

European Agency for Safety and Health at Work

# Home-based teleworking and preventive occupational safety and health measures in European workplaces: evidence from ESENER-3

European Risk Observatory

Report

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## 1 Introduction

Teleworking, the many definitions of which vary across geographical and regulatory contexts, is a relatively recent phenomenon, developed in parallel with the advent and development of new communication and information technologies. This study aims to identify the main characteristics of home-based teleworking employees across European workplaces and provide information on occupational safety and health- (OSH)-related prevention practices. Results are presented in terms of both the physical risk factors, with respect to musculoskeletal disorders (MSDs) in particular, and the psychosocial risk factors, with the aim of investigating the aspects that may negatively affect teleworkers' physical health and their overall well-being.

Following the digital transformation triggered by the development of the internet, the prevalence of teleworking has slowly but continuously increased in the European Union (EU) in the past two decades, primarily in the case of self-employed, freelance and mobile workers<sup>1</sup>, and mostly in the technology-intensive services sector. As the evidence presented in this study shows, the growth in teleworking — while displaying some differences across gender and age — has been constant across many NACE (Nomenclature statistique des activités économiques dans la Communauté européenne — statistical classification of economic activities in the European Community) sectors in the past 10 years.

In 2020, the global COVID-19 pandemic had a huge impact on global economies and abruptly triggered a massive increase in the number of people working from home. In the current crisis, teleworking is generally considered an efficient way to re-establish and uphold the functioning of entire sectors (EU-OSHA, 2021a). The level of teleworking has rapidly increased, 10-fold in some countries, and it has unexpectedly become established across entire sectors in which, prior to 2019, it was very rare. Prior to the epidemic, in many countries (such as Bulgaria, Greece and Italy) relatively few people worked from home. In a few other countries, the phenomenon had already reached considerable proportions (mainly in Finland and the Netherlands). The main differences occur at a geographical level, rather than with respect to sectors (see for instance Fana et al., 2020). With some exceptions, however, national regulatory and policy settings have begun to be updated only recently. In fact, in many cases, the issue has been handled only at company level and by referring to the regulations in force in each country for workers who carry out their tasks at their employer's premises.

The current crisis has generated a sudden transformation in the organisation of work, and it is not easy to predict to what extent enterprises and employees will decide to revert to previous practices. Such a rapid expansion in the rate of workers carrying out their jobs outside their employers' premises during the COVID-19 pandemic gives rise to the question of whether this trend is irreversible, or, in contrast, if the number of people working from home is likely to remain stable or even return to pre-pandemic levels.

Working from home can be regarded as a valuable way to successfully manage work-life balance; however, at the same time, it can potentially have detrimental effects on physical and mental health, and even blur the boundaries between work and private life (Messenger, 2019). Nonetheless, statistically representative studies on the working conditions for teleworkers are still few in number, especially at a cross-country level. In particular, not much is yet known about the specific risks that workers may face in relation to the specific nature of their activities (EU-OSHA, 2008). In spite of its related risks, recent data show that over three-quarters of employees interviewed in July 2020 stated that they would like to continue to work from home, even after COVID-19 restrictions ease, at least occasionally (Eurofound, 2020a). At the company level, many workplaces are reported to have embraced the potential of digital technology (EU-OSHA, 2021a); the infrastructure and experience are now available and are constantly evolving.

To contribute to the current debate on teleworking and related changes in regulation, in this article we employ the latest data collected from both companies and employees in the pre-COVID-19 scenario, since this information relates to non-exceptional working conditions and can therefore provide a more accurate and reliable picture of the teleworking situation in the EU than information relating to teleworking during the pandemic.

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<sup>1</sup> For a definition, see <https://www.eurofound.europa.eu/observatories/eurwork/industrial-relations-dictionary/ict-based-mobile-work>.

In this study, we aim to understand how worker and enterprise characteristics influence whether or not companies have teleworking in place. Both descriptive and model-based statistical evidence are exploited to obtain valuable facts and figures for those planning and implementing teleworking agreements and policies for managing teleworking in the post-pandemic setting, specifically taking into account risk awareness among European companies and the prevention measures implemented. To this end, we employ data from the Eurofound sixth European Working Conditions Survey (EWCS) (2015) and the EU-OSHA third European Survey of Enterprises on New and Emerging Risks (ESENER-3) (2019) to investigate the characteristics of teleworkers and of the workplaces that have teleworking in place.

The article is organised as follows: defining aspects are discussed in the light of recent literature (Chapter 2); teleworking trends over the past 10 years are described on the basis of European Union Labour Force Survey (EU-LFS) data (Chapter 3); teleworkers' characteristics and the main risks to their physical and mental health are described using the most recent (2015) EWCS data (Chapter 4); and, using the information collected by ESENER-3 (2019), we focus on the characteristics of the enterprises that have teleworking in place, and on the measures implemented to counteract its potential risks (Chapter 5). Results are illustrated by means of descriptive and modelling analyses, with respect to a number of factors, such as company size, NACE sectors and main geographical areas. Some concluding remarks end the article. Supplementary tables and methodological issues are presented in three annexes that follow the references section.

## 2 Definitions and recent literature

### 2.1 Classification of home-based teleworking

To better understand current and future challenges, and properly investigate the OSH issues relevant to home-based remote work or teleworking across Europe, it is essential to define ‘teleworking’, particularly — but not only — in light of what has recently happened as a consequence of the COVID-19 pandemic (for example ILO, 2018, 2020a,b; Fana et al., 2020). Although teleworking has been the subject of research for some years, a commonly shared definition is not yet in place<sup>2</sup> (Baruch, 2001; Parry et al., 2021). Baruch (2001, p. 114) complained that, despite the already lively discussion in the literature, there was not even a shared terminology: ‘There is not even an agreed term: “teleworking” (common in European literature), “telecommuting” (common in American literature), “home-working”, “working-at-a-distance”, “off-site workers”, or “remote-workers” — all these terms may have similar meanings and are used exchangeably’.

At EU level, a first shared definition is that of the European cross-sector social partners’ Framework Agreement on Telework (2002), which refers to ‘a form of organising and/or performing work’ by means of ‘information technology, in the context of an employment contract/relationship’ regularly carried out away from the employer’s premises<sup>3</sup> (EU-OSHA, 2017a). Since this first agreement, home-based teleworking has developed considerably, mainly as a result of advances in information and communications technology (ICT) and in response to societal changes, including those driven by globalisation, digitalisation and automation (Mandl et al., 2015). Such developments in ICT afforded a wide range of remote working options and led to varying degrees of implementation across sectors and countries. Therefore, in the European Commission report (2008)<sup>4</sup> on the implementation of the 2002 social partners’ agreement, allowing for a comprehensive characterisation of teleworking was considered necessary.

### 2.2 Home-based teleworking before the COVID-19 crisis

As evidenced by a growing body of literature, flexibility of work in terms of time and space has long been regarded as a key factor in significantly increasing productivity (for example Eurofound, 2011, 2012; Harker Martin and MacDonnell, 2012), while at the same time enabling individuals to better manage challenging work and life pressures (Van Dyne et al., 2007). Notwithstanding its potential, teleworking was rarely applied at either European or global level (Eurofound, 2010), with some exceptions. This was for a variety of reasons associated with organisational issues, the lack of a welfare framework and people’s need — sometimes perceived as crucial — to meet face to face.

Hence, although teleworking has prompted advances at both business and societal levels (Bailey and Kurland, 2002), some of its specific benefits have long been regarded as a privilege for employees, particularly in terms of reducing difficulties in balancing work and non-work responsibilities (Putnam et al., 2014). In fact, until the current epidemic<sup>5</sup>, mainly because of organisational issues and the lack of

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<sup>2</sup> According to the classifications in the Eurofound and ILO report (2017, p. 5), a basic distinction should be made between ‘working from home’, which refers to home-based teleworking, and ‘working at home’, which describes the performance of work ‘done at home using the home as a place of work and production without ICT’. An example of the latter is that of workers sewing garments at home to sell their products to a company — a system generally based on piece-rate remuneration.

<sup>3</sup> Negotiated in 2001/2002, this document was the first to be implemented by social partners at the national level. In the agreement, teleworking is explicitly regarded as a driver of modernisation for companies and public service organisations, as well as an instrument for workers to better reconcile work and social life, and experience greater autonomy in the accomplishment of their tasks. See <https://www.worker-participation.eu/EU-Social-Dialogue/Interprofessional-ESD/Outcomes/Framework-agreements/Framework-agreement-on-telework-2002>.

<sup>4</sup> The document (European Commission, 2008) clearly states that the 2002 agreement greatly contributed to achieving ‘a more dynamic knowledge-based economy’, while pointing out the need for ‘raising awareness among individual employers and local-level trade unions’, and ‘concentrating on those sectors and professions with high incidences of telework’.

<sup>5</sup> In the literature on working conditions, the attention paid to the effects of disastrous and unexpected events has so far been quite limited. However, some consequences of crises that have profoundly affected (or interrupted for a certain period) work activities because sites have become inaccessible or clearly unsafe for work have been studied. One instance is that of the terrorist attacks of 11 September 2001 (Alvaro et al., 2011). Another interesting study refers to the consequences of the earthquakes in Christchurch, New Zealand, which led to the sudden implementation of teleworking, meant to guarantee the continuity of work activities in a situation of national emergency (Donnelly and Proctor-Thomson, 2015). In this latter case, public sector organisations were requested to operate within a disaster situation, and teleworking played a crucial role in accelerating the allocation of work tasks across dispersed workforces.

national regulatory and welfare frameworks, working from home remained an elusive possibility in many countries (Baruch, 2001; Ogbonna and Harris, 2006), often unachievable for most workers (Eurofound, 2010, 2020b; Pyöriä, 2011).

As explored in the following sections, teleworking may involve specific occupational risks. Some scholars suggest that teleworkers may be exposed to physical risks linked to prolonged sedentary behaviour. Working in one position for very long periods without moving may increase the risk of health problems including obesity, heart disease, MSDs, eye strain and visual fatigue (for example EU-OSHA, 2020a,b). In addition, teleworking is associated with specific psychosocial risk factors and greater levels of stress than experienced by office workers; this is likely to cause physical as well as mental health symptoms.

In explaining the reasons behind the slow uptake of teleworking, Rasmussen and Corbett (2008) underlined the importance of traditional management and workers' attitudes, including the real prospect<sup>6</sup> of employees feeling or becoming isolated while working at home. Other researchers (for example Mann and Holdsworth, 2003), while indicating some practical benefits of teleworking such as increased flexibility and a reduction in commuting, also point out its potentially detrimental effects on employees' mental health. More specifically, such unfavourable consequences would primarily lead to perceived loneliness, social isolation and presenteeism (Steidelmüller et al., 2020). With respect to work-life conflict, there is also recognition of challenges related to the boundaries between work and individual obligations and free time. This may be the case for workers with caring or parenting responsibilities.

To investigate the occupations that may be more easily performed in teleworking mode (in line with other studies, including Mas and Pallais, 2017; Briken et al., 2017), a joint study by Eurofound and the International Labour Organisation (ILO) (2017) clearly underlined that some jobs are, by their very nature, more suitable for flexible and home-based work than others.

Finally, although in the past decade increasing advances in ICT have enabled working outside employers' premises, the determinantal effects that may influence an expansion of this type of working are still widely debated and likely to differ strongly at country level (Messenger and Gschwind, 2016; Messenger, 2019).

### 2.3 Home-based teleworking and the COVID-19 pandemic

In 2020, the COVID-19 pandemic severely affected economies and overall social and working lives in Europe and throughout the world. Governments decided to control the spread of the disease through social distancing; therefore, private and public companies experimented with ways to reduce the number of people in contact with each other, including making it possible for employees to work at home. As a result, and quite unexpectedly, an unprecedented number of workers around the world were requested or allowed to work from home, after decades of often ineffective attempts to broaden the use of teleworking.

As reported by national experts and European bodies (for example European Parliament, 2021; EU-OSHA, 2021a), it is challenging to obtain conclusive information about the effects of teleworking on the current labour market based on existing studies on the topic. On the one hand, research may not have been undertaken on a scale that can give an adequate foundation for broad conclusions. On the other hand, the available operational classifications for data collection on the subject are not always consistent.

Teleworking may be a realistic option for only certain categories of employees, such as those employed in knowledge-based sectors (Bouziri et al., 2020; Espinoza and Reznikova, 2020), whose tasks do not involve the provision of personal services and who require neither the use of machines or tools, nor direct sales services and/or assistance. In the manufacturing sector, for instance, if work needs to be executed through a production line or in a workshop, it is of course more difficult to arrange any teleworking opportunities. Conversely, for office jobs in private and public companies, as well as for those occupations where employees have a relatively high level of responsibility and work relatively

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<sup>6</sup> In referring to the 'glacier-speed' rise of teleworking, Rasmussen and Corbett (2008, p. 24) stress the risk of struggling between work and 'home life, external distractions, and a lowered awareness of internal organisation issues', not to mention workers' concerns about being 'out of mind' as well as out of sight of colleagues and supervisors.



independently, as in the case of managers, sales officers, etc., diverse and flexible work organisation is easier to implement.

Differences are evident among sectors and occupations, suggesting that individual choices — at both employer and employee levels — in whether or not to use teleworking are as important as the type of job and organisational culture, and sometimes even more prominent. The variation in flexible working settings has increased dramatically since the outbreak of COVID-19 pandemic, an unforeseen worldwide event so disrupting as to be examined by some scholars as a 'natural experiment' the far-reaching effects of which can be assessed by comparing the situation 'before' and 'after' the momentous epidemic (Dunatchik et al., 2021, p. 4). However, before the current epidemic, the attention paid to the effects of disastrous and unexpected events on labour markets was quite limited.

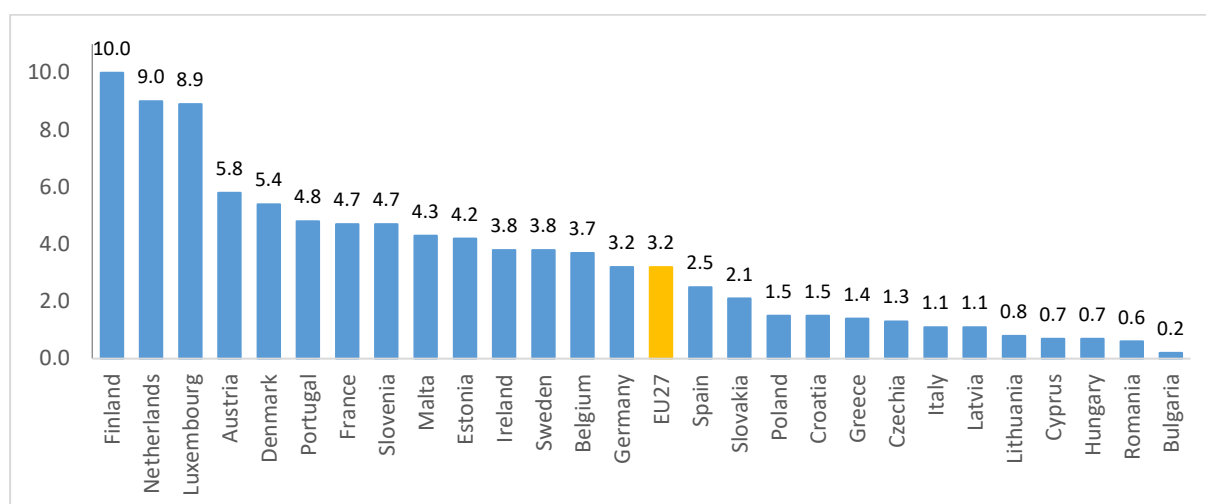
As a result of the global pandemic, teleworking has become the new normal worldwide, and relevant themes long neglected, or only partially addressed by public and private decision-makers, have come to the centre of public discussions in traditional and social media. A novel divide based on teleworkability — the level to which an occupation can be performed remotely given the currently available technology — is now being debated in the literature, with the suggestion that variation in teleworkability among occupations is likely to severely deepen economic and social inequalities (for example Mahler, 2012; Fana et al. 2020; Sostero et. al., 2020). This notion of teleworkability is crucial for examining the influence of the 2020-2021 measures on the implementation of teleworking on labour market and working conditions.

### 3 Recent teleworking trends in Europe

Figure 1 provides a picture of EU employees working from home<sup>7</sup> in 2019 by country, using data from the EU-LFS<sup>8</sup>, which also collects evidence on workplaces and related characteristics. It seems clear that, although a teleworking revolution had been predicted for many years, this expected change did not actually occur until the COVID-19 crisis; in fact, in 2019 only about 3 % of employees<sup>9</sup> in the 27 EU Member States (EU-27) worked mostly from home. When taking into account those working from home occasionally, this figure rises to about 11 % of the total number of employees in EU-27 countries.

Across EU countries, the actual implementation of teleworking practices is extremely varied, suggesting that its expansion is likely to exert very different impacts on national labour markets. Figure 1 shows that, in 2019, three countries (Finland, the Netherlands and Luxembourg) clearly differed from the rest of the EU countries, with the percentages of home-based workers in these countries being almost three times higher than the EU average (3.2 %). For countries mainly in continental and northern Europe, the percentages range between 3.7 % and 5.8 %. Germany is in line with the EU average, whereas eastern European countries, together with Spain and Italy, recorded less than 2 % of workers who worked mostly from home pre-COVID-19.

Figure 1: Employees working usually from home by country (% of total employees aged 15-64), EU-27, 2019



Source: Eurostat, EU-LFS. Dataset: lfsa\_ehomp (last update: 2 June 2021)

The results show trends that have been consistent in terms of the number of people working mostly from home, by both gender and age group. This continued stability can be ascribed to structural issues of both the economy and the organisation of work in each country. Therefore, the differences across countries are strongly linked to sectoral factors and are also the result of regulatory systems in place at the national level.

<sup>7</sup> In the EU-LFS, the group of reference is persons (self-employed and employees) working from home, which does not necessarily entail the use of ICT. In this report, we focus on employees who mostly and sometimes work from home. Online data code LFSA\_EHOMP was considered, as updated on 2 June 2021 ([https://ec.europa.eu/eurostat/databrowser/view/lfsa\\_ehomp/default/table?lang=en](https://ec.europa.eu/eurostat/databrowser/view/lfsa_ehomp/default/table?lang=en)).

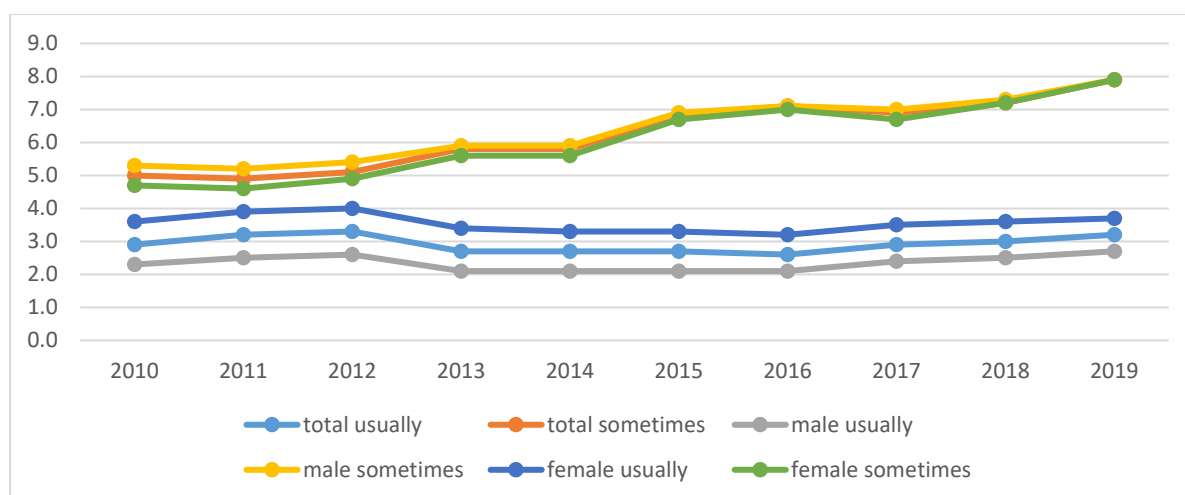
<sup>8</sup> Carried out in all Member States, four candidate countries and three countries of the European Free Trade Association (EFTA), the EU-LFS is the largest (household) European sample survey, offering quarterly findings on labour participation of people aged 15 and over and on persons outside the labour force. Its key statistical purpose is to categorise the population of working age into three mutually exclusive groups: employed persons, unemployed persons (making up the so-called 'labour force') and economically inactive persons ('outside the labour force'), such as retired persons, students and homemakers. Variables are collected on a yearly basis, but a selection of them are available on a quarterly basis, although this is not the case for the evidence relating to workplaces (Eurostat, 2021).

<sup>9</sup> Notice that, in each Member State, self-employed respondents reported working mostly from home more than employees did. The highest figure was recorded in Finland (with about 44.8 % of self-employed interviewees declaring to work mostly from home in 2019), closely followed by the Netherlands (almost 43 %) and Austria (42.2 %). Source: Eurostat, EU-LFS lfsa\_ehomp (2019) dataset.

