics are found by using the difference between the variance covariance matrices of the generalized least squares estimator and the within-group estimator. If the difference between parameters is not systematic, that is, H_0 cannot be denied, a random effects estimator is used. Hausman test aims to test whether the difference of variance-covariance between these two estimators is equal to zero. The fact that the

difference between the estimators mentioned here is not systematic, in other words, means that the null hypothesis (H_0) is accepted and the use of the random effects model is preferred. On the other hand, the fact that the difference between the estimators is systematic means that the research hypothesis (H_1) is accepted, and the the null hypothesis (H_0) is rejected, and it means that the use of the fixed effects model is preferred. Hausman test statistics are found with the help of the following equation.

$$\textbf{Hausman}=(\hat{\delta}^{SE}-\hat{\delta}^{RE})'[\text{Var}(\hat{\delta}^{SE})-\text{Var}(\hat{\delta}^{RE})]-1(\hat{\delta}^{SE}-\hat{\delta}^{RE}) \qquad (3.45)$$

In Equation (3.45), Hausman test statistic is expressed equal to the transpose of the coefficient matrix formed by the model estimators and the multiplication of the inverse of the variance-covariance matrix with the same coefficient matrix. Moreover, the "SE" force multiplier here refers to the estimators of the fixed effects model, while the "RE" force multiplier refers to the estimators of the random effects model. Additionally, Var($\hat{\delta}^{SE}$) and Var($\hat{\delta}^{RE}$) show the asymptotic covariance variance matrices calculated from the estimation of fixed and random effects models, respectively.

3.3.5.2. Hausman Test for Two-Way Model

The hausman test, which enables us to make the right choice between random and fixed effects estimators in unidirectional models, enables us to choose the correct estimator in bidirectional models by expanding it when necessary. For a Hausman test that can be applied to test bidirectional fixed and random effects models against each other; S.J. The assumption put forward by Kang (1985), in addition to defending the necessity of expanding the hypotheses so that they can be tested, adopts the view that the model will reach more accurate results.

$$H_0: E(\lambda_t X_{it}) = 0 \ (when\ E(\mu_i X_{it}) \neq 0) \qquad (1)$$

$$H_0: E(\mu_i X_{it}) = 0 \ (\ when\ E(\lambda_t X_{it}\ ) \neq 0) \qquad (2)$$

$$H_0: E(\lambda_t X_{it}) = 0 \ (\ when\ E(\mu_i X_{it}) = 0) \qquad (3)$$

$$H_0: E(\mu_i X_{it}) = 0 \ (\ when\ E(\lambda_t X_{it}) = 0) \qquad (4)$$

$$H_0: E(\lambda_t X_{it}) = E(\mu_i X_{it}) = 0 \qquad (5)$$

There are five different null hypotheses above. And these hypotheses overlap with the research hypotheses, so a definitive decision cannot be reached in terms of determining the most effective model. Therefore, in order to overcome this situation, first hypothesis number (3) should be analyzed. The research hypothesis presented against the number (3) hypothesis implies that there is a connection between at least one time effect and the explanatory variable in terms of the direction and strength of the relationship. Consequently, this situation causes the rejection of the null hypothesis as a result of the test to be applied, and reveals the necessity to test the following hypotheses in order. However, if such a situation does not occur and the null hypothesis is accepted, it is assumed that the use of two-way random effects model will be the most effective method.

$$H_0: E(\mu_i X_{it}) = 0$$

$$H_0: E(\lambda_t X_{it}) = 0$$

3.3.6. Fixed Effects Model

This model is based on the assumption that a conditional inference is made. However, it makes this assumption considering the sampling effects included in the regression. In addition to the analysis using the panel data type, it is a frequently used model in cases where unobservable effects that may occur in cross sections.

$$Y_{it} = \alpha_i^* + \delta' X_{it} + u_{it} \qquad (3.46)$$

$$i = 1,2,3, \ldots, n$$

$$t = 1,2,3, \ldots, t$$

The above equation expresses the model to be applied and that the unobservable effects are on α_i. In addition, the least squares shadow variable estimator δ_i is described as the covariance estimator. It is possible to list the methods used in the application of the model as in-group satisfaction and between-group satisfaction. However, in terms of the types of methods used in the analysis of the study, it was deemed appropriate to give summary information about the above terms by ignoring the other methods of the fixed effects model.

3.3.6.1. The Least Squares Method with Shadow Variable

In this method, which is applied by adding the shadow variable estimator to the least squares method, the unit effect (u) appears as a predictable coefficient like

the explanatory variable parameter (δ) rather than being an unobservable variable. In the estimation of the coefficients, the situation called cross section variability disappears. Moreover, the time variability within the units is used in the application of this method. However, this method is not preferred unless deemed necessary due to the loss of information in the analysis. Although the determination coefficient (R^2) is not reliable in the application of this method, it can be calculated and interpreted. Because, the inclusion of a shadow variable for each unit in the model will make the changes in the dependent variable more meaningful. The pooled least squares method, which is a modification of the least squares method, is applied to the intragroup transformed data in order to obtain information on how much of the time changes that will occur on the dependent variable are related to the time changes in the explanatory variables. And R^2, which expresses the determination coefficient obtained as a result of this application, explains this situation.

3.3.6.2. Intragroup Estimation Method

In the fixed effects model application, where the ultimate goal is slope estimation, it is not necessary to add shadow variables to explain the unit effect created by the explanatory variables. This method is applied by taking the difference of unit averages from a group of time series observations for each unit and converting the variables. The pooled least squares method is applied to the new model created with these transformed variables. Moreover, the unit shadow variable coefficients can be estimated by using the group averages of the residuals, in other words the error terms.

3.3.6.3. Intergroup Estimation Method

In addition to the intragroup estimation method, another method preferred to be used in some cases is known as the intergroup estimation method. One of these cases is that the intragroup estimation method used in cases where there are time-dependent changes in units containing cross sections become insufficient when there is variation in observations between horizontal sections. In the application of this method, time-dependent unit averages are calculated for each observation as in the intra-group estimation method.

$$\bar{Y} = \delta_0 + \bar{X}_i + \mu_i + \bar{u}_i \quad (3.47)$$

Since the above equation is obtained with the help of time-dependent averages, it is also called the time averages model. Even if there is no correlation between u_i and x_{it}, the intergroup estimation method cannot be applied. The reason for this is shown as an interpretation based on averages and the disappearance of time series information.

