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Adjustment of daily activities to restrictions and reported spread of the COVID-19 pandemic across Europe

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Adjustment of daily activities to restrictions and reported spread of the COVID-19 pandemic across Europe

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Abstract

This paper addresses adjustments of daily activities in the wake of the COVID-19 pandemic among people aged 50 years and older in Europe, and investigates the extent to which such adjustments are associated with the stringency of governmental restrictions and the overall spread of COVID-19. We use data from the SHARE Corona Survey collected during summer 2020, published data on government response stringency, and reported country-specific prevalence and mortality of COVID-19. Our analyses show that older Europeans across the continent have reduced their daily activities quite substantially during the pandemic. However, we observe variation across countries and demographic groups, which may be important to highlight for policymakers. Our explanatory analysis replicates previous studies using mobility data, showing that both restrictions and infections predict a reduction in mobility. Thus, policymakers could potentially rely on both restrictions and voluntary adjustments in order to decrease the spread of the virus. However, it is noteworthy that we find relatively weaker associations with restrictions compared to previous studies using mobility data. One explanation for this discrepancy could be that our study focuses on older people, who face a higher risk of becoming severely ill and therefore have stronger incentives to adjust their behaviours independent of governmental regulations.

Keywords: daily activities, activity adjustment, COVID-19, government response stringency, reported COVID -19 cases, cross-national comparisons, SHARE

Introduction

Since the initial spread of the COVID-19 pandemic in early 2020, European countries have applied different strategies to reduce daily activities and encourage physical distancing, aiming to curb the spread of the virus. While some countries have applied a strict lockdown, others have relied more on recommendations and voluntary adjustments (Hale et al. 2020). The extent to which the stringency of restrictions is related to the spread of the pandemic is still an open question, and the effectiveness of the various policies has become a topical issue. Key questions for policymakers are the extent to which people have adjusted their daily activities to mandated restrictions and the degree to which this is due to voluntary adjustment and individual risk aversion when the virus is spreading and, moreover, how activity adjustment differs by age, gender, and socioeconomic position. Previous research on daily activities based on mobility data for whole populations has shown a substantial reduction of daily activities across European countries, but also great variations across countries (Santamaria et al. 2020; Mendolia et al. 2020). These variations can partly be attributed to the stringency of governmental restrictions and the overall spread of the pandemic (ibid). However, to our knowledge, no studies have analysed the adjustment of different types of daily activities among older people – the most vulnerable group – across European countries or the extent to which older people's adjustment of different kinds of activities can be associated with restrictions and the diffusion of the pandemic.

The aim of this study is twofold. The first aim is to describe the adjustment of daily activities by Europeans over age 50 in Europe and investigate the extent to which activity adjustment differs between countries and demographic groups. The second aim is to analyse associations between the adjustment of daily activities on the one hand and, on the other, the stringency of country-specific restrictions and the reported spread of the virus on country level.

While previous research on activity adjustment and policy restrictions during the COVID-19 pandemic has mainly been based on changes in general mobility patterns, here we will examine the adjustment of various kinds of activities. We investigate this adjustment among older people aged 50 and older – the most vulnerable group – by age, gender, and education level, and address the following research questions: To what extent have people adjusted their daily activities? What activities are reduced the most? How does the reduction of daily activities vary across sociodemographic groups by age, gender, and education level? To what extent do we find more reduction in countries with stringent policies and in countries with a more extensive spread?

For this purpose, we examine data from the SHARE Corona Survey on the reported adjustment of daily activities (walking, shopping, visiting family members and meeting more than five people) collected via telephone interviews in 27 European countries as well as Israel during summer 2020. Moreover, we use published information on reported country-specific prevalence of COVID-19 cases and deaths as well as government response stringency measures.

This first part of the SHARE COVID-19 research on the adjustment of daily activities during the pandemic includes descriptive statistics and basic correlations.

Background and previous research

Some previous studies on activity adjustment during the COVID-19 pandemic have used mobility data from Google (location history) or mobile network providers, and have shown a sharp reduction in mobility since the onset of the pandemic in more or less all countries, but also great variation across countries (Mendolia et al. 2020; Santamaria et al. 2020). Analyses of mobile positioning data have indicated an association between daily activity and policy stringency in comparative studies across Europe (ibid.). Mendolia et al. (2020) found that both government-imposed policies (restrictions) and people's response to the diffusion of the infection (voluntary social distancing) explained mobility patterns across countries.

However, data on the association between policy stringency and the spread of the disease show an indistinct pattern (Hale et al. 2020; Johns Hopkins University CSSE COVID-19 Data). For instance, Sweden – the European country with the least stringent restrictions during the period – has had fewer cases and deaths per million inhabitants than several countries with more restrictive policies (e.g. England and Wales, France, and Belgium), but a much higher number of cases and deaths than their neighbouring Nordic countries, where more strict policies were established (Johns Hopkins University CSSE COVID-19 Data; Hale et al. 2020). These indistinct patterns may be due to various circumstances, e.g. the extent to which people comply with restrictions and recommendations. The associations (or lack thereof) between restriction stringency and the spread of the virus may also be due to timing, i.e. when the virus started to spread and when restrictions were introduced. Some countries may have successfully reduced the spread of the virus in an early stage through stringent restrictions, while in other countries a strict lockdown may be a late response to high prevalence. For instance, in a study of seven European countries and the US from March to April 2020, Del-Fava et al. (2020) found that reduction of activity was a response to government guidelines on physical distancing rather than an adjustment to the announcement of lockdown.