### 3.1 Employees working from home: 2010-2019

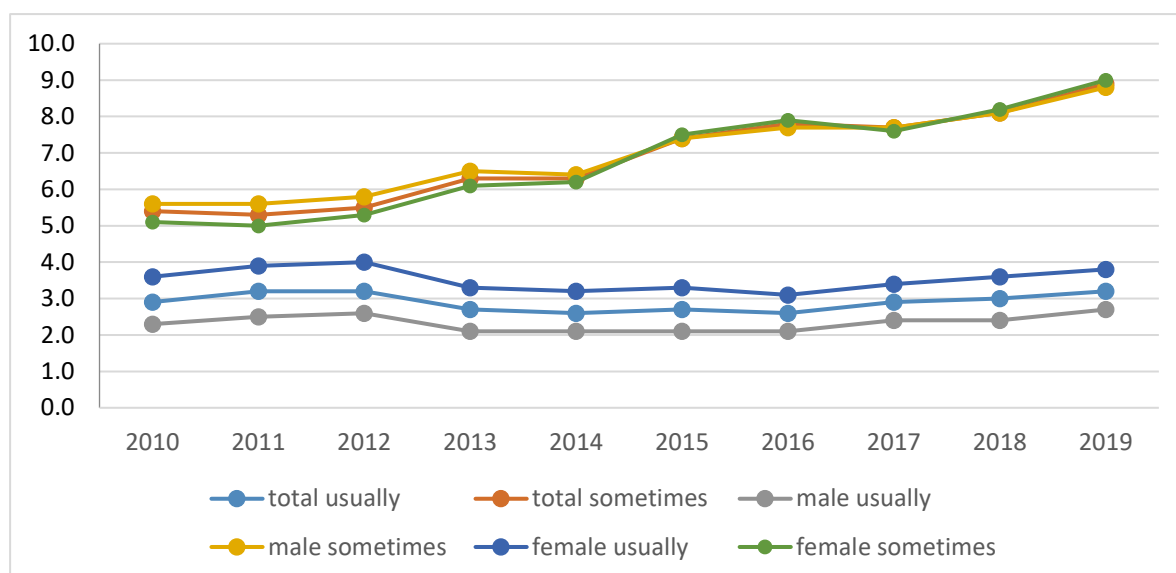
Examining the trend of the previous decade, it is apparent that the average percentage of employees working mostly from home has remained constant, at around 3.2 % (as shown in Figures 2 and 3), with a higher number of women than men working mostly from home. However, throughout the period, the share of employees who state that they work from home sometimes has risen from 5 % to 8 %, with no significant differences by gender. When distinguishing responses by age, it is evident that working from home is slightly more common among younger people, as shown in Figure 3: in the 25-49 age range, the share of people working from home regularly is higher, reaching 9 %, than in other age ranges.

**Figure 2: Employees working from home by gender and frequency (% of total employees aged 15-64), EU-27, 2010-2019**



Source: Eurostat, EU-LFS. Dataset: lfsa\_ehomp (last update: 2 June 2021)

**Figure 3: Employees working from home by gender and frequency (% of total employees aged 25-49), EU-27, 2010-2019**



Source: Eurostat, EU-LFS. Dataset: lfsa\_ehomp (last update: 2 June 2021)

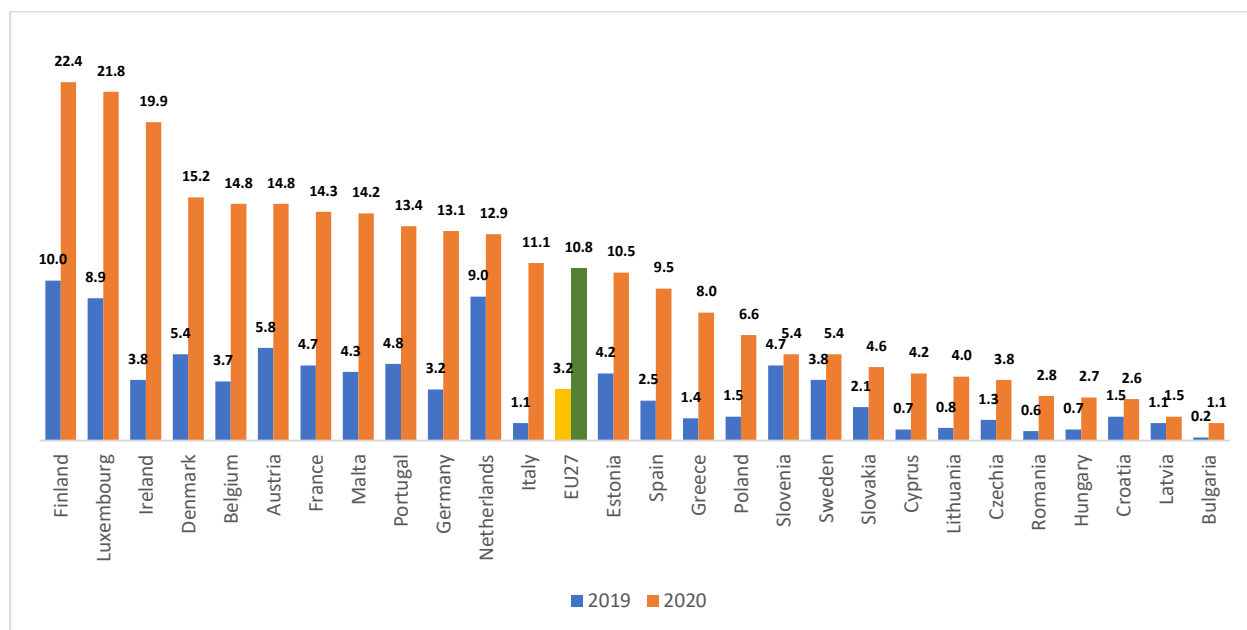
### 3.2 The effects of the 2020 COVID-19 crisis on home-based work

The public health emergency and subsequent suspension (or reduction, in some cases) of entire sectors' activities have affected everyday life enormously, and, since March 2020, working from home unexpectedly become the norm for millions of workers in the EU and around the world (Hodder, 2020). At various stages of the COVID-19 crisis, which initially affected EU countries at different moments and with varying levels of severity, governments decided to control the spread of the disease through lockdown and social distancing measures. Private and public companies therefore started experimenting with ways to reduce the number of people in contact with each other including letting employees work at home.

As observed in Figure 4, 2020 saw a huge difference in the average number of home-based workers compared with 2019, with the percentage of home-based employees being substantially higher in 2020 in all Member States and jumping from 3.2 % to 10.8 % at EU level. Even though the relative growth in some countries was relatively small, in others the increase was notable, with huge differences between northern, southern and eastern Member States seeming to persist.

The differences between 2019 and 2020 are particularly remarkable for countries where the share of home-based workers was very small before the crisis. In Italy, the number of home-based workers increased 10-fold, representing the largest relative rise. In Ireland and Greece, the figure was almost eight times higher, while the proportion grew four times in Belgium, Germany and Spain. Thus, regardless of the different economic structures and internal regulations, some Member States faced an abrupt and major expansion in home-based teleworking (for example EU-OSHA, 2021a). Among the countries that, in the years preceding the pandemic, regularly registered higher numbers of employees working from home, Finland and Luxembourg roughly doubled their share in 2020, while in the Netherlands this share increased less. The generalised growth is mainly the result of the shift to home-based working in the public administration and education sectors. This is more the case for Italy and Spain, in particular at the first stages of the epidemic upsurge. On the other hand, the different pattern in some eastern EU Member States may be linked to the lower incidence of the disease<sup>10</sup> in the first phase of the epidemic, namely from March to September 2020 (EU-OSHA, 2021a).

**Figure 4: Employees working mostly from home by country (% of total employees aged 15-64), EU-27, 2019 and 2020**



Source: Eurostat, EU-LFS. Dataset: Ifsa\_ehomp (last update: 2 June 2021)

<sup>10</sup> For further details, see <https://coronavirus.jhu.edu/>, implemented by the Johns Hopkins Coronavirus Resource Center (CRC).

A comprehensive table (Table A1.1) distinguishing employees working from home by country and gender is provided in Annex 1 and reveals a noteworthy trend. When it comes to working from home, there was little difference between genders at EU level in 2020: the proportion of women rose from 3.7 % to 11.7%, whereas that of men increased from 2.7 % to 9.9 %. In most countries in 2019, women reported working mostly from home slightly more than men, with very few exceptions, namely in the Netherlands and Sweden, where the opposite was true. Such a trend persisted in 2020, with significant percentage increases, as discussed above. Some notable cases are those of Italy and Germany. In Italy in 2019, 1.2 % of female respondents worked mostly from home, increasing to 13.4 % in 2020, while the figure for men went from 1.0 % in 2019 to 9.2 % in 2020. In Germany, 3.6 % of women worked from home in 2019, growing to 12.6 % in 2020, while the figure for male respondents went from 2.8 % in 2019 to 13.7 % in 2020.

The highest increases among men were more frequent in some countries, especially among those with the longest EU membership. In the case of Luxembourg, for example, the percentage growth among male respondents is particularly evident. This may even be a result of the structure of the labour market itself, characterised by financial services and advanced administration, sectors in which home-based teleworking is more feasible than in other sectors, for both women and men (for example Fana et al., 2020).

Eurofound monitored the conditions experienced by workers during the pandemic in the period April 2020-March 2021 through three waves of the e-survey 'Living, working and COVID-19' (Eurofound, 2020a). With the aim of getting a picture of the most prominent and immediate effects of the pandemic, this survey made it possible to obtain valuable information promptly, even though influenced by the emergency situation in both the method of collection and the drawing of samples<sup>11</sup>. In the first wave of the survey, preliminary rough estimates had shown that around 40 % of those working in the EU-27 countries had started teleworking from home full time owing to the pandemic. Those figures at first indicated that over a third of employees were working only from their own home during the first months of the crisis. These results come from the responses of almost half of employees (48 %) who declared that they were working from home at least some of the time, while over a third (34 %) stated that they were working exclusively from home.

Furthermore, a recent study by the European Commission's Joint Research Centre (JRC) on the effects of the early 2020 COVID-19 confinement measures on EU labour markets (Fana et al. 2020) suggests that an estimated 25 % of EU jobs are teleworkable, and indicates that, before the outbreak of the pandemic, less than 15 % of employees in the EU had experienced teleworking. The emergency situation compelled many companies and workers to take up teleworking, in many cases in an unprepared way. The persistence of the crisis for the whole duration of 2020 and part of 2021 made it possible for companies and workers to adopt some measures to adjust the management of teleworking. When comparing the prevalence of teleworking in 2020 with the prevalence before the pandemic, it is evident that the difficulties encountered by both workers and employers are likely to have varied substantially, depending mostly on country-based rather than sector-based factors. As stated in the report, 'Even in the less teleworkable sectors in the Netherlands or Finland the prevalence of teleworking is significantly higher than in the teleworkable sectors of Italy or Spain' (Fana et al., 2020, p. 25).

This finding is prominent and likely to influence any further assessment of the effects of such a rapid transition to teleworking for a substantial proportion of employees, since it is the result of multiple factors: the intrinsic structure of national economies; normative and regulatory aspects of the labour market and welfare; and the specific needs and attitudes of companies and workers. More detailed scrutiny of the conditions experienced by both workers and companies can be carried out by means of information stemming from the 2015 EWCS and ESENER-3 (2019). As these surveys were conducted in different periods before the pandemic, they could shed some light on the matter from a perspective that is not affected by the current emergency situation, which has changed the organisational and working habits of millions of employers and workers across the EU.

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<sup>11</sup> The survey fieldwork was carried out online 'among respondents who were reached via Eurofound's stakeholders and social media advertising'. See <https://www.eurofound.europa.eu/publications/report/2020/living-working-and-covid-19>

## 4 Teleworking in the European Working Conditions Survey

The EWCS provides comprehensive evidence on a wide range of topics related to workers and workplaces, including exposure to physical and psychosocial risks, work organisation, the balance between private and professional life, and perceived health and well-being. The most recent EWCS data refer to 2015 (sixth edition), meaning that the available information may offer a picture of 'pre-COVID-19 Europe at work', when home-based teleworking was still quite a marginal feature of the labour market.

Through question Q35 of the EWCS questionnaire ('How often have you worked in each location during the last 12 months in your main paid job?'), it is possible to investigate, for the whole workforce (employees and self-employed persons), the proportion of working time spent in various job locations. Table A2.1 in Annex 2 presents the proportion of employees and self-employed respondents stating that they work from home (daily, several times a week or less often<sup>12</sup>) in each EU-27 country. It is clear that, before the COVID-19 epidemic, working from home every day was a minor phenomenon in most countries, although with some notable exceptions, as discussed in the current literature (for example Fana et al., 2020; ILO, 2020a,b; Sostero et al., 2020; EU-OSHA, 2021a).

In fact, looking at only workers who declare that they work from home daily, the percentage is lower than 1 % in 11 out of 27 countries, for example in Cyprus and Malta (0.1 %), Estonia (0.4 %) and Lithuania (0.6 %). In a few other countries, such as France (26 %), Germany (11.6 %) and Italy (9.2 %), the proportions are much higher, mainly owing to the proportion of self-employed respondents.

To examine the prevalence of teleworking among the employees surveyed, we selected a workers' subgroup<sup>13</sup> (as the EWCS does not contain specific questions to identify such typology). In the following paragraphs, we refer exclusively to these respondents as teleworkers (1,177 respondents), which is proportionally consistent with the evidence of the EU-LFS<sup>14</sup>. Of these, 53.4 % are men and 53.9 % are employed in the private sector.

Figure 5 presents the percentage of teleworkers among the total number of employees in each EU-27 Member State. It can be observed that, in 2015, teleworking represented a minor phenomenon across Europe: the EU-27 average value was 3.7 % and in some countries the percentage of teleworkers was negligible, for instance in Italy (0.5 %) and Greece (0.9 %). The few exceptions were Belgium (where teleworkers comprised 7.2 % of the workforce), Denmark (9.8 %), the Netherlands (9.6 %) and Sweden (8.8 %). In general, we can argue that a distinct cluster of countries, comprising mainly northern Member States and/or economies more dependent on tertiary jobs, are more likely to adopt teleworking practices. On the other hand, countries with an economy oriented more towards manufacturing and tourism seem not to be as likely to implement teleworking.

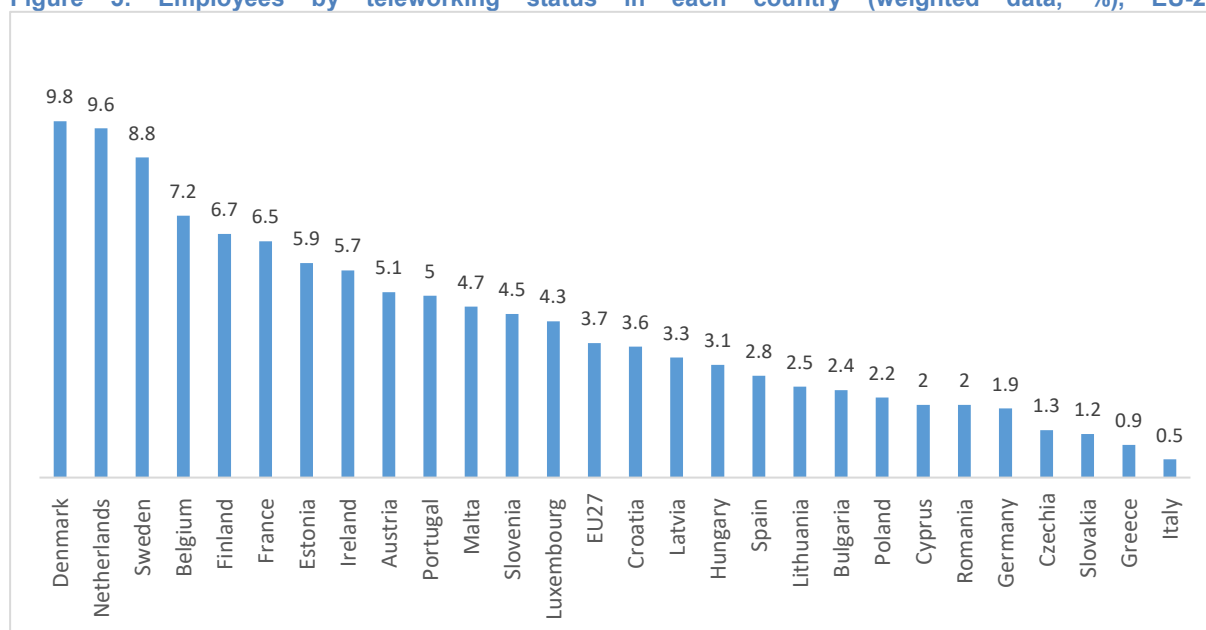
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<sup>12</sup> Q35 of the EWCS questionnaire asks respondents to indicate their job location by distinguishing between the following: 'Your employer's/your own business' premises', 'Clients' premises', 'A car or another vehicle', 'An outside site', 'Your own home' and 'Public spaces (...)'. It should be noted that most of the items included in the EWCS questionnaire apply to respondents who work primarily at their employers' premises, especially when contemplating the matter of perceived risk. Respondents are in fact required to rate the amount of time spent in each job location based on a 5-point Likert scale, distinguishing between 'daily', 'several times a week', 'several times a month', 'less often' and 'never'. Hereafter, for better readability of the results, the answers 'several times a month', 'less often' and 'never' are grouped together.

<sup>13</sup> The group of interest comprises employees who state that they work from home at least several times a week, using a digital device at least three-quarters of their working time (Q35e and Q30i of the questionnaire, respectively).

<sup>14</sup> The main benefit of using the EWCS rather than the EU-LFS is its wider coverage of specific dimensions of job quality with respect to working time, worker autonomy, health outcomes, job satisfaction, work-life balance, ICT tools and so on.

Figure 5: Employees by teleworking status in each country (weighted data, %), EU-27



Source: Author's elaboration on EWCS 2015 data

## 4.1 Teleworkers' main characteristics

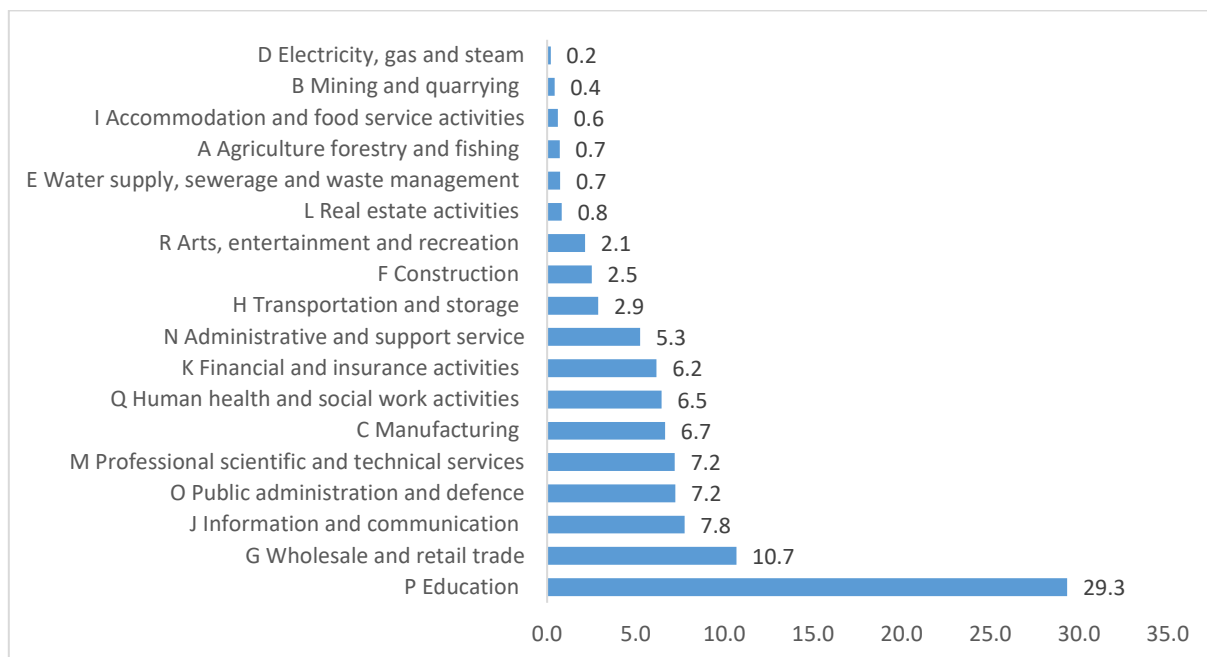
Teleworkers, as identified by the definition in section 2, are almost equally distributed by gender (53.4 % are men), and 53.9 % work in the private sector.

Based on the EWCS sample, a prominent incidence of home-based teleworking in sales, the ICT sector, knowledge-intensive business services and the education sector<sup>15</sup> is apparent. As pointed out above with respect to the issue of teleworkability and as a wide body of research attests (for example Messenger and Gschwind, 2016; OECD, 2020; Sostero et al., 2020), some sectors have traditionally been more likely to consider and allow for teleworking. According to EWCS 2015 evidence, as reported in Figure 6, the sectors with the highest share of teleworkers, apart from education, are wholesale and retail (10.7 %), the ICT sector (7.8 %), the public sector (7.2 %), and professional and scientific activities (7.2 %).

Moreover, such sectors tend to employ relatively highly skilled employees who, as discussed later, are also much more likely to work remotely (Sostero et al., 2020).

<sup>15</sup> With regard to the education sector in particular, some responses are elicited on the type of tasks actually carried out at home. It may be that teachers tend to respond that they work at home while preparing their lessons or correcting/grading pupils' homework, for instance. This circumstance may help to clarify some of the other findings illustrated in the following sections with respect teleworkers' education level (for more on the subject, see Sostero et al., 2020).

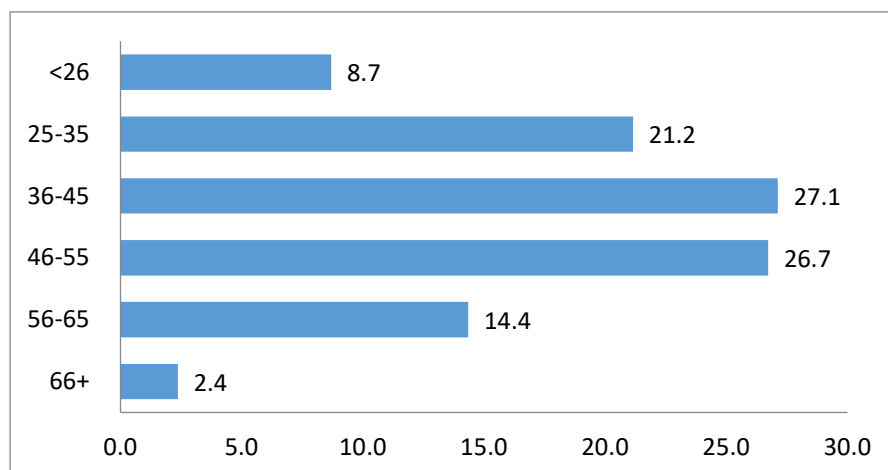
**Figure 6: Teleworkers by economic sector (NACE) (weighted data, %), EU-27**



Source: Author's elaboration on EWCS 2015 data

Figure 7 presents the percentage of teleworkers by age category. More than half of teleworkers are aged between 36 and 55 years, reflecting the age distribution of the workforce.