In general, the intergroup estimation method is seen as a tool to explain the estimator in the random effects model. When a model is designed in which there are measurement errors in the independent variables but no unit effect (u_i) is designed, it is seen that taking the mean over time reduces the measurement errors and the effect of a deviation resulting from these errors. This feature is expressed as one of the most important advantages of this method. It has been previously emphasized that the least squares method with shadow variables is a frequently used method to find the fixed effects model estimator. However, this situation causes a lot of loss in the degree of freedom due to the large number of units. Moreover, this situation means that the application of the intra-group estimation method will be beneficial and this method is also known as the fixed effects estimator.

3.3.7. Random Effects Model

If the individual effects are not related to the independent variables and if the constant terms of the variables are randomly distributed according to the variables, the model should be given a form in this direction and made an appropriate model (Greene, 2003). In the random effects model, the changes that will occur in cross-sections and time-dependent changes are included as part of the components that make up the error terms within the scope of the model. The main reason for this situation is the view that the loss in degrees of freedom mentioned in the fixed effects model has been eliminated thanks to the random effects model (Baltagi, 2015). The positive aspect of the fixed effects model in the application of the random effects model is that the time invariance can be added to the model as a variable. In terms of this cost of benefit, the absence of a relationship in terms of the direction and strength of all the explanatory variables with unit effect is

considered. In such a case, the methods to be used are listed as resistive standard errors and pooled least squares method.

As in the application of the pooled least squares method, including the term μ_i into the error term and the use of the random effects model that tries to distinguish the errors is considered as one of the effective methods in terms of the results and interpretation of the analysis.

If we list the estimation methods used by the random effects model; It is possible to sort as pooled least squares, generalized least squares, maximum likelihood, general flexible generalized least squares and two-stage generalized least squares, flexible generalized least squares. The most preferred method among these listed methods is the generalized least squares method. The fact that this method is a method that can be overcome the problems encountered in addition to the ease of calculation and analysis compared to the most probability method makes this choice effective. Generalized least squares method is also described as random effects estimator in terms of usage frequency and efficiency in this application.

3.3.8. Cox (Proportional Hazards) Regression Analysis

Cox published an article with a title of “Regression Models and Life-Tables” in 1972. This study was become one of frequently quoted statistical papers in statics and medicine. İn this study, Cox identified the proprtional hazards model. Moreover, he outlined in this study the method for estimation that he mentioned to employing conditional likelihood. However, it was stated in the literature that there may have some flaws in his rationality and his poferred was not conditional likelihood. In 1975, Cox reformed his method of estimation and called as “partial likelihood” in Biometrika.

Cox sighted that if the proportional hazards supposition holds or assumed to hold then it is likely to estimate the impact of parameter(s) with no consideration of the hazard function. This approximation to survival data is named exercise of the Cox proportional hazards model, and also sometimes shortened as proportional hazards model or Cox model (Cox, 1972). On the other hand, he also noted that biological exposition of the proportional hazards supposition can be quite tricky.(Cox, 1997)

Cox proportional hazards regression analysis is one of the most common regression methods for survival analysis. Survival models is used to relate various risk factors or exposures, considered at the same time, to survival time. Survival models is used to relate various risk factors or exposures, considered at the same time, to survival time. In a proportional hazards metod, the unique impact of a unit rise in a covariate is multiplicative according to the hazard rate.

Cox regression analysis is a statistical method that elicits the relationship between the dependent variable and over one independent variable. The goal in Cox regression metod is to create a model that states the general condition of survival data. In this way, the impacts of independent variables that are considered to have an impact on life span can be clarified simultaneously, that is, measured. Risk associated with X independent variables of an observation function is denoted by h (t,x) and expressed as;

$$h(t,x) = h_0(t) \exp(\beta x) \qquad (3.48)$$

- X is a vector of covariates of concern, which may contain: continuous factors (age, blood pressure), discrete factors (sex, marital status), possible interactions (age by gender interaction).
- $h_0(t)$ is named the baseline hazard function. And also it projects the underlying hazard for matters with all covariates X_1, ..., X_p equal to 0 (i.e., the “reference group”). The reason $h_0(t)$ is called "baseline" is that if x = 0, then $h(t / x) = h_0(t)$.
- (t) is the time-scale of choice.
- h (t,x) is a conditional unsuccess rate, which the risk function of the lifetime T. And also this function can be identified as the probability of unsuccess in a very brief time interval. This function can also be defined as the probability of failure in a very short time interval.

The general form is:

$$h(t|x) = h_0(t) \exp(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_p X_p) \qquad (3.49)$$

Therefore, when we substitute entire Xj ’s equivalent to 0, we get:

$$h(t|X = 0) = h_0(t) \exp(\beta_1 * 0 + \beta_2 * 0 + \cdots + \beta_p * 0) = h_0(t) \qquad (3.50)$$

In the general condition, we consider of the i-th individual owning a set of covariates $X_i = (X_{1i}, X_{2i}, ..., X_{pi})$, and we model hazard rate of them as some multiple of the basic hazard rate:

$h_i(t) = h(t|X_i) = h_0(t) \exp(\beta_1 X_{1i} + \cdots + \beta_p X_{pi})$ (3.51)

on the log-scale

$\log(h_i(t)) = \log [(h_0(t) \exp(\beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_p X_{ip})]$ (3.52)

$= \log [h_0(t)] + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots + \beta_p X_{ip}.$ (3.53)

This stands for that the Cox model supposes that the impacts of covariates are additive and also linear on the log-rate measure.

In a Cox (proportional hazards) regression analysis, the measure of impact is the hazard ratio, which is the risk of failure, given that the participant has survived up to a specific time. A probability range must lie between 0 and 1. However, the hazard stands for the anticipated number of incidents per-one unit of the time. Moreover, the Cox proportional hazards analysis is called a semi-parametric metod, since there are no suppositions about the form of the baseline hazard function.

The partial likelihood function;

The partial likelihood function is used to estimate the β unknown coefficients vector. The partial probability function was determined by Cox as follows;

$$L(\beta) = \prod_{k=1}^{n} \frac{\exp(\beta' X_k)}{\sum_{j \epsilon R(t_i)} \exp(\beta' X_j)} \qquad (3.54)$$

For the significance tests of the coefficients, the null hypothesis is expressed as H_0: β = 0. There are three methods used to test the significance of β coefficients in the Cox model.

