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Diversity of flexible working time arrangements and workers' health: An analysis of a workers' panel and linked employer-employee data for France[☆]

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ABSTRACT

Flexible working time arrangements (FWTA) have increased over the last decades, favored by labor market deregulation, the decentralization of collective bargaining and the development of new technologies. The negative impact of some non-standard working hours on health (like night work, shift work) is quite well-known but other forms of FWTA have been studied less so far.

This article aims to investigate the relationship between FWTA and workers' health. It focuses on employer-oriented FWTA and uses a job demands-control framework to identify different types of working time demands and control.

The study uses individual data from the French working conditions survey, including panel data from 2013 to 2019 (64,981 observations) and cross-sectional employer-employee linked data from 2019 (5687 employees from 4672 workplaces).

We identify empirically two main dimensions of employer-oriented FWTA, based on 14 working time variables. The first type involves "atypical working hours", such as working weekends, nights, early mornings, evenings, or doing shift work. The second type – "work overflow" – is characterized by long working hours, overtime, taking work home, and having variable working hours.

Using a fixed-effects model based on panel data, we show that both types of FWTA have a negative impact on workers' self-rated general health and mental health, as measured by the WHO-5 index. The study also finds that workers who have more control – both individual and collective – to face these demands demonstrate better health. Workers with control over their working hours report better health and are less negatively affected by FWTA. Moreover, workplace-level practices have ambiguous relationships with workers' health. However, those involving social dialogue and workers' participation have more favorable effects: the positive effect of health and safety committees is especially clear.

To improve workers' health in the context of increased flexible working time arrangements, public policies should promote the development of control over working time and participation of workers to social dialogue on working time related issues.

1. Introduction

Over the last 25 years, working time has been decreasing on average in developed countries, but it has also become more flexible (Messenger, 2018). This trend towards flexibility can be related to the move towards an on-demand economy and the decline of collective regulation in most

industrialized countries, in spite of different institutional contexts (Wood, 2020). According to working conditions surveys, traditional forms of flexible working time that include atypical hours (working nights, evenings or weekends), shift work, part-time work, and long hours have not decreased, whereas new forms of flexibility have emerged, such as fragmented hours, flexible schedules and working

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from home outside normal working hours.

According to the French Labor Force Survey, in 2021, 45% of workers had worked atypical hours (evenings, nights, Saturdays or Sundays) at least once in the last four weeks (Nguyen, 2022). The negative impact of some non-standard working hours on health is quite well-known (Sato et al., 2020; Moreno et al. 2019; Greubel et al., 2016, Tucker and Folkard, 2012), for instance in the case of night work and shift work, which have a desynchronizing effect, or of long working hours (Dinh et al., 2017; Kamerade et al., 2019). However, other forms of flexible working time arrangements may also disorganize social life and make rest more difficult, with potential negative effects on health. These forms have been less studied in the literature so far.

Traditional as well as newer forms of flexible working time arrangements represent a challenge for the future of workers' health. Flexible hours or blurred boundaries between working time and family life are undoubtedly favored by the development of digital technologies, which allow working from home. But the development of human resource management software also now facilitates flexible time management within companies. Labor market reforms (and especially in France the latest labor law reforms of 2016 and 2017) have increasingly introduced flexibility in managing working time at the company and industry level: for example, rules for night work, Sunday work or part-time work may now be negotiated at the industry level. Overtime has been encouraged through cuts in social contributions and income tax since 2019. At the same time, institutions for health at work have been reformed, with health and safety committees in firms of 50 employees and more no longer being compulsory. Finally, the COVID crisis has led to the rapid development of teleworking, which is positively perceived by employees, as it increases their autonomy but also increases risks of work overflow (Oakman et al., 2020).

From a theoretical point of view, the effects of such flexible working time arrangements on workers' health can be analyzed by applying the "job demands-control framework" of Karasek's (1979) to working times-related demands and controls. Karasek's model is usually considered as one of the main reference models to analyze the links between psychosocial working conditions and health outcomes. Here, we focus on working time arrangements as specific components of working conditions. Some characteristics of these working time arrangements can be considered as work demands, which may be divided into three types: i) the number of working hours; ii) atypical working hours during the day/the week; iii) irregularity/variability of working hour patterns. Other features provide control for workers, including firstly individual control over working hours and times, and secondly the existence of collective regulatory instruments (like collective bargaining and agreements, or health and safety committees).

Using a recent French survey from 2019 that includes both a workers' panel and a linked employer-employee cross-sectional dataset, our study analyzes the effect of various forms of flexible working time arrangements on employees' self-declared general health and mental health.

Our research makes three main contributions to the literature on working time and health. First, it uses a broad definition of working time flexibility and includes non-standard hours as well as newer forms of flexibility. Second, by using the panel structure of the data the study allows for controlling unobserved heterogeneity and establishing causal effects of flexible forms of working time on workers' health. Third, we have been able to analyze the effects of some workplace characteristics from a cross-sectional perspective.

In the following section, we summarize the main results from the literature on working time arrangements and health. Then we present our data (Section 3) and our methods (Section 4). The presentation of the results (Section 5) is followed by a discussion and conclusion (Section 6).

2. Working time arrangements and workers' health: a summary of the literature

Our analysis is based on a job demands-control model, focusing on working time arrangements and including three types of demands on workers (number of hours, atypical hours, irregular/variable hours) and two categories of control (individual control over working hours and collective arrangements and regulations at the workplace). In this framework, the health effects of working time depend on existing demands and control, as well as on the balance between them. In the following paragraphs, we summarize the literature analyzing the effects of these three types of demands and two types of controls on workers' health.

The first dimension of working time is quantitative, related to the number of hours worked during the day, or week, or even throughout the year. While some studies show that not working at all can be bad for health (Kamerade et al., 2019), most studies focusing on the effects of long hours show detrimental effects in various national and workplace contexts. Looking only at those which rely on longitudinal data to deal with unobserved heterogeneity, it appears that long working hours harm health (Bassanini and Caroli, 2014). Based on Australian data, Dinh et al. (2017) estimate that 39 h a week is the threshold beyond which mental health declines: this threshold is even lower for women as they carry out most domestic tasks. Comparing Germany and Australia, Otterbach et al. (2021) also show that over-employment, defined as working more than the desired number of hours, is detrimental to workers' mental health. In France, Berniell and Bietenbeck (2020) show that the reduction in working time in 1998 had positive impacts on self-reported health and had specific health outcomes for both blue and white-collar workers in terms of smoking reduction for the former and Body Mass Index (BMI) decrease for the latter.