**Figure 7: Teleworkers by age (weighted data, %), EU-27**

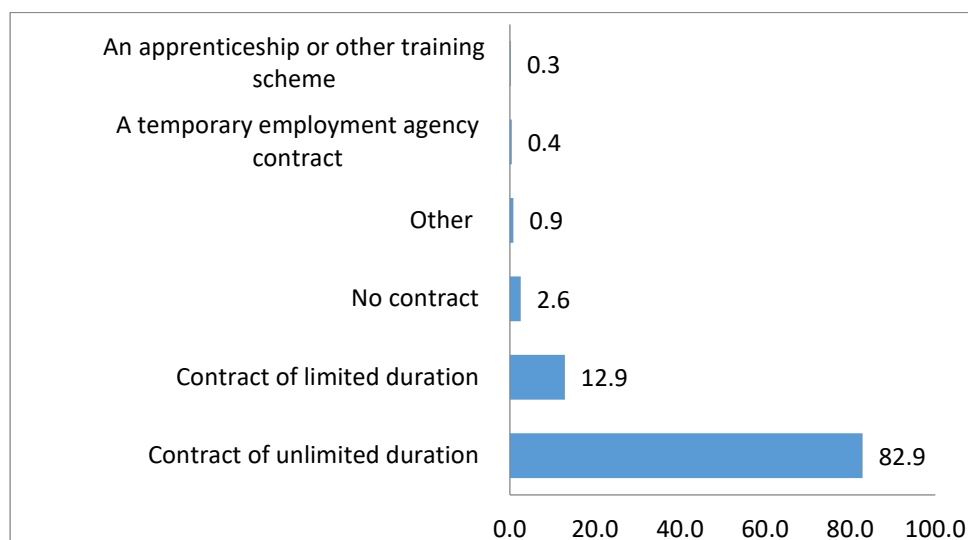


Source: Author's elaboration on EWCS 2015 data

The types of job contract held by respondents are presented in Figure 8. As can be observed, over 80 % of teleworkers hold a contract of unlimited duration.



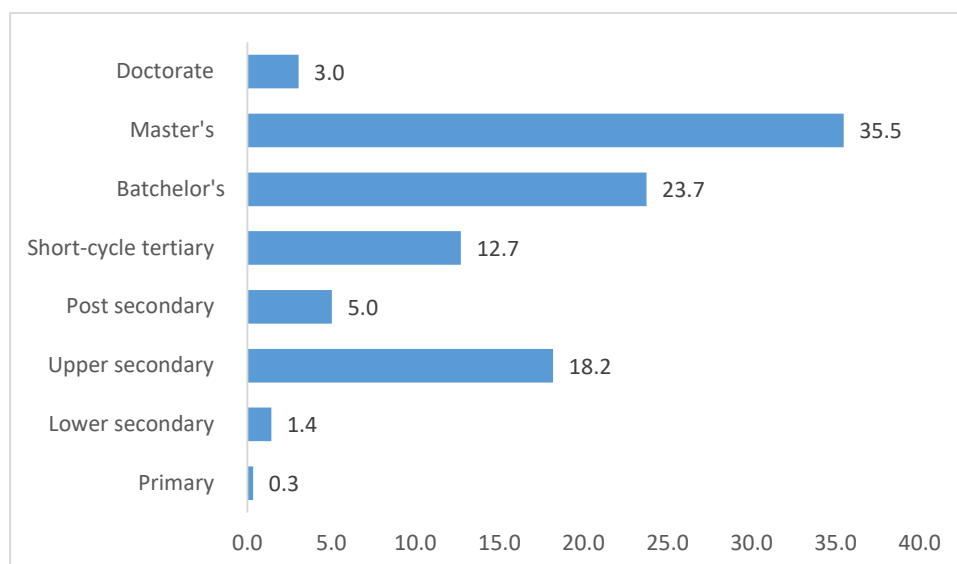
**Figure 8: Teleworkers by contract duration (weighted data, %), EU-27**



Source: Author's elaboration on EWCS 2015 data

Figure 9 shows the percentage of teleworkers by educational level. A high level of education seems to play a substantial role in the distribution of teleworkers, confirming findings from other recent studies on occupations more suited to teleworking and related educational issues (Fana et al., 2020; OECD, 2020). However, if those who work in the education sector are excluded, the importance of master's degrees decreases, dropping from 35.5 % to 26.4 %, while the weight of PhD qualifications remains unchanged, at 3.2 %.

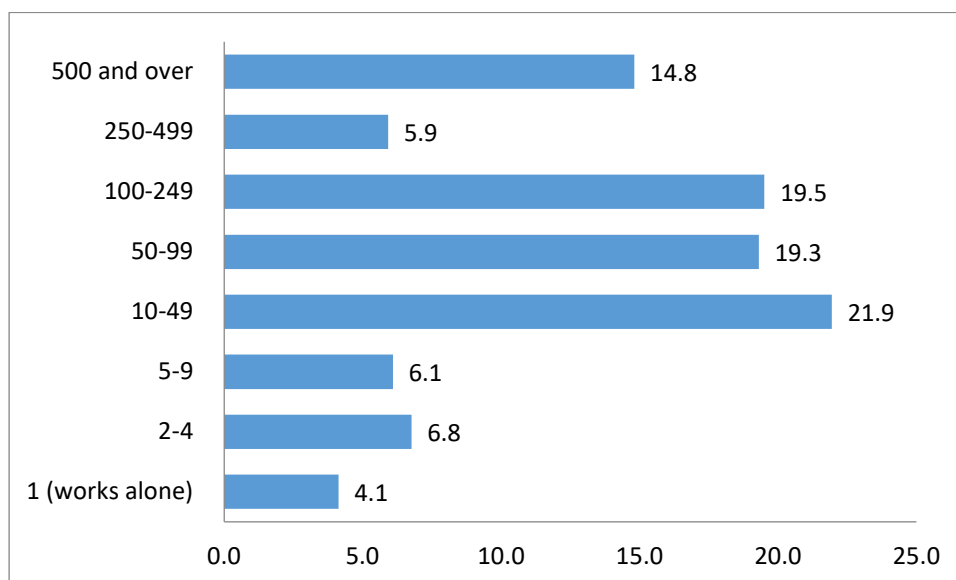
**Figure 9: Teleworkers by level of education (weighted data, %), EU-27**



Source: Author's elaboration on EWCS 2015 data

Figure 10 presents the percentage of teleworkers by size of workplace (measured by the number of employees), and corroborates evidence suggesting that the implementation of teleworking is strongly related to company size.

Figure 10: Teleworkers by size of workplace (number of employees) (weighted data, %), EU-27



Source: Author's elaboration on EWCS 2015 data

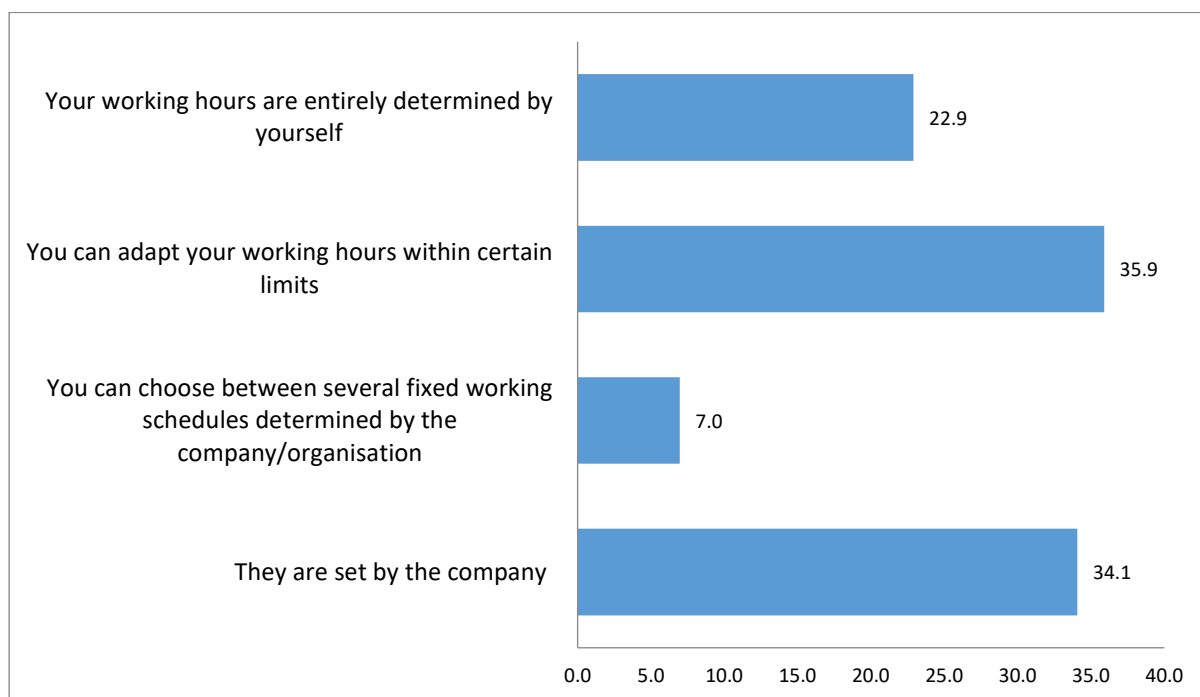
## 4.2 Working conditions of teleworkers

The actual conditions experienced by teleworkers can be investigated with respect to certain dimensions of job quality (Eurofound and ILO, 2017) by means of specific questions in the EWCS on autonomy and perceived health, and by analysing exposure to possible risk factors (as recognised in recent literature, for instance Messenger and Gschwind, 2016; EU-OSHA, 2013, 2021b; Eurofound 2020b), both physical, mostly related to prolonged sitting and static postures, and psychosocial, essentially connected to job intensity and quality of relationships with colleagues and supervisors.

With reference to worker autonomy, the EWCS includes a set of items<sup>16</sup> to assess working time management. In the case of teleworking, 22.9 % of respondents say that they could decide their own working hours, while 34.1 % declare that their working hours are entirely decided by their company (Figure 11). It is reasonable to argue that the latter category may have duties strictly connected with the schedules of the other workers who are likely to be at the employer's premises (for example in the case of ICT assistance, administrative services, etc.). Greater flexibility in working time (Eurofound and ILO, 2017; López-Igual and Rodríguez-Modroño, 2020; OECD, 2020; Rodríguez-Modroño and López-Igual, 2021) is more likely to be experienced by those involved in carrying out activities related to specific assistance tasks, for example in marketing, communication and customer follow-up.

<sup>16</sup> Investigated through items of Q42 of the EWCS 2015 questionnaire.

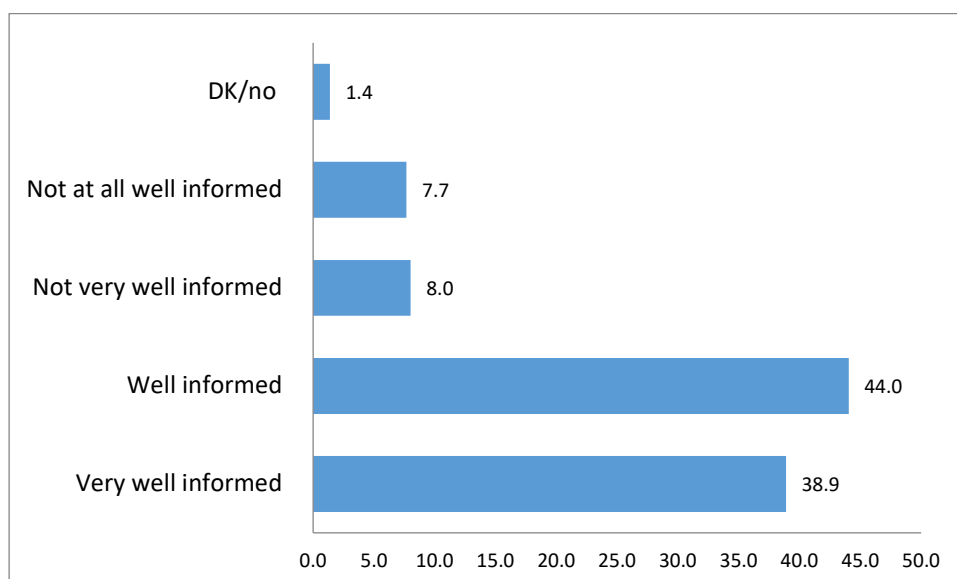
Figure 11: 'How are your working time arrangements set?' Q42 (weighted data, %), EU-27



Source: Author's elaboration on EWCS 2015 data

Teleworking seems to be associated with the provision of information on safety and health matters. Figure 12 shows that over 80 % of teleworkers report being well or very well informed on safety and health risks related to the performance of their job.

Figure 12: 'Regarding the health and safety risks related to the performance of your job, how well informed would you say you are?' Q33 (weighted data, %), EU-27

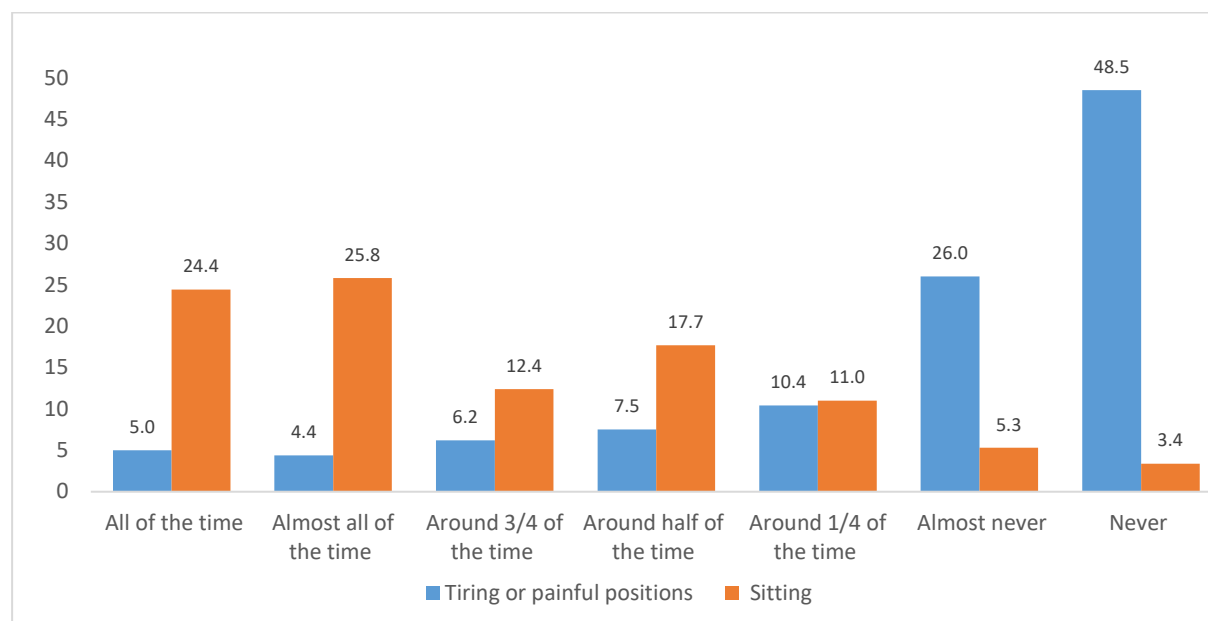


Source: Author's elaboration on EWCS 2015 data

One physical risk factor (EU-OSHA, 2013, 2016, 2021b) typically associated with teleworking is sedentary behaviour (namely prolonged sitting postures). As reported in Figure 13, more than half of

teleworkers (50.2 %) indeed claim<sup>17</sup> that they sit all the time or most of the time, whereas only 20 % say that they stay seated for around a quarter or less of their working time.

Figure 13: ‘Does your main paid job involve...?’ Q30a and b (weighted data, %), EU-27



Source: Author’s elaboration on EWCS 2015 data

These results are in line with those of several previous studies, including studies conducted more recently<sup>18</sup> (for example EU-OSHA, 2013, 2021a,b). We also refer to findings from ESENER-3, which are discussed in the following chapter.

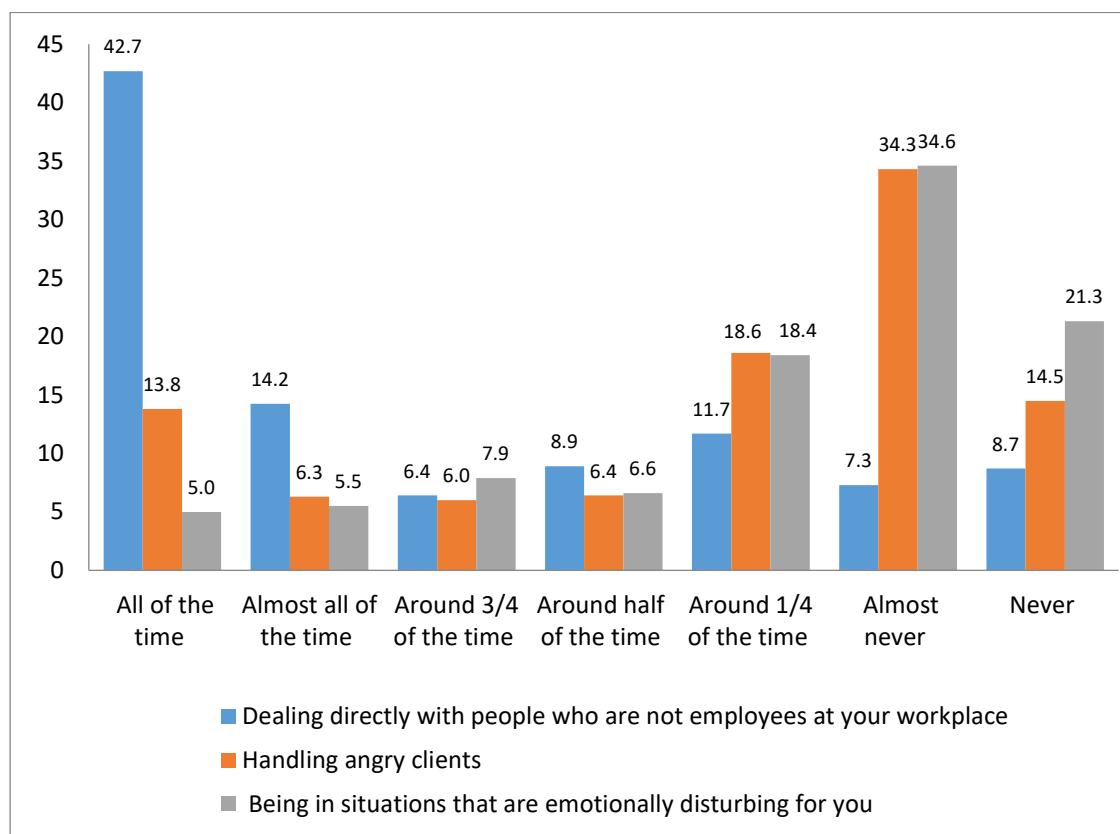
In line with ESENER-3 findings, only a very limited number of teleworkers (15.6 %) say that their job involves uncomfortable (tiring or painful) positions for at least three-quarters of the time, while 74.5 % say that their job never or almost never involves these positions.

Among the main psychosocial risk factors, Figure 14 addresses problems arising from interactions with non-colleagues<sup>19</sup> (e.g. contractors, customers, passengers, students) and angry clients, and from emotionally disturbing situations. Some 56.9 % of teleworkers claim that they interact with non-colleagues all or almost all of their working time, while only 16 % declare that they never or almost never interact with them. Some 20.1 % of teleworkers say that their job involves handling angry customers all or most of their working time, while almost half of respondents (48.8 %) say that they never or almost never interact with angry customers. This allows us to infer that teleworkers essentially perform two main types of tasks: tasks involving direct contact with customers, perhaps sales or after-sales services, and organisational and managerial tasks.

By contrast, only 10.5 % of teleworkers say that their job always or almost always involves emotionally disturbing situations, while 55.9 % declare that they are never or almost never in this type of situation.

<sup>17</sup> Item Q30a investigates how long the respondent assumes painful positions, while Q30d refers to sitting for a long time.  
<sup>18</sup> A detailed review and an original compositional analysis on the subject were carried out recently by Johansson et al. (2020) on a Swedish convenience sample.  
<sup>19</sup> Items Q30f, Q30g, Q30h.

Figure 14: ‘Does your main paid job involve...?’ Q30f, g and h (weighted data, %), EU-27



Source: Author’s elaboration on EWCS 2015 data

### 4.3 Comparing teleworkers and non-teleworkers

One of the most debated aspects in current literature is whether, and to what extent, there are differences in the physical and psychosocial risk factors experienced by teleworkers and on-site workers (ILO, 2018). This section discusses the distribution of survey responses, which highlights the main differences<sup>20</sup> between teleworkers and on-site workers.

Some items in the EWCS relating to physical and mental health issues can be usefully explored to highlight the possible differences between the working conditions experienced. With respect to physical health issues, the response patterns suggest differences for certain types of MSDs (see Figure 15 and Tables A2.2 to A2.8).

In terms of reporting pain in the shoulders and neck<sup>21</sup> (and/or upper limbs), there does not seem to be a noticeable difference between teleworkers and non-teleworkers (Figure 15 and Table A2.2), although the former do report such muscular pain slightly more often (43.8 %) than the latter (41.9 %). With respect to reporting pains in the lower limbs, however, the situation is different, with these pains seeming to affect non-teleworkers (30 %) to a greater extent than teleworkers (24.7 %). These differences between different types of MSDs can be explained by the fact that non-teleworkers are likely to stand for a long time much more frequently than teleworkers, who, in contrast, as indicated above, face the

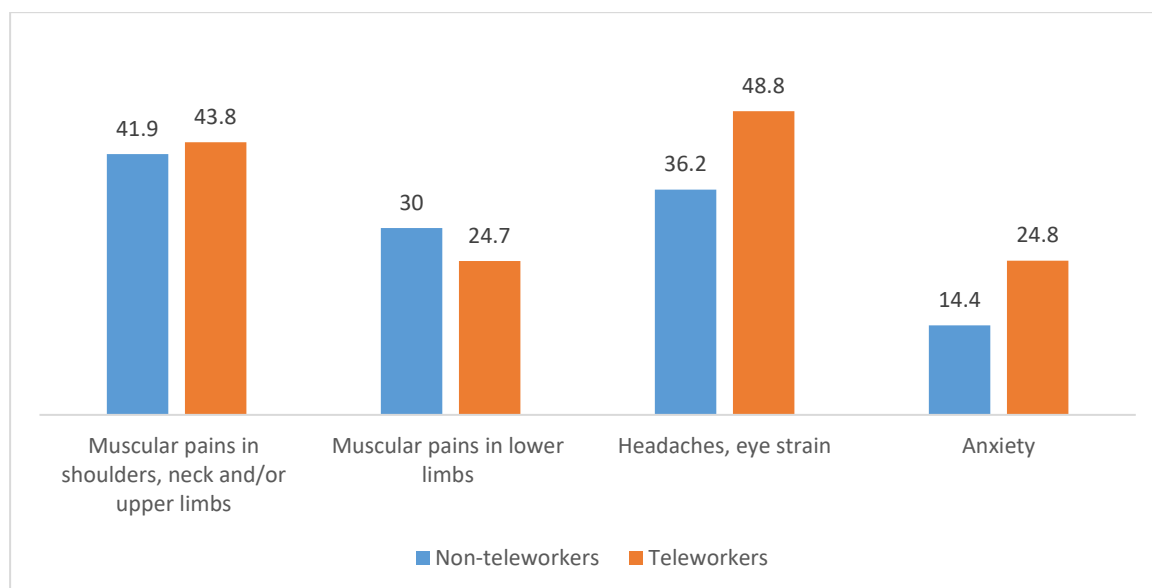
<sup>20</sup> By using the weight assigned by the sample design to each worker, a simple comparison between the distributions of the two groups of interest (teleworkers and non-teleworkers) was carried out. This investigation was conducted without controlling for other individual variables, such as the educational level, working hours or sector, which generally affect the characteristics of the two subgroups. This decision was made in consideration of the small sample size of the teleworkers population and to the well-known over-representation of workers in the education sector in this survey (see Figure 6). However, with the aim of verifying whether the distributions by type of worker are statistically different, a test on the difference between the percentages was conducted for each analysed survey item. The tests were statistically significant for all the variables considered, even in cases in which the discrepancies did not seem noticeable.

