

Office 650.723.9741

Fax 650.723.6530

Stanford University

Encina Hall, E301

Stanford, CA 94305-6055

aparc.fsi.stanford.edu

*Stanford University
Walter H. Shorenstein Asia-Pacific Research Center
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Intended and Unintended Consequences of a New Limit on Working Hours in South Korea: Implications for Precarious Employment

Sungchul Park, PhD, MPH, *Department of Health Management and Policy, Dornsife School of Public Health, Drexel University*

Hansoo Ko, PhD, MD, *Robert F. Wagner Graduate School of Public Service, New York University*

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For information, contact:

Karen Eggleston (翁笙和)

Director, Asia Health Policy Program

Deputy Director, Walter H. Shorenstein Asia-Pacific Research Center

Senior Fellow, Freeman Spogli Institute for International Studies

Stanford University

616 Jane Stanford Way, Encina Hall C323

Stanford, CA 94305-6055

karene@stanford.edu

<https://aparc.fsi.stanford.edu/asiahealthpolicy>

Intended and unintended consequences of a new limit on working hours in South Korea: Implications for precarious employment

Sungchul Park, PhD,¹ and Hansoo Ko, PhD, MD²

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Abstract

Effective as of July 1, 2018, South Korea set a new cap on employees' weekly working hours, decreasing the maximum number from 68 to 52. In this study, we comprehensively analyze the effectiveness of the law's implementation by observing changes in work time, health status, health care utilization, health behavior, monthly expenses, and satisfaction between pre- and post-implementation periods (2014–2017 vs. 2019). We find evidence of both intended and unintended consequences—and, in this last category, some are beneficial and some not. As intended, employees eligible for the 52-hour work week saw their average working hours decrease, while their monthly spending on leisure increased substantially. A beneficial unintended consequence was that work time also decreased in firms with less than 300 employees that had not yet implemented the 52-hour work schedule (they have done so since, in January 2020). Among adverse unintended consequences, the most notable were heterogeneous effects across employment types (full-time vs. precarious employment) and, in particular, negative impacts on precarious employees (that is, those facing relatively high levels of job insecurity). Despite almost no change in their work time, precarious employees saw substantial increases in outpatient visits and monthly expenses for health care, indicating suggestive evidence of adverse health consequences. Another adverse unintended consequence was that overall job satisfaction decreased among several groups of employees. This may reflect a heavy workload among employees still expected to work overtime, especially experienced employees or those working in large firms. While employment rates increased after the new schedule's implementation, the majority were in precarious jobs. This has negative implications because of the adverse health impacts of being in precarious employment; also, the workload of experienced employees in this field might have intensified amid all the new hiring. Our findings suggest key policy recommendations for how to leverage the benefits of the 52-hour cap on weekly working hours while addressing its negative unintended consequences.

¹ Department of Health Management and Policy, Dornsife School of Public Health, Drexel University, 3215 Market Street, Philadelphia, PA, 19104. E-mail: smp462@drexel.edu.

² Robert F. Wagner Graduate School of Public Service, New York University, 295 Lafayette Street, New York, NY, 10012. E-mail: hk87@nyu.edu.

1 Introduction

There has been an upsurge of interest around the world in improving employment conditions, amid growing recognition that employment conditions are key social determinants of health and well-being [1, 2]. Long working hours are of particular interest as they are among the main risk factors for health and well-being. According to a conceptual framework developed by Caruso et al. [3], long working hours lead to increased exposure to work-related stress and less time for non-work activities to recover from work such as sleep or leisure. Evidence suggests that long working hours tend to result in fatigue [4], cognitive dysfunction [5], depression, anxiety, poor sleep quality [6], and poor satisfaction due to lack of work-life balance [7]. Such imbalance between work and recovery can be associated with various health-related outcomes as well as unhealthy behaviors such as smoking [8] and alcohol consumption [9]. Also, long working hours are associated with higher risks for occupational injuries [10], coronary heart disease, stroke [11], diabetes [12], and cardiovascular disease [13].

Reducing working hours has been a high priority in many countries over the past several decades. The fundamental goal of doing so is to improve the health and well-being of employees. Several countries have implemented nationwide policies to reduce weekly working hours. Empirical studies find that reducing working hours leads to improved mental health [14], self-rated health [15, 16], job and leisure satisfaction [17], and health behaviors [18], while decreasing industrial injury rates [19], absences from the job due to illness, and physician visits [16]. These results support the proposition that reducing working hours can decrease work-related stress and injuries and increase time for non-work activities, leading to improvements in the health and well-being of employees [3]. Moreover, reducing working hours has the potential to create jobs and increase employment. However, both theoretical and empirical evidence are indecisive. According to a theoretical framework developed by Kapteyn et al. [20], whether reducing working hours increases employment depends heavily on context-specific social and labor conditions. Several empirical studies show that reducing working hours leads to increased employment [21, 22] and improved work productivity [21]. However, others find no or negligible changes in employment [23, 24].

Thus, important gaps remain in our knowledge of the consequences of reducing working hours. Since most studies to date focused on selected outcomes, their results may be limited. Also, interpreting these results is challenging. For example, improvements in health may come at the cost of other factors not examined by a study. Also, exclusive focus on some factors over others may lead analysts to miss out on the unintended consequences of reducing working hours. Understanding unintended consequences is an essential task of policy analysis, as such consequences are common and can arise at all stages of the policy process. Detecting them requires comprehensive investigation across various outcomes, to capture a complete picture of how reducing working hours affects health and well-being.

Second, the consequences of reducing working hours may be heterogeneous by employment conditions, but evidence is limited. Prior studies found heterogeneous consequences by age and/or sex [14–18]. However, employment conditions may be more relevant sources of the heterogeneity as they reflect indicators of socioeconomic status, such as income and education [1, 2]. Precarious employment in particular is of high policy relevance due to its strong linkage to adverse health and well-being. Although there is still no consensus on its definition, precarious employment is considered as a range of employment arrangements characterized by job insecurity, limited workplace rights and social protections, and a lack of power to exercise workplace rights [1]. According to a conceptual model developed by Benach et al. [1], there are three main pathways by which precarious employment induces adverse effects on the health and well-being of employees. The first is based on high exposure to unsafe and unhealthy working conditions, resulting in high risks for work-related stress and injuries. The second is lack of control over professional and personal lives, leading to psychosocial stress. The third is related to the social and material consequences of precariousness outside the immediate sphere of production such as low income and material deprivation. Indeed, compared to full-time employees, precarious employees tend to have unhealthy behaviors [25] and adverse health [26]. In particular, evidence from South Korea, where labor power is relatively weak, precarious employment was found to be negatively associated with self-rated health [27]. This suggests that there may be unintended and adverse consequences of reducing working

hours on the health and well-being of precarious employees through changes in income, job-related stress, and work intensity.

There may be other unknown consequences of reducing working hours. First, a large proportion of employees may still work long hours, but there are limited data on their characteristics. Understanding their characteristics is of high policy relevance because their heavy workload may have adverse impacts on their health and well-being. This points to the importance of identifying employees with long working hours and developing targeted interventions aimed at decreasing their working hours while encouraging hiring. Prior studies examined whether reducing working hours increases the quantity of jobs available [20–24], but less is known about whether their quality increases. Increasing high-quality employment such as full-time work may help reduce employee workloads and improve work productivity in the long run. However, such consequences may be limited if a large portion of the increase in jobs is attributable to precarious employment [28]. As precarious employment tends to be less stable, part-time, temporary, and low-skilled, precarious employees are less likely to fully replace full-time employees. This suggests that the magnitude of improvement in workload and work productivity may be limited, but an increase in precarious employment may induce more adverse health and well-being consequences.

We focus on South Korea, one of the countries with the longest working hours in the world. Starting in July 2018, South Korea implemented a new law reducing maximum weekly work hours from 68 to 52 hours in order to promote work-life balance and work productivity, thereby improving health and well-being. Under the 52-hour work schedule, employees can work up to 40 hours on weekdays and an additional 12 hours of overtime on weekdays and weekends. Employees are guaranteed to receive overtime pay if they work over 40 hours in a workweek at a rate of 1.5 times or more the regular rate of pay. A violation of this new work schedule could subject employers to up to three years in prison or a fine of up to 20 million Korean won (₩). The 52-hour work schedule was implemented in several phases. First, in July 2018 it was introduced in firms with 300 or more employees and in public institutions. This is being gradually expanded to smaller firms (firms with 50 or more employees in January 2020 and firms with five or more employees in July 2021). Second, there were 26 industries exempt under the prior work schedule, but only five

industries (in transport and health care) were exempted from the 52-hour work schedule. For employees in these 21 industries, the new work schedule was initially adopted in firms with 300 or more employees and in public institutions in July 2019, and then gradually expanded to smaller firms (firms with 50 or more employees in January 2020 and firms with five or more employees in July 2021). Employees in any of the remaining five industries were required to have a break of at least 11 continuous hours between work shifts. It is worth noting that complementary policies were also introduced in an effort to encourage new employment by subsidizing wages for new employees.

In this study, we aim to understand the intended and unintended consequences of the implementation of the 52-hour work schedule in South Korea. We conducted three analyses: a main analysis (Part I) and two secondary analyses (Part II). In our main analysis, we comprehensively analyzed the consequences by examining whether the implementation of the 52-hour work schedule was associated with changes in work time, health status, health care utilization, health behavior, monthly expenses, and satisfaction. We carried out this analysis for the entire population as well as by employment type. In our first secondary analysis, we examined characteristics of employees working more than 52 hours per week and employees working less than 52 hours per week under the 52-hour work schedule. In our second secondary analysis, we examined whether implementation of the 52-hour work schedule was associated with an increase in new employment and whether the increase in new employment was disproportionately higher in precarious employment than full-time employment.

2 Part I: Main analysis

2.1 Method

2.1.1 Data and sample

We used data from the Korean Welfare Panel Study (KOWEPS) for 2014–2019, which was conducted by the Korean Institute of Health and Social Affairs and the Social Welfare Research Institute of Seoul National University. The KOWEPS is a longitudinal survey of a nationally representative sample of South Korean households. It annually surveys this sample of roughly 17,000 participants from about 7,000

households. Households are selected using a stratified multistage probability design, and household members aged 15 years or above are included in the data. Data are collected through face-to-face interviews with participants at their home by trained personnel. The KOWEPS is particularly well suited for our analysis because the data are collected with the goal of understanding the economic conditions and welfare demands of South Korean households. It intentionally oversamples individuals with low socioeconomic status, who are more likely to have precarious employment but less likely to be recruited in a survey. This allows us to analyze the consequences of the 52-hour work schedule by employment type.

Using the 2014–2019 KOWEPS, we identified adults (18–65 years of age) who were continuously employed during 2014–2019. We excluded adults who were self-employed, those who remained outside of the labor force, and those with incomplete follow-up during the study period. We created a five-year panel data set for 2014–2019 except for 2018 (Fig. 1). Then, we identified a pair of groups: 1) employees eligible for the 52-hour work schedule and 2) employees exempt from the 52-hour work schedule. We used two criteria to determine whether employees were exempt from the 52-hour work schedule. First, five industries were exempted from the 52-hour work schedule, and therefore we classified by industry: 1) employees in non-exempt industries and 2) employees in the five industries exempt from the 52-hour work schedule. We used the following occupational codes for the Korean Standard Industrial Classification (KSIC) to identify employees in the five industries exempt from the 52-hour work schedule: 49 (land transport), 50 (water transport), 51 (air transport), 529 (transport support activities), and 85 (health care). Second, the 52-hour work schedule was introduced to firms with less than 300 employees in January 2020, and hence we classified by firm size: 1) employees in firms with 300 or more employees and 2) employees in firms with less than 300 employees.