Second, apart from the number of hours worked, atypical hours also create a specific type of demand on workers. They are generally defined with reference to a standard working day (8 or 9 AM to 5 or 6 PM), from Monday to Friday. They naturally include working evenings, nights or weekends, and may (or not) involve shift work or daily hours separated by a long break. In theory, there are different mechanisms through which non-standard hours may affect workers' health (Tucker and Folkard, 2012; Althaus et al., 2013). The first one is related to biological rhythms: working nights, evenings and/or long hours may disturb the body clock, while shortening and disturbing sleep. The second mechanism results from interactions with family and social life. Time available for care or social activities may be reduced because of work, which may indirectly affect health (especially mental health). Through these channels, non-standard working hours are likely to increase fatigue and affect mood and performance in the short run, while in the long run, they can result in chronic effects on mental and physical health. Other authors add another indirect channel linking working time and health, related to the remaining available time for health "production" at home (e.g., longer working hours reduce the time for physical exercise: Berniell and Bietenbeck, 2020). The empirical literature on the effects of various non-standard working time arrangements is well-developed (Merkus et al., 2015). Recent studies in various national contexts and focusing on specific social groups have confirmed the generally negative effects of atypical hours on workers' health. Taking a wider perspective of non-standard working hours (including evenings, night shifts and irregular hours), and based on a survey of US young adults, Winkler et al. (2018) find that workers with non-standard working schedules are at increased risk of non-optimal sleep, substance use, greater recreational screen time, worse dietary practices, obesity, and depression. Using the European Working Conditions Survey (EWCS) from 2005 to 2010, Greubel et al. (2016) show that evening work and Sunday work are systematically associated with an increased risk of work-related health complaints. In Japan, Sato et al. (2020) also show that long and atypical hours have negative effects on mental health for both blue and white-collar workers, especially working after midnight for the

former and working long hours as well as during weekends for the latter. Besides, a large literature has analyzed the relationship between shift work and health, especially in epidemiology and medicine. [Moreno et al. \(2019\)](#) review the epidemiological evidence on the association between shift work and health and conclude that there is strong evidence linking shift work and some negative health outcomes (cardiovascular diseases, gastrointestinal and metabolic disorders). However, there is less consistent evidence linking shift work to cancer, mental health problems and reproduction-related problems.

Third, in addition to traditional forms of working time demands (such as long hours, overtime, atypical hours or shift work), newer forms of flexible working time arrangements have also emerged over the last years such as flextime (giving workers control over when they begin and end work, within certain limits, [Messenger, 2018](#)). New ICT technologies adopted at work can be considered as drivers of new forms of flexible working time arrangements, such as telework and ICT-based mobile work ([Eurofound, 2020](#)). These technologies can lead to more workers bringing work back home and to the blurring of work-life boundaries (with the possibility for instance of being contacted by an employer outside working hours). Flextime and variability in working hours may also have ambiguous effects on workers' satisfaction and health. Only a few studies focus on irregular hours. In France, irregular working hours are found to increase the probability of being on sick leave ([Afsa and Givord, 2009](#)). In a review, [Nicol and Botterill \(2004\)](#) also emphasized the major role played by on-call work on health at work for some high-skilled occupations. More recently, [Ha et al. \(2020\)](#) studied the effect of the low predictability of working time arrangements in Korea and found that it is associated with sleep disturbance symptoms. However, few studies analyze the effects of these newer forms of flexible working time arrangements (variability and unpredictability) on worker health and they tend to focus on specific occupations, especially healthcare employees ([Karhula et al., 2020](#)).

Concerning control, there is an important and well-established effect of individual control over working hours. In their survey of the literature, [Bassanini and Caroli \(2014\)](#) highlight that most of the evidence on the negative health impact of work found in the literature is based on situations in which workers have essentially no choice over the amount of work they provide. The negative effect of long working hours on health is not so much related to the working hours themselves, but rather to the gap between the actual and desired amount of work. The importance of control is also emphasized by [Tucker and Folkard \(2012\)](#), who recall that the effects of working time flexibility on workers' health or satisfaction depends on the degree of control that they have over working hours. The importance of working time control on health has also been more recently demonstrated by [Shiri et al. \(2022\)](#), in a review including only employee-oriented flexible work: low employees' control over working time is found to increase the risk of depressive symptoms, psychological distress, burnout, and accumulated fatigue. At the European level, [Backhaus \(2022\)](#) also shows that high working time variability is related to poor health, yet the correlation is weaker when it is combined with high working time control. The positive relationship between working time control and health may also be related to a direct link between control and the capacity to reconcile work and social/family life. Since night work, long hours, irregular hours, and work in evenings and weekends are associated with reduced social and family well-being, adequate worker control over working hours can reduce work-life or work-family conflict and have positive effects on health ([Arlinghaus et al., 2019](#)).

Collective resources have been less investigated in the literature, and existing studies focus on the effects of workplace occupational safety and health (OSH) practices on employees' health. The results provide mixed evidence. In the UK, a study based on interviews in 31 organizations, combined with a cross-sectional survey of employees from these organizations, shows that more proactive occupational safety and health (OSH) management leads workers perceiving a safer working environment, but the results show no significant relationship between workers'

declared health and OSH management ([Ward et al., 2008](#)). In the US, an old study ([Boden et al., 1984](#)) found no impact of joint labor and management health and safety councils on the administration of OSH complaints. By contrast, the results of a recent French study based on a large occupational health survey show that health and safety committees do indeed improve workers' health ([Bouville, 2016](#)).

Beyond these results about the effects of working time demands and control, the literature also highlights important methodological issues that must be taken into account to identify the effects of working time on workers' health. When considering workers' health, the first issue to address concerns the selection of the appropriate indicator. Health status can be identified using administrative data about in-work accidents, sickness leave, or even medicine consumption. However, in most surveys, it is identified through individual self-evaluation or questions about pain. Health status thus includes both physical and mental health. Self-assessed health measures are subjective and may vary across individuals or depend on the content of the questionnaire ([Barnay, 2016](#)). However, such indicators remain good predictors of actual health status and illness ([Delpierre et al., 2009](#); [Idler and Benyamini, 1997](#)), especially for mental health through the so-called WHO-5 index ([Topp et al., 2015](#); [Krieger et al., 2014](#)). Beyond the choice of indicators, a crucial issue is related to the direction of causality between work and health ([Sato et al., 2020](#); [Henseke, 2018](#); [Barnay, 2016](#)). Indeed, on the one hand, healthy workers are more likely to be employed in jobs characterized by hard working conditions and are also more likely to remain in employment while they get older: this effect is called the "healthy worker effect" ([McMichael, 1976](#)). On the other hand, physical or time constraints at work are likely to deteriorate health. Empirical analyses of the consequences of working time constraints on health have to deal carefully with such causality issues.

Based on this literature, we will consider three main hypotheses in our empirical analysis:

- first, employer-oriented working-time flexibility arrangements are diverse, including both traditional forms (overtime, atypical hours, etc.) and more recent forms, involving the variability and unpredictability of working hours and time.
- second, employer-oriented working-time flexibility arrangements, which can be considered as 'work demands' are likely to deteriorate health, both directly but also indirectly because they make employees' work-life balance more difficult.
- third, this negative health effect may be reduced if workers have control (JD-C hypothesis), including: i) individual control over working hours and times; and ii) the existence of collective regulation instruments like collective bargaining and agreements, or health and safety committees.