<sup>21</sup> Items Q78d and Q78e.

opposite problem of prolonged sitting. These findings are largely consistent with what has recently been underlined in new research by the European Agency of Safety and Health at Work (EU-OSHA, 2021b,c), which emphasises the necessity of good ergonomic working conditions for both sedentary sitting and standing postures at work, to make work more sustainable.

A remarkable difference was reported with regard to headaches and eye strain, which seem to cause problems for 48.8 % of teleworkers but only 36.2 % of non-teleworkers (Figure 15 and Table A2.3). With reference to reported anxiety, a higher prevalence among teleworkers is even more notable: 24.8 % of teleworkers report anxiety versus 14.4 % of non-teleworkers (Figure 15 and Table A2.3).

**Figure 15: Percentage of non-teleworkers and teleworkers reporting a number of health issues (weighted data, %), EU-27**



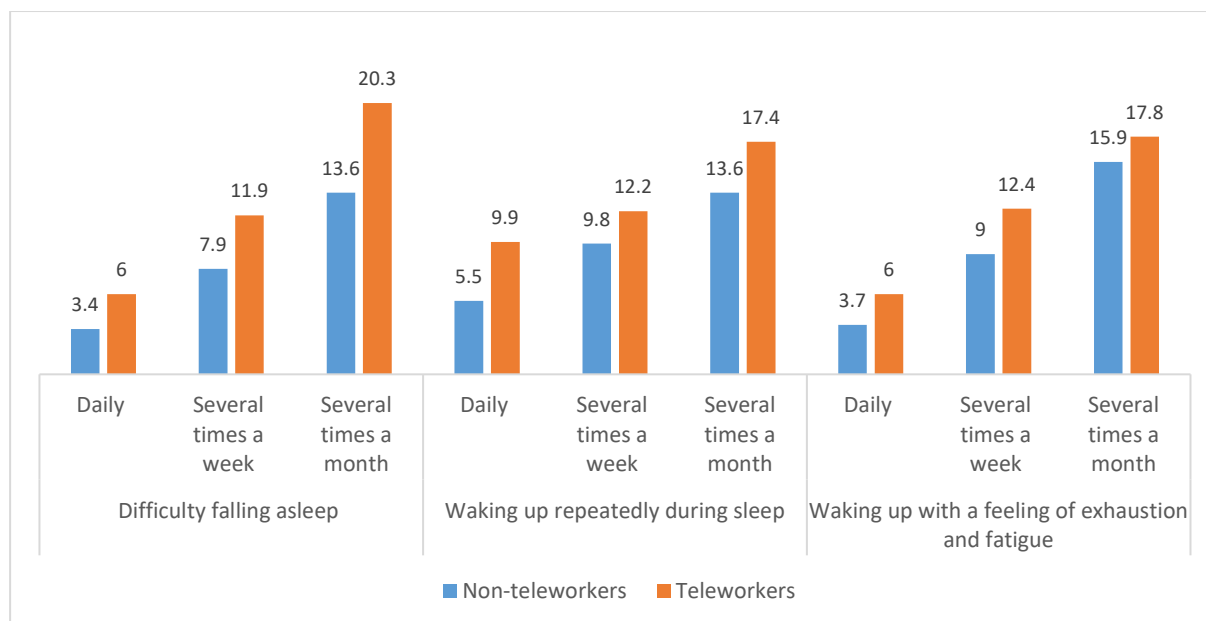
Source: Author's elaboration on EWCS 2015 data

As the European Parliament's policy unit also pointed out recently (European Parliament, 2021), anxiety is likely to adversely influence teleworkers' mental and physical well-being. Issues related to anxiety must be given the utmost attention given the amplified risks linked to the social isolation experienced as a result of COVID-19 confinement measures.

Moreover, sleeping disorders<sup>22</sup> (difficulty falling asleep; waking up repeatedly during sleep; waking up with a feeling of exhaustion and fatigue) seem to have a greater impact on teleworkers than non-teleworkers (comparisons are reported in Table A2.4 and in Figure 16).

<sup>22</sup> Investigated by items Q79a, Q79b, Q79c.

**Figure 16: Percentage of non-teleworkers and teleworkers reporting sleeping disorders (weighted data, %), EU-27**



Source: Author's elaboration on EWCS 2015 data.

These results are also confirmed by evidence that teleworkers experience greater stress<sup>23</sup> than non-teleworkers (Table A2.5). In fact, 20 % of teleworkers say that they are always stressed, compared with only 8.7 % of non-teleworkers. The percentage difference between those who declare that they are stressed most of the time is smaller, although the proportion is still higher for teleworkers: 19.1 % versus 16.4 % (Eurofound, 2020c).

Teleworkers report the need to hide one's feelings while working<sup>24</sup> more than non-teleworkers, with 29.5 % of non-teleworkers stating that their job 'never' requires them to hide their feelings, compared with 18.3 % of teleworkers (Table A2.5).

With respect to the multifaceted aspects of work-life balance<sup>25</sup>, although teleworking may help to facilitate it, it also seems that a significant effect of teleworking arrangements is working beyond contractual hours, or at least never 'disconnecting' (Vargas Llave and Weber, 2020). In particular, as expected with reference to the literature on the subject, teleworkers report experiencing work-related issues more often than non-teleworkers. In fact, our results (Table A2.6) support evidence (Eurofound and ILO, 2017; Eurofound, 2020b; EU-OSHA, 2021a) showing that teleworkers seem to worry about their work more frequently even when they are not working (about 33.7 % of teleworkers versus 12.9 % of non-teleworkers). This implies that teleworkers may perceive working hours and weeks to be never ending (European Parliament, 2021). A similar pattern can be noted as regards difficulties in managing time to carry out other personal and family commitments. Some 15.9 % of teleworkers declare that they feel 'too tired after work to do some household jobs which need to be done' at least almost all of the time, compared with 10.7 % of non-teleworkers. By contrast, the differences in response patterns with respect to difficulties in reconciling family and work responsibilities are less prominent (Table A2.7).

The problem highlighted in the literature is widely confirmed by the EWCS evidence, since a much higher percentage of teleworkers than non-teleworkers state that they have worked during their free time<sup>26</sup>: 34.3 % of teleworkers state that they work daily or several times a week in their free time, compared with only 6.9 % of non-teleworkers (see Figure 17).

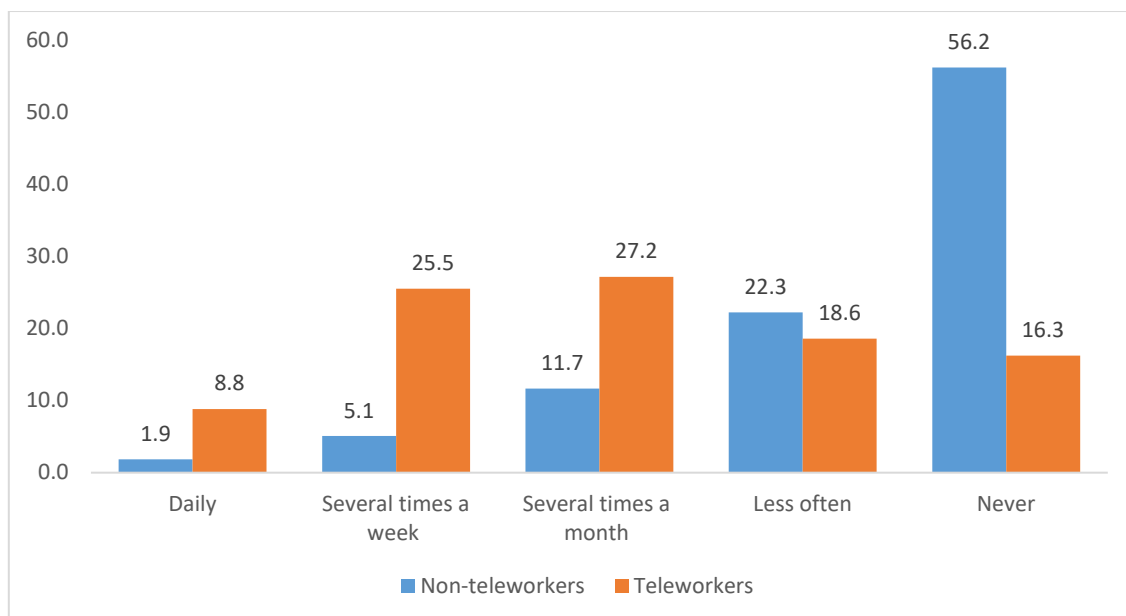
<sup>23</sup> Item Q61m.

<sup>24</sup> Item Q61o.

<sup>25</sup> See, for example, Bailey and Kurland (2002), Hilbrecht et al. (2013), Putnam et al. (2014).

<sup>26</sup> Q46.

**Figure 17: ‘Since you started your main paid job how often have you worked in your free time?’ Q46 (weighted data, %), EU-27**

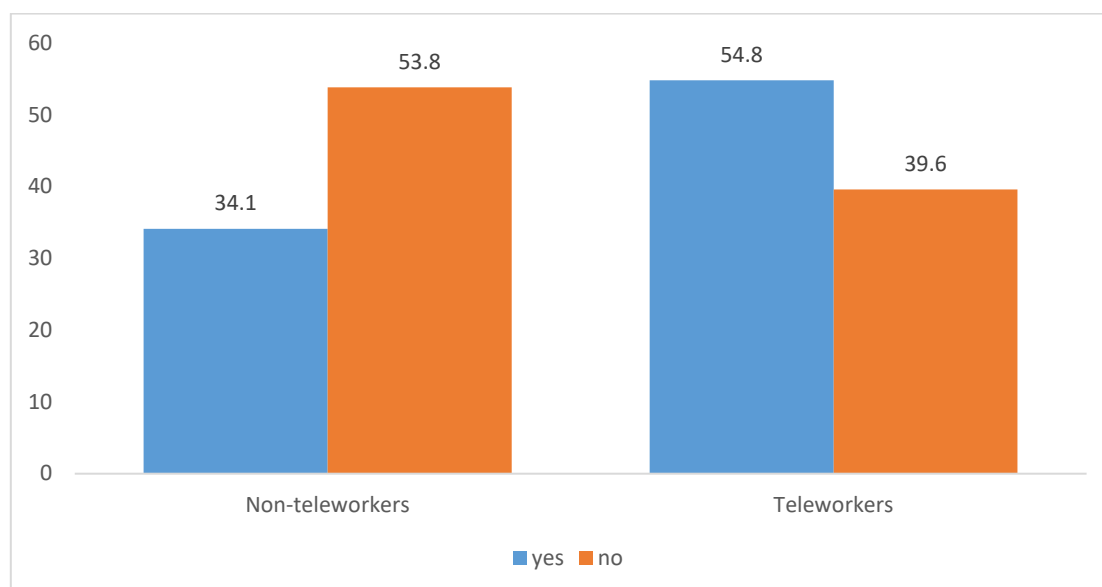


Source: Author’s elaboration on EWCS 2015 data

Moreover, more than half of teleworkers declare that they have also worked when ill<sup>27</sup>. In fact, as shown in Figure 18, 34.1 % of non-teleworkers declare that they have worked while being sick, while the percentage of teleworkers declaring this reaches 54.8 %.

It should be pointed out that these findings are statistically significant and in line with other evidence on work intensification (Kelliher and Anderson, 2010). This topic is often associated with perceived stress and the blurring of work-life boundaries, evoking the ‘right to disconnect’ concept (see for example Vargas Llave and Weber, 2020; Rodríguez-Modroño and López-Igual, 2021).

**Figure 18: ‘Over the past 12 months did you work when you were sick?’ Q84a (weighted data, %), EU-27**



Source: Author’s elaboration on EWCS 2015 data

<sup>27</sup> Item Q84a.



Finally, unpaid family duties represent another element in which the behaviour of teleworkers differs from that of non-teleworkers. In the current literature, this issue is often analysed from a gender perspective (for example Alon et al., 2020; Del Boca et al., 2020; Dunatchik et al., 2021).

With respect to spending time caring for and/or educating children and/or grandchildren<sup>28</sup>, the analysis conducted (Table A2.8 in Annex 2) shows remarkable differences in response by gender. In addition, 46.7 % of women teleworkers declare that they take care of their family daily, compared with 37.7 % of non-teleworkers. Even male teleworkers declare that they take care of their family daily in a much higher proportion than their non-teleworker counterparts (38.1 % versus 21.4 %). These figures confirm that teleworking is frequently used as a tool to conciliate work and caring responsibilities.

In summary, analysis of the EWCS data highlights that teleworkers are exposed to a number of psychosocial risks (including long working hours, presenteeism, increased caring and domestic responsibilities) more frequently than non-teleworkers and are more likely to suffer from work-related physical and mental health issues, in line with the findings of other relevant studies.

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<sup>28</sup> Item Q95c.

## 5 Evidence on teleworking from the European Survey of Enterprises on New and Emerging Risks

The literature reports extensive evidence of how physical risk factors can influence the health and therefore well-being of workers. In modern workplaces, occupational risk exposure is often associated more with the way work is organised than with the nature of the work itself (Litchfield et al., 2016) and more with the working environment (EU-OSHA, 2013) than it is with specific physical, biological and chemical agents. Harm is therefore often more likely to be psychological than physical'. This is even more relevant in the case of home-based teleworkers, as the findings from the analysis of the EWCS data illustrated in Chapter 4 confirm.

ESENER investigates, from the company viewpoint, how safety and health risks are managed in the workplace<sup>29</sup>, with a focus on psychosocial risks, such as work-related stress, violence, bullying and harassment. The units of interest are the establishments, and target respondents are those in charge of safety and health at the work premises.

With regard to OSH, it should be noted that carrying out risk assessments, regardless of the actual workplace, is the employer's responsibility. Nevertheless, assessing a working environment at home is difficult, and it is also difficult for inspection authorities to check private premises: hence, teleworking is — in relation to risk assessment — still a 'grey area' for a number of reasons (EU-OSHA, 2008; ILO, 2018). This implies that this new way of working, which has only recently become widespread, comes with challenging management issues and complex legal aspects.

Data from the ESENER-3, carried out in 2019, are used in this study to explore the multifaceted risks associated with teleworking<sup>30</sup>, concentrating on perceived risks and company measures implemented to prevent such risks, and distinguishing these, where possible, by sector, size and main geographical area.

As already mentioned, the survey fieldwork was carried out pre-COVID; therefore, the attention devoted to teleworking practices was inevitably marginal. Nonetheless, these data provide valuable insights with respect to the situation experienced by companies in a context more easily comparable with non-emergency conditions. Such information could also help to identify areas for improvement and specific areas that are often problematic when it comes to teleworking and therefore require enhanced monitoring.

### 5.1 Establishments with teleworking in place

As observed in Figure 19, the proportion of establishments that have home-based teleworking arrangements in place significantly varies across countries — from 30.5 % in the Netherlands to 2.4 % in Italy, with an EU average of 11.6 % — thus confirming that the prevalence of home-based teleworking practices is mainly country related, as seen in Fana et al. (2020) and López-Igual and Rodríguez-Modroño (2020).

A number of reasons are suggested to explain such considerable differences between countries, starting with the quality of the ICT infrastructure and how widespread digital skills are among workers, as

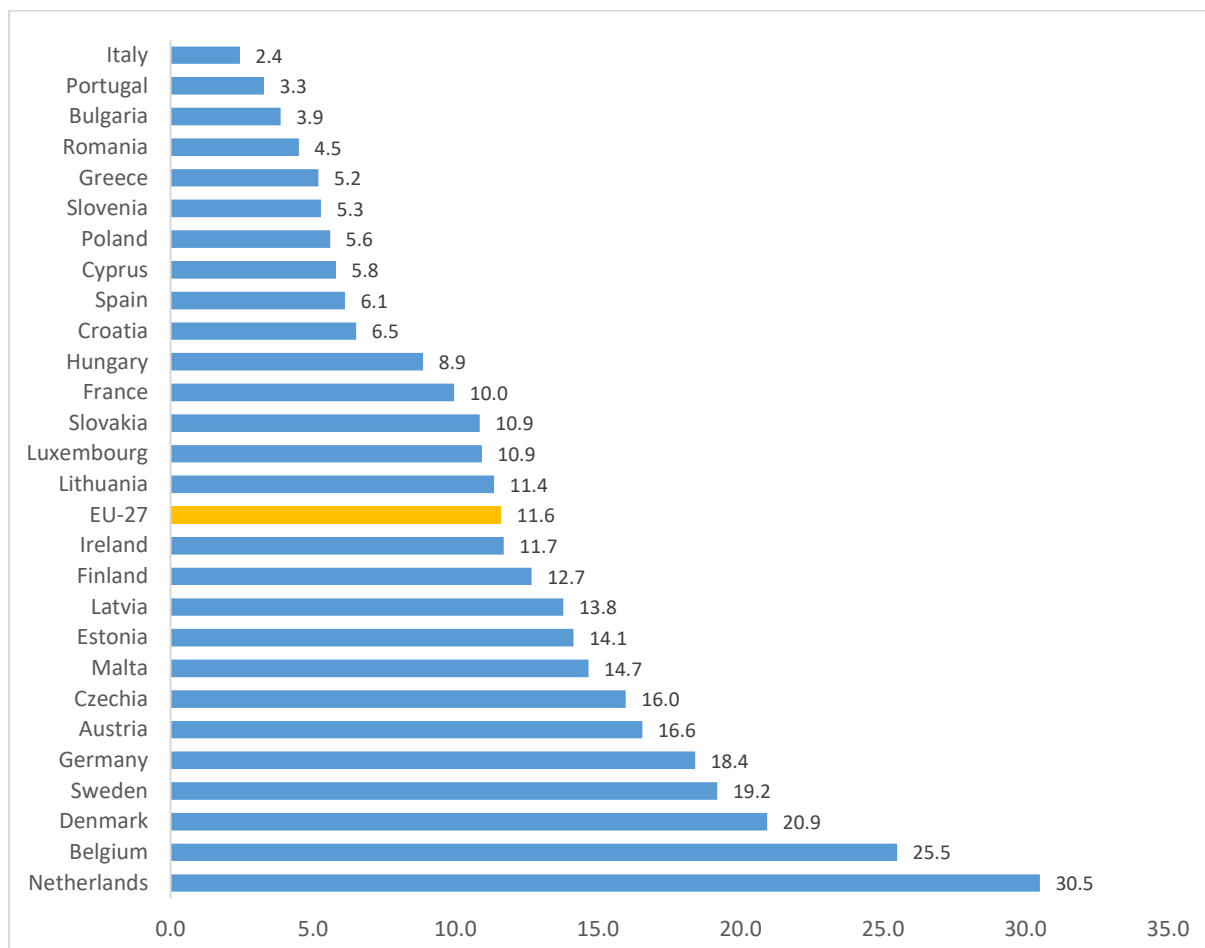
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<sup>29</sup> The statistical population encompasses all establishments with five or more employees. The 2019 survey covers 45,420 enterprises across 33 countries (the 27 EU Member States and Iceland, North Macedonia, Norway, Serbia, Switzerland and the United Kingdom).

<sup>30</sup> Our target variable is the company answer to Q106 ('Do any of the employees regularly work from home?'). Using this response, we can ascertain whether each establishment has teleworkers, although we cannot disclose other potentially relevant information (e.g. the proportion of home-based workers as a percentage of the total number of company employees, the type of occupation/tasks). The responses to this item are considered in combination with the answers to Q310\_1 and Q310\_2, which refer to the use of ICT devices. Around 86 % of the sample claims to use personal computers at fixed workplaces (Q310\_1); this figure rises to 91 % for companies declaring to have people regularly working from home. Similar percentages (83 % and 95 %, respectively) were reported for the answers to Q310\_2, which refers to the use of laptops, tablets, smartphones or other mobile computer devices. Therefore, to avoid missing any useful observations, our analyses focus on this combined variable: 'Teleworking in place'. The dataset of interest covers the EU-27 and includes the responses of 37,460 establishments. In the following sections, responses provided by interviewees claiming to have teleworking in place are compared with those of the other establishments.

mentioned in the introduction. The structure of the economy and the related prevalence of different sectors in each country, not to mention a country's organisational and management culture, also play a prominent role (Eurofound and ILO, 2017; Sostero et al., 2020; EU-OSHA, 2021a; European Parliament, 2021).