- Wald test
- Likelihood ratio test
- Score test

The baseline assumptions of the Cox regression analysis can be expressed as follows:

(1) The impacts of independent variables on hazard function are loglinear.

(2) The relationship between the loglinear function of independent variables and the risk function is multiplicative (Özdamar, 2001).

(3) The observations must be independent of each other and the risk ratio must not change over time, that is, it must be constant. This assumption about the risk ratio is known as the proportional risk assumption. When the proportional risk assumption is not provided, the Cox regression model with independent variables with time is applied.

Additionally in this study, we used Cox Regression method to analyze control variables.

Our dependent variable; Sleep

Our explanatory variable; Working hours

4. RESULTS

The data obtained from the Health and Retirement study conducted by the University of Michigan in the US were analyzed with the help of the STATA program and the results are examined in detail below. Stata gives results at 95% confidence interval for our study. First of all, it is necessary to give information about the independent variables that determine the dependent variable.

The table below contains basic statistical information about independent variables.

Table 4.1: Summary Statistics

Variable	Mean	Std.Dev	Min	Max
Inyearlyhourswo	2.083	3.367	0	9.768.412
Age	6.840	1.091	20	109
White	0.800	0.399	0	1
Realhouseholdtotincome	3.018	2.867	0	81100000
Married	0.609	0.487	0	1
Living-situation	2.200	1.184	1	19
Numberofchildren	3.236	2.178	0	22
Base-health	1.961	0.953	1	5
Obese	0.276	0.447	0	1
Base-BMI	2.461	4.799	7	64.6
Hosp	0.277	0.447	0	1
Selfreported health	2.913	1.134	1	5
Howmany disease	2.019	1.483	0	8
Health_limited	0.307	0.461	0	1
Worse_health	0.270	0.444	0	1
Drink	0.473	0.499	0	1
Smoke	0.142	0.350	0	1
Jobstressdum	0.161	0.367	0	1
Jobphysdum	0.101	0.302	0	1
Rtenure	4.075	9.116	0	75
Runemployed	0.018	0.134	0	1
Lessthan_hs	0.266	0.442	0	1
Hs_grad	0.335	0.472	0	1
Collegeplus	0.100	0.300	0	1
N		178.095		

[1] How many hours the individual worked in a year?, [2] The respondent birthdate at beginning of the interview,

[3] 1 means respondent comes from white race, [4] How much total income a household received last calendar year?(respondent and spouse)

[5] 1 means person is married, [6]Other than you [and your (husband/wife/partner)], how many people are living with you?

[7]How many (other) living children or step-children do you [or your husband/wife/partner)] have? [8] The baseline health of person (1.The best, 5 The worst), [9] BMI>30, [10] The baseline weight of person

[11] 1 means respondent stayed at hospital in previous two years, [12] 1 means excellent and 5 means poor [13] How many out of eight diseases the individual has?

(High blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis) [14]Do you have any health problems that prevent you from working? 1 means yes, [15] Worse health,

[16]Have you ever drunk alcohol? 1 means yes, [17] Have you ever smoked cigarettes? 1 means yes.

[18]Does current job involve lots of stress ? (1 means Strongly agree, 2.Agree , 3.Disagree , 4.Strongly disagree , 5.Does not apply)

[19] Does current job require lots of physical effort ? (1 means All/almost all the time, 2.Most of the time , 3.Some of the time , 4.None/almost none of time , 5.Does not apply)

[20] Tenure of the person in the current job(job start date is used.) [21]İf person is not working for pay and also reports actively looking for a job in the last four weeks, it means unemployed.

[22] if person has college degree and more (educ>16), [23] İf person graduated high school (educ> 12), [24] İf person has less that high school degree (educ<12)

The regression form used in our study is shown below:

SLEEP= β_0 + β_IInyearlyhourswo + $\beta_2$age + $\beta_3$white + β_4 realhouseholdtotincome + $\beta_5$married + β_6 living-situation + $\beta_7$numberofchildren + $\beta_8$base-health + $\beta_9$obese + β_{10}base-BMI + β_{11}hosp + β_{12}selfreportedhealth+ β_{13}howmany disease + β_{14}health_limited + β_{15}worse_health + β_{16}drink+ β_{17}smoke + β_{18}Jobstressdum + β_{19}jobphsdum + β_{20}rtenure+ β_{21}runemployed + β_{22} lessthan-hs + β_{23}hs-grad + β_{24}collegeplus + ε (1)

Cox Regression analysis and a panel study were conducted by using these data obtained from the Health and Retirement study. The analysis is based on equation (1) above. To explain variables;

• Sleep: Self-reported sleep status of the individual

Sleep was restless-raw for 1992: 1.All or almost all

2.Most of the time

3.Some of the time

4.None or almost non

However, after 1992 sleep variables are changed. Accordingly,1 means respondent has restless sleep (1.All or almost all, 2.Most of the time, 3.Some of the time), while 0 means the answer that 4.None or almost non.

Among these independent variables that show above, variables such as gender, race, obesity, alcohol consumption and cigarette consumption, self-reported health status were used as control variables. Inyearlyhoursw0 is annual working hours of the individual which is represented our referance group. The age variable is the birth date of the respondent. Self-reported health is scored between 1 and 5 (1.excellent, 2.very good, 3.good, 4.fair, 5.poor) by respondent.

In addition, 1 means person comes from white race and realhouseholdtotincome variable is total income which household (respondent and spouse) received last calendar year. Moreover, 1 means person is married and living_situation variable means how many people are living with respondent, not including spouse. The numberofchildren variable means the number of living children which respondent and spouse have.

Basehealth variable is stated the baseline health of respondent and it is scored between 1 and 5 (1. The best, 5. The worst) in the HRS. Obese means the

person's body mass index is above the obesity limit and basebmi variable is stated the baseline weight of respondent. Hosp is the variable that shows have respondent stayed at hospital in previous two years and 1 means yes. Selfreportedhealth is the variable which indicates respondent health statue (1.excellent and 5. poor).

The variable of howmany disease is that whether person has disease like high blood pressure, diabetes, cancer, lung disease, heart disease, stroke, psychiatric problems, and arthritis. Health_limited means whether person has health problems which prevent from working. Moreover, 1 means person has drunk alcohol and 1 means person has smoked. Jobstressdum is the variable which means whether current job involve lots of stress and scored between 1 and 5 (1.Strongly agree, 2.Agree , 3.Disagree , 4.Strongly disagree , 5.Does not apply).

