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Middle Managers and Employee Health[1]

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Abstract

Effective health management is crucial for enhancing employee productivity within organizations. Despite this, the impact of health management practices in the workplace, particularly the role of managers on their subordinates' health, remains largely underexplored. Leveraging periodic employee transfers at a large-scale, publicly-listed firm in Japan, this study examines the effects of middle managers on their subordinates' overtime hours and, eventually their health outcomes. Our analysis indicates that manager-driven overtime work correlates with an increased stress burden among male employees in a non-managerial track, who also report a higher incidence of physical symptoms, such as headaches and backaches. Interestingly, our findings reveal divergent associations with the risk of metabolic syndrome across genders. These findings highlight the necessity of developing gender- and career track-specific health support programs to mitigate the health risks associated with excessive overtime work.

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

[1] This study is conducted as a part of the collaborative projects by “Productivity Effects of HRM Policies and Management Quality'” (PI: Hideo Owan) and “Research on Diverse Workstyles and their Impact on Health and Productivity” (PI: Sachiko Kuroda) conducted at the Research Institute of Economy, Trade and Industry (RIETI). This study in also conducted as part of projects in the Health and Productivity Seminar (organizer: Japan Productivity Center). This study draws implications from applied economics and positions itself within the domain of economics and business management research. The analysis using the personnel records was conducted following an agreement approved by Japan Productivity Center, Ewel, Inc., and Waseda and Doshisha Universities. The authors are grateful to Yoko Asuyama, Wouter Dessein, Akifumi Ishihara, Hiro Ishise, Hiroyuki Kasahara, Toru Kitagawa, Desmond Lo, Masayuki Morikawa Ruo Shangguan, Kohei Takahashi, Katsuya Takii, Mari Tanaka, Kensuke Teshima, Kotaro Tsuru, Ken Yamada, Xuanli Zhu, and participants at the RIETI DP Seminar where the draft of this paper was presented, Kyoto Summer Workshop on Applied Economics 2023, Organizational Economics Conference 2023, AASLE 2023 Conference, and the 26th Colloquium on Personnel Economics 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, #22H00857, #22H00858, #23H00056, #21K13318). We also appreciate many insights and great support provided by Yuji Kawata and Hayato Kanayama. Finally, the authors would like to sincerely thank the anonymous listed firms and their HR teams for providing us with their internal data and the consistent support provided for 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 (Nishinoue et al., 2012; Kaku et al., 2012; Halpern et al., 2015; Royer et al., 2015; Nakada et al., 2018; Halpern et al., 2018; Robbins et al., 2019).[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. We follow the value-added approach and estimate manager-specific effects in the monthly-level subordinate panel model. We then examine the impact of allocating the managers with a higher contribution on their subordinates' health outcomes.

Our analyses show that managers play nontrivial role in determining the subordinates' overtime work. By replacing the managers with estimated overtime contribution at the top 5th percentile with those at the bottom 5th percentile, one can reduce the overtime work by 11.1 hours per month (Table 2 and Figure 1). To assess the exogeneity of manager allocation, we analyzed the supervision transitions among subordinates according to manager type which we defined by the estimated effects of managers. Our findings suggest no clear evidence of subordinates being transferred to managers of similar types in the following allocations. Thus, the assignment of managers to employees was likely to be orthogonal to the employees' time-invariant characteristics (Table 1).

Importantly, managers assignments are associated with changes in the subordinates' health status, 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 a heavier burden at work, a lower degree of autonomy, and reduced job and life satisfaction (Table 5).

[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. Robbins et al. (2019) provides a comprehensive overview of studies examining the impact of workplace intervention programs on employee health.

They also reported a higher frequency of physical ailment symptoms related to heavy desk work, such as headache and backache, in addition to diarrhea (Table 6). In contrast, we detected no significant associations between the manager-driven overtime work and health-related habits of employees, including smoking, snacking, drinking, and exercising (Table 4). Our analyses also reveal an important gender gap in the impact on the biomarkers for metabolic risk. In particular, manager-driven overtime work is associated with a lower probability of being diagnosed with large abdomen for men in management track, while it is associated with a *higher* risk of large abdomen for women in non-management track (Table 3). We also observed moderate evidence of a similar gender gap in the complementary analysis using health check-up records from another listed firm (Appendix Table 2). Taken together, our findings indicate a necessity to develop health support programs tailored by gender and career path, aimed at mitigating health risks associated with excessive overtime work.