**Figure 19: Percentage of workplaces with teleworking in place by country (weighted data, %), EU-27**



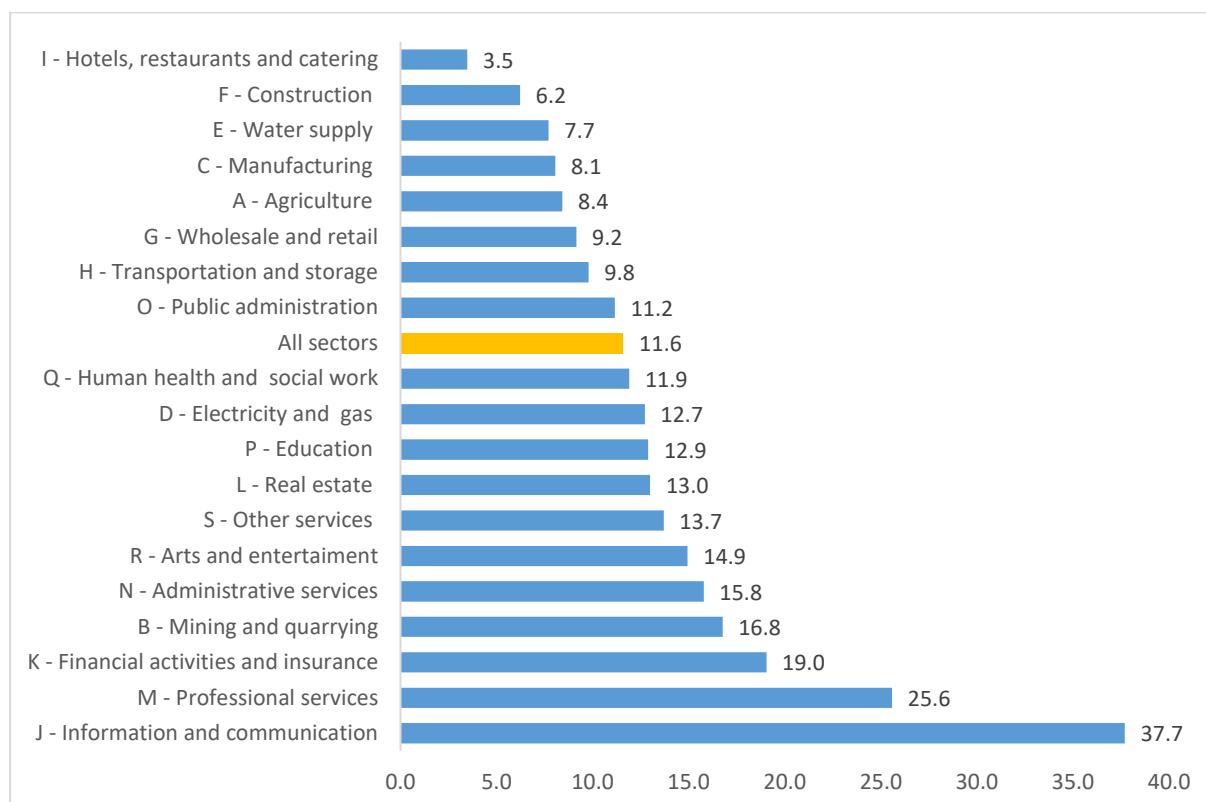
Source: Author's elaboration on ESENER 2019 data

Distinguishing by economic sector (according to NACE categories)<sup>31</sup>, Figure 20 illustrates the distribution of firms with teleworking in place. As expected, the sectors most likely to implement teleworking<sup>32</sup> are information and communication (J), professional services (M) and finance (K). We also notice that the education sector is much less significant in the ESENER dataset than it appears in the EWCS findings, as shown above.

<sup>31</sup> NACE Rev.2, at one-digit breakdown, is considered. For the structure of the classification, see: <https://ec.europa.eu/eurostat/web/nace-rev2/correspondence-tables/publications>

<sup>32</sup> In some sectors, for example mining (B) or transportation and storage (H), the presence of teleworkers is presumably linked to managerial and organisational roles that do not necessarily imply on-site presence or that perhaps do require worker mobility across different sites.

Figure 20: Percentage of workplaces with teleworking in place by NACE (weighted data, %), EU-27



Source: Author's elaboration on ESENER 2019 data

When grouping companies by size, we observe that the larger the company, the more likely it is to have teleworking in place (Table A3.1). In fact, company size is a significant factor in the prevalence of teleworking because, as found in a number of studies, larger enterprises are more likely to embrace flexible working arrangements than smaller ones (for example Sostero et al., 2020). This is in turn interrelated with the types of sector more prevalent in each country. Furthermore, legislation and regulatory requirements and their application also often differ depending on company size, as in the case of collective bargaining or other direct normative provisions between employer and employee. This implies that large and very large enterprises are likely to be better organised and equipped to deal with diverse, flexible forms of work (see also Eurofound and ILO, 2017).

## 5.2 Risk awareness and teleworking

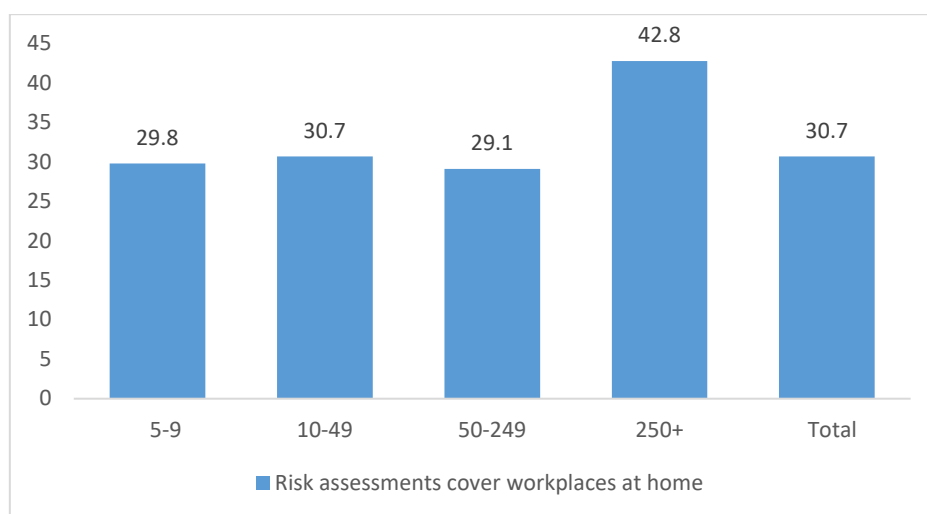
As already illustrated in section 2, teleworking may lead to particular types of risk (for example Messenger and Gschwind, 2016; Vargas Llave and Weber, 2020; EU-OSHA, 2021a). It is therefore informative to analyse companies' awareness of occupational hazards with respect to both physical and psychosocial factors in the context of implementing teleworking<sup>33</sup>.

In general, companies that do not have teleworking in place state that they carry out risk assessment evaluations more frequently than those that do implement teleworking (76.0 % versus 70.3 %) (Table A3.2). Among those workplaces that do not regularly carry out risk assessments, only 27.2 % declare that they have in place some other measures to monitor safety and health in the establishment (Table A3.3); this proportion is similar for the various types of establishment.

<sup>33</sup> Notice that, as mentioned above with respect to the analysis of the EWCS data, for cross-tabulations and charts based on the ESENER data, the statistical tests on difference of proportions between two samples are significant (for all compared items). Statistical significance of the reported findings applies in each case, even when the differences in response patterns for companies with and without teleworking in place do not seem remarkable.

Moreover, specific and sometimes conflicting issues may arise in the case of home workplace risk assessments, since, unlike assessing occupational hazards at employers' premises, the evaluation of risks at employees' homes is not yet standardised or well established. In fact, the risk assessment of a private home as a workplace is likely to differ significantly across countries, depending on the regulatory approaches at national level (Eurofound, 2020c). From Figure 21, it can be noted that 30.7 % of companies with teleworking in place conduct risk assessments that also cover home-based workplaces (referred to in item Q253 of the questionnaire) and that, for very large companies (more than 250 employees), this percentage reaches 42.8 %. It is undoubtedly the case that the larger the company, the higher the level of awareness of home workplace-specific risks. This is often the case among multinational and very large companies, which were therefore more accustomed to teleworking before and during the COVID-19 pandemic (EU-OSHA, 2021a; European Parliament, 2021).

**Figure 21: Workplaces with teleworking in place performing risk assessments at home by size (number of employees) (weighted data, %), EU-27**



Source: Author's elaboration on ESENER 2019 data

Within the area of OSH, the so-called hazard-harm pathway recalls a well-recognised aetiological model of identifying the relationship between exposure to occupational hazards and employees' safety and health in modern workplaces (Bryson et al., 2014; Litchfield et al., 2016). This model, as adapted by EU-OSHA (2013), also comprises psychosocial risks.

However, despite the increasing attention paid to non-physical risk factors (i.e. risks frequently related more to psychosocial features such as the way work is organised, the working environment and the nature of work itself), quantitative evidence on the effects of psychosocial risks on health and well-being is still relatively limited from EU and comparative intra-EU perspectives (see also EU-OSHA, 2017b). In the 2019 wave of ESENER, extensive consideration is devoted to investigating psychosocial risks. Traditional and new safety and health risks in establishments were surveyed<sup>34</sup> by a list of physical<sup>35</sup> factors and risks resulting from the way work is organised<sup>36</sup>. Recent studies prove the prominence of

<sup>34</sup> The list of traditional and emerging safety and health risks is presented to respondents in section 6 of the questionnaire: Q200 refers to physical risks, while psychosocial ones are covered by Q201.

<sup>35</sup> Lifting or moving people or heavy loads; repetitive hand or arm movements; prolonged sitting; tiring or painful positions; loud noise; heat, cold or draught; risk of accidents with machines or hand tools; risk of accidents with vehicles in the course of work but not on the way to or from work; chemical or biological substances in the form of liquids, fumes or dust; increased risk of slips, trips and falls. The EU-OSHA [OSHWiki article on physical agents](#) provides information on different physical agents and briefly discusses related risks and how those factors may be controlled. With respect to risk factors related to MSDs, see more recent articles by EU-OSHA (2020a,b,c,d).

<sup>36</sup> Time pressure; poor communication or cooperation within the organisation; fear of job loss; having to deal with difficult customers, patients, pupils, etc.; long or irregular working hours; threats, abuse or assaults (violence); harassment or bullying; sexual harassment. For a comprehensive discussion on the effects of psychosocial risk exposure on individuals' health, see the OSHwiki article 'Psychosocial risks and workers' health' (EU-OSHA, 2013). For more specific research on disadvantaged groups, see the OSHwiki article 'Psychosocial risks and vulnerable groups' (EU-OSHA, 2017b).

health problems associated with prolonged sitting<sup>37</sup> (item Q200\_3 of the questionnaire) with respect to neck, back, and upper and lower limb aches and pains. A number of different types of worker may be exposed to prolonged sitting, including office workers, call centre employees, service/help desk operators, workers on some types of production line, cashiers and drivers. A remarkable finding of ESENER-3 (EU-OSHA, 2020c) was that prolonged sitting was identified as the second most frequently reported risk factor in the EU-27 countries (in 61 % of workplaces), which closely follows the most reported one: repetitive hand or arm movements (reported by 65 % of workplaces). The prominence of this risk factor reflects the clear perception of static sitting as an evolving health risk factor that must be dealt with (EU-OSHA, 2021b).

However, with specific reference to risk factors connected to digitalisation and screen work<sup>38</sup>, the survey results on prolonged sitting<sup>39</sup> reveal a noteworthy difference in response patterns depending on the type of workplace, as can be observed in Figure 22. Regardless of the sector<sup>40</sup>, 81.3 % of companies where teleworking is in place report prolonged sitting — a figure that is much higher than that reported by those companies without teleworking in place (58 %).

**Figure 22: Workplaces reporting physical risks, Q200\_1 and Q200\_3 (weighted data, %), EU-27**



Source: Author's elaboration on ESENER 2019 data.

On the other hand, painful positions (item Q200\_4, with distributions presented in Figure 22) are reported by about 30 % of both types of enterprise, meaning that this risk is not primarily connected with teleworking activities.

As recognised in the current literature on teleworkability (for example Sostero et al., 2020; Eurofound, 2020b; European Parliament, 2021), teleworking is feasible in the case of only certain occupations, namely desk-based jobs, which are likely to involve prolonged static sitting. Instead, with regard to other jobs, for instance those requiring physical or manual work, some tasks may be more likely to involve experiencing painful positions. The ESENER-3 findings and those illustrated by the EWCS data (see

<sup>37</sup> See EU-OSHA (2020e) for a detailed article on prolonged static sitting as sedentary behaviour at work that also contains tips on teleworking.

<sup>38</sup> It should be kept in mind that comprehensive and updated information at EU level on screen work (and on sedentary work more generally) with respect to MSDs is still limited. The same limitation does exist with respect to data on the preventive measures implemented (EU-OSHA, 2020f). Therefore, these insights from ESENER-3 are even more relevant for policy — particularly in light of the pandemic crisis.

<sup>39</sup> Motivated by mounting evidence linking ill health to a sedentary lifestyle, EU-OSHA is currently carrying out the EU-wide 2020-2022 'Healthy Workplaces Lighten the Load' campaign, aimed at encouraging employers, workers and other stakeholders to work together to prevent MSDs and promote good musculoskeletal health among EU workers. Related issues are those of postural attitudes (dynamic sitting instead of static prolonged sitting, for example) and non-sedentary behaviours.

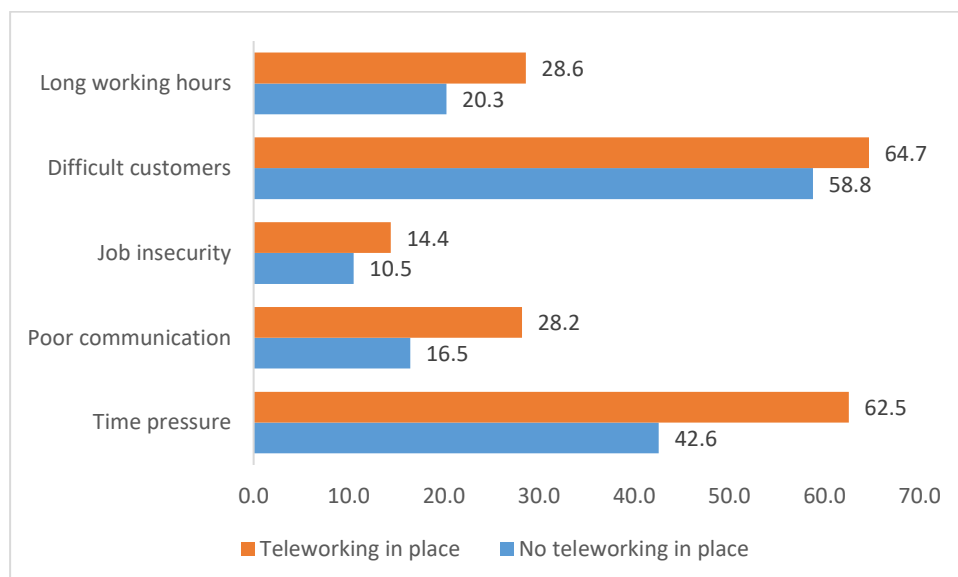
<sup>40</sup> Distinguishing by sector (EU-OSHA, 2020f, p. 6), this type of risk is reported more often in finance and insurance (93 %) information and communication (92 %), and public administration (91 %).

Figure 13) seem to be consistent with findings discussed in previous sections<sup>41</sup> with reference to sitting positions maintained for a long time by teleworkers. In addition, as discussed above, prolonged sitting is likely to lead to other associated conditions, such as headaches and eye strain, more frequently in teleworkers than in non-teleworkers.

The attitude of companies with teleworking in place with respect to psychosocial risks appears to be far more varied than that of companies without teleworking in place. Workplaces implementing teleworking outperform those without teleworking in place in most dimensions related to psychosocial factors assessed (Q201 items 1 to 5) (Figure 23).

Psychosocial risks associated with time pressure are reported by 62.5 % of companies with teleworking in place, compared with 42.6 % of those without teleworking in place. A large difference is also observed with regard to poor communication, with the percentages being 28.2 % and 16.5 %, respectively. Reporting job insecurity is rare for both types of company, although there is still a notable difference in responses (14.4 % of companies with teleworking in place versus 10.5 % of companies without). By contrast, a high proportion of both types of company report risks linked to the management of difficult customers (64.7 % of companies with teleworking in place versus 58.8 % of companies with no teleworking in place). Finally, with respect to long working hours, this risk is reported by 28.6 % of companies with teleworking in place and 20.3 % of companies without.

**Figure 23: Workplaces reporting specific psychosocial risks, Q201, (weighted data, %), EU-27**

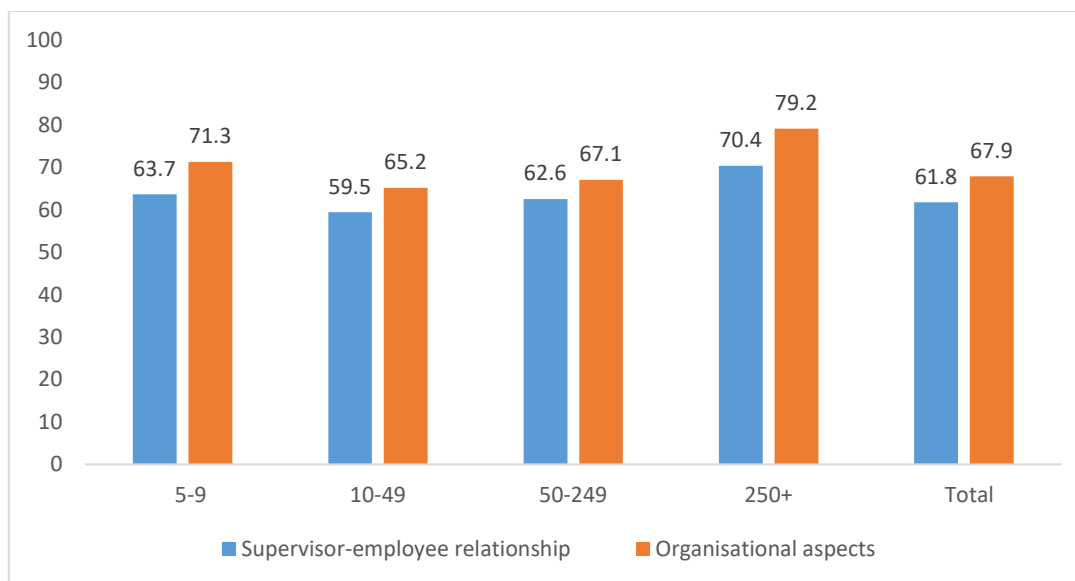


Source: Author's elaboration on ESENER 2019 data.

Enterprises with teleworking in place are also more likely to identify psychosocial risks than those without teleworking in place; this is the case for all the specific psychosocial risks covered by the survey. Taking into consideration only companies with teleworking in place, about 60 % declare that they carry out risk assessments that cover specific features of work relationships, such as that between employee and supervisor, and organisational aspects of work (items Q252\_5 and Q252\_6), regardless of the size of the company (Figure 24). This has significant implications for the future development of teleworking practices, since organisational aspects and trust in management are, although challenging, crucial in establishing good working relationships. In fact, building fruitful working relationships strongly depends on the ability of managers to successfully supervise teleworkers by using motivating and engaging methods.

<sup>41</sup> Similarly, as regards working in painful positions, we find confirmation that there is no difference in response behaviours when distinguishing by type of company and worker.

**Figure 24: Workplaces with teleworking in place performing risk assessment, including organisational aspects, by size (number of employees), Q252\_5 and Q252\_6, (weighted data, %), EU-27**



Source: Author's elaboration on ESENER 2019 data.

### 5.3 Teleworking and preventive OSH measures

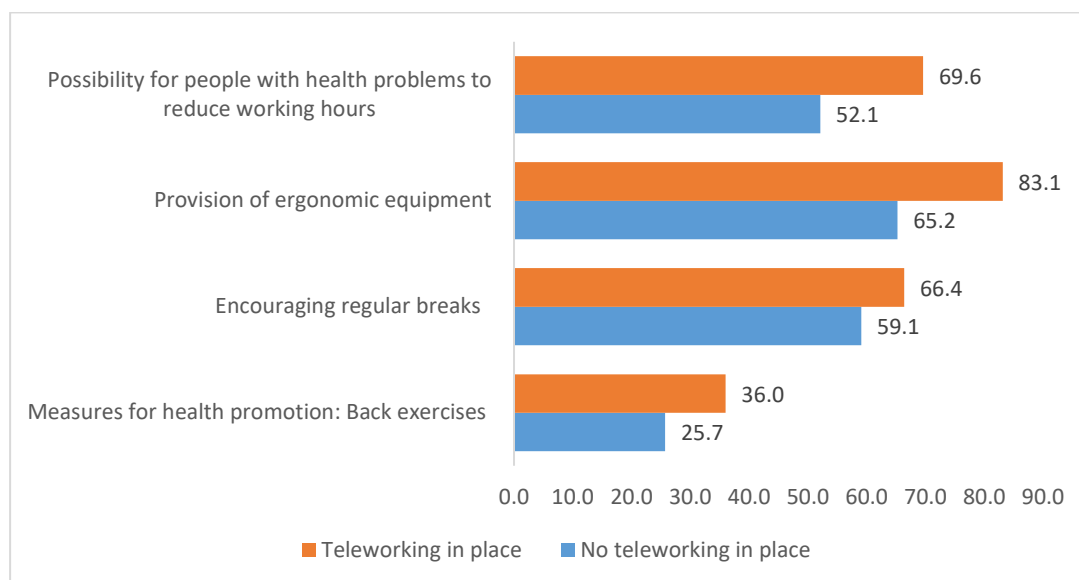
For all the dimensions investigated, establishments that allow teleworking state more frequently that they have implemented some preventive measures to deal with OSH risks than those without home-based teleworking in place. The fact that companies with teleworking in place are more likely to implement preventive measures to tackle diverse workplace risk factors suggests that the organisational culture of these companies is one of considering workers' safety and health. Therefore, if establishments (large ones more often than other sizes) have already implemented some measures to deal with potential occupational hazards at their premises, they are more likely to extend both risk assessment and related measures to teleworkers as well (as seen in, for example, Sostero et al., 2020; EU-OSHA, 2021a).

As illustrated in Figure 25, this pattern is clear in the case of the provision of ergonomic equipment for instance, with 83.1 % of companies with teleworking in place providing this, compared with 65.2 % of those without teleworking in place; this often occurs<sup>42</sup> with other interventions as well. Companies that implement teleworking are more often disposed (69.6 %) to allowing people with health problems to reduce their working hours than those with no teleworkers within their workforce (52.1 %). With respect to facilitating regular work breaks, 66.4 % of enterprises with teleworking in place report that they encourage this practice, compared with 59.1 % of those without teleworking in place. The proportions are markedly lower for both types of company when it comes to measures to promote health, for instance through back exercises; however, the proportion of workplaces with teleworking in place that promote health measures is again higher (36.0 %) than those that do not implement teleworking (25.7 %), showing a greater recognition of such problems, in line with what is noted above in relation to the identification of the specific hazards associated with prolonged sitting.