In addition, we can assume that people are more likely to avoid risks when higher numbers of cases and deaths are reported; hence, the reduction of activities may be due to physical and social distancing as a voluntary risk-aversion strategy. The indistinct pattern may also be due to reverse causality, as higher stringency may be mandated as a late response to the rapid spread of the pandemic and a high prevalence of the disease could result from incautious behaviour. To better understand how policy restrictions have influenced the spread of the virus, it is crucial to explore how people in Europe have adjusted their activities in countries with more or less stringent restrictions and with different levels of reported cases and deaths, although the mechanisms may be difficult to sort out.

Previous studies based on mobility data provide important information about the general reduction of activities across countries. However, for several reasons it is essential to also examine the adjustment of various kinds of activities by sociodemographic group. A major concern during the COVID-19 pandemic has been the possible impact of the pandemic on health inequality, for instance by gender and socioeconomic position. As it is well-known that those who are highly educated on average have better access to information and are more conscious of health risk, and therefore generally comply better with health recommendations (e.g. Marmot et al. 2005; Mackenbach et al. 2008), we may assume that the highly educated

have adjusted to restrictions and recommendations to a greater degree. However, in a study following the lockdown in France, Brouard et al. (2020) found no association between level of education and compliance with restrictions, while consciousness of the disease was positively associated with compliance. Brouard et al. (2020) also found higher rates of compliance among older persons and women. Echoing these findings, in a study on COVID-19 Perotta et al. (2020) maintain that women are more likely to adopt preventive behaviour, and Gomez et al. (2020) found more worries among women. These results are in line with previous research revealing stronger compliance with various kinds of health protective behaviour among women (Lonnquist et al. 1992); this is an important finding, given the overrepresentation of men among those who have died from COVID-19.

As older people are the group that is most vulnerable to COVID-19, here we focus specifically on how people over the age of 50 have adjusted to restrictions and to the spread of the virus. In previous studies, Radwan et al. (2021) and Sepúlveda-Loyola et al. (2020) also point to the possible negative long-term impact of stringent policy-mandated restrictions on older adults' health, as the reduction of social contact and fewer physical activities may have long-term negative consequences for physical and mental health. Older people may also behave differently in response to societal levels of restrictions and infections since they belong to the most vulnerable group. For instance, older people may self-isolate more or less independent of restrictions as they have strong self-interested reasons for avoiding being infected, while this is not the case to the same degree among younger people. Older people may also have other opportunities to adjust their activities. For instance, they can depend more on their social contacts to manage their activities of daily life. However, as many are retired, they are often less dependent on performing activities outside the home. Therefore, it is essential to explore how older people – both young-old and old-old – have adjusted different kinds of daily activities both at home and outside the home during the spread of the COVID-19 pandemic.

Data and methods

Data

For our purposes, we have used data from the SHARE COVID-19 dataset, collected through computer-assisted telephone interviews (CATI) during June-August 2020 (Börsch-Supan 2020). The SHARE Corona Survey was an extension of the ordinary SHARE Wave 8 of data collection[1] and covers a subsample of SHARE respondents in 27 European countries as well as Israel. Included in the survey were questions about changes in life during the COVID-19 lockdown such as health and health behaviours, healthcare, daily activities, changes in work, economic situation, and social networks. The SHARE COVID-19 data include a total of 52,310 respondents, of whom 42,296 met our inclusion criteria: 1) aged 50 years and older and 2) have ever left home since COVID-19 broke out[2]. Table 1 presents the characteristics of the respondents in the sample. The sample consists of more women (56%) than men, more than

[1] The collection of SHARE data is usually performed through computer-assisted personal interviewing (CAPI). SHARE is a bi-annual longitudinal survey, focusing on economic and social issues in the ageing population in Europe. See Börsch-Supan et al. (2013) for more detailed information on SHARE data.

[2] In the SHARE Corona Survey the respondents were asked "*Since the outbreak of Corona, have you ever left your home?"* Of the respondents aged 50 years and older, 81.6% answered this question with "yes".

two-thirds of the respondents were aged 60 years or older, a majority was not employed or self-employed when COVID-19 broke out, and one out of four respondents were highly educated.

Table 1. Characteristics of the respondents in the sample (%), unweighted

Variable	Category	% in Each Category		
		Female (n=23,815)	Male (n=18,481)	Total (n=42,296)
Age group	50 - 59	15.2	10.8	13.3
	60 - 69	39.8	40.5	40.1
	70 - 79	31.3	34.5	32.7
	80+	13.7	14.2	14
Education	Low	31.4	27.5	29.7
	Middle	42.5	44.2	43.3
	High	24.5	25.7	25
Employed/Self-employed when COVID-19 broke out	Yes	23.6	26.1	24.7

Measures

We determined the adjustment of activities based on the question *"Since the outbreak of Corona, how often have you done the following activities, as compared to before the outbreak?"* The respondents were asked to specify the extent to which they have adjusted the following daily activities: *"Going shopping"*, *"Going out for a walk"*, *"Meeting with more than 5 people from outside your household"*, and *"Visiting other family members"*. A binary variable was created from the original variable, and respondents who reported "Not anymore" or "Less often" were coded 1 (reduction of activity) and those who reported "About the same" or "More often" were coded 0. Included in the analysis were also sociodemographic variables such as gender, age, and education level. Education is measured on the International Standard Classification of Education Scale (ISCED-97), ranging from 0 (none/early childhood education) to 6 (doctoral or equivalent level). In this study, education is categorized into "Low" (ISCED 0, 1), "Middle" (ISCED 3, 4), and "High" (ISCED 5, 6).

