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The SHARE accelerometer study

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Working Paper Series 85-2023
DOI: 10.6103/wp.852023

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SHARE BERLIN Institute

This project has received funding from the European Union under grant agreement SOCPL No 101102412 and the European Union's Horizon 2020 research and innovation programme under grant agreements No 870628, No 101015924.

SPONSORED BY THE Federal Ministry of Education and Research

Supported by the NIH National Institute on Aging

Device-measured physical activity of older Europeans. The SHARE accelerometer study

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Abstract

Wave 8 of the Survey of Health, Ageing and Retirement in Europe (SHARE) comprises a physical activity measurement of the elderly (50+) by means of accelerometers in ten European countries. Respondents wore an accelerometer at the thigh in everyday life for eight days (8 x 24 hours). This paper describes the SHARE accelerometer study and provides first descriptive results in terms of the activity pattern along demographic, socio-economic, and health related characteristics. Total volume and intensity of physical activity is investigated with accelerometer derived measures ENMO and intensity gradient, respectively. Analysis show that physical activity volume and intensity vary by age, while intensity varies by gender. Poor health and higher number of limitations in mobility are factors that independently correlate with less activity of older persons. The intensity gradient seems to be lower in Eastern Europe, which is driven by those of age 80 and older. Self-reported activity and accelerometer based metrics are correlated for intensity but not volume of physical activity.

Keywords: Activity volume; Activity intensity; Accelerometry; Study description; Health behaviour

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1. Introduction

Regular physical activity is part of a healthy lifestyle. To promote physical activity and reduce inactivity is an important aim of the World Health Organization (World Health Organization 2018). Physical activity is a key prevention strategy for various diseases. The importance of physical activity for health has been demonstrated by a plethora of studies. Being physically active regularly helps prevent cardiovascular diseases (Hamer, Blodgett and Stamatakis 2022; Liu et al. 2017; Sattelmair et al. 2011), stroke (Howard and McDonnell 2015), diabetes (Gill and Cooper 2008; Laaksonen et al. 2005), and various types of cancer (Friedenreich, Neilson and Lynch 2010; Kerr, Anderson and Lippman 2017). Physical activity has also been linked to lower mortality (Ekelund et al. 2020; Paluch et al. 2022; Tarp et al. 2021). Regular physical activity and exercises has been shown to effectively prevent and help in coping with depression (Cocker et al. 2021; Gordon et al. 2018; Schuch et al. 2016) as well as reducing falls in older people (Sherrington et al. 2020). As physical activity is such a crucial factor for health, it is vital to collect reliable information of activity in population-based surveys to further investigate this relationship.

In addition to asking people for their activity behaviour, a growing number of studies directly capture movements by using accelerometers, small devices with a sensor that measures acceleration, worn by study participants during everyday life. Device-measured activity has become a common way to get reliable and comparable information on people's behaviour that is not biased by social desirability and differential item functioning which is often found in self-reported measures (cf. Teresi and Fleishman 2007). Differential item functioning can result from inter-personal and inter-cultural variation in interpretation from response categories for the same question. Divergent interpretations of "moderate" and "vigorous" activity, different reference levels for different age groups as well as cultural norms are factors that influence the comparability of questions on activity (Shephard 2003).

In addition to possibly divergent interpretations and response behaviours across countries, self-reports of physical activity involve measurement error as people tend to overestimate their activity (Hagstromer et al. 2010; Larsson et al. 2019) and underestimate their sedentary time (Prince et al. 2020). Concordance between device based and self-reported metrics of physical activity vary considerably in available studies (Keating et al. 2019; Kowalski et al. 2012; Prince et al. 2008; Skender et al. 2016). Considering this background, measuring physical activity with devices seems a more appropriate approach to quantify activity, especially when it comes to country comparisons. However, when using devices to collect data on physical activity, there are many specifications that influence results (Loyen et al. 2017). These include the data collection itself – type of device, position of device, wear time, sampling frequency, etc. – as well as decisions in the data processing – non-wear definition, intensity cut-points, epoch length, etc. For this reason, results from most studies are not suitable for reliable comparisons. There are a few studies that use harmonised device-measured data to compare physical activity of different European countries. Loyen et al. (2017) use representative samples of people aged 20–75 years from four countries. In terms of moderate to vigorous physical activity Norway ranked first, followed by Portugal, Sweden and England. Norway also ranked first concerning sedentary time, followed by England, Sweden, and Portugal. Kapteyn et al. (2018) compared the physical activity of people age 50 and older in the Netherlands, England, and the USA with no difference in activity between the Dutch and English, but both were more active than the Americans. Other multi-country studies include data from different European countries but have limitations due to biased samples based on their sampling strategy (Giné-Garriga et al. 2020; Marsaux et al. 2016).

The Survey of Health, Ageing and Retirement in Europe (SHARE) is a panel study of the European population aged 50 and older that emphasises objective measurements of health, e.g. by using grip strength test, peak flow measurement, or chair stand assessment (Börsch-Supan et al. 2013). To study physical activity in old age in more detail, Wave 8 of SHARE included a collection of physical activity data by means of thigh-worn accelerometers. Participating SHARE respondents were asked to wear the device for eight consecutive days (day and night) in everyday life. The SHARE accelerometer study

offers data to analyse activity levels and patterns of the 50+ population in different European countries that come with a lot of additional information of respondent's life, available through the SHARE panel interviews.

This paper describes the SHARE accelerometer study and investigates the activity patterns of the 50+ population in Europe shortly before and during the onset of the Corona crisis, measured using acceleration sensors. We compare the activity patterns between demographic groups and health related characteristics. We also evaluate whether the objective measures of activity correlate with the self-reported survey measures of activity for the 50+ sample. Finally, we examine some behavioural differences across European countries and regions. We find older and less healthy people to be less active than younger and healthier ones. There are differences in self-reported activity levels for different groups of socio-economic status – in terms of financial situation and education – that, however, are not observable with device-measured indicators of physical activity. Only small differences in activity behaviour between the European countries are visible in the data: We observe less activity in Eastern countries. When comparing self-reported and device-measured activity, results indicate that self-reports are rather based on the activities' intensity than on total volume. The next section describes the SHARE accelerometer study, section 3 collects the results of the study. The last section concludes and highlights our observations.

2. The SHARE accelerometer study

The SHARE accelerometer study was conducted in Wave 8 in ten countries: Belgium, Czech Republic, Denmark, France, Germany, Italy, Poland, Spain, Slovenia, and Sweden. The Axivity AX3 (Axivity Ltd, Newcastle upon Tyne, United Kingdom), a small and lightweight triaxial accelerometer, was used. Accelerometers were set to a sampling frequency of 50 Hz with a range of $\pm 8g$ ($1g = 9.81\frac{\mathrm{m}}{\mathrm{s}^2}$). During the SHARE face-to-face interview, a subsample of panel respondents was asked if they were willing to wear an accelerometer on the upper thigh for eight consecutive days, if possible, without breaks. Participants subsequently received the accelerometer via postal mail, together with an information letter and an illustrated instruction brochure on how to put on the device using the provided medical adhesive tape and gauze pads as well as a reply card to note wear time, placement (right or left thigh), and additional notes. Participants also received a prepaid return envelope to send the accelerometer and the reply card back to the respective survey agency after the wear time.

The subsample of respondents who was asked for participation was a stratified sample selected from longitudinal respondents before the fieldwork of wave 8 started. It included only the panel sample, i.e. respondents who participated in SHARE before, to allow the use of information from previous interviews. Stratification was based on age group and self-reported physical activity in the previous SHARE wave. As the strata of physically inactive panel respondents were relatively small, they were oversampled by design to ensure an adequate number of accelerometer measurements for this group. For details on sampling see (Scherpenzeel et al. 2021). Some of the consenting respondents received the device with some delay due to the limited number of available devices. Another reason for delayed shipping was the intended spreading of the measurements over the whole fieldwork period (originally planned until June 2020). Some consenting respondents did not receive the device at all because of the suspension of fieldwork. Initial interviews of SHARE Wave 8 were conducted in October 2019. Due to the COVID-19 pandemic, the data collection, including collection of accelerometer data, was suspended in March 2020 (Scherpenzeel et al. 2020). Accelerometer measurements were collected from November 2019 until April 2020[1].

In SHARE Wave 8 release 8.0.0 (Börsch-Supan 2022), accelerometer data is available from 856 respondents. Numbers by country range from 36 in Denmark to 129 in Poland. Appendix 1 shows the

[1] Data collection was suspended in March 2020, however, due to downstream procedures, single measurements were collected in April.

sample size per country by age group. In our subsequent analysis, we consider Denmark and Sweden as *Northern*, Belgium, France, and Germany, as *Central*, Italy and Spain as *Southern* and Czech Republic, Poland, and Slovenia as *Eastern* European countries. Regions were determined by geographic and cultural similarities. The entire accelerometery sample consists of 499 female (58.3 percent) and 357 male (41.7 percent) persons, aged 50 – 97 years (mean 68.6). The number of valid measurement days per respondent range from 1 to 11 with a mean of 7.5. For over 84 percent of respondents seven or more days are available (see Appendix 2).

2.1 Physical activity measures

2.1.1 Subjective activity measures

Physical activity is assessed by self-reported measures in the SHARE interview with two questions. Respondents indicate the frequency of vigorous (including sports, heavy housework, and a job that involves physical labour) and moderate physical activity (e.g. gardening, cleaning the car, or doing a walk). Response options are "hardly ever, or never", "one to three times a month", "once a week" and "more than once a week".

2.1.2 Mean ENMO

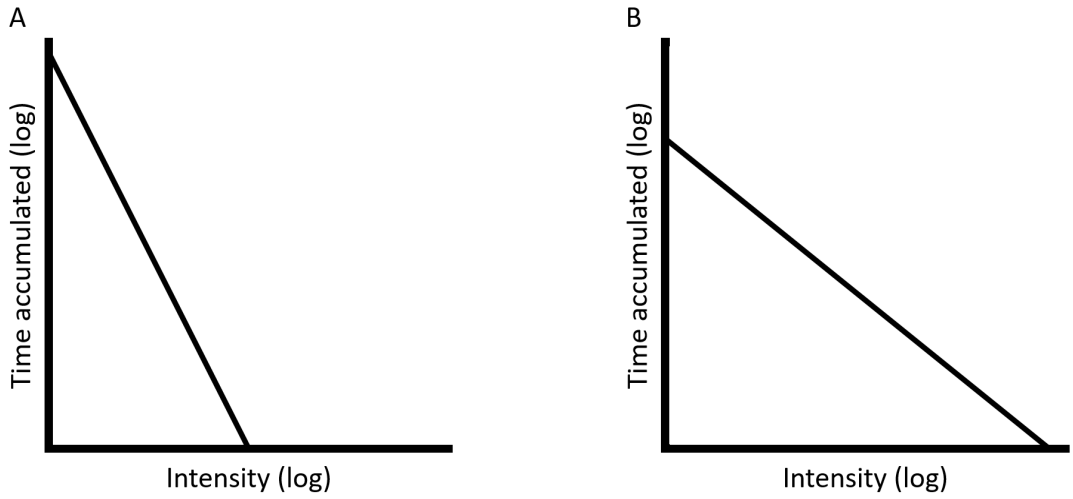
SHARE provides physical activity measures based on the collected raw accelerometer data that is processed with GGIR version 2.4-0 (Migueles et al. 2019; Sabia et al. 2014; van Hees et al. 2013), an open source package for the statistical computing software R (R Core Team 2020). High frequency acceleration data (in gravity unit: $1g = 9.81\frac{m}{s^2}$) of all three axes is collapsed to five second epochs by calculating the vector magnitude (Euclidean norm $=\sqrt{x^2 + y^2 + z^2}$). As accelerometers also record gravity, $1g$ is subtracted from the Euclidean norm. The Euclidean norm minus one (ENMO) ($\sqrt{x^2 + y^2 + z^2} - 1$) with negative values set to zero is generated (van Hees et al. 2013). ENMO, in the SHARE data denoted in milligravity units (1 mg = $9.81\frac{\mathrm{m}}{\mathrm{s}^2}/1000$), is a measure to specify the average acceleration in a time interval, describing the volume of activity. Accelerometer data is calibrated (van Hees et al. 2014), non-wear time is detected and imputation of non-wear time is performed. Only measurements from days (midnight to midnight) with a minimum of 16 hours valid wear time are included in the SHARE dataset.

2.1.3 Intensity gradient

Additional variables based on ENMO are provided in the SHARE data. The time (per hour/day/total) spent in ENMO intensity levels cut into 25 mg intervals is also included in the SHARE accelerometer datasets. Based on this information, the intensity gradient (IG) is calculated. The IG is a metric to describe the distribution of intensities proposed by Rowlands et al. (2018) which describes the intensity profile, i.e. the distribution of high and low intensity activities. Typically, per day most of the time is spent in low-intensity activities, less time is spent in moderate-intensity activities, and only a short amount of time is spent in high-intensity activities therein "if you plot time accumulated against intensity you get a curvilinear plot […]. If you take the natural logs of time and intensity, this becomes a straight-line graph" (Rowlands 2018:453). This relation is illustrated in Figure 1. The (negative) slope of this line is the intensity gradient. A steep line (more negative IG) describes a less favourable intensity profile, i.e. little share of high intensities and a high share of low intensity activities (graph A in Figure 1). A shallow line (less negative IG) describes an intensity profile including more high intensity activities and less low intensity activities (graph B in Figure 1).

IG is meant to be a complementary metric to describe the activity behaviour in more detail, therefore it is not necessarily highly correlated with the volume of activity (mean ENMO). Reported correlations based on wrist worn accelerometers range from r=0.39 to r=0.56 (Buchan et al. 2019; Fairclough et al. 2019; Rowlands et al. 2018). Studies showed that IG can be correlated to health indicators independent of the volume of activity (Fairclough et al. 2019; Rowlands et al. 2018; Rowlands et al. 2019).

Figure 1: Intensity gradient



Source: Rowlands et al. (2018)

2.2 Covariates

Other information used in the analyses are gender, age, month of accelerometer measurement, and self-reported health with response options "excellent", "very good", "good", "fair", and "poor". Another health indicator is the number of limitations in mobility mentioned by the respondent out of a list of ten activities[2] grouped into categories of none, one, and two or more limitations. Education of the respondent is grouped into primary education[3], secondary education, and tertiary education, based on the ISCED classification (UNESCO 2011). The financial situation of the household is assessed with the question "Thinking of your household's total monthly income, would you say that your household is able to make ends meet..." and response options "with great difficulty", "with some difficulty", "fairly easily", and "easily" as well as employment status (working vs. not working).

As the accelerometer study was ongoing at the onset of the COVID-19 pandemic, the SHARE accelerometer dataset contains two variables derived from the Oxford Covid-19 Government Response Tracker (OxCGRT) (Hale et al. 2021) that describes the situation in the country at the time when the respondent wore the accelerometer. First, the stringency index, ranging from 0 to 100, describing the strictness of pandemic related regulations, with a higher index indicating more restrictive measures. Second, the "stay at home regulations" are indicated with categories "no measures", "recommend not leaving house", and "require not leaving house with exceptions for daily exercise, grocery shopping, and 'essential' trips". According to the OxCGRT indicators, 73 measurements (8.5 percent) were gathered during "stay at home" orders (recommendation or requirement) in the respective country. Average stringency index is between 3.6 in Denmark and 34.3 in France. Out of the 855 respondents, 70 (7.8 percent) wore the accelerometer when the stringency index was above 50. For 341 respondents the stringency index was zero at the time of data collection.