This study aims 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 introduce a new perspective on the role of middle managers by demonstrating the substantial variation in their management styles, particularly in how they influence employees' working hours.

Second, our study sheds light on a potential pathway through which middle managers influence employee well-being. We achieve this by examining the correlation between employee health outcomes and the estimated fixed effects of managers. Previous research in the field of middle management studies has consistently shown that employees were more inclined to leave their roles due to poor management (Kuroda and Yamamoto, 2018; Hoffman and Tadelis, 2021). Furthermore, it is well-documented that workers' job satisfaction and mental health decline under managers lacking in technical expertise or communication skills (Artz et al., 2017; Kuroda and Yamamoto, 2018). Our research takes a step further by exploring the mechanism by which managerial patterns impact employee well-being, which could lead to further behavioral response as shown in the previous studies. Our rich personnel dataset, along with their health and stress check-up records, allows us to pursue this investigation.

Third, we also contribute to the literature using the value-added approach. Previous studies have estimated the value-added of school teachers and university professors in terms of their students' outcomes (Chetty et al., 2014; Kikuchi and Nakajima, 2016, etc.), the value-added of CEOs in terms of 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 provides a new example of the value-added approach by estimating the value added of middle managers in terms of the overtime hours worked by their subordinates. Additionally, the application of value-added estimates in further regressions presents a versatile method, particularly relevant in the field of insider econometrics. To our knowledge, this research is one of the first to apply the value-added framework to quantify managers' contributions to their subordinates' overtime hours, and eventually on their health.

Lastly, our study contributes to the literature on work hours and worker well-being, as evidenced by Kuroda and Yamamoto (2019) and Sato et al. (2020). The detrimental effects of prolonged work hours on mental and physical health, as well as on productivity, have been documented in several studies.[2] However, the discourse on the determinants of work hour length has been somewhat overlooked in these studies, with many relying on actual working hours for analysis without adequately addressing who decides these hours. This oversight leaves room to question whether long hours are self-imposed or externally enforced, such as by job requirements or managerial discretion. In cases where long hours are self-selected, the impact on well-being might be less adverse. Our paper makes a novel contribution by accounting for individual preferences for longer hours (Oshio et al., 2015; Kuroda and Yamamoto, 2019; Sato et al., 2020, etc.) and division-specific effects, while also leveraging data on subordinate-supervisor pairings to pinpoint supervisors who influence their subordinates' extended work hours. This approach allows us to isolate the negative well-being impacts on employees compelled to work excessive hours due to managerial discretions.

[2] For instance, recent research addressing mental health includes Virtanen et al. (2011), Virtanen et al. (2012), Oshio et al. (2015), Kuroda and Yamamoto (2019), and Sato et al. (2020); Pencavel (2015) explores productivity impacts; and Virtanen et al. (2018) provides a review and meta-analysis of prospective cohort studies across 35 countries.

The remainder of the paper is organized as follows: Section 2 summarizes the institutional background and introduces the corporate data utilized in this study. Section 3 describes the estimating models. Section 4 presents the results and conducts robustness tests to assess the external validity of our findings. Section 5 offers concluding remarks.

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.

Although we cannot strictly establish the exogneity of manager assignments to subordinate outcomes, several facts will be useful in interpreting our results.[5] First, when allocating employees to new divisions, HR considers the proposals of subordinates, but only assigns them a minor weight. Second, once the new assignments are announced, employees cannot reject the offers except for limited special cases. Finally, from an operational perspective, managers have considerable discretion in determining their subordinates' overtime hours. Subordinates must obtain

[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 a single middle manager for each division. In cases where two or more individuals were in managerial roles within the same division, we selected the manager based on a hierarchy of criteria: salary rank, tenure length at the firm, and years of managerial experience.

[5]Based on the interview with the HR team of the firm.

their permission to work overtime.

In our main analyses, we divide our subordinate samples by gender and two types of career track offered at the firm, the management and expert tracks. In the 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. The expert track is roughly equivalent to the non-managerial track, where employees are anticipated to develop specialized skills to support future management, including performing clerical tasks. The starting salary for new college graduates in the management track is more than 10% higher than that of the expert track. Due to a small sample size, we do not present the estimation results for female subordinates in the management track.