In addition to the SHARE COVID-19 data, we used published data on government response stringency and reported country-specific prevalence and mortality of COVID-19. Data from the Oxford COVID-19 Government Response Tracker (OxCGRT) were used to measure government response across Europe and Israel (Hale et al. 2020). The OxCGRT is a composite measure based on nine policy indicators on country level, including school and workplace closures and restrictions in movement (ibid.). The stringency index measures government policy responses to the COVID-19 pandemic, rescaled to a value from 0 to 100, where 100 is the strictest level. For this study, mean levels were calculated for all countries for the period 1 March-31 July 2020, equivalent to the time period when COVID-19 broke out and the time period for the SHARE Corona Survey fieldwork (Figure 1).

Data on confirmed COVID-19 cases and deaths for all countries were retrieved from the COVID-19 Data Repository by the Centre for Systems Science and Engineering (CSSE) at Johns Hopkins University, maintained by *Our World in Data* (www.ourworldindata.org/covid-

cases). The data include country-by-country information on confirmed COVID-19 cases and deaths on a daily basis[3]. As cases and deaths are positively correlated (r=.56), and as people may rely on information about both cases and deaths as a proxy for the overall spread of COVID-19 (Mendolia et al. 2020), we computed an overall measure of the infection rate across countries by combining reported cases and deaths (Figure 2). To obtain this measure, we estimated a latent factor using principal component analysis and estimated factor scores for each country. This latent measure explained 77% of the variation in both infections and deaths. Further, this measure of infections was almost unrelated to that of restrictions (R=.08).

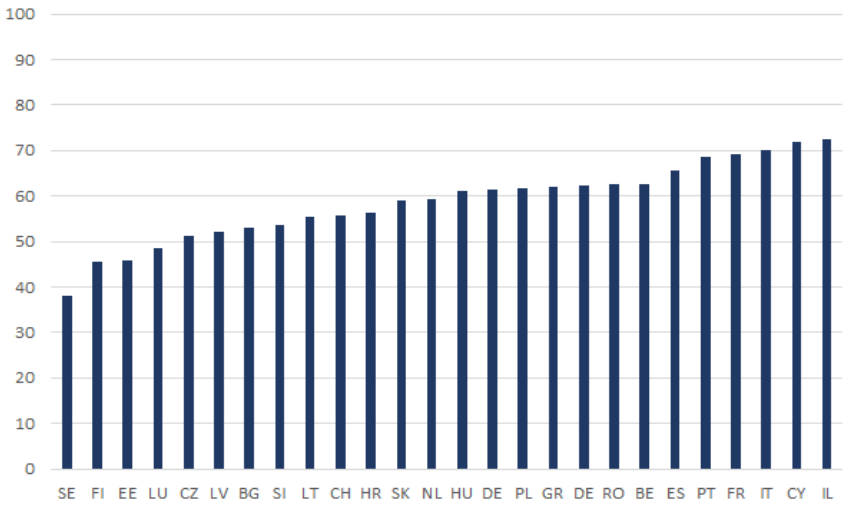

Figure 1. The Oxford COVID-19 Government Response Tracker (OxCGRT) across Europe and Israel, mean levels between 1 March and 31 July 2020.
Source: Hale et al. (2020). Oxford COVID-19 Government Response Tracker, Blavatnik School of Government.

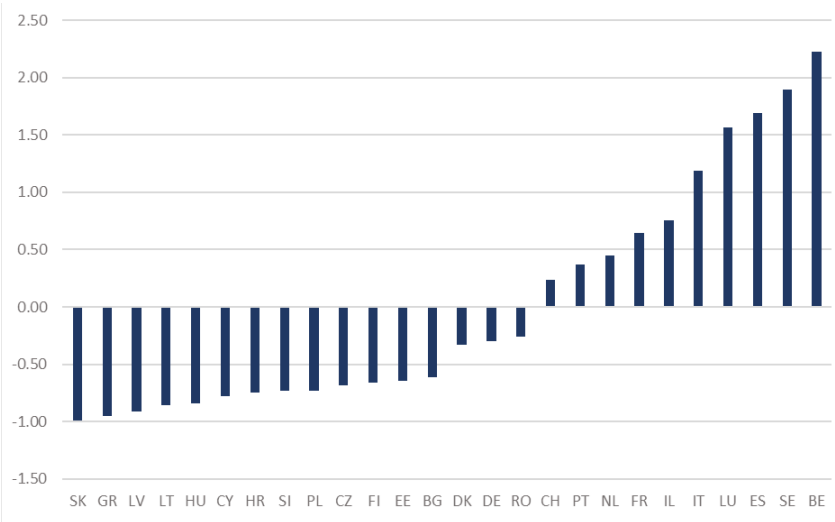

Figure 2. Confirmed COVID-19 cases and deaths per capita across Europe and Israel, standardized factor scores, 31 July 2020.
Source: Johns Hopkins University CSSE COVID-19 data.

[3] The reported confirmed cases are provided by national governments and reporting institutions. The criteria for how cases are defined and reported can differ between different countries; for more information, see *Cases of COVID-19: background* (https://ourworldindata.org).

We used descriptive analyses for an initial examination of the variation in older people's activity adjustment across European countries and Israel. Furthermore, we analysed the associations between the adjustment of daily activities on the one hand and, on the other, the stringency of country-specific restrictions and the reported spread of the virus and mortality on the respective country level. Malta was excluded from these analyses due to no existing data on the government response stringency. We used the terms "infections", "spread of the virus", and "infection rates" synonymously. All results from the SHARE COVID-19 data were weighted with calibrated individual cross-sectional weights (on age, gender, and NUTS1 regions) unless stated otherwise.

