Humanities & Social Sciences Communications

ARTICLE

https://doi.org/10.1057/s41599-026-06696-0 OPEN

Working time variation, work autonomy, and self-reported Health during the COVID-19 pandemic in China

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With the rise of flexible work arrangements and digital technologies, working time variation has become increasingly prevalent in the labor market. However, its health implications remain debated: some suggest that working time variation enhances flexibility and promotes well-being, while others argue it leads to increased precarity and adverse health outcomes. Utilizing data from a nationally representative survey in China during the COVID-19 pandemic, this study examines how work autonomy moderates the relationship between working time variation and health, and whether these effects differ by gender. The findings indicate that the relationship between working time variation and self-reported health is moderated by work autonomy. Specifically, working time variation is positively associated with self-reported health when work autonomy is high, but negatively associated with self-reported health when work autonomy is low. This pattern is particularly pronounced among women compared to men. These results contribute to the literature on working time variation by highlighting the conditional health impacts of working time variation through the lens of work autonomy, thus advancing the debate on its health consequences.

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Introduction

With the rise of flexible work arrangements and digital technologies, working time variation has become increasingly prevalent in the labor market (Blustein et al. 2016, 2023; Ruiz Gonzalez 2020). The growth of remote work, gig economy jobs, and digital platforms has transformed traditional work schedules, allowing for more personalized and non-standard working hours (Spreitzer et al. 2017; Wang et al. 2021). This shift has provided employees with the ability to tailor their work schedules to better fit personal needs and responsibilities, theoretically offering greater work-life balance (Kelly et al. 2014a; Kogan and Rishniw 2024). For many, this represents a break from rigid, standardized hours, enabling a more dynamic and responsive approach to managing work commitments (Wood et al. 2019; Chatterjee et al. 2022). However, its health implications remain debated: some suggest that working time variation enhances flexibility and promotes well-being, while others argue it leads to increased precarity and adverse health outcomes (Arlinghaus et al. 2019; Cai et al. 2019).

Against the backdrop of the growing popularity of flexible working and new forms of employment, working time variation has a multidimensional impact on the health of workers to a certain extent. According to the biopsychosocial model, working time variation, time shifts, and irregularities are often closely related to an individual's physiological rhythms, sleep cycles, stress levels, ability to maintain healthy behaviors, and quality of social interactions. Whether working hours are increased, decreased or shifted, there may be compounding effects on individuals' physiological functioning, psychological state, and subjective well-being (Crnko et al. 2019). At the same time, these effects are not fixed, and work autonomy often plays an important moderating role (Spreitzer 1995). Health risks may be buffered by adaptive regulation when workers have control over their time, or they may be significantly amplified by externally imposed temporal constraints (Morgeson and Humphrey 2006). This effect was particularly pronounced during the COVID-19 pandemic in China (Pan et al. 2023). The pandemic profoundly altered the structural characteristics of working time schedules, rendering them more uncertain and involuntary. This high-pressure context amplifies the effect of working time variation as a stressor and the resource properties of work autonomy in buffering health risks. Compared to the normative period, this high-pressure context enhances the interaction between the three, providing a significant opportunity to revisit their mechanisms of action and the boundaries of their theoretical applicability.

It is worth noting that, within China's unique socio-economic and cultural context, the relationship between working time variation, work autonomy, and health may also exhibit significant gender differences. Specifically, the traditional gender division of labour model reinforces women's double burden of "work-family", making female workers face more severe role conflicts when coping with time fluctuations (Feng and Savani 2020). Second, gender segregation in the labour market distributes men and women across different industries and positions, leading to systematic differences in the frequency, predictability, and autonomy of working time variation (Xiao and Asadullah 2020). Third, different expectations of men's and women's work and family roles, resulting from sociocultural factors, also affect individuals' perceptions of working time variation, access to coping resources, and ultimately, measures of health (Blau and Kahn 2007).

Therefore, it is of great theoretical and practical significance to link working time variation, work autonomy, and health status and to conduct an in-depth study under a China-specific gender perspective. This will not only help reveal the dynamic path of the time-health relationship under flexible working and elucidate the specific process by which work autonomy is regulated, but also reveal the differential manifestation of this pattern of association in the gender dimension. This research is valuable for deepening the understanding of the relationship between labour market changes and public health in the Chinese context, and for developing more targeted policy interventions.

Formulation of research hypotheses

Working time variation and health. The independent variable examined in this study is working-time variation (WTV). Working time variation refers to changes in the number of paid hours an individual works from week to week, including both regular and overtime hours (Lu 2024; Pan et al. 2023). It reflects how a person's total working time fluctuates over time, rather than when or where the work is performed. This makes it different from flexible work arrangements like remote work or shift work, which are more about control over the timing or location of work than the actual amount of time worked.

While working time variation reflects objective fluctuations in work hours, these patterns often stem from two distinct underlying motivations. According to the existing literature, two primary sources of working time variation can be distinguished (Schneider and Harknett 2019). On the one hand, there is employee-initiated flexibility, such as flexible work arrangements or work time control (Agnoletto 2024; Kelly et al. 2014b; Wang and Cheng 2023). On the other hand, there is employer-driven variation, such as on-call scheduling, involuntary overtime, or unstable shifts (Henly and Lambert 2014). Most existing studies adopt self-reported survey items to assess the extent to which employees have control over their working hours, which is commonly used as a proxy for work-time flexibility(-Chung and van der Lippe 2020a; Kelly et al. 2014). Other studies rely on similar subjective measures to capture whether working time variations are made in response to employer requirements (Ananat and Gassman-Pines 2021; Presser and Ward 2011). However, in real-world settings, these two mechanisms often coexist. Individual working time variation typically results from a combination of structural conditions and personal choice. Although company policies provide structural constraints, individual choices can frequently shape how these policies are implemented in practice(Salazar Jr. n.d.; Sun 2025).

Given the complexity of real-world working conditions and the potential biases inherent in self-reported measures, it is often difficult to determine the underlying drivers of working time variation—whether they are initiated by employers or employees. To address this measurement challenge, the present study adopts an outcome-based, objective measure of working-time variation (WTV), which focuses on actual fluctuations in working hours rather than perceived control or motivation (Wang et al. 2024). This approach provides a more objective basis for assessing the potential impact of temporal instability in work schedules on subjective well-being among employees.

With this objective measure of working time variation established, we now turn to the literature on its potential effects, which highlights how such working time variation may influence employees' health and well-being. On the one hand, proponents of flexible schedules argue that working time variation can reduce stress, improve job satisfaction, and support overall mental and physical health by allowing workers to manage better personal and family obligations (Li and Wang 2022). Specifically, theories on work-life balance and stress management suggest that working time variation may positively influence health by reducing rigid constraints and allowing workers to better accommodate their personal needs (Pedersen and Jeppesen 2012). Flexibility in work

schedules will enable individuals to adjust their working hours to accommodate family responsibilities, personal preferences, and social activities, thereby creating a more balanced lifestyle (Eshun and Segbenya 2024). This ability to tailor work to one's unique circumstances can reduce work-life conflict and provide opportunities for restorative activities such as exercise and adequate sleep (Joyce et al. 2010). Additionally, the capacity to self-regulate one's work time can enhance psychological well-being by fostering a sense of control over one's daily life (Shifrin and Michel 2022). Therefore, these perspectives support the hypothesis that greater variation in working time is positively associated with self-reported health.