Jobphysdum is about whether current job require lots of physical effort (1.All/almost all the time, 2.Most of the time , 3.Some of the time , 4.None/almost none of time , 5.Does not apply). By using job start date of person, tenure of the person in current job is stated in the HRS, with rtenure variable. Unemployed is the person who is not working for pay and also reports actively looking for a job in the last four weeks and 1 means respondent is unemployed.

Collegeplus means that the person has been educated for more than 16 years. Hs_grad means that the person graduated from high school and has more than 12 years of education, while lessthan_hs means the person has less than 12 years of education.

Confidence levels of the coefficients are shown as follows:

• If it has a p value less than 0.01, it is indicated with the *** sign and this shows the 99% confidence level.
• If it has a p value between 0.01 and 0.05, it is indicated with a ** sign, and this indicates the 95% confidence level.
• If it has a p value between 0.05 and 0.1, it is marked with an * sign, indicating a 90% confidence level.
• If it has a p value greater than 0.1, no sign is specified

Table 4.2: Cox Regression Results For All

	Coefficient	S.E
Inyearlyhourswo	0.983***	0.005
Age	0.981***	0.000
White	1.147***	0.017
Realhouseholdtotincome	0.999***	0.000
Married	0.887***	0.010
Living_situation	0.985***	0.004
Numberofchildren	1.001	0.002
Base-health	1.098***	0.007
Obese	1.032**	0.014
Base-bmı	1.002*	0.001
Hosp	0.990	0.009
Selfreportedhealth	1.158***	0.007
Howmanydisease	1.059***	0.004
Health_limited	1.115***	0.011
Worse_health	1.223***	0.012
Drink	1.046***	0.011
Smoke	1.016	0.024
Jobstressdum	1.302***	0.025
Jobphysdum	1.063***	0.021
Rtenure	0.996***	0.000
Runemployed	1.116***	0.028
Lessthan-hs	1.086***	0.018
Hs-grad	1.077***	0.017
Collegeplus	0.921***	0.024
N	178.095	

**** p<0.01 ** p<0.05 * p<0.10*

Cox regression results for all gender groups are shown in Table 4.2. According to these results, a unit increase in annual working hours statistically decreases the possibility of having restless sleep since the coefficient of 0.983 (S.E:0.005) takes a value less than 1. In other words, there is a statistically significant relationship between the annual working hours and restless sleep independent of the sample.

Additionally, we can make inference that a unit increase in working hours do not increase sleep distress of people due to the fact that an increase in working hours raises their degree of fatigue.

One of the control variables, the base-health status is stated between (1) the best and (5) worst in HRS. That is, if the base-health status is greater than 1, it indicates that the health has deteriorated.

According to results, a unit increase of in the base-health coefficient 1.098 (S.E:0.007) significantly increases the probability of restless sleep. In other words, there is a statistically significant relationship between deterioration in base-health status and restless sleep.

The jobstress dumy coefficient is seen as 1.302 (S.E:0.025) at the 99% confidence level, that is, a one-unit increase in job stress increases statistically significant the likelihood of having restless sleep. In other words, the increase in work stress statistically related to the probability of sleep distress, independent of the sample.

Another the coefficient, which is belong to obese variable, is 1.032 (S.E:0.014) and greater than 1 so a unit increase of person's obesity level increases the likelihood of restless sleep. This conclusion is due to obese person having lots of working hours.

However, when we look at the relationship between smoke and sleep, the fact that smoke which is the coefficient of 1.016 (S.E: 0.024) greater than 1,having smoke habit increases the likelihood of restless sleep. But this relationship is statistically not significant.

Table 4.3: Cox Regression Results For Female

	Coefficient	S.E
Inyearlyhourswo	0.988*	0.006
Age	0.983***	0.000
White	1.144***	0.020
Realhouseholdtotincome	0.999*	0.000
Married	0.977	0.014
Living_situation	0.981***	0.005
Numberofchildren	0.999	0.003
Base-health	1.095***	0.009
Obese	1.010	0.017
Base-BMI	1.004***	0.001
Hosp	0.999	0.011
Selfreportedhealth	1.165***	0.008
Howmanydisease	1.054***	0.005
Health_limited	1.096***	0.013
Worse_health	1.198***	0.014
Drink	1.089***	0.015
Smoke	1.036**	0.018
Jobstressdum	1.268***	0.031
Jobphysdum	1.060**	0.026
Rtenure	0.996**	0.001
Runemployed	1.074**	0.034
Lessthan-hs	1.123***	0.023
Hs-grad	1.099***	0.021
Collegeplus	0.903***	0.031
N	105.273	

**** p<0.01 ** p<0.05 * p<0.10*

Cox regression results for females are shown in table 4.3 above. Results appear similar to Cox regression results for all. However, there are some differences. According to Table 4.3, similarly, an unit increase in annual working hours does not increase likelihood of restless sleep in women. Nevertheless, this result has a coefficient of 0.988 (S.E:0.006). This result may be stated by women having less working hours than men or women having more responsibilities at home. Another point is that the married variable gives meaningful result for women,but, only for this observation sample. Therefore, we can conclude that being married does not increase likelihood of restless sleep in women because of the coefficient of 0.977 (S.E:0.014) is less than 1, however, this result is statistically not-significant.

Table 4.4: Cox Regression Results For Male

	Coefficient	S.E
Inyearlyhourswo	0.986*	0.008
Age	0.985***	0.001
White	1.125***	0.029
Realhouseholdtotincome	0.999**	0.000
Married	0.833***	0.018
Living_situation	0.996	0.007
Numberofchildren	1.000	0.004
Base-health	1.103***	0.012
Obese	1.005	0.024
Base-BMI	1.008***	0.002
Hosp	0.993	0.015
Selfreportedhealth	1.168***	0.012
Howmanydisease	1.069***	0.007
Health_limited	1.192***	0.022
Worse_health	1.240***	0.022
Drink	1.062***	0.020
Smoke	1.037	0.025
Jobstressdum	1.325***	0.042
Jobphysdum	1.091***	0.037
Rtenure	0.996**	0.001
Runemployed	1.276***	0.051
Lessthan-hs	1.033**	0.029
Hs-grad	1.003	0.027
Collegeplus	0.999	0.039
N	72.822	

**** p<0.01 ** p<0.05 * p<0.10*

Cox regression results for men are shown in Table 4.4 above. Results are almost similar to Cox regression results for all. Nevertheless, it is possible to see the differences in some variables in detailed examination. According to table 4.4., annual working hours has the coefficient of 0.986 (S.E:0.008). It means that having long working hours significantly reduces the likelihood of restless sleep in men. This conclusion is because of overworking causes more fatigue and therefore deep sleep.