Results

Descriptive statistics

In the analysis of the adjustment of daily activities in all participating countries, the descriptive results show that more than half of the respondents report that they have completely stopped meeting more than five people outside the household since the outbreak of the corona pandemic (Figure 3). Approximately 40% also report that they have not been visiting other family members during this period. Furthermore, a majority of respondents report that since the pandemic began they go shopping less often. Walking is the only activity for which we also notice an increase, with about 10% reporting that they have started walking more often and 40% that they have neither increased nor decreased their walking since the outbreak.

We further observe a significant reduction of daily activities across all countries (Figure 4), especially regarding social activities (visiting other family members and meeting more than five people outside household). For these activities, the reduction ranged from approximately 60% of the respondents in Bulgaria to 90% of those in Spain and Luxemburg, respectively. The greatest differences between countries can be seen in the reduction of walking. Less than 20% of respondents from the Nordic countries and the Netherlands report that they have reduced their walks since the pandemic broke out. This compared to Estonia, Italy, and Romania, where over 80% of the respondents report a reduction of walking during this period.

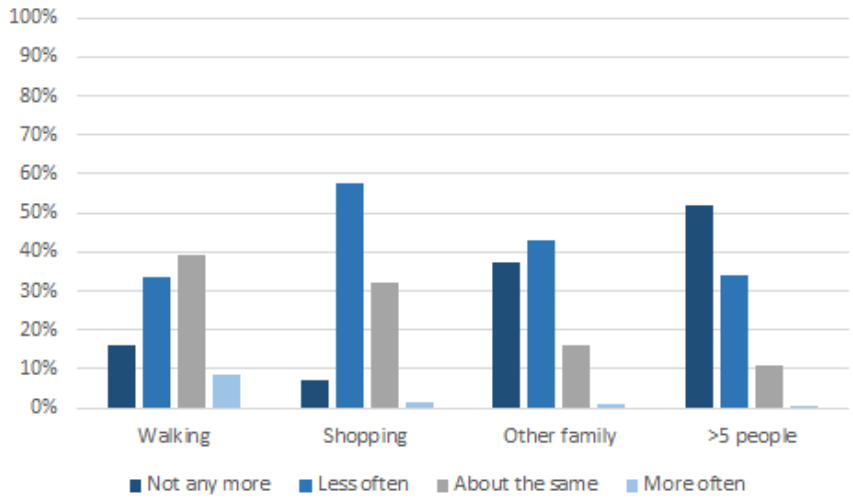

Figure 3. Adjustment of daily activities, all countries (%).

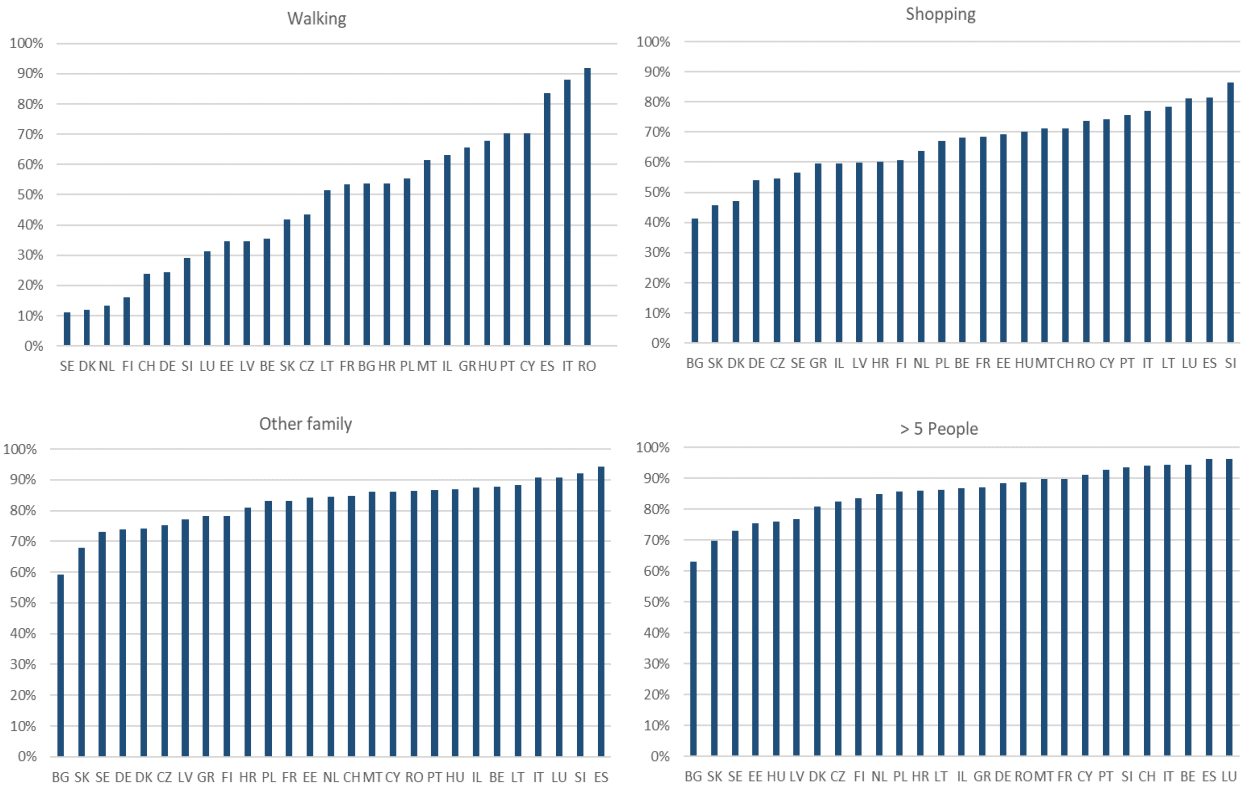

Figure 4. Reduction of daily activities across countries in Europe and Israel (%).