On the other hand, critics highlight that working time variability can blur boundaries between work and personal life, increase job insecurity, and create irregular income patterns, all of which contribute to stress and deteriorate health (Wang et al. 2021). Specifically, the circadian rhythm disruption theory explains that our bodies are programmed to follow a roughly 24-hour cycle, regulating sleep, metabolism, and other vital bodily functions (Crnko et al. 2019). When work hours are inconsistent, it interferes with these natural cycles, causing sleep disturbances, fatigue, and increased stress levels (Kurowska 2020; Schneider et al. 2000; Schneider and Harknett 2019). Such disruptions can impair cognitive function, weaken the immune system, and increase the risk of chronic conditions, including cardiovascular disease and mental health issues (Arlinghaus et al. 2019). Moreover, work time variability often accompanies insecure employment conditions, where unpredictable hours can signify a lack of job security and control over one's work environment (Zhou 2013). This sense of insecurity and loss of control is linked to poorer mental and physical health outcomes, as it fosters an atmosphere of uncertainty and stress (Kim and von dem Knesebeck 2016). In addition to evidence from Western societies, Chinese scholars have underscored comparable risks, shaped by the country's distinctive labour-market institutions and cultural conditions. As one of the world's largest manufacturing and service economies, China's workforce is routinely exposed to unpredictable schedules. In traditional manufacturing, sudden overtime and rotating shifts remain common, while in the platform and gig economy, on-demand scheduling and just-in-time assignments have become everyday practices. Such instability in working hours, coupled with insufficient rest, has intensified problems of circadian rhythm disruption and chronic fatigue. Meanwhile, the rapid expansion of flexible and precarious employment has produced income volatility and limited social protection, leaving workers vulnerable not only to economic uncertainty but also to heightened insecurity and psychological strain. Within this institutional and market environment, variability in working hours substantially erodes workers' capacity to sustain their health.

Overall, this duality in perspectives highlights the need for further research into the nuanced impacts of working time variation, particularly regarding how these effects may vary across different job types, individual circumstances, and social contexts. As a result, we formulate the following competing hypotheses.

H1A: Workers' greater working time variation is negatively associated with self-reported health.

H1B: Workers' greater working time variation is positively associated with self-reported health.

Additionally, due to the influence of multiple factors, including government policies, openness to the world market (FDI and exports), market integration, public infrastructure, educational attainment, geographical conditions, and internal migration, significant regional differences exist across China in terms of economic development, education levels, and labor market structures (Chen and Xue 2024; Lu 2008; Zhang and Zou 2012). These regional disparities are key determinants of labor patterns, variations in working time, and workers' psychological well-being. Therefore, regional fixed effects were controlled for in the regression analyses to account for such contextual influences.

Moderating role of work autonomy. It should be clarified that working time variation does not naturally equate to flexibility in scheduling. Some time changes are flexible in the context of full employee autonomy and reflect an individual's proactive approach to harmonising the pace of work with the pace of life (Bennett et al. 2018). Other time changes, however, result from organisational arrangements or employer requirements, where employees lack decision-making power, and this uncertainty and uncontrollability is more likely to be reflected in job instability, which in turn has an impact on individual health (Lin et al. 2014). Therefore, the key to the positive health effects of working time variation is whether employees have sufficient work autonomy. This is why we introduced "work autonomy" as a moderator variable in our study design.

The Job Demands-Resources (JD-R) model posits that job characteristics can be classified into demands, which are aspects of a job that require sustained effort, and resources, which are aspects that help achieve work goals, reduce job demands, or stimulate personal growth and development (Bakker and Demerouti 2007; Demerouti et al. 2001). Work autonomy is considered a critical job resource because it provides employees with control over how, when, and where they complete their work tasks (Spreitzer 1995). When work autonomy is high, employees have the flexibility to manage working time variations in ways that best suit their personal needs and preferences (Bennett et al. 2018; Crawford et al. 2010). This ability to exert control over work time can buffer the adverse effects of working time variation, transforming it from a potential stressor into a beneficial form of flexibility that enhances well-being (Morgeson and Humphrey 2006).

Conversely, when work autonomy is low, working time variation can exacerbate job demands, leading to increased stress and poorer health outcomes. According to work-family conflict theory, low work autonomy restricts employees' ability to manage their work and personal responsibilities effectively, particularly when work schedules are irregular (Schieman et al. 2009; Voydanoff 2004). In such cases, working time variation becomes a source of unpredictability and control loss, contributing to work-family conflict, where the demands of work interfere with family and personal life (Lin et al. 2014, 2015; Wu and Zhou 2022). This heightened conflict can lead to psychological strain, fatigue, and poorer overall health. Furthermore, the lack of control over work hours amplifies feelings of job insecurity and instability, making the variability in work schedules a significant source of stress (Schieman et al. 2009; Voydanoff 2004).

In the Chinese context, the moderating role of work autonomy is particularly salient. China's labour market is undergoing simultaneous industrial upgrading and diversification of employment forms, where traditional factory-based shift regimes coexist with platform-mediated work arrangements. Within this environment, tensions persist between statutory labour protections and organisational practices, while performance-driven management and the norm of presenteeism remain pervasive. Under such institutional conditions, work autonomy operates not only as a critical job resource but also as the decisive factor in whether working time variation is experienced as flexibility or as strain (Deng and Li 2021). Overall, the interaction between working time variation and work autonomy underscores the dual nature of

flexible working time: they can either promote or hinder health, depending on the level of control employees have over their work schedules. Thus, we formulate the following hypotheses.

H2: The effect of working time variation on self-reported health is moderated by work autonomy.

H2A: If the association between working time variation and self-reported health is positive, higher work autonomy will strengthen this positive relationship.

H2B: If the association between working time variation and self-reported health is negative, higher work autonomy will weaken this negative relationship.

Gender differences. We further expect that the positive interaction effect between working time variation and work autonomy on self-reported health exhibits significant gender differences, with a more substantial impact observed among women compared to men. This expectation is shaped by both traditional gender norms and the broader working culture in China (Bianchi 2000; Bianchi and Milkie 2010).

Social role theory further explains how gendered expectations shape responses to work demands and resources (Li and Wang 2022; Zarzycki et al. 2023; Feng and Savani 2020). In China, societal norms often require women to be adaptable to family needs, making work autonomy particularly important for managing working time variation (Xiao and Asadullah 2020; Deutsch 2007; Ferree 2010). This control helps women balance work and family roles without compromising their health (Barbulescu and Bidwell 2013; Dousin et al. 2021; Chung and van der Lippe 2020b; Fein and Skinner 2015). On the contrary, men are generally expected to prioritize work over family, which reduces the perceived importance of work autonomy in managing working time variation (Blau and Kahn 2007; Booth et al. 2003; Zuckerman 2012). As a result, the interaction between working time variation and work autonomy on self-reported health is more significant for women, as they navigate complex roles influenced by traditional gender expectations.

Moreover, an essential aspect of Chinese culture is the "996" working-time system, which refers to working from 9 AM to 9 PM, six days a week. Although unofficial, this practice is common in specific industries, such as technology and finance, which reinforces a culture of long hours and limited flexibility. These conditions place particular strain on employees with caregiving responsibilities, many of whom are women. Thus, we formulate the following hypothesis.

H3: The significant positive interaction effect between working time variation and work autonomy on self-reported health (including H2A and H2B) exhibits significant gender differences, with a more substantial impact observed among women compared to men.

Methods

Data and sample. The study adopted the China General Social Survey (CGSS) 2021 as the data source. Initiated in 2003, the CGSS is the earliest national, comprehensive, and ongoing social survey project in China (Bian and Li 2012). It aims to collect information on various aspects of Chinese society, economy, culture, and beyond. The CGSS is conducted periodically, gathering data across multiple fields, including personal and family backgrounds, employment status, income, health, social attitudes, and social networks. The survey employed a multi-stage stratified sampling method to collect data from urban and rural residents across multiple provinces in China. The original CGSS 2021 sample consists of 8148 respondents. Ethical approval and informed consent were obtained from Renmin University of China and the Survey Research Center of the Hong Kong University of Science and Technology. For more details, see http://cgss.ruc.edu.cn/English/Home.htm. This study utilized secondary data and was not involved in data collection.

To address potential non-response bias and enhance the representativeness of the findings, we applied the probability weights supplied by the CGSS dataset. All descriptive statistics and regression analyses were performed using Stata's svyset command, which accounts for the complex survey design and unequal selection probabilities. This adjustment improves the accuracy of our estimates in representing the characteristics of the target population.