3. Data and measures

3.1. Data set: a panel and a linked employer-employee survey on working conditions

The empirical analysis is based on the three last waves of the French Working Conditions Survey (2013, 2016 and 2019), which include both a representative panel of individuals and a linked employer-employee survey. The survey has been conducted by the Ministry of Labor since 1978, but before 2013 only workers were questioned, and the survey took place every seven years. It is produced within the framework of French public statistics system and validated by the French National Statistical Council, ensuring ethical purposes for data collection and research.¹ It includes many questions on working time, work organization, physical constraints, psychosocial risk factors and health at work. It is representative of employees up to 60 years old in all industries. The

¹ <https://www.cnis.fr/avis-dopportunit-e-delivres-par-le-cnis/>.

representative panel of individuals cannot be matched with the linked employer-employee dataset. For our empirical analysis, we use both the individual panel (2013–2019) that includes 64,981 observations over the three waves and the cross-section-linked employer-employee data for 2019 (including 5,687 employees from 4,672 workplaces).

3.2. Outcome variables on workers' health

Two main variables are used to assess employees' health when using both the panel and the cross-sectional data. The first one is a self-rated health variable that comes from the following question of the survey: "How do you rate your general state of health?" with five possible answers from "very bad" to "very good", which are transformed into a continuous index from 0 (very bad) to 1 (very good). The second health variable we use is the World Health Organization – Five Well-Being Index (WHO-5) which is a validated, self-reported measure of mental health and well-being (Topp et al., 2015; Krieger et al., 2014).²

As secondary measures of health that we will use for robustness checks, we consider two variables related to declared physical pains: the number of frequent pains the employee reports "in any part of [my] body, over the past twelve months" (from 0 up to 20) and a dummy variable that takes 1 if the employee reports at least one pain. These two variables are not available for the 2013 wave.

Table 1 shows the level of health indexes in 2019 for workers according to their working time arrangements. Health scores are higher for workers who do not experience a given form of flexible working time arrangement. Workers who have control over their working hours also declare better health compared to workers who do not have such control.

3.3. Independent variables: measures of flexible working time arrangements

To identify the main dimensions of flexible working time arrangements, we use 14 dummy variables on working time that are available in the survey or that are built from other variables (see Table 1). These variables reflect the three main dimensions of working time demands defined above: i) quantity of working hours (long hours, overtime, minimum rest); ii) atypical hours (nights, Saturdays, Sundays, early mornings, evenings, interruptions and shift work); and iii) irregularity/variability of hours (variable hours, late notification of working hours, contacts outside working hours, taking work home).

Another variable will be introduced in some regressions, stemming from the following question: "Can you change your own working hours?" (yes/no). This may be considered as a measure of control over working hours. This variable is only available for 2019 and therefore it can only be introduced in the cross-sectional analysis. A detailed list of these working time variables is provided in the Appendix (Table A1), and some descriptive statistics about their frequency are presented in Table 1 below. The latter shows that many forms of FWTA concern more than 20% of workers (overtime, Saturday work, variable hours, not knowing working hours for the next week or day, contacts outside working hours), while 43% of workers declare that they have some control over their working hours. Besides, some FWTA appear significantly related to lower levels of both self-rated health and mental health, such as working overtime, having less than 48 consecutive hours off in a week, usually working on Saturdays, Sundays, evenings, and being contacted outside working hours. Other types of FWTA are either negatively related to self-rated general health only (long working hours, night and early morning work, shift work, interruption, late notification of working hours) or to mental health only (variable working hours, taking work home).

Table 1
Health indexes by working time arrangements variables, in 2019.

	Share %		Self-rated health (index)	T-test (p-value)	WHO-5 score (index)	T-test (p-value)
Working hours demands						
i) Quantity of working hours						
Having long working hours (>42 h a week)	18.9%	Yes	0.732	0.037	0.645	0.510
		No	0.747		0.641	
Working overtime: always or often working beyond the regular end time	26.8%	Yes	0.718	0.000	0.606	0.000
		No	0.755		0.655	
Having less than 48 consecutive hours off in a week	15.3%	Yes	0.71	0.000	0.592	0.000
		No	0.751		0.651	
ii) Atypical working hours						
Usually working on Saturdays	23.8%	Yes	0.71	0.000	0.613	0.000
		No	0.755		0.651	
Usually working on Sundays	11.3%	Yes	0.698	0.000	0.603	0.000
		No	0.75		0.647	
Usually working at night - between midnight and 5 AM	7.4%	Yes	0.704	0.000	0.637	0.599
		No	0.747		0.643	
Usually working between 8 pm and midnight	13.7%	Yes	0.727	0.012	0.622	0.003
		No	0.747		0.645	
Usually working between 5 and 7 in the morning	18.5%	Yes	0.722	0.000	0.647	0.377
		No	0.749		0.641	
Shift work (2*8; 3*8 ...)	10.3%	Yes	0.735	0.098	0.616	0.130
		No	0.745		0.645	
Working day usually divided into 2 periods separated by 3 h or more	5.4%	Yes	0.703	0.000	0.634	0.459
		No	0.746		0.643	
iii) Irregularity/variability of working hours						
Having variable working hours from one day to the other	28.9%	Yes	0.737	0.244	0.636	0.001
		No	0.747		0.645	
Being notified of one's working hours less than one month in advance (not knowing working hours for the next week or day)	22.5%	Yes	0.725	0.000	0.644	0.626
		No	0.75		0.641	
Having been contacted at least once over the last 12 months by a colleague/manager out of working hours for work-related purposes	45.9%	Yes	0.739	0.086	0.63	0.000
		No	0.749		0.652	
Taking work home ("every day" or "often")	9.0%	Yes	0.735	0.283	0.614	0.001
		No	0.745		0.645	
Control						
Control over working hours	43.0%	Yes	0.772	0.000	0.656	0.000
		No	0.722		0.631	
Total			0.743		0.642	

Source: French working conditions survey (2019). Descriptive statistics: share of employees in each WTA and average scores of health indexes.

² See Table A1 in appendix for details on the WHO-5 index.

3.4. Other employee-level variables

In addition, the survey provides a large set of socio-economic variables such as age, gender, occupation, seniority and type of contract (fixed-term or permanent, part-time or full-time). Employees are also asked about a chronic illness. The individual data include information about the firm and workplace, such as the industry, region, firm size, variation of the workforce over the last 12 months, and whether it is a single or multiple workplace firm.

3.5. Firm-level variables

The employer part of the survey provides additional information on the social context and on the work environment of the workplace. Three variables are used at the workplace level to characterize the context and workplace practices in terms of occupational health and safety and the existence of collective resources to face FWTA demands:

- Whether the workplace is covered by a Health, Safety and Working Conditions (CHSCT) Committee (which involves both employee representatives and management);
- Whether there have been negotiations and/or an agreement signed about working conditions over the last 12 months;
- Whether the workplace has implemented some specific policies to prevent stress and well-being problems at work over the last three years (see [Table A1](#) in Appendix for details).

4. Methods

Our analysis proceeds in three main steps to examine the impact of various FWTA on workers' health.