As could be expected, the descriptive statistics of the pooled sample reveal differences in daily activity adjustments between genders and age groups. Figure 5 shows a greater reduction of all activities, except visiting other family members, among the older respondents as compared to the younger ones.

We also find that women across all participating countries have reduced their daily activities more than men, especially regarding *going out for a walk* and *going shopping* (Figure 6). However, it is among the social activities where most respondents have reduced their activities. In general, four out of five respondents, both men and women, report that they have reduced their visits and meetings with family members and others outside the household.

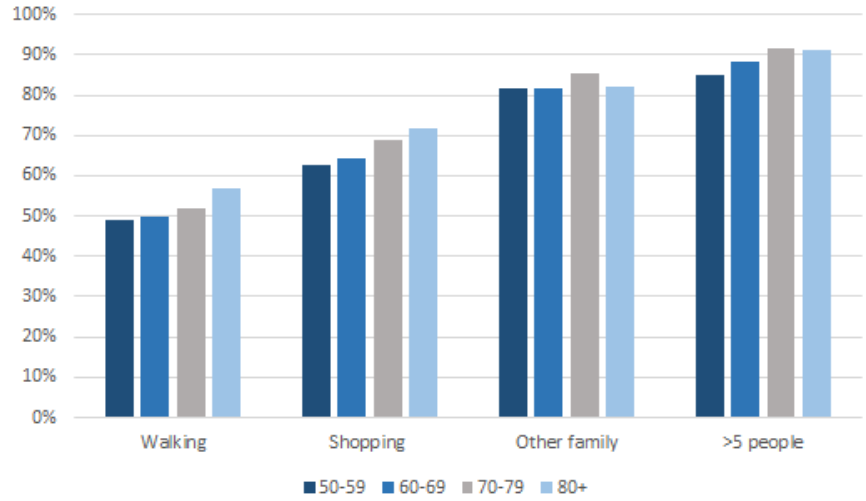

Figure 5. Reduction of daily activities by age groups, all countries (%).

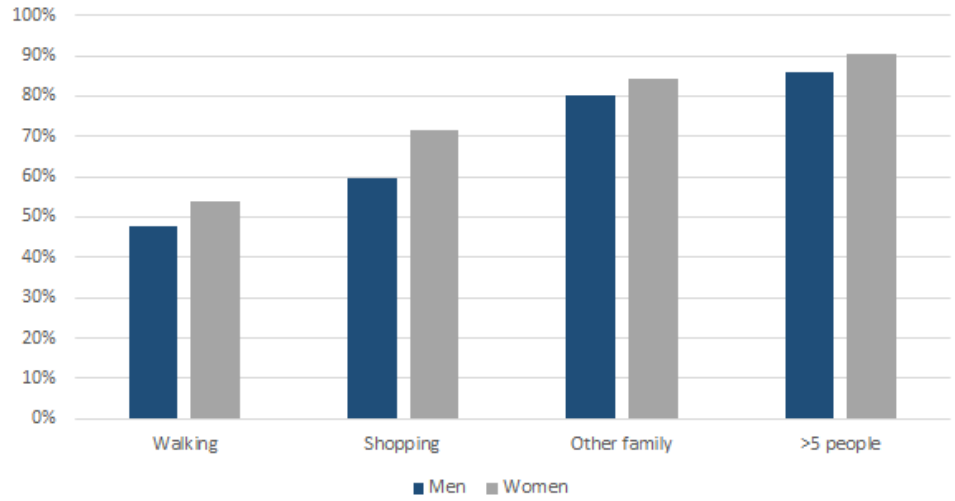

Figure 6. Reduction of daily activities by gender, all countries (%).

A similar pattern can be seen when analysing activity adjustment by level of education (Figure 7). Visiting family and meeting people are the areas in which a large majority of the respondents have reduced their activity (80% and more), while walking and shopping are those in which fewer respondents report a reduction. However, in these activities the differences between the education groups are the greatest; e.g., over 60% of the respondents with a low education compared to 40% of the highly educated report a reduction of walking.

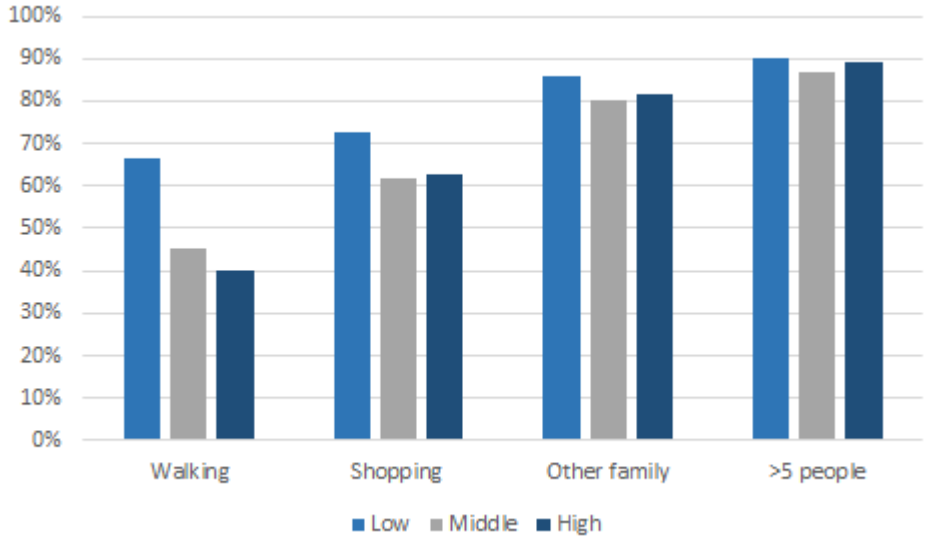

Figure 7. Reduction of daily activities by education level, all countries (%).