2.1.2 Outcomes

We included six types of outcomes. All outcomes were self-reported and measured as an annual value unless specified. First, we assessed work time using the following three measures: monthly working days, weekly working hours, and whether working hours exceeded more than 52 per week. Second, we assessed

health status using the following three measures: general health status, depression, and presence of chronic disease. General health status was given one of two labels: good (including excellent or very excellent) or poor (including fair). A higher value indicates better health status. Depression was measured using the Korean version of the Center for Epidemiological Studies Depression (CES-D) scale 11 and then assessed using two labels: moderate/severe depression or mild/no depression. The CES-D 11 inquires about 11 items based on the past week on a scale of zero to three. Scores are multiplied by 20/11 for comparability with the standard CES-D 20 score. Scores are usually categorized into the following four groups: no depression (0–9 points), mild depression (10–15 points), moderate depression (16–24 points), or severe depression (more than 25 points). Following prior research, we used a cutoff point of 16 to detect probable depression. Presence of chronic disease was assessed as a binary: yes or no. Third, we assessed annual health care utilization for the following three types of care: number of inpatient admissions, outpatient visits, and checkups. Fourth, we assessed health behaviors using the following six measures: currently smoking cigarettes, how many times per day, how many hours exposed to indirect smoke per day, currently drinking, drinking more than four times per week, and drinking more than seven glasses each time. Fifth, we assessed monthly expenses across the following three domains: out-of-pocket spending on health, smoking or drinking, and leisure. All expenses were inflation adjusted using the 2019 Consumer Price Index in South Korea and reported in Korean won (₩). Finally, we assessed satisfaction across the following three domains: overall, job, and leisure. Five degrees of satisfaction were listed: very dissatisfied, dissatisfied, neutral, satisfied, or very satisfied. A higher value indicates better satisfaction.

2.1.3 Independent variables

There were two primary independent variables. The first was an indicator for the post-implementation period. We defined the pre-implementation period as being from 2014 to 2017 and the post-implementation period as being 2019. The second was an indicator for employment type. We defined employment as full-time if all four of the following conditions were satisfied: 1) direct employment by employers (vs. subcontracted or dispatched employment), 2) full-time employment (vs. part-time employment), 3) non-

fixed-term employment (vs. temporary employment), and 4) employment with high job security (vs. insecure employment). We defined employment as precarious if any of the above conditions were not satisfied.

To control for differences in characteristics, we included the following covariates: age, sex, educational level, marital status, household income, tenure at the current workplace, residence location, and number of households.

2.1.4 Statistical analysis

We first examined distributions of weekly working hours for each pair of groups across the following three periods: the pre-implementation period (2014–2017), the implementation period (2018), and the post-implementation period (2019). We then estimated distributions of three measures for work time in each year from 2014 to 2019, for all employees and stratified by employment type. When stratified by employment type, we limited our sample to employees with continuous full-time employment status or employees with continuous precarious employment status throughout the study period. We reported the sample characteristics in the year prior to the implementation of the policy (2017).

We estimated adjusted changes in the outcomes associated with the implementation of the 52-hour work schedule. We first used an inverse-probability weighting with the propensity scores method to balance observed variables between employees eligible for the 52-hour work schedule and employees exempt from it. Specifically, we used logistic regression to estimate the inverse probability of treatment weighting using propensity scores as a function of all variables described above, including outcomes and covariates. Then we used difference-in-difference models with individual fixed effects. Fixed-effect models allow us to control for all time-invariant unobserved factors. Specifically, we used a multivariate linear regression model for continuous outcomes and a linear probability model for binary outcomes. All models controlled for all covariates described above, as well as the indicator for the post-implementation period, the indicator for employees eligible for the 52-hour work schedule, and the interaction between these two indicators as follows:

$$Y_{it} = \alpha_t + \beta_1 Post_t + \beta_2 52hour_i + \beta_3 Post \times 52hour_{it} + X_i\gamma + Z_{it}\delta + \varepsilon_{it}$$

In this equation, Y_{it} is the outcome at time t for individual i , α_t is the intercept at time t . β_1 , β_2 , β_3 are the coefficients for the indicator for the post-implementation period, the indicator for employees eligible for the 52-hour work schedule, and the interaction between these two indicators. γ is the vector of coefficients for all time-constant individual characteristics, δ is the vector of coefficients for all time-invariant characteristics. ε is the idiosyncratic error term that is time varying. It is notable that the vector of time-constant characteristics, $X_i\gamma$, was removed from our fixed-effect models.

We ran models for all employees as well as by employment type. Using the predictive marginal effects at representative values estimated from the difference-in-difference model with fixed effects, we estimated the predicted mean values of the outcomes for employees eligible for the 52-hour work schedule and employees exempted from the 52-hour work schedule in the pre- and post-implementation periods, respectively. This method calculates the mean predicted outcome value while holding constant all other variables except the variable of interest, allowing us to compare the outcome of interest between employees eligible for the 52-hour work schedule and employees exempted from the 52-hour work schedule in the pre- and post-implementation periods. We then conducted post-estimation tests to estimate the differences in the outcomes between the pre- and post-implementation periods and reported the differences as changes associated with the implementation of the 52-hour work schedule.

Although fixed-effect models enable us to control for time-invariant unobserved characteristics, there may be unobserved time-variant factors that affect our outcomes. Thus, we also considered an instrumental variable (IV) approach. To capture exogenous variation in policy implementation, we used two instrument candidates: 1) the indicator for employees in the five industries exempt from the 52-hour schedule and 2) the indicator for employees in firms with less than 300 employees. Each of the instruments must satisfy two requirements: to be statistically strong and validly excluded from the main equation. To assess instrument strength, we tested whether each of the instruments was correlated with the treatment of interest (weekly working hours and whether working more than 52 hours per week). We found that the first

instrument candidate was significantly predictive of the likelihoods of having greater weekly working hours as well as working more than 52 hours per week. However, such a significant relationship was not observed in the second instrument candidate. Furthermore, when we tested the strength of these instrument candidates, we found a F-statistics lower than ten, indicating a weak instrument. Since use of a weak instrument could affect the validity of findings by leading to finite sample bias, we decided to use difference-in-difference models with fixed effects. We used survey weights to create national estimates. We adjusted the standard errors for clustering within individuals. All P values were from two-sided tests, and results were deemed statistically significant at $P < .05$.

2.1.5 Sensitivity analysis

We conducted several sensitivity analyses. First, fixed-effect models can eliminate any time-invariant unobserved characteristics, but certain time-varying unobserved characteristics absorbed in the error term can influence both work time and health status. To rule out this possibility, we examined whether work time in the current year was associated with health status in the prior years. Specifically, we conducted linear probability models with one- to three-year lagged values of the three measures for health status as independent variables and each of the three measures for working time as an outcome. Second, 26 industries were exempt under the original rule of the 52-hour work schedule, but 21 industries were no longer exempt from the revised rule (KSIC codes in Appendix Table A.1). Since the 52-hour work schedule was introduced to employees in 21 industries in July 2019, we performed the difference-in-difference models with fixed effects described above by excluding employees in the 21 industries from our analysis.

2.2 Results

2.2.1 Descriptive statistics

Our sample included a balanced panel of 1,862 employees for 2014–2019 (Table 1). For all employees, mean weekly working hours decreased from 44.19 hours in 2017 to 42.92 hours in 2019. The proportion of working more than 52 hours per week also decreased from 17.08% in 2017 to 14.12% in 2019. However,

there were negligible changes in monthly working days. When stratified by industry and firm size, the largest proportion of employees worked between 40 and 42.5 hours per week and the proportion increased in the post-implementation period relative to the pre-implementation period (Figs. 2–5). The proportion was particularly high for employees in non-exempt industries and employees in firms with 300 or more employees (Figs. 2 and 5). Also, employees in the five industries exempt from the 52-hour work schedule and employees in firms with less than 300 employees had a relatively high proportion of working more than 52 hours per week in the post-implementation period (Figs. 3 and 4). Descriptive statistics of working time by industry and firm size are reported in Appendix Table A.2.

Our sample also included a balanced panel of 895 full-time employees and 269 precarious employees (Table 1). Weekly working hours decreased for full-time employees as well as precarious employees between 2017 and 2019 (44.84 hours to 43.32 hours for full-time employees and 39.56 hours to 38.54 hours for precarious employees). Also, the proportion of employees working more than 52 hours per week decreased between 2017 and 2019 (14.08% to 11.06% for full-time employees and 13.06% to 9.70% for precarious employees). However, there were no or negligible changes in monthly working days. It is worth noting that precarious employees had shorter weekly working hours and a smaller proportion of people working more than 52 hours per week than did full-time employees.

Sample characteristics classified by employment type are reported in Appendix Table A.3. There are several notable sample characteristics. For all employees, 8.59% were in non-exempt industries and 28.03% worked in firms with 300 or more employees. Differences in sample characteristics between full-time employees and precarious employees were of particular interest. Compared to full-time employees, precarious employees were more likely to be older, female, to have no college degree, to be divorced/separated or widowed, to have lower household income, to have a shorter work history at the current workplace, to have a smaller household, and to work in firms with less than 300 employees. However, no significant difference was observed by industry.

2.2.2 Main results by industry

While implementing the 52-hour work schedule was associated with decreases in working time and increases in leisure-related outcomes among employees in non-exempt industries, changes in other outcomes were limited and the changes were bidirectional (Table 2). Monthly working days and weekly working hours decreased by 0.280 and 1.221. The likelihood of working more than 52 hours per week decreased by 3.4 percentage points. Monthly expenses for health care, smoking or drinking, and leisure increased, but the magnitude of the increase was the largest for leisure (~~₩~~75,180). Also, leisure satisfaction increased by 0.054. However, changes in health status, health care utilization, and health behaviors were limited and the direction of the changes was mixed. On the one hand, the likelihood of reporting health status as good decreased by 3.1 percentage points, the number of outpatient visits increased slightly by 0.872, and the likelihood of drinking increased by 3.0 percentage points. On the other hand, the likelihood of having depression decreased by 2.5 percentage points. However, we did not detect significant changes in other outcomes. There were no significant changes in the outcomes among employees in the five exempt industries except for monthly expenses for leisure.

The changes in the outcomes associated with the implementation of the 52-hour work schedule were heterogeneous by employment type. For full-time employees in non-exempt industries, weekly working hours decreased by 1.387 and the likelihood of working more than 52 hours per week decreased by 5.9 percentage points (Table 3). Monthly expenses for health care, smoking or drinking, and leisure increased, and the extent of the increase was the largest for leisure (~~₩~~99,280). However, job satisfaction decreased by 0.106. We did not find significant changes in other outcomes. For full-time employees in the five exempt industries, there were no significant changes in the outcomes except for monthly expenses for leisure. For precarious employees in non-exempt industries, on the other hand, working time did not change (Table 4). However, significant changes in other outcomes were found and the changes were bidirectional. Health status, health behaviors, and satisfaction improved to some extent. The likelihood of having depression decreased by 10.2 percentage points. Although the likelihood of drinking increased by 32.4 percentage points, the likelihood of smoking or of drinking more than seven glasses of alcohol at a time decreased by 32.4 and 36.3 percentage points, respectively. However, there was suggestive evidence of

adverse health consequences. The number of outpatient visits substantially increased by 5.849. While monthly expenses increased in all domains, a substantial increase was observed for health care (₩80,710). A similar result was shown among precarious employees in the five exempt industries. The likelihood of drinking increased by 73.5 percentage points, but the likelihood of drinking more than seven glasses each time decreased by 83.0 percentage points. However, there were several notable differences. First, monthly working days decreased by 2.223. Second, we found more pronounced adverse consequences. The likelihood of having chronic disease increased by 57.3 percentage points and monthly expenses for health care were higher (₩101,660). Moreover, all satisfaction measures decreased (1.273 for overall satisfaction, 1.381 for job satisfaction, and 1.129 for leisure satisfaction).