To construct the analytic sample, we first restricted it to individuals who are employed and aged between 18 and 65. Self-employed respondents were then excluded, as their work conditions differ significantly from those of employees. Specifically, self-employed individuals often have greater control over their work hours and may experience more significant variability in their working time. Additionally, they face distinct challenges related to job autonomy, income instability, and health outcomes that differ from those encountered by employees with regular work schedules. Subsequently, we restricted the sample to individuals who completed all key questions, excluding those for whom specific questions were not asked or deemed not applicable. Finally, after excluding cases with missing data on key variables, which accounted for a missing data rate of 1.45%, the final sample comprised 1,832 respondents. A detailed breakdown of the steps used to construct the analyzed samples, along with the number of observations, is provided in Table 4 of the appendix.

Variables and measures

Dependent variable: self-reported health. The dependent variable in this study was self-reported health. Self-reported health is a widely used subjective indicator for measuring an individual's overall health status, providing a relatively reliable reflection of their perceptions of both physical and mental health (Bharat et al. 2023; Butler et al. 1987; Prince et al. 2020). The five-point Likert scale is commonly used in social science research to measure self-rated health, as it effectively captures the range from "very unhealthy" to "very healthy". Higher scores correspond to better health status (Idler and Benyamini 1997). In this study, self-reported health was assessed using the question: "How would you rate your current physical health?". Responses were measured on a five-point scale, ranging from 1 (very unhealthy) to 5 (very healthy).

Independent variable: working time variation. The independent variable of this study was working time variation. To measure the temporal instability of an individual's work schedule, we constructed an indicator based on the average absolute deviation from regular weekly working hours. Specifically, respondents reported their regular weekly working hours, as well as the maximum and minimum hours worked in the past month. $H_{regular}$ denotes an individual's usual weekly working hours, $H_{\max}$ refers to the maximum number of weekly hours worked in the past month, and $H_{\min}$ represents the minimum number of weekly hours worked during the same period. We then calculated the average deviation of the maximum and minimum weekly hours

from the regular value using the following formula:

$$Working\ time\ variation = \frac{\left|H_{max} - H_{regular}\right| + \left|H_{min} - H_{regular}\right|}{2}$$

This indicator captures the extent to which actual work schedules deviate from expected norms. It more directly reflects the irregularity and unpredictability of working time, which are central concepts in the theoretical framework linking schedule control to health outcomes. To reduce the influence of extreme outliers, the final working time variation variable was top-coded at 32 h. This value was selected as a conservative upper bound based on the empirical distribution—lying just above the 94th percentile and corresponding to roughly four full working days—beyond which weekly fluctuations are unlikely to be realistic for most workers. This approach minimizes the impact of a small number of highly irregular schedules while preserving meaningful variation across the majority of the sample.

Moderator: work autonomy. For this study, work autonomy was measured by the question: "To what extent can you independently decide the specific way you work in your current job", which is on a four-point scale from 1(Completely autonomous) to 4 (Completely unable to be autonomous). Based on this scoring scale, this study categorized work autonomy into two groups: high work autonomy (scores 1 or 2) and low work autonomy (scores 3 or 4). This binary approach simplifies the statistical model, ensuring the focus remains on the key differences between employees with significant autonomy and those with limited autonomy, thereby allowing for a clearer exploration of the impact of high versus low autonomy on the results (Backhaus, 2022).

Confounders. Existing research literature identifies socio-demographic and job characteristics as critical confounding factors that influence the relationship between work autonomy, working time variation, and the dependent variable of interest (Lu et al. 2023; Pan et al. 2023; Wang and Li 2023). To account for these potential confounding factors, this study incorporated a range of sociodemographic and job characteristics.

Socio-demographic characteristics include age, age squared, the presence of a partner, ethnicity, education, and political party membership. Hukou type, region, and the presence of dependent children. Age was calculated by subtracting the respondent's birth year from 2021. Only individuals aged 18 to 65 were included, and implausible values were excluded from the analysis. To account for potential nonlinearity in the relationship between age and the dependent variable, the square of age was also added to the model. Marital status was recoded as a binary variable, distinguishing between respondents with partners (married or cohabiting) and those without partners (unmarried, divorced, separated, or widowed). The multi-category ethnicity variable was simplified into a binary variable, distinguishing between ethnic minorities and the Han majority. Education was initially divided into four categories: illiterate, primary school, secondary school, and university or higher. For this study, it was grouped into two categories: "secondary and below" (illiteracy, primary school and secondary school) and "tertiary and above" (university or higher). This categorization was adopted to reduce model complexity while retaining the main gradient in educational attainment.

Political party identity was classified into two categories: non-political party members (the masses and members of the Communist Youth League) and political party members (members of democratic parties and the Communist Party). Hukou types were classified as "rural" and "non-rural". The rural household registration was coded as 0, while non-rural registration (including urban and other types) was coded as 1. Based on the classification criteria for the eastern, central, western, and northeastern regions provided by the China National Bureau of Statistics in 2021, provinces were divided into four regions (National Bureau of Statistics n.d.). A binary variable was constructed to indicate the presence of children, regardless of age, which serves as a proxy for caregiving responsibilities. Respondents who reported having any children were coded as "1" (children present), while those without children were coded as "0" (no children).

Job characteristics include occupational class (high/middle/low); weekly logged personal income; work type (full-time job/part-time job); contract type (permanent/temporary); and job sector (private/public). See Table 1 for details about descriptive statistics of analytical variables. Occupational information was coded according to the International Standard Classification of Occupations (ISCO-88) (Elias 1997). These occupational codes

Table 1 Descriptive statistics of self-reported health and working time variation, work autonomy, and covariates.

	Women (M/%)	Men (M/%)	Min	Max
Self-reported health	3.89	3.88	1	5
Working time variation	11.32	13.86	0	32
Work autonomy (%)				
Low	35.51%	37.48%		
High	64.5%	62.52%		
Age	38.33	39.98	18	65
Have a partner (%)				
No	22.8%	27.56%		
Yes	77.2%	72.44%		
Childcare responsibilities (%)				
No	20.99%	27.85%		
Yes	79.01%	72.15%		
Education (%)				
Secondary and below	62.33%	68.32%		
Tertiary and above	37.67%	31.68%		
Ethnicity (%)				
Han	94.09%	95.17%		
Minority	5.91%	4.83%		
Occupational class (%)				
High	44.43%	31.82%		
Middle	30.27%	10.53%		
Low	25.31%	57.65%		
Work type (%)				
Full-time job	90.29%	91.38%		
Part-time job	9.71%	8.62%		
Party (%)				
No	90.38%	86.96%		
Yes	9.62%	13.03%		
Hukou (%)				
Non-rural	48.32%	47.31%		
Rural	51.68%	52.69%		
Region (%)				
Western	17.48%	16.51%		
Northeast	5.71%	7%		
Central	31.81%	30.31%		
East	45.00%	46.17%		
Sector (%)				
Private sector	76.34%	83.50%		
Public sector	23.66%	16.50%		
Contract type (%)				
Non-permanent type	75.02%	77.06%		
Permanent type	24.98%	22.94%		
Regular Working hours per week	46.65	52.02	1	72

Data source: China General Social Survey (CGSS 2021). $N = 1832$.
M means, % column percentages, column percentages may not add up to 100 due to rounding.

were then used, together with information on employment status and supervisory responsibilities, to derive occupational class based on the Erikson–Goldthorpe–Portocarero (EGP) class schemam (Erikson et al. 1979, 2010). The original EGP categories were collapsed into three broader groups: professional/managerial, routine non-manual, and manual/agricultural occupations. For ease of presentation and consistency with tables and figures, these three groups are labeled as "high," "medium," and "low" occupational classes, respectively. In the regression analyses, occupational class was included as a categorical variable, with the high occupational class serving as the reference category.