Associations between stringency, infection rates, and activities

We now turn to our second research aim: to determine the extent to which governmental stringency and infections are associated with cross-national variation in activity adjustment. We begin by first visualizing the predicted probabilities of reduced daily activities adjusted by age and gender for all participating countries. Figure 8 shows the share of respondents in the

respective country and the strictness in government responses (OxCGRT), while Figure 9 shows the corresponding figures and rate of infections. As can be seen in Figure 8, there is an overall trend that countries with high restrictions tend to have a greater reduction of activities. However, while this pattern is obvious for walking it is much less clear for shopping, visiting other family members, and meeting more than five people. For example, countries with the highest levels of restrictions do not necessarily display a greater reduction of shopping compared to those with medium or even low levels of restrictions. The same pattern applies to the two variables measuring the reduction of social activities. For the latter activities, some countries (such as Sweden and Italy) behave in the expected way, combining high (low) restrictions with high (low) reductions. However, many countries deviate from this pattern. For instance, Denmark and Germany combine a relatively high level of restrictions with a relatively low level of activity reduction.

When it comes to the relationship between infections and activity reduction (Figure 9), there is an overall trend that countries with higher infection rates tend to have a greater reduction of shopping, visiting other family members, and meeting more than five people. However, walking is unrelated to infections and the associations for the other activities are generally weak. For instance, while Bulgaria displays both a low infection rate and low activity reduction, Sweden combines high infection rates with low levels of activity reduction.

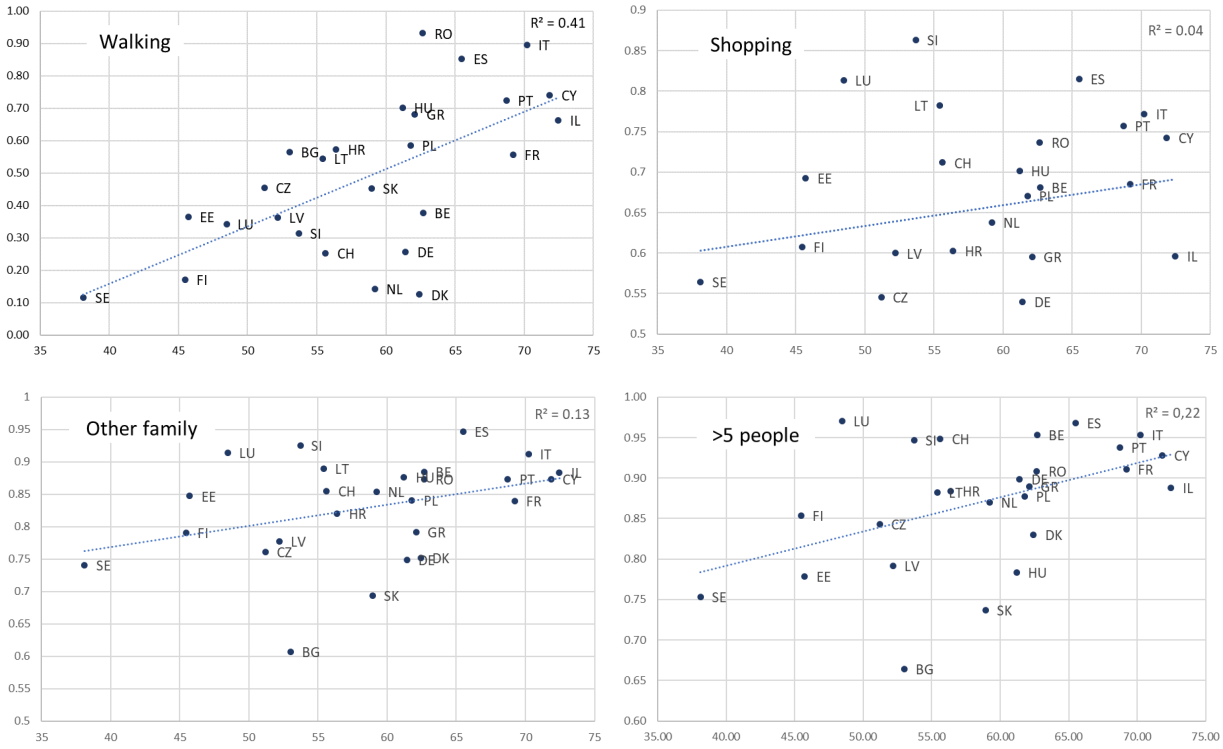

Figure 8. Cross-country predicted probabilities (y-axis; %) among respondents reporting reduction of daily activities in relation to government responses (stringency index). Adjusted by age and gender.