4.1. Multiple correspondence analysis

First, we run a multiple correspondence analysis (MCA) which is a semi-supervised data analysis method that studies the association between two or more qualitative variables ([Abdi and Valentin, 2011](#)). This method is particularly useful when studying a multidimensional phenomenon such as FWTA. It is indeed very likely that workers face different types of FWTA simultaneously: they may for instance work nights and Sundays; or they may work overtime as well as often taking work home. MCA helps uncover the underlying dimensions best able to describe the central oppositions in the data. In our case, it will detect which types of FWTA often come together. MCAs are often used to build synthetic variables: results are displayed as "factors" that are synthetic information on what is contained in the data. In order to detect which are the main forms of FWTA, we include the 14 variables presented in the previous section in the MCA. We will then describe the first two synthetic "factors" resulting from the MCA. These will then be used as measures of flexible working time arrangements and we will estimate their impact on workers' health through different types of regressions.

4.2. Panel regressions

We estimate the impact of the two main types of flexible working time arrangements identified in the MCA on two health outcomes: general health and mental health. We run fixed-effects regressions, using panel data on individuals (2013, 2016 and 2019) to tackle unobserved, individual heterogeneity. We restrict our sample to employees who have not changed either workplace, nor their position in the workplace, so that we also tackle unobserved, workplace heterogeneity.

All time-invariant variables at the individual and workplace level (such as sex, age group, occupation, seniority and firm industry) are dropped in the fixed-effects models. Firm size and type (single or multiple workplaces), workers' type of contract and part-time work are introduced as controls. The two variables generated by the MCA are our

only continuous variables.³ All other explanatory variables used in our models are dummy variables (or dichotomized categorical variables). This enables us to compare directly the magnitude of the regression coefficients.

While fixed-effects models control for unobserved heterogeneity, three methodological issues remain that could bias our estimation of the effects of FWTA on declared health. The first concerns attrition, so we checked whether there are significant health differences between workers who stay for two or three waves (nine years) in the panel, and we did not find any significant difference in terms of their self-declared health or mental health, except a slightly lower level of mental health for workers who were surveyed three times (see [Table A3](#) in appendix). The second issue is related to the restriction to workers who did not change either workplace or position in the same workplace, as their health may differ from the health levels of workers who change to another workplace and/or position. We thus test if our results are affected by this restriction. Finally, even if the fixed-effects method limits this problem, our analysis may still be subject to the "healthy worker effect", namely that workers who experience a variation in health may be more likely to experience a change in their working time arrangements. To reduce this effect, we introduce a dummy variable that controls for whether the worker suffers from a chronic illness in all our regressions.

4.3. Cross-sectional regressions on linked employer-employee data

In the last step, we enrich the analysis, using the employer-employee linked survey for 2019. In this step, we will observe the relationships between FWTA and health outcomes at the individual level, but we will also include employer-level variables that characterize the workplace (presented in the previous section). Though we cannot take advantage of the panel in this case, we want to test two additional hypotheses. First, we test whether workers who declare they can change their working hours have better health outcomes and whether this control over working hours modifies the impact of FWTA on their health. The variable for control over working hours has only been available since 2019, which is why we could not introduce it in the panel analysis. Second, we want to test whether some firm-level practices are related to workers' health outcomes. This last step adopts a more descriptive approach since we cannot implement fixed-effect regressions with cross-sectional data. However, we introduce many control variables to capture firm-level and individual-level heterogeneity.

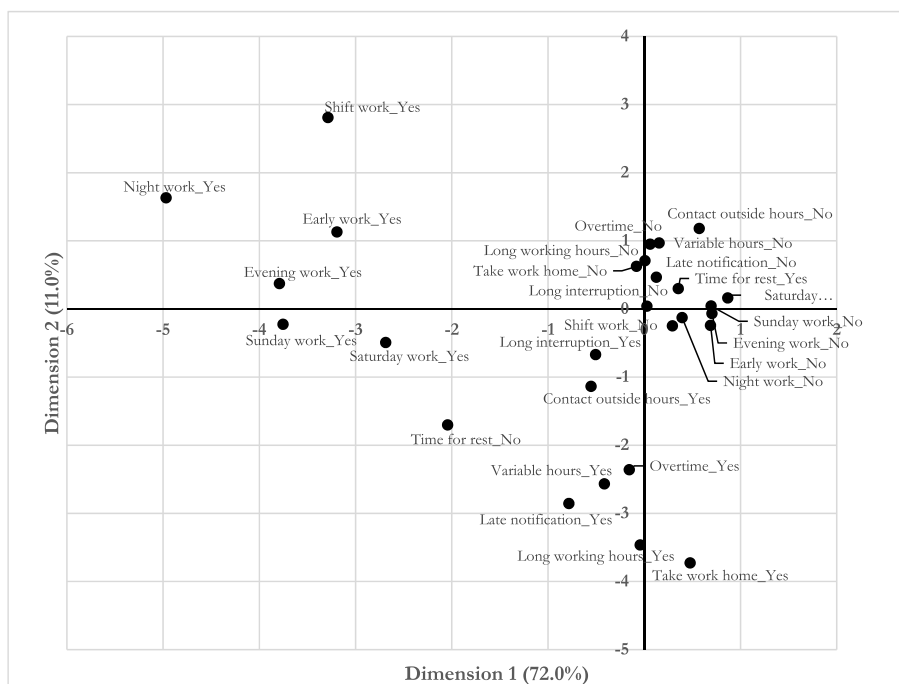
5. Results

5.1. Results from the multiple correspondence analysis: the main empirical dimensions of flexible working time arrangements

The two first axes (or factors) of the MCA account for about 83% of the adjusted inertia (Burt inertia), with the first axis accounting for 72% and the second axis for another 11% ([Graph 1](#)). With these two synthetic dimensions, we are thus able to account for 83% of the total information contained in the data.

The results of the MCA are represented in [Graph 1](#). The first dimension of flexible working time arrangements is represented on the horizontal axis. On the right-hand side of this axis, we find the categories defining this first dimension, namely: working nights, evenings, early mornings, Saturdays, Sundays or doing shift work. We call this first synthetic dimension, "atypical working hours." It corresponds to the second type of working time demands identified in our job demands-control model. These generally, directly depend on the production

³ [Table A2](#) in appendix presents their overall standard deviations decomposed into their between- and within-components. The same indicators are presented for the two health outcomes. We can observe that within variations are much more limited than between variations for all these four variables.



Graph 1. Multiple correspondence analysis of flexible working time arrangements (14 variables). Source: Working conditions survey (2013, 2016 and 2019). Method: multiple correspondence analysis, first two dimensions displayed.

process and the organization of the firm.

The second dimension of flexible working time arrangements that is represented on the (lower part) of the vertical axis is related to the following items: taking work home, long working hours (>42 h a week), working hours that vary from day to day, late notification of working hours, overtime and to a lesser extent not having a rest period of 48 h (or more) in a row, per week, and having been contacted at least once over the last 12 months by a colleague/manager outside working hours. These flexible working time arrangements combine the two other types of working time demands, namely the quantity of hours and their irregularity/variability. These FWTAs also relate to structural trends, including the development of the service sector (in which hours adapt to clients' needs) and of digital technologies. We call this synthetic axis "work overflow."