2.3 Sample

For the description of physical activity in the SHARE accelerometer sample 22 cases were dropped because of missing values in one of the covariates. Only participants with at least four days of valid accelerometer data (minimum of 16 hours valid wear time) are considered for analyses (cf. Migueles et al. 2017). The analysis sample consists of 798 SHARE respondents (58.8 percent female, mean age 68.7

[2] walking 100 metres; sitting for about two hours; getting up from a chair after sitting for long periods; climbing several flights of stairs without resting; climbing one flight of stairs without resting; stooping, kneeling, or crouching; reaching or extending your arms above shoulder level; pulling or pushing large objects like a living room chair; lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries; picking up a small coin from a table.

[3] Including less than primary education.

years, mean days of observation per respondent 7.7). The description of the sample is shown in Appendix 3. For most analyses we use average ENMO and IG over the respondents' whole observation time. Only for the description of the intraday activity patterns and weekdays is hourly resp. daily ENMO measure used.

3. Results and discussion

In this section we examine the univariate and bivariate relations of the subjective and objective measures for physical activity present in SHARE. The first sub-section looks, in depth, at subjective and device-measured activity (volume (ENMO) and intensity (IG)) and their correlations with socio-demographic, and health characteristics. In the second sub-section, the activity pattern over a time span of a week and day is described as well as the activity levels across SHARE countries / regions.

3.1 Physical activity measurements

3.1.1 Subjective measures of physical activity

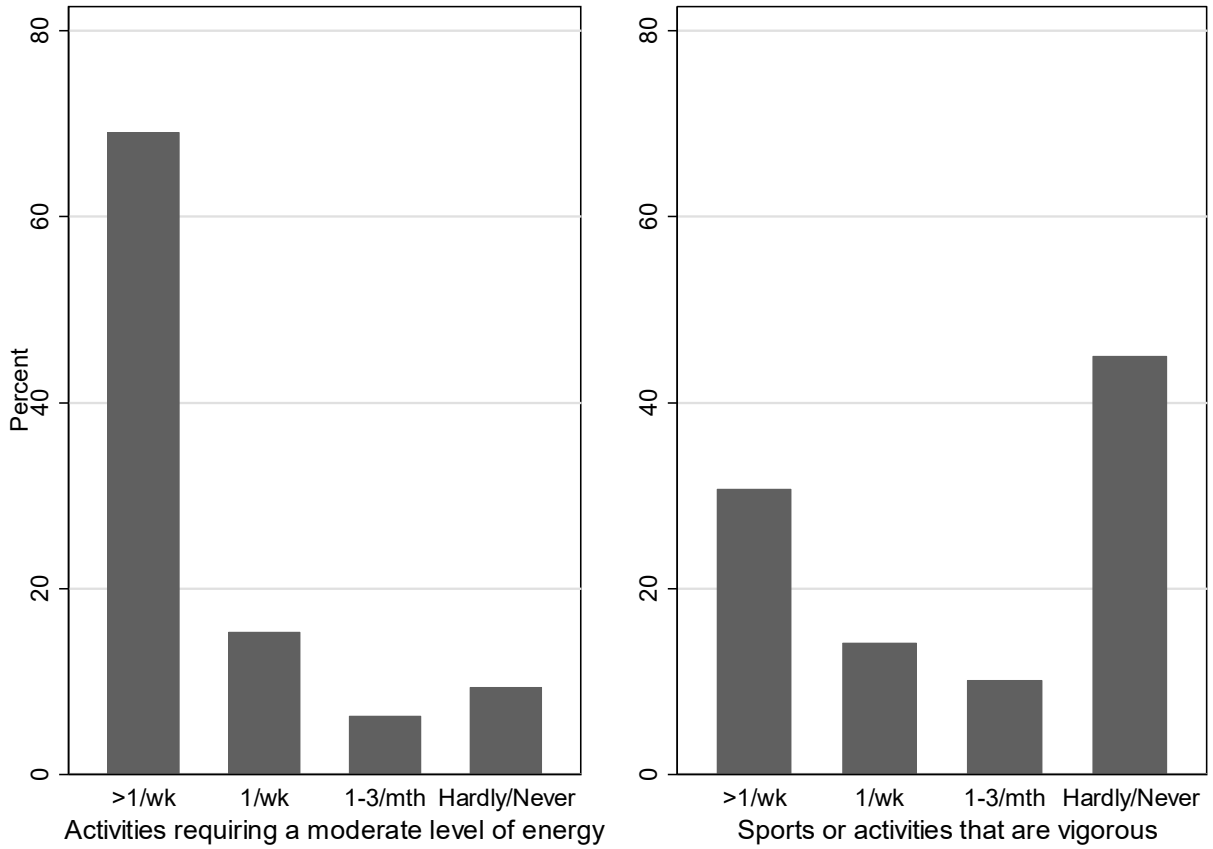
In the SHARE interview, respondents were asked to report the frequency by which they undertook "vigorous physical activity" and "moderate physical activity". The former was defined as undertaking activities that included: sports, heavy housework, or a job that involves physical labour; while the latter was defined as activities that involved a moderate level of energy such as "gardening, cleaning the car, or taking a walk". Respondents were asked to choose their activity level on a 4-point scale [More than once a week; Once a week; One to three times a month; Hardly ever, or never]. In this section we examine the simple distributions of these two questionnaire items in regard to age, gender, education level as well as financial status (employment status and how well respondents can "make ends meet"). We first examine self-reported moderate activity levels then vigorous activity levels.

We find that responses are highly skewed with 69.1 percent reporting to undertake moderate activity levels "more than once a week", see Figure 2. Conducting test on group mean differences (ANOVA) we find no significant differences along gender and employment status for reported moderate activity levels. However, significant differences in means arise along age groups, education, making ends meet, and other self-reported health measures (perceived health status and mobility limitations). We find that the age group of 80+ reports less moderate activity than age group 50- 64. Moreover, those who reached primary education levels report less moderate activity compared to secondary and tertiary education completers. Reporting more difficulty in "making ends meet" corresponds to lower reported moderate activity. As can be expected, reporting lower health status and two or more mobility limitations decreases the reported level of moderate activity. There is a significant ($p<0.05$) correlation of Oxford stringency index and self-reported moderate activity. Mean differences between reporting in regard to the stay at home measures leads to only a 10% significant difference. See Appendix 4.

Turning to reported vigorous activity levels, we find that the distribution of answers takes the form of a slight U-shape, see Figure 2 with 30.7 percent of respondents reporting to partake in vigorous activity levels "more than once a week". A similar analysis on differences in means between groups suggests that there are significant differences along all socio-demographic factors (see Appendix 5). Men significantly report higher levels of vigorous activity. Younger age groups report higher vigorous activity compared to their predecessor age-groups, lower educated individuals report lower levels than higher ones. Being employed increases vigorous activity reporting; while, similar to moderate activity levels, reporting financial difficulty corresponds to lower vigorous activity. Reporting lower health status or limited mobility decreases reported vigorous activity. There does not seem to be significant differences along the Oxford stringency index or stay at home measures.

These simple bivariate analyses paint a picture of higher moderate and vigorous activity levels associated with younger individuals, still in employment with some level of financial comfort, as indicated by findings on education and reported financial stability.

Figure 2: Distribution of self-reported activity levels



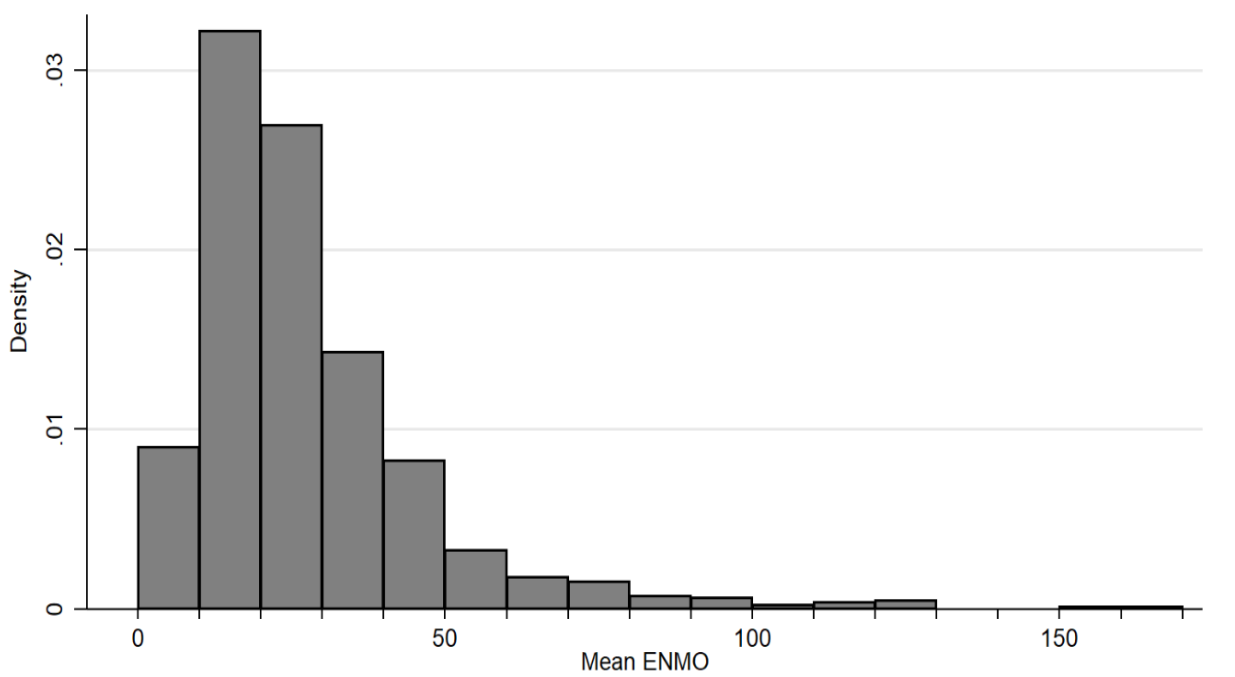
Note: 798 observations, unweighted.
Source: SHARE Wave 8 release 8-0-0

3.1.2 Accelerometer measures of physical activity (volume and intensity)

In this sub-section we analyse the objective measures of physical activity along the same socio-demographic delineations. As physical behaviour is a multidimensional construct (Stevens et al. 2020), it is important to capture as much dimensions as possible to fully understand the relationship of physical behaviour and socio-demographics characteristics. This is where the SHARE accelerometer data offers advantages compared to the limited information that can be retrieved from the usual subjective questions in surveys on aging. The metrics derived from the SHARE accelerometer data allows for separate measurement of intensity and volume, see for detail Section 2.

In looking at the volume of physical activity, we find that the mean ENMO of all respondents is around 27.86 (median: 22.65). The distribution is normally distributed for values between 0 to 60 with a right tail until values of 160 (see Figure 3). Mean IG in the sample is -2.42. However, this number alone is not informative. The IG can only be interpreted in comparison of different groups. Therefore, we focus our analysis by comparing the distributions of the volume and intensity gradient of the physical activity by groups in order to interpret physical behaviour more concretely. Mean ENMO and IG are moderately correlated (r=0.41). Taking gender and age (quadratic term) into account (linear OLS predicted values for ENMO and IG), the correlation is considerably stronger (r=0.69).

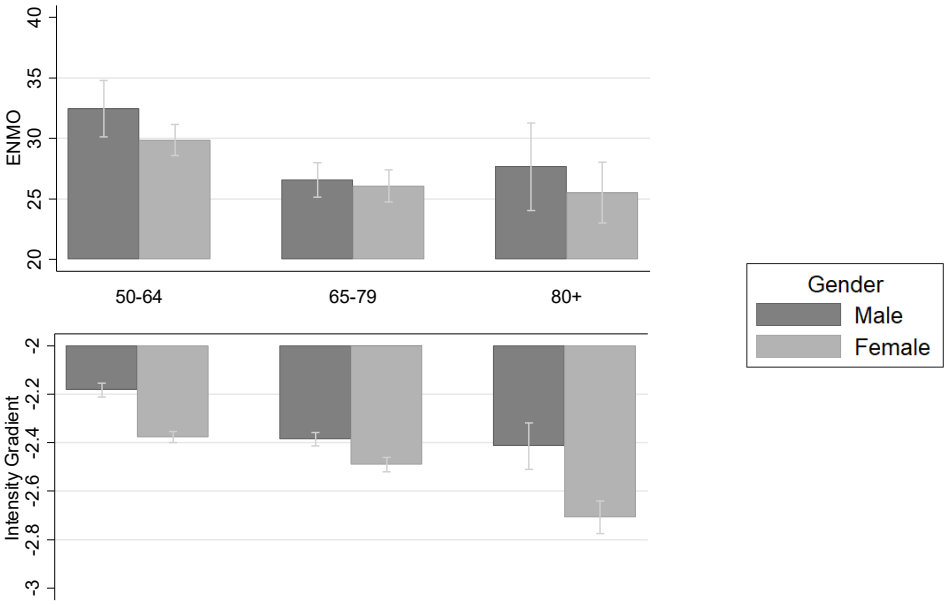
Figure 3: Histogram of mean ENMO



Note: 798 observations, unweighted.
Source: SHARE Wave 8 release 8-0-0

Figure 4 shows the mean ENMO (upper panel) and IG (bottom panel) by age groups and gender. In the sample of the SHARE accelerometer study, men tend to have more favourable intensity profiles and slightly higher volumes of activity than women in all age groups. The difference, however, is only significant for intensity gradients. Higher age is associated with less favourable intensity profiles, but not necessarily with lower volumes of activity. Although persons aged 80 and older spend less time in high intensity activities, they achieve a similar activity volume compared to the persons aged 65-79.

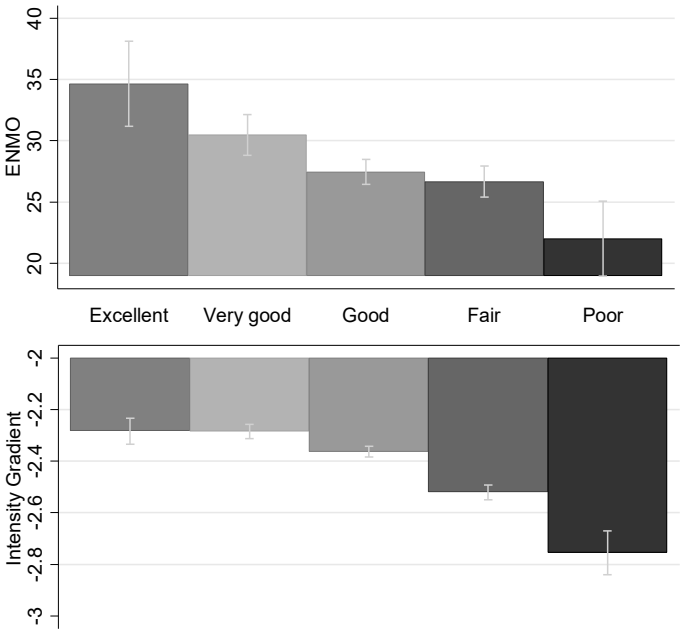
Figure 4: ENMO & IG by gender and age



Note: 798 observations, unweighted, brackets denote standard errors. For detailed numbers see Appendix 6.
Source: SHARE Wave 8 release 8-0-0

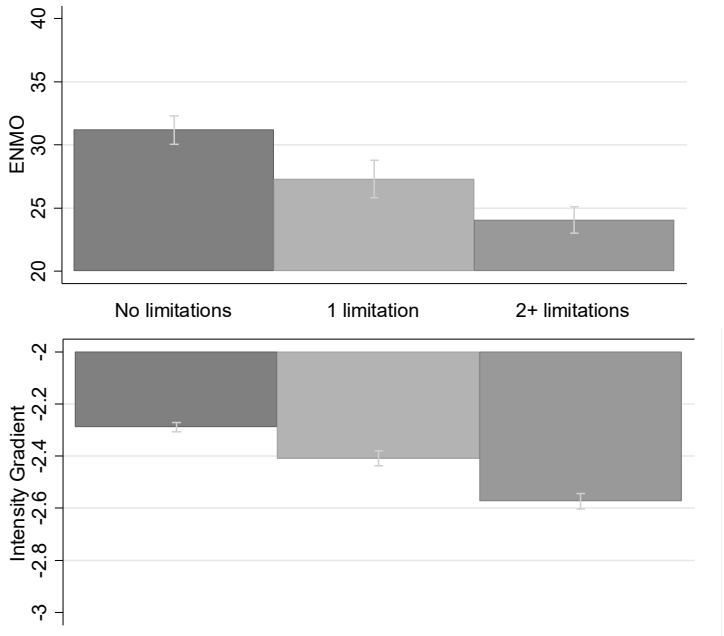
There does not seem to be significant differences in physical activity volumes between group means for differing education brackets, working status, or subjective financial stability categories. Larger differences between these groups arise, however, when looking at physical intensity levels. Those with secondary and tertiary education levels are more likely to have more favourable intensity profiles. This pattern is similar between those who find it very difficult to make ends meet compared to all other groups. Furthermore, employment also has a positive relation with more favourable physical intensity profiles. COVID stringency and stay at home measures do not have significant differences on intensity profiles.