<sup>42</sup> The only exception being that of measures devoted to reducing repetitive movements and physical strain, which are more likely to be in place in a production setting than for teleworkers in a home-based setting. The issue is covered by items Q202-2 to 202-5 of the ESENER questionnaire.



Figure 25: Workplaces implementing MSD-related preventive measures, Q202, (weighted data, %), EU-27



Source: Author's elaboration on ESENER 2019 data.

With respect to measures carried out to manage new risks, namely psychosocial risks and those linked to digitalisation, substantial differences are reported in response behaviour.

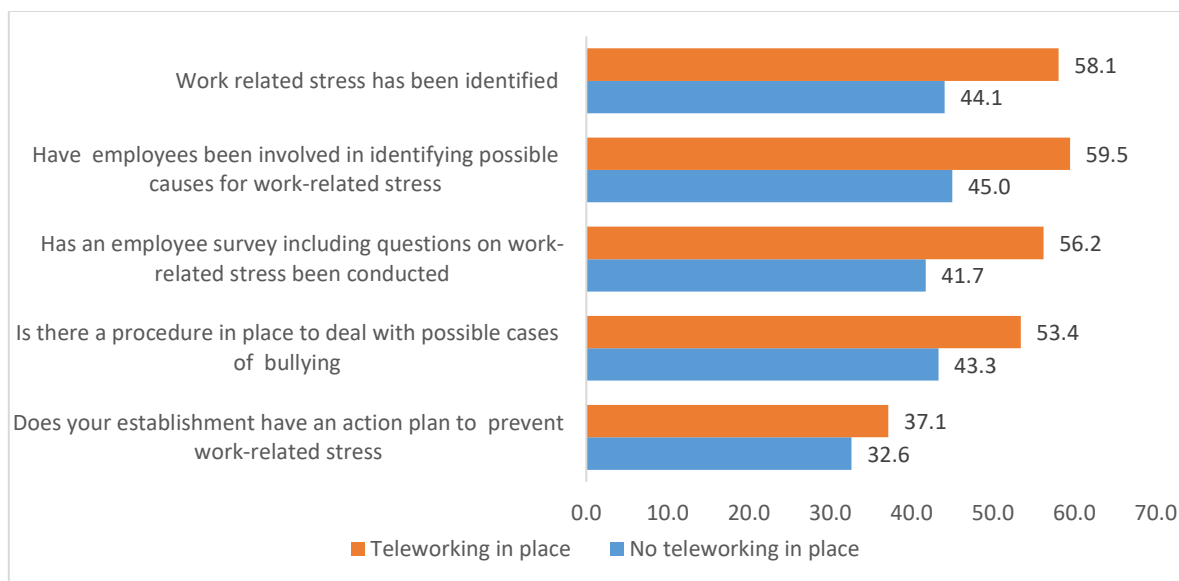
More specifically, as shown in Figure 26, which relates to measures in place to identify and combat occupational stress<sup>43</sup>, work-related stress is recognised as a problem by 58.1 % of establishments with teleworking in place, but by only 44.1 % of companies that do not implement teleworking. Again, the companies with teleworking in place more frequently report (37.1 %) having implemented an action plan to prevent work-related stress than those without teleworking (32.6 %). The difference is even larger with respect to procedures to deal with possible cases of bullying or harassment, put in place by 53.4 % of workplaces with home-based teleworkers, but by only 43.3 % of other workplaces. Furthermore, 56.2 % of companies that implement teleworking report having conducted an employee survey containing questions on work-related stress (in the 3 years preceding ESENER-3) — a frequency far greater than that of other workplaces (41.7 %).

Similar patterns are identified in smaller companies<sup>44</sup> with reference to the involvement of employees in identifying possible causes of occupational stress (59.5 % of companies with teleworking in place versus 45.0 % without). This suggests that, regardless of company size, when home-based teleworking is in place, investigating and addressing work-related stress is more likely.

<sup>43</sup> In section 8 of the ESENER questionnaire, work-related stress matters are investigated by items Q300 to Q303 (a and b).

<sup>44</sup> Item Q303b is included for companies with less than 20 employees.

**Figure 26: Workplaces implementing measures to identify and address stress, Q302, (weighted data, %), EU-27**



Source: Author's elaboration on ESENER 2019 data.

Once again, in analysing the practices implemented to deal with work intensity and pressure<sup>45</sup>, the establishments that have teleworking in place are also found to be those that more frequently implement specific organisational measures to address psychosocial risk factors at work<sup>46</sup>.

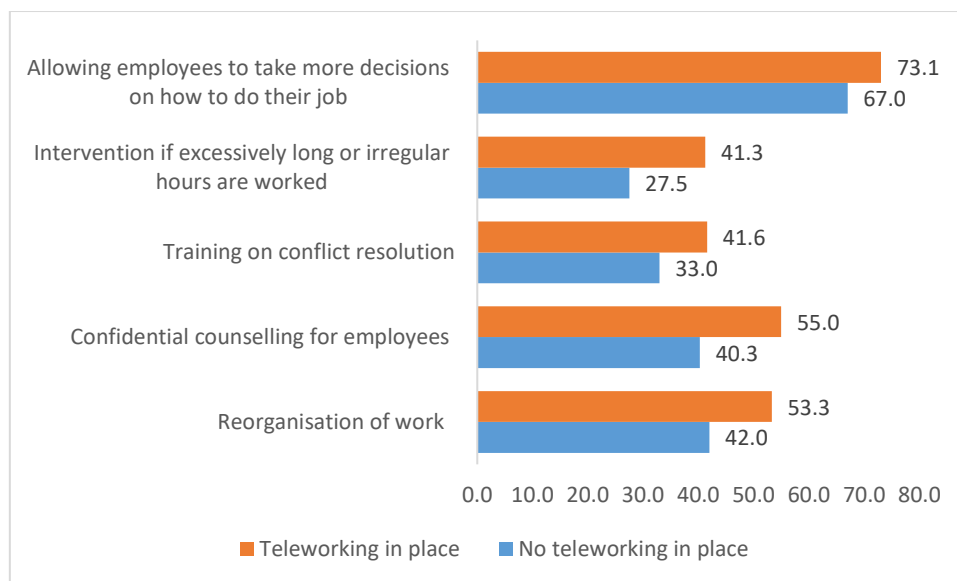
In particular, as presented in Figure 27, the difference is notable in the case of confidential counselling provided to employees (55.0 % versus 40.3 %), and in the case of measures implemented to address extremely long or irregular working hours (41.3 % versus 27.5 %). Even with respect to reorganising work, the difference in responses is marked, with 53.3 % of companies with teleworking in place implementing some measures, compared with 42.0 % of those without teleworking in place. This trend, taking into account the design sample effect, could be a feature of the largest and well-structured companies, such as multinationals (European Parliament, 2021).

For other measures aimed at addressing psychosocial risks, this gap in response behaviour in favour of establishments with teleworkers persists but is less marked, as in the case of training for conflict resolution at work (offered by 41.6 % of workplaces with teleworking in place versus 33.0 % of those without). The same can be said with respect to the managerial approach of allowing employees more autonomy in making decisions related to their job (73.1 % versus 67.0 %).

<sup>45</sup> These measures are recalled in items Q304-1 to Q304-5 of the ESENER questionnaire.

<sup>46</sup> More precisely, the matters considered in the ESENER questionnaire are reorganisation of work to reduce job demands and work pressure; provision of confidential counselling for employees; training on conflict resolution; intervention if excessively long or irregular hours are worked; allowing employees to make more decisions on how to do their job.

**Figure 27: Workplaces implementing measures to deal with psychosocial risks, Q304, (weighted data, %), EU-27**



Source: Author's elaboration on ESENER 2019 data.

Some of these risk factors have been proven to exert negative impacts on perceived general health, as in the case of excessively long or irregular hours (Messenger, 2019), leading to an increased level of stress, sleeping problems and other physical and mental conditions. Job autonomy and support from supervisors (and colleagues) can play a role in moderating such effects.

These findings are consistent with a growing body of literature (for example Mandl et al., 2015; Eurofound and ILO, 2017; Messenger, 2019; Parry et al., 2021; Rodríguez-Modroño and López-Igual, 2021) that examines psychosocial risk factors linked to work intensity, including in the case of teleworking practices. Our results are in line with a recent European Commission communication<sup>47</sup> (2021) that explicitly recognises psychosocial risks and work-related stress as key issues that need to be addressed. In the context of broad technological and societal transformations, there is a need to update policies to deal with traditional and new and emerging work-related risks, such as those accompanying digitalisation.

However, the conclusions of these descriptive findings leave an underlying question unaddressed: what characteristics of enterprises make them more likely to allow home-based teleworking? In the following sections, some modelling results are presented to inform the development of approaches to tackling this prominent issue.

## 5.4 Statistical modelling analysis

To conclude the statistical analysis of the ESENER-3 data, with the aim of providing more robust information in terms of preventive OSH measures that could be implemented in workplaces with teleworking in place, modelling analysis was carried out. Our goal was to identify the circumstances in which establishments are more likely to implement teleworking and what measures are more likely to be effective at preventing teleworking-related risks (focusing specifically on MSD-related risks) in such establishments. After comparing different and more complex statistical models, we selected probit<sup>48</sup>

<sup>47</sup> The European Pillar of Social Rights Action Plan, which aims to protect the health and well-being of workers while allowing for increasing labour productivity, suggests specific areas of interventions to improve workers' well-being, in a sustainable economic recovery framework.

<sup>48</sup> In our analysis, the objective of the probit models was to estimate the probability of having teleworking in place, and to identify the extent to which certain explanatory variables influence this probability. Thus, we studied the probability of having teleworking in place as a function of variables that relate to the type of enterprise and characteristics of the workforce, and the measures implemented to tackle specific risk factors.

models, as their results can be easily interpreted (Agresti, 2010). All the technical details of the estimation procedure and the coefficients used are described in Annex 4.

In this exercise, we developed two separate models to estimate the distinct effects on the probability of having teleworking<sup>49</sup> in place of two preventive measures that companies may implement to deal with MSD-related issues, considering for both models the same set of variables as main determinants. The first model estimates the effect of implementing a specific measure to combat MSDs, namely encouraging regular breaks for people working in uncomfortable or static postures, including prolonged sitting (as covered by Q202\_3 in the ESENER-3 questionnaire) on the probability of having teleworking in place. The second model estimates the effect of providing ergonomic equipment on the probability of having teleworking in place, such as ergonomic chairs or desks to prevent MSD risks (covered by Q202\_4).

The first preventive measure considered is connected to job autonomy, since, depending on company management style, an employee may or may not be entitled to take breaks regularly, which is a measure recognised to prevent MSDs. The second measure indicates the responsiveness of a company to preventing MSD risks in terms of providing the equipment necessary to enable an employee to work ergonomically.

Based on a statistical procedure aimed at identifying statistically significant variables, a number of variables were included in the models as possible determinants of teleworking<sup>50</sup>: establishment size and company structure; NACE group; age composition of the company workforce; OSH outsourcing and training; measures implemented to deal with MSDs; occupational stress awareness and related measures.

In more detail, the determinants considered in both models are:

- establishment size (sorted into four categories: 5-9 employees, as the reference category; 10-49 employees; 50-249 employees; more than 250 employees);
- company structure<sup>51</sup> (used as a dummy variable: 0 assumed for single site, as the reference; 1 for multisite);
- economic sector based on NACE categories, distinguishing eight groups<sup>52</sup>;
- prevalence of employees aged 55 years or older among the total workforce<sup>53</sup> (discriminating the following classes: none, as the reference category; less than a quarter; a quarter to half; more than half);
- OSH outsourcing<sup>54</sup> (as a dummy variable, with 'NO', i.e. no outsourcing, as the reference category);
- OSH training<sup>55</sup> ('NO', i.e. no training, as the reference category);
- stress awareness in the company<sup>56</sup> (as a dummy variable, derived from considering a positive answer to the two items related to stress policies, with 'NO', i.e. no stress awareness, as the reference category).

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<sup>49</sup> The binary-dependent variable ( $Y_i$ ) assumes value 1 in the case where the company ( $i$ ) implements teleworking; otherwise it assumes value 0.

<sup>50</sup> Variable selection was driven by considering sample size limitations and findings from the descriptive results (as reported in Chapter 4), which indicate that company size, structure and sector are likely to be the main drivers of having teleworking in place. The age structure of the workforce can be a relevant factor, as we are considering the use of ICT, and, therefore, older workers might face more difficulties than younger ones. Each variable is considered through a stepwise procedure to assess its addition to the set of explanatory variables, based on the statistical significance of their associated coefficients (results are shown in Tables A4.1 and A4.2).

<sup>51</sup> Q100: 'Is this establishment a single organisation, or is it one of several establishments at different locations in [country] belonging to the same company or organisation?'

<sup>52</sup> (1) Agriculture (A), considered the reference category; (2) mining and quarrying, electricity and gas, water supply, construction (B, D, E, F); (3) manufacturing (C); (4) wholesale and retail, transportation and storage, HORECA, arts and entertainment (G, H, I, R); (5) information and communication, financial activities and insurance, real estate, professional services, administrative services, other services (J, K, L, M, N, S); (6) public administration (O); (7) education (P); (8) human health and social work (Q).

<sup>53</sup> Q105: 'About what proportion of the employees is aged 55 years or older?'

<sup>54</sup> Q152: 'In the last 3 years: has your establishment used the services of any external provider to support you in your health and safety tasks?'

<sup>55</sup> Items Q164a and b: 'Have you personally received any training on how to manage health and safety?'

<sup>56</sup> Item Q303a, administered to establishments with more than 20 employees: 'Has an employee survey including questions on work-related stress been conducted in your establishment in the last 3 years'. Item Q303b, administered to establishments

Furthermore, a dummy variable for countries is included in both models, to detect the response patterns of those countries with a share higher than 10 % of companies with teleworking in place. More specifically, this last variable presents the following composition:

- country group 1 (more than 10 % of companies have teleworkers): Belgium, Czechia, Denmark, Germany, Estonia, Ireland, France, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Austria, Slovakia, Finland, Sweden;
- country group 2 (less than 10 % of companies have teleworkers): Bulgaria, Greece, Spain, Croatia, Italy, Cyprus, Hungary, Poland, Portugal, Romania, Slovenia.

The model estimates<sup>57</sup> are based on 34,741 observations, where 4,613 companies have teleworking in place (dummy target variable with value equal to 1). The estimated coefficients, the associated estimated standard errors and the related statistically significant tests are reported in Tables A4.1 and A4.2.

Model findings, illustrated in detail in the following sections, indicate that the variables that positively affect the probability of having teleworking in place (that is, the dependent variable) are somehow expected in light of the current literature and are consistent with the descriptive results previously presented with respect to size, sector and country. Nonetheless, some of the findings are unexpected, such as the fact that workforce age seems to be irrelevant. Through this simple modelling approach, it is possible to get a picture of the joint effects on the probability of having teleworking in place of the different determinants, as reaching conclusions on the combined impact of these determinants on the probability of teleworking being in place is not easy on the basis of simple descriptive analysis. Moreover, the most effective way of highlighting the role played by such determinants is to estimate the probability of having teleworking in place using different combinations of the variable values and comparing them using graphs. In fact, the results reported in such charts allow to verify whether or not statistically significant differences do occur in the probability of having teleworking in place, taking into account the values of some determinants of particular interest, such as the company size.

### **5.4.1 Model 1: the effect of ‘regular breaks’**

The first probit model focuses on the effect on the probability of having teleworking in place of a specific measure implemented to combat MSDs, namely ‘regular breaks’, in combination with the determinants described above. In particular, it turns out that the variable<sup>58</sup> ‘regular breaks’ seems to have a positive and highly significant impact on the probability of teleworking being in place. The estimated coefficients are shown in Table A4.1, where the estimation procedure is also detailed.

The company size coefficients, which are all statistically different from zero, seem to exert a positive impact, meaning that the greater the company size, the higher the probability of having teleworking in place, as anticipated by the descriptive findings. The coefficients for the ‘services’ NACE group are also positive and significant. As expected, the NACE groups play different roles; however, considering the agriculture sector the reference category, it seems that only the ‘services’ group<sup>59</sup> exerts a significant and strongly positive effect on response patterns, in line with the descriptive results and current literature, as referenced in the previous section.

Other drivers — OSH outsourcing, stress awareness and belonging to country group 1 — positively influence the estimated probabilities of having teleworking in place. The prevalence of workers older than 55 years does not seem to be statistically significant, and neither does ‘OSH training’.

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with less than 20 employees: ‘Have employees been involved in identifying possible causes for work-related stress, such as e.g. time pressure or difficult clients?’

<sup>57</sup> Notice that for the variance equation of the heteroskedastic probit models we inserted as explanatory variables company size and prevalence of employees aged 55 years or older.

<sup>58</sup> We refer to item Q202\_3: ‘Encouraging regular breaks for people in uncomfortable or static postures including prolonged sitting’, and it is included in the model as a dummy variable, which assumes value 0, as the reference category, when the company does not implement the measure, and the value 1 otherwise.

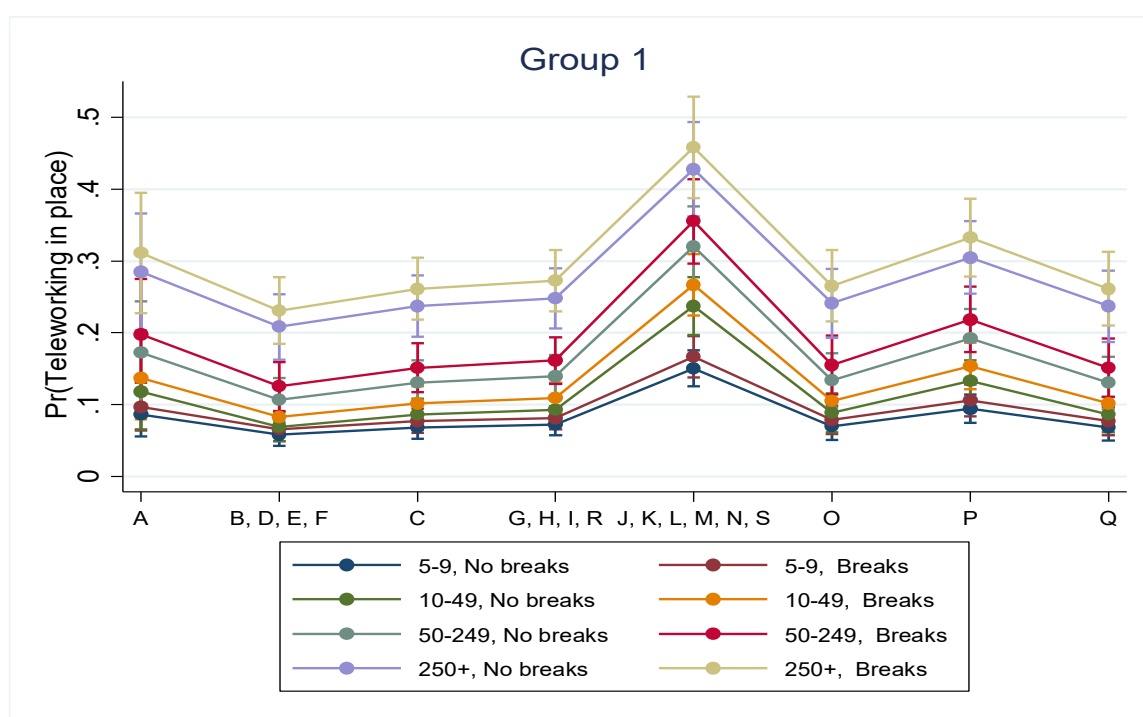
<sup>59</sup> The ‘services’ sector group is that composed by J (Information and communication), K (Financial activities and insurance), L (Real estate), M (Professional services), N (Administrative services), and S (Other services).

Figures 28 and 29 present the estimated probabilities<sup>60</sup> of having teleworking in place, differentiated by country groups<sup>61</sup>. These estimated probabilities are evaluated for each NACE group and size class, and by the measure implemented to combat MSDs (regular breaks).

In both figures, the dynamics of the estimated probabilities are similar: larger firms are more likely to have teleworking in place, and this probability is higher in firms belonging to NACE services group. The probit model allows us to estimate the probability of having teleworking in place for the groups of countries considered and to appreciate the difference between these groups. We recall that group 1 is largely composed of northern European countries already inclined to favour policies that promote teleworking practices, owing to both labour market structure and the presence of large industrial groups. The comparison of Figures 28 and 29 allows us to state that the probability of having teleworking in place is almost double for group 1 than for group 2, for all company sizes and for all NACE groups.

Moreover, in group 2 the behaviour of large firms differs from that of smaller firms to a greater extent than it does in group 1. In fact, for companies with under 50 employees, no significant differences are identified in the estimated probabilities.

**Figure 28: Estimated probabilities of having teleworking in place, by NACE group, company size and 'regular breaks' — country group 1**



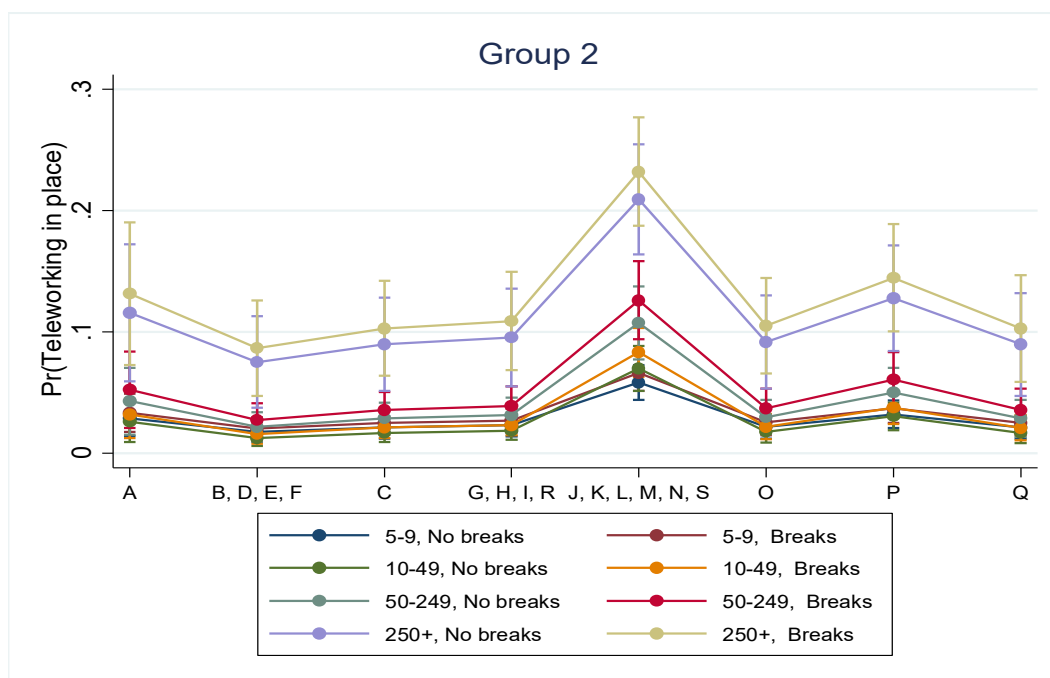
Source: Author's elaboration on ESENER 2019 data.