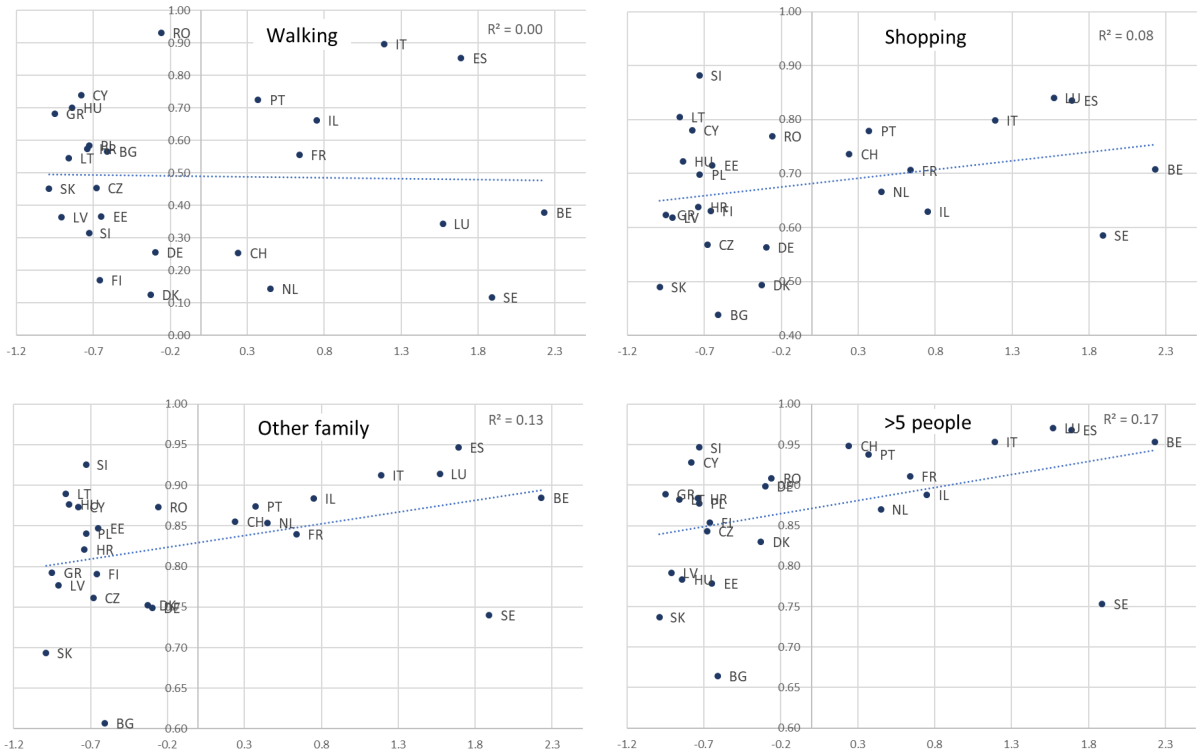

Figure 9. Cross-country predicted probabilities (y-axis; %) among respondents reporting reduction of daily activities in relation to infection rates. Adjusted by age and gender.

To more formally assess the possible impact of governmental restrictions as well as infection rates on older people's activity adjustment across Europe, we ran a series of regression analyses using our measures of stringency and infections as independent variables and each of the four types of activities as the dependent variables. In order to make it easier to compare the effects of the two independent variables (stringency and infections), we display standardized regression coefficients. Results from the multiple regression analyses are presented in Table 2. As can be seen, both policy stringency and infection rates display statistically significant positive associations with the two measures of social activities (meeting more than five people and meeting family members outside the household), explaining 30% of the variance in meeting more than five people and 18% of the variance in meeting family members outside the household. Further, the magnitude of these associations is similar in size, suggesting that both restrictions and infections are about equally important for reducing these social activities across countries. However, the explained variance is still relatively low, which is in line with the weak patterns observed in Figures 8 and 9.

When it comes to shopping, the associations with both restrictions and infections are markedly weaker and not statistically significant. These weak associations are also reflected in the explained variance for this regression model (3%), which is very low. Walking, on the other hand, displays a strong positive association with stringency levels but not with infection rates. In terms of explained variance, stringency alone explains more variance (36%) in walking than do stringency and infections combined for any of the other three activities.

Table 2. Relationship between policy stringency, infection rates, and activity reduction. Adjusted by age and gender.

Predictors	Type of activity reduction			
	Meeting > 5 people	Meeting Family	Shopping	Walking
Stringency	.43**	.33*	.19	.64***
Infection rate	.37**	.34*	.27	-0.08
Adjusted R2	30%	18%	3%	36%

Note: * p < 0.10, ** p < 0.05, *** p<0.01. Cell entries represent standardized regression coefficients.

Discussion

The purpose of this study was to increase the knowledge regarding how older people in Europe have adjusted their daily activities after the coronavirus outbreak in early 2020. Results from our descriptive analysis suggest that older people in all 27 countries that participated in the SHARE Corona Survey reduced their activities quite drastically from the onset of the pandemic until the summer of 2020. We observe the greatest reductions in activities related to social relations, such as visiting other family members or meeting more than five people outside the household. A majority of the older people in the analysed European countries also reported a decline in shopping, which may not necessarily be a social activity in itself but may nevertheless involve various forms of social interaction. That most of the respondents report a decline in activities involving social interactions is expected, given that COVID-19 primarily spreads when people interact in close proximity (WHO 2020). While the reported frequency of walking among the respondents also declined in most countries, the rate of this decline was generally weaker and much more heterogeneously spread across countries. The overall smaller share of respondents reporting a reduction of walking is expected, given that walking is an activity that can be done alone. Further, even when people walk together, this is an activity typically done outside in the open air, which is a relatively safe activity from an infection point of view. It is also worth noting that a small but significant proportion of Europeans had actually increased their walking since the onset of the pandemic. This may be explained by the facts that walking is considered to be a healthy activity and that some countries' public health authorities recommended that older people go for walks during the pandemic.

When it comes to differences between sociodemographic groups, older age groups reported a reduction of their activities to a somewhat greater extent than their younger counterparts, and women slightly more so than men. We observed these group differences in the pooled sample of all 27 countries and in most of the individual countries, but certainly not all of them. Future studies should investigate why these associations sometimes differ between countries. Nevertheless, the fact that slightly more older people than younger people have reduced their activities can be explained by the fact that the older age groups face a higher risk of becoming severely ill if they are infected by the virus (Caramelo et al. 2020). Regarding gender, other studies have shown that women display more prosocial values (Schwartz and Rubel-Lifschitz 2009) and personality traits (Mac Giolla and Kajonius 2018), and tend to engage in health-protecting behaviour more than men do (Lonnquist et al. 1992). These factors may explain why women also reduced their activities to a greater extent than men among the respondents across Europe.