Weekly working hours were treated as a continuous variable, with a maximum of 70 h, corresponding to the 90th percentile of the distribution. This approach helps mitigate the impact of extreme outliers while preserving the integrity of most respondents' data. Extreme working hours may indicate abnormal situations, such as prolonged overtime or unreasonable work arrangements. Therefore, applying a 90th percentile truncation better reflects typical work conditions. Contract type was derived from the labor contract status reported in the CGSS dataset. Workers with an open-ended contract were recoded as "permanent contracts." In contrast, those without a contract or with fixed-term contracts were categorized as "non permanent contracts". This classification aligns with prevailing practices in the Chinese labor market, where both the absence of a labor contract and the use of fixed-term contracts are commonly associated with lower job stability compared with open-ended contracts.

The job sector was classified into public and private sectors. The public sector included party and government agencies, public institutions, social organizations, residential committees, and the military. The private sector comprised enterprises, self-employed individuals, and other non-public entities.

We also calculated the Variance Inflation Factor (VIF) to assess multicollinearity for the multiple linear regression models. The VIF values for multiple linear regression models indicate that the majority of independent variables have VIF values within an acceptable range ($1 < \text{VIF} < 5$). This suggests that there is no significant multicollinearity issue between the independent variables used in the different models, ensuring that the regression coefficients are reliable.

Analytic approach. The study uses multiple linear regression models. As a statistical technique, multiple linear regression models utilize multiple independent variables to predict the outcome of the dependent variable, enabling analysts to determine the model's variation and the relative contribution of each independent variable to its total variance (Katz 2003).

When using this model to study the factors affecting self-reported health, we adopted a stepwise regression analysis approach: the first step is only to test the relationship between the primary independent variable (working time variation) and the dependent variable (self-reported health); In the second step, in addition to the primary dependent variable and independent variable, other variables that may also affect the independent variable are added; The third part introduces the interaction term between independent and moderating variables, which is the interaction between working time variation and work autonomy.

Results

Descriptive analysis. Table 1 presents the descriptive statistics of the key study variables. Below is a summary of the sample characteristics. The final analytic sample consisted of 1832 respondents, which comprised 57.23% men and 42.76% women. On average, men were slightly older (39.98 years) than women (38.33 years). Men reported higher levels of working time variation (13.86 h) compared to women (11.32 h). Regarding work autonomy, men and women reported similar distributions, with about 62.52% of men and 64.5% of women reporting high autonomy. In terms of partnership status, a slightly higher proportion of women (77.2%) than men (72.44%) reported having a partner. Childcare responsibilities were also more common among women (79.01%) than men (72.15%). Educational attainment showed that a larger proportion of women (37.67%) had a tertiary education compared to men (31.68%). Women were slightly more likely to belong to minority ethnic groups (5.91%) than men (4.83%). Occupational class differed notably: 44.43% of women were in high occupational classes, compared to 31.82% of men. In contrast, men were more concentrated in lower occupational classes (57.65%) than women (25.31%). Most respondents were employed full-time, with a slightly higher proportion among men (91.38%) than women (90.29%). Political party membership was reported more frequently among men (13.03%) than women (9.62%). Sector distribution indicated that men were more likely to work in the private sector (83.5%) compared to women (76.34%). Regarding contract type, the majority of both women and men were employed on non-permanent contracts (75.02% and 77.06%, respectively), with only about one quarter holding permanent positions. Regular working hours were longer for men (52.02 h per week) compared to women (46.65 h per week).

The relationship between working time variation and self-reported health. In Model 1 of Table 2, working time variation was used as the sole independent variable to show its direct relationship with self-reported health. The coefficient is −0.004, indicating that for each hour increase in working time variation, the self-reported health score decreases by 0.004 ($p < 0.1$). This suggests that as working time variation increases, there will be negative impacts on self-reported health. In Model 2 of Table 2, in addition to working time variation, work autonomy and other confounders were also included. In Model 2, the coefficient of working time variation is −0.004, indicating a more substantial adverse effect compared to Model 1 ($p < 0.05$). With a coefficient of 0.102, work autonomy suggests that workers with high autonomy report self-reported health scores 0.102 points higher than those with low autonomy ($p < 0.05$). Also, work autonomy shows a significant positive impact on self-reported health, while the adverse effects of working time variation remain evident.

In Model 3 of Table 2, the interaction term between working time variation and work autonomy is introduced, further illustrating how work autonomy moderates the effect of working time variation on self-reported health. The coefficient of working time variation is −0.009 ($p < 0.01$). The coefficient of the interaction term is 0.007 ($p < 0.1$), indicating that the interaction between working time variation and work autonomy has a significant impact on self-reported health. These results suggest that while working time variation negatively affects self-reported health, this negative impact is partially mitigated when employees have a higher degree of autonomy.

It is worth noting that the main effect of work autonomy is no longer significant in Model 3. To some extent, this result reflects the context-dependent nature of work autonomy as a moderator variable. In other words, the effect of work autonomy on health does not exist linearly or stably. Instead, it exhibits a significant buffering impact only in contexts with high working time variation. Therefore, the insignificance of the main effect does not imply the ineffectiveness of work autonomy; rather, it is more indicative of its impact being manifested mainly through the mechanism of interaction with working time variation.

Table 2 Multiple linear regression models examining the associations among working time variation, work autonomy, and self-reported health.

	Model 1	Model 2	Model 3
Working time variation	−0.004*	−0.004**	−0.009***
	(0.002)	(0.002)	(0.003)
Work autonomy (Ref. = Low)		0.102**	0.013
		(0.047)	(0.064)
Working time variation*Work autonomy			0.007*
			(0.004)
Age		−0.012**	−0.012***
		(0.005)	(0.005)
Age Squared		0.000**	0.000**
		(0.000)	(0.000)
Have a partner (Ref. = No)		−0.004	−0.006
		(0.071)	(0.071)
Education (Ref. = Secondary and below)		−0.043	−0.045
		(0.054)	(0.055)
Childcare responsibilities (Ref. = No)		0.116	0.119
		(0.084)	(0.084)
Ethnicity (Ref. = minority)		−0.011	−0.011
		(0.102)	(0.102)
Occupational class (Ref. = High)			
Middle		0.049	0.048
		(0.060)	(0.060)
Low		0.109**	0.109**
		(0.054)	(0.054)
Work type (Ref. = Full-time job)		−0.047	−0.050
		(0.073)	(0.073)
Party (Ref. = No)		0.107*	0.107*
		(0.062)	(0.063)
Hukou (Ref. = Rural)		−0.002	−0.002
		(0.048)	(0.048)
Region (Ref. = Western)			
Northeast		−0.110	−0.117
		(0.093)	(0.092)
Central		0.025	0.020
		(0.065)	(0.065)
East		−0.048	−0.049
		(0.062)	(0.062)
Regular Working hours per week		-0.001	-0.001
		(0.002)	(0.002)
Sector (Ref. = Private sector)		−0.047	−0.048
		(0.058)	(0.058)
Contract type (Ref. = Non-permanent type)		0.012	0.008
		(0.050)	(0.050)
Constant	3.928***	4.186***	4.258***
	(0.031)	(0.292)	(0.294)
Observations	1832	1832	1832
R-squared	0.003	0.064	0.066

Standard errors in parentheses. Data source: China General Social Survey (CGSS 2021).
$N = 1832$. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

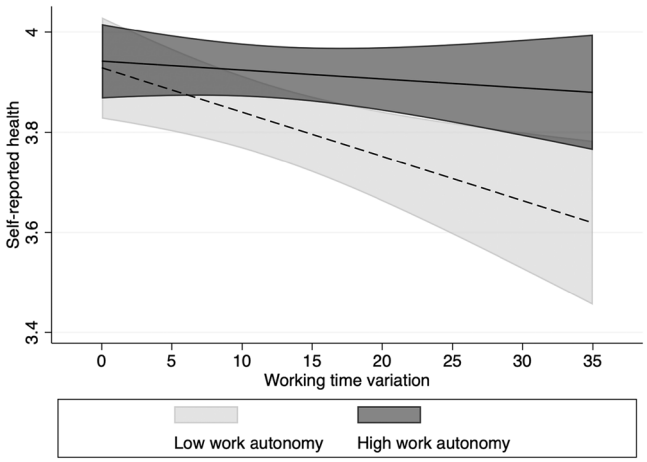

Fig. 1 Interaction effects among working time variation and work autonomy on self-reported health.