Note: Agriculture (A), considered as the reference category and, respectively: Mining and quarrying, Electricity and gas, water supply, construction (B, D, E, F); Manufacturing(C); Wholesale and retail, Transportation and storage, Hotels, restaurants and catering, Arts and entertainment (G, H, I, R); Information and communication, Financial activities and insurance, Real estate, Professional services, Administrative services (J, K, L, M, N, S); Public administration (O); Education(P); Human health and social work (Q).

<sup>60</sup> In the regression model, the estimated values of the dependent variable of interest are obtained by replacing the estimated coefficients and the values of the independent variables, for each observation, in the model. Similarly, in the probit model, the estimated probability of the variable of interest being equal to 1, for each unit, is obtained by substituting in the model the estimated coefficients and the values of the independent variables for each observation. It is usual to present results with associated 95 % confidence intervals.

<sup>61</sup> To evaluate the estimated probabilities, the remaining variables not explicitly mentioned in the figures are set to their reference category.

**Figure 29: Estimated probabilities of having teleworking in place, by NACE group, company size and 'regular breaks' — country group 2**



Source: Author's elaboration on ESENER 2019 data.

Note: Agriculture (A), considered as the reference category and, respectively: Mining and quarrying, Electricity and gas, water supply, construction (B, D, E, F); Manufacturing(C); Wholesale and retail, Transportation and storage, Hotels, restaurants and catering, Arts and entertainment (G, H, I, R); Information and communication, Financial activities and insurance, Real estate, Professional services, Administrative services (J, K, L, M, N, S); Public administration (O); Education(P); Human health and social work (Q).

### 5.4.2 Model 2: the effect of 'ergonomic equipment'

To estimate the effect of the variable 'ergonomic equipment'<sup>62</sup> on the probability of teleworking being in place, a second probit model was developed to consider this preventive measure in combination with the determinants already mentioned. The estimated coefficients are shown in Table A4.2, where the estimation procedure is also detailed.

Even in this case, the company size coefficients are all statistically different from zero and seem to exert a positive impact, meaning that the greater the company size, the higher the probability of having teleworking in place. The coefficients for the NACE services group (sectors J, K, L, M, N and S) are also positive and significant. Again, the effects of OSH outsourcing, stress awareness and being in country group 1 are positive and significant.

Similarly to the probabilities estimated using the previous model, the probabilities estimated using this model allow us to grasp the combined effects of the variable 'ergonomic equipment' and the abovementioned determinants on the probability of having teleworking in place.

Figures 30 and 31 show the estimated probabilities differentiated by country groups<sup>63</sup>. The estimated probabilities are evaluated for each NACE group and size category, and by the preventive measure, i.e. ergonomic equipment.

<sup>62</sup> The variable refers to item Q202\_4, 'Provision of ergonomic equipment, such as specific chairs or desks', and it is included in the model as a dummy variable, assuming a value of 0, as a reference category, when the company does not implement the measure, and a value of 1 otherwise.

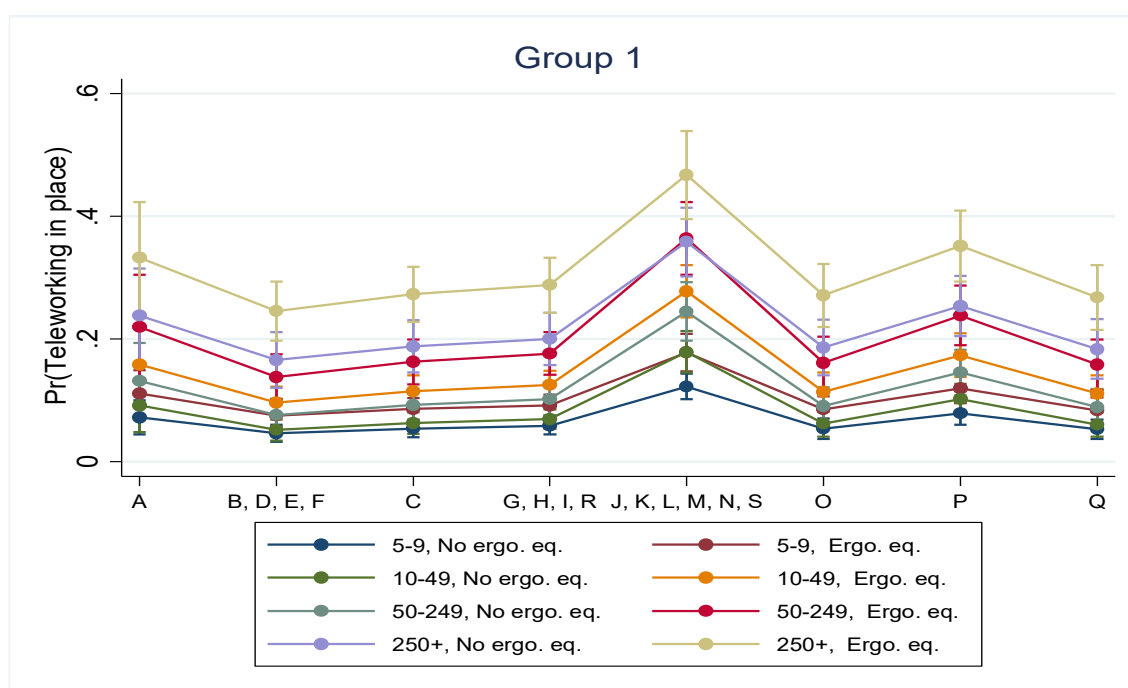
<sup>63</sup> The remaining variables are set to their reference category.

Both figures show a pattern comparable to the previous model: larger firms are more likely to have teleworking in place, and this probability is higher for companies in the ‘services’ group. In this second model, in particular for the countries in group 2, the differences in the estimated probabilities for each sector group for large companies seem greater. In fact, as can be seen for both country groups, the size of the establishment plays (even in this second model) a prominent role, since, for all NACE groups, the highest probability of having teleworking in place is clearly associated with the largest companies. The implementation of an OSH policy that involves making some ergonomic adjustments seems to impact on the response pattern. Moreover, the different behaviour of the ‘services’ group (NACE sectors J, K, L, M, N and S) is clear, with this group being associated with the highest estimated probability of having teleworking in place, consistent with established literature.

For country group 2, the estimated probabilities are again lower than those observed for the companies in group 1, and this is true for all company sizes. For country group 2, the effect of providing ergonomic equipment in large firms is clearly more pronounced than it is in smaller companies. In addition, as regards companies with under 50 employees, providing ergonomic equipment does not appear to have any significant effect on the estimated probabilities in country group 2, whereas a difference is observed in group 1. These results suggest that, in southern and eastern European countries, large companies may be more disposed to allow for teleworking than smaller companies. The behaviour of large companies is clearly distinct from that of smaller companies, and, in this second model, when it comes to the provision of ergonomic equipment, the difference between larger and smaller establishments in the probability of having teleworking in place is less evident than in the first model.

In summary, it is clear that the influence of size is the most notable of all the determinants considered, especially in this second model. When comparing the two measures under consideration, a possible explanation for this difference may be that the supply of equipment is generally controlled by legal and regulatory systems, while measures linked to work organisation (e.g. encouraging regular breaks) may more directly reflect company culture and management style.

**Figure 30: Estimated probabilities of having teleworking in place, by NACE group, company size and ‘ergonomic equipment’ (ergo. eq.) provision — country group 1**



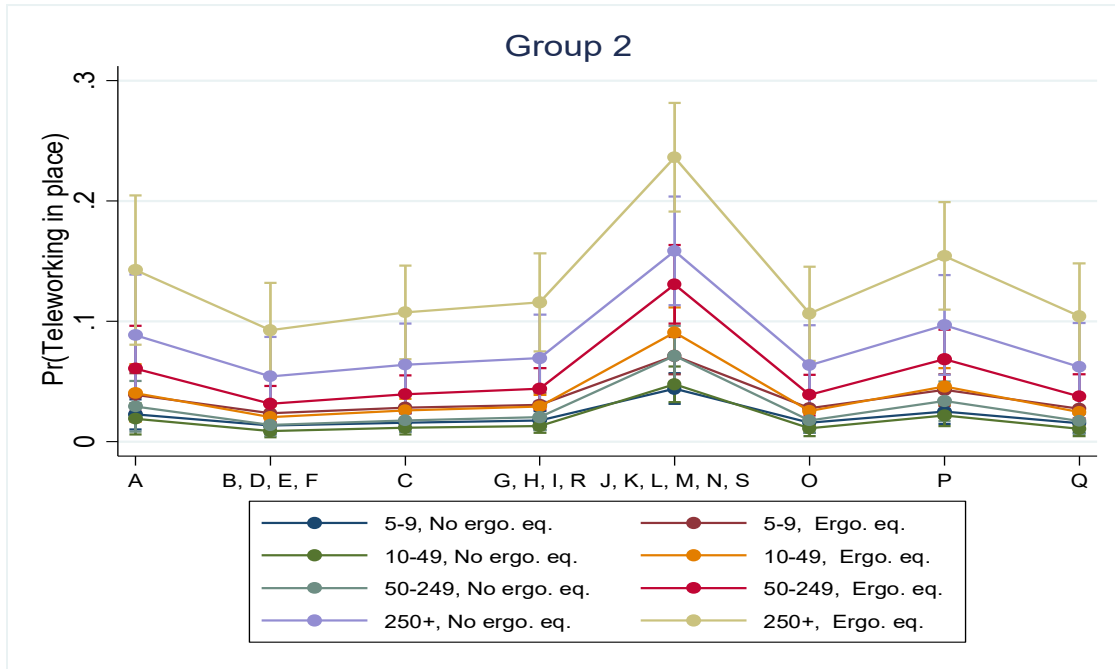
Source: Author’s elaboration on ESENER 2019 data.

Note: Agriculture (A), considered as the reference category and, respectively: Mining and quarrying, Electricity and gas, water supply, construction (B, D, E, F); Manufacturing(C); Wholesale and retail, Transportation and storage, Hotels, restaurants and catering, Arts and entertainment (G, H, I, R); Information and communication, Financial activities and insurance, Real estate,



Professional services, Administrative services (J, K, L, M, N, S); Public administration (O); Education(P); Human health and social work (Q).

**Figure 31: Estimated probabilities of having teleworking in place, by NACE group, company size and 'ergonomic equipment' (ergo. eq.) provision — country group 2**



Source: Author's elaboration on ESENER 2019 data.

Note: Agriculture (A), considered as the reference category and, respectively: Mining and quarrying, Electricity and gas, water supply, construction (B, D, E, F); Manufacturing(C); Wholesale and retail, Transportation and storage, Hotels, restaurants and catering, Arts and entertainment (G, H, I, R); Information and communication, Financial activities and insurance, Real estate, Professional services, Administrative services (J, K, L, M, N, S); Public administration (O); Education(P); Human health and social work (Q).

## 6 Conclusions

Regardless of the profound transformation generated by the advancement of ICT in the organisation of work, teleworking was not a frequent practice before the 2020 pandemic, the implementation of such practices being slower than expected in previous years (Anandarajan et al., 2006; Mandl et al., 2015). Despite the media attention and both corporate and academic emphasis on the limitless promises of teleworking, only a relatively low number of establishments and organisations had in fact adopted home teleworking practices pre-COVID-19. In general, even in recent years, home-based teleworking and further flexible working practices do not seem to have been readily accepted by employers or, sometimes surprisingly, employees (Kaduk et al., 2019; Messenger, 2019). Nonetheless, teleworking has undergone key transformations in the past 10 years, mainly due to an exponential growth in ICT developments, which, year after year, have made it simpler to work from home, but also thanks to the arrangements implemented by some pioneering companies.

At the European level, the phenomenon has developed to a certain extent over the years, although has remained negligible in certain countries. Up to 2020, teleworkers made up at most 9-10 % of all EU workers, with deep cross-country disparities.

The substantial upsurge in teleworking induced by the COVID-19 crisis and its continuation for over a year may have permanently changed the attitude of both workers and enterprises towards the matter. In Europe's most advanced economies, teleworking during the COVID-19 crisis has been estimated to account for from about one-quarter to two-thirds of all employment, varying significantly by country (Sostero et al., 2020). Such an increase has been registered more among employees rather than the self-employed, indicating that, for most employees, doing their job at their employer's premises was not even debateable before the implementation of the social distancing measures. Before the pandemic, to find employees working from home on a regular basis was the exception, with some geographical differences, even for the most teleworkable occupations.

It remains to be investigated how sustainable this radical transformation will be in the long term and whether European companies and workers will be able to adapt to this major change. A question arises about whether and in what forms working from home may be likely to persist and even increase, or not, with the end of the crisis. From a company perspective, recent evidence from the business rental market suggests that the use of teleworking can lead to substantial savings in rental costs; however, companies complain that workers' isolation can negatively affect their engagement and productivity.

Therefore, it is essential to effectively identify and manage the related new and emerging risks at work. With the aim of analysing the preconditions that can favour the implementation of teleworking and therefore investigating the possible related risks, the present study employs the most recent official data available on the subject, as regards the viewpoints of both workers (EWCS) and companies (ESENER-3). The use of these data collected pre-COVID-19 may be beneficial for addressing issues related to the prospects of teleworking developing in a non-emergency period. The evidence provided is, in fact, an illustration of the non-temporary structural conditions of the labour market and economies of the Member States.

The report, while pointing out that the incidence of teleworking was marginal pre-pandemic, has underlined, in line with current literature, that advances in teleworking are likely to depend mostly on country-based factors, rather than exclusively on differences among sectors or types of occupation.

Results from ESENER-3 support evidence suggesting that northern and central European countries have been structurally more disposed to implementing teleworking, for reasons mostly related to a number of factors, including the economy and labour market structures, and also the existing company cultures and prevailing organisational models, based on performance appraisals and trust. The same can be said with respect to both awareness of the specific risks linked to home-based teleworking and the measures implemented to address them.

The other aspect exerting a significant impact is the company size, as emerged from both ESENER-3 and EWCS 2015 data. The size of the enterprise, more than the sector of activity, plays a significant role, meaning that larger companies are more likely to allow for teleworking. Conversely, the possibility of implementing productive teleworking experiences seems to be less achievable and sustainable in smaller enterprises. Not disregarding some exceptions, smaller companies *per se* are often associated

with lower risk awareness. In smaller enterprises, while home-based teleworkers are often provided with work equipment as a measure to prevent OSH risks connected to teleworking, other preventive measures and risk assessments covering domestic premises are much less common.

In light of these findings, we also sought to investigate through a modelling approach whether different patterns may occur with respect to variables other than geographical location and size. Particularly with respect to safety and health risk management measures, evidence from ESENER-3 has shown that working from home more often occurs in larger establishments, where a greater interest in flexible work organisation practices may also be found. This seems to depend on the structure of the firm itself, rather than other aspects such as the age of the workforce, which does not appear to be relevant. In fact, in these companies the existence of departments/offices in charge of arranging teleworking (as well as other flexible job features) appears to be more easily attainable, thanks to established and documented procedures, and also a set of corporate welfare measures and risk assessment practices.

As underlined above, working conditions have profoundly changed at the global level in the most unexpected and uncontrolled way, taking companies, workers, and policy- and decision-makers by surprise. The body of literature published on the subject during the past year is indeed substantial. Across European countries for instance, there have been many small- and large-scale surveys — not only those carried out by EU bodies, national institutes of statistics and universities, but also those conducted by private and public companies. The effects of the abrupt expansion of teleworking have been communicated by means of traditional and social media, with respect to the quality of working time, stress associated with work-life balance issues, and so on.

In line with other research (Espinoza and Reznikova, 2020; Fana et al., 2020; Sostero et al., 2020; EU-OSHA, 2021a), results (from EWCS data) highlight the role of education as an important driver in the development of teleworking. Indeed, there are fewer opportunities for teleworking among workers with below tertiary level education. These conclusions give rise to vital questions about present labour market inequalities, which are likely to become more ingrained as a result of the pandemic and in the pandemic's aftermath.

Moreover, critical challenges concerning safety and health issues at home, such as the adequacy of working ICT devices and a number of ergonomic aspects, have emerged in all their significance. Finally, the 'right to disconnect' has acquired relevance within general readership.

The combined effect of the extension of digitalisation and the measures implemented due to the COVID-19 pandemic is likely to lead to a permanent increase of telework in all types of companies, regardless of sector and size (EU-OSHA, 2021a). Nevertheless, while in larger companies OSH preventive measures are more developed compared to smaller companies, especially in the area of telework and digitalisation, action targeting the micro and small establishment to support the development of OSH measures (i.e. regulation, guidance and support, tools) is needed.

So far, the application of long-lasting policies to encourage teleworking and deal with the related risks, at the country and company levels, is far from being achieved. Primarily, country-specific determinants should be identified to help encourage and foster teleworking arrangements. Then, policy measures should challenge the negative effects of teleworking on OSH and working conditions that have already been identified, for example by limiting the availability of work during non-working time. In the context of policies meant to favour the participation in the labour market of women with children, older workers and disabled people, teleworking activities can in fact play a prominent role.

On a final note, it is important to stress the limitations of this analysis, which stem directly from the data used and the surveys themselves, namely the fact that we have analysed only self-reported information on a number of variables. Furthermore, the survey tools used are designed to investigate general working conditions and related risks, not to specifically study the occurrence of teleworking. Therefore, a survey specifically designed to study working conditions for those who carry out teleworking could deepen our knowledge of telework-specific occupational risks

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## Annex 1: Data from the European Union Labour Force Survey

Table A1.1: Employees working mostly from home (% of all employees aged 15-64) by country and gender, EU-27, 2019-2020

| Country     | % Women |      | % Men |      |
|-------------|---------|------|-------|------|
|             | 2019    | 2020 | 2019  | 2020 |
| Belgium     | 4.8     | 16.1 | 2.7   | 13.6 |
| Bulgaria    | 0.5*    | 1.9  | 0.4*  | 0.5* |
| Czechia     | 1.5     | 4.4  | 1     | 3.4  |
| Denmark     | 5.4     | 15.6 | 5.4   | 14.7 |
| Germany     | 3.6     | 12.6 | 2.8   | 13.7 |
| Estonia     | 5.1     | 12.6 | 3.3   | 8.4  |
| Ireland     | 3.8     | 20.1 | 3.8   | 19.7 |
| Greece      | 1.7     | 10.1 | 1.2   | 6.3  |
| Spain       | 2.9     | 10.9 | 2.1   | 8.2  |
| France      | 6.3     | 16.1 | 3.1   | 12.4 |
| Croatia     | 2.2     | 3.6  | 0.8   | 1.7  |
| Italy       | 1.2     | 13.4 | 1     | 9.2  |
| Cyprus      | 0.9     | 4.8  | 0.6   | 3.6  |
| Latvia      | 1.4     | 1.5  | 0.9   | 1.5  |
| Lithuania   | 0.9     | 4.8  | 0.7   | 3.1  |
| Luxembourg  | 10.2    | 22.6 | 7.8   | 21.1 |
| Hungary     | 0.6     | 3.3  | 0.7   | 2.2  |
| Malta       | 6.1     | 18   | 2.9   | 11.2 |
| Netherlands | 7.9     | 12   | 10    | 13.9 |
| Austria     | 7.3     | 15.9 | 4.3   | 13.8 |
| Poland      | 2.1     | 8.6  | 1.1   | 4.7  |
| Portugal    | 5.3     | 14   | 4.3   | 12.8 |
| Romania     | 0.9     | 4.2  | 0.4   | 1.8  |
| Slovenia    | 6.2     | 7    | 3.3   | 3.9  |
| Slovakia    | 2.4     | 5.6  | 1.8   | 3.6  |
| Finland     | 10.6    | 23   | 9.4   | 21.8 |
| Sweden      | 3.7     | 5.4  | 3.9   | 5.5  |
| EU27        | 3.7     | 11.7 | 2.7   | 9.9  |

Source: Eurostat, EU-LFS. Dataset: lfsa\_ehomp (last update: 2 June 2021)

Notes: Data refer to employees only, not the self-employed. \*Very low reliability.