2.2.3 Main results by firm size

Whereas implementing the 52-hour work schedule was associated with decreases in working time among employees in firms with 300 employees or more as well in firms with less than 300 employees, we found different patterns of changes in other outcomes (Table 5). For employees in firms with 300 employees or more, weekly working hours decreased by 1.012. Monthly expenses for health care and leisure increased, but the magnitude of the increase for leisure was substantial (₩122,450). However, it is notable that overall satisfaction and job satisfaction decreased by 0.165 and 0.117, respectively. We did not detect significant changes in health status, health care utilization, and health behavior except for checkup visits. For employees in firms with less than 300 employees, we also found decreases in working time. Weekly working hours decreased by 1.112 and the likelihood of working more than 52 hours per week decreased by 2.6 percentage points. There were significant changes in health status, health care utilization, and health behaviors, but the direction of the changes was mixed. On the one hand, health behaviors and satisfaction improved. Although the likelihood of drinking increased by 4.1 percentage points, the likelihood of smoking decreased by 2.1 percentage points and the number of times per day decreased by 3.06. Also, leisure satisfaction increased by 0.139. On the other hand, we found suggestive evidence of adverse health

consequences. The likelihood of reporting health status as good decreased by 3.7 percentage points, and the number of outpatient visits increased by 1.762.

Changes in the outcomes differed by employment status. For full-time employees in firms with 300 employees or more, there was no significant change in working time (Table 6). We detected limited changes in other outcomes, and the changes were bidirectional. The number of inpatient visits slightly decreased, by 0.034. Monthly expenses for health care and leisure increased and the extent of the increase for leisure was substantial (₩128,690). However, a notable result was that overall satisfaction decreased by 0.140. For full-time employees in firms with less than 300 employees, weekly working hours decreased by 1.167 and the likelihood of working more than 52 hours per week decreased by 4.3 percentage points. The number of outpatient visits increased by 2.666. However, we found slight improvements in health behaviors and satisfaction. While the likelihood of drinking increased by 5.7 percentage points, the likelihood of drinking more than four times per week decreased by 5.3 percentage points. Monthly expenses for health care and leisure increased, but the magnitude of the increase was greater for leisure than health care. Furthermore, leisure satisfaction increased by 0.128.

For precarious employees in firms with 300 employees or more, the likelihood of working more than 52 hours per week decreased by 13.3 percentage points (Table 7). However, we detected unhealthy behaviors. The likelihood of drinking more than four times per week increased by 12.0 percentage points. Also, monthly expenses increased only for smoking or drinking (₩35,550). For precarious employees in firms with less than 300 employees, we did not observe significant changes in working time. However, there were significant changes in other outcomes and the direction of the changes was inconsistent. On the one hand, we found improvements in health status, health behaviors, and satisfaction. The likelihood of having depression decreased by 9.4 percentage points. Although the likelihood of drinking increased by 6.6 percentage points, the likelihood of drinking more than seven glasses each time decreased by 10.8 percentage points. The likelihood of smoking decreased by 3.6 percentage points and the number of times per day decreased by 0.718. Furthermore, leisure satisfaction increased by 0.148. On the other hand, there

was a precursor for adverse health consequences. The number of outpatient visits substantially increased by 3.583 and monthly expenses increased only for health care (₩60,830).

2.2.4 Results from sensitivity analyses

There were no significant associations between working time in the current year and health status in the prior three years, suggesting that decreases in working time were not attributable to poor health status (Appendix Tables A.4–A.6).

Our main findings were robust to sensitivity analyses excluding employees in the 21 newly non-exempt industries, but there were several differences. For employees in non-exempt industries, we observed a similar magnitude of decreases in working time and increases in monthly expenses (Appendix Table A.7). However, significant changes in health status and leisure satisfaction were not found in sensitivity analyses. For employees in firms with 300 or more employees, robust findings were found in terms of a substantial increase in monthly expenses for leisure and decreases in all satisfaction measures (Appendix Table A.8). However, a significant decrease in weekly working hours was not observed in the sensitivity analyses. For employees in firms with less than 300 employees, weekly working hours and the likelihood of working more than 52 hours per week decreased, as shown in our main findings. However, changes in general health status and outpatient visits were not found in the sensitivity analyses.

3 Part II: Secondary analysis

3.1 Method

3.1.1 Data and sample

Using the KOWEPS, we identified a distinct population for each secondary analysis. For our first secondary analysis, we used the same population as in our main analysis but focused on the data for 2019 (Fig. 1). For our second secondary analysis, we used the KOWEPS for 2017–2019 and identified adults (18–65 years of age) who were unemployed but were actively looking for a job in 2017 or 2018. We excluded adults who were self-employed, those who remained outside the labor force, and those whose follow-up across the

study period remained incomplete. Then, we created two-year panel data sets (2017–2018 and 2018–2019) (Fig. 1).

3.1.2 Outcomes

We had separate outcomes for each secondary analysis. For our first secondary analysis, we assessed whether employees worked more than 52 hours per week in 2019. For our second secondary analysis, we assessed employment status in the second year of each panel, using the following three measures: newly employed, newly employed as a full-time employee, and newly employed as a precarious employee.

3.1.3 Independent variables

Our primary independent variable was a binary indicator for the post-implementation period. We defined the pre-implementation period as the first year of each panel (2017 or 2018) and the post-implementation period as the second year of each panel (2018 or 2019). We treated 2018 in the 2017–2018 panel data as the post-implementation period because although the 52-hour work schedule went into effect in July 2018, the implementation was announced prior to 2018. This indicates that employers might have developed hiring plans for 2018 by accounting for the 52-hour work schedule. We used the same covariates described in our main analysis except for years of tenure at the current workplace.

3.1.4 Statistical analysis

We first sampled characteristics and tested differences between those newly employed and those who remained unemployed, and between those newly employed as a full-time employee and those newly employed as a precarious employee. We used analysis of variance for continuous variables and chi-square tests for categorical variables. We reported the sample characteristics in the second year of each panel. We had a distinct statistical analysis for each secondary analysis. For our first secondary analysis, we reported descriptive statistics. We estimated sample characteristics and tested differences between employees working less than 52 hours per week and employees working more than 52 hours per week in 2019. For

our second secondary analysis, we used a linear probability model with fixed effects to examine whether implementing the 52-hour work schedule was associated with an increase in new employment. We ran the model for all employees regardless of employment status as well as by employment status. All models controlled for all covariates described above and adjusted the standard errors for clustering within individuals. We used survey weights to create national estimates.

3.2 Results

3.2.1 Results from the first secondary analysis

Of 1,862 employees, 16.44% worked more than 52 hours per week even after the 52-hour work schedule was implemented (Table 8). Compared to employees working less than 52 hours per week, employees working more than 52 hours per week were more likely to be older, male, to have no college degree, to have a lower household income, to have a smaller household, and to be employed in the five industries exempt from the 52-hour work schedule. However, they were more likely to have a long tenure at their current workplace and to work in a firm with 300 employees or more. No significant difference was observed by employment type.

3.2.2 Results from the second secondary analysis

Of 199 unemployed in the pre-implementation period, 56.29% were newly employed in the post-implementation period (Appendix Table A.9). Compared to those who remained unemployed, those newly employed were more likely to be female. However, no significant differences were found in other sample characteristics. Of the 112 newly employed, 28.57% were full-time employees and 71.43% were precarious employees. Compared to those newly employed as a full-time employee, those newly employed as a precarious employee were more likely to be older, to have lower household income, and to work in firms with less than 300 employees. There were no significant differences in other sample characteristics. However, it is worth noting that those newly employed as a precarious employee had similarities in sample

characteristics with those who still remained unemployed rather than those newly employed as a full-time employee.

The implementation of the 52-hour work schedule was associated with a 59.9 percentage point increase in new employment overall (Table 9). When stratified by employment type, the increase in new employment was observed in both full-time employment and precarious employment. However, the magnitude of the increase was greater for precarious employment than full-time employment (43.1 vs. 16.8 percentage points).

4 Discussion

Our study is the first to examine the effectiveness of the implementation of the 52-hour work schedule in South Korea. Our findings show evidence of the intended and unintended consequences of the 52-hour work schedule. There were multiple unintended consequences, but the most notable finding was that there were heterogeneous consequences by employment type and more adverse unintended consequences were detected among precarious employees. These findings suggest key policy implications for how to improve the 52-hour work schedule while addressing its unintended consequences.

Our study found that work time decreased for employees eligible for the 52-hour work schedule as well as some employees exempt from the 52-hour work schedule, but there was little evidence of improved health and well-being. Particularly, a decrease in working time for employees in firms with less than 300 employees was notable because these firms were not required to implement the new schedule until January 2020. This may reflect forward-looking behavior in marginal firms that voluntarily adopted the schedule earlier than required to attract talent in a competitive hiring market. We observed suggestive evidence for improving well-being attributable to a substantial increase in leisure expenses, but there were limited changes in health status, health care utilization, and health behaviors. There may be multiple explanations for the limited changes. First, it may be too early to induce significant behavioral changes, and thus our findings may merely capture the short-term effects of implementation. Second, the decrease in working time may not be sufficiently large to lead to improvements in health and well-being. On average, our

estimates show that weekly working hours decreased by one hour. Finally, merely reducing working time may be necessary but not sufficient to improve health and well-being. Affecting these variables may require additional employment policies that go further to improve the quality of work and the working environment.

The main contribution of our study was to show that the consequences of the 52-hour work schedule were heterogeneous by employment type. For precarious employees, the length of the workweek barely changed. This may be, in part, due to the fact that precarious employees tended to work fewer hours before the implementation of the 52-hour work schedule than full-time employees. However, adverse consequences were more pronounced among precarious employees. Although clear evidence was not found that health status substantially deteriorated, there was suggestive evidence of adverse health consequences. Outpatient visits and spending on health care substantially increased and unhealthy behaviors were observed, suggesting a precursor to poor health. There may be multiple explanations for these findings, but one potential explanation may be related to job insecurity. Since precarious employment is accompanied by fewer benefits and more limited or uncertain employment tenure, precarious employees tend to experience anxiety about job loss and an uncertain future overall, possibly triggering unhealthy behaviors and poor health [25, 26]. Such adverse consequences were more evident among precarious employees in the five industries exempt from the 52-hour work schedule, showing decreases across all satisfaction measures. This indicates that this population is at higher risk due to a lack of social protection around job security and working time. Consequently, additional policies need to be developed to address the adverse consequences observed among precarious employees, especially those in the five industries exempt from the 52-hour work schedule.

Identifying how to further improve the 52-hour work schedule would be of great relevance and deserves further attention. Overall and/or job satisfaction decreased among several groups of employees whose work time decreased as a result of the 52-hour work schedule. This may be explained by their high likelihood of working more than 52 hours even after the implementation of the 52-hour work schedule. Specifically, this pattern was prevalent among experienced employees or employees in firms with 300 or more employees. This suggests that these employees cannot be easily replaced with new employees, and

thus may experience a heavier workload or higher work intensity, leading to poor satisfaction. Moreover, we found that employment increased after implementing the 52-hour work schedule, but the majority was precarious employment that tends to be less stable, part-time, temporary, and low skilled. In particular, research has reported that precarious employees in South Korea are subject to social exclusion and discrimination in terms of wage rates and working conditions [27]. This has negative implications not only for new precarious employees, due to the potential adverse health impacts of precarious employment, but also for existing employees due to a heavy workload and high work intensity. Furthermore, this may have negative implications for employers because long working time deteriorates not only employees' health [4–6, 10–13] but also productivity [29], possibly incurring greater opportunity costs such as the recruitment and training of new employees. Taken together, our findings point to the importance of developing employment policies and practices designed to promote high-quality employment, and thus improving work productivity while providing job security.