Figure 5: Mean ENMO & IG by self-reported overall health



Note: 798 observations, unweighted, brackets denote standard errors. For detailed numbers see Appendix 9
Source: SHARE Wave 8 release 8-0-0

Figure 6: Mean ENMO & IG by limitations in mobility



Note: 798 observations, unweighted, brackets denote standard errors. For detailed numbers see Appendix 10.
Source: SHARE Wave 8 release 8-0-0

Similar to subjective measures of physical activity, subjective overall health measures seem to be related to device-measured activity. Reporting poorer overall health status is associated with a significantly lower level of physical activity as well as less favourable physical intensity profile, see Figure 5. This negative correlation also holds for mobility limitations, see *Figure 6*, especially in the case of two or more limitations. The drop in volume and intensity of physical activity is particularly striking in the group with poor health. It is no surprise that persons who indicated in the SHARE Wave 8 interview that they were limited in mobility, have on average a lower volume as well as lower intensity in the accelerometer measurement. These bivariate relations (numbers in Appendix 7 & Appendix 8) for volume and intensity are looked at more concisely in our multivariate regression results in the following section.

3.1.3 Determinants of (device-measured) physical activity

Table 1: Linear OLS Regression: ENMO& IG

	(1) Mean ENMO	(2) Mean ENMO	(3) IG	(4) IG
Gender: Female (Ref: Male)	-1.397	-.881	-.159***	-.126***
	(1.432)	(1.45)	(.029)	(.029)
Age: 65-79 (Ref: 50-64)	-4.611***	-3.955**	-.15***	-.107***
	(1.544)	(1.576)	(.032)	(.031)
Age: 80+ (Ref: 50-64)	-4.43*	-3.971*	-.285***	-.223***
	(2.282)	(2.335)	(.047)	(.047)
OxCGRT stringency index		.094		-.002
		(.081)		(.002)
OxCGRT not leaving house: Recommendation (Ref: No)		-2.5		.003
		(4.445)		(.089)
OxCGRT not leaving house: Requirement (Ref: No)		-2.826		.027
		(5.139)		(.102)
Education: Secondary (Ref: Primary)		-2.698		.065
		(2.077)		(.041)
Education: Tertiary (Ref: Primary)		-.51		.09*
		(2.442)		(.049)
Make ends meet: Some difficulties (Ref: Great difficulties)		-.783		.078
		(2.888)		(.058)
Make ends meet: Fairly easily (Ref: Great difficulties)		1.303		.108*
		(2.839)		(.057)
Make ends meet: Easily (Ref: Great difficulties)		-.635		.107*
		(2.93)		(.058)
Health: Very good (Ref: Excellent)		-4.682		-.009
		(3.153)		(.063)
Health: Good (Ref: Excellent)		-6.029**		-.04
		(2.958)		(.059)
Health: Fair (Ref: Excellent)		-5.237		-.119*
		(3.226)		(.064)
Health: Poor (Ref: Excellent)		-7.578*		-.297***
		(4.058)		(.081)
Limitation in mobility: 1 (Ref: 0)		-3.077		-.073*
		(1.99)		(.04)
Limitations in mobility: 2+ (Ref: 0)		-5.431***		-.132***
		(1.836)		(.037)
Constant	31.672***	47.712***	-2.206***	-2.258***
	(1.521)	(7.127)	(.031)	(.142)
Observations	798	798	798	798
R-squared	.012	.076	.077	.189

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

Note: Models 2 and 4 include month of observation and number of measurement days as controls. Complete table available in Appendix 11.
Source: SHARE Wave 8 release 8-0-0

Table 1 shows multivariate linear OLS regression models (Migueles et al. 2021) to check whether correlations hold when controlling for other factors, including month of observation and OxCGRT indicators. We drop as a covariate an indicator for working as it is highly correlated with age group. The regression results confirm some of the bivariate relations found.

Models 1 and 2 show results for the average ENMO. There is no difference in volume of activity between men and women. When controlling for health indicators, education, financial situation, time of observation, and COVID-19 situation (model 2), the youngest age group (50-64) has a higher volume of activity compared to the older persons in the sample. Model 2 shows no significant correlations of ENMO with OxCGRT COVID-19 indicators, month of observation, education, and financial situation. Self-reported overall health status as well as limitations in mobility independently correlate with ENMO. Those with good, and poor health have a lower volume of activity compared to persons reporting excellent health. Also, those who reported two or more limitations in mobility have a significantly lower ENMO compared to people without mobility limitations.

Models 3 and 4 show the results for IG. In the sample of the SHARE accelerometer study, there is a significant difference in the IG between men and women, with men tending to have more favourable intensity profiles. The intensity declines with higher age but is still significant when controlling for health indicators and other control variables. Regulations due to COVID-19 seem to not be correlated to the IG. Fair and poor subjective health is associated with a lower activity level, in comparison with people with good, very good, and excellent health. There is also a significant difference in IG of people reporting poor and those with fair health. Independently from overall health status, one or more limitations in mobility are correlated with a less favourable intensity profile. Higher education and no difficulties in making ends meet are correlated with more favourable intensity profiles.

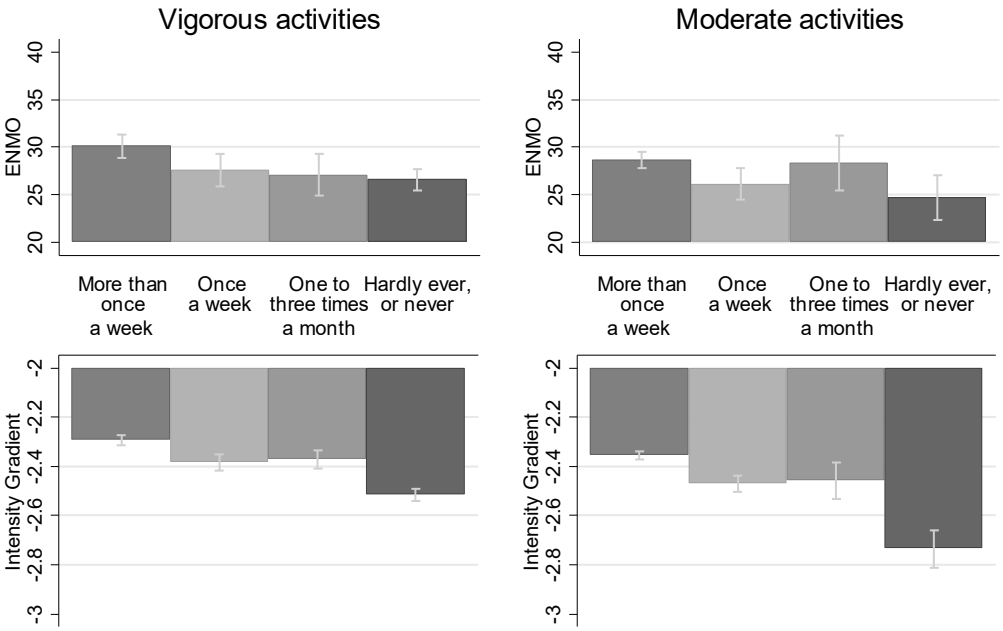
3.1.4 Self-reported vs. accelerometer measured physical activity

In this sub-section we examine the relationship between self-reported and device-measured activities. Mean ENMO seems to be higher with more frequent self-reported vigorous activities (Figure 7, Panel 1), however, only the groups with highest and lowest self-reported vigorous activity differ significantly (see regression in Appendix 12). There does not seem to be a clear ordering regarding moderate activity reporting and mean ENMO levels and there are no significant differences. In contrast, there is a strong, significant and positive relationship between individuals' intensity gradients (IG) and self-reported activity, in both cases of moderate and vigorous activity levels. This correlation is mainly driven by those who report undertaking vigorous or moderate activities hardly ever or never (see Appendix 12).

We further examine these bivariate relations in respect to a few key socio-demographic characteristics (see Appendix 15). The significant and non-significant results on the mean ENMO hold for vigorous respective moderate activity when controlling for other socio-demographic characteristics with few exceptions. The non-significant correlations of ENMO and moderate activity hold when looking at sub-groups, with the exception of a significant difference of lowest and highest self-reported activity for the 65-79 year olds. The significant result of a difference in ENMO between lowest and highest self-reported vigorous activity, however, hold only for those with low education, who are working, and are able to make ends meet easily. We find that the significant relations between self-reported moderate and vigorous activity level and objective measures of physical activity in regard to the IG holds when we factor in gender, age, education, and financial situation. Yet, the relations are not significant for the groups of working individuals and those with good health (self-reported and limitations in mobility).

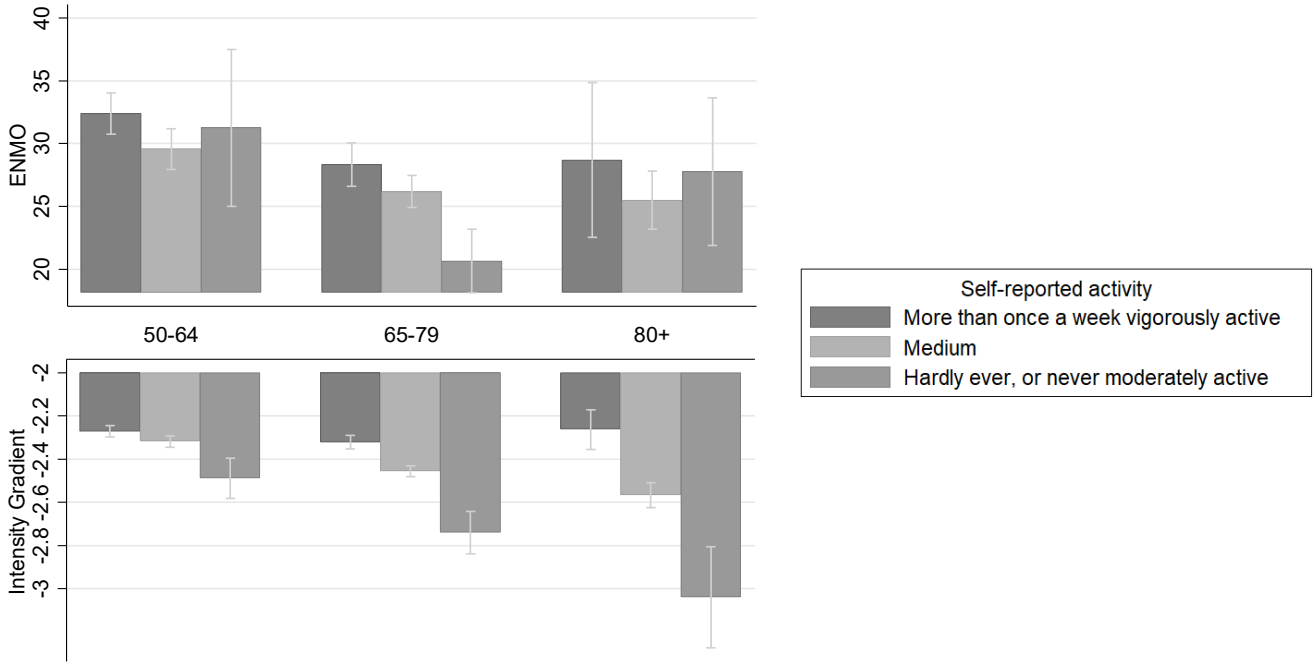
The only comparable analysis, investigating correlation of self-reported frequency of activities and accelerometer based volume of activity, was conducted by Kapteyn et al. (2018). Using wrist-worn accelerometry data from the Netherlands, England, and the USA they report a moderate correlation and not consistent pattern of reported frequency and device-measured volume of activity. We do not observe the same pattern in the thigh-worn SHARE accelerometer data. However, we observe a correlation of self-reported frequencies of moderate and vigorous activities and IG.

Figure 7: ENMO & IG by self-reported frequency of vigorous and moderate physical activities



Note: 798 observations, unweighted, brackets denote standard errors. For detailed numbers see Appendix 13 and Appendix 14.
Source: SHARE Wave 8 release 8-0-0

Figure 8: ENMO & IG by age and self-reported frequency of activity



Note: 798 observations, unweighted, brackets denote standard errors. For detailed numbers see Appendix 16. For graph and numbers on ENMO and IG by self-reported frequency of moderate and vigorous activities see Appendix 17.
Source: SHARE Wave 8 release 8-0-0

In Figure 8 self-reported frequencies of vigorous and moderate activities are combined into one variable to differentiate between very active (vigorously active more than once a week), very inactive (hardly ever or never moderately active), and all others. It also depicts the average ENMO and IG by age group and activity level. We divide the measurements in this manner as we see that it is the extreme self-

reported activity values that seem to have the highest correlations with device-measured activity, especially for IG (see Appendix 17 and Appendix 12). The self-reported activity seems to capture the actual intensity profile, showing stronger correlation with higher age. With the exception of "active" vs. "medium active" in the youngest age group, all differences in IG between activity groups (per age group) are significant. However, self-reports do not represent the volume of activity (see Appendix 12).

3.2 Physical activity comparisons

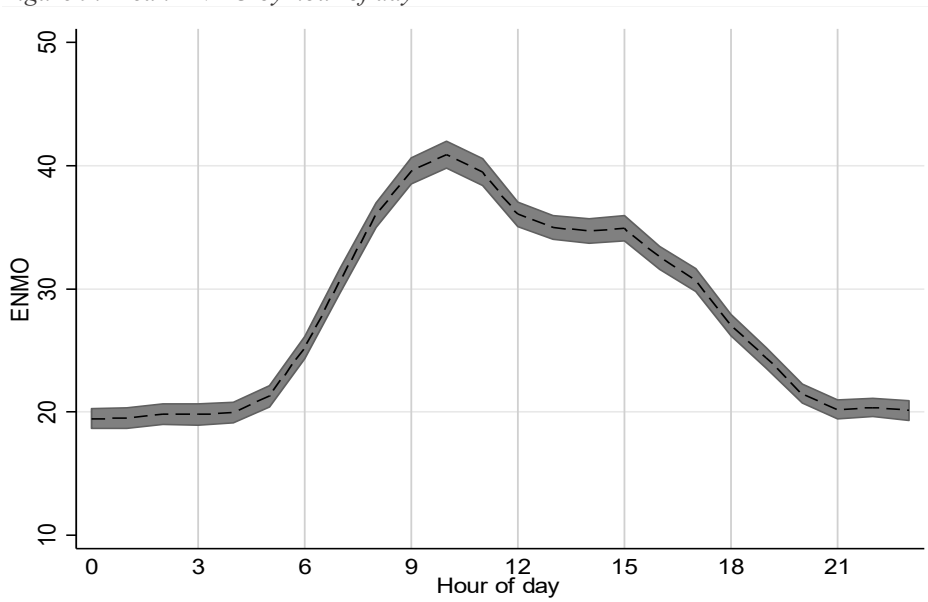
3.2.1 Activity patterns across week and day

A great advantage of using accelerometer data is being able to compare typical activity profiles by characteristics. In the following we examine objective physical daily and weekly activity levels in accordance with three major demographic characteristics that should have differing profiles; namely: age, gender, and working status. The average activity over the course of the day in intervals of one hour is displayed in Figure 9. Figure shows the activity across the day separated by gender and age.