The interaction effect between working time variation and work autonomy. The interaction term in Model 3 of Table 2 shows that higher work autonomy weakens the negative impact of working time variation on self-reported health ($\beta = 0.007$, $p < 0.1$). This result confirms Hypothesis 2, indicating that work autonomy moderates the relationship between working time variation and self-reported health. Thus, it's necessary to investigate further the interaction effect between working time variation and work autonomy for workers. To better understand this, Fig. 1 used coefficients from Model 3 to predict self-reported health for workers with significant and less variation in working time under high and low work autonomy ($\beta = 0.007$, $p < 0.1$). This graph clearly illustrates the impact of working time variation on self-reported health, dividing it into two groups: "low work autonomy" and "high work autonomy".

Figure 1 shows that when workers have higher work autonomy, those with either less or greater working time variation tend to have similar levels of self-reported health, and the overall self-reported health status is better than that of workers with low work autonomy. However, for workers with lower work autonomy, an increase in working time variation leads to worse health outcomes. These results align with Hypothesis H2B, not H2A. H2B states that while the association between working time variation and self-reported health is negative, this effect is attenuated when work autonomy is high. Significant fluctuations in working time are likely to aggravate job demands and unpredictability, both of which can contribute to a decline in health status. However, when employees have high autonomy over their work, they are better equipped to manage these demands and adapt to fluctuating schedules, thereby mitigating the adverse health effects. In contrast, when employees have limited control over their work, they may find it more challenging to cope with high job demands, leading to increased stress levels and poorer health outcomes.

In summary, the coefficients for working time variation across the three models in Table 2 are -0.004, -0.004, and -0.009, respectively. According to the regression results, the coefficient for working time variation remains significantly negative, indicating that an increase in working time variation is associated with a decrease in self-reported health scores. Therefore, the regression results in Table 2 support hypothesis H1A. In contrast, hypothesis H1B, which posits a positive correlation between working time variation and self-reported health, is inconsistent with the regression findings and is thus rejected.

Interaction effect of working time variation and work autonomy by gender. To further explore the impact of working time variation on self-reported health, as well as the interaction between working time variation and work autonomy across genders, we conducted a grouped multiple linear regression analysis for women and men, as shown in Table 3. In both Model 3 and Model 6, the estimated coefficients were identical for women and men ($\beta = -0.009$); however, the level of statistical significance differed, with stronger evidence for women ($p < 0.01$) than for men ($p < 0.1$). Overall, these results provide support for

Table 3 Multiple linear regression model examining the associations among working time variation, work autonomy, and self-reported health for women and men.

	Women			Men		
VARIABLES	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Working time variation	−0.000	−0.001	−0.009**	−0.006**	−0.007**	−0.009*
	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.005)
Work autonomy (Ref. = Low)		0.134**	-0.007	–	0.071	0.031
		(0.062)	(0.082)		(0.067)	(0.096)
Working time variation* Work autonomy			0.013**			0.003
			(0.005)			(0.005)
Age		−0.017**	−0.018**		−0.011*	−0.011*
		(0.008)	(0.008)		(0.006)	(0.006)
Age Squared		0.000	0.000		0.000	0.000
		(0.000)	(0.000)		(0.000)	(0.000)
Have a partner (Ref. = No)		0.053	0.038		-0.044	−0.044
		(0.105)	(0.102)		(0.096)	(0.096)
Education (Ref. = Secondary and below)		−0.079	−0.084		−0.050	−0.050
		(0.078)	(0.077)		(0.077)	(0.077)
Childcare responsibilities (Ref. = No)		0.089	0.102		0.102	0.101
		(0.117)	(0.114)		(0.115)	(0.115)
Ethnicity (Ref. = Han)		0.001	0.013		−0.003	−0.005
		(0.141)	(0.138)		(0.144)	(0.145)
Occupational class (Ref. = High)						
Middle		0.091	0.093		−0.050	−0.052
		(0.070)	(0.069)		(0.115)	(0.115)
Low		0.044	0.052		0.119	0.118
		(0.091)	(0.090)		(0.073)	(0.073)
Work type (Ref. = Full-time job)		0.027	0.004		−0.085	−0.084
		(0.107)	(0.105)		(0.105)	(0.105)
Party (Ref. = No)		0.134	0.138*		0.103	0.103
		(0.084)	(0.083)		(0.087)	(0.087)
Hukou (Ref. = Rural)		0.066	0.057		−0.045	−0.044
		(0.067)	(0.067)		(0.068)	(0.068)
Region (Ref. = Western)						
Northeast		0.025	0.033		−0.201*	-0.207*
		(0.146)	(0.144)		(0.119)	(0.118)
Central		0.045	0.041		0.012	0.009
		(0.095)	(0.095)		(0.091)	(0.091)
East		−0.033	−0.036		−0.046	−0.047
		(0.087)	(0.087)		(0.088)	(0.088)
Regular Working hours per week		−0.001	−0.001		−0.001	−0.001
		(0.003)	(0.003)		(0.003)	(0.003)
Sector (Ref. = Private sector)		−0.043	−0.052		−0.064	−0.061
		(0.075)	(0.075)		(0.090)	(0.091)
Contract type (Ref. = Non-permanent type)		0.042	0.026		−0.014	−0.015
		(0.070)	(0.069)		(0.070)	(0.070)
Constant	3.893***	4.236***	4.406***	3.962***	4.352***	4.377***
	(0.041)	(0.452)	(0.448)	(0.045)	(0.388)	(0.392)
Observations	875	875	875	957	957	957
R-squared	0.000	0.084	0.091	0.007	0.063	0.064

Standard errors in parentheses. Data source: China General Social Survey (CGSS 2021).
$N = 1832$. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Hypothesis H1A. This indicates that increased variation in working time is consistently associated with lower levels of self-reported health across both male and female workers. In the female group of Model 3, the interaction term had a significant coefficient of 0.013 ($p < 0.05$). This suggests that high work autonomy significantly alleviates the negative impact of working time variation on women's self-reported health. However, in the male group of Model 6, the coefficient of the interaction term was 0.003, but it was not significant. This indicates that, for men, high work autonomy does not significantly mitigate the negative impact of working time variation on health. These results validate hypothesis H3: the interaction effect between working time variation and work autonomy on self-reported health exhibits significant gender differences, with a stronger impact observed among women compared to men.

To better understand the interaction effect between work autonomy and working time variation for women and men. Figure 2 targets both groups, illustrating the interactive effects of working time variation and work autonomy on self-reported health status. The curve in the graph depicts a difference in responses between women and men, with this difference being especially pronounced under conditions of both low and high work autonomy. For women with low work autonomy, the dashed line indicates a steeper downward slope, suggesting that greater variation in working hours has a more pronounced negative impact on their health. The solid line, representing

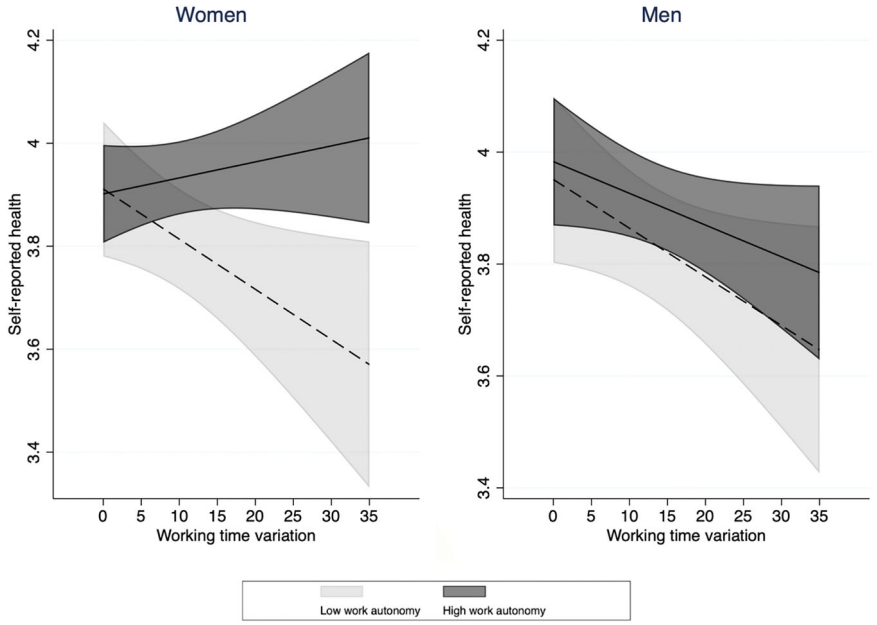

Fig. 2 Interaction effects among working time variation and work autonomy on self-reported health for women and men.