Contrary to the cox regression result for female, marriage significantly reduces the probability of restless sleep in male, with the coefficient of 0.986 (S.E:0.008). Therefore, it can be clearly stated that there is a statistically significant correlation between being married and restless sleep in men.

On the other hand, the probability of restless sleep increases in men as the reported health status worsens.There is a statistically significant correlation between the health status reported by the respondent and restless sleep, with a coefficient of 1.168 (S.E 0.012) in men. It means that the higher the coefficient value the worse the person's health condition is, so the worsening of health condition increases the likelihood of sleep distress (Self-reported health 1-excellent and 5-poor).

Table 4.5: Cox Regression Results With Hour Dummies For All

	Coeeficient	S.E
Working Hours is between 35 and 40h[1]	0.890***	0.020
Working Hours is between 41 and 48h[2]	0.857***	0.029
Working Hours is between 49 and 54h[3]	0.846***	0.029
Working Hours is 55h+[4]	0.873***	0.029
Age	0.981***	0.000
White	1.147***	0.017
Realhouseholdtotincome	0.999***	0.000
Married	0.886****	0.010
Living stuation	0.985***	0.004
Numberofchildren	1.001	0.002
Base-health	1.098***	0.007
Obese	1.032**	0.014
Base-BMI	1.002*	0.001
Hosp	0.990	0.009
Selfreported health	1.158***	0.007
Howmanydisease	1.059***	0.004
Health-limited	1.112***	0.011
Worse-health	1.223***	0.012
Drink	1.047***	0.011
Smoke	1.016	0.014
Jobstressdum	1.333***	0.026
Jobphysdum	1.064***	0.021
Rtenure	0.996***	0.000
Runemployed	1.112***	0.028
Lesthan-hs	1.086***	0.018
Hs_grad	1.076***	0.017
Collegeplus	0.922***	0.024
N	178.095	

**** p<0.01 ** p<0.05 * p<0.10*

[1]Have you worked 35 and 40h in a week? 1means yes.

[2]Have you worked 41 and 48h in a week? 1 means yes.

[3]Have you worked 49 and 54 h in a week? 1 means yes.

[4]Have you worked 55h+ in a week? 1 means yes.

Since we examined the correlation between working hours and sleep, we determined the dummies as working hours is between 35 and 40h, between 41 and 48h, between 49 and 54h, 55 hours and more. Cox regression results with hour dummies for all are shown in Table 4.5 above. Accordingly, having working hours between 35 and 40h reduces the likelihood of restless sleep statistically with the coefficient of 0.890 coefficient (S.E:0.020). In other words, there is a statistically significant correlation between working 35 and 40 hours and sleep. Working between 41 and 48 hours , which has the coefficient of 0.857 (S.E:0.029), statistically reduces more the probability of restless sleep. As a result, a statistically significant correlation is observed between them. Similar results are observed when we look at the other dummy that working between 49 and 54 hours. According to this, working between 49 and 54 hours statistically decreases the probability of restless sleep with the coefficient of 0.846 (S.E:0.029). Morover working 55h+, which has the coefficient of 0.873 (S.E:0.029), significantly reduces the likelihood of restless sleep compared to working less than 35 hours. Therefore, it is clear that there is a statistically significant correlation between working hours dummies and sleep.

Table 4.6: Cox Regression Results With Hour Dummies For Women

	Coefficient	S.E
Working Hours is between 35 and 40h	0.920***	0.025
Working Hours is between 41 and 48h	0.936	0.041
Working Hours is between 49 and 54h	0.960	0.044
Working Hours is 55h+	0.960	0.044
Age	0.983***	0.000
White	0.143***	0.020
Realhouseholdtotincome	0.999*	0.000
Married	0.976	0.014
Living stuation	0.981***	0.005
Numberofchildren	0.999	0.003
Base-health	1.095***	0.009
Obese	1.010	0.017
Base-BMI	1.004***	0.001
Hosp	1.000	0.011
Selfreported health	1.165***	0.008
Howmanydisease	1.054***	0.005
Health-limited	1.094***	0.013
Worse-health	1.198***	0.014
Drink	1.089***	0.015
Smoke	1.037**	0.018
Jobstressdum	1.280***	0.031
Jobphsdum	1.061**	0.026
Rtenure	0.996**	0.001
Runemployed	1.072**	0.034
Lesthan-hs	1.123***	0.023
Hs_grad	1.099***	0.021
Collegeplus	0.902***	0.031
N	105.273	

**** p<0.01 ** p<0.05 * p<0.10*

Cox regression results with hour dummies for women are shown in Table 4.6 above. According to results, working between 35 and 40 hours, which has 0.920 coefficient (S.E:0.025), reduces the likelihood of restless sleep statistically compared to working less than 35 hours for women. In other words, there is a statistically significant correlation between them. Similarly, working between 41 and 48h, which has the coefficient of 0.936 (S.E:0.041), reduces the probability of restless sleep. Nevertheless, this result is only observed for observation sample ,that is, not significant. The similar results are also observed for other hour dummies because of women are less involved in jobs that has overtime hours.

Table 4.7: Cox Regression Results With Hour Dummies For Men

	Coefficient	S.E
Working Hours is between 35 and 40h	0.868***	0.034
Working Hours is between 41 and 48h	0.831***	0.044
Working Hours is between 49 and 54h	0.822***	0.044
Working Hours is 55h+	0.892**	0.043
Age	0.985***	0.001
White	1.125***	0.029
Realhouseholdtotincome	0.999**	0.000
Married	0.832***	0.018
Living stuation	0.997	0.007
Numberofchildren	1.000	0.004
Base-health	1.103***	0.012
Obese	1.004	0.024
Base-BMI	1.008***	0.002
Hosp	0.993	0.015
Selfreported health	1.168***	0.012
Howmanydisease	1.068***	0.007
Health-limited	1.187***	0.022
Worse-health	1.240***	0.022
Drink	1.062***	0.020
Smoke	1.035	0.025
Jobstressdum	1.356***	0.043
Jobphsdum	1.097***	0.037
Rtenure	0.997*	0.001
Runemployed	1.266***	0.051
Lesthan-hs	1.034	0.029
Hs_grad	1.003	0.027
Collegeplus	0.998	0.039
N	72.822	

**** p<0.01 ** p<0.05 * p<0.10*

Cox regression results with hour dummies for men are shown in Table 4.7 above. With the reference to these results, working between 35 and 40 hours with coefficient of 0.868 (S.E:0.034) reduces the likelihood of restless sleep statistically significant compared to working less than 35 hours or not working.

