Middle Managers and Employee Health*

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September, 2023

Abstract

Health management is an important way to promote employee productivity within organizations. However, little is known about the impact of health management within workplace, particularly the role of managers on subordinates' health. By taking advantage of the periodic transfer of employees at a large-scale listed firm in Japan, this study identifies the contribution of middle managers to subordinates' hours of overtime work, and eventually their health outcomes. Our analyses reveal that manager-driven overtime work affects stress level of male employees in non-managerial track. These employees also report a higher frequency of physical ailment symptoms such as headache, stiff shoulder, and backache. No impact was detected on healthy habits of employees. Interestingly, we also observed opposing impacts on the risk of metabolic syndrome between men and women. Results in this study call for a need to design health support programs customized by gender and career track, in order to accommodate health-related risks induced by extra overtime work.

Keywords: overtime work; periodic transfer of employees; health management; value-added.
JEL Classification Code: J24, M12, M50.

*The analysis using the personnel records was conducted following an agreement approved by Japan Productivity Center, Ewel, Inc., Waseda and Doshisha Universities. The authors are grateful to Yoko Asuyama, Wouter Dessein, Akifumi Ishihara, Hiro Ishise, Hiroyuki Kasahara, Toru Kitagawa, Desmond Lo, Ruo Shangguan, Kohei Takahashi, Katsuya Takii, Mari Tanaka, Kensuke Teshima, Ken Yamada, Xuanli Zhu, and participants at Kyoto Summer Workshop on Applied Economics 2023 and Organizational Economics Conference 2023 for their comments and suggestions. Authors acknowledge research grants from Japan Productivity Center, Ewel, Inc., Waseda and Doshisha Universities, JSPS Grant-in-Aid for Scientific Research (#18H03632, #22H00858), etc. Finally, authors would like to sincerely thank the anonymous listed firm and their HR team for providing us with their internal data and consistent support to our study.

1 Introduction

Health management is an important way to promote employee productivity within organizations. Studies have shown the effectiveness of health management programs outside of the workplace, such as incentive plans or benefits, in developing healthy habits among employees.[1] However, much less is known about the impact of health management *within* their workplace, particularly the role of managers on subordinates' health.

This study investigates the contribution of middle managers to subordinates' hours of overtime work, and eventually their health outcomes. To serve this purpose, we take advantage of the periodic rotations of managers at a large-scale listed firm in Japan across divisions. Frequent rotations, along with detailed monthly work hour information, allow us to disentangle the manager's contributions to the subordinates' overtime work, including the hours worked on holidays/weekend and during night. We follow the value-added approach and estimate manager-specific effects in the monthly-level subordinate panel model. We then test the impact of allocating the managers with a higher contribution on longer overtime working hours to their subordinates' health outcomes.

Our analyses show that managers play a significant role in determining the subordinates' overtime work. By replacing the managers with estimated overtime contribution at top 5th percentile with those at bottom 5th percentile, one can reduce the overtime work by 11.1 hours per month (Table 1 and Figure 1). To test the exogeneity of the allocation of managers, we also estimated an event study model with the subordinate-month panel data. We found that the allocation of managers with specific overtime tendency had little economically significant explanatory power on the subordinates' hours of overtime work prior to the manager transfer (Figure 2). Importantly, managers affected the subordinates' mental health, particularly stress level of male employees in non-managerial track. Those male subordinates assigned to the manager with a higher overtime contribution tended to report heavier burden at their work and a higher stress level (Table 5). They also reported a higher frequency of physical ailment symptoms related to heavy desk work, such as headache, stiff shoulder, and backache (Table 6). In the current version of the analysis, we did not find any significant impacts of manager-driven overtime work on health-related habits of employees, including smoking, snacking, drinking, exercising, etc (Table

[1] For instance, Royer et al. (2015) found that the incentive designs with employee's own commitments helped them developing workout habits in the long run.

4). Thus, managers affect employees' work schedule, and for some employees, physical symptoms and stress level, however, no impact was detected on their health-related behaviors. Our analyses also reveal an important gender gap in the impact on the biomarker for metabolic risk. In particular, manager-driven overtime work is associated with lower probability of being diagnosed with large abdomen for men in management track, while it is associated with *higher* risk of large abdomen for women in non-management track (Table 3).

This study intends to contribute to the several streams of literature. First, we add new evidence to understand the roles of middle managers within organizations. Several studies report that good managers significantly increase the productivity of the supervised workers or units (Uehara et al., 2013; Lazear et al., 2015; Kuroda and Yamamoto, 2018; Hoffman and Tadelis, 2021; Metcalfe et al., 2023). Although the variations in middle managers' quality are occasionally ascribed to specific management skills or personality such as communication skills and integrity (Kuroda and Yamamoto, 2018; Hoffman and Tadelis, 2021), how differently they actually manage remains an open question. We provide a new aspect of how middle managers matter by showing that there is a quite large variation in their managing styles in terms of their contribution to employees' working hours.

Second, our study sheds light on a crucial pathway through which middle managers impact employee well-being. We achieve this by examining the relationship between employee health outcomes and the estimated fixed effects of managers. Previous research in the field of middle manager studies has consistently shown that employees are more likely to leave their positions when they have poor managers (Kuroda and Yamamoto, 2018; Hoffman and Tadelis, 2021), Therefore, it is reasonable to anticipate that middle managers have an influence on employee well-being. It has been documented that workers' job satisfaction or mental health deteriorates when they report to managers with poor technical knowledge or communication skills (Artz et al., 2017; Kuroda and Yamamoto, 2018). Our research takes a step further by exploring the mechanism behind this phenomenon. We delve into how managerial patterns impact employee well-being after accounting for variations in managers' skills and personalities, which ultimately result in different labor management approaches. Our unique setting enables us to identify the consequences of middle managers' management on employee well-being, utilizing comprehensive and objective health status information from the company's annual health check records, which are recorded by occupational health experts.