Highest activity can be observed before noon. A "lunchbreak" is visible before a second (lower) peak in the afternoon, while evening activity levels are slowly decreasing. This pattern is more or less stable across all age groups. On average more activity is recorded for older men and women (80+) at night-time.

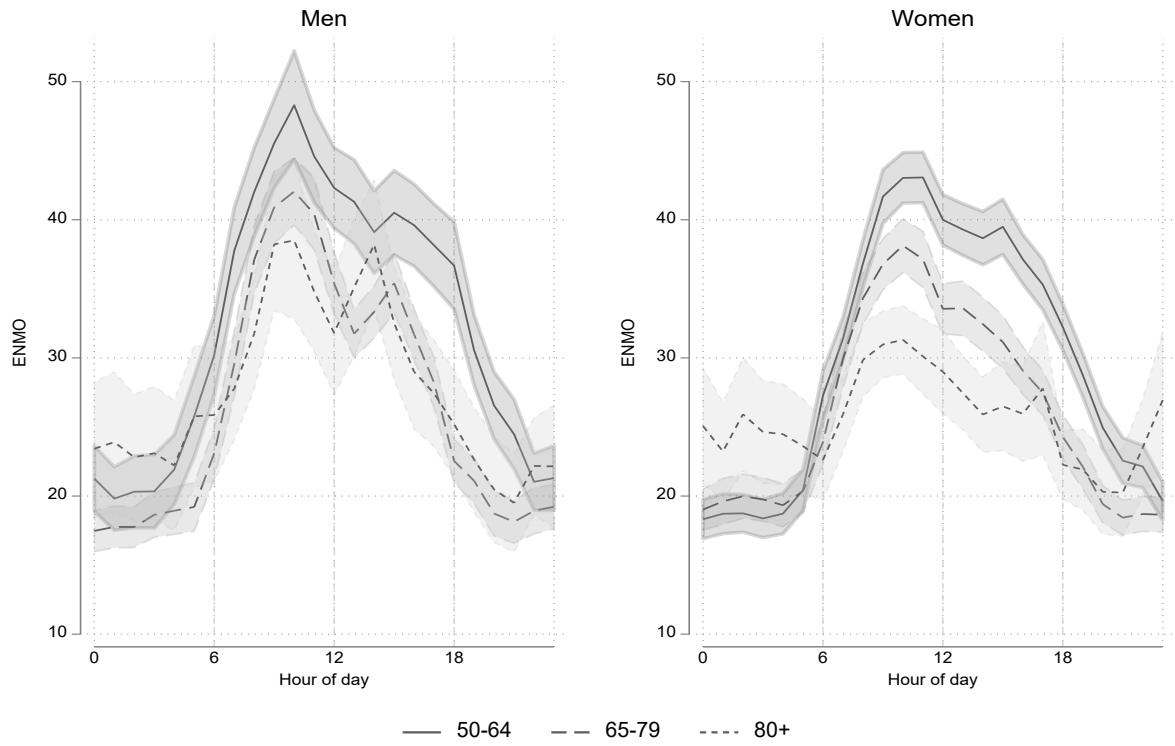
The average volume of activity and intensity profile per day of the week for men and women by working status is displayed in *Figure*. People who work seem to be more active than non-working people; however, working status is highly correlated with age. Furthermore, the difference in volume of activity between working and non-working is much bigger for men than for women; differences in ENMO are only significant for men, whereas the differences in IG are significant for men and women. The average ENMO is higher at weekdays compared to weekends for working and non-working persons, see *Figure*. In all groups the lowest activity volume is present on Sundays. However, within groups there are no significant differences between days of the week.

Figure 9: Mean ENMO by hour of day



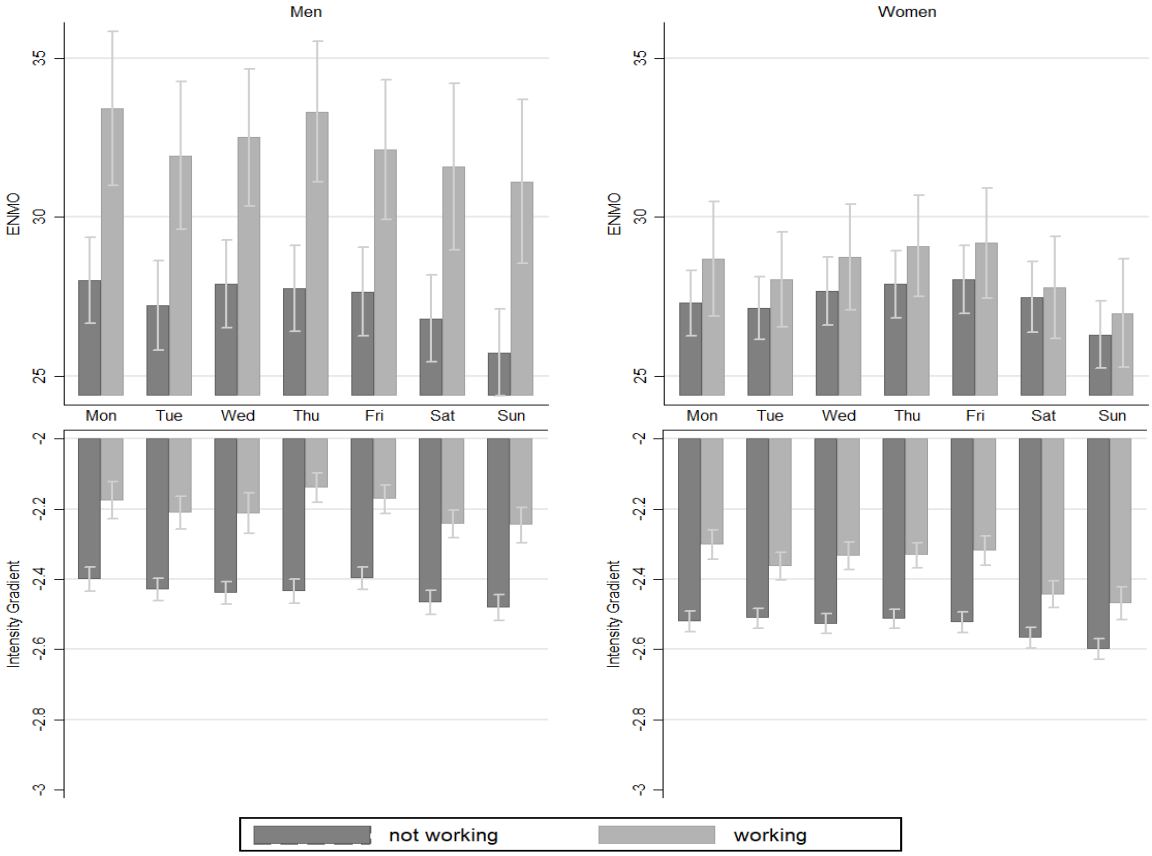
Note: 798 observations, unweighted, brackets denote standard errors.
Source: SHARE Wave 8 release 8-0-0

Figure 10: Mean ENMO by hour of day, gender, and age



Note: Men: 329 observations, women: 469 observations, unweighted, brackets denote standard errors.
Source: SHARE Wave 8 release 8-0-0

Figure 11: ENMO & IG by weekday, gender, and working status



Note: 798 observations, unweighted, brackets denote standard errors.
Source: SHARE Wave 8 release 8-0-0

Observed activity pattern over the course of the day and week are comparable to findings from other studies (Doherty et al. 2017; Sartini et al. 2015). Similar daily pattern are found for all age groups, but the level of activity declines with higher ages. Moreover, previous studies often find a (temporary) increase of leisure time activity in the transition to retirement, especially for those with physically demanding jobs. Our findings, however, is in line with previous studies that report higher total activity level of the working persons (Gropper et al. 2020).

3.2.2 Cross country comparisons

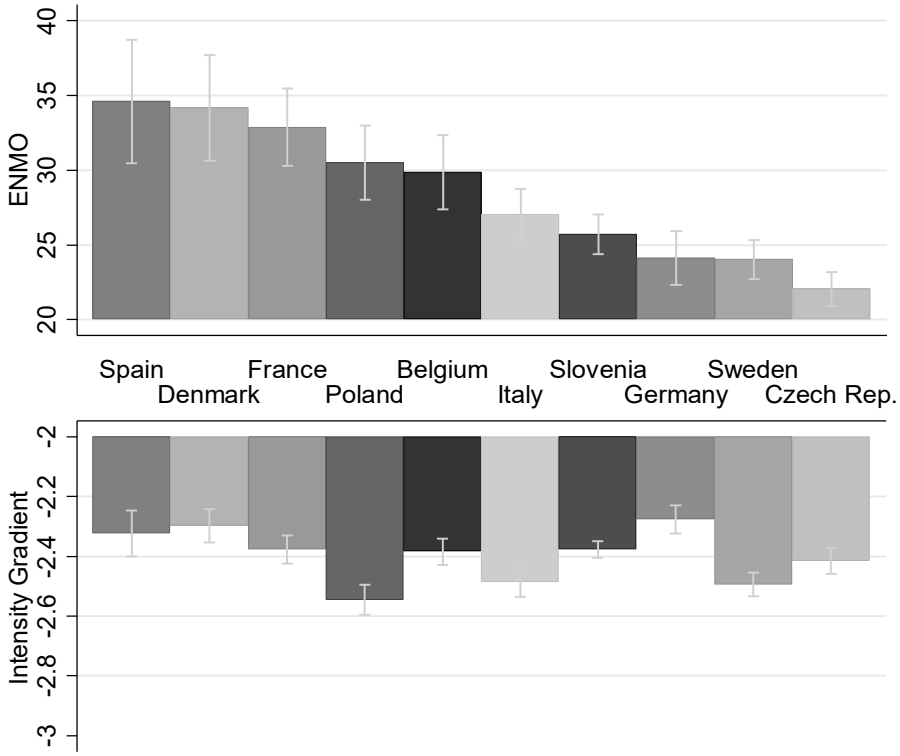
Compared to other studies using accelerometer data to measure physical activity level in this sub-population (age 50+), SHARE has a large advantage in conducting cross-country comparisons. It is through these comparisons that we are able to draw some conclusions regarding European nations' physical activity levels and profiles. In the following, we first look at an overview of physical activity levels of individual countries then combine them into regions in order to draw conclusions.

Differences in physical activity measures between countries (mean ENMO and IG) are displayed in Figure . Spain, Denmark, and France rank first, Germany, Sweden, and Czech Republic rank last in average volume of activity in the sample of the SHARE accelerometer study. Participants from Spain and Denmark seem to show, on average, the highest volume of activity with concurrently high IG, suggesting a preferable intensity profile. In general, ENMO and IG do not seem to be strongly correlated on a country level. For example, the highest (most favourable) IGs were measured for Swedish participants. However, Sweden ranks second to last in the average volume of activity. Conversely, Polish participants have on average the least favourable intensity profile but rank fourth in activity volume. The picture looks more consistent when controlling ENMO and IG for gender and age (quadratic term), see Figure 12b. The correlation of predicted values of ENMO and IG is stronger (cf. section 3.1.2) and differences between countries are smaller.

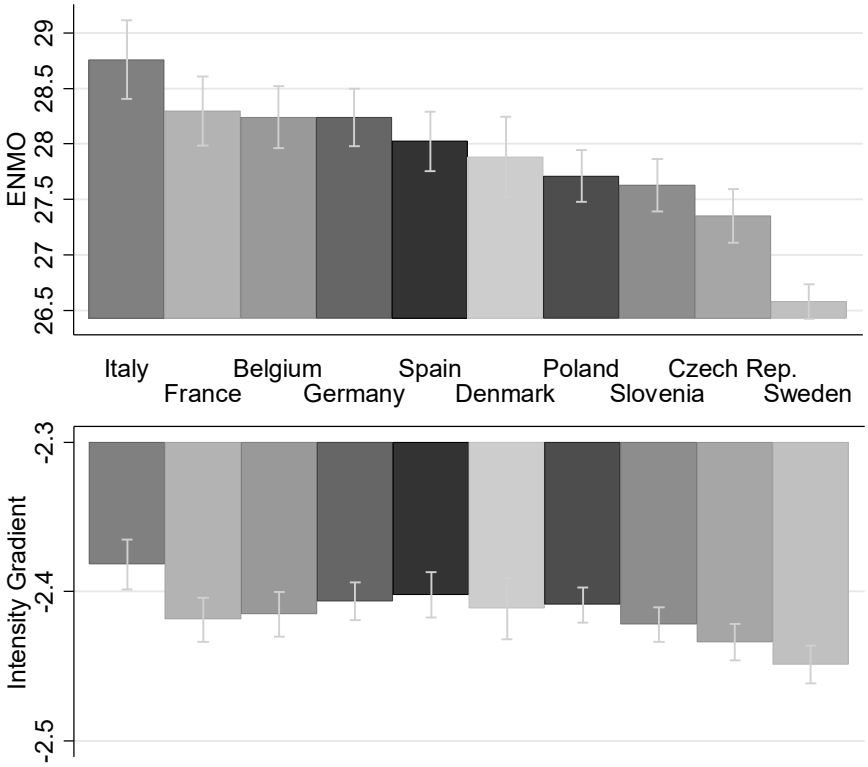
As above, Figure shows the self-reported frequencies of vigorous and moderate activities combined into one variable to differentiate between very active (vigorously active more than once a week), very inactive (hardly eve or never moderately active), and medium activity levels. Self-reports and device-measured activity seem to coincide in some countries, e.g. Italy, Denmark, and Czech Republic. For these countries we see that self-reported active people have higher ENMO and IG whereas self-reported inactive people have the lowest ENMO and IG. In other countries, e.g. Germany and Slovenia, there does not seem to be a consistent pattern between self-reported activity and mean ENMO and IG. In general, the concurrence of self-report and IG is higher than for self-report and ENMO, but differences by country and age exist.

However, when comparing countries, it is important to note that numbers of observations are quite small and greatly differ. As explained in section 2, unfortunately, due to Covid19 field restrictions, the number of cases per country sampled is rather limited. Furthermore, as there are no weights applied, it is not assured that results are representative for the 50+ population in each country. Therefore, in order to be able to draw some meaningful insights we cluster observations by regions in most of our analysis. Regions were determined by geographic and cultural similarities. Table 2 outlines the separate regions of study, the countries included and the number of observations per country and region. In order to compare like groups by region we further break down our analysis by age groups.