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 utilizes biomarkers from health check-up examinations to explore various physiological risk factors linked to chronic conditions. The health check-up records include comprehensive anthropometric and clinical data derived from blood samples.[6] We focus on three primary risk factors that are particularly prevalent and well-documented in Japan. First, we adopt overweight status, defined as a body mass index (BMI) of 25 or higher, which elevates the risk of cardiovascular diseases, stroke, diabetes, and musculoskeletal disorders (Ng et al., 2014). Besides height and weight measurements, abdominal circumference is also assessed. Excessive abdominal fat, indicated by a circumference greater than 85cm for men and 90cm for women, points to significant

[6] Under the Industrial Safety and Health Law, employers are mandated to conduct annual health check-ups for their employees. The purpose of these check-ups is to detect potential diseases at an early stage and encourage health-enhancing behaviors through regular health monitoring. Employers bear the costs of these health check-ups.

health risks.

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 our study, we determine hypertension status by calculating the mean systolic and diastolic blood pressure from three measurements. A diagnosis of hypertension is made if the mean systolic pressure is 140 mmHg or higher, the mean diastolic pressure is 90 mmHg or higher, or if the individual is currently on anti-hypertensive medication.

The third health condition examined in this study is dyslipidemia, a key risk factor for cardiovascular diseases. Health check-ups include blood sample analyses to measure total cholesterol, high-density lipoprotein (HDL) cholesterol, low-density lipoprotein (LDL) cholesterol, and triglycerides. Dyslipidemia is diagnosed 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 undergoing lipid-lowering treatment. Additionally, this study considers diabetes as a final risk factor. Diabetes diagnosis relies on biomarkers like glycosylated hemoglobin (HbA1c) and fasting glucose levels. 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 incorporates information on employees' daily health-related lifestyles. During annual check-ups, individuals respond to standardized questions about their lifestyles, covering physical activity, dietary habits, and sleep patterns. These factors are linked to the health risks of various non-communicable diseases (Swinburn et al., 2004; Akseer et al., 2020). We create a binary variable to represent the presence of health-related habits, based on responses from the health check-up questionnaires. This information is available only for employees aged 35 and older.

To assess physical activity habits, we consider two criteria. First, we examine if individuals engage in daily walking for more than one hour. Second, we evaluate the presence of a regular exercise routine, defined as light sweating from physical activity for at least 30 minutes, at least twice a week, consistently maintained for over a year.

Dietary habits are assessed based on factors such as the individual's perception of eating speed relative to others, frequency of consuming dinner within two hours before bedtime (more than three times a week), intake of snacks or sugary beverages between meals, and skipping breakfast more than three times a week. These dietary behaviors are identified as significant predictors of higher body mass (Nishitani et al., 2009).

Additionally, we assess other health-related lifestyle practices. Alcohol consumption patterns are examined by considering the frequency with which individuals consume different types of alcohol, including sake, beer, wine, whisky, or brandy. Smoking status is determined by both the duration of smoking and the quantity of cigarettes consumed. An individual is classified as a regular smoker if they have smoked more than 100 cigarettes in total or have smoked for more than six months, including in the past month. Again, each of these health-related lifestyle practices is represented by a binary variable.

2.4 Stress Measurements

This study investigates the impact of occupational stress on employees' mental health, utilizing individuals' scores from the stress check test in accordance with guidelines set by the Ministry of Health, Labour, and Welfare (Ministry of Health, Labour & Welfare, 2016).[7] A 2015 amendment to the Industrial Safety and Health Law mandates annual stress assessments for organizations with 50 or more employees. These evaluations aim to quantify the psychological burden on employees, employing the Brief Job Stress Questionnaire (BJSQ) — a tool endorsed by the Ministry, consisting of 57 standardized questions about job stress (Kawakami and Tsutsumi, 2016). Our analysis leverages records from a firm that implements the BJSQ to gauge employee stress levels.[8] The questionnaire measures both physical and psychological stresses related to work, including self-assessed workloads and the degree of control employees have over their tasks, evaluated on a five or four-point scale. Although the BJSQ records a comprehensive set of stress measurements, for the sake of brevity, this study reports the findings on self-reported burden, subjective degree of autonomy and job and the level of life and job satisfaction.

[7] 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).

[8] For reference, studies utilizing these records include Inoue et al. (2020); Kachi et al. (2020); Imamura et al. (2018).