Third, we also contribute to the literature taking the value-added approach. Previous studies have estimated the value-added of school teachers and university professors on their students' outcomes (Chetty et al., 2014; Kikuchi and Nakajima, 2016, etc.), the value-added of CEOs on their firms' performance (Bertrand and Schoar, 2003), and the value-added of bosses in the workplace (Uehara et al., 2013; Lazear et al., 2015; Benson et al., 2019). Our study offers a new example of the value-added approach by estimating the "value-added" of middle managers in terms of their subordinates' hours worked overtime, on the night shift, and on holidays. It is also noted that our usage of the value-added estimates for another regression can be applied in a wide range of contexts, especially in the field of insider econometrics. As far as we are aware, this study is the first to apply the value-added framework to estimate the manager's contribution to their subordinates' health.

Lastly, our study also provides new insights on the health management for organizations, particularly on the stress management of their employees and its role of managers. We found that those employees assigned to managers with high overtime work contribution tend to express the heavier burden at workplace and to report a higher stress level. In addition, our research is also related to the literature on work hours and worker well-being (e.g., Kuroda and Yamamoto (2019); Sato et al. (2020)). The possibility that long working hours may have a negative impact on workers' mental and physical health and productivity has been reported in several previous studies.[2] However, since many of the previous studies have used workers' actual working hours for their estimates, the question of who determines the length of actual working hours has not always been adequately discussed. For example, some workers may work long hours of their own volition. On the other hand, some workers may be forced to work long hours because they are assigned to a division or job that requires them to work long hours or because they work for a workaholic boss. In the former case, long working hours may be the result of the worker's voluntary actions and may not be detrimental to wellbeing. A novel contribution of this paper's approach is that it not only controls for individual worker preferences for longer working hours Oshio et al. (2015); Kuroda and Yamamoto (2019); Sato et al. (2020, etc.) and division fixed effects, but also uses matching information between subordinates and supervisors to identify supervisors

[2]for example, recent studies include Virtanen et al. (2011), Virtanen et al. (2012), Oshio et al. (2015), Kuroda and Yamamoto (2019), Sato et al. (2020) for mental health; Pencavel (2015) for productivity; see also Virtanen et al. (2018) for review and meta-analysis of prospective cohort studies from 35 countries.

who make their subordinates to work longer hours. In this way, we examine the negative effects of long working hours by examining the wellbeing of subordinates who are forced to work long hours using multiple indicators.

2 Institutional Context and Data

2.1 The Firm, Periodic Transfer, and Data Overview

This study combines several confidential personnel records from an anonymous large-scale listed firm in Japan ("the firm", hereafter). Due to the agreement with the firm, we are unable to disclose the exact characteristic of the firm. Some of the publicly available information indicate that the nature of the firm's working environment is superior to those of other listed firms in Japan.[3]

The dataset are available either on a monthly or annual basis, covering the period from April 2015 to April 2021. We begin by using monthly attendance records to estimate the manager's contribution to the working schedule of their subordinates, including their overtime work. We identify a manager for each full-time employee at a given month by combining the rotation records of all employees.[4] Rotations take place two to three times a year, typically in April, October or February. It should be noted that all regular employees including both managers and subordinates are subject to periodic transfers. An average employee stayed in the same division for approximately 22.4 months and worked for the same manger for 17.4 consecutive months. An average manager was responsible to supervise 5.7 subordinates at a given time.

In our main analyses, we divide our subordinate samples by gender and two types of career track offered at the firm, Management and Expert Tracks. In Management Track, employees engage in a wide range of experiences at an early stage of their career. Employees in this track are expected to take charge of management-related tasks in the future. In Expert Track, employees specialize in their selected fields. Employees in this track are expected to develop specialized skills to support the management in the future. Due to a small sample size, we do not present the estimation results for female subordinates in Management Track.

[3]In particular, the firm constantly locates in a upper tail of the overall distribution in their health management ranking, which is administered by Japanese Ministry of Economy, Trade and Industry.

[4]In the final dataset, we identified one middle manager within each division. When we observed two or more workers in a managerial position within the same division, we identify one manager by the salary rank, length of tenure at the firm, and years of manager experience.

Finally, we draw on the annual health checkup and stress check records to examine the impact of managers' assignments on their subordinates' health status. We divide our outcome variables into four groups: (1) biomarker, (2) healthy habits, (3) stress measurements, and (4) physical symptoms. We provide detailed explanations on each of these groups in the following subsections. Unfortunately, no comparable information is available to measure productivity or performance level of the individual employees across different divisions in our datasets. Due to the agreement with the firm, we are unable to disclose the summary statistics for the employee outcomes.

2.2 Biomarker

This study draws on biomarkers collected during health check-up examinations in order to examine several physiological risk factors associated with chronic conditions. Specifically, the health check-up records contain detailed anthropometric information and clinical data obtained from blood samples. The first factor is being overweight, which refers to individuals having a body mass index (BMI) of 25 or higher. Having a high BMI increases the chances of developing cardiovascular diseases, stroke, diabetes, and musculoskeletal disorders (Ng et al., 2014). In addition to height and weight, abdominal circumference is measured during the check-ups. A large abdominal circumference is an indicator of excessive abdominal fat. For men, a large abdomen is defined as a circumference over 85cm, while for women, it is defined as a circumference over 90cm.

The second factor is hypertension, a well-known cause of life-threatening complications like heart attacks, strokes, kidney failure, and premature mortality (World Health Organization, 2013). In this study, the mean of three measurements is calculated using systolic blood pressure and diastolic blood pressure. A diagnosis of hypertension is given if the mean systolic blood pressure is 140 mmHg or higher, the mean diastolic blood pressure is 90 mmHg or higher, or if the individual is taking anti-hypertensive medication.