The results on education and activity reduction revealed an unanticipated pattern, whereby a larger share of respondents with a lower education level reduced their activities compared to those with a higher education level. This was most evident for going out for a walk. However, this result is in line with the finding by Brouard et al. (2020), in a study in France during the COVID-19 pandemic, that education level is not associated with public compliance. One possible explanation for this is that these differences are mediated by different value priorities between educational groups, as studies show that less educated individuals attribute more importance to security and conformity values (Steinmetz et al. 2009). Further, highly educated individuals may engage more in deliberate decision-making compared to individuals with a lower education, and for this reason prioritize a reduction of social activities more than walking.

Regarding our explanatory analysis, we found that both levels of restrictions and infections were positively associated with a reduction of social activities. Furthermore, restrictions (but not number of infections) also displayed a strong positive association with reduced walking. Shopping, on the other hand, was only weakly associated with restrictions and infections (and this association was not statistically significant). That stringency is strongly associated with reduced walking is not surprising, as high restrictions generally go hand in hand with stay-at-home orders, which prevent people from taking part in "unnecessary" activities outside the home. However, buying groceries (for obvious reasons) still tends to be permissible independent of restrictions. As grocery shopping is often a necessary, and most likely frequent, part of people's shopping behaviour, especially among the old, it is not surprising that restrictions did not have a significant relationship with shopping.

In general, our explanatory analyses replicate previous studies using mobility data which have found that both restrictions and infections predict a reduction in mobility (Mendolia et al. 2020). However, it is noteworthy that we find relatively weaker associations with restrictions compared to some previous studies using mobility data (Mendolia et al. 2020). One explanation for this discrepancy could be that our study focuses on older people, who face a higher risk of becoming severely ill and therefore have strong incentives to adjust their behaviours, independent of governmental regulation. However, methodological explanations for this discrepancy could not be ruled out as our study relied on self-reports, rather than data that are more objectively collected through mobile phones, an approach used in previous studies.

Our study has a number of limitations that we would like to highlight. First, our analysis was restricted to people aged 50 years or older in 26 European countries as well as Israel. The associations we found between stringency and infection rates in relation to activity reduction may differ for older people in other countries. Second, we used self-reported measures of activity adjustment, which may not be perfectly reliable (Schwarz 2007). As it is hardly possible to remember exactly how one's behaviour has changed over time, respondents had to make an educated guess. However, if this guess is noisy but relatively unbiased, aggregated differences in activity adjustment between groups and countries should still be valid. Third, in our explanatory analyses we used a cross-sectional correlational research design, which is not suitable for causal inference. For this reason, observed associations between stringency, infection rates, and activity reduction could potentially be explained by other factors or by reversed causality. In our study we analysed the association between data: on the one hand,

activity adjustment as recalled by the respondents since the outbreak of the pandemic until summer 2020, and on the other, the average stringency of restrictions for the period March-July. Therefore, our analyses are not based on information about the actual timing of the adjustment or about the introduction of the restrictions. This may explain why we found weak associations between adjustment stringency and the spread of the infection. While some countries may have been successful in limiting daily activities and the spread of the virus through early restrictions, others may have introduced restrictions as a response to incautious behaviours in the population and to the spread of the virus. Hence, the association between stringency and activity adjustment may go in different directions. It is therefore important to underline that our results on associations between stringency, virus spread, and activity adjustment should not be interpreted as a causal relation.

Although this is beyond the scope of this study, it is vital to emphasize that some of the unexplained variation in activity adjustment on country level may be due to the impact of various country-specific features, including welfare regimes (Warburton and Jeppsson Grassman 2011), level of economic development (Gomez et al. 2020), and cultural orientation such as individualism/collectivism (Huynh 2020). Biddlestone et al. (2020) found that collectivism were associated with intentions to reduce the spread of the virus. In a cross-national comparison during the pandemic, Gomez et al. (2020) found less compliance with regulations and less trust of the government response in low- and middle-income countries as compared to high-income ones. They also found more worries in low- and middle-income countries. However, it is important to note that such analyses would most likely require a larger sample of countries compared to the one analysis in this study.

Future studies should also investigate the impact of stringency and infection rates using a multilevel framework combining macro and micro data, and study interactions between macro-level and individual-level factors. For instance, do gender, socioeconomic status, personality, and age moderate the impact of restrictions on activity adjustment? Ideally, such analyses should utilize panel data, which are more suited to causal inference. Future research should also study how other forms of daily activities among the old have changed in response to the COVID-19 pandemic. For instance, to what extent have older people reduced their visits to friends and physical exercise due to the pandemic? Lastly, future research should also study the consequences of activity adjustment among the old; e.g., to what extent does a reduction of social activities reduce older people's health and well-being? Such analysis is important in order to obtain more complete information, which can be used to weigh the costs and benefits of interventions aimed at decreasing the spread of COVID-19 by reducing daily activities.

From a policy perspective, the main take-home message from our study is that older people in Europe seem to respond to both governmental restrictions and information about the spread. Thus, policymakers could potentially rely on both restrictions and voluntary adjustments in order to decrease the spread of the virus. However, since the associations found between restrictions and infections on the one hand and activity reduction on the other were far from perfect, one should not expect dramatic activity reduction from such policies. We would also like to point out that policy stringency was most strongly correlated with walking, which can be seen as unfortunate, as walking may improve health and well-being among the elderly and at the same time is relatively safe from a transmission point of view. We would also like to

stress that any policy advice aimed at reducing older people's activities should consider the potential negative effects activity reduction may have on their health and well-being.

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