2.5 Physical Symptoms

The Brief Job Stress Questionnaire (BJSQ) includes various items assessing physical symptoms experienced in the last month. These symptoms encompass dizziness, joint pain, headaches, shoulder discomfort, back pain, eye strain, palpitations, gastrointestinal issues, poor appetite, diarrhea, constipation, and disrupted sleep. Employees self-assess the frequency of experiencing these symptoms using a four-point scale, ranging from ’almost never’ to ’almost always’, with higher values indicating a greater frequency. We generated binary variables indicating a response of ’often’ or ’almost always’ as one, and zero otherwise.

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 monthly hours of overtime work 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. 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.[9]

In the second step, we examine the impact of managers on their subordinates’ health status recorded every year. In particular, we estimate the following health outcome model by including

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

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.

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 examine the exogeneity of manager assignments indirectly by checking the transition matrix of manager assignments. Specifically, we examine whether those employees assigned to a manager with high (low) $\widehat{\psi}_j$ were assigned to managers with high (low) $\widehat{\psi}_j$ later in their career. In doing so, we can assess whether employees initially supervised by managers with high overtime work contributions tend to be supervised by similar types of managers again in the future. We operationalize this approach first by defining the two types of managers based on our estimates of manager effects ($\hat{\psi}$) 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. We then construct transition matrices of subordinates by the type of managers six or twelve months after the time of each observation. We exclude those subordinates who experienced no changes in supervising managers in constructing the matrices.

Table 1 presents the transition matrices of subordinates based on the types of managers. The matrices reveal an interesting pattern of transitions. First, managers tend to be lower type in the later periods in general. Conditional on transfers, we have a larger number of high-type managers at m than we do at m+6 or m+12 (i.e., see last row and column). Second, there is no clear evidence that the previous types of managers determine the type of the next managers, particularly given that manager types are slightly lower in the later periods in general. For instance, the proportions of subordinates with low-type managers at $m + 6$ are very similar across subordinates with low and high-type managers at m. This pattern is also observed for transitions at $m + 12$. Thus, it is less likely that subordinates with specific traits (e.g., high patience) were repeatedly supervised by "tough" or high $\hat{\psi}_j$ managers in subsequent assignments. While our test is admittedly crude, one interpretation is that manager assignments exhibit moderate exogeneity against unobserved time-invariant traits of subordinates.

4 Results

4.1 Manager-speficif Effects

Table 2 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 total hours of overtime work. At subordinate-level, we identified managers of approximately 67.9% of all observations in our sample.[10] 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).[11] 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.

To validate that the estimated manager-specific effects accurately predict the subordinates' overtime hours following the assignment of a manager, we estimated an event study model using a stacked regression approach (Cengiz et al., 2019). In particular, 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 took a window of eleven months, that is, five months before and after a new manager assignment (e.g., $w = 5$). The estimated treatment effects, $\hat{\gamma}^s$, compare the performance trajectories between the

[10]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.

[11]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.

treated and untreated subordinates for $s > 0$. We defined treatment and control groups based on our estimates of manager effect ($\hat{\psi}$) in equation (3). Specifically, we define high $\hat{\psi}_j$ managers 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 a significant and positive jump in subordinates' overtime hours for at least five months after the new assignment. This outcome is expected, as the manager-specific effects were estimated from subordinates' hours of overtime work. Nevertheless, these results descriptively demonstrate that our estimated manager effects accurately reflect the actual changes in the subodinates' overtime hours in the following months. In the subsequent main analyses, we present the impact of such manager-driven overtime hours on subordinates' health status, utilizing the estimated manager effects.

4.2 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 categories.

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 the management track, while it is associated with *higher* risk of large abdomen for women in the 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 the management track while we increase the same risk by 20.6 percentage points for women in the expert track.We also observe a significantly reduced risk of dyslipidemia for men in the expert track. Table 7 estimates the same models by limiting observations to employees aged 35 or older. We found similar but slightly large estimates for the impact on being diagnosed with large abdomen.