The third health condition examined in this study is dyslipidemia, which increases the risk of cardiovascular diseases. During the health check-ups, blood samples are collected to measure various components, including total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides. A diagnosis of dyslipidemia is given if an individual's total cholesterol is 260 mg/dL or higher, HDL cholesterol is 35 mg/dL or lower, LDL cholesterol is 180 mg/dL or higher, triglycerides are 300 mg/dL or higher, or if they are taking medication for reducing lipid levels. The final risk factor considered in this study is diabetes. To diagnose diabetes, biomarkers such as glycosylated hemoglobin (HbA1c) and fasting glucose levels are measured. An individual is diagnosed with diabetes if their HbA1c is 6.5% or higher, their fasting glucose level is over 125 mg/dL, or if they are taking medication for diabetes.

2.3 Healthy Habits

This study also uses information of employees' daily base health-related lifestyles. Individuals are asked standardized questions regarding their lifestyles during annual check-ups, which encompass physical activity, dietary habits, and sleep patterns.[5] These are associated with various health risks of non-communicable diseases (Swinburn et al., 2004; Akseer et al., 2020). To assess physical activity habits, two criteria are considered. Firstly, it examines whether individuals engage in daily walking for more than one hour. Secondly, it evaluates whether they have a regular exercise routine that involves light sweating for at least 30 minutes, at least twice a week, consistently for over a year. Dietary habits are evaluated based on several factors, including an individual's perception of eating meals at a faster pace compared to others, consuming dinner within two hours of bedtime more than three times a week, consuming snacks or sugary beverages between meals, and skipping breakfast more than three times a week. These eating behaviors are significant indicators of higher body mass (Nishitani et al., 2009).

Other health-related lifestyle practices are also assessed. Sleeping quality is evaluated based on individuals' self-reported satisfaction regarding whether they obtain sufficient sleep for restful purposes. Individuals report their alcohol consumption patterns as well as their current and past smoking status. Alcohol consumption is assessed by considering the frequency of drinking various types of alcohol, such as sake, beer, wine, whisky, or brandy. The smoking status category takes into account both the duration of smoking and the number of cigarettes smoked. An individual is classified as a regular smoker if they have smoked over 100 cigarettes in total or if

[5] According to the Industrial Safety and Health Law, employers are required to conduct annual health check-ups for their employees. These check-ups aim to detect potential diseases at an early stage and promote health-enhancing behaviors by regularly monitoring individuals' health. The costs associated with these health check-ups are covered by the employers.

they have been smoking for more than 6 months and have smoked in the past month. All these health-related lifestyle practices are binary variables. Additionally, the study considers individuals' motivation to improve their lifestyles. During check-ups, individuals are asked about their intent to improve their lifestyles. A binary variable is created based on whether they plan to make lifestyle improvements within six months or if they are already actively making efforts to improve their lifestyles.

2.4 Stress Measurements

This study examines the impact on employees' mental health. Occupational stress levels are determined by individuals' scores on the stress check test, which follows the guidelines developed by the Ministry of Health, Labour and Welfare (Ministry of Health, Labour & Welfare, 2016).[6] The study assesses both the physical and psychological burdens associated with occupational factors. Descriptions of each outcome are provided in Table 2. As a measure of job burdens, we consider self-assessed workloads in terms of quantity and quality, as well as the level of work-related strain. Additionally, this study explores individuals' psychological responses to their jobs, including aptitude, satisfaction, enthusiasm, frustration, and feelings of depression. These factors are evaluated using a five-point scale (Table 2). An individual is classified as highly stressed if their overall stress levels exceed the threshold specified in the guidelines.

To evaluate various aspects of mental health, stress levels are measured from multiple perspectives, including job-related stress, physical stress, exhaustion, and psychological stress. These stress levels are classified as high, somewhat high, or low, as shown in Table 2. The study also examines various psychosocial work environments, such as conducive working conditions, the degree of autonomy, and the effective utilization of specialized knowledge and skills. These factors are evaluated using a five-point or four-point scale, as outlined in Table 2. These assessments capture the occupational stress associated with specific tasks performed by individuals. For example, high job demands indicate a perceived heavy workload, and high job control refers to the

[6] A revision to the Industrial Safety and Health Law in 2015 mandates that companies and organizations with a workforce of 50 or more must perform an annual stress check. This assessment aims to evaluate the level of psychological burden experienced by employees. The Brief Job Stress Questionnaire (hereafter, the BJSQ) which consists of 57 standardized questions related to job stress, is highly recommended to firms by the Ministry of Health, Labour and Welfare for screening (Kawakami and Tsutsumi, 2016) and the company analyzed in this paper also uses the BJSQ to measure employee stress levels (Inoue et al., 2020; Kachi et al., 2020; Imamura et al., 2018).

level of freedom an individual has in deciding how they work. The detrimental effects of these occupational stresses on health have been reported in high-income countries (Marmot et al., 1997; Bosma et al., 1997; Stansfeld et al., 1998; Toker et al., 2012).

2.5 Physical Symptoms

The BJSQ includes various items on physical symptoms during the last month. Those include dizziness, joint pain, headaches, shoulder discomfort, back pain, eye strain, palpitations, gastrointestinal issues, poor appetite/diarrhea/constipation, and disrupted sleep. Employees are asked to self-assess the frequency of experiencing these physical symptoms in a four-point scale (ranging from almost never to almost always), with higher values indicating a greater frequency.