Our findings should be interpreted keeping in mind several caveats. First, our findings should be interpreted as early evidence because the post-implementation period covered only one year after the implementation of the 52-hour work schedule. Additional research using multiple years of data is warranted to examine whether the implementation of the 52-hour work schedule translates into long-term improvements in health and well-being. Second, our findings may not necessarily be applicable to the general population because our sample included disproportionately more adults with lower socioeconomic status than adults in the entire population. Further investigation exploring the consequences for the general population is warranted. Third, we should be cautious in interpreting our findings as causal relations because there may be unobserved time-variant factors that affect our outcomes. For example, unobserved health shocks such as a new diagnosis of disease may lead to decreased work time. However, our sensitivity analysis showed that such reverse causality is unlikely. Finally, some outcomes may be interpreted in multiple ways, but our interpretation relied on a certain assumption. For example, we assumed that an increase in outpatient visits does not necessarily mean poor health status as it may reflect that employees

have time to see a doctor. Similarly, we assumed that an increase in the likelihood of drinking does not necessarily indicate an unhealthy behavior unless the drinking is heavy.

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Table 1. Descriptive statistics of work time.

	N	Mean (SD)	Weekly working hours			Whether worked more than 52 hours per week, %	Monthly working days, mean (SD)
			25 th percentile	50 th percentile	75 th percentile		
All employees							
2014	1862	43.94 (11.06)	40.00	50.00	60.00	17.88	21.11 (3.52)
2015	1862	43.86 (11.26)	40.00	48.00	58.50	16.17	21.03 (3.53)
2016	1862	43.86 (10.18)	40.00	48.00	56.00	15.90	21.04 (3.07)
2017	1862	44.19 (10.22)	40.00	49.00	58.00	17.08	21.13 (3.08)
2018	1862	43.46 (10.00)	40.00	48.00	56.00	14.98	21.07 (3.03)
2019	1862	42.92 (9.90)	40.00	48.00	55.00	14.12	20.87 (2.76)
Full-time employees							
2014	895	44.73 (8.56)	40.00	48.00	56.00	16.65	21.18 (2.81)
2015	895	44.58 (9.04)	40.00	48.00	56.00	15.87	20.96 (3.19)
2016	895	44.39 (8.66)	40.00	48.00	55.00	13.63	20.99 (2.74)
2017	895	44.84 (8.31)	40.00	48.00	55.00	14.08	21.10 (2.61)
2018	895	44.13 (8.39)	40.00	48.00	55.00	13.74	21.07 (2.63)
2019	895	43.32 (7.56)	40.00	45.00	52.00	11.06	20.78 (2.43)
Precarious employees							
2014	268	38.31 (15.16)	30.00	48.00	54.00	12.31	19.91 (4.70)
2015	268	40.11 (15.36)	30.00	48.00	56.00	11.94	20.53 (4.22)
2016	268	40.07 (13.39)	35.00	48.00	55.00	11.94	20.38 (3.64)
2017	268	39.56 (13.93)	35.00	48.00	55.00	13.06	20.24 (3.89)
2018	268	38.65 (12.64)	30.00	48.00	50.00	9.33	20.38 (3.76)
2019	268	38.54 (13.32)	30.00	45.00	54.00	9.70	20.28 (3.47)

Table 2. Changes associated with the implementation of the 52-hour work schedule in outcomes for all employees by industry.

Outcomes	Estimate (95% CI)	
	Employees in non-exempt industries	Employees in five exempt industries
Work time		
Monthly working days	-0.280 (-0.461 to -0.099)	-0.042 (-0.723 to 0.640)
Weekly working hours	-1.221 (-1.752 to -0.690)	-1.165 (-2.691 to 0.361)
Whether worked more than 52 hours per week	-0.034 (-0.056 to -0.012)	-0.061 (-0.132 to 0.011)
Health status		
General health status	-0.031 (-0.054 to -0.008)	0.024 (-0.040 to 0.087)
Depression	-0.025 (-0.047 to -0.002)	-0.006 (-0.068 to 0.056)
Chronic disease	0.016 (-0.011 to 0.042)	0.039 (-0.043 to 0.120)
Health care utilization		
Number of inpatient admissions	0.004 (-0.014 to 0.021)	-0.012 (-0.067 to 0.043)
Number of outpatient visits	0.872 (0.008 to 1.735)	0.342 (-1.599 to 2.282)
Number of checkups	-0.006 (-0.038 to 0.026)	0.034 (-0.054 to 0.123)
Health behavior		
Whether currently smoking	-0.009 (-0.023 to 0.004)	0.015 (-0.02 to 0.050)
How many times smoking per day	-0.195 (-0.421 to 0.032)	0.074 (-0.581 to 0.728)
How many hours exposed to indirect smoking per day	-0.021 (-0.047 to 0.004)	-0.023 (-0.112 to 0.065)
Whether currently drinking	0.030 (0.008 to 0.051)	-0.010 (-0.070 to 0.051)
Whether drinking more than 4 times per week	-0.010 (-0.024 to 0.004)	0.004 (-0.052 to 0.060)
Whether drinking more than 7 glasses each time	-0.017 (-0.046 to 0.013)	0.048 (-0.037 to 0.133)
Monthly expense (¥10,000)		
Health care	4.066 (2.696 to 5.435)	1.484 (-2.124 to 5.091)
Smoking or drinking	0.665 (0.261 to 1.070)	0.356 (-0.518 to 1.231)
Leisure	7.518 (5.688 to 9.349)	9.793 (3.276 to 16.311)
Satisfaction (1–5 scale)		
Overall	-0.005 (-0.041 to 0.031)	0.021 (-0.093 to 0.136)
Job	-0.027 (-0.072 to 0.018)	0.073 (-0.044 to 0.191)
Leisure	0.054 (0.004 to 0.105)	0.057 (-0.111 to 0.224)

Bold characters indicate statistical significance ($p < .05$).

Table 3. Changes associated with the implementation of the 52-hour work schedule in outcomes for full-time employees by industry.

Outcomes	Estimate (95% CI)	
	Full-time employees in non-exempt industries	Full-time employees in five exempt industries
Work time		
Monthly working days	-0.235 (-0.491 to 0.021)	-0.069 (-0.825 to 0.687)
Weekly working hours	-1.387 (-2.079 to -0.695)	-1.351 (-2.958 to 0.256)
Whether worked more than 52 hours per week	-0.059 (-0.094 to -0.024)	-0.107 (-0.205 to -0.008)
Health status		
General health status	-0.003 (-0.034 to 0.028)	0.040 (-0.025 to 0.104)
Depression	-0.013 (-0.046 to 0.019)	-0.043 (-0.098 to 0.013)
Chronic disease	0.029 (-0.011 to 0.068)	0.014 (-0.094 to 0.122)
Health care utilization		
Number of inpatient admissions	-0.009 (-0.032 to 0.015)	-0.032 (-0.116 to 0.053)
Number of outpatient visits	0.429 (-0.883 to 1.742)	-1.289 (-3.789 to 1.211)
Number of checkups	-0.027 (-0.076 to 0.022)	0.029 (-0.090 to 0.149)
Health behavior		
Whether currently smoking	-0.004 (-0.025 to 0.018)	0.027 (-0.022 to 0.077)
How many times smoking per day	0.054 (-0.309 to 0.416)	0.711 (-0.092 to 1.515)
How many hours exposed to indirect smoking per day	-0.053 (-0.120 to 0.014)	-0.094 (-0.291 to 0.104)
Whether currently drinking	0.028 (-0.008 to 0.064)	-0.006 (-0.080 to 0.069)
Whether drinking more than 4 times per week	-0.019 (-0.039 to 0.001)	0.007 (-0.053 to 0.067)
Whether drinking more than 7 glasses each time	-0.003 (-0.049 to 0.043)	0.011 (-0.102 to 0.124)
Monthly expense (₩10,000)		
Health care	2.769 (0.732 to 4.807)	0.797 (-4.67 to 6.265)
Smoking or drinking	0.318 (-0.28 to 0.916)	0.309 (-0.895 to 1.514)
Leisure	9.928 (6.587 to 13.268)	16.546 (6.511 to 26.581)
Satisfaction (1–5 scale)		
Overall	-0.101 (-0.157 to -0.044)	0.016 (-0.111 to 0.142)
Job	-0.106 (-0.172 to -0.040)	0.013 (-0.150 to 0.177)
Leisure	-0.014 (-0.094 to 0.066)	0.113 (-0.133 to 0.360)

Bold characters indicate statistical significance ($p < .05$).

Table 4. Changes associated with the implementation of the 52-hour work schedule in outcomes for precarious employees by industry.

Outcomes	Estimate (95% CI)	
	Precarious employees in non-exempt industries	Precarious employees in five exempt industries
Work time		
Monthly working days	0.552 (-0.709 to 1.813)	-2.223 (-4.169 to -0.277)
Weekly working hours	-0.838 (-2.409 to 0.733)	-2.841 (-7.930 to 2.248)
Whether worked more than 52 hours per week	-0.004 (-0.054 to 0.046)	-0.179 (-0.363 to 0.005)
Health status		
General health status	-0.111 (-0.36 to 0.137)	-0.341 (-0.792 to 0.109)
Depression	-0.102 (-0.156 to -0.049)	0.089 (-0.038 to 0.217)
Chronic disease	0.118 (-0.129 to 0.365)	0.573 (0.268 to 0.879)
Health care utilization		
Number of inpatient admissions	0.043 (-0.006 to 0.091)	0.038 (-0.045 to 0.12)
Number of outpatient visits	5.849 (0.301 to 11.398)	6.049 (-1.156 to 13.255)
Number of checkups	-0.009 (-0.085 to 0.067)	0.161 (-0.043 to 0.366)
Health behavior		
Whether currently smoking	-0.030 (-0.059 to -0.001)	-0.016 (-0.110 to 0.077)
How many times smoking per day	-0.580 (-1.202 to 0.043)	-0.427 (-1.841 to 0.986)
How many hours exposed to indirect smoking per day	-0.011 (-0.034 to 0.013)	0.060 (-0.032 to 0.152)
Whether currently drinking	0.324 (0.077 to 0.571)	0.735 (0.185 to 1.284)
Whether drinking more than 4 times per week	-0.027 (-0.065 to 0.010)	0.112 (-0.081 to 0.306)
Whether drinking more than 7 glasses each time	-0.363 (-0.613 to -0.113)	-0.830 (-1.323 to -0.336)
Monthly expense (₩10,000)		
Health care	8.071 (4.260 to 11.882)	10.166 (4.280 to 16.052)
Smoking or drinking	1.508 (0.401 to 2.615)	2.078 (0.380 to 3.775)
Leisure	3.983 (0.820 to 7.145)	2.324 (-2.729 to 7.376)
Satisfaction (1–5 scale)		
Overall	0.138 (0.022 to 0.254)	-1.273 (-1.910 to -0.636)
Job	0.068 (-0.071 to 0.207)	-1.381 (-1.907 to -0.854)
Leisure	-0.296 (-0.805 to 0.213)	-1.129 (-2.087 to -0.17)

Bold characters indicate statistical significance ($p < .05$).

Table 5. Changes associated with the implementation of the 52-hour work schedule in outcomes for all employees by firm size.