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 only for employees aged 35 or older, 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 examines any association of manager-driven overtime work and proxies of employees' stress burden, as derived from mandatory stress examination results. We estimated equation (2) with dependent variables replaced by likert-scale measurements. To facilitate interpretation, we converted the stress measurements to binary variables and ran the same regression on these binary variables. These binary variables are assigned a value of one if any adverse effects on stress status are observed, and zero otherwise.[12] Our results imply disproportionate mental effects on men in the expert track. They tend to report significant increases in job burden both in quality and quantity after being allocated to managers with higher overtime work contribution although the estimate is statistically insignificant in column (5). The manager-driven overtime work is also associated with lower satisfaction level and lower degree of control over their work. These estimates imply nontrivial impact of manager-driven overtime work in employees' mental status and their well-being. For instance, according to the estimate in column (8), one can increase the probability that the subordinates fall under low satisfaction category by 15.58% by replacing the managers with estimated overtime contribution at top 10th percentile with those at bottom 10th percentile.

Finally, we examine whether the allocation of managers with a higher tendency for overtime work is linked to more frequent physical symptoms among subordinates. The estimation results are presented in Table 6, with dependent variables represented as binary variables indicating a

[12]Specifically, the binary variable takes a value of one if employees are categorized as having either "high" or "slightly high" stress burden, and zero otherwise (columns 5 and 6). It takes a value of one if employees are categorized as having "low" or "slightly low" sense of control over their work, and zero otherwise (column 7). Similarly, it takes a value of one if employees are categorized as having "low" or "slightly low" levels of job and life satisfaction (column 8).

higher frequency of each symptom. Consistently, we find that the negative impacts of manager-driven overtime work are predominantly observed among men in the expert track. Specifically, an increase in manager-driven overtime work is associated with men in the expert track reporting more frequent headaches and backaches. Importantly, these symptoms suggest a direct negative impact of prolonged desk work. Additionally, we observe a small positive association between manager-driven overtime work and the likelihood of high-frequency insomnia among men in the management track. However, no significant effects are detected on physical symptoms among women in the expert track.

4.3 External Validity

One significant limitation of the present study is the potential lack of external validity. To assess the generalizability of our aforementioned findings to the context of other firms, we conducted similar analyses using personnel records from another publicly listed company in Japan (”the other firm” hereafter). The advantage of the dataset provided by the other firm is its more precise information for linking subordinates with their managers. However, it does not include information on stress check examinations, unlike the firm studied in the previous sections. We present the results related to the other firm in the appendix.

There are several key findings. First, similar to the previous case, manager fixed effects were found to explain subordinates' total hours of overtime work. According to variance decompositions, both subordinate and manager fixed effects account for approximately one-sixth of the variance in total hours of overtime work, respectively. Substituting managers with estimated overtime contributions at the top 5th percentile with those at the bottom 5th percentile resulted in a reduction of total hours of overtime work by 16.5 hours per month, which is larger than the 11.1 hours observed in the previous firm (see Appendix Table 1 and Appendix Figure 1). Second, we also found weak evidence indicating that manager-driven overtime work had differing effects on the risk of metabolic syndrome by gender (see Appendix Table 2). We observed that female subordinates were more likely to be diagnosed with a BMI exceeding the standard level, whereas such an effect was not observed among male subordinates. Finally, in contrast to the previous firm, managers at the other firm had an impact on the healthy habits of their subordinates. Appendix Table 3 demonstrates that working under managers with a high contribution to overtime work resulted in irregular eating habits among male subordinates. Specifically, male subordinates were more likely to snack or skip breakfast due to manager-driven overtime work. Once again, our results imply the importance of tailoring health management or assistance programs based on gender.

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 examination 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, manager-driven overtime work is significantly associated with the mental status 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 tendency of physical ailment symptoms related to heavy desk work, such as headache and backache. We did not find any significant impacts of manager-driven overtime work on health-related habits of employees, including smoking, snacking, drinking, exercising, etc. 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 the 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 a detrimental impact of manager-induced overtime work on stress levels and physical symptoms, but only among men on the non-management track. Unfortunately, we are unable to determine whether the increased stress levels disrupt the autonomic nervous system and lead to physical symptoms, or vice versa. Nonetheless, our findings suggest that prolonged periods at the desk, which is common among the employees in our dataset, have adverse effects. Introducing small exercise or massage programs within the workplace may help alleviate these physical symptoms. Second, we discovered divergent effects on the risk of metabolic syndrome between men and women. Specifically, excessive overtime work tended to result in weight loss in men and weight gain in women. This highlights a significant gender disparity in how subordinates react to additional overtime work, suggesting a differential impact on dietary habits. During busy periods, women might eat more, whereas men might do the opposite. These findings underscore the necessity of designing health support programs that are tailored by gender to mitigate health risks associated with excessive overtime work.