women with high work autonomy, exhibits a gentle upward trend. This suggests that high work autonomy significantly mitigates the negative impact of increased working time variation, even reversing the relationship between working time variation and health from negative to positive. That is, with high work autonomy, an increase in working time variation can lead to an improvement in women's self-reported health. For men, regardless of whether they have high or low work autonomy, their self-reported health declines as working time variation extends. However, compared to the low autonomy group, the solid line representing the high autonomy group shows a relatively gentle decline, indicating that while working time variation still has a negative impact on health, the effect is relatively minor. This suggests that for men, high work autonomy can somewhat mitigate the negative effects of working time variation, but it cannot entirely eliminate them. These results validate hypothesis H3: the interaction effect between working time variation and work autonomy on self-reported health exhibits significant gender differences, with a more substantial impact observed among women compared to men.

Robustness checks. To ensure the robustness check, the study adopts ordinal logistic regression models (OLR model) to examine the associations between work autonomy and self-reported health. Since the OLR model can treat the dependent variable as an ordered categorical variable, it is possible to use the OLR model to test whether it is appropriate to treat the dependent variable as continuous data in multiple linear regression; OLR can test the robustness of various regression coefficients in multiple linear regression models, evaluating whether they remain stable and reliable under different model settings. It allows the results of the multiple linear regression model to be tested for broad applicability, not just for a specific setting.

In Table 5 of the appendix, we use the OLR model to test the robustness of the results from the multiple linear regression model presented in Table 2. In Models 1–3 of Table 5, the coefficients for the independent variable "working time variation" are all negative, indicating that as working time variation increases, self-reported health scores decrease. In Model 2 of Table 5, a significant positive relationship exists between high work autonomy and self-reported health. In Model 3, the interaction term between work autonomy and working time variation shows a significant positive correlation with self-reported health. These results are all consistent with those from the multiple linear regression analysis in Table 2.

In Table 6 of the appendix, we use the OLR model to test the robustness of the results from the multiple linear regression analysis presented in Table 3. In Model 3 and Model 6, working time variation still has a significant negative impact on self-reported health. There are still substantial gender differences in the impact of interaction terms on self-reported health: High autonomy has a significant buffering effect on the negative impact of working time variation on women's self-reported health. However, for men, high work autonomy does not significantly buffer the impact of working time variation on their health. The OLR testing results indicate that, across different models and genders, the negative impact of working time variation on health remains robust. In some cases, work autonomy can moderate this negative impact. These findings are consistent with the results of the previous multiple linear regression model, confirming the robustness of the multiple linear regression models.

Discussion and conclusions

With the rise of flexible work arrangements and digital technologies, there has been extensive debate over the health consequences of working time variation, especially during the COVID-19 pandemic. It should be noted that working time variation is not in itself the same as flexibility in scheduling. In reality, working time variations may result from both autonomous adjustments by workers and passive variations, such as additional overtime and uncertain scheduling arrangements made by employers. Especially in the Chinese labour market, where long working hours and compulsory overtime are common, high time variability often does not mean that workers have real control over their time. Therefore, extrapolating the health impacts of working time variation alone may overlook key mechanistic differences. To more accurately distinguish between positive time flexibility and negative time instability, the present study introduces the moderator variable of work autonomy into the analysis.

Using nationally representative data from China, this study aims to enrich the debate by exploring the moderating role of work autonomy and yields several significant findings. This study highlights the moderating role of work autonomy in the relationship between working time variation and self-reported health, offering significant theoretical implications. According to the Job Demands-Resources (JD-R) model, work autonomy acts as a crucial resource that can buffer the negative impacts of job demands, such as irregular work hours (Xue and McMunn 2021). Our findings align with this framework, demonstrating that high work autonomy allows workers to manage working time variation more effectively, converting potential stressors into opportunities for better work-life balance and enhanced well-being. This supports the argument that the health impacts of flexible work arrangements are not inherently positive or negative but are heavily influenced by the availability of job resources (Scholarios et al. 2017).

In contrast, when work autonomy is low, working time variation exacerbates stress and work-family conflict, leading to poorer health outcomes. This suggests that autonomy should be considered an essential element in assessing the overall impact of working time variability on employee health. In our view, changes in working hours can only be understood as functional flexibility if they are accompanied by a certain degree of autonomy for the worker, contributing to a greater sense of control over their lives and, consequently, to better health (Morgeson and Humphrey 2006). Conversely, when changes in hours are not supported by a corresponding degree of autonomy, they are more likely to be characterised as a form of involuntary change or vulnerable employment, which can exacerbate stress and health burdens (Schieman et al. 2009).

In China, in particular, increased work autonomy is even more crucial in mitigating the negative impact of working time variation on health. In the Chinese labour market, especially in the manufacturing and service sectors, work schedules are often subject to rigid management and strict time control by organisations, leaving limited room for employees to autonomously regulate their working hours. Under such circumstances, frequent fluctuations in working hours often exacerbate individual psychological pressure and work-family conflicts, which in turn harm health (Wang et al. 2021). Enhancing work autonomy, as evidenced by granting employees more autonomy in time scheduling, increasing their participation in work decision-making, and improving their self-management abilities, can help increase employees' sense of control and psychological security (Bennett et al. 2018). When workers can adjust the pace of their work according to their own state, for example, focusing on complex tasks when they are energetic or taking a short break when they are fatigued, the stress caused by time uncertainty can be effectively buffered (Crawford et al. 2010). Such work autonomy is not only an adjustment of work style, but also a respect for the subjectivity of workers, enabling them to feel more in control of their work, rather than being passively subjected to the "manipulation' of time schedules.

Additionally, work autonomy enables workers to balance their work and family life better. In China, where the concept of family is deeply ingrained, workers often have to assume additional family responsibilities. Increased work autonomy enables them to organise their working hours more flexibly, for example, by staggering household chores, participating in children's education or caring for older people, thus reducing the psychological pressure and anxiety arising from work-family conflicts (Barbulescu and Bidwell 2013; Dousin et al. 2021). This balance not only enhances the mental health of workers but also promotes harmonious family relationships (Barbulescu and Bidwell 2013; Dousin et al. 2021). When workers do not have to sacrifice family time due to the rigid constraints of working hours, their overall quality of life and state of health may form a virtuous cycle, ultimately having a positive impact on both individuals and society.