Outcomes	Estimate (95% CI)	
	Employees in firms with 300 or more employees	Employees in firms with less than 300 employees
Work time		
Monthly working days	-0.139 (-0.53 to 0.252)	-0.156 (-0.372 to 0.06)
Weekly working hours	-1.012 (-1.959 to -0.065)	-1.112 (-1.699 to -0.526)
Whether worked more than 52 hours per week	-0.011 (-0.051 to 0.03)	-0.026 (-0.05 to -0.003)
Health status		
General health status	-0.017 (-0.098 to 0.064)	-0.037 (-0.066 to -0.008)
Depression	0.020 (-0.033 to 0.073)	-0.019 (-0.043 to 0.006)
Chronic disease	0.028 (-0.044 to 0.101)	0.019 (-0.016 to 0.054)
Health care utilization		
Number of inpatient admissions	-0.012 (-0.04 to 0.016)	0.005 (-0.015 to 0.024)
Number of outpatient visits	-0.78 (-2.17 to 0.611)	1.762 (0.504 to 3.019)
Number of checkups	-0.109 (-0.188 to -0.03)	0.009 (-0.026 to 0.043)
Health behavior		
Whether currently smoking	-0.004 (-0.023 to 0.014)	-0.021 (-0.039 to -0.003)
How many times smoking per day	-0.03 (-0.31 to 0.249)	-0.306 (-0.585 to -0.028)
How many hours exposed to indirect smoking per day	0.02 (-0.034 to 0.073)	-0.008 (-0.031 to 0.015)
Whether currently drinking	-0.002 (-0.044 to 0.04)	0.041 (0.017 to 0.065)
Whether drinking more than 4 times per week	0.019 (-0.018 to 0.057)	-0.028 (-0.051 to -0.005)
Whether drinking more than 7 glasses each time	-0.012 (-0.097 to 0.074)	-0.024 (-0.058 to 0.009)
Monthly expense (₩10,000)		
Health care	3.903 (0.526 to 7.28)	4.628 (2.894 to 6.363)
Smoking or drinking	0.684 (-0.004 to 1.372)	0.489 (0.029 to 0.949)
Leisure	12.245 (8.309 to 16.181)	6.848 (4.465 to 9.231)
Satisfaction (1–5 scale)		
Overall	-0.165 (-0.272 to -0.057)	0.035 (-0.005 to 0.075)
Job	-0.117 (-0.228 to -0.006)	0.02 (-0.031 to 0.071)
Leisure	-0.155 (-0.298 to -0.012)	0.139 (0.081 to 0.196)

Bold characters indicate statistical significance ($p < .05$).

Table 6. Changes associated with the implementation of the 52-hour work schedule in outcomes for full-time employees by firm size.

Outcomes	Estimate (95% CI)	
	Full-time employees in firms with 300 or more employees	Full-time employees in firms with less than 300 employees
Work time		
Monthly working days	0.054 (-0.421 to 0.530)	-0.097 (-0.573 to 0.379)
Weekly working hours	-0.217 (-1.460 to 1.027)	-1.167 (-2.116 to -0.217)
Whether worked more than 52 hours per week	0.036 (-0.032 to 0.105)	-0.043 (-0.08 to -0.005)
Health status		
General health status	-0.004 (-0.058 to 0.050)	-0.027 (-0.075 to 0.021)
Depression	0.007 (-0.040 to 0.055)	-0.004 (-0.043 to 0.035)
Chronic disease	0.017 (-0.041 to 0.074)	0.05 (-0.012 to 0.112)
Health care utilization		
Number of inpatient admissions	-0.034 (-0.066 to -0.002)	-0.011 (-0.038 to 0.017)
Number of outpatient visits	-0.413 (-1.816 to 0.989)	2.666 (0.011 to 5.320)
Number of checkups	-0.05 (-0.106 to 0.007)	0.004 (-0.05 to 0.058)
Health behavior		
Whether currently smoking	-0.003 (-0.027 to 0.021)	-0.027 (-0.065 to 0.010)
How many times smoking per day	-0.001 (-0.387 to 0.385)	-0.264 (-0.800 to 0.273)
How many hours exposed to indirect smoking per day	-0.015 (-0.058 to 0.028)	-0.006 (-0.048 to 0.036)
Whether currently drinking	-0.028 (-0.095 to 0.038)	0.057 (0.011 to 0.104)
Whether drinking more than 4 times per week	0.035 (-0.019 to 0.090)	-0.053 (-0.102 to -0.005)
Whether drinking more than 7 glasses each time	0.053 (-0.027 to 0.134)	-0.037 (-0.096 to 0.022)
Monthly expense (¥10,000)		
Health care	4.148 (0.806 to 7.489)	5.080 (1.561 to 8.599)
Smoking or drinking	0.062 (-0.815 to 0.938)	0.002 (-0.826 to 0.830)
Leisure	12.869 (8.718 to 17.021)	6.583 (2.101 to 11.064)
Satisfaction (1–5 scale)		
Overall	-0.140 (-0.256 to -0.025)	-0.026 (-0.084 to 0.031)
Job	-0.117 (-0.236 to 0.001)	-0.021 (-0.111 to 0.069)
Leisure	-0.051 (-0.178 to 0.076)	0.128 (0.035 to 0.221)

Bold characters indicate statistical significance ($p < .05$).

Table 7. Changes associated with the implementation of the 52-hour work schedule in outcomes for precarious employees by firm size.

Outcomes	Estimate (95% CI)	
	Precarious employees in firms with 300 or more employees	Precarious employees in firms with less than 300 employees
Work time		
Monthly working days	-0.711 (-2.148 to 0.726)	-0.170 (-0.687 to 0.346)
Weekly working hours	-2.346 (-4.784 to 0.092)	-1.225 (-2.880 to 0.430)
Whether worked more than 52 hours per week	-0.133 (-0.223 to -0.043)	-0.015 (-0.068 to 0.037)
Health status		
General health status	-0.188 (-0.542 to 0.167)	-0.024 (-0.095 to 0.047)
Depression	-0.024 (-0.102 to 0.055)	-0.094 (-0.151 to -0.038)
Chronic disease	-0.238 (-0.629 to 0.152)	0.034 (-0.045 to 0.113)
Health care utilization		
Number of inpatient admissions	0.011 (-0.083 to 0.105)	0.047 (-0.006 to 0.100)
Number of outpatient visits	-12.285 (-26.116 to 1.546)	3.583 (0.931 to 6.235)
Number of checkups	-0.018 (-0.236 to 0.200)	-0.004 (-0.082 to 0.075)
Health behavior		
Whether currently smoking	-0.012 (-0.037 to 0.012)	-0.036 (-0.067 to -0.005)
How many times smoking per day	0.004 (-0.672 to 0.681)	-0.718 (-1.335 to -0.101)
How many hours exposed to indirect smoking per day	0.000 (-0.024 to 0.024)	-0.010 (-0.031 to 0.011)
Whether currently drinking	-0.131 (-0.303 to 0.041)	0.066 (0.013 to 0.119)
Whether drinking more than 4 times per week	0.120 (0.002 to 0.239)	-0.021 (-0.062 to 0.020)
Whether drinking more than 7 glasses each time	0.028 (-0.210 to 0.266)	-0.108 (-0.181 to -0.036)
Monthly expense (¥10,000)		
Health care	-1.970 (-7.633 to 3.693)	6.083 (2.545 to 9.620)
Smoking or drinking	3.550 (0.151 to 6.948)	0.835 (-0.219 to 1.888)
Leisure	8.271 (-2.794 to 19.335)	1.848 (-1.925 to 5.620)
Satisfaction (1–5 scale)		
Overall	-0.028 (-0.227 to 0.171)	0.035 (-0.062 to 0.132)
Job	-0.382 (-0.824 to 0.059)	0.004 (-0.127 to 0.136)
Leisure	-0.331 (-0.716 to 0.054)	0.148 (0.007 to 0.289)

Bold characters indicate statistical significance ($p < .05$).

Table 8. Descriptive statistics of sample characteristics by status of whether an employee worked more than 52 hours per week in 2019.

	% or N (SD)		P value
	Employees working less than 52 hours per week (N=1599)	Employees working more than 52 hours per week (N=263)	
Age			0.022
18–30	2.81	1.90	
31–45	36.40	34.60	
46–60	53.78	52.09	
61–65	7.00	11.41	
Female	44.72	27.00	<.001
Education			<.001
Less than high school	7.82	14.83	
High school graduate	34.83	43.35	
2-year college	18.20	16.35	
4-year college above	39.15	25.48	
Marital status			0.164
Never married	13.88	16.35	
Married	76.86	70.34	
Divorced/separated	1.75	3.80	
Widowed	7.50	9.51	
Household income (₩10,000)	14868 (7457)	13639 (7607)	0.015
Years of tenure at the current workplace	0.50 (8.65)	7.99 (7.86)	<.001
Residence location			0.728
Special city (Capital of South Korea)	15.76	19.39	
Metropolitan cities	29.52	24.71	
Cities	44.03	46.39	
Counties	8.63	7.60	
Others	2.06	1.90	
Household			0.009
1	6.63	8.75	
2	15.20	15.97	
3	28.02	31.94	
≥4	50.16	43.35	
Industry eligible for exemption of 52-hour work schedule			<.001
Yes	8.13	13.31	
No	91.87	86.69	
Firm size			<.001
<300	31.14	19.77	
≥300	68.86	80.23	
Employment type			0.151
Full-time employment	71.54	69.20	
Precarious employment	28.46	30.80	

Table 9. Changes in employment associated with the implementation of the 52-hour work schedule among adults who were unemployed.

Outcomes	Estimate (95% CI)
Employment	0.599 (0.514 to 0.685)
Full-time employment	0.168 (0.105 to 0.231)
Precarious employment	0.431 (0.342 to 0.519)

Bold characters indicate statistical significance ($p < .05$).

Appendix Table A.1 Korean Standard Industrial Classification (KSIC) codes for 21 industries.

KSIC codes	Description of industry
37	Sewage, wastewater, human, and animal waste treatment services
45	Sale of motor vehicles and parts
46	Wholesale trade on own account or on a fee or contract basis
47	Retail trade except motor vehicles and motorcycles
521	Warehousing and storage
55	Accommodation
56	Food and beverage service activities
59	Motion picture, video and television program production, sound recording and music publishing activities
60	Broadcasting activities
611	Postal activities
612	Telecommunications
64	Financial service activities except insurance and pension funding
65	Insurance and pension funding
66	Activities auxiliary to financial service and insurance activities
70	Research and development
713	Advertising
714	Market research and public opinion polling
742	Cleaning of building and industrial facilities
85	Education
87	Social work activities
961	Personal care services

Table A.2 Descriptive statistics of work time between 2014 and 2019 by industry and firm size.

	N	Weekly working hours			Whether worked more than 52 hours per week, %	Monthly working days, mean (SD)
		Mean (SD)	25 th percentile	50 th percentile	75 th percentile	
Industry						
Employees in non-exempt industries						
2014	1704	43.65 (11.09)	40.00	48.00	60.00	21.05 (3.49)
2015	1708	43.55 (11.13)	40.00	48.00	56.00	20.99 (3.51)
2016	1707	43.48 (10.03)	40.00	48.00	55.00	20.96 (3.06)
2017	1702	44.01 (10.20)	40.00	48.00	56.00	21.08 (3.08)
2018	1700	43.26 (10.07)	40.00	48.00	55.00	21.00 (3.01)
2019	1697	42.49 (9.66)	40.00	45.00	54.00	20.80 (2.75)
Employees in five industries exempt from 52-hour work schedule						
2014	158	46.90 (10.28)	40.00	51.00	60.00	21.79 (3.71)
2015	154	47.13 (12.06)	40.00	51.00	62.00	21.45 (3.71)
2016	155	47.73 (10.96)	40.00	50.00	65.00	21.83 (3.04)
2017	160	46.02 (10.23)	40.00	50.00	60.00	21.58 (3.01)
2018	162	45.47 (9.05)	40.00	50.00	60.00	21.77 (3.15)
2019	165	46.97 (11.28)	40.00	50.00	60.00	21.48 (2.80)
Firm size						
Employees in firms with less than 300 employees						
2014	1338	44.40 (11.99)	40.00	50.00	60.00	21.39 (3.69)
2015	1322	44.47 (11.81)	40.00	50.00	60.00	21.37 (3.51)
2016	1359	44.09 (10.90)	40.00	48.00	59.00	21.28 (3.27)
2017	1340	44.62 (10.85)	40.00	50.00	60.00	21.40 (3.17)
2018	1330	43.86 (10.69)	40.00	48.00	60.00	21.38 (3.12)
2019	1312	43.19 (10.67)	40.00	48.00	57.00	21.10 (2.81)
Employees in firms with less than 300 employees						
2014	524	42.89 (8.50)	40.00	45.00	53.00	20.48 (3.00)
2015	540	42.51 (9.79)	40.00	46.00	51.00	20.29 (3.47)
2016	503	43.28 (8.05)	40.00	48.00	53.00	20.44 (2.38)
2017	522	43.12 (8.37)	40.00	48.00	53.00	20.47 (2.75)
2018	532	42.53 (8.10)	40.00	45.00	52.00	20.34 (2.66)
2019	550	42.29 (7.88)	40.00	44.00	50.00	20.34 (2.58)

Table A.3 Descriptive statistics of sample characteristics at baseline (2017).