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Figures and Tables

Table 1: Subordinates' Transitions by Manager Type

Manager at m \ **Manager at** $m+6$	low type	high type	total
low type	3,731 (52.97)	3,312 (47.03)	7,043 (100.00)
high type	3,817 (51.85)	3,544 (48.15)	7,361 (100.00)
total	7,548 (52.40)	6,856 (47.60)	14,404 (100.00)

Manager at m \ **Manager at** $m+12$	low type	high type	total
low type	5,730 (50.72)	5,567 (49.28)	11,297 (100.00)
high type	5,947 (52.77)	5,346 (47.23)	11,320 (100.00)
total	11,704 (51.75)	10,913 (48.25)	22,617 (100.00)

Note: Tables present transition matrices of subordinates by the type of managers six or twelve months after the time of each observation. Each cell represents the number of subordinates. Proportions in % are in the parentheses. We defined the two types of managers based on our estimates of manager effects ($\hat{\psi}$) in equation (1). In particular, we defined high $\hat{\psi}_j$ managers if the estimated manager effect is above median; low $\hat{\psi}_j$ managers, otherwise. We excluded those subordinates who experienced no changes in supervising managers in constructing the matrices.

Table 2: 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

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

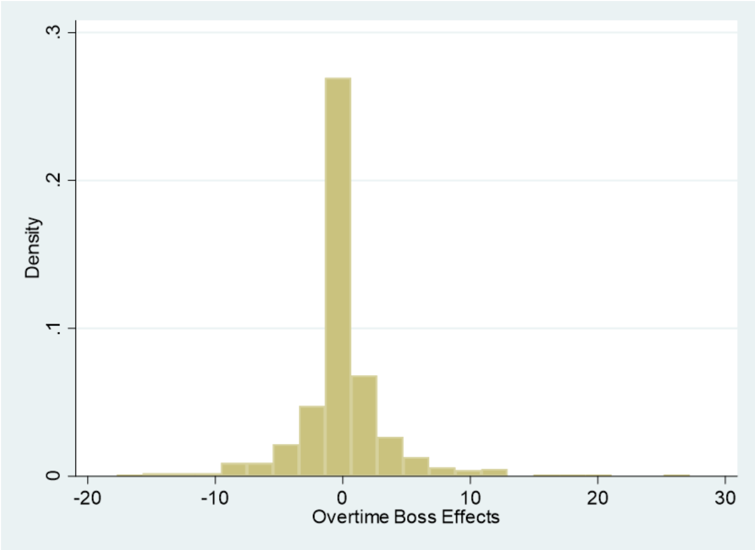


Figure 1: Histogram for Estimated Manager Effects

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

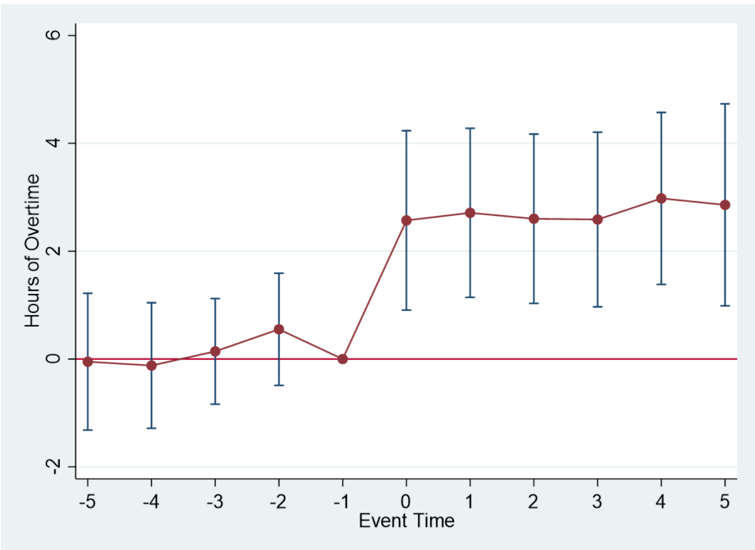


Figure 2: Event Study Estimates of Manager Allocation on Subordinate's Work Schedule