3 Estimating Models

This study estimates manager's contribution to the health status of employees in two steps. In the first step, we leverage monthly attendance records of employees' working hours to estimate the manager-specific effects on employees' working hours beyond their regular working schedule. In particular, we estimate the following outcome equation for employee i at month m with two-sided unobserved heterogeneity:

$$h_{im} = \alpha_i + \psi_{j(i,m)} + \theta_m + \delta_k + \epsilon_{im} \tag{1}$$

where h_{im} is the work hour outcome of employee i at month m,δ_k is a division-specific effect, α_i is an employee fixed effect, ψ_j is a manager effect and $(i,m) \longmapsto j(i,m)$ is a matching function defining the employee i's manager at month m. We also control for time-variant manager and employee characteristics, namely, their tenures and the polynomials. We use three outcome variables that describe the employees' irregular working schedules: total hours of overtime work, hours of night work, and hours worked on weekends and holidays. In estimating the manager effect, we identify groups of subordinates and managers that are connected by mobility of subordinates (Cornelissen, 2008). In the second step of our analysis, we exclude those observations which were not connected within the same group.[7]

In the second step, we examine the impact of managers on their subordinates' health status recorded every year. In the current version of the study, we estimate the following parsimonious model by including the estimated manager effect, $\widehat{\psi}_j$:

$$Y_{it} = a_i + \gamma\widehat{\psi}_{j(i,t)} + x'_{it}b + c_t + d_k + e_{it} \tag{2}$$

where Y_{it} is the health outcome of employee i at year t, x_{it} is a vector of time-varying individual characteristics, etc.

To identify these models, we need to ensure that the allocation of managers are random to the employee outcomes. Although this identification assumption is not directly testable, we investigate the exogeneity of manager assignment by checking whether those employees assigned to managers with high $\widehat{\psi}_j$ had the similar work hour outcomes prior to the assignment when compared against those otherwise similar employees assigned to managers with low $\widehat{\psi}_j$. To account for the staggered timings of manager assignments, we adopt stacked-by-event approach proposed by (Cengiz et al., 2019). Specifically, we created a dataset containing treated and untreated subordinates for each event h (e.g., manager rotation event in April 2019), then stacked all event-specific datasets to estimate the following equation:

$$h_{img} = \sum_{s=-w}^{w} \gamma^s I(event^s_{img}) + \alpha_{ig} + \theta_{mg} + delta_{kg} + \epsilon_{img} \tag{3}$$

where h_{img} is an hours worked variable for subordinate i in month m in dataset g. We take a window of eleven months, that is, five months before and after a new manager assignment (e.g., $w = 5$). The estimated treatment effects, $\hat{\gamma}^s$, compared the performance trajectories between the treated and untreated subordinates for $s > 0$. We tested the validity of the common trend assumption by examining the magnitude of the estimates of γ^s for $s \leq -1$.

[7]More than 99% of the original observations were identified to be connected within the same group.

4 Results

4.1 Manager-speficif Effects

Table 1 presents distribution of estimated manager effects $\hat{\psi}_j$ from equation (1). Figure 1 shows histograms for the estimated manager effects. In total, we identified fixed effects of 496 managers for three types of overtime outcomes: total hours of overtime work, hours nighttime work, and hours worked on weekends and holidays. At subordinate-level, we identified managers of approximately 67.9% of all observations in our sample.[8] According to variance decompositions, subordinate fixed effects (α_i) explain the highest variance of total hours of overtime work (0.634) while estimated manager fixed effects explain small proportion of overall variance (0.043).[9] Nonetheless, the estimated manager-effects suggest nontrivial impact of managers in shaping overtime work schedule of their subordinates. In particular, by replacing the managers with estimated overtime contribution at top 5th percentile with those at bottom 5th percentile, one can reduce the total hours of overtime by 11.1 hours per month. Similarly, by replacing the managers with estimated overtime contribution at top 10th percentile with those at bottom 10th percentile, one can reduce the total hours of overtime by 6.4 hours per month. On the other hand, we found small variations in the estimated manager effects for the other two variables, hours of nighttime work and hours worked on weekends and holidays (Table 1).

4.2 Exogeneity of Manager Allocation

An important identification assumption behind our main model is that manager allocation is exogenous to subordinates' initial tendency to overtime work and their health outcomes. To partially examine this assumption, we estimated an event study model in equation (3) by following stacked regression approach (Cengiz et al., 2019). We defined treatment and control groups based on our estimates of manager effect ($\hat{\psi}$) in equation (1). Specifically, we define high $\hat{\psi}_j$ managers

[8]We estimated a linear probability model to address any attrition concern in our main health outcome equation. In particular, we regressed an indicator of subordinates with unidentified managers on their predetermined characteristics such as age, gender, tenure, schooling etc. Although a majority of estimates are insignificant, we found that dummy variables to indicate degrees from graduate school or technical college had modestly significant and large positive estimates.

[9]We followed an approach in Netcalfe et al. (2023) to decompose the variance of total hours of overtime work. In particular, we took residuals of total hours of overtime work after regressing it on month-fiscal year dummies and polynomials of tenure. We then decomposed the variances in the residualized hours of overtime work.

if the estimated manager effect is above median; low $\hat{\psi}_j$ managers, otherwise. Figure 2 presents the estimated treatment effect, $\hat{\gamma}^s$, in equation (3). We observe significant and positive treatment effect on subordinates' hours of overtime work at least for five months after the new assignment. Importantly, we also observe insignificant and economically small treatment effect before the treatment period. Thus, subordinates in treatment and control groups had essentially same overtime work schedule prior to the manager assignment. On the other hand, we observe either small or noisy treatment effects for the case of hours of nighttime work and hours worked on weekends and holidays. This may arise due to small variations in the estimated manager effects, as shown in Table 1. In the following main analyses, we present the estimation results using the estimated manager effects on total hours of overtime work only.

4.3 Impact on Subordinate's Health

To examine the impact of manager allocation on employee health, we estimated equation (2) for four types of health outcomes: (1) biomarker, (2) healthy habits, (3) stress measurements, and (4) physical symptoms. Tables 3 to 6 show the estimation results for each of these outcome groups.