5.2. Panel analysis: the impact of "atypical working hours" and "work overflow" on workers' general and mental health

Table 2 shows the results from the analysis of the fixed-effects models to explain our two main dependent variables, namely self-rated health and mental health (WHO-5 index). We observe that both types of FWTAs – "atypical working hours" and "work overflow" – worsen the self-rated general health and mental health measured by the WHO-5 index. The magnitude of the effects cannot be interpreted straightforwardly since our two FWTAs variables are synthetic indexes derived from the MCA. However, inspired by the recommendation proposed by Mummolo and Peterson, 2018⁴, we have computed the ratios of the (within) standard variations of health outcomes divided by the marginal effects of one (within) standard variation of each working-time arrangement (see Table A4 in appendix). Results show that a standard variation of the

⁴ More generally, when using fixed-effects models, this method also avoids "discussing the effect of changes in X that are larger than any changes observed within units in the data" since fixed-effects models rely on variations over time for each individual and as such on sometimes small within-variations of X and Y (as can be seen in our case in Table A2 in appendix where within variances are much smaller than between variances).

Table 2
Fixed-effects model explaining self-rated health and WHO-5 score.

Panel fixed effects models	Self-rated health (index)	WHO-5 score (index)
Atypical working hours	-0.005** (0.002)	-0.007*** (0.002)
Work overflow	-0.005*** (0.001)	-0.010*** (0.001)
Chronic illness	-0.107*** (0.003)	-0.035*** (0.003)
Year 2016	-0.020*** (0.002)	0.011*** (0.002)
Year 2019	-0.030*** (0.002)	-0.001 (0.002)
Intercept	0.766*** (0.005)	0.635*** (0.005)
<i>Control variables: type of contract, part-time, firm size and type (single or multiple workplaces)</i>		
Number of Obs.	61171	57227
Two waves of observations	15709	14516
Three waves of observations	31512	29980
Attrition	13950	12731
Log pseudo likelihood	59702.32	57795.50
R-squared within	0.078	0.013
R-squared between	0.204	0.044

Note: Standard errors in parentheses.

+ p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Source: French working conditions survey (2013-2016-2019). Method: Fixed effect panel analysis.

atypical hours variable explains 1.9% of the standard variation in self-rated health and 2.4% of the standard variation in the WHO-5 score. A standard variation of the work overflow variable explains 2.4% of the standard variation in self-rated health and 4.3% of the standard variation in the WHO-5 score. Even though these effects are relatively small in magnitude, they are highly significant and close to those found in recent studies using fixed-effects models on similar issues (Kamerade et al., 2019). Indeed, general and mental health have many potential determinants from outside the work environment. These effects seem robust to various controls and empirical checks. First, in order to limit a

potential “healthy worker” reverse causality effect, we introduced a dummy variable on chronic illness in all our models. Unsurprisingly, this variable presents a strong and negative coefficient (especially in the self-rated health model). Most importantly, it appears that the effects of the two dimensions of FWTA on workers’ health remain negative and significant, independently of health variations (proxied by the outbreak or disappearance of a chronic illness).

Second, we also ran additional regressions to assess the possible bias related to the limitation of our sample to employees who stayed in the same workplace and position. These regressions include all employees and dummy variables to identify employees changing workplace or position (Table A5 in appendix). While we observe that staying in the same workplace leads to a decrease in health (especially mental health) compared to those who moved to another workplace, the effect of FWTA on all our health outcomes remains exactly the same, supporting the robustness of our baseline estimations.

Finally, we ran additional panel regressions to support the robustness of the effects of the two MCA dimensions on workers’ health. To do so, we tested the effects of the 14 different working time characteristics on health, taken first separately and then in two groups corresponding to each axis of the MCA. The results confirm that the effects of all these working time demands on health act in the same direction (i.e., they reduce workers’ health).⁵

5.3. The role of working time control and firm-level practices on workers’ health: a cross-sectional analysis of control

The cross-sectional analysis based on linked employer-employee data of 2019 explores our two further hypotheses on ‘job control’: the role of individual control over working hours and the role of firm-level practices on workers’ health. We estimate four successive sets of models for both general health and mental health (Table 3): Models 1 include the two synthetic working time variables, chronic illness and controls, the second set of models adds control over working hours; the third set of models also includes interactions between control and working time variables, and finally the fourth set of models integrates workplace-level variables, reflecting health and safety practices.

The results for the effect of flexible working time arrangements on general and mental health are very similar to those from the panel. In Models 1, the coefficients for the two synthetic dimensions of FWTA remain negative and significant for mental health. Only the coefficient for the “work overflow” component remains significant for general health, while it stays negative but becomes non-significant for “atypical working hours”.

In Models 2, we introduce a variable measuring whether the worker can change his/her working hours, which can be interpreted as an individual’s control to face working time demands. We can see that the relationship between control over working hours and both general and mental health is positive, significant and higher than the negative effect of one unit variation of work overflow (see Table 3). In terms of mental health, the effect of control over working hours exceeds, on average, the combined negative effects of FWTA.

In Models 3, we get the variable of control over working hours to interact with the two synthetic variables of FWTA, to see if control over working time may mitigate the negative effect of FWTA on health. Coefficients of interacting terms show that control over working time more

⁵ Self-rated health is significantly and negatively affected by long working hours, overtime, working at night, evenings, having less than 48 consecutive hours off in a week, taking work home, and not knowing working hours for the next week or day, while WHO-5 index is negatively impacted by long working hours, overtime, usually working on Saturdays, Sundays, early mornings, having less than 48 consecutive hours off in a week, not knowing working hours for the next week or day, having variable working hours from one day to the other, taking work home, contacts outside working hours.

than compensates the negative effect of atypical hours on mental health i.e. atypical working hours can be associated with better mental health when workers have control over working time.

Finally, in Models 4, we introduce workplace-level variables that we consider as collective resources to face working time demands. We look at whether firms’ practices in terms of health and safety correlate with workers’ health. Three variables are tested (see section 3.5). Our results show that when the workplace is covered by a Health, Safety and Working Conditions Committee (CHSCT), the self-rated health of workers is higher, while mental health is not significantly different. Workplaces where there have been negotiations as well as an agreement signed about working conditions over the last 12 months do not show higher levels of general or mental health. Finally, the last variable that indicates whether the workplace has implemented some specific policies to prevent stress and well-being problems at work (over the last three years) shows a negative and significant coefficient for general health. The coefficient for mental health is positive but not significant. In addition to these results concerning collective resources in the workplace, we can also note that the interaction of control and work overflow becomes significant in the full model for general health.

For both cross-sectional and panel analysis, we also estimated all the models using alternative variables of health as dependent variables. These health variables focused on physical pain (existence and number of pains). The results are very close to those obtained in our main estimations: see Tables A6 and A7 of the Appendix.