Figure 12: Mean ENMO & IG by country
12a: Original values

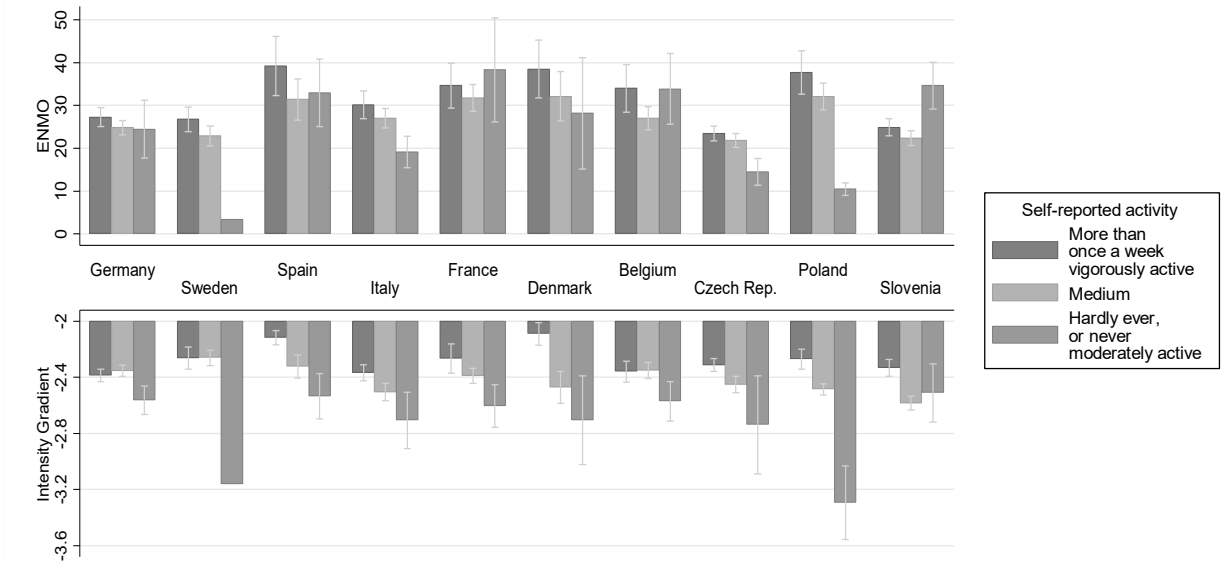


12b: Predicted values (linear OLS controlled for gender and age (quadratic)



Note: 798 observations, unweighted, brackets denote standard errors. Figures 11a and 11b have a different y-axis scale. For detailed numbers see Appendix 18.
Source: SHARE Wave 8 release 8-0-0

Figure 13: ENMO and IG by country and self-reported frequency of activity



Note: 798 observations, unweighted, brackets denote standard errors. For detailed numbers see Appendix 19.
Source: SHARE Wave 8 release 8-0-0

Table 2: Regional splits

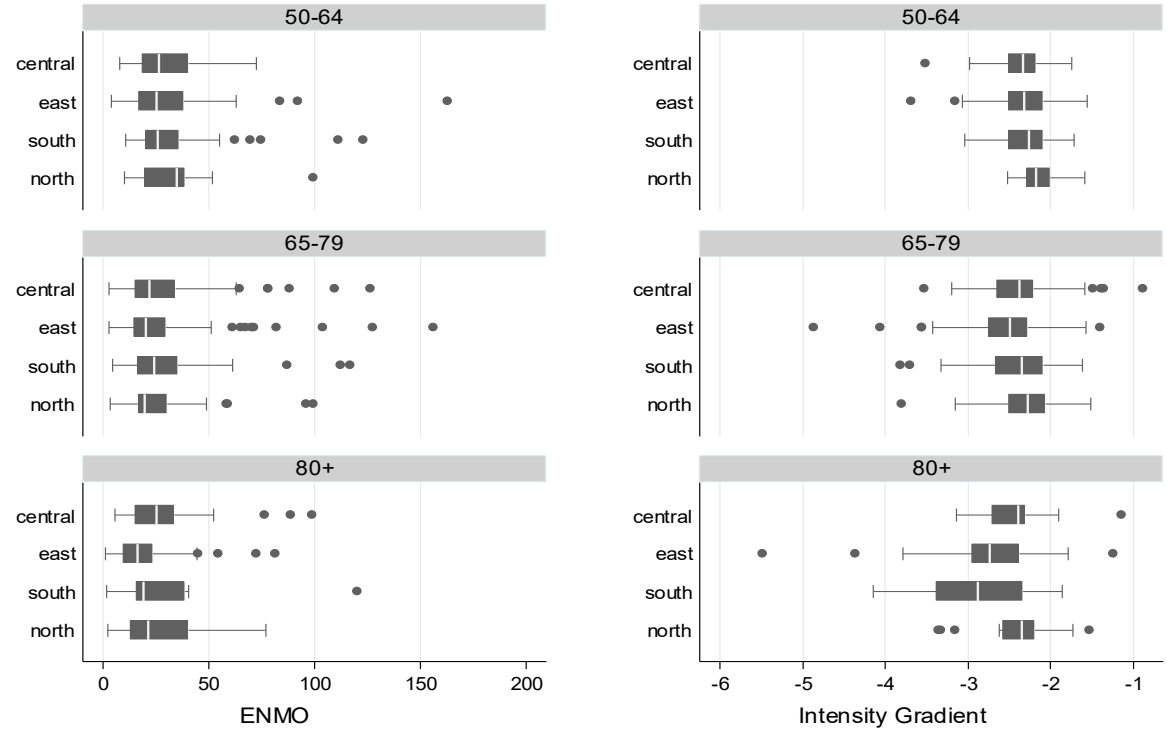
Region	n (region)	Country	n (country)
Central	253	France	73
		Germany	107
		Belgium	73
East	318	Czech Republic	99
		Poland	122
		Slovenia	97
South	130	Italy	66
		Spain	64
North	97	Denmark	34
		Sweden	63

Source: SHARE Wave 8 release 8-0-0

We find that there are slight differences in terms of self-reported physical activity between regions by age groups. On average we find that individuals in the south report lower levels of moderate physical activities than their cohorts in other parts of Europe. Moreover, the northern region higher levels of vigorous activities are reported compared to the South. Yet, these significant differences seem to be driven by individuals in age group 65-79. These findings suggest that northern countries are more prone to defining their activity as vigorous compared to the other regions. However, the fact that age groups play a large role in what becomes significant may also suggest that changes in reporting may be more due to retirement status or other socio-economic factors regardless of region of residence. In order to see if this discrepancy in reporting also holds in accelerometer measured physical activity, we look our two main accelerometer measures.

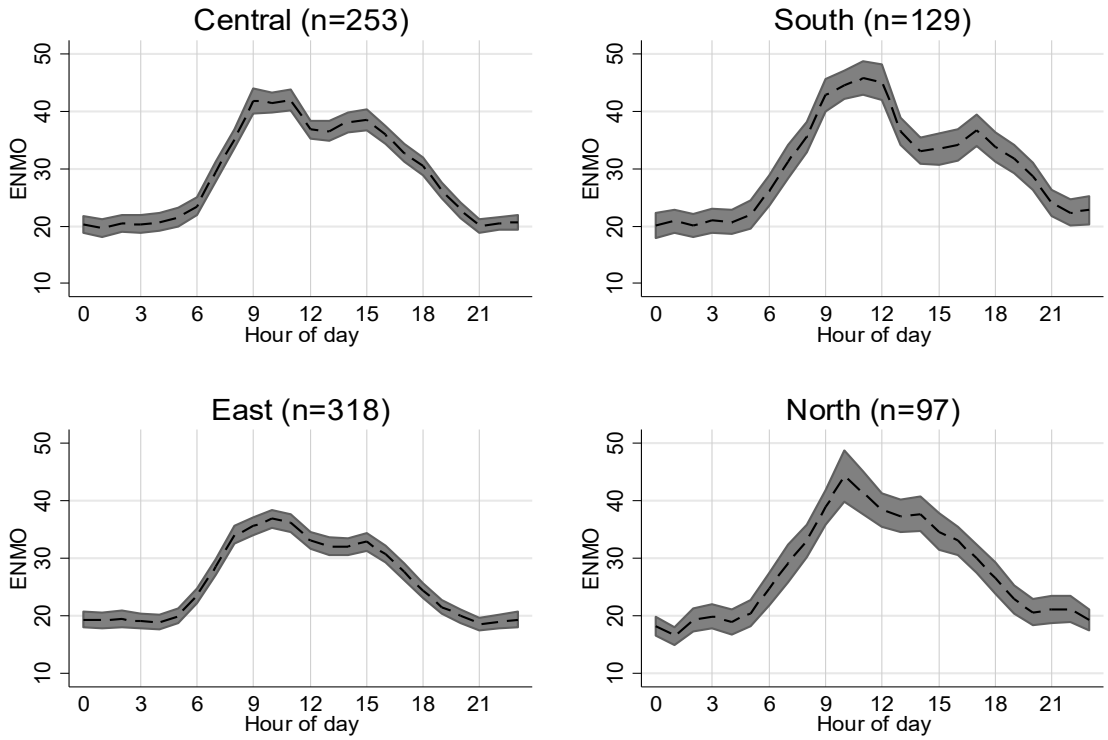
We find no significant differences between volumes of physical activity between regions at any age group, see Panel 1 of Figure. Examining activity levels over a 24-hour interval we find that although the average volume of activity between regions are not significantly different, there are slight differences in levels of activities over a day see Figure . In all regions the peak activity level seems to occur between 9 and 12, which then decreases as the day goes on. The peak seems to more gradually decrease in the central and eastern regions compared to the north, while in the south there is another smaller peak in the evening (15-18) followed by the decrease.

Figure 14: Mean and distribution of ENMO and IG by region



Note: 798 observations.
Source: SHARE Wave 8 release 8-0-0

Figure 15: Mean ENMO over 24 hr span by region



Note: 798 observations, unweighted, brackets denote standard errors.
Source: SHARE Wave 8 release 8-0-0

However, we do find significant differences along regions when examining physical intensity gradients, see Panel 2 of Figure. Results suggest that the east have on average lower intensity physical activity levels compared to the north and central regions. However, these significant differences by region seem to be driven by the group of 65-79 year olds. We check on the robustness of these findings in our analysis below.

Table 3: Objective measures determinants with regions included

		Mean ENMO			IG	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Female	-1.250	-0.891	-0.838	-0.150***	-0.120***	-0.118***
	-1.494	-1.515	-1.531	(0.030)	(0.030)	(0.030)
65-79	-4.250***	-3.694**	-3.705	-0.155***	-0.107***	-0.063
	-1.597	-1.679	-2.647	(0.028)	(0.030)	(0.046)
80+	-4.242*	-3.840	-1.329	-0.300***	-0.229***	-0.038
	-2.423	-2.569	-3.745	(0.059)	(0.054)	(0.063)
East	-2.648	-1.929	-1.178	-0.099***	-0.101***	-0.002
	-1.648	-1.768	-2.640	(0.034)	(0.036)	(0.046)
South	1.287	-0.814	-1.123	-0.039	-0.029	0.015
	-2.302	-2.372	-3.230	(0.042)	(0.045)	(0.048)
North	-0.269	-1.977	0.669	0.108**	0.042	0.117*
	-2.302	-2.482	-5.554	(0.046)	(0.049)	(0.065)
65-79 # East			-0.051			-0.105*
			-3.495			(0.063)
65-79 # South			0.756			0.021
			-5.000			(0.080)
65-79 # North			-2.733			-0.075
			-6.260			(0.088)
80+ # East			-6.130			-0.298**
			-5.173			(0.130)
80+ # South			2.103			-0.452**
			-9.664			(0.200)
80+ # North			-5.212			-0.230
			-8.359			(0.143)
Controls	no	yes	yes	no	yes	yes
Constant	32.251***	47.632***	46.540***	-2.174***	-2.317***	-2.350***
	-1.765	-7.982	-7.907	(0.031)	(0.151)	(0.153)
R-Sq.	0.018	0.078	0.081	0.102	0.201	0.217
Observations	798	798	798	798	798	798

*** *p<.01, ** p<.05, * p<.1*

Note: OLS coefficients shown. Robust standard errors in parenthesis. Controls added in models 2, 3, 5, 6 for month of measurement, total number of valid days, Oxford stringency index and stay at home measure, self-reported health, limitations in mobility, education, financial difficulty. Full table in Appendix 20.
Source: SHARE Wave 8 release 8-0-0

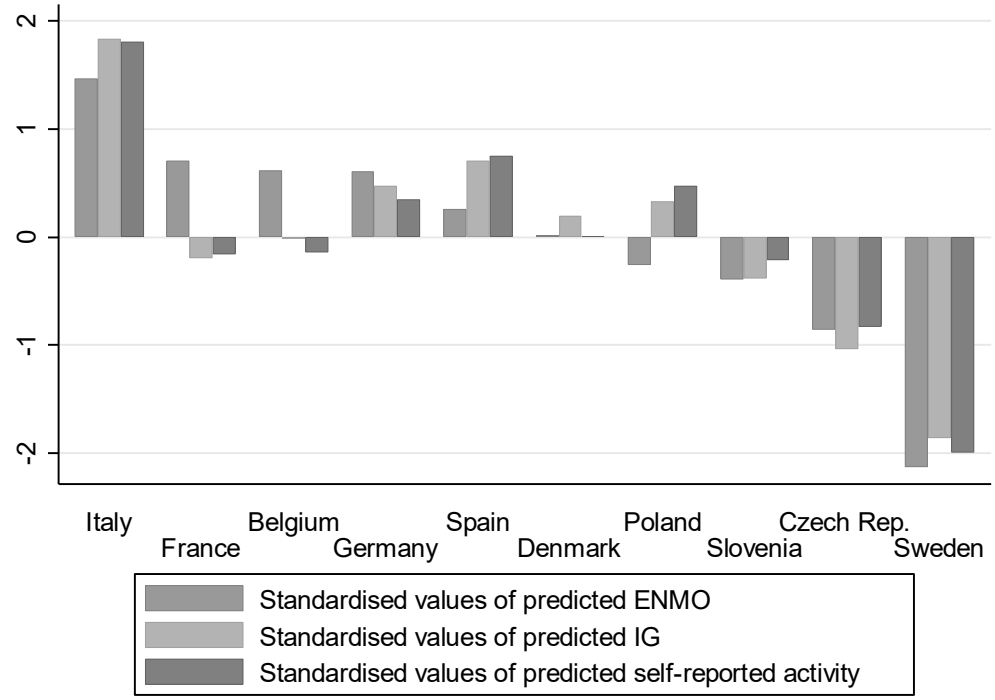
Finally, in order to test the above correlation results, we add to our previous multi-variate analysis on determinants, regional dummies as well as an interaction term between regions and the three pre-defined age groups (Models 3 and 6). Once more we exclude working status as it is highly correlated with age. The highlights of the results of the analysis can be found in Table 3, for the full table please refer to Appendix 20. Models 1, 2, and 3 confirm that there are indeed no differences between physical activity volumes (mean ENMO) by regions. The base models 1 and 4 seem to suggest that older age groups have lower volume and intensity profile for physical activity compared to 50–64-year-olds, however, significant differences are not maintained once adding region and age interactions. Furthermore, model 4 also suggests a difference between the east (negative) and the north (positive) compared to the central

regions for physical intensity. Moreover, the significance for the east is lost once factoring in interaction terms, see Model 6. Indeed, these specifications allow us to see the importance of taking into account age differences across regions in understanding physical activity across Europe. Although we see that average volume of activity is similar across regions and ages, we are able to determine that it is the activity intensity levels in the oldest age group (80+) that are driving regional and age differences witnessed above.

Other determinants have similar results as seen before. While women's volume of physical activity does not significantly differ from men, the intensity profile is highly more negative. Generally worse health and more limitations in mobility is associated with worse volume and intensity levels (see Appendix 20).