The study also reveals significant gender differences in the effects of working time variation and work autonomy, which are particularly pronounced among women (Ridgeway 2009). These findings can be understood through the lens of social role theory and work-family conflict theory (Ferree 2010; Ridgeway 2009). In the Chinese context, traditional gender norms impose additional expectations on women to manage both professional and domestic responsibilities, thereby increasing their susceptibility to work-family conflict when autonomy at work is lacking (Bianchi et al. 2012; Deutsch 2007). High work autonomy enables women to navigate these dual roles more effectively, thereby mitigating the adverse health effects of variable work hours. For men, who typically face fewer household demands, work autonomy plays a less critical role in moderating the health impacts of working time variation (Johnston-Anumonwo, 1992; Turner and Niemeier 1997). In fact, the roots of this phenomenon lie in China's distinctive socio-economic and cultural context. Since the 1990s, with the advance of market-oriented reforms and intensified global competition, the Chinese labor market has gradually developed a set of work norms centered on long working hours, performance orientation, and workplace visibility. Organizations commonly treat overtime and sustained presence as key indicators of professional loyalty and competence (Bianchi and Milkie 2010). Within this environment, practices such as the "996" work schedule have become normalized and profoundly shaped workplace operations. Although recent policies have promoted flexible working arrangements and diverse forms of employment, their implementation remains limited, and the working hour regime continues to be characterized by rigidity and long working hours. This gap between policy and practice has further intensified the pressure on workers to demonstrate continuous commitment within organizations. At the same time, Chinese workplace culture places strong emphasis on collectivism and hierarchical order, where promotion and evaluation mechanisms often rely on observable and quantifiable work inputs rather than on output performance alone. The mutual reinforcement of employment institutions and workplace culture has not only increased the burden on workers but also amplified the visibility of gender disparities in the workplace. Moreover, the lack of external support systems has exacerbated these pressures. China's public childcare, eldercare, and care service systems remain underdeveloped, leaving families as the primary locus of social reproduction. Familialist values and entrenched gendered divisions of labor reinforce this pattern, with women expected to assume extensive unpaid care work even when engaged in the formal labor market (Bianchi 2000), while men are generally positioned as primary economic providers (Blau and Kahn 2007). In this institutional, policy, and cultural nexus, work autonomy functions not merely as an individual-level resource but as a socially embedded mechanism shaped by labor norms, family responsibilities, and gender orders.

Specifically, for Chinese women, fluctuations in working hours are often compounded by heavy family responsibilities, which frequently trigger work–family conflict and the accumulation of health risks (Feng and Savani 2020). Greater work autonomy provides women with the flexibility to redistribute time and balance work with family obligations, thereby mitigating the adverse consequences of temporal uncertainty (Fein and Skinner 2015). The situation is different for Chinese men. Although their family responsibilities are relatively lighter (Bianchi and Milkie 2010), they are strongly influenced by a performance-oriented workplace culture and the normative expectation of fulfilling the breadwinner role. As a result, they tend to channel work autonomy into additional professional commitments rather than using it to balance work and family. This pattern reduces the

significance of work autonomy in managing working time variation, thereby limiting the health benefits it can provide for men.

The structural distribution of occupational gender segregation further amplifies these differences. Chinese women are disproportionately concentrated in service and clerical positions, where institutional arrangements offer little scope for work autonomy and working schedules are highly rigid. For women in such roles, any increase in autonomy often represents a break from institutional constraints, enabling time redistribution and producing substantial health improvements. By contrast, Chinese men are more often employed in technical and managerial positions, which already afford relatively high levels of autonomy, leaving limited marginal benefits from further increases in autonomy. This occupational segregation not only reflects structural gender divisions but also illustrates how workplace norms and cultural expectations channel work autonomy into different patterns of practice, thereby reinforcing the gendered disparities observed in self-reported health outcomes.

In addition, variations in the type and orientation of social support help to explain why the moderating role of work autonomy exhibits significant gender differences. Chinese women are more likely to rely on relational forms of support, including emotional assistance and everyday help from family members, colleagues, and intra-organizational networks. Greater work autonomy provides women with the flexibility to mobilize and coordinate these resources, thereby alleviating time pressures and psychological strain and ultimately enhancing health outcomes (Wang and Li 2023). Chinese men, by contrast, tend to rely more heavily on institutionalized channels of support tied to career development, such as promotion systems and performance evaluations. While such resources reinforce self-realization and achievement orientation, they do not readily translate into buffers against daily stress. As a result, increases in work autonomy for men are more likely to intensify work commitments rather than generate substantial health improvements.

Interestingly, demonstrate that in European and American contexts, high levels of work autonomy, combined with remote working, typically result in time savings. Men are more likely to use the time saved for leisure, while women devote more of it to family responsibilities. By contrast, as discussed above, Chinese men tend to channel work autonomy into additional professional commitments, whereas women rely on autonomy to reconcile the dual demands of work and family. This pattern is further supported by the findings of. The juxtaposition of these cases illustrates that work autonomy is not a universal and homogeneous resource, but one that is differentially constructed within distinct institutional and cultural contexts. In Europe and the United States, autonomy is more closely associated with the logic of "work–life balance," while in China, it is embedded within performance-oriented norms and gaps in care provision, generating divergent health outcomes. Such comparisons highlight the cross-cultural variability in the mechanisms of autonomy and suggest that future research should examine more closely how institutional arrangements, cultural norms, and gender roles interact to shape the social meanings and health consequences of work autonomy.

The findings have practical policy implications for employers, policymakers, and organizational leaders. To enhance the positive health effects of flexible work arrangements, it is crucial to promote work autonomy, particularly in roles with high variability in working hours. Employers should consider implementing policies that empower employees with greater control over their work schedules, such as flexible start and end times, self-scheduling options, and increased remote work opportunities (Crawford et al. 2010; Demerouti et al. 2001; Nahrgang et al. 2011; Wu and Zhou 2022). Among them, various types of flexible work systems, such as core working hours systems, flexible working hours, negotiated working hours arrangements, telecommuting, and compressed workweek pilots, are institutionalized arrangements that organizations can focus on. At the same time, the promotion of the concept of results-oriented management reduces the over-reliance on fixed working hours. It emphasises performance objectives and task completion, thus weakening the logic of time obedience and helping to enhance employees' sense of identity and control over the organisation's system. Moreover, targeted support for women, such as flexible childcare arrangements and encouraging equitable sharing of family responsibilities, can help address the additional burdens faced by women in the workplace (Hwang 2019; Van der Lippe et al. 2019; Yucel and Fan 2023). By fostering a culture that values both flexibility and autonomy, organizations can create healthier work environments that support employee well-being and productivity.

Looking further ahead, in the policy dimension, the Government can create a more stable and predictable working-time environment for workers by improving labour laws and regulations, such as explicitly restricting involuntary overtime work, reinforcing the implementation of paid leave, and safeguarding the rights of non-standard work groups (Wu and Zhou 2022). To alleviate the structural pressure on female workers, the Government should also promote the development of inclusive childcare services, expand the scope of application of the policy on parental leave for men, and encourage enterprises to implement support measures for mothers and infants, among other things, to build a gender-equal family support system proactively (Van der Lippe et al. 2019). In addition, the government can explore the establishment of a certification system for gender equality in the workplace, and provide policy incentives to enterprises that perform well in terms of working hour arrangements, autonomy support, and family-friendly policies, to promote the transformation of the labour system from 'uniformity and regulation' to 'differentiated responsiveness', and to truly achieve a system design that responds to the needs of diverse workers.

Despite its contributions, this study has several limitations that should be addressed in future research. First, the use of cross-sectional data limits the ability to draw causal conclusions about the relationship between working time variation, work autonomy, and health outcomes. Longitudinal studies are necessary to establish causality and investigate how these relationships develop over time. Second, the study lacks measures of other job resources, such as workplace support and social support, which could also play critical roles in moderating the effects of working time variation on health. Future research should incorporate these additional resources to provide a more comprehensive understanding of how various job characteristics interact to influence employee health.

Further, this study is based on data from the COVID-19 pandemic. Large-scale work interruptions and the normalization of telecommuting during the pandemic characterized working time variation with a higher frequency and stronger magnitude, which may have amplified its adverse effects on health. At the same time, the significance of work autonomy as a coping initiative may have been further amplified in the crisis. Together, these factors led to some context-specificity in the study findings. Future studies may further compare the similarities and differences in the mechanisms of working time variation before and after the epidemic to enhance the reliability of the results. Additionally, exploring these dynamics across different cultural contexts could provide valuable insights into the generalizability of the findings and help identify culturally specific factors that affect the health impacts of flexible work arrangements. Overall, this study highlights the importance of work autonomy in shaping the health impacts of working time variation and underscores the need for more nuanced approaches

to flexible work policies that consider gender differences and other contextual factors.

Received: 8 October 2024; Accepted: 4 February 2026;
Published online: 16 March 2026

Data availability

The data are available at: http://www.cnsda.org/index.php?r=projects/view&id=65635422.