6. Discussion

Flexible working time arrangements (FWTA) take different forms and may thus have heterogeneous effects on workers’ health. Using large and recent longitudinal data, representative of French employees and a job demands-control framework, this paper takes into account individual heterogeneity and investigates the causal relationship between FWTA and workers’ general and mental health. Consequently, our analysis does not suffer from two of the most important methodological weaknesses identified in the literature on this topic (Tucker and Folkard, 2012): i.e., relatively small samples and the use of cross-sectional designs. As in many studies, we use self-reported data for measures of both health and flexible working time arrangements. However, alternative regressions using variables on localized pains, which might be less liable to subjective bias, lead to similar results. The main limitation of our analysis is related to the use of pre-Covid data (2013–2019) since the very last wave of the French Working Conditions Survey is not yet available. We discuss our results hereafter using recent literature on this period.

Our analysis has led to three valuable findings.

First, we show that two main types of FWTA can be distinguished empirically, which correspond to three main types of working time demands. The first one concerns atypical working hours, including working weekends, nights, early mornings, evenings or shift work. The second dimension could be seen as “work overflow” since it includes both the number of working hours (long working hours, overtime work and short rest) and the irregularity/variability of working schedules (taking work home, having variable hours of work from one day to the other and late notification of working hours). In our second finding, using fixed-effects models, we show that these two forms of FWTA have adverse effects on both the general and mental health of workers. Third, using richer cross-sectional data, we show that control over working hours influences the health effects of working time demands: individual control improves workers’ health and reduces the negative impact of FWTA, while workplace-level practices present ambiguous relationships with workers’ health.

Our research confirms the negative impacts of atypical working hours that have already been shown in some previous studies (though generally with more fragile methodologies). It also shows that newer forms of flexibility may have adverse effects on workers’ general and

Table 3
Cross-sectional models.

	Self-rated health (index)				WHO-5 score (index)			
	Model 1 (b/se)	Model 2 (b/se)	Model 3 (b/se)	Model 4 (b/se)	Model 1 (b/se)	Model 2 (b/se)	Model 3 (b/se)	Model 4 (b/se)
Chronic illness	-0.177*** (0.010)	-0.175*** (0.010)	-0.174*** (0.010)	-0.168*** (0.010)	-0.068*** (0.010)	-0.067*** (0.010)	-0.066*** (0.010)	-0.063*** (0.011)
Atypical working hours	-0.007 (0.005)	-0.005 (0.005)	-0.006 (0.005)	-0.011+ (0.006)	-0.014** (0.005)	-0.012* (0.005)	-0.016** (0.006)	-0.016* (0.006)
Work overflow	-0.017*** (0.004)	-0.019*** (0.004)	-0.025*** (0.006)	-0.026*** (0.007)	-0.008+ (0.004)	-0.009* (0.004)	-0.008 (0.007)	-0.010 (0.007)
Control over working hours		0.021* (0.009)	0.022* (0.009)	0.020* (0.010)		0.025** (0.009)	0.027** (0.009)	0.030** (0.009)
Atypical working hours*control			0.007 (0.011)	0.008 (0.012)			0.020+ (0.010)	0.023* (0.011)
Work overflow*control			0.013 (0.009)	0.016+ (0.010)			-0.002 (0.008)	-0.001 (0.009)
Health and social Council				0.025* (0.012)				0.005 (0.012)
Collective bargaining on working conditions				0.014 (0.013)				0.008 (0.013)
Collective agreement on working conditions				-0.005 (0.017)				-0.004 (0.016)
Policy on psychosocial risks				-0.030** (0.011)				0.004 (0.011)
Intercept	0.766*** (0.033)	0.760*** (0.034)	0.761*** (0.034)	0.771*** (0.039)	0.717*** (0.031)	0.711*** (0.032)	0.711*** (0.032)	0.685*** (0.037)
Control variables: Gender, age, occupation, seniority, contract duration, part-time, industry, region, firm size, single or multiple workplaces, workforce variation								
Number of Obs.	5284	5233	5233	4370	4996	4950	4950	4135
R2	0.253	0.255	0.256	0.265	0.103	0.104	0.106	0.124

Note: Standard errors in parentheses.

+ p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Source: French working conditions survey (2019). Method: OLS analysis with robust (clustered) standard error.

mental health. As mentioned in Section 2, the empirical literature on the health effects of such arrangements is scarce. Our study therefore makes an important contribution in a context where FWTA are likely to develop even more with the advent of the 24/7 society (Anttila and Oinas, 2018). The outbreak of the Covid pandemic has also transformed working time arrangements, especially with the development of remote work, including for workers who were not concerned by such arrangements before (ILO, 2022). Our analysis shows that working long hours, working overtime but also taking work home, as well as being contacted outside working hours by colleagues can raise the risk of general and mental health problems. This result is of primary importance in the context of expanding ICT use, and because it can also be seen as more ‘family-friendly’ and developed by employers in occupations where there are skill shortages.

At the individual level though, control over working hours allows this negative impact of flexible working time arrangements to be limited, confirming the job demands-control framework, as well as the literature distinguishing FWTA between employer-oriented and employee-oriented flexibility, depending on whether they involve more control by employers or employees over hours and working time organization (Wood, 2020). Costa et al. (2006) already suggested distinguishing between *variability* which involves control by employers over hours and working time organization; and *flexibility* controlled by employees, and found that flexibility and variability were inversely related to health, with favorable effects of higher flexibility and lower variability. The issue of employee-oriented flexibility has received growing interest recently, given the development of new forms of working time organization (including working from home). Based on a systematic review of recent studies on the associations between various forms of employee-oriented flexible work and mental health, Shiri et al. (2022) conclude that such forms of working time flexibility may have small beneficial effects on mental health. However, they also emphasize that existing studies do not allow the causes of health effects due to flexible work to be identified. Besides, other studies point out the

ambiguity of these newer forms of flexible working time in terms of well-being. Uglanova and Dettmers (2018), using the German Socio-Economic Panel, show that the effects of a transition to an employee-oriented FTWA is heterogeneous across genders, with a deterioration of satisfaction with leisure time for men, whereas satisfaction improves for women in the long run. Chung (2022) provides theoretical analysis and empirical evidence of a “flexibility paradox”, defined as the fact that employee-oriented flexibility (like autonomy and latitude) is often associated with more intensity of working-time (overtime and long hours). Thus, the positive effect we obtain for control over working hours does not mean that employee-oriented flexibility is always favorable to workers. Additional work on the relationships between such flexibility and health is thus still needed.

As far as collective resources are concerned, the effects of specific practices implemented at the workplace level to improve workers’ health and safety appear mixed. Policies focusing on psychosocial risks are associated with a lower level of general health, which may reflect a deteriorated context (reverse causality), or an adverse effect on workers’ perceptions. By contrast, workplace practices involving social dialogue seem to have more favorable effects: this is the case for health and safety committees, improving general health, and for collective bargaining which decreases the frequency and number of pains. In both cases, employee representatives as well as management representatives are involved. This is not necessarily the case for preventive policies, which can be decided unilaterally by employers and which are management-driven. Employee representatives specialized in health and safety and social dialogue on working conditions can influence workers’ health through both cognitive and political mechanisms: they increase the awareness of health issues at work among workers, and they may also lead to some pressure on the management to improve working conditions. Our results are consistent with a French study on health and safety committees (Bouville, 2016), as well as with a recent analysis of Belgian data showing an association between the poor quality of social dialogue and workers’ physical and mental health during the COVID (Wels et al.,

2024).