Table 3 estimates linear probability models with dummy variables indicating metabolic risks taken from several biomarkers. Our results reveal opposing effects of overtime work on metabolic risk between men and women. According to column 1, an allocation of manager with higher $\hat{\psi}_j$ is associated with lower probability of being diagnosed with large abdomen for men in Management Track, while it is associated with *higher* risk of large abdomen for women in Expert Track. The estimated effects are both statistically and economically significant. By replacing the managers with estimated overtime contribution at top 10th percentile with those at bottom 10th percentile, we reduce the risk of large abdomen by approximately 7.8 percentage points for men in Management Track while we increase the same risk by 20.6 percentage points for women in Expert Track.We also observe a significantly reduced risk of dyslipidemia for men in Expert Track. Table 7 estimates the same models by limiting observations to employees above 35 years old. We found similar but slightly large estimates for the impact on being diagnosed with large abdomen. Results here imply important gender gap in the impact of manager-driven overtime work.

Table 4 examines possible mechanism in which managers affect their subordinates health by promoting or preventing healthy habits outside of their workplace. In particular, we estimate linear probability models with dependent variables indicating specific health-related habits. It should be noted that data for healthy habits is available for employees above 35 years old only, due to the design of health checkup questionnaire. Results in Table 4 show no significant impact of manager-driven overtime work on these healthy habits. The estimated coefficients are overall small in magnitude. Thus, overtime work does not immediately affect employees health behavior outside of their workplace. The results here also assures that our estimation framework does not pick up a possible endogeneity concern, such that employees with specific health-related habits (e.g., smoking, drinking, exercising) could be selected into the workplace with managers with higher overtime work tendency.

Table 5 investigates the impact of manager-driven overtime work on employees' mental health, specifically on proxies of stress level taken from mandatory stress examination results. We estimate equation (2) with dependent variables replaced by categorical variables indicating the extent of subjective stress level (see Table 2). Our results indicate disproportionate mental effects on men in Expert Track. They report significant increases in job burden both in quality and quantity after being allocated to managers with higher overtime work contribution. They also report lower job satisfaction level and higher work stress. Estimates on work stress in column (5) suggests nontrivial impact of manger-driven overtime work in their work stress level. By replacing the managers with estimated overtime contribution at top 10th percentile with those at bottom 10th percentile, we reduce their stress level by 0.31 unit-scale in 3-likert scale stress score. On the other hand, we found that men in Management Track report smaller mental stress level when allocated to managers with higher $\hat{\psi}_j$.

Finally, we test whether an allocation of managers with greater overtime work tendency is associated with more frequent physical symptoms of subordinates. We present the estimation results in Table 6, where dependent variables are four-likert scale frequency of specific symptoms with a higher value indicating higher frequency. Again, we found that the negative impacts of manager-driven overtime work are concentrated among men in Expert Track. By increasing the manager-driven overtime work, men in Expert Track tend to report more frequent headache, stiff shoulder and backache. Importantly, these symptoms imply direct detriment of heavy desk work. We did not find any other significant impacts on other symptoms related to automatic nerve systems. No significant effect is detected on physical symptoms of men in Management Track and women in Expert Track.

5 Conclusion

Health management has attracted the interests of stakeholders of many organizations, given its potential to enhance employees well-being, and eventually firm profitability. However, little is known about the impact of health management within workplace, particularly the role of managers on subordinates' health. We investigated the role of managers in shaping their subordinates' health, by focusing on the mechanism via overtime work induced by specific managers. To pursue this purpose, we took advantage of periodic transfer of employees at a large-scale listed firm in Japan and identified manager-specific contributions to their subordinates' hours of overtime work. Frequent rotations, along with detailed monthly work hour information, allowed us to disentangle the manager ' s contributions to the subordinates ' overtime work. We followed value-added approach and estimated manager-specific effects in the monthly-level subordinate panel model. We then tested the impact of allocating managers with a higher contribution on longer overtime working hours to their subordinates' health outcomes. Mandated nature of some health programs in Japan enabled us to access to a comprehensive and comparable set of rich health outcomes, including biomarkes from blood test, stress level and self-evaluated measurements for daily health-related habits as well as physical ailment symptoms.

Our analyses show that managers matter to subordinates' hours of overtime work, and some health outcomes. Specifically, managers affected the subordinates' mental health, particularly stress level of male employees in non-managerial track. Those male subordinates assigned to the manager with a higher overtime contribution tended to report heavier burden at their work and a higher stress level. They also reported a higher frequency of physical ailment symptoms related to heavy desk work, such as headache, stiff shoulder, and backache. In the current version of the analysis, we did not find any significant impacts of manager-driven overtime work on health-related habits of employees, including smoking, snacking, drinking, exercising, etc. Thus, managers affect employees' work schedule, and for some employees, physical symptoms and stress level, however, no impact was detected on their health-related behaviors. Our analyses also reveal an important gender gap in the impact on the biomarker for metabolic risk. In particular, manager-driven overtime work is associated with lower probability of being diagnosed with large abdomen for men in management track, while it is associated with *higher* risk of large abdomen for women in non-management track.

Our study provides several managerial implications. First, we observed detrimental impact of manager-induced overtime work on stress level and physical symptoms, only among men in non-management track. Unfortunately, we do not know whether the higher stress level disturbed automatic nervous system and brought some physical symptoms, or vice versa, physical symptoms drove stress level high. Yet, our results implies the detrimental effect of extra long hours in front of the desk, as many of the employees in our dataset engage in desk work. Small exercise or massage programs within workplace may help them releasing physical symptoms at least. Second, we found opposing impacts on the risk of metabolic syndrome between men and women. In particular, extra overtime work tended to make men thinner and women fatter. This result implies important gender gap in ways subordinates respond to the extra overtime work. One implication is the differential impact on dietary habits after extra overtime work. At the busy time, women may eat more while men may do the opposite. Results here call for a need to design health support programs customized by gender, in order to accommodate with health-related risks induced by extra overtime work.