Finally, we look at the relation of subjectively measured activity levels with the accelerometer measurements. Figure depicts the standardised values of predicted (linear OLS regressions with gender and age (quadratic term) as controls) ENMO, IG, and self-reported activity by country. In addition to the country differences, the consistency of the different measures is visible here. By comparing self-report with ENMO and IG, we see that the self-report underestimates ENMO in France and Belgium, but overestimates ENMO in Poland and Spain. Again, the graph shows that self-report is closer to IG than ENMO with the exception of Denmark and Czech Republic.

Figure 16: Standardised activity measure by country



Note: 798 observations.
Source: SHARE Wave 8 release 8-0-0

The bivariate relations suggest that physical intensity levels may inform self-reported measurements. To test this, we take as dependent variables the self-reported measures on moderate and vigorous activity and use the device based measures as independent determinants, as controls we use the usual control variables. As the dependent variables are ranked, we run ordered probit models with robust standard errors. A short version of the results can be found in Table 4, the full results can be found in the Appendix 21.

Table 4: Subjective measures determinants with regions included

	Moderate activity	Vigorous activity
Mean ENMO	-0.002	0.000
	(0.003)	(0.002)
IG	0.551***	0.252**
	(0.130)	(0.126)
Female	0.122	-0.127
	(0.101)	(0.089)
65-79	0.138	-0.170*
	(0.108)	(0.096)
80+	0.020	-0.572***
	(0.165)	(0.156)
East	0.098	0.058
	(0.125)	(0.117)
South	-0.235	0.024
	(0.155)	(0.151)
North	0.170	0.185
	(0.189)	(0.161)
cut1		
Constant	-2.554***	-0.862
	(0.626)	(0.564)
cut2		
Constant	-2.186***	-0.565
	(0.626)	(0.564)
cut3		
Constant	-1.595**	-0.140
	(0.621)	(0.564)
Pseudo R^2	0.097	0.085
Observations	798	798

*** p<.01, ** p<.05, * p<.1*

Note: Ordered probit coefficients shown. Robust standard errors in parenthesis. Controls added for month of measurement, total number of valid days, Oxford stringency index and stay at home measure, self-reported health, limitations in mobility, education, financial difficulty. Full table in Appendix 21.
Source: SHARE Wave 8 release 8-0-0

As indicated in the bivariate analysis, we only find a significant relation between IG and subjective reporting of physical activity. This relation exists both for reporting on moderate and vigorous physical activity levels, is positive and significant. Moreover, the relation holds when controlling on other socio-demographic factors. This result bolsters the assumption that individuals in Europe might associate the amount of physical activity undertaken more so with the type or intensity of the activity rather than with the overall volume of activity undertaken in a span of time. However, this result is limited given the very low power of the models, as suggested by the calculated pseudo R^2. Therefore, further research should be undertaken to more concisely determine the factors that influence subjective health reporting. Moreover, although controls mirror prior findings, regional difference seem to not be important in determining reporting once all controls are factored in. This is not surprising given the weak associations in the bivariate relations.

4. Conclusions

The aim of this paper is to describe the SHARE accelerometer study and the available data derived from accelerometer measurements as well as draw some initial conclusions on physical activity levels for the older sub-population in Europe. The study included measurements from a selected sub-sample from the overall Wave 8 sample in ten countries. Participants were given thigh-worn accelerometers that

measured the acceleration of individuals over the span of a week. The SHARE accelerometer data provides different measures that describe physical behaviour of respondents. We use the volume (ENMO) and intensity profile(IG) for our analyses, metrics which are not yet widely spread, but provide potential for future research, e.g. in the relationship between physical activity and health by the "investigation of independent, additive and interactive associations of volume and intensity" (Migueles et al. 2021:4). The SHARE accelerometer data in combination with the rich database of SHARE surveys offer many opportunities for research on the relationship between physical activity and indicators of health and well-being.

In our study we found that physical activity volume and intensity vary by age, overall health, and mobility limitations. Similar results have been reported e.g. by Lohne-Seiler et al. (2014) and Jefferis et al. (2014). Furthermore, physical intensity levels also vary by gender with women showing less favourable profiles than men. These results are comparable to regression models predicting high activity and inactivity based on self-reports.

While there are some bivariate correlations of self-reported physical activity related to respondents' education and financial situation, these relations do not hold for both device-measured indicators. Higher education and fewer financial difficulties are correlated to higher intensities (IG) but not to higher volumes of activities (ENMO). Apart from the measure used, the domain of activities seems to be important in the correlation physical activity and socio-economic status. While some studies find a positive correlation of socio-economic factors and physical activity (e.g. Kari et al. 2015), a review of Stalsberg and Pedersen (2018) concludes that a positive relationship of socio-economic status and physical activity holds only for leisure time physical activity, but not for transport, occupational, and housing activity.

Some of the accelerometer measurements were taken during "stay at home" restrictions due to the COVID-19 pandemic. Yet, no systematic link of COVID-19 related restrictions and physical activity can be seen in the SHARE data. This is in line with a review that reports no clear trend in changes in physical activity patterns during lockdown in older adults (Wunsch, Kienberger and Niessner 2022). However, as the number of affected respondents in SHARE is quite small, no conclusions can be drawn about physical behaviour during lockdown situations.

Differences in activity between countries are small, especially when taking the composition of the sample (gender and age) into account. Northern countries seem to report more vigorous activity and southern countries report lower levels of moderate activities than their European counterparts when it comes to bivariate relations. However, these self-reports do not translate to any substantial differences along physical activity volume and only slight differences in activity intensities. A multi-variate analysis confirms that there is a weakly significant difference between east and central countries. However, results are greatly dependent on individual age groups with the oldest showing said significant difference.

Studies show that correlation of device based and self-reported metrics of physical activity vary considerably, with many studies reporting a low to moderate correlation, even for elaborated physical activity questionnaires and diaries (Keating et al. 2019; Kowalski et al. 2012; Prince et al. 2008; Skender et al. 2016). This is a result bolstered by the SHARE data. We find only a highly significant level of correlation between the intensity of physical activity but not the overall volume undertaken per week. Further multi-variate analysis also confirms this finding. Therein, subjective measurements in SHARE seem to mirror more closely physical intensity rather than overall volume. Nevertheless, there are possible flaws that might foster disagreement in self-reports and device-measurements such as a biased sample e.g. regarding cognitive functions and education. Both, good cognitive functions and higher education, has been identified as relevant individual characteristics of participants that are connected to a higher consistency of self-report and device measurement (Herbolsheimer, Riepe and Peter 2018; Lagerros et al. 2006; Winckers et al. 2015). Other factors that might influence agreement of both measurements is the onset of the COVID-19 pandemic and the lack of seasonal variation (accelerometer

measurements were only conducted in winter). We find that there are slight differences in reporting between countries. By comparing self-reports with device-measured activity, we see the largest discrepancies in France and Belgium where the volume of activity is underestimated. On the other hand, we find that respondents in Poland and Spain overestimate their activity in terms of volume. However, the self-reported measures are similarly correlated to the intensity of physical activity in all countries. These findings might rather result from the wording of the questions than from differential item functioning. Respondents are asked to report the frequency of activities with different intensities (moderate and vigorous), which seems to be captured by the IG.

There are several limitations to this study. First, given the curtailment of fieldwork due to Covid19, the sample is unfortunately too small to look in detail at individual cross-country differences which was the original aim of the study. The sample size also limits the power of the results found. Moreover, at this moment, the sample size and cross-sectional does not allow for causal interpretation.

Nonetheless, the descriptive results of this study highlight the need for further research on the topic in Europe. Regional differences in physical activity intensities between some regions and age groups indicate that there may be differences in the type of activities that individuals across Europe undertake; some of which may be more beneficial for healthy aging. This is especially pertinent as SHARE data indicates that there are indeed differences across the average Body Mass Index (BMI) and self-reported physical health levels across regions (see Appendix 22). These differences could be a result of varying lifestyles across regions, as indicated by the hourly volume of physical activity per region in our results, differing public health policies and campaigns, or most likely, a combination of both. Furthermore, even with the limitations of the study, it is clear that there is indeed a difference in the way that people self-report their physical activity and the actual intensity of physical activity they undertake. When comparing self-reported activity with accelerometer measurements from older persons in the Netherlands, England, and USA, Kapteyn et al. (2018) conclude in a similar manner that: "Individuals in different environments and in different age groups simply have different standards of what it means to be physically active" (Kapteyn et al. 2018:476). This result underscores the need to collect more harmonised "objective" measurements of physical activity alongside self-reports in national and trans-national studies.

Acknowledgement

The SHARE accelerometer study was financed by the NIA grant "Enhancing the Comparability of SHARE with HRS and ELSA", submitted in June 2015 (R01AG052527). Data processing and release of the accelerometer data was supported by the European Union within the Social Science & Humanities Open Cloud (SSHOC: GA N°823782).

The SHARE data collection has been funded by the European Commission, DG RTD through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982, DASISH: GA N°283646) and Horizon 2020 (SHARE-DEV3: GA N°676536, SHARE-COHESION: GA N°870628, SERISS: GA N°654221, SSHOC: GA N°823782) and by DG Employment, Social Affairs & Inclusion through VS 2015/0195, VS 2016/0135, VS 2018/0285, VS 2019/0332, and VS 2020/0313. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C, RAG052527A) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

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Appendix

Appendix 1: Available cases in the SHARE accelerometer study release 8.0.0

Country	*Age*			*Total*
	50-64	*65-79*	*80+*	
Denmark	13	18	5	36
Sweden	6	53	12	71
Germany	45	51	20	116
France	32	37	10	79
Belgium	38	32	11	81
Spain	28	35	9	72
Italy	33	29	5	67
Czech Republic	29	61	15	105
Poland	42	74	13	129
Slovenia	36	52	12	100
Total	302	442	112	856

Source: SHARE Wave 8 release 8-0-0

Appendix 2: Number of valid measurement days

Number of valid days of accelerometer measurement	*Freq.*	*Percent*	*Cum.*
1	8	0.93	0.93
2	15	1.75	2.69
3	14	1.64	4.32
4	12	1.40	5.72
5	17	1.99	7.71
6	67	7.83	15.54
7	202	23.60	39.14
8	336	39.25	78.39
9	168	19.63	98.01
10	16	1.87	99.88
11	1	0.12	100.00
Total	856	100.00	

Source: SHARE Wave 8 release 8-0-0

Appendix 3: Sample

		BE	CZ	DK	FR	DE	IT	PL	ES	SI	SE	Total
Gender	Male	29	35	17	23	47	28	52	28	36	34	329
	Female	44	64	17	50	60	38	70	36	61	29	469
Age	50-64	31	26	12	31	41	33	39	27	33	3	276
	65-79	31	60	17	33	47	28	71	31	52	48	418
	80+	11	13	5	9	19	5	12	6	12	12	104
Education	low	13	6	1	12	1	22	30	26	2	9	122
	medium	29	75	19	41	65	38	79	24	78	34	482
	high	31	18	14	20	41	6	13	14	17	20	194
Make ends meet	Great difficulty	1	2		3	6	14	16	9	11	1	63
	Some difficulty	13	16		17	12	25	45	14	40	8	190
	Fairly easily	22	44	5	23	39	24	50	17	30	23	277
	Easily	37	37	29	30	50	3	11	24	16	31	268
Limitations in mobility	0	30	32	16	36	42	32	47	41	48	37	361
	1	13	28	12	13	27	9	13	6	11	11	143
	2+	30	39	6	24	38	25	62	17	38	15	294
Self-rated health	Excellent	9	3	6	6	2	6	2	2	6	11	53
	Very good	14	15	11	15	20	15	9	12	16	18	145
	Good	32	56	7	28	40	26	48	28	39	23	327
	Fair	15	23	7	21	35	16	42	21	27	7	214
	Poor	3	2	3	3	10	3	21	1	9	4	59
Vigorous activities	More than once a week	20	36	15	16	39	22	19	20	33	25	245
	Once a week	12	7	3	8	21	9	15	6	18	14	113
	One to three times a month	7	12	1	6	11	3	14	5	16	6	81
	Hardly ever, or never	34	44	15	43	36	32	74	33	30	18	359
Moderate activities	More than once a week	48	70	26	49	80	35	80	40	70	53	551
	Once a week	9	17	2	14	15	15	18	9	15	8	122
	One to three times a month	4	6	3	5	6	6	10	3	6	1	50
	Hardly ever, or never	12	6	3	5	6	10	14	12	6	1	75

Appendix 3: Sample (Continued)

		BE	CZ	DK	FR	DE	IT	PL	ES	SI	SE	Total
Month of accel. measure-ment	Nov 2019	2	11		3	17	3	7		3	4	50
	Dec 2019	11	17	10	9	13	7	26	9	18	10	130
	Jan 2020	16	19	16	4	14	26	20	18	26	8	167
	Feb 2020	26	38	7	20	29	24	33	31	33	24	265
	Mar 2020	18	14	1	37	33	6	36	6	17	17	185
	Apr 2020					1						1
Number of days	Mean	7.5 (1.1)	8 (1.2)	7.3 (1.1)	7.5 (1.3)	7.6 (1.1)	7.2 (1)	8.1 (.8)	7.4 (1.1)	8.1 (.9)	7.7 (1)	7.7 (1.1)
OxCGRT Stringency index	Mean	11.1 (13.8)	11.6 (11.1)	3.1 (6)	33.4 (25.8)	19.5 (24.2)	25 (28.4)	13.7 (18.9)	9.9 (12.5)	4.1 (8.8)	4.3 (10.4)	14 (19.9)
OxCGRT stay at home	No measures	71	98	31	66	77	49	122	63	96	62	735
	Recommend not leaving house			3		17				1	1	22
	Require not leaving house[1]	2	1		7	13	17		1			41
	Total	73	99	34	73	107	66	122	64	97	63	798

[1]with exceptions for daily exercise, grocery shopping, and 'essential' trips

Source: SHARE Wave 8 release 8-0-0

Appendix 4: Correlation with self-reported moderate activity (ANOVA)

	d.f. b/w groups	d.f. w/in groups	F-stat	P-val.	Sign. Groups.	Diff.	P-val. (between separate groups)
gender	1	796	0.83	0.362			
age group	2	795	2.59	0.076	80+ / 50-64	-0.241	0.090
education	2	795	11.55	0.000	medium / low	0.449	0.000
					high / low	0.458	0.000
working	1	796	2.53	0.112			
financial	3	794	8.23	0.000	fairly easy / great difficulties	0.343	0.061
					fairly easy / some difficulties	0.286	0.009
					easily / great difficulties	0.442	0.006
					easily / some difficulties	0.385	0.000
subjective health	4	793	16.71	0.000	fair / excellent	-0.492	0.007
					fair / very good	-0.551	0.000
					fair / good	-0.364	0.000
					poor / excellent	-0.883	0.000
					poor / very good	-0.941	0.000
					poor / good	-0.754	0.000
					poor / fair	-0.390	0.050
mobility limitations	2	794	34.66	0.000	2+ / 0	-0.578	0.000
					2+ / 1	-0.541	0.000

Source: SHARE Wave 8 release 8-0-0

Appendix 5: Correlation with self-reported vigorous activity (ANOVA)