Ethics approval

Statement that Ethics approval is not required:
 We do not use data requiring ethics approval.
 The individual data we use (employee- and workplace-level) can only be accessed via a secure box of the Secure Data Access Center.
 The Secure Data Access Center is a consortium that organize and implement secure access services for confidential data for non-profit research, study, evaluation or innovation, activities described as “research services”, mainly public.

Appendix

Table A1
 List of variables

Variable	Question in the survey	Coding
Health		
General health	How would you rate your general state of health? 1. Very good 2. Good 3. Quite good 4. Poor 5. Very poor	Continuous variable, index from 0 (very poor) to 1 (very good)
Mental health (WHO5)	How often have you experienced the following statements over the past two weeks in your everyday life, at work and away from work? a) I felt good and in a good mood b) I felt calm and peaceful c) I felt full of energy and vigorous d) I woke up feeling refreshed and alert e) My daily life was full of interesting things All the time (5), most of the time (4), more than half the time (3), less than half the time (2), some of the time (1), at no time (0).	Continuous variable, index obtained by summing up the answers for the 5 items
Pains	Over the last twelve months, have you often felt pain in any part of your body? 1. Yes 2. No	Dummy variable
Pains (number)	If pain in any part of the body: number of localized pains: head, eyes, sinuses, ears, teeth, neck, shoulders, elbows, wrists, hands, chest, stomach, legs, hips, knees, ankles, feet, back, arms, other.	Continuous variable (0–20)
Working time arrangements		
Long working hours	In your main job, how many hours a week do you usually work?	Working hours >42 h
Saturday	Do you work on Saturdays? 1. Usually/2. Occasionally/3. Never	Dummy variable = 1 if usually, 0 if occasionally or never
Sunday	Do you work on Sundays? 1. Usually/2. Occasionally/3. Never	Dummy variable = 1 if usually, 0 if occasionally or never
Early morning	Do you work between 5 and 7 a.m.? 1. Usually/2. Occasionally/3. Never	Dummy variable = 1 if usually, 0 if occasionally or never
Evening	Do you work between 8 and midnight? 1. Usually/2. Occasionally/3. Never	Dummy variable = 1 if usually, 0 if occasionally or never
Night	Do you work at night between midnight and 5 a.m.? 1. Usually/2. Occasionally/3. Never	Dummy variable = 1 if usually, 0 if occasionally or never
Overtime	Do you ever work overtime? 1. Every day/2. Often/3. Sometimes/4. Never	Dummy variable = 1 if every day or often, 0 if sometimes or never
Shift work	Are your daily working hours? 1. The same every day/2. Alternating 2 × 8 (shifts, brigades)/3. Alternating 3 × 8 (shifts, brigades) or more/4. Variable from one day to the next	Shift work: Dummy variable = 1 if alternating 2 × 8 or 3 × 8 Variable hours: Dummy variable = 1 if Variable from one day to the next
Long interruption	Is your working day usually divided into 2 periods separated by 3 h or more? 1.Yes 2.No	Dummy variable = 1 if yes
Contact outside working hours	During the last 12 months, have you been contacted by your establishment, colleagues or superiors outside working hours for work-related purposes? 1.Yes 2.No 3. N/A	Dummy variable = 1 if yes
Taking work home	Do you ever take work home with you? 1. Every day or almost every day/2. Often/3. Sometimes/4. Never/5. N/A (work from home, technical impossibility, etc.)	Dummy variable = 1 if every day, almost every day or often = 0 if sometimes, never
Rest	Do you have at least 48 consecutive hours off during the week? 1. Yes/2. No	Dummy variable = 1 if yes
Knowledge	Knowledge of schedules to be carried out ... 1. In the next month/2. Next week/3. Tomorrow/4. No	Dummy variable = 1 if in the next month = 0 if next week, tomorrow or no
Control over working hours (HORDET)	Can you change your working hours yourself? 1. Yes/2. No/3. Not applicable	Dummy variable = 1 if yes
Workplace-level variables		
CHSCT	Is this establishment covered by a CHSCT (Health, Safety and Working Conditions Committee)? Yes/No	Dummy variable = 1 if yes

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CRedit authorship contribution statement

Christine Erhel: Writing – original draft, Software, Methodology, Formal analysis, Conceptualization. **Mathilde Guergoat-Larivière:** Writing – original draft, Software, Methodology, Formal analysis, Conceptualization. **Malo Mofakhami:** Writing – original draft, Software, Methodology, Formal analysis, Conceptualization.

Data availability

The authors do not have permission to share data.

Table A1 (continued)

Variable	Question in the survey	Coding
Negotiation and/or agreement on working conditions	Over the last 12 months, have there been any negotiations, in the establishment or in the company, on the issue of working conditions? – 1 Yes vs. 2 No 3 Don't know - If Yes: Did these negotiations result in ... 1) an agreement, 2) a unilateral decision, and 3) nothing	Negotiation Dummy variable = 1 if yes Agreement Dummy variable = 1 if an agreement
Workplace policy (stress, etc.)	With regard to stress or unhappiness at work, over the last 3 years, has your establishment put in place one or more of the following procedures to prevent such suffering? (Several answers possible): Reporting employees at risk/Confidential assistance to employees/Reporting of employees with addictive behavior/Audit, expertise from a specialist consultancy/Specific training for supervisory staff/Specific training for employees/Adjustment of working hours/Qualitative or quantitative survey on psychosocial risks/Conflict resolution procedure/Psychosocial risk prevention plan/Other	Dummy variable = 1 if at least one procedure
Control variables		
Gender	Male or female	Dummy variable = 1 if female
Age	Age at time of survey	Continuous variable
Occupation	What is your main occupation? Aggregate socio-professional category (French nomenclature PCS, 2003)	Categorical variable in four categories: - High-skilled - Medium-skilled - Blue collars - Other low-skilled workers
Contract duration	What kind of type of employment do you have?	Dummy variable = 1 if open-ended contract and 0 if fixed term
Part-time	In your main job, do you work? - Full-time - Part-time	Dummy variable = 1 if Part-time
Industry	NACE classification of sector	Categorical variable in six categories: - Agriculture - Manufacturing - Construction - Wholesale and retail trade - Transporting and storage - Other services
Region of the workplace	Administrative classification	Categorical variable representing the 12 French metropolitan regions plus one category for the overseas regions
Firm size	Approximately how many employees are there in this plant?	Categorical variable in four categories: – 1 to 9 employees – 10 to 49 employees – 50 to 499 employees - More than 500 employees
Single or multiple workplaces	Are there any other sites in the company?	Dummy variable = 1 if yes
Workforce variation	How has your workforce changed over the last 12 months? - Downward - Upwards - Stable	Categorical variable in three categories

Table A2

Variance decomposition of variation of health outcomes and working-time arrangement variables

	Mean	Standard deviation	
Self-rated health (index)	0.63	Overall	0.20
		Between	0.19
		Within	0.09
WHO-5 score (index)	0.72	Overall	0.20
		Between	0.19
		Within	0.10
Atypical working hours	0.05	Overall	1.01
		Between	0.95
		Within	0.34
Work overflow	0.13	Overall	1.09
		Between	1.03
		Within	0.43

Source: French working conditions survey (2013, 2016 and 2019).