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 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)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	likert-scale				binary variable			
	low burden (quantity)	low burden (quality)	high degree of control	high satisfaction	high burden (quantity)	high burden (quality)	low degree of control	low satisfaction
Male subordinates								
Management Track	0.00761	0.00995	-0.0043	0.0174	-0.0017	-0.0013	0.0058	-0.0074
	(0.010)	(0.010)	(0.011)	(0.014)	(0.005)	(0.006)	(0.006)	(0.005)
Expert Track	-0.0345*	-0.0376*	-0.0750***	-0.0046**	0.0088	0.0231*	0.0216*	0.0242***
	(0.020)	(0.021)	(0.019)	(0.019)	(0.010)	(0.012)	(0.012)	(0.009)
Female subordinates								
Expert Track	-0.0165	0.00144	-0.0351	-0.0132	0.0107	-0.0034	0.0170	-0.0076
	(0.026)	(0.029)	(0.029)	(0.033)	(0.014)	(0.027)	(0.012)	(0.0149)

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	0.0017	-0.0031	0.0052	0.0013	-0.0039	-0.0004	0.0018	0.0013	0.0024	-0.0024	0.0094*
	(0.0041)	(0.0035)	(0.0058)	(0.0077)	(0.0040)	(0.0073)	(0.0024)	(0.0063)	(0.0023)	(0.0056)	(0.0048)
Expert Track	-0.0081	-0.0047	0.0164**	0.0126	0.0204**	0.0153	0.0079	0.0112	0.0080	0.0138*	0.0038
	(0.0109)	(0.0078)	(0.0078)	(0.0090)	(0.0092)	(0.0115)	(0.0050)	(0.0148)	(0.0077)	(0.0081)	(0.0120)
Female subordinates											
Expert Track	-0.0015	0.0040	0.0125	-0.0144	-0.0012	-0.0144	-0.0091	-0.0051	-0.0052	-0.0114	-0.0113
	(0.0086)	(0.0065)	(0.0232)	(0.0245)	(0.0224)	(0.0226)	(0.0120)	(0.0170)	(0.0032)	(0.0104)	(0.0128)

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)

	(1) large abdomen	(2) high BMI	(3) hyper-tension	(4) dyslipi-demia	(5) 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)

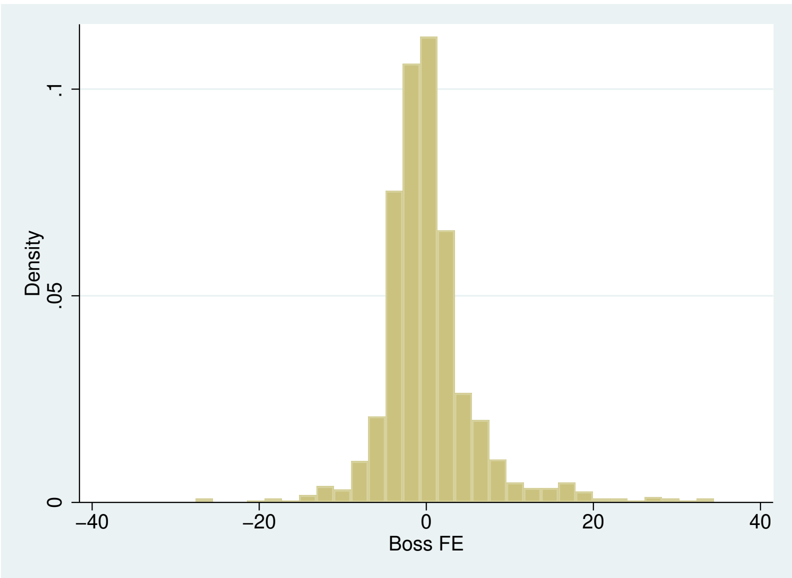
Note: Each cell represents a separate estimate for the coefficient of manager effect ($\hat{\gamma}$) in equation (2). Robust standard errors in parentheses. Controls include individual, fiscal year, and division fixed effects. Standard errors are clustered at the division and employee levels. Data is 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 Data from the Other Firm
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 Data from the Other Firm
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 Data from the Other Firm
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 Data from the Other Firm
Impact of Manager Effect ($\hat{\psi}$) on Employee's Healthy Habits (35 years old or older)

	(1) smoking	(2) exercise	(3) walking	(4) eat night	(5) snacking	(6) skip breakfast	(7) drink everyday	(8) eat fast	(9) 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. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$