	% or N (SD)			P value (full-time employees vs precarious employees)
	All employees (N=1862)	Full-time employees (N=895)	Precarious employees (N=268)	
Age				<.001
18–30	2.69	1.56	2.99	
31–45	36.14	45.25	13.81	
46–60	53.54	50.50	62.31	
61–65	7.63	2.68	20.90	
Female	42.21	30.50	61.19	<.001
Education				<.001
Less than high school	8.75	3.46	23.51	
High school graduate	36.36	27.71	44.78	
2-year college	17.88	18.55	14.18	
4-year college above	37.00	50.28	17.54	
Marital status				<.001
Never married	15.25	12.63	12.31	
Married	75.24	83.13	67.54	
Divorced/separated	1.93	1.01	3.73	
Widowed	7.57	3.24	16.42	
Household income (¥10,000)	13906 (8185)	15452 (7697)	11299 (6757)	<.001
Years of tenure at the current workplace	8.76 (8.06)	11.60 (8.22)	5.65 (6.38)	<.001
Residence location				0.062
Capital city	17.13	16.54	19.78	
Metropolitan cities	28.46	25.47	31.72	
Cities	43.34	46.70	37.31	
Counties	8.75	8.27	10.82	
Others	2.31	3.02	0.37	
Household				<.001
1	6.87	5.25	9.33	
2	13.80	10.73	23.51	
3	29.05	28.04	33.21	
≥4	50.27	55.98	33.96	
Industry eligible for exemption of 52-hour work schedule				0.126
Yes	8.59	9.16	5.22	
No	91.41	90.84	94.78	
Firm size				<.001
<300	71.97	55.53	94.03	
≥300	28.03	44.47	5.97	
Employment type				
Full-time employment	69.76	100.00	0.00	
Precarious employment	30.24	0.00	100.00	

Table A.4 Sensitivity analysis to rule out reverse causality in our difference-in-difference models with fixed effects for all employees.

	Estimate (95% CI)		
	Monthly working days	Weekly working hours	Whether worked more than 52 hours per week
General health status			
Lag 1	0.106 (-0.091 to 0.303)	0.302 (-0.338 to 0.943)	-0.006 (-0.029 to 0.016)
Lag 2	-0.027 (-0.223 to 0.168)	-0.334 (-0.97 to 0.301)	-0.008 (-0.03 to 0.014)
Lag 3	0.018 (-0.174 to 0.21)	0.025 (-0.599 to 0.649)	-0.002 (-0.023 to 0.02)
Depression			
Lag 1	-0.005 (-0.164 to 0.154)	-0.413 (-0.93 to 0.103)	-0.015 (-0.033 to 0.003)
Lag 2	-0.038 (-0.199 to 0.124)	-0.347 (-0.872 to 0.178)	0.001 (-0.017 to 0.019)
Lag 3	0.015 (-0.141 to 0.171)	-0.01 (-0.518 to 0.498)	0.008 (-0.009 to 0.026)
Chronic disease			
Lag 1	-0.014 (-0.209 to 0.18)	0.038 (-0.593 to 0.669)	0.017 (-0.005 to 0.039)
Lag 2	0.094 (-0.101 to 0.289)	-0.028 (-0.661 to 0.606)	0.007 (-0.015 to 0.029)
Lag 3	0.045 (-0.148 to 0.239)	-0.233 (-0.863 to 0.396)	0.005 (-0.017 to 0.027)

Bold characters indicate statistical significance ($p < .05$).

Table A.5 Sensitivity analysis to rule out reverse causality in our difference-in-difference models with fixed effects for full-time employees.

	Estimate (95% CI)		
	Monthly working days	Weekly working hours	Whether worked more than 52 hours per week
General health status			
Lag 1	-0.137 (-0.408 to 0.135)	-0.652 (-1.464 to 0.161)	-0.026 (-0.06 to 0.008)
Lag 2	-0.094 (-0.367 to 0.178)	-0.078 (-0.894 to 0.738)	-0.006 (-0.04 to 0.028)
Lag 3	0.176 (-0.095 to 0.447)	0.15 (-0.66 to 0.96)	0.007 (-0.027 to 0.04)
Depression			
Lag 1	-0.019 (-0.224 to 0.186)	0.003 (-0.61 to 0.616)	-0.019 (-0.044 to 0.007)
Lag 2	-0.11 (-0.321 to 0.101)	-0.108 (-0.739 to 0.522)	-0.002 (-0.028 to 0.024)
Lag 3	0.155 (-0.05 to 0.36)	-0.034 (-0.648 to 0.58)	-0.002 (-0.027 to 0.024)
Chronic disease			
Lag 1	-0.069 (-0.344 to 0.206)	-0.65 (-1.471 to 0.172)	-0.006 (-0.04 to 0.028)
Lag 2	-0.03 (-0.306 to 0.246)	-0.378 (-1.203 to 0.448)	-0.006 (-0.04 to 0.028)
Lag 3	0.173 (-0.102 to 0.449)	0.583 (-0.241 to 1.407)	0.02 (-0.014 to 0.054)

Bold characters indicate statistical significance ($p < .05$).

Table A.6 Sensitivity analysis to rule out reverse causality in our difference-in-difference models with fixed effects for precarious employees.

	Estimate (95% CI)		
	Monthly working days	Weekly working hours	Whether worked more than 52 hours per week
General health status			
Lag 1	0.318 (-0.24 to 0.877)	-0.532 (-2.419 to 1.355)	-0.008 (-0.051 to 0.036)
Lag 2	-0.001 (-0.564 to 0.563)	-0.617 (-2.52 to 1.286)	0.009 (-0.035 to 0.052)
Lag 3	-0.232 (-0.791 to 0.327)	-0.918 (-2.806 to 0.97)	0.002 (-0.041 to 0.046)
Depression			
Lag 1	-0.154 (-0.67 to 0.361)	-1.748 (-3.49 to -0.005)	-0.018 (-0.058 to 0.022)
Lag 2	-0.064 (-0.589 to 0.46)	-0.161 (-1.934 to 1.611)	0.022 (-0.018 to 0.063)
Lag 3	-0.088 (-0.603 to 0.428)	-0.087 (-1.829 to 1.654)	-0.017 (-0.057 to 0.023)
Chronic disease			
Lag 1	-0.407 (-0.986 to 0.171)	-1.376 (-3.331 to 0.579)	-0.008 (-0.053 to 0.037)
Lag 2	0.631 (0.044 to 1.218)	-1.593 (-3.577 to 0.39)	0.014 (-0.031 to 0.06)
Lag 3	-0.26 (-0.838 to 0.318)	-1.476 (-3.429 to 0.476)	-0.001 (-0.046 to 0.044)

Bold characters indicate statistical significance ($p < .05$).

Table A.7 Changes associated with the implementation of the 52-hour work schedule in outcomes for employees excluding those in industries that were exempted from the original rule, but not exempt from the new rule by industry (person-year observations = 5735).

Outcomes	Estimate (95% CI)	
	Employees in non-exempt industries	Employees in five exempt industries
Work time		
Monthly working days	-0.395 (-0.62 to -0.171)	0.239 (-0.581 to 1.060)
Weekly working hours	-1.333 (-1.995 to -0.670)	-0.928 (-2.774 to 0.917)
Whether worked more than 52 hours per week	-0.047 (-0.076 to -0.019)	-0.064 (-0.149 to 0.02)
Health status		
General health status	-0.015 (-0.044 to 0.013)	0.049 (-0.027 to 0.125)
Depression	-0.002 (-0.029 to 0.025)	-0.038 (-0.096 to 0.021)
Chronic disease	0.006 (-0.028 to 0.039)	0.060 (-0.028 to 0.149)
Health care utilization		
Number of inpatient admissions	0.008 (-0.014 to 0.029)	-0.006 (-0.063 to 0.051)
Number of outpatient visits	0.698 (-0.380 to 1.775)	0.138 (-1.743 to 2.020)
Number of checkups	-0.040 (-0.082 to 0.003)	0.051 (-0.041 to 0.144)
Health behavior		
Whether currently smoking	-0.021 (-0.039 to -0.003)	0.015 (-0.027 to 0.058)
How many times smoking per day	-0.371 (-0.681 to -0.062)	0.125 (-0.694 to 0.943)
How many hours exposed to indirect smoking per day	-0.029 (-0.069 to 0.010)	-0.056 (-0.198 to 0.085)
Whether currently drinking	0.035 (0.009 to 0.061)	-0.019 (-0.074 to 0.036)
Whether drinking more than 4 times per week	-0.013 (-0.032 to 0.006)	0.003 (-0.067 to 0.073)
Whether drinking more than 7 glasses each time	-0.018 (-0.056 to 0.020)	0.056 (-0.032 to 0.144)
Monthly expense (¥10,000)		
Health care	4.403 (2.625 to 6.181)	2.123 (-1.782 to 6.027)
Smoking or drinking	0.710 (0.192 to 1.228)	0.510 (-0.525 to 1.544)
Leisure	7.640 (5.261 to 10.018)	10.170 (2.556 to 17.784)
Satisfaction (1–5 scale)		
Overall	-0.027 (-0.073 to 0.018)	0.004 (-0.124 to 0.133)
Job	-0.033 (-0.087 to 0.022)	0.070 (-0.064 to 0.203)
Leisure	0.029 (-0.034 to 0.092)	0.038 (-0.130 to 0.207)

Bold characters indicate statistical significance ($p < .05$).

Table A.8 Changes associated with the implementation of the 52-hour work schedule in outcomes for employees excluding those in industries that were exempted from the original rule, but non-exempt from the new rule by firm size (person-year observations = 5735).