Factor Var.	d.f. b/w groups	d.f. w/in groups	F-stat	P-val.	Sign. Groups.	Diff.	P-val. (between separate groups)
gender	1	796	6.49	0.010	female / male	-0.240	0.011
age group	2	795	14.77	0.000	65-79 /50-64	-0.312	0.006
					80+ /50-64	-0.794	0.000
					80+ / 65-79	-0.482	0.002
education	2	795	12.57	0.000	medium / low	0.448	0.002
					high/ low	0.751	0.000
					high / medium	0.302	0.019
working	1	796	20.43	0.000	working / not working	0.540	0.000
financial	3	794	5.70	0.001	fairly easy / great difficulties	0.518	0.027
					easily / great difficulties	0.722	0.000
Subjective health	4	793	25.09	0.000	good / very good	-0.441	0.004
					fair / excellent	-0.919	0.000
					fair / very good	-0.995	0.000
					fair / good	-0.554	0.000
					poor / excellent	-1.420	0.000
					poor / very good	-1.496	0.000
					poor / good	-1.055	0.000
					poor / fair	-0.501	0.062
mobility limitations	2	795	40.15	0.000	2+ / 0	-0.867	0.000
					2+ / 1	-0.676	0.000

Source: SHARE Wave 8 release 8-0-0

Appendix 6: ENMO and IG by gender and age

Gender	Age	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
Male	50-64	94	27.300	32.47	2.33	2.33	-2.18	-2.18	0.28	0.03
Male	65-79	190	21.52	26.570	1.43	1.43	-2.35	-2.39	0.39	0.03
Male	80+	45	19.240	27.670	3.61	3.61	-2.360	-2.41	0.64	0.10
Female	50-64	182	25.440	29.870	1.29	1.29	-2.380	-2.38	0.30	0.02
Female	65-79	228	21.080	26.080	1.310	1.310	-2.470	-2.490	0.440	0.030
Female	80+	59	21.160	25.520	2.5	2.5	-2.730	-2.710	0.520	0.070

Source: SHARE Wave 8 release 8-0-0

Appendix 7: Correlation with mean ENMO (ANOVA)

Factor Var.	d.f. b/w groups	d.f. w/in groups	F-stat	P-val.	Sign. Groups.	Diff.	P-val. (between seperate groups)
gender	1	796	0.42	0.517			
age group	2	795	4.51	0.011	65-79 /50-64	-4.425	0.012
education	2	795	1.73	0.178			
working	1	796	2.51	0.119			
financial	3	794	0.40	0.756			
subjective health	4	793	3.74	0.005	fair / excellent	-7.996	0.085
					poor / excellent	-12.654	0.007
					poor / very good	-8.479	0.056
mobility limitations	2	795	10.73	0.000	2+ / 0	-7.126	0.000

Source: SHARE Wave 8 release 8-0-0

Appendix 8: Correlation with IG (ANOVA)

Factor Var.	d.f. b/w groups	d.f. w/in groups	F-stat	P-val.	Sign. Groups.	Diff.	P-val. (between separate groups)
gender	1	796	22.46	0.000	female / male	-0.142	0.000
age group	2	795	17.98	0.000	65-79 /50-64	-0.132	0.000
					80+ /50-64	-0.270	0.000
					80+ / 65-79	-0.138	0.007
education	2	795	12.23	0.000	secondary/primary	0.154	0.001
					tertiary/primary	0.238	0.000
					tertiary/secondary	0.084	0.054
working			28.32	0.000	working/non working	0.203	0.000
	1	796					
financial	3	794	7.19	0.000	some difficulties/ great difficulties	0.171	0.031
					fairly easy / great difficulties	0.222	0.001
					Easily/ great difficulties	0.261	0.000
Subjective health	4	793	20.58	0.000	fair/excellent	-0.237	0.001
					fair/very good	-0.236	0.000
					fair / good	-0.157	0.000
					poor / excellent	-0.471	0.000
					poor / very good	-0.470	0.000
					poor / good	-0.391	0.000
					poor / fair	-0.234	0.001
mobility limitations	2	795	40.21	0.000	1 / 0	-0.120	0.008
					2+ / 0	-0.284	0.000
					2+ / 1	-0.165	0.000

Source: SHARE Wave 8 release 8-0-0

Appendix 9: ENMO and IG by self-reported overall health

Self-reported overall health	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Media n IG	Mean IG	SD IG	SE IG
Excellent	53	25.90	34.65	25.38	3.49	-2.31	-2.28	0.36	0.05
Very good	145	24.99	30.47	20.21	1.68	-2.28	-2.29	0.33	0.03
Good	327	22.33	27.45	18.44	1.02	-2.35	-2.36		0.02
Fair	214	22.36	26.65	18.64	1.27	-2.49	-2.52	0.41	0.03
Poor	59	15.61	21.99	23.56	3.07	-2.71	-2.75	0.65	0.09

Source: SHARE Wave 8 release 8-0-0

Appendix 10: ENMO and IG by number of limitations in mobility

Limitations in mobility	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
0	361	24.35	31.18	21.50	1.13	-2.27	-2.29	0.33	0.02
1	143	22.91	27.29	17.78	1.49	-2.42	-2.41	0.34	0.03
2+	294	19.41	24.06	18.06	1.05	-2.52	-2.57	.50	0.03

Source: SHARE Wave 8 release 8-0-0

Appendix 11: Linear OLS Regression: ENMO& IG (complete table)

	(1) Mean ENMO	(2) Mean ENMO	(3) IG	(4) IG
Gender: Female (Ref: Male)	-1.397	-.881	-.159***	-.126***
	(1.432)	(1.45)	(.029)	(.029)
Age: 65-79 (Ref: 50-64)	-4.611***	-3.955**	-.15***	-.107***
	(1.544)	(1.576)	(.032)	(.031)
Age: 80+ (Ref: 50-64)	-4.43*	-3.971*	-.285***	-.223***
	(2.282)	(2.335)	(.047)	(.047)
No. valid days		-1.455**		-.009
		(.639)		(.013)
OxCGRT stringency index		.094		-.002
		(.081)		(.002)
OxCGRT not leaving house: Recommendation (Ref: No)		-2.5		.003
		(4.445)		(.089)
OxCGRT not leaving house: Requirement (Ref: No)		-2.826		.027
		(5.139)		(.102)
Month: Dec. 2019 (Ref: Nov. 2019)		10.086***		.057
		(3.266)		(.065)
Month: Jan. 2020 (Ref: Nov. 2019)		3.805		.044
		(3.174)		(.063)
Month: Feb. 2020 (Ref: Nov. 2019)		1.875		.097
		(3.166)		(.063)
Month: Mar. 2020 (Ref: Nov. 2019)		-.547		.094
		(4.099)		(.082)
Month: Apr. 2020 (Ref: Nov. 2019)		-22.405		-.321
		(20.428)		(.407)
Education: Medium (Ref: low)		-2.698		.065
		(2.077)		(.041)
Education: High (Ref: low)		-.51		.09*
		-.783		.078
Make ends meet: Some difficulties (Ref: Great difficulties)		(2.888)		(.058)
		1.303		.108*
Make ends meet: Fairly easily (Ref: Great difficulties)		(2.839)		(.057)
		-.635		.107*
Make ends meet: Easily (Ref: Great difficulties)		(2.93)		(.058)
		-.783		.078
Health: Very good (Ref: Excellent)		-4.682		-.009
		(3.153)		(.063)
Health: Good (Ref: Excellent)		-6.029**		-.04
		(2.958)		(.059)
Health: Fair (Ref: Excellent)		-5.237		-.119*
		(3.226)		(.064)
Health: Poor (Ref: Excellent)		-7.578*		-.297***
		(4.058)		(.081)
Limitation in mobility: 1 (Ref: 0)		-3.077		-.073*
		(1.99)		(.04)
Limitations in mobility: 2+ (Ref: 0)		-5.431***		-.132***
		(1.836)		(.037)
Constant	31.672***	47.712***	-2.206***	-2.258***
	(1.521)	(7.127)	(.031)	(.142)
Observations	798	798	798	798
R-squared	.012	.076	.077	.189

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*
Source: SHARE Wave 8 release 8-0-0

Appendix 12: Linear OLS regression: Self-reportd activity as determinants of mean ENMO and IG

	(1) ENMO	(2) ENMO	(3) IG	(4) IG
More than once a week vigorously active (Ref: Medium activity)	2.941*		.132***	
	(1.557)		(.032)	
Hardly ever, or never moderately active (Ref: Medium activity)	-2.38		-.32***	
	(2.523)		(.052)	
Vigorous activity: Once a week (Ref: More than once a week)		-2.482		-.088*
		(2.265)		(.046)
Vigorous activity: One to three times a month (Ref: More than once a week)		-2.73		-.052
		(2.599)		(.053)
Vigorous activity: Hardly ever, or never (Ref: More than once a week)		-2.993*		-.157***
		(1.763)		(.036)
Moderate activity: Once a week (Ref: More than once a week)		-1.93		-.094**
		(2.024)		(.041)
Moderate activity: One to three times a month (Ref: More than once a week)		.83		-.044
		(3.027)		(.062)
Moderate activity: Hardly ever, or never (Ref: More than once a week)		-2.804		-.308***
		(2.597)		(.053)
_cons	27.167***	30.34***	-2.427***	-2.281***
	(.904)	(1.287)	(.019)	(.026)
Observations	798	798	798	798
R-squared	.007	.009	.08	.094

Standard errors are in parentheses
**** p<.01, ** p<.05, * p<.1*
Source: SHARE Wave 8 release 8-0-0

Appendix 13: ENMO and IG by frequency of vigorous activities

Vigorous activities	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
More than once a week	245	26.13	30.11	18.92	1.21	-2.29	-2.30	0.32	0.02
Once a week	113	21.87	27.57	17.93	1.69	-2.38	-2.39	0.35	0.03
One to three times a month	81	22.25	27.07	19.84	2.20	-2.45	-2.37	0.34	0.04
Hardly ever, or never	359	21.11	26.59	21.04	1.11	-2.46	-2.52	0.49	0.03

Source: SHARE Wave 8 release 8-0-0

Appendix 14: ENMO and IG by frequency of moderate activities

Moderate activities	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
More than once a week	551	23.36	28.63	20.13	0.86	-2.36	-2.36	0.36	0.02
Once a week	122	20.93	26.13	18.37	1.66	-2.44	-2.47	0.36	0.03
One to three times a month	50	21.33	28.31	20.31	2.87	-2.51	-2.46	0.52	0.07
Hardly ever, or never	75	21.92	24.71	20.07	2.32	-2.61	-2.74	0.66	0.08

Source: SHARE Wave 8 release 8-0-0

Appendix 15: Correlation of IG and ENMO with self-reported moderate and vigorous activity (linear OLS regression)

a) IG - vigorous activity

	(1) All	(2) Male	(3) Female	(4) 50-64	(5) 65-80	(6) 80+	(7) Low edu	(8) Medium edu	(9) High edu	(10) Not working	(11) Working
Vigorous activity: Once a week	-.09*	-.05	-.09	0	-.11*	-.37	-.29	-.07	-.05	-.13**	.04
	(.05)	(.07)	(.06)	(.06)	(.06)	(.25)	(.19)	(.06)	(.08)	(.06)	(.06)
Vigorous activity: One to three times a month	-.08	-.08	-.07	-.05	-.06	-.27	-.19	-.08	-.03	-.09	.02
	(.05)	(.08)	(.07)	(.06)	(.07)	(.25)	(.22)	(.06)	(.08)	(.06)	(.08)
Vigorous activity: Hardly ever, or never	-.22***	-.22***	-.2***	-.1**	-.21***	-.41***	-.39***	-.17***	-.17***	-.24***	.01
	(.03)	(.05)	(.05)	(.04)	(.05)	(.15)	(.13)	(.04)	(.06)	(.04)	(.05)
constant	-2.3***	-2.23***	-2.36***	-2.27***	-2.32***	-2.26***	-2.28***	-2.32***	-2.26***	-2.31***	-2.26***
	(.03)	(.04)	(.04)	(.03)	(.04)	(.13)	(.11)	(.03)	(.04)	(.03)	(.03)
Observations	798	329	469	276	418	104	122	482	194	652	146
R-squared	.05	.06	.04	.02	.05	.07	.07	.04	.04	.06	0

	(12) Great difficulty	(13) Some difficulty	(14) Faily easily	(15) Easily	(16) Excellent health	(17) Very good health	(18) Good health	(19) Fair health	(20) Poor health	(21) No mob. lim.	(22) 1 mob. lim.	(23) 2+ mob. lim.
Vigorous activity: Once a week	-.16	-.06	-.06	-.1	.02	-.15*	-.04	-.08	-.29	-.12**	.06	-.09
	(.26)	(.1)	(.08)	(.07)	(.13)	(.08)	(.06)	(.11)	(.49)	(.05)	(.09)	(.11)
Vigorous activity: One to three times a month	-.03	-.12	-.09	.03	.07	0	-.02	-.12	-.26	-.04	-.11	-.04
	(.37)	(.1)	(.08)	(.09)	(.2)	(.1)	(.07)	(.11)	(.55)	(.06)	(.09)	(.12)
Vigorous activity: Hardly ever, or never	-.17	-.2***	-.2***	-.22***	-.16	-.07	-.15***	-.19***	-.14	-.14***	-.07	-.2**
	(.2)	(.07)	(.06)	(.05)	(.12)	(.07)	(.05)	(.07)	(.4)	(.04)	(.07)	(.08)
constant	-2.48***	-2.34***	-2.29***	-2.26***	-2.25***	-2.24***	-2.3***	-2.38***	-2.6***	-2.22***	-2.37***	-2.43***
	(.18)	(.06)	(.04)	(.04)	(.08)	(.04)	(.04)	(.06)	(.39)	(.03)	(.05)	(.07)
Observations	63	190	277	268	53	145	327	214	59	361	143	294
R-squared	.02	.04	.05	.07	.05	.03	.03	.03	.01	.03	.03	.03

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

b) IG - moderate activity

	(1) All	(2) Male	(3) Female	(4) 50-64	(5) 65-80	(6) 80+	(7) Low edu	(8) Medium edu	(9) High edu	(10) Not working	(11) Working
Moderate activity: Once a week	-.12***	-.06	-.16***	-.08	-.14**	-.21	-.13	-.09*	-.16**	-.14***	-.04
	(.04)	(.06)	(.05)	(.05)	(.06)	(.18)	(.13)	(.05)	(.07)	(.05)	(.06)
Moderate activity: One to three times a month	-.1*	.01	-.17**	-.06	-.1	-.15	-.48**	0	-.15	-.12*	.02
	(.06)	(.09)	(.08)	(.08)	(.09)	(.19)	(.2)	(.07)	(.13)	(.07)	(.1)
Moderate activity: Hardly ever, or never	-.38***	-.47***	-.32***	-.19***	-.36***	-.58***	-.57***	-.26***	-.25**	-.4***	-.03
	(.05)	(.08)	(.06)	(.07)	(.07)	(.16)	(.12)	(.07)	(.1)	(.06)	(.1)
constant	-2.36***	-2.28***	-2.41***	-2.28***	-2.38***	-2.45***	-2.39***	-2.38***	-2.28***	-2.38***	-2.24***
	(.02)	(.03)	(.02)	(.02)	(.02)	(.07)	(.06)	(.02)	(.03)	(.02)	(.03)
Observations	798	329	469	276	418	104	122	482	194	652	146
R-squared	.07	.09	.07	.03	.07	.12	.18	.03	.05	.08	0