Similarly, working between 41 and 48h ,which has the coefficient of 0.831 (S.E:0.044), statistically reduces the probability of restless sleep compared to working less than 35 hours. Furthermore, this correlation is statistically significant.

Likewise, working between 49 and 54hours statistically decreases the likelihood of restless sleep with the coefficient of 0.822 (S.E:0.044) compared to working less than 35 hours. As a result, there is a statistically significant relation between them.

Based on these evidence, we can conclude that long working hours reduce the likelihood of restless sleep in men. To explain this situation, it is possible to say that men have long working hours and therefore fatigue that is caused by overwork reduces the possibility of having sleep distress.

Table 4.8: Panel Regression Results For All

	Coefficient	S.E
Inyearlyhourswo	0.004	0.008
Age	0.039***	0.001
White	0.312***	0.027
Realhouseholdtotincome	-0.000	0.000
Married	-0.199***	0.020
Living_situation	0.014*	0.007
Numberofchildren	0.000	0.004
Base-health	0.348***	0.012
Obese	0.019	0.023
Base-BMI	-0.008***	0.002
Hosp	0.035**	0.016
Selfreportedhealth	0.248***	0.009
Howmanydisease	0.122***	0.007
Health_limited	0.286***	0.017
Worse_health	0.408***	0.017
Drink	0.032*	0.017
Smoke	0.013	0.025
Jobstressdum	0.362***	0.026
Jobphysdum	0.040	0.028
Rtenure	-0.002*	0.001
Runemployed	0.127***	0.044
Lessthan-hs	0.376***	0.030
Hs-grad	0.192***	0.027
Collegeplus	-0.136***	0.040
N	194,971	

**** p<0.01 ** p<0.05 * p<0.10*

Panel regression results for all are shown at Table 4.8 above. According to this results, being married decreases the likelihood of having restless sleep , with a coefficient of -0.199 (S.E:0.020). Total household income , which has the coefficient of -0.000(S.E:0.000), has correlation with restless sleep but this relation is only based to observation sample. On the other hand, person's job start date has relationship with sleep. Accordingly, an increase in a person's tenure , which has the coefficient of -0.002 (S.E:0.001), reduces the probability of having restless sleep. Similary, having college degree or more than 16 years of education reduces the likelihood of having restless sleep, with the coefficient of -0.136 (S.E:0.040).

However, the deterioration of the person's reported health condition, which has the coefficient 0.248 (S.E:0.009), increases the probability of having restless sleep. Being white, number of living chidren, being obese, number of disease and other variables are increased the likelihood of having restless sleep.

Table 4.9: Panel Regression Results For Female

	Coefficient	S.E
Inyearlyhourswo	0.015	0.011
Age	-0.36***	0.001
White	0.328***	0.035
Realhouseholdtotincome	-0.000	0.000
Married	-0.095***	0.026
Living_situation	0.008	0.009
Numberofchildren	-0.006	0.006
Base-health	0.346***	0.016
Obese	0.011	0.029
Base-BMI	-0.002	0.003
Hosp	0.061***	0.020
Selfreportedhealth	0.254***	0.012
Howmanydisease	0.107***	0.009
Health_limited	0.251***	0.021
Worse_health	0.368***	0.021
Drink	0.077***	0.022
Smoke	0.046	0.033
Jobstressdum	0.281***	0.035
Jobphysdum	0.038	0.037
Rtenure	-0.003*	0.001
Runemployed	0.073	0.058
Lessthan-hs	0.414***	0.038
Hs-grad	0.207***	0.034
Collegeplus	-0.136***	0.055
N	116.736	

**** p<0.01 ** p<0.05 * p<0.10*

Panel regression results for females are shown in Table 4.9 above. As we can see in the regression results, annual working hours have a positive effect on the likelihood of restlessness in sleep. However, age, marriage, obesity negatively affect the possibility of sleep restlessness in women. Other independent variables have similar results to panel regression for all.

Table 4.10: Panel Regression Results For Male

	Coefficient	S.E
Inyearlyhourswo	-0.002	0.012
Age	-0.038***	0.001
White	0.275***	0.044
Realhouseholdtotincome	-0.000*	0.000
Married	-0.277***	0.020
Living_situation	0.024**	0.012
Numberofchildren	0.006	0.007
Base-health	0.353***	0.019
Obese	-0.012	0.037
Base-bmı	-0.007	0.004
Hosp	0.006	0.026
Selfreportedhealth	0.247***	0.015
Howmanydisease	0.143***	0.012
Health_limited	0.362***	0.028
Worse_health	0.464***	0.028
Drink	0.027	0.028
Smoke	0.016	0.038
Jobstressdum	0.461***	0.041
Jobphysdum	0.062	0.045
Rtenure	-0.000	0.001
Runemployed	0.264***	0.066
Lessthan-hs	0.335***	0.047
Hs-grad	0.122***	0.044
Collegeplus	-0.005	0.060
N	78.235	

**** p<0.01 ** p<0.05 * p<0.10*

Panel regression results for men are shown in Table 4.10. According to the results, annual working hours negatively affect sleep restlessness in men. In addition, age, being married, obese and having more than 16 years of education

negatively affect sleep.However, worse health, alcohol and smoke have a positive effect on the likelihood of restlessness in sleep.

5.CONCLUSION

In modern societies, people have to work and produce in order to survive. The level of prosperity that mankind has reached now is at the highest level in history. The basic point that enables to reach this level of prosperity is production. Increasing production opportunities with the developing technology and the wild nature of capitalism push people to work harder each day to produce more than the previous day. Given this structure of modern society, the lives of workers who earn money by selling their labor cannot be considered independent of working conditions.

Working hours are the most influential factor on human life in working life because the longer work means the more return. And generating more income provides more comfortable and better living opportunities. That is why people endure working hours that are definite or indefinite in various business lines, in line with their choices. On the other hand, the time a person spends on working is very influential on factors such as one's health and good living conditions.