Outcomes	Estimate (95% CI)	
	Employees in firms with 300 or more employees	Employees in firms with less than 300 employees
Work time		
Monthly working days	-0.064 (-0.688 to 0.560)	-0.203 (-0.517 to 0.111)
Weekly working hours	-0.646 (-1.829 to 0.537)	-1.137 (-1.911 to -0.362)
Whether worked more than 52 hours per week	-0.003 (-0.054 to 0.048)	-0.039 (-0.072 to -0.005)
Health status		
General health status	0.021 (-0.108 to 0.150)	-0.024 (-0.061 to 0.014)
Depression	0.033 (-0.040 to 0.105)	-0.007 (-0.039 to 0.024)
Chronic disease	0.062 (-0.042 to 0.166)	-0.033 (-0.070 to 0.005)
Health care utilization		
Number of inpatient admissions	-0.013 (-0.046 to 0.019)	0.005 (-0.019 to 0.030)
Number of outpatient visits	-1.051 (-2.830 to 0.728)	0.498 (-0.598 to 1.593)
Number of checkups	-0.131 (-0.256 to -0.006)	-0.037 (-0.080 to 0.006)
Health behavior		
Whether currently smoking	-0.011 (-0.031 to 0.009)	-0.027 (-0.048 to -0.007)
How many times smoking per day	-0.070 (-0.416 to 0.276)	-0.506 (-0.850 to -0.161)
How many hours exposed to indirect smoking per day	0.043 (-0.027 to 0.113)	-0.016 (-0.051 to 0.019)
Whether currently drinking	-0.021 (-0.077 to 0.035)	0.053 (0.023 to 0.083)
Whether drinking more than 4 times per week	0.024 (-0.022 to 0.071)	-0.025 (-0.048 to -0.002)
Whether drinking more than 7 glasses each time	-0.030 (-0.167 to 0.108)	-0.033 (-0.079 to 0.013)
Monthly expense (¥10,000)		
Health care	3.961 (-1.166 to 9.088)	4.571 (2.454 to 6.687)
Smoking or drinking	0.726 (-0.068 to 1.520)	0.617 (0.116 to 1.119)
Leisure	15.678 (10.498 to 20.858)	6.212 (3.043 to 9.382)
Satisfaction (1–5 scale)		
Overall	-0.263 (-0.409 to -0.118)	0.040 (-0.014 to 0.094)
Job	-0.207 (-0.352 to -0.061)	0.051 (-0.011 to 0.114)
Leisure	-0.291 (-0.481 to -0.101)	0.150 (0.075 to 0.226)

Bold characters indicate statistical significance ($p < .05$).

Table A.9 Descriptive statistics of sample characteristics by status of employment status during 2018–2019.

	Employed			P value (full-time vs. precarious employment)	Unemployed	
	% or N (SD)		% or N (SD)		P value	
	All (N=112)	Full-time employment (N=32)	Precarious employment (N=80)		All (N=87)	(employed vs. unemployed)
Age				0.048		0.725
18–30	32.14	46.88	26.25		29.89	
31–45	32.14	31.25	32.50		37.93	
46–60	28.57	21.88	31.25		20.69	
61–65	7.14	0.00	10.00		11.49	
Female	47.32	56.25	43.75	0.305	32.18	0.023
Education				0.057		0.812
Less than high school	8.04	0.00	11.25		6.90	
High school graduate	33.93	25.00	37.50		39.08	
2-year college	24.11	25.00	23.75		22.99	
4-year college above	33.93	50.00	27.50		31.03	
Marital status				0.715		0.101
Never married	62.50	71.88	58.75		64.37	
Married	26.79	18.75	30.00		32.18	
Divorced/separated	1.79	3.12	1.25		0.00	
Widowed	8.93	6.25	10.00		3.45	
Household income (¥10,000)	11708 (7234)	14199 (8800)	10621 (6193)	0.015	11720 (9847)	0.992
Residence location				0.319		
Special city	23.21	21.88	23.75		17.24	
Metropolitan cities	24.11	28.12	22.50		31.03	
Cities	38.39	43.75	36.25		37.93	
Counties	11.61	3.12	15.00		10.34	
Others	2.68	3.12	2.50		3.45	
Household				0.532		0.891
1	6.25	6.25	6.25		5.75	
2	19.64	18.75	20.00		12.64	
3	30.36	25.00	32.50		34.48	
4+	43.75	50.00	41.25		47.13	
Industry eligible for exemption of 52-hour work schedule				0.341		0.256
Yes	6.25	3.12	7.50		-	
No	93.75	96.88	92.50		-	
Firm size				0.048		
<300	91.07	84.38	93.75		-	
≥300	8.93	15.62	6.25		-	
Employment type						
Full-time employment	28.57	100.00	0.00		-	
Precarious employment	71.43	0.00	100.00		-	

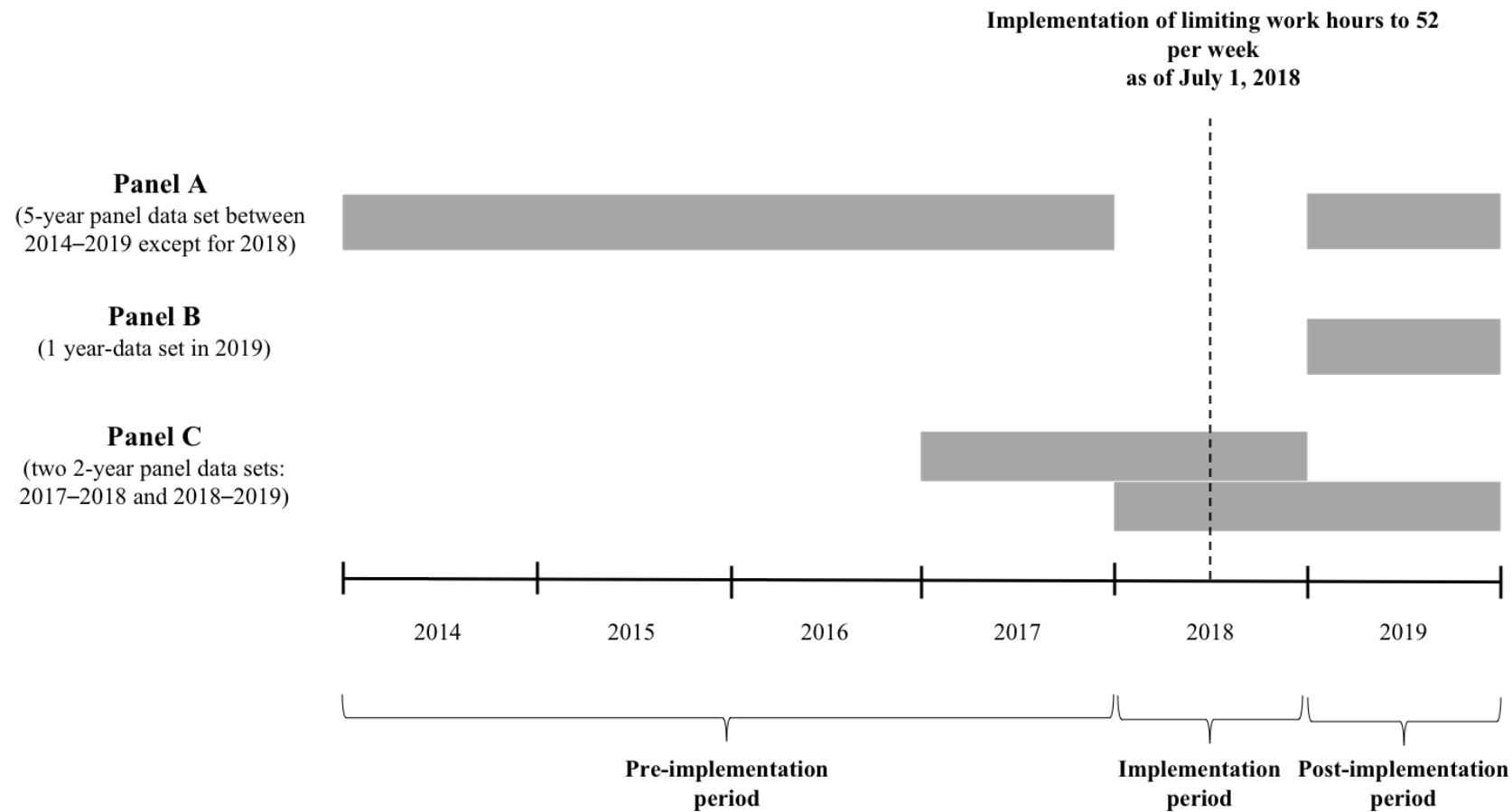


Fig. 1. Study samples.

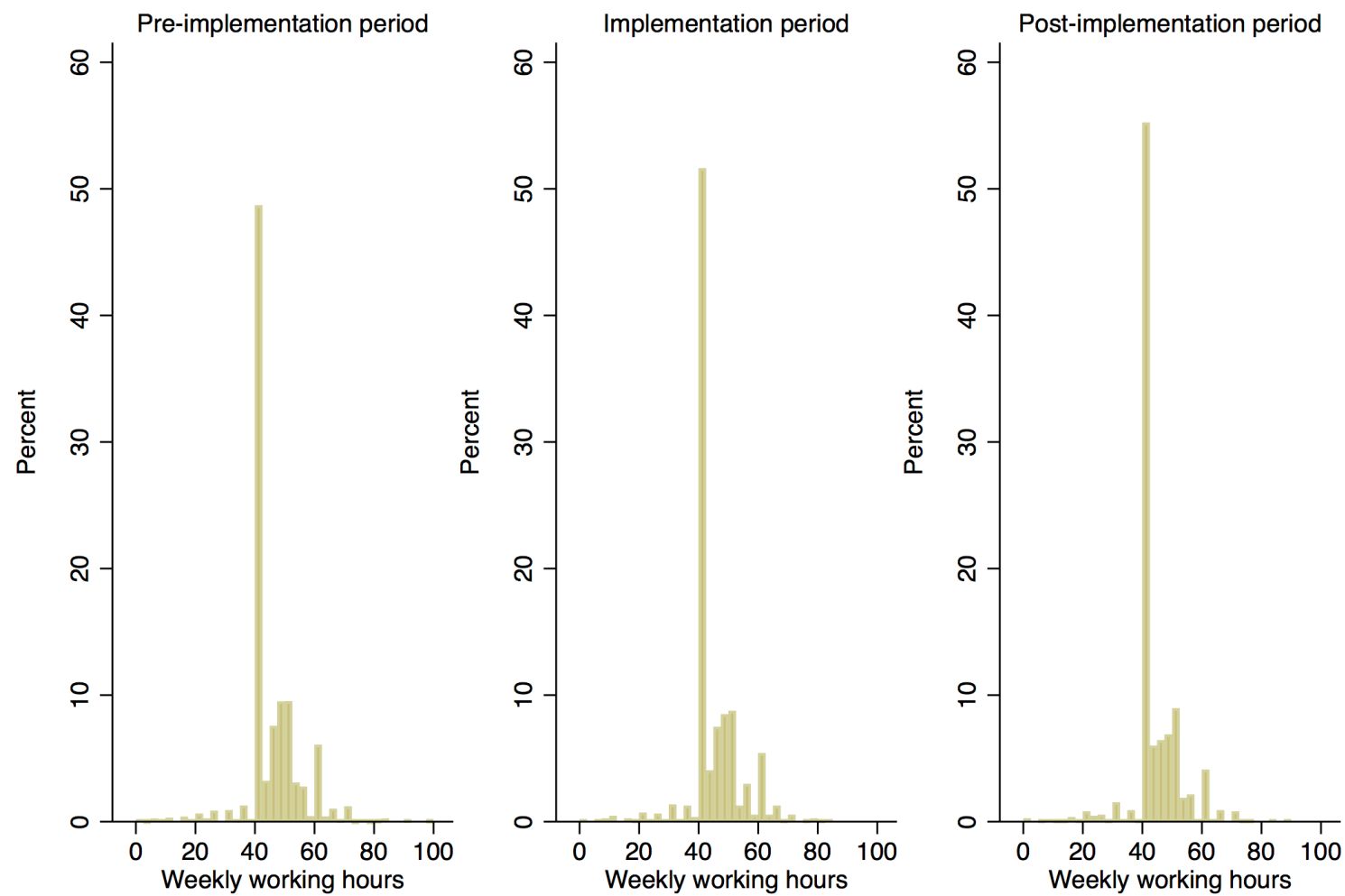


Fig. 2. Distribution of weekly working hours for employees in non-exempt industries.