Appendix

Tables 4-6

Table 4 Analytic sample construction process.

Steps	Sample restriction	Sample
0	Original sample of CGSS (2021)	$N = 8148$
1	Restrict the sample to individuals who are employed, age 18-65	$N = 2616$
2	Restrict the sample respondents who are not self-employed	$N = 1859$
3	Restrict the sample to respondents who completed all key questions (excluding those who are not asked or not applicable)	$N = 1859$
4	Listwise delete couples with missing values for the variables used (1.45% of the original sample)	$N = 1832$ (final analytic sample)

CGSS China General Social Survey.

Table 5 Ordinal logistic regression models examining the associations among working time variation, work autonomy and self-reported health.

	Model 1	Model 2	Model 3
Working time variation	−0.004	−0.006	−0.016**
	(−1.22)	(−1.54)	(−2.54)
Work autonomy (Ref. = Low)		0.208**	0.020
		(2.20)	(0.15)
Working time variation*Work autonomy			0.016**
			(2.02)
Age		−0.026***	−0.026***
		(−3.03)	(−3.01)
Age Squared		0.001**	0.001**
		(2.16)	(2.19)
Have a partner (Ref. = No)		0.020	0.020
		(0.14)	(0.14)
Education (Ref. = Secondary and below)		−0.118	−0.123
		(−0.99)	(−1.04)
Childcare responsibilities (Ref. = No)		0.174	0.174
		(1.04)	(1.04)
Ethnicity (Ref. = minority)		0.110	0.114
		(0.54)	(0.56)
Occupational class (Ref. = High)			
Middle		0.036	0.034
		(0.29)	(0.28)
Low		0.236**	0.238**
		(2.03)	(2.04)
Work type (Ref. = Full-time job)		−0.186	−0.189
		(−1.15)	(−1.17)
Party (Ref. = No)		0.277**	0.280**
		(2.13)	(2.15)
Hukou (Ref. = Rural)		−0.043	−0.045
		(−0.43)	(−0.45)
Region (Ref. = Western)			
Northeast		−0.179	−0.190
		(−0.88)	(−0.94)
Central		−0.006	−0.013
		(−0.05)	(−0.09)
East		−0.140	−0.139
		(−1.08)	(−1.07)
Regular Working hours per week		−0.001	−0.002
		(−0.36)	(−0.53)
Sector (Ref. = Private sector)		−0.057	−0.059
		(−0.50)	(−0.51)
Contract type (Ref. = Non-permanent type)		0.072	0.059
		(0.70)	(0.58)
/Cut1	−4.997***	−5.674***	−5.829***
	(−17.71)	(−9.02)	(−9.20)
/Cut2	−2.768***	−3.428***	−3.582***
	(−25.90)	(−6.00)	(−6.21)
/Cut3	−0.841***	-1.449**	-1.599***
	(−12.54)	(−2.57)	(-2.81)
/Cut4	1.126***	0.608	0.461
	(16.09)	(1.08)	(0.81)
Observations	1832	1832	1832

Standard errors in parentheses. Data source: China General Social Survey (CGSS 2021).
$N = 1832$. ***$p < 0.01$, **$p < 0.05$, *$p < 0$.

Table 6 Ordinal logistic regression models examining the associations among working time variation, work autonomy and self-reported health for women and men.

	Women			Men		
VARIABLES	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Working time variation	−0.000	−0.002	−0.019**	−0.009*	−0.010*	−0.016*
	(−0.01)	(−0.30)	(−1.97)	(−1.73)	(−1.88)	(−1.83)
Work autonomy (Ref. = Low)		0.294**	0.024		0.114	−0.010
		(2.15)	(0.13)		(0.86)	(−0.05)
Working time variation*Work autonomy			0.025**			0.010
			(2.19)			(0.88)
Age		−0.042***	−0.044***		−0.023**	−0.023**
		(−2.75)	(−2.83)		(−2.09)	(−2.06)
Age Squared		0.001	0.001		0.001	0.001
		(1.02)	(0.98)		(1.20)	(1.23)
Have a partner (Ref. = No)		0.030	0.007		0.002	0.008
		(0.14)	(0.03)		(0.01)	(0.04)
Education (Ref. = Secondary and below)		−0.212	-0.225		−0.095	−0.096
		(−1.22)	(−1.30)		(−0.57)	(−0.58)
Childcare responsibilities (Ref. = No)		0.225	0.249		0.099	0.093
		(0.89)	(0.99)		(0.43)	(0.41)
Ethnicity (Ref. = minority)		0.068	0.088		0.215	0.214
		(0.24)	(0.31)		(0.73)	(0.73)
Occupational class (Ref. = High)						
Middle		0.086	0.090		−0.024	−0.030
		(0.57)	(0.59)		(−0.11)	(−0.14)
Low		0.156	0.169		0.234	0.233
		(0.82)	(0.88)		(1.51)	(1.49)
Work type (Ref. = Full-time job)		−0.072	−0.108		−0.239	−0.232
		(−0.30)	(−0.45)		(−1.07)	(−1.04)
Party (Ref. = No)		0.379*	0.392**		0.195	0.193
		(1.92)	(1.99)		(1.10)	(1.09)
Hukou (Ref. = Rural)		0.105	0.094		−0.167	−0.166
		(0.72)	(0.65)		(−1.20)	(−1.20)
Region (Ref. = Western)						
Northeast		0.097	0.110		−0.377	−0.394
		(0.31)	(0.35)		(−1.39)	(−1.44)
Central		0.020	0.017		−0.008	−0.016
		(0.10)	(0.08)		(−0.04)	(−0.08)
East		−0.137	−0.138		−0.113	−0.112
		(−0.74)	(−0.74)		(−0.62)	(−0.62)
Regular Working hours per week		−0.002	−0.003		−0.001	−0.001
		(−0.36)	(−0.59)		(−0.23)	(−0.30)
Sector (Ref. = Private sector)		−0.030	−0.048		−0.092	−0.083
		(−0.19)	(−0.30)		(−0.54)	(−0.49)
Contract type (Ref. = Non-permanent type)		0.094	0.061		0.065	0.064
		(0.64)	(0.41)		(0.45)	(0.44)
/Cut1	−5.159***	−6.401***	−6.713***	-4.898***	−5.600***	−5.687***
	(−11.41)	(−6.24)	(−6.48)	(−13.52)	(−6.69)	(−6.75)
/Cut2	−2.804***	−4.016***	−4.326***	−2.755***	−3.444***	−3.531***
	(−17.89)	(−4.32)	(−4.59)	(−18.69)	(−4.48)	(−4.56)
/Cut3	−0.765***	−1.903**	−2.204**	−0.925***	−1.566**	−1.652**
	(−8.28)	(−2.08)	(−2.38)	(−9.47)	(−2.07)	(-2−.16)
/Cut4	1.184***	0.161	−0.133	1.061***	0.503	0.418
	(12.03)	(0.18)	(−0.14)	(10.64)	(0.66)	(0.55)
Observations	875	875	875	957	957	957

Standard errors in parentheses. Data source: China General Social Survey (CGSS 2021). $N = 1832$. ***$p < 0.01$, **$p < 0.05$, *$p < 0$.

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Author contributions

F.F.J. reviewed the literature and contributed to the writing of the original paper. M.Z. reviewed the paper and contributed to the writing of the original paper. Q.W. conducted the analysis and revised the paper. S.C. conducted the analysis and revised the paper. H.T. revised and reviewed the paper. S.L. revised and reviewed the paper. S.W. reviewed, revised the paper and contributed to the writing of the paper.

Competing interests

The authors declare no competing interests.

Ethical approval

The ethical approval for data collection was obtained from the Renmin University of China and the Survey Research Center of the Hong Kong University of Science and Technology. For more details, see http://cgss.ruc.edu.cn/English/Home.htm. This study uses secondary data and was not involved in the data collection process.

Informed consent

Informed consent was obtained prior to data collection. For more details, see: http://cgss.ruc.edu.cn/English/Home.htm. This study only used the secondary data and was not involved in the data collection.

Additional information

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