In this study, the relationship between sleep and working hours is investigated, as it covers a significant period of human life and has an important effect on individual health and life. It is well known that the sleep quality of individuals is affected by many variables and that sleep quality has an important effect on human life, especially human health.

In the study, it is seen that the effects of many factors such as income level, social status, education, social and physical environment as well as working hours on sleep quality are discussed. In this context, it is seen that a longitudinal data set is needed to see the change in the sleep quality of individuals, and the national representative data set Health and Retirement Study (HRS) is used to meet this need.

Moreover, so far, no other study has been found in the literature examining the relationship between working time and sleep with a national data (HRS) for individuals living in the United States. Data from HRS were tested using various econometric methods such as panel regression, mainly Cox regression.

In the Cox regression model, independent variables such as the individual's annual working hours, gender, age, smoke, alcohol consumption, self-reported health status, employment status, obesity (overweight), and educational status were used. In addition, hour dummies (35-40h, 41-48h, 49-54h and 55+) were used to see the effects of working hours on the likelihood of having restless sleep in detail. The effects of these independent variables on the probability of restlessness of sleep, which is the dependent variable, were analyzed using Cox regression model. In the analyzes made in the study, the effects were divided by gender and tested separately for men and women. The main reason for dividing the analysis by gender is that there is a risk of developing sleep restlessness in women and men with different possibilities.

STATA gives results at 95% confidence interval for regression analysis. According to Cox regression results for all, we concluded that working hours decrease the probability of experiencing sleep restlessness. Variables such as marriage, age, total household income, education level of more than 16 years, tenure in a person's current job are effective factors in reducing the likelihood of sleep restlessness. Despite this, worsening of health, less than 16 years of education, more stress or physical strength required for work, smoking and alcohol, and obesity variables increase the possibility of sleep restlessness. Additionally, similar results are seen when examining separate analyzes for male and female observation groups.

For the Cox regression with hour dummies, the hour dummies were examined as working 35-40 hours, 41-48 hours, 49-54 hours and 55+ hours per week. Hour dummies is compared to less than 35 hours a week or not working at all. Accordingly, working between 35 and 40 hours a week reduces the likelihood of sleep restlessness compared to working for less than 35 hours or not at all. Similarly, other hour dummies reduce the likelihood of sleep restlessness compared to working for less than 35 hours or not working at all. The reason for this is that working more hours causes more fatigue in individuals and therefore deeper sleep. Consequently, the person experiences less restlessness in sleep. Separate analyzes for groups of women and men have similar results as for all. According to our results, long working hours reduce the possibility of an individual to experience

sleep restlessness. In other words, fatigue caused by long working hours causes deeper sleep and therefore restlessness during sleep.

Our results are statistically significant. Due to the importance of the subject, it is essential to keep the subject alive and to research more in future studies.

REFERENCES

Afonso, P., Fonseca, M., & Pires, J. F. (2017). Impact of working hours on sleep and mental health. Occupational Medicine, 67(5), 377-382.

Ayas, N. T., White, D. P., Manson, J. E., Stampfer, M. J., Speizer, F. E., Malhotra, A., & Hu, F. B. (2003). A prospective study of sleep duration and coronary heart disease in women. Archives of internal medicine, 163(2), 205-209.

Baglioni, C., Battagliese, G., Feige, B., Spiegelhalder, K., Nissen, C., Voderholzer, U., ... & Riemann, D. (2011). Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies. Journal of affective disorders, 135(1-3), 10-19.

Bannai, A., Ukawa, S., & Tamakoshi, A. (2015). Long working hours and sleep problems among public junior high school teachers in Japan. Journal of occupational health, 15-0053.

Baltagi, B. H. (Ed.). (2015). The Oxford handbook of panel data. Oxford Handbooks.

Basner, M., & Dinges, D. F. (2018). Sleep duration in the United States 2003–2016: first signs of success in the fight against sleep deficiency?. Sleep, 41(4), zsy012.

Basner, M., Fomberstein, K. M., Razavi, F. M., Banks, S., William, J. H., Rosa, R. R., & Dinges, D. F. (2007). American time use survey: sleep time and its relationship to waking activities. Sleep, 30(9), 1085-1095.

Biddle, J. E., & Hamermesh, D. S. (1990). Sleep and the Allocation of Time. Journal of Political Economy, 98(5, Part 1), 922-943.

Buysse, D. J. (2014). Sleep health: can we define it? Does it matter?. Sleep, 37(1), 9-17.

Cappuccio, F. P., Taggart, F. M., Kandala, N. B., Currie, A., Peile, E., Stranges, S., & Miller, M. A. (2008). Meta-analysis of short sleep duration and obesity in children and adults. Sleep, 31(5), 619-626.

Chatzitheochari, S., & Arber, S. (2009). Lack of sleep, work and the long hours culture: evidence from the UK Time Use Survey. Work, Employment and Society, 23(1), 30-48.

Cox, D. R. (1972). Regression models and life-tables. Journal of the Royal Statistical Society: Series B (Methodological), 34(2), 187-202.

Davis, D. E., Colten, C. E., Nelson, M. K., Saikku, M., & Allen, B. L. (2006). Southern United States: an environmental history. ABC-CLIO.

Ferrie, J. E., Shipley, M. J., Akbaraly, T. N., Marmot, M. G., Kivimäki, M., & Singh-Manoux, A. (2011). Change in sleep duration and cognitive function: findings from the Whitehall II Study. Sleep, 34(5), 565-573.

Fisher, G. G., & Ryan, L. H. (2018). Overview of the health and retirement study and introduction to the special issue. Work, aging and retirement, 4(1), 1-9.

Gangwisch, J. E., Heymsfield, S. B., Boden-Albala, B., Buijs, R. M., Kreier, F., Pickering, T. G., ... & Malaspina, D. (2006). Short sleep duration as a risk factor for hypertension: analyses of the first National Health and Nutrition Examination Survey. hypertension, 47(5), 833-839.

Ge, B., & Guo, X. (2015). Short and long sleep durations are both associated with increased risk of stroke: a meta-analysis of observational studies. International Journal of Stroke, 10(2), 177-184.

Gujarati, D. N. (2009). Basic Econometrics. Tata McGraw-Hill Education.

Greene, William H. 2003. Econometric Analysis. Prentice Hall.

Hafner, M., Stepanek, M., Taylor, J., Troxel, W. M., & Van Stolk, C. (2017). Why sleep matters—the economic costs of insufficient sleep: a cross-country comparative analysis. Rand health quarterly, 6(4).