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Figures and Tables

Table 1: Summary Statistics (Estimated Manager Effects, N = 496)

	mean	SD	P5	P10	P25	P50	P75	P90	P95
Hours of overtime work	0.068	3.80	-5.57	-3.29	-0.90	0.00	0.78	3.15	5.57
Hours of nighttime work	0.075	2.19	-0.78	-0.31	-0.10	0.00	0.07	0.30	0.71
Hours worked on weekends	0.035	0.61	-0.55	-0.33	-0.09	0.00	0.07	0.35	0.65

Note: This table presents summary statistics for estimated manager effects ($\hat{\psi}_j$) in equation (1).

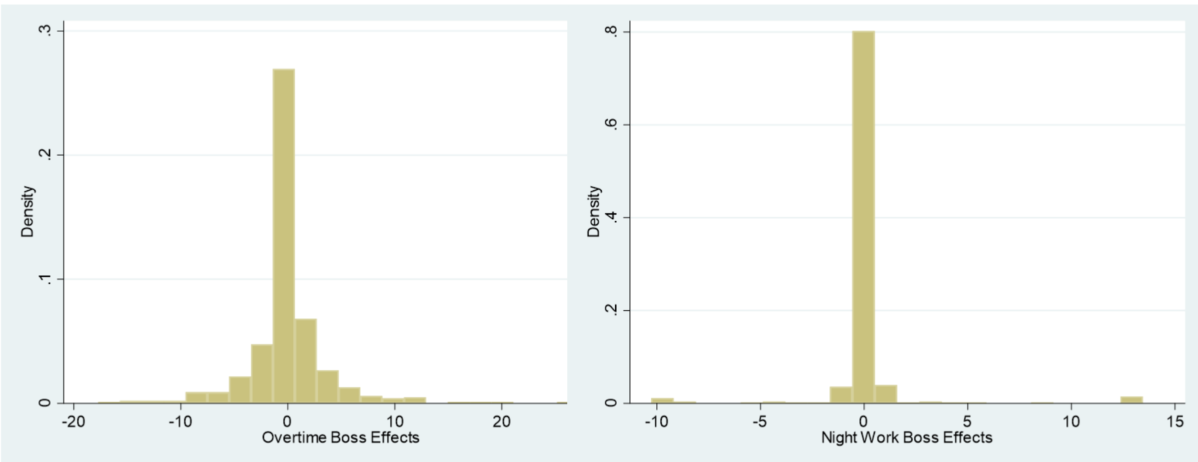


Figure 1: Histogram for Estimated Manager Effects
(left = monthly hours of overtime work, right = monthly hours of night-time work)

Note: Histograms present the distribution of estimated manager effect ($\hat{\psi}_j$) in equation (1).

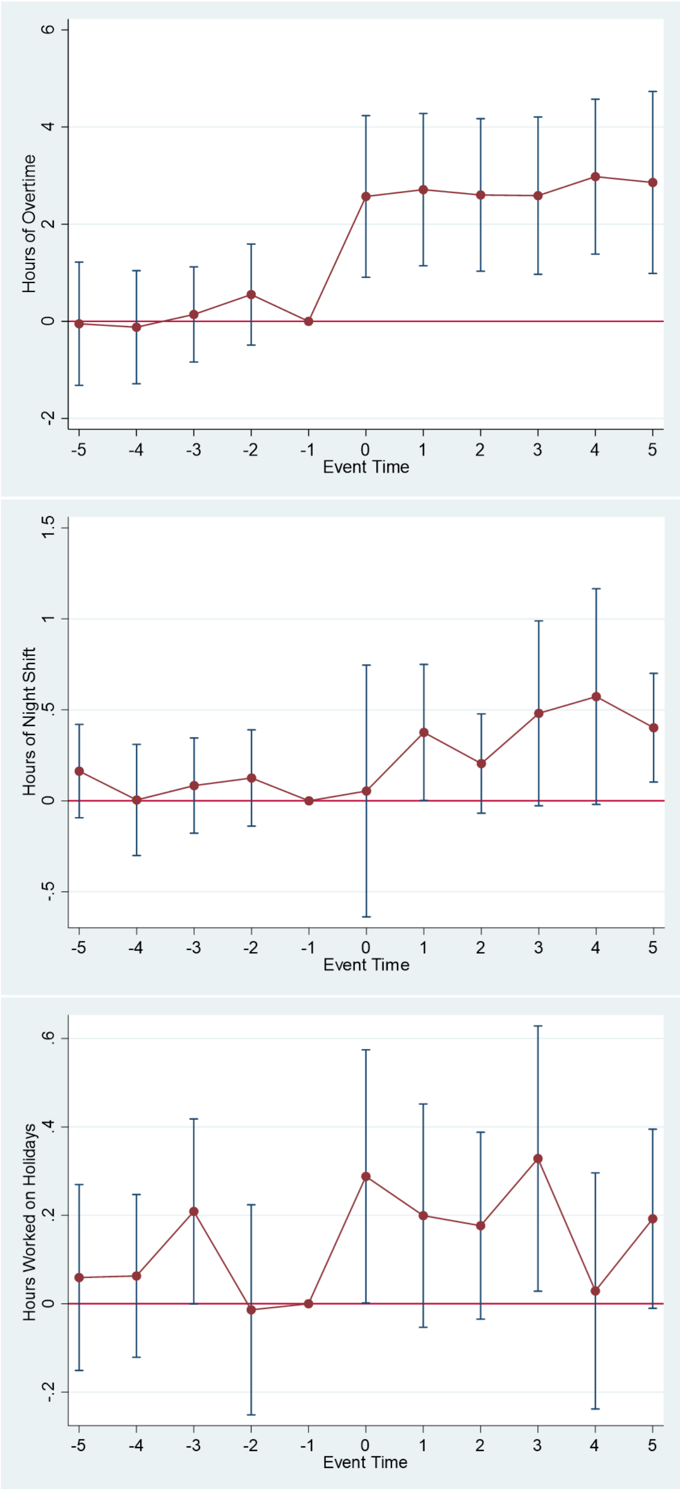


Figure 2: Event Study Estimates of Manager Allocation on Subordinate's Work Schedule