Table A3
Attrition check table

	Number of observation	Self-rated health (index)	T-test p-value	WHO-5 score (index)	T-test p-value
<i>Employees by number of years surveyed (T-test 1vs2 and 1vs3)</i>					
1	14,376	0.726		0.637	
2	15,937	0.719	0.000	0.636	0.848
3	31,816	0.726	0.345	0.630	0.000

Source: French working conditions survey (2013-2016-2019). Descriptive statistics

Table A4
Assessment of the magnitude of the coefficients

	Self-rated health (index)	WHO-5 score (index)
Within standard variation of the outcome variable (A)	0,09	0,1
Marginal variation of the outcome variable for one standard variation of <i>Atypical working hours</i> (B)	-0,0017	-0,00238
Ratio of standard variation of the outcome variable for Marginal standard variation of <i>Atypical working hours</i> (B/A)	1,9%	2,4%
Marginal variation of the outcome variable for one standard variation of <i>Work overflow</i> (C)	-0,00215	-0,0043
Ratio of standard variation of the outcome variable for one marginal standard variation of <i>Work overflow</i> (C/A)	2,4%	4,3%

Source: French working conditions survey (2013-2016-2019). Method: Fixed effect panel analysis.

Table A5
Fixed-effects model on health variables with all employees (including those who have changed to another position or workplace)

Panel fixed effects models	Self-rated health (index)	WHO-5 score (index)	Physical pains (numbers)	Physical pain (dummy)
Atypical working hours	-0.005** (0.001)	-0.007*** (0.002)	0.012* (0.006)	0.094** (0.026)
Work overflow	-0.006*** (0.001)	-0.010*** (0.001)	0.014** (0.005)	0.086** (0.021)
Chronic illness	-0.111*** (0.002)	-0.038*** (0.002)	0.132*** (0.009)	0.731*** (0.042)
Did not change position nor workplace	-0.002 (0.003)	-0.009** (0.003)	0.003 (0.009)	0.037 (0.040)
Change position in the same workplace	-0.007** (0.003)	-0.013*** (0.003)	0.005 (0.010)	0.027 (0.044)
Year 2016	-0.021*** (0.002)	0.009*** (0.002)		
Year 2019	-0.028*** (0.002)	0.002 (0.002)	0.001 (0.005)	0.104*** (0.021)
<i>Intercept</i>	<i>0.778***</i> <i>(0.005)</i>	<i>0.659***</i> <i>(0.005)</i>	<i>0.625***</i> <i>(0.017)</i>	<i>1.633***</i> <i>(0.080)</i>
<i>Control variables: type of contract, part-time, firm size and type (single or multiple workplaces)</i>				
Number of Obs.	82014	76591	49069	49083
Log pseudo likelihood	60038.45	74186.82	6082.70	-69188.47
R2	0.053	0.018	0.017	0.026

Note: Standard errors in parentheses.

+ p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Source: French working conditions survey (2013-2016-2019). Method: Fixed effect panel analysis.

Table A6
Fixed-effects model explaining physical pains

Panel fixed effects models	Physical pains (numbers)	Physical pain (dummy)
Atypical working hours	0.011 (0.008)	0.092** (0.036)
Work overflow	0.014** (0.006)	0.081** (0.030)
Chronic illness	0.134*** (0.012)	0.687*** (0.056)
Year 2016	0.000 (.)	0.000 (.)
Year 2019	0.004 (0.006)	0.114*** (0.028)
<i>Intercept</i>	<i>0.639***</i> <i>(0.026)</i>	<i>1.833***</i> <i>(0.118)</i>
<i>Control variables: type of contract, part-time, firm size and type (single or multiple workplaces)</i>		

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Table A6 (continued)

Panel fixed effects models	Physical pains (numbers)	Physical pain (dummy)
Number of Obs.	28216	28224
Two waves of observations	19377	19381
Attrition	8839	8843
Log pseudo likelihood	5246.88	-37911.34
R-squared within	0.019	0.025
R-squared between	0.062	0.087

Note: Standard errors in parentheses.
 + p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.

Source: French working conditions survey (2013-2016-2019). Method: Fixed effect panel analysis.

Table A7
 Cross-sectional models explaining physical pains

	Physical pain (dummy)				Physical pains (numbers)			
	Model 1 (b/se)	Model 2 (b/se)	Model 3 (b/se)	Model 4 (b/se)	Model 1 (b/se)	Model 2 (b/se)	Model 3 (b/se)	Model 4 (b/se)
Chronic illness	1.055*** (0.121)	1.037*** (0.121)	1.027*** (0.122)	0.985*** (0.135)	1.384*** (0.158)	1.360*** (0.160)	1.345*** (0.158)	1.222*** (0.156)
Atypical working hours	0.078 (0.057)	0.052 (0.059)	0.043 (0.066)	0.056 (0.073)	0.034 (0.051)	0.002 (0.052)	0.010 (0.061)	0.037 (0.062)
Work overflow	0.219*** (0.052)	0.238*** (0.053)	0.436*** (0.078)	0.472*** (0.086)	0.199*** (0.052)	0.220*** (0.052)	0.328*** (0.082)	0.389*** (0.086)
Control over working hours		-0.294** (0.110)	-0.297**	-0.283* (0.112)		-0.366*** (0.105)	-0.362*** (0.104)	-0.409*** (0.097)
Atypical working hours*control			0.028 (0.125)	0.021 (0.139)			-0.062 (0.105)	-0.110 (0.112)
Work overflow*control			-0.386*** (0.103)	-0.405*** (0.113)			-0.236* (0.106)	-0.265* (0.122)
Health and Social Council				-0.162 (0.156)				-0.091 (0.154)
Collective bargaining on working conditions				-0.245+ (0.149)				-0.226+ (0.132)
Collective agreement on working conditions				0.298 (0.206)				0.083 (0.164)
Policy on psychosocial risks				0.242+ (0.146)				0.325* (0.136)
Intercept	0.408 (0.385)	0.513 (0.389)	0.533 (0.400)	0.365 (0.463)	1.852*** (0.361)	1.948*** (0.363)	1.942*** (0.367)	1.754*** (0.418)
Control variables: Gender, age, occupation, seniority, contract duration, part-time, industry, region, firm size, single or multiple workplaces, workforce variation								
Number of Obs.	5287	5236	5236	4373	5288	5237	5237	4373
R2 (or pseudo R2 for logit)	0.094	0.097	0.101	0.110	0.163	0.169	0.171	0.196

Note: Standard errors in parentheses.
 + p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001.
 Source: French working conditions survey (2019). Method: Logit analysis for the dummy variable and OLS analysis with robust (clustered) standard errors for the continuous variable.

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