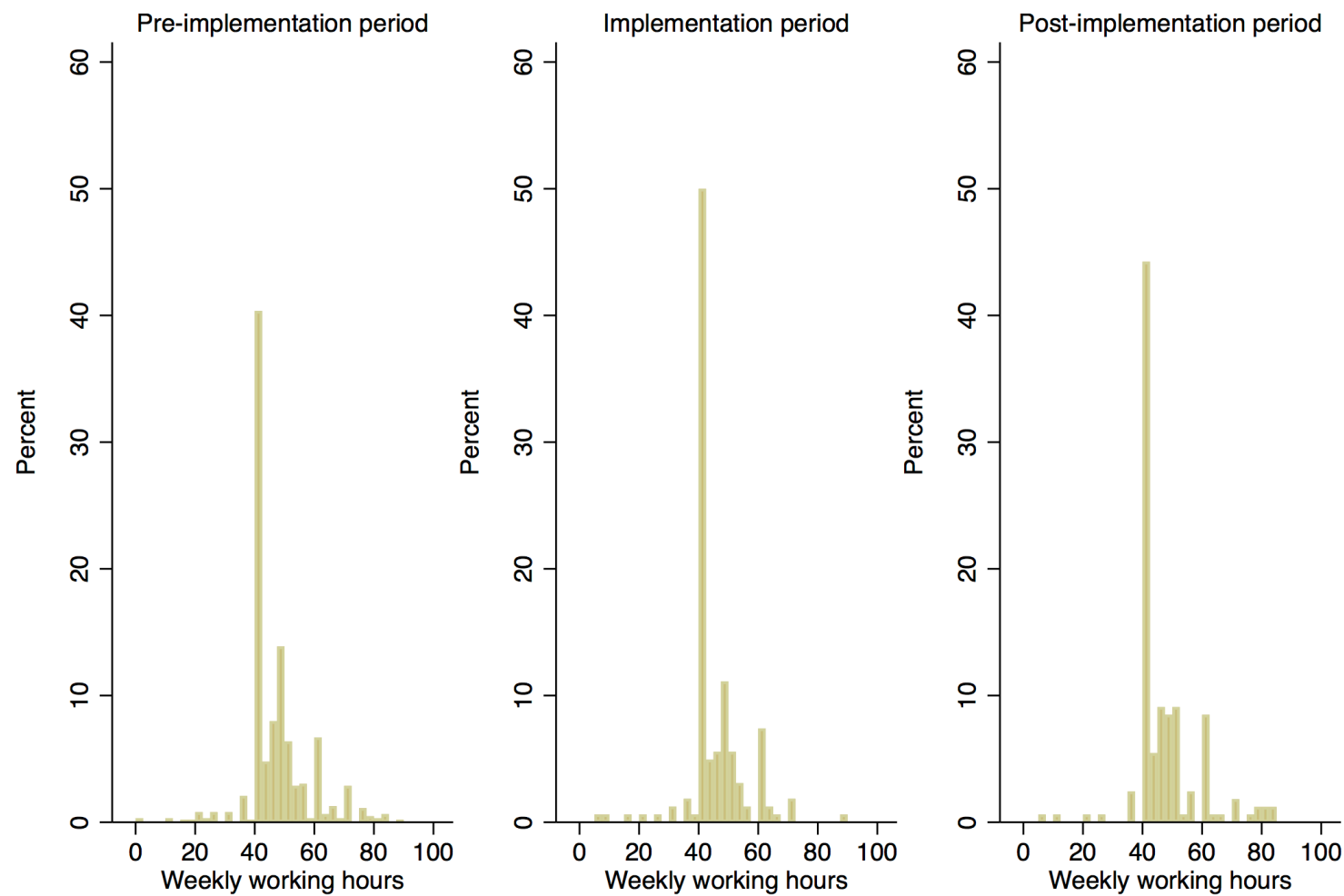


Fig. 3. Distribution of weekly working hours for employees in five industries exempt from the implementation of the 52 hour-work schedule.

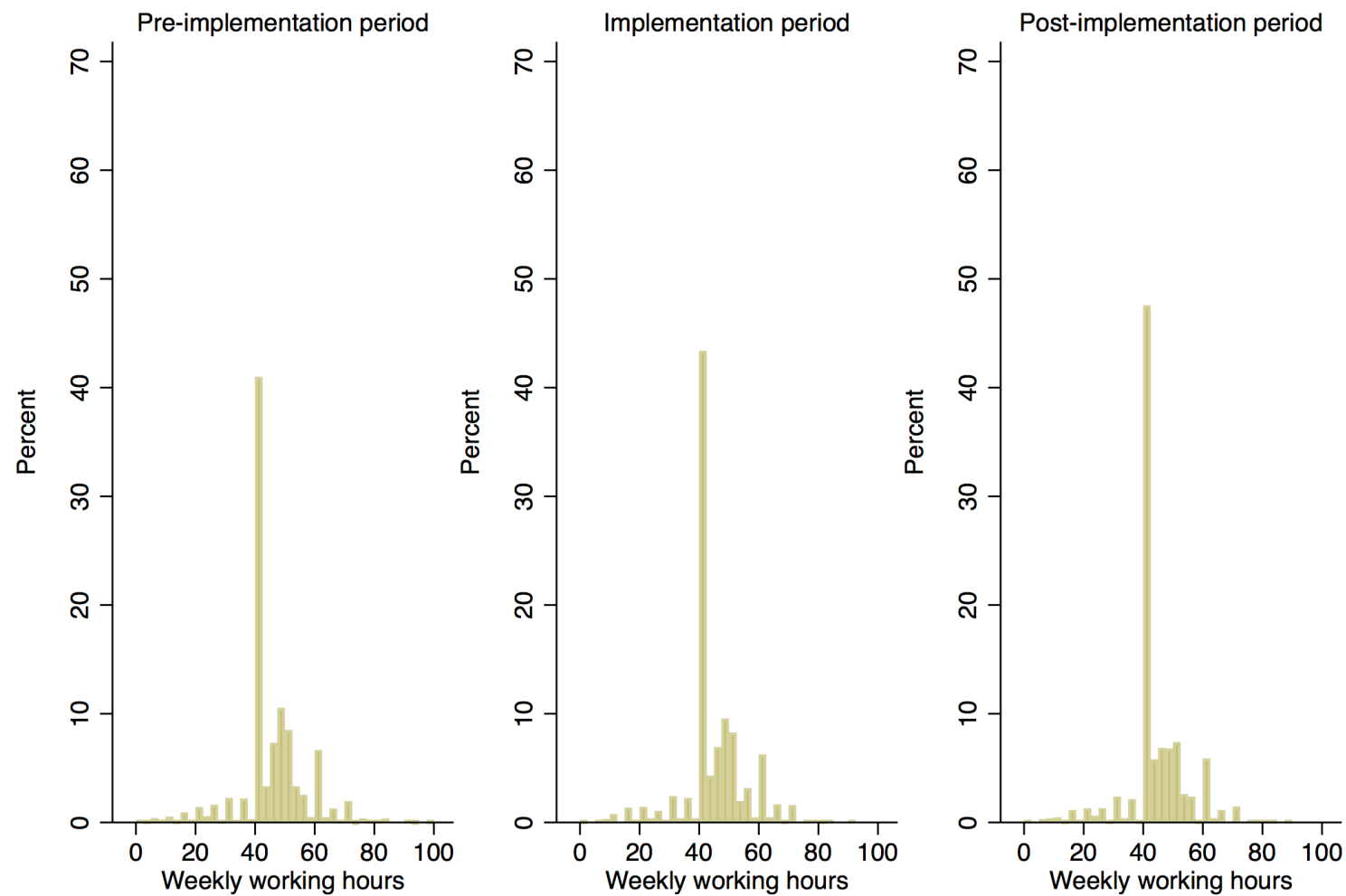


Fig. 4. Distribution of weekly working hours for employees in firms with less than 300 employees.

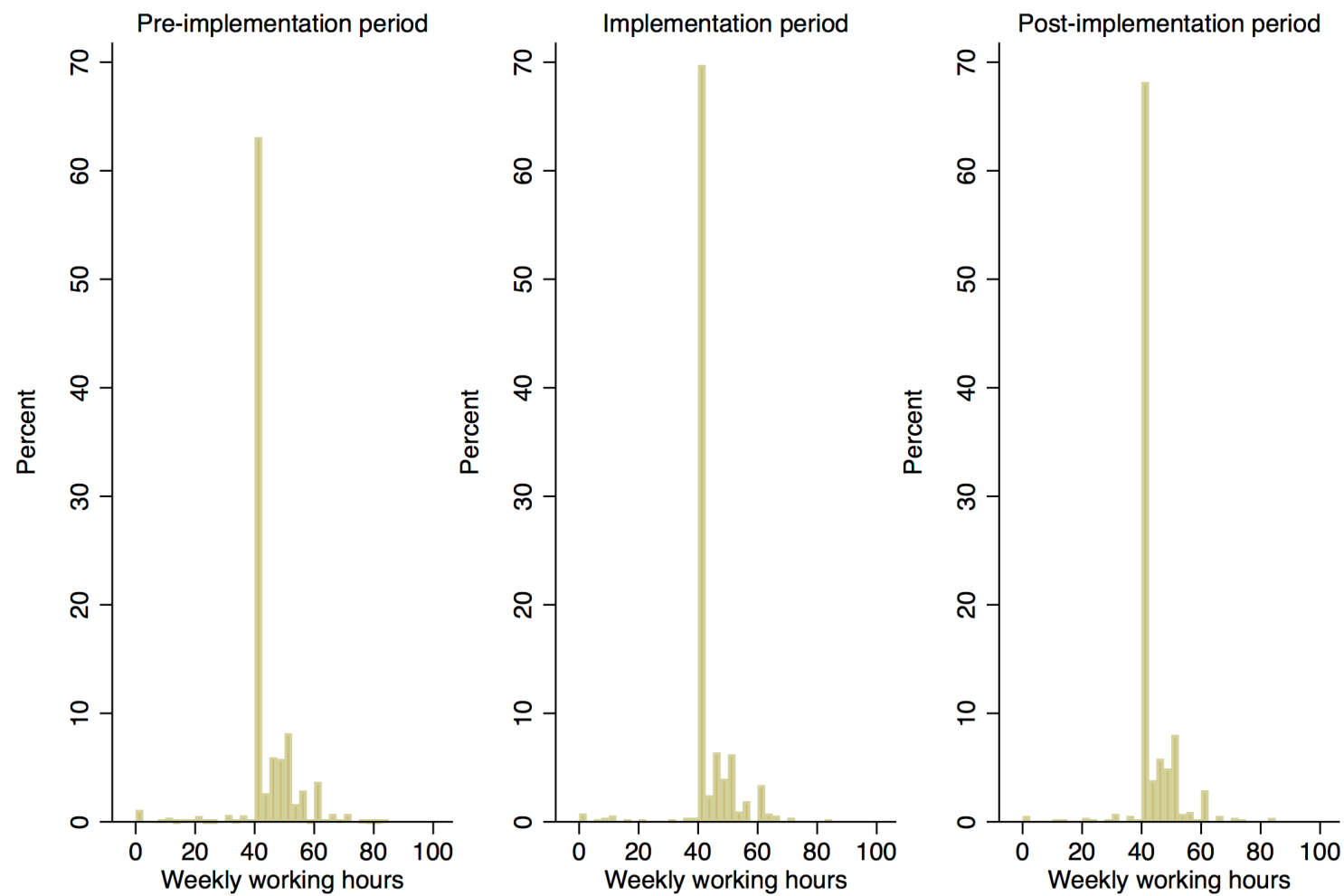


Fig. 5. Distribution of weekly working hours for employees in firms with 300 employees or more.