Treatment = managers changed from those with low $\hat{\psi}_j$ to high $\hat{\psi}_j$
Control = managers changed from low $\hat{\psi}_j$ to low $\hat{\psi}_j$

Note: The figure plots the estimated coefficients of new manager assignments on subordinates' monthly hours of overtime work (equation 3). We define the treatment and control groups based on our estimates of manager effect ($\hat{\psi}$) in equation (1). In particular, we define high $\hat{\psi}_j$ managers if the estimated manager effect is above median; low $\hat{\psi}_j$ managers, otherwise.

Table 2: Stress Measurments

Outcome	Description	Scale
low burden (quantity)	Workload quantity	1=high, 2=somewhat high, 3=average, 4=somewhat low, 5=low
low burden (quality)	Workload quality	1=high, 2=somewhat high, 3=average, 4=somewhat low, 5=low
low burden (physical)	Physical strain of work	1=high, 2=somewhat high, 3=average, 4=low
high job aptitude	Aptitude for the job	1=low, 2=somewhat low, 3=average, 5=high
high job satisfaction	Sense of fulfillment in work	1=low, 2=somewhat low, 3=average, 5=high
high energy	Enthusiasm for work	1=high, 2=somewhat high, 3=average, 4=somewhat low, 5=low
high frustration	Frustration at work	1=high, 2=somewhat high, 3=average, 4=somewhat low, 5=low
less depress	Feeling of depression	1=high, 2=somewhat high, 3=average, 4=somewhat low, 5=low
high stress level	Classification as high stress	0=low, 1=high
low work stress	Job-related stress	1=high, 2=somewhat high, 3=low
low physical stress	Physical stress	1=high, 2=somewhat high, 3=low
low exhaustion	Stress caused by exhaustion	1=high, 2=somewhat high, 3=low
low psychological stress	Psycological stress	1=high, 2=somewhat high, 3=low
high contol	Degree of control/autonomy in work	1=low, 2=somewhat low, 3=average, 4=somewhat high, 5=high
high environment	Degress of working environments	1=low, 2=somewhat low, 3=average, 4=somewhat high, 5=high
high skill use	Level of skill application in the job	1=low, 2=somewhat low, 3=average, 4=somewhat high/high

Table 3: Impact of Manager Effect ($\hat{\psi}$) on Employee's Health Examination Results

	(1) large abdomen	(2) high BMI	(3) hyper-tension	(4) dyslipi-demia	(5) diabetes
Male subordinates					
Management track	-0.0123*	-0.00359	-0.00755	-0.00335	-0.000987
	(0.006)	(0.003)	(0.005)	(0.010)	(0.001)
Expert track	0.0102	-0.004	-0.00249	-0.0109**	0.000191
	(0.006)	(0.010)	(0.012)	(0.005)	(0.007)
Female subordinates					
Expert track	0.0323*	0.0122	-0.00557	-0.00688	-7.01E-05
	(0.017)	(0.016)	(0.003)	(0.006)	(0.000)

Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level health-checkup examination records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 4: Impact of Manager Effect ($\hat{\psi}$) on Employee's Healthy Habits (35 years old or older)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	smoking	exercise	walking	eat night	snacking	skip breakfast	drink everyday	eat fast
Male subordinates								
Management track	-5.09e-06	-0.00841	0.000423	0.0119	-0.00295	0.00614	0.00730	0.00873
	(0.00603)	(0.00819)	(0.0101)	(0.0112)	(0.0162)	(0.0101)	(0.00846)	(0.00575)
Expert track	-0.00629	0.00336	0.00875	0.00667	0.0128	0.00782	-0.0701	0.006263
	(0.00623)	(0.00918)	(0.0112)	(0.0100)	(0.0103)	(0.00494)	(0.00436)	(0.00824)
Female subordinates								
Expert track	NA	0.0176	0.0306	0.0178	0.00600	-0.00291	-0.00363	0.0132
		(0.0113)	(0.0213)	(0.0141)	(0.0140)	(0.00320)	(0.00780)	(0.0210)

Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level health-checkup examination records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 5: Impact of Manager Effect ($\hat{\psi}$) on Employee Stress Measurements

	(1) low burden (quantity)	(2) low burden (quality)	(3) low burden (physical)	(4) high job satisfaction	(5) low work stress	(6) low physical stress	(7) low mental stress
Male subordinates							
Management Track	0.00761	0.00995	-0.0113	0.00179	-0.00093	0.000324	0.0164*
	(0.010)	(0.010)	(0.010)	(0.019)	(0.009)	(0.008)	(0.009)
Expert Track	-0.0345*	-0.0376*	-0.012	-0.0334*	-0.0491***	-0.0201	-0.0182
	(0.020)	(0.021)	(0.019)	(0.020)	(0.016)	(0.014)	(0.020)
Female subordinates							
Expert Track	-0.0165	0.00144	0.00219	-0.0217	0.00359	0.0131	0.0201
	(0.026)	(0.029)	(0.025)	(0.030)	(0.021)	(0.017)	(0.015)

Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level stress test diagnosis records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: Impact of Manager Effect ($\hat{\psi}$) on Employee's Physical Symptoms

	(1) vertigo	(2) knuckles ache	(3) head -ache	(4) stiff shoulder	(5) back -ache	(6) eye strain	(7) palpi- tations	(8) gastro- intestinal	(9) low appetite	(10) constipation /diarrhea	(11) in- somnia
Male subordinates											
Management Track	0.00233	-0.00331	-0.00481	0.00384	-0.0137	0.00761	0.000391	-0.00548	-0.000987	-0.00584	-0.00423
	(0.009)	(0.011)	(0.009)	(0.014)	(0.010)	(0.010)	(0.009)	(0.013)	(0.010)	(0.010)	(0.011)
Expert Track	-0.0138	0.0129	0.0422***	0.0505**	0.0333*	0.0167	0.00321	0.0114	0.0141	0.0214	-0.0062
	(0.016)	(0.018)	(0.014)	(0.020)	(0.019)	(0.019)	(0.018)	(0.029)	(0.021)	(0.015)	(0.020)
Female subordinates											
Expert Track	-0.0153	0.0346	0.0294	-0.0273	-0.0153	-0.0224	0.000446	-0.047	-0.028	-0.0199	0.00256
	(0.034)	(0.028)	(0.030)	(0.045)	(0.033)	(0.034)	(0.030)	(0.041)	(0.019)	(0.016)	(0.027)

Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level stress test diagnosis records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 7: Impact of Manager Effect ($\hat{\psi}$) on Employee's Health Examination Results (35 years old or older)

	(2) large abdomen	(3) high BMI	(4) hyper-tension	(5) dyslipi-demia	(6) diabetes
Male subordinates					
Management track	-0.0165**	-0.00277	-0.00674	-0.00461	-0.00101
	(0.007)	(0.004)	(0.005)	(0.011)	(0.001)
Expert track	0.0102	-0.00407	-0.00262	-0.0102*	0.000127
	(0.006)	(0.010)	(0.012)	(0.006)	(0.007)
Female subordinates					
Expert track	0.0325*	0.0125	-0.00245	-0.0069	-6.00E-05
	(0.017)	(0.016)	(0.002)	(0.006)	(0.000)

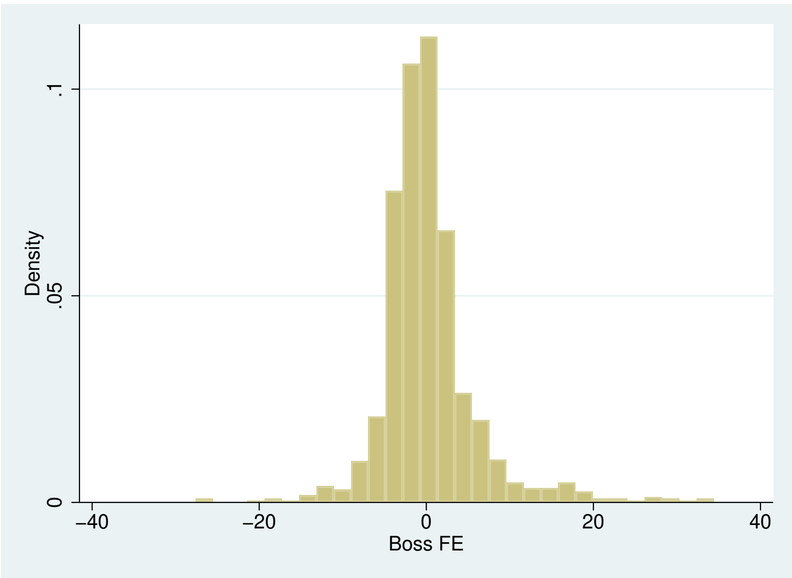
Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level health-checkup examination records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix

Appendix Table 1: Testing External Validity with Firm B Data
Summary Statistics (Estimated Manager Effects, N = 1116)

	mean	SD	P5	P10	P25	P50	P75	P90	P95
Hours of overtime work	0.233	5.752	-6.479	-4.649	-2.723	-0.424	2.023	6.048	10.03

Note: This table presents summary statistics for estimated manager effects ($\hat{\psi}_j$) in equation (1).



Appendix Figure 1: Testing External Validity with Firm B Data
Histogram for Estimated Manager Effects (monthly hours of overtime work)

Note: Histograms present the distribution of estimated manager effect ($\hat{\psi}_j$) in equation (1).

Appendix Table 2: Testing External Validity with Firm B Data
Impact of Manager Effect ($\hat{\psi}$) on Employee's Health Examination Results

	(1) large abdomen	(2) high BMI	(3) hyper-tension	(4) dyslipi-demia	(5) diabetes
Male subordinates	-0.002	0.001	0.001	-0.004	0.001
	(0.003)	(0.002)	(0.003)	(0.003)	(0.001)
Female subordinates	0.000	0.007*	0.005	0.003	-0.003
	(0.003)	(0.004)	(0.004)	(0.010)	(0.002)

Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level health-checkup examination records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Appendix Table 3: Testing External Validity with Firm B Data
Impact of Manager Effect ($\hat{\psi}$) on Employee's Healthy Habits (35 years old or older)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
						skip	drink		
	smoking	exercise	walking	eat night	snacking	breakfast	everyday	eat fast	sleeping
Male subordinates	0.001	0.001	0.001	0.000	0.006*	0.004*	0.000	-0.002	-0.008**
	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)
Female subordinates	0.000	0.005	0.018	0.003	0.002	0.003	0.000	0.007	-0.002
	(0.000)	(0.007)	(0.012)	(0.011)	(0.011)	(0.007)	(0.002)	(0.008)	(0.011)

Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is taken from annual-employee level health-checkup examination records. Number of observation is not available due to the agreement with the firm. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$