Hale, L. (2005). Who has time to sleep?. Journal of Public Health, 27(2), 205-211.

Hall, M. H., Muldoon, M. F., Jennings, J. R., Buysse, D. J., Flory, J. D., & Manuck, S. B. (2008). Self-reported sleep duration is associated with the metabolic syndrome in midlife adults. Sleep, 31(5), 635-643.

Härmä, M., Karhula, K., Puttonen, S., Ropponen, A., Koskinen, A., Ojajärvi, A., & Kivimäki, M. (2019). Shift work with and without night work as a risk factor for fatigue and changes in sleep length: A cohort study with linkage to records on daily working hours. Journal of sleep research, 28(3), e12658.

Hoevenaar-Blom, M. P., Spijkerman, A. M., Kromhout, D., van den Berg, J. F., & Verschuren, W. M. (2011). Sleep duration and sleep quality in relation to 12-year cardiovascular disease incidence: the MORGEN study. Sleep, 34(11), 1487-1492.

Hublin, C., Partinen, M., Koskenvuo, M., & Kaprio, J. (2007). Sleep and mortality: a

population-based 22-year follow-up study. Sleep, 30(10), 1245-1253.

Johnson, D. H. (1999). The insignificance of statistical significance testing. The journal of wildlife management, 763-772.

Khubchandani, J., & Price, J. H. (2020). Short sleep duration in working American adults, 2010–2018. Journal of community health, 45(2), 219-227.

Kim, B. H., & Lee, H. E. (2015). The association between working hours and sleep disturbances according to occupation and gender. Chronobiology international, 32(8), 1109-1114.

Kim, T. K. (2015). T-test as a parametric statistic. Korean journal of anesthesiology, 68(6), 540.

Knutson, K. L., Van Cauter, E., Rathouz, P. J., DeLeire, T., & Lauderdale, D. S. (2010). Trends in the prevalence of short sleepers in the USA: 1975–2006. Sleep, 33(1), 37-45.

Krueger, P. M., & Friedman, E. M. (2009). Sleep duration in the United States: a cross-sectional population-based study. American journal of epidemiology, 169(9), 1052-1063.

Lombardi, D. A., Wirtz, A., Willetts, J. L., & Folkard, S. (2012). Independent effects of sleep duration and body mass index on the risk of a work-related injury: evidence from the US National Health Interview Survey (2004–2010). Chronobiology international, 29(5), 556-564.

Magee, C. A., Iverson, D. C., & Caputi, P. (2009). Factors associated with short and long sleep. Preventive medicine, 49(6), 461-467.

Messenger, J. C., Lee, S., & McCann, D. (2007). Working time around the world: Trends in working hours, laws, and policies in a global comparative perspective. Routledge.

Nakashima, M., Morikawa, Y., Sakurai, M., Nakamura, K., Miura, K., Ishizaki, M., ... & Nakagawa, H. (2011). Association between long working hours and sleep problems in white-collar workers. Journal of sleep research, 20(1pt1), 110-116.

National Sleep Foundation. International Bedroom Poll. 2013. As of 28 November 2016: https://sleepfoundation.org/sleep-polls-data/other-polls/2013-international-bedroom-poll

Ohtsu, T., Kaneita, Y., Aritake, S., Mishima, K., Uchiyama, M., Akashiba, T., ... & Ohida, T. (2013). A Cross-sectional Study of the Association between Working Hours and Sleep Duration among the Japanese Working Population. Journal of occupational health, 55(4), 307-311.

Özdamar, K. (1999). SPSS'le Biyoistatistik. Kaan Kitapevi, Eskişehir, 1.

Philip, P., Chaufton, C., Orriols, L., Lagarde, E., Amoros, E., Laumon, B., ... & Sagaspe, P. (2014). Complaints of poor sleep and risk of traffic accidents: a population-based case-control study. PloS one, 9(12), e114102.

Pohlman, J. T., & Leitner, D. W. (2003). A comparison of ordinary least squares and logistic regression.

Poole, M. A., & O'Farrell, P. N. (1971). The assumptions of the linear regression model. Transactions of the Institute of British Geographers, 145-158.

Schiller, H., Lekander, M., Rajaleid, K., Hellgren, C., Åkerstedt, T., Barck-Holst, P., & Kecklund, G. (2017). The impact of reduced worktime on sleep and perceived stress–a group randomized intervention study using diary data. Scandinavian journal of work, environment & health, 109-116.

Sheehan, C. M., Frochen, S. E., Walsemann, K. M., & Ailshire, J. A. (2019). Are US adults reporting less sleep?: Findings from sleep duration trends in the National Health Interview Survey, 2004–2017. Sleep, 42(2).

Swanson, L. M., Arnedt, J. T., Rosekind, M. R., Belenky, G., Balkin, T. J., & Drake, C. (2011). Sleep disorders and work performance: findings from the 2008 National Sleep Foundation Sleep in America poll. Journal of sleep research, 20(3), 487-494.

Twenge, J. M., Hisler, G. C., & Krizan, Z. (2019). Associations between screen time and sleep duration are primarily driven by portable electronic devices: Evidence from a population-based study of US children ages 0–17. Sleep medicine, 56, 211-218.

Van Dongen, P. A., Baynard, M. D., Maislin, G., & Dinges, D. F. (2004). Systematic interindividual differences in neurobehavioral impairment from sleep loss: evidence of trait-like differential vulnerability. Sleep, 27(3), 423-433.

Virtanen, M., Ferrie, J. E., Gimeno, D., Vahtera, J., Elovainio, M., Singh-Manoux, A., ... & Kivimäki, M. (2009). Long working hours and sleep disturbances: the Whitehall II prospective cohort study. Sleep, 32(6), 737-745.

Web (2019). https://hrs.isr.umich.edu (Erişim Tarihi: 16.11.2020)

Yaggi, H. K., Araujo, A. B., & McKinlay, J. B. (2006). Sleep duration as a risk factor for the development of type 2 diabetes. Diabetes care, 29(3), 657-661.

Yong, L. C., Li, J., & Calvert, G. M. (2017). Sleep-related problems in the US working population: prevalence and association with shiftwork status. Occupational and environmental medicine, 74(2), 93-104.

BIOGRAPHY

Sevgi Biter was born in Diyarbakır in 1993. She graduated from Sakarya University, Department of Labor Economics and Industrial Relations in 2015. She started her Master of Economics program in Gebze Technical University in 2018.