## Annex 2: Data from the European Working Conditions Survey 2015

Table A2.1: Employees and self-employed working from home by country and frequency (% of respondents), EU-27 (weighted data)

| Country     | Daily | Several times a week | Less often | Don't know | Total |
|-------------|-------|----------------------|------------|------------|-------|
| Belgium     | 3.2   | 3.9                  | 2.3        | 3.8        | 2.4   |
| Bulgaria    | 0.9   | 1.2                  | 1.7        | 1.5        | 1.6   |
| Czechia     | 1.5   | 2                    | 2.8        | 2.4        | 2.7   |
| Denmark     | 1.7   | 2.8                  | 1.4        | 0.3        | 1.5   |
| Germany     | 11.6  | 13.6                 | 22.5       | 6.5        | 21.2  |
| Estonia     | 0.4   | 0.3                  | 0.3        | 0.2        | 0.3   |
| Ireland     | 1.8   | 1.4                  | 1          | 0.1        | 1     |
| Greece      | 0.5   | 1.9                  | 2          | 0.5        | 1.9   |
| Spain       | 7     | 5.9                  | 9.7        | 18.6       | 9.4   |
| France      | 26.2  | 15.3                 | 12.9       | 13.9       | 13.9  |
| Croatia     | 1.2   | 0.5                  | 0.8        | 0.8        | 0.8   |
| Italy       | 9.2   | 8.9                  | 12.3       | 7.6        | 11.9  |
| Cyprus      | 0.1   | 0.1                  | 0.2        | 0.1        | 0.2   |
| Latvia      | 0.6   | 0.5                  | 0.5        | 1.2        | 0.5   |
| Lithuania   | 0.6   | 0.8                  | 0.7        | 0.4        | 0.7   |
| Luxembourg  | 0.2   | 0.2                  | 0.1        | 0.3        | 0.1   |
| Hungary     | 2.2   | 2.8                  | 2.2        | 5.4        | 2.2   |
| Malta       | 0.1   | 0.1                  | 0.1        | 0          | 0.1   |
| Netherlands | 5.3   | 10.2                 | 4          | 2          | 4.4   |
| Austria     | 2.6   | 3.6                  | 2.1        | 0.2        | 2.2   |
| Poland      | 9.2   | 8                    | 8.3        | 23.5       | 8.5   |
| Portugal    | 1.9   | 2.3                  | 2.4        | 2.7        | 2.4   |
| Romania     | 5.5   | 5.9                  | 4.4        | 5.4        | 4.5   |
| Slovenia    | 0.9   | 0.5                  | 0.5        | 0.1        | 0.5   |
| Slovakia    | 0.5   | 0.6                  | 1.4        | 0.8        | 1.3   |
| Finland     | 2.6   | 2.2                  | 1.1        | 0.5        | 1.3   |
| Sweden      | 2.9   | 4.8                  | 2.4        | 1.2        | 2.6   |
| Total       | 100.0 | 100.0                | 100.0      | 100.0      | 100.0 |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.2: Percentages of non-teleworkers and teleworkers reporting muscular pain in upper and lower limbs, EU-27 (weighted data)**

| Response | Muscular pains in shoulders, neck and/or upper limbs |             | Muscular pains in lower limbs |             |
|----------|--|-------------|-------------------------------|-------------|
|          | Non-teleworkers                                      | Teleworkers | Non-teleworkers               | Teleworkers |
| Yes      | 41.9   | 43.8        | 30.0                          | 24.7        |
| No       | 57.9   | 56.1        | 69.7                          | 75.2        |
| DK       | 0.2  | 0.1         | 0.3                           | 0.1         |
| Total    | 100.0  | 100.0       | 100.0                         | 100.0       |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.3: Percentage of non-teleworkers and teleworkers reporting headaches/eye strain and anxiety, EU-27 (weighted data)**

| Response | Headaches, eye strain |             | Anxiety         |             |
|----------|-----------------------|-------------|-----------------|-------------|
|          | Non-teleworkers       | Teleworkers | Non-teleworkers | Teleworkers |
| Yes      | 36.2                  | 48.8        | 14.4            | 24.8        |
| No       | 63.5                  | 51.1        | 85.3            | 75.2        |
| DK       | 0.3                   | 0.1         | 0.3             | 0.1         |
| Total    | 100.0                 | 100.0       | 100.0           | 100.0       |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.4: Percentage of non-teleworkers and teleworkers reporting sleeping disorders, EU-27 (weighted data)**

| Response              | Difficulty falling asleep |             | Waking up repeatedly during sleep |             | Waking up with a feeling of exhaustion and fatigue |             |
|-----------------------|---------------------------|-------------|-----------------------------------|-------------|--|-------------|
|                       | Non-teleworkers           | Teleworkers | Non-teleworkers                   | Teleworkers | Non-teleworkers                                    | Teleworkers |
| Daily                 | 3.4                       | 6.0         | 5.5                               | 9.9         | 3.7  | 6.0         |
| Several times a week  | 7.9                       | 11.9        | 9.8                               | 12.2        | 9.0  | 12.4        |
| Several times a month | 13.6                      | 20.3        | 13.6                              | 17.4        | 15.9   | 17.8        |
| Less often            | 28.6                      | 24.6        | 26.2                              | 25.5        | 28.3   | 28.4        |

| Response | Difficulty falling asleep |       | Waking up repeatedly during sleep |       | Waking up with a feeling of exhaustion and fatigue |       |
|----------|---------------------------|-------|-----------------------------------|-------|--|-------|
| Never    | 46.4                      | 37.0  | 44.6                              | 34.8  | 42.9   | 35.1  |
| DK       | 0.2                       | 0.3   | 0.2                               | 0.2   | 0.3  | 0.2   |
| Total    | 100.0                     | 100.0 | 100.0                             | 100.0 | 100.0  | 100.0 |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.5: Percentage of non-teleworkers and teleworkers on perceived stress and necessity of hiding feelings, EU-27 (weighted data)**

| Response         | Do you experience stress in your work? |             | Does your job require you to hide your feelings? |             |
|------------------|--|-------------|--|-------------|
|                  | Non-teleworkers                        | Teleworkers | Non-teleworkers                                  | Teleworkers |
| Always           | 8.7                                    | 20.0        | 12.7   | 17.9        |
| Most of the time | 16.4                                   | 19.1        | 16.9   | 20.0        |
| Sometimes        | 39.1                                   | 36.4        | 21.9   | 24.7        |
| Rarely           | 20.4                                   | 16.2        | 15.0   | 16.9        |
| Never            | 14.1                                   | 8.3         | 29.5   | 18.3        |
| Total            | 100.0                                  | 100.0       | 100.0  | 100.0       |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.6: Percentage of non-teleworkers and teleworkers on work-life balance, Q45 (a,b), EU-27 (weighted data)**

| Response         | Kept worrying about work when you were not working |             | Felt too tired after work to do some of the household jobs which need to be done |             |
|------------------|--|-------------|--|-------------|
|                  | Non-teleworkers                                    | Teleworkers | Non-teleworkers  | Teleworkers |
| Always           | 3.4  | 11.7        | 4.4  | 5.1         |
| Most of the time | 9.5  | 22.0        | 14.6   | 17.4        |
| Sometimes        | 24.9   | 33.5        | 36.0   | 37.9        |
| Rarely           | 23.7   | 15.1        | 23.3   | 21.5        |
| Never            | 37.4   | 17.6        | 20.6   | 17.9        |
| Total            |  | 100.0       | 100.0  | 100.0       |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.7: Percentage of non-teleworkers and teleworkers on work-life balance, Q45 (c,d,e), EU-27 (weighted data)**

| Response         | Found that your job prevented you from giving the time you wanted to your family |             | Found it difficult to concentrate on your job because of your family responsibilities |             | Found that your family responsibilities prevented you from giving the time you should to your job |             |
|------------------|--|-------------|---|-------------|---|-------------|
|                  | Non-teleworkers  | Teleworkers | Non-teleworkers   | Teleworkers | Non-teleworkers   | Teleworkers |
| Always           | 2.8  | 5.3         | 0.6   | 0.8         | 0.5   | 1.0         |
| Most of the time | 7.9  | 10.6        | 2.7   | 2.7         | 2.5   | 2.5         |
| Sometimes        | 24.5   | 33.9        | 16.9  | 20.5        | 12.6  | 17.3        |
| Rarely           | 24.8   | 23.7        | 28.8  | 30.3        | 25.3  | 31.6        |
| Never            | 38.3   | 25.8        | 49.5  | 45.2        | 57.2  | 46.8        |
| Total            | 100.0  | 100.0       | 100.0   | 100.0       | 100.0   | 100.0       |

Source: Author's elaboration on EWCS 2015 data.

**Table A2.8: Percentage of non-teleworkers and teleworkers caring for and/or educating their children or grandchildren, Q95 (c), EU-27 (weighted data)**

| Response              | Men             |             | Women           |             |
|-----------------------|-----------------|-------------|-----------------|-------------|
|                       | Non-teleworkers | Teleworkers | Non-teleworkers | Teleworkers |
| Daily                 | 21.4            | 38.1        | 37.7            | 46.7        |
| Several times a week  | 12.7            | 10.2        | 8.9             | 8.3         |
| Several times a month | 8.3             | 11.2        | 7.0             | 4.5         |
| Less often            | 10.0            | 6.5         | 8.5             | 5.3         |
| Never                 | 40.1            | 27.5        | 30.9            | 27.7        |
| Not applicable        | 7.6             | 6.6         | 7.0             | 7.6         |
| Total                 | 100.0           | 100.0       | 100.0           | 100.0       |

Source: Author's elaboration on EWCS 2015 data.

## Annex 3: Data from the European Survey of Enterprises on New and Emerging Risks 2019

Table A3.1: Percentage of companies with teleworking in place by size, EU-27 (weighted data)

| Company size (number of employees) | % of companies with no-teleworking in place | % of companies with teleworking in place | Total |
|------------------------------------|---|--|-------|
| 5-9                                | 91.7  | 8.3                                      | 100.0 |
| 10-49                              | 87.1  | 13                                       | 100.0 |
| 50-249                             | 79.5  | 20.5                                     | 100.0 |
| 250+                               | 67.4  | 32.6                                     | 100.0 |

Source: Author's elaboration on ESENER 2019 data.

Table A3.2: Percentage of companies with and without teleworking in place that carry out workplace risk assessments , EU-27 (weighted data)

| Response  | % of companies with no-teleworking in place | % of companies with teleworking in place | Total |
|-----------|---|--|-------|
| Yes       | 76.0  | 70.3                                     | 75.3  |
| No        | 22.4  | 28.4                                     | 23.1  |
| No answer | 1.6   | 1.3                                      | 1.6   |
| Total     | 100.0                                       | 100.0                                    | 100.0 |

Source: Author's elaboration on ESENER 2019 data.

Table A3.3: Percentage of companies with and without teleworking in place that implement measures to check safety and health, EU-27 (weighted data)

| Response  | % of companies with no-teleworking in place | % of companies with teleworking in place | Total |
|-----------|---|--|-------|
| Yes       | 27.7  | 24.5                                     | 27.2  |
| No        | 70.3  | 74.6                                     | 70.9  |
| No answer | 2.0   | 0.9                                      | 1.9   |
| Total     | 100.0                                       | 100.0                                    | 100.0 |

Source: Author's elaboration on ESENER 2019 data.

## Annex 4: Models and estimation procedure

With the aim of estimating the probability that establishments have teleworking in place, we estimated probit models, choosing as a response variable the combination of questions Q106 ('Do any of the employees regularly work from home?'), and Q310\_1 and Q310\_2 (which refer to the use of digital technologies for work, namely personal computers at fixed workplaces, and laptops, tablets, smartphones or other mobile computer devices). Therefore, the binary-dependent variable ( $Y_i$ ) assumes value 1 in the case where the company ( $i$ ) implements teleworking; otherwise it assumes value 0.

A probit model<sup>64</sup> is given by the following expression:

$$\Pr(Y_i = 1 | x_i) = F(x_i \beta) \quad (1)$$

where  $F$  is the cumulative distribution function of the standard normal distribution,  $\beta$  is a  $k \times 1$  vector of coefficients, and  $x_i$  is a vector of the values of the  $k$ -relevant variables observed for company  $i$ .

To take into account the effects of heteroskedasticity<sup>65</sup>, mainly due to company size, a heteroskedastic probit model was implemented. It is well known that, if a binary (or an ordinal) regression model incorrectly assumes a homoskedastic error, the standard errors are wrong, and the parameter estimates are biased (Yatchew and Griliches, 1985). Subsequently, the inferential conclusions based on the usual  $z$ -test may be misleading. Considering the great variety of attributes of the companies considered and the different characteristics of the economies of EU countries, it seems reasonable to suppose that our sample data would hardly support the hypothesis of error homoskedasticity. Specifically, heteroskedastic probit models assume the following variance equation:

$$\sigma_i^2 = \exp\left(\sum_j z_{ij} \gamma_j\right) \quad (2)$$

where  $Z$  is the vector of  $j$  values of the  $i$ th observation (for the company  $i$ ) defining groups with different error variances in the underlying latent variable. The vector  $Z$  might include dummy or continuous variables related to the error variances (Williams, 2009).

As described in section 5.4, two distinct models have been estimated with the same variable set, although inserting different variables with respect to the OSH measures implemented, which turn out to have a statistically significant effect on the probability of teleworking being in place, after a listwise deletion procedure.

In model 1, the Wald test result allows us to reject the null hypothesis that all the coefficients are simultaneously equal to zero (test value 1029.43 with a  $p$ -value of 0.00 with respect to a chi-squared distribution with 19 degrees of freedom). In the variance equation, the two coefficients associated with company size are statistically different from zero, whereas none of the coefficients for a workforce with over 50 % of employees aged 55 years or older is statistically different from zero. The associated Wald test, equal to 22.55, with a  $p$ -value of 0.001 with respect to a chi-squared distribution with 6 degrees of freedom, rejects the null of homoskedasticity. These occurrences confirm the presence of heteroskedasticity in the sample considered.

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<sup>64</sup> A probit model is a non-linear regression model used when the dependent variable is dichotomous. The objective of the model is to estimate the probability of observing one value or the other of the dependent variable for each unit, as a function of one or more explanatory variables. Therefore, this model can be used to classify observations into two categories based on the characteristics of the respondents (Agresti, 2010).

<sup>65</sup> In regression models, observations can often be affected by heteroskedasticity. When dealing with probit models, this heteroskedasticity can be considered by specifying an error variance equation as a function of the individual values of the explanatory variables that are supposed to affect it. The usual tests to verify the presence of heteroskedasticity — for example Breusch Pagan or Cook-Weisberg — cannot be run in the current framework since they are based on the model residuals. As well known in fact, for generalised linear models, as the probit ones, there is no unique definition of the residuals (Agresti, 2010). Therefore, we apply a heteroskedastic probit model and, to verify the presence of heteroscedasticity we evaluate the usual statistical significance test of the estimated coefficients in the equation for the variance since the standard homoskedastic probit model is nested in the heteroskedastic one.

Table A4.1: Model 1: estimated coefficients

| Determinants  | Coefficient | Standard. Error | z-value | p-value |
|---|-------------|-----------------|---------|---------|
| <b>Size (reference: 5-9)</b>  |             |                 |         |         |
| 10-49   | 0.56        | 0.09            | 6.46    | 0.00*** |
| 50-249  | 0.76        | 0.09            | 8.50    | 0.00*** |
| 250+  | 0.93        | 0.10            | 9.51    | 0.00*** |
| <b>Multisite (reference: no)</b>                                      |             |                 |         |         |
| Yes   | 0.03        | 0.03            | 1.06    | 0.29    |
| <b>NACE groups (reference: A)</b>                                     |             |                 |         |         |
| B D E F   | -0.22       | 0.10            | -2.16   | 0.03**  |
| C   | -0.13       | 0.10            | -1.35   | 0.18    |
| G H I R   | -0.10       | 0.09            | -1.09   | 0.28    |
| J K L M N S   | 0.35        | 0.10            | 3.55    | 0.00*** |
| O   | -0.12       | 0.11            | -1.15   | 0.25    |
| P   | 0.05        | 0.10            | 0.55    | 0.59    |
| Q   | -0.13       | 0.10            | -1.31   | 0.19    |
| <b>Proportion of workers aged 55 year and older (reference: none)</b> |             |                 |         |         |
| Less than a quarter   | 0.02        | 0.08            | 0.31    | 0.76    |
| A quarter to half   | -0.05       | 0.09            | -0.60   | 0.55    |
| More than half  | -0.17       | 0.16            | -1.07   | 0.29    |
| <b>OSH outsourcing (reference: no)</b>                                |             |                 |         |         |
| Yes   | 0.11        | 0.03            | 4.04    | 0.00*** |
| <b>OSH training (reference: no)</b>                                   |             |                 |         |         |
| Yes   | -0.02       | 0.03            | -0.63   | 0.53    |
| <b>Regular breaks (reference: no)</b>                                 |             |                 |         |         |
| Yes   | 0.07        | 0.03            | 2.63    | 0.01*** |
| <b>Stress awareness (reference: no)</b>                               |             |                 |         |         |

| Determinants  | Coefficient  | Standard. Error | z-value       | p-value        |
|---|--------------|-----------------|---------------|----------------|
| Yes   | 0.14         | 0.03            | 5.02          | 0.00***        |
| <b>Country group (reference: G2)</b>                                  | <b>0.57</b>  | <b>0.05</b>     | <b>10.55</b>  | <b>0.00***</b> |
| <b>Constant</b>   | <b>-1.97</b> | <b>0.12</b>     | <b>-16.83</b> | <b>0.00***</b> |
| <b>Variance equation</b>  |              |                 |               |                |
| <b>Size (reference: 5-9)</b>  |              |                 |               |                |
| 10-49   | -0.35        | 0.09            | -3.97         | 0.00***        |
| 50-249  | -0.37        | 0.10            | -3.61         | 0.00***        |
| 250+  | -0.16        | 0.14            | -1.12         | 0.26           |
| <b>Proportion of workers aged 55 year and older (reference: none)</b> |              |                 |               |                |
| Less than a quarter   | -0.01        | 0.07            | -0.11         | 0.91           |
| A quarter to half   | 0.06         | 0.08            | 0.73          | 0.47           |
| More than half  | 0.19         | 0.12            | 1.51          | 0.13           |

\* Significant at 10% level; \*\* Significant at 5% level; \* \* \* Significant at 1% level

Source: Author's elaboration on ESENER 2019 data.

#### Sectors

Agriculture (A), considered as the reference category and, respectively: Mining and quarrying, Electricity and gas, water supply, construction (B, D, E, F); Manufacturing(C); Wholesale and retail, Transportation and storage, Hotels, restaurants and catering, Arts and entertainment (G, H, I, R); Information and communication, Financial activities and insurance, Real estate, Professional services, Administrative services (J, K, L, M, N, S); Public administration (O); Education(P); Human health and social work (Q).

In addition, for the second model, the Wald test rejects the null hypothesis that all the coefficients are simultaneously equal to zero (test value 980.41 with a  $p$ -value of 0.00 with respect to a chi-squared distribution with 19 degrees of freedom). Even in this second model, in the variance equation two coefficients associated with company size are statistically different from zero, while none of the coefficients for the proportion of workers aged 55 years and older is significant when this quota exceeds 50 %; this can be seen in the previous exercise. The associated Wald test, equal to 20.96, with a  $p$ -value of 0.002 with respect to a chi-squared distribution with 6 degrees of freedom, rejects the null of homoskedasticity. These occurrences confirm the presence of heteroskedasticity in the target sample.

**Table A4.2: Model 2: estimated coefficients**

| Determinants                 | Coefficient | Standard. Error | z-value | p-value |
|------------------------------|-------------|-----------------|---------|---------|
| <b>Size (reference: 5-9)</b> |             |                 |         |         |



| Determinants  | Coefficient | Standard Error | Z-value      | p-value        |
|---|-------------|----------------|--------------|----------------|
| 10-49   | 0.52        | 0.09           | 6.03         | 0.00***        |
| 50-249  | 0.72        | 0.09           | 8.18         | 0.00***        |
| 250+  | 0.90        | 0.10           | 9.29         | 0.00***        |
| <b>Multisite (reference: no)</b>                                      |             |                |              |                |
| Yes   | 0.02        | 0.03           | 0.60         | 0.55           |
| <b>NACE groups (reference: A)</b>                                     |             |                |              |                |
| B, D, E, F  | -0.23       | 0.11           | -2.19        | 0.03**         |
| C   | -0.15       | 0.10           | -1.52        | 0.13           |
| G, H, I, R  | -0.12       | 0.10           | -1.19        | 0.24           |
| J, K, L, M, N, S  | 0.32        | 0.10           | 3.14         | 0.00***        |
| O   | -0.16       | 0.11           | -1.45        | 0.15           |
| P   | 0.05        | 0.10           | 0.46         | 0.65           |
| Q   | -0.17       | 0.11           | -1.61        | 0.11           |
| <b>Proportion of workers aged 55 year and older (reference: none)</b> |             |                |              |                |
| Less than a quarter   | 0.01        | 0.08           | 0.15         | 0.88           |
| A quarter to half   | -0.06       | 0.09           | -0.67        | 0.50           |
| More than half  | -0.17       | 0.16           | -1.04        | 0.30           |
| <b>OSH outsourcing (reference: no)</b>                                |             |                |              |                |
| Yes   | 0.10        | 0.03           | 3.60         | 0.00***        |
| <b>OSH training (reference: no)</b>                                   |             |                |              |                |
| Yes   | -0.02       | 0.03           | -0.75        | 0.45           |
| <b>Ergonomic equip. (reference: no)</b>                               |             |                |              |                |
| Yes   | 0.25        | 0.04           | 6.09         | 0.00***        |
| <b>Stress awareness (reference: no)</b>                               |             |                |              |                |
| Yes   | 0.13        | 0.03           | 4.79         | 0.00***        |
| <b>Country group (reference: G2)</b>                                  | <b>0.57</b> | <b>0.06</b>    | <b>10.20</b> | <b>0.00***</b> |

| Determinants  | Coefficient | Standard. Error | Z-value | p-value |
|---|-------------|-----------------|---------|---------|
| <b>Constant</b>   | -2.05       | 0.13            | -16.33  | 0.00*** |
| <b>Variance equation</b>  |             |                 |         |         |
| <b>Size (reference: 5-9)</b>  |             |                 |         |         |
| 10-49   | -0.32       | 0.09            | -3.70   | 0.00*** |
| 50-249  | -0.36       | 0.10            | -3.65   | 0.00*** |
| 250+  | -0.16       | 0.14            | -1.19   | 0.23    |
| <b>Proportion of workers aged 55 year and older (reference: none)</b> |             |                 |         |         |
| Less than a quarter   | -0.01       | 0.07            | -0.07   | 0.95    |
| A quarter to half   | 0.06        | 0.08            | 0.66    | 0.51    |
| More than half  | 0.18        | 0.12            | 1.45    | 0.15    |

\* Significant at 10% level; \*\* Significant at 5% level; \* \* \* Significant at 1% level

Source: Author's elaboration on ESENER 2019 data.

#### Sectors

Agriculture (A), considered as the reference category and, respectively: Mining and quarrying, Electricity and gas, water supply, construction (B, D, E, F); Manufacturing(C); Wholesale and retail, Transportation and storage, Hotels, restaurants and catering, Arts and entertainment (G, H, I, R); Information and communication, Financial activities and insurance, Real estate, Professional services, Administrative services (J, K, L, M, N, S); Public administration (O); Education(P); Human health and social work (Q).

**The European Agency for Safety and Health at Work (EU-OSHA)**

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