	(12) Great difficulty	(13) Some difficulty	(14) Faily easily	(15) Easily	(16) Excellent health	(17) Very good health	(18) Good health	(19) Fair health	(20) Poor health	(21) No mob. lim.	(22) 1 mob. lim.	(23) 2+ mob. lim.
Moderate activity: Once a week	-.08	-.02	-.11	-.15**	-.09	-.19**	-.09	-.06	-.08	-.14***	-.09	-.04
	(.15)	(.08)	(.07)	(.07)	(.16)	(.08)	(.06)	(.07)	(.26)	(.05)	(.09)	(.08)
Moderate activity: One to three times a month	-.22	.01	-.18*	-.03	-.23	.46**	-.03	-.14	.01	.03	.3*	-.14
	(.28)	(.11)	(.1)	(.12)	(.19)	(.18)	(.09)	(.09)	(.3)	(.09)	(.15)	(.1)
Moderate activity: Hardly ever, or never	-.58***	-.31***	-.33***	-.34***	.02	-.15	-.06	-.34***	-.58***	-.05	-.16	-.4***
	(.2)	(.09)	(.09)	(.1)	(.37)	(.14)	(.09)	(.08)	(.18)	(.09)	(.12)	(.08)
constant	-2.5***	-2.4***	-2.35***	-2.32***	-2.26***	-2.27***	-2.35***	-2.45***	-2.57***	-2.27***	-2.4***	-2.48***
	(.09)	(.04)	(.03)	(.03)	(.06)	(.03)	(.02)	(.04)	(.11)	(.02)	(.03)	(.04)
Observations	63	190	277	268	53	145	327	214	59	361	143	294
R-squared	.13	.07	.06	.05	.03	.09	.01	.08	.17	.02	.05	.09

Standard errors are in parentheses

**** p<.01, ** p<.05, * p<.1*

c) ENMO - vigorous activity

	(1) All	(2) Male	(3) Female	(4) 50-64	(5) 65-80	(6) 80+	(7) Low edu	(8) Medium edu	(9) High edu	(10) Not working	(11) Working
Vigorous activity: Once a week	-2.54	-.44	-3.72	.06	-3.09	-10.17	-5.84	-1.45	-3.24	-3.56	.89
	(2.26)	(3.79)	(2.81)	(3.5)	(3.07)	(9.44)	(8.95)	(2.67)	(4.19)	(2.7)	(3.65)
Vigorous activity: One to three times a month	-3.03	-3.03	-3	-1.25	-2.87	-11.42	-8.57	.59	-8.15*	-2.11	-6.02
	(2.55)	(4.06)	(3.27)	(3.86)	(3.57)	(9.44)	(10.34)	(3.09)	(4.42)	(2.96)	(4.55)
Vigorous activity: Hardly ever, or never	-3.52**	-4.11	-3.06	-4.4	-2.78	-1.17	-11.33*	-1.1	-4.42	-2.8	-5.56*
	(1.65)	(2.7)	(2.09)	(2.74)	(2.29)	(5.45)	(5.91)	(1.97)	(3.32)	(1.92)	(3.16)
constant	30.11***	30.44***	29.8***	32.4***	28.34***	28.69***	36.74***	27.53***	33.01***	29.38***	32.27***
	(1.27)	(1.96)	(1.67)	(1.89)	(1.8)	(4.81)	(5.17)	(1.53)	(2.24)	(1.53)	(2.01)
Observations	798	329	469	276	418	104	122	482	194	652	146
R-squared	.01	.01	.01	.01	0	.03	.03	0	.02	0	.03

	(12) Great difficulty	(13) Some difficulty	(14) Faily easily	(15) Easily	(16) Excellent health	(17) Very good health	(18) Good health	(19) Fair health	(20) Poor health	(21) No mob. lim.	(22) 1 mob. lim.	(23) 2+ mob. lim.
Vigorous activity: Once a week	10.41	-2.04	-5.89	-1.31	-10.17	-6.79	.03	4.42	-15.95	-5.78*	5.18	1.13
	(13.03)	(4.45)	(3.98)	(3.41)	(9.4)	(4.77)	(3.1)	(5.08)	(17.49)	(3.26)	(4.7)	(4.16)
Vigorous activity: One to three times a month	-3.48	4.42	-7.75*	-3.34	-12.92	-6.65	1.88	-4.01	-1.21	-3.19	-3.5	1.08
	(18.08)	(4.74)	(4.14)	(4.34)	(13.89)	(6.09)	(3.53)	(4.79)	(19.56)	(3.84)	(4.99)	(4.52)
Vigorous activity: Hardly ever, or never	.82	-.08	-4.11	-5.64**	-8.31	1.11	-.77	-2.58	-8.06	-3.54	.02	1.46
	(9.67)	(3.39)	(2.85)	(2.51)	(8.51)	(4.06)	(2.41)	(3.34)	(14.25)	(2.69)	(3.47)	(2.91)
constant	25.58***	26.7***	32.38***	30.36***	40.09***	31.9***	27.53***	28.24***	29.96**	33.65***	26.97***	22.91***
	(8.69)	(2.7)	(2.2)	(1.8)	(5.35)	(2.41)	(1.78)	(2.91)	(13.83)	(1.78)	(2.5)	(2.59)
Observations	63	190	277	268	53	145	327	214	59	361	143	294
R-squared	.02	.01	.02	.02	.04	.02	0	.01	.02	.01	.02	0

Standard errors are in parentheses

*** p<.01, ** p<.05, * p<.1

d) ENMO - moderate activity

	(1) All	(2) Male	(3) Female	(4) 50-64	(5) 65-80	(6) 80+	(7) Low edu	(8) Medium edu	(9) High edu	(10) Not working	(11) Working
Moderate activity: Once a week	-2.5	-2.28	-2.77	-.31	-4.04	-4.48	-10.15	1.18	-7.09*	-2.62	-2.63
	(1.99)	(3.21)	(2.52)	(3.16)	(2.71)	(7.06)	(6.39)	(2.4)	(3.84)	(2.34)	(3.42)
Moderate activity: One to three times a month	-.32	-5.76	3.36	-.95	1.17	-2.54	-15.46	2.85	.95	.6	-4.65
	(2.94)	(4.95)	(3.6)	(4.79)	(4.34)	(7.36)	(9.96)	(3.31)	(6.65)	(3.33)	(5.88)
Moderate activity: Hardly ever, or never	-3.92	-8.48*	-1.29	-1.2	-6.6**	.71	-10.17*	.08	-8	-3.9	-1.12
	(2.45)	(4.39)	(2.89)	(4.57)	(3.34)	(6.04)	(5.71)	(3.36)	(5.26)	(2.69)	(6.26)
constant	28.63***	29.8***	27.8***	30.95***	27.47***	27.06***	33.16***	26.5***	31.68***	28.08***	31.03***
	(.85)	(1.4)	(1.05)	(1.41)	(1.15)	(2.65)	(3.04)	(.99)	(1.64)	(.98)	(1.58)
Observations	798	329	469	276	418	104	122	482	194	652	146
R-squared	0	.01	.01	0	.01	.01	.05	0	.03	0	.01

	(12) Great difficulty	(13) Some difficulty	(14) Faily easily	(15) Easily	(16) Excellent health	(17) Very good health	(18) Good health	(19) Fair health	(20) Poor health	(21) No mob. lim.	(22) 1 mob. lim.	(23) 2+ mob. lim.
Moderate activity: Once a week	-10.93	3.77	-2.83	-4.75	4.13	-7.85	-2.64	1.38	-8.83	-5.48*	5.7	-.45
	(7.89)	(3.87)	(3.55)	(3.35)	(11)	(5.18)	(2.88)	(3.35)	(9.85)	(3.27)	(4.64)	(2.86)
Moderate activity: One to three times a month	-12.68	.14	-3.71	44440	10.26	20.5*	-3.03	2.1	-15.48	5.26	4.34	-.99
	(14.2)	(4.97)	(4.99)	(5.6)	(13.19)	(11.68)	(4.64)	(4.42)	(11.33)	(5.69)	(8.15)	(3.61)
Moderate activity: Hardly ever, or never	-17.75*	-1.62	-5.29	1.36	45.71*	6.63	1.08	-3.87	-11.58	.35	-3.52	-1.51
	(10.1)	(4.03)	(4.65)	(4.57)	(25.5)	(9.12)	(4.21)	(3.81)	(7.02)	(5.88)	(6.18)	(2.9)
constant	33.75***	26.52***	29.88***	27.79***	32.54***	30.74***	27.94***	26.72***	27.89***	31.72***	26.68***	24.51***
	(4.73)	(1.79)	(1.44)	(1.26)	(3.89)	(1.82)	(1.2)	(1.7)	(4.34)	(1.28)	(1.69)	(1.44)
Observations	63	190	277	268	53	145	327	214	59	361	143	294
R-squared	.07	.01	.01	.02	.07	.04	0	.01	.07	.01	.02	0

Standard errors are in parentheses

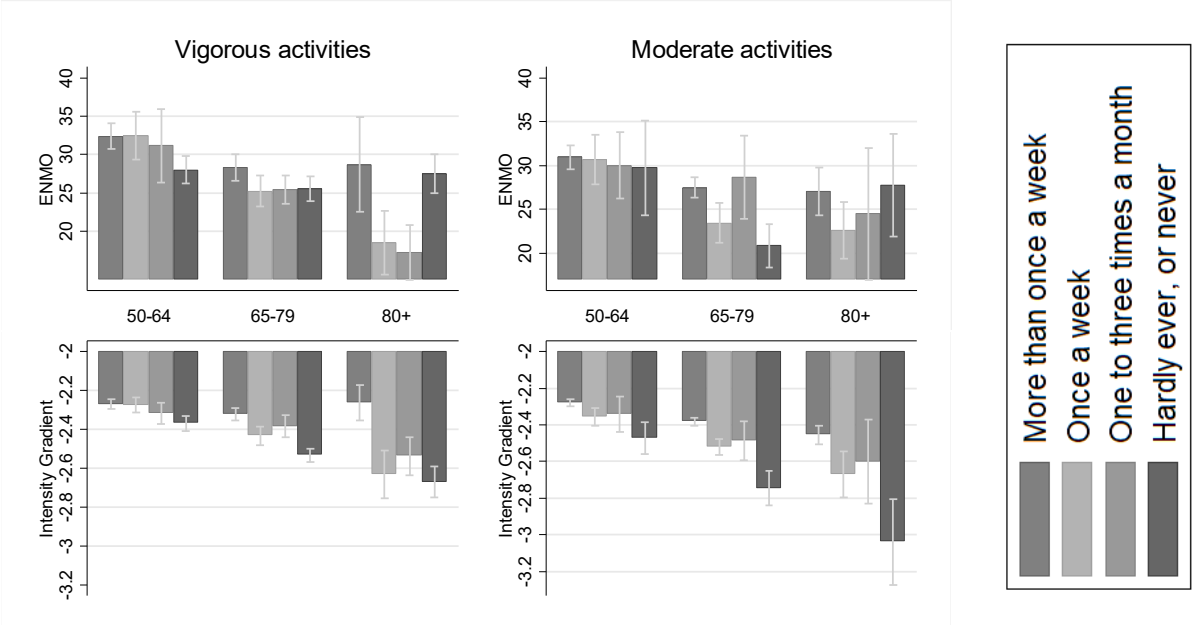
*** *p<.01, ** p<.05, * p<.1*

Appendix 16: ENMO and IG by self-reported activity and age

Self- reported activity	Age	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
More than once a week vigorously active	50-64	105	29.05	32.40	1.65	1.65	-2.27	-2.27	0.26	0.03
More than once a week vigorously active	65-79	120	24.09	28.34	1.72	1.72	-2.31	-2.32	0.35	0.03
More than once a week vigorously active	80+	20	19.88	28.69	6.17	6.17	-2.27	-2.26	0.41	0.09
Medium	50-64	154	23.09	29.57	1.62	1.62	-2.33	-2.32	0.32	0.03
Medium	65-79	260	20.22	26.19	1.27	1.27	-2.45	-2.46	0.40	0.02
Medium	80+	68	21.16	25.48	2.32	2.32	-2.52	-2.57	0.47	0.06
Hardly ever, or never moderately active	50-64	17	24.57	31.25	6.24	6.24	-2.42	-2.49	0.39	0.09
Hardly ever, or never moderately active	65-79	38	16.31	20.64	2.54	2.54	-2.64	-2.74	0.60	0.10
Hardly ever, or never moderately active	80+	16	22.93	27.77	5.89	5.89	-2.91	-3.04	0.94	0.23

Source: SHARE Wave 8 release 8-0-0

Appendix 17: ENMO and IG by self-reported frequency of vigorous and moderate activity and age



Vigorous activity	Age	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
More than once a week	50-64	105	29.05	32.40	1.65	1.65	-2.27	-2.27	0.26	0.03
More than once a week	65-79	120	24.09	28.34	1.72	1.72	-2.31	-2.32	0.35	0.03
More than once a week	80+	20	19.88	28.69	6.17	6.17	-2.27	-2.26	0.41	0.09
Once a week	50-64	43	26.38	32.46	3.15	3.15	-2.27	-2.27	0.24	0.04
Once a week	65-79	63	20.30	25.24	1.99	1.99	-2.43	-2.43	0.39	0.05
Once a week	80+	7	15.41	18.52	4.13	4.13	-2.55	-2.63	0.33	0.12
One to three times a month	50-64	33	24.16	31.16	4.78	4.78	-2.35	-2.32	0.32	0.06
One to three times a month	65-79	41	23.06	25.46	1.83	1.83	-2.47	-2.38	0.36	0.06
One to three times a month	80+	7	12.67	17.27	3.58	3.58	-2.47	-2.54	0.26	0.10
Hardly ever, or never	50-64	95	22.30	28.01	1.83	1.83	-2.36	-2.37	0.37	0.04
Hardly ever, or never	65-79	194	19.58	25.56	1.62	1.62	-2.47	-2.53	0.46	0.03
Hardly ever, or never	80+	70	22.85	27.52	2.51	2.51	-2.58	-2.67	0.65	0.08

Source: SHARE Wave 8 release 8-0-0

Moderate activity	Age	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
More than once a week	50-64	191	25.94	30.95	1.39	1.39	-2.28	-2.28	0.28	0.02
More than once a week	65-79	293	21.87	27.47	1.18	1.18	-2.37	-2.38	0.38	0.02
More than once a week	80+	67	20.83	27.06	2.71	2.71	-2.42	-2.45	0.43	0.05
Once a week	50-64	47	22.30	30.64	2.83	2.83	-2.35	-2.36	0.34	0.05
Once a week	65-79	64	19.51	23.43	2.27	2.27	-2.52	-2.52	0.34	0.04
Once a week	80+	11	22.07	22.58	3.25	3.25	-2.73	-2.67	0.42	0.13
One to three times a month	50-64	18	22.83	30.01	3.81	3.81	-2.32	-2.34	0.41	0.10
One to three times a month	65-79	22	21.49	28.65	4.76	4.76	-2.52	-2.49	0.50	0.11
One to three times a month	80+	10	16.70	24.52	7.53	7.53	-2.52	-2.60	0.73	0.23
Hardly ever, or never	50-64	20	23.63	29.75	5.41	5.41	-2.40	-2.47	0.38	0.09
Hardly ever, or never	65-79	39	16.33	20.87	2.48	2.48	-2.66	-2.75	0.60	0.10
Hardly ever, or never	80+	16	22.93	27.77	5.89	5.89	-2.91	-3.04	0.94	0.23

Source: SHARE Wave 8 release 8-0-0

Appendix 18: ENMO and IG by country

Country	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
Czech Republic	99	19.11	22.06	11.30	1.14	-2.41	-2.42	0.42	0.04
Slovenia	97	22.36	24.03	12.77	1.30	-2.47	-2.49	0.39	0.04
Sweden	63	19.63	24.13	14.34	1.81	-2.25	-2.28	0.37	0.05
Germany	107	24.14	25.70	13.64	1.32	-2.37	-2.38	0.29	0.03
Italy	66	24.58	27.02	13.90	1.71	-2.46	-2.49	0.39	0.05
Belgium	73	22.22	29.87	21.13	2.47	-2.38	-2.38	0.38	0.04
Poland	122	21.23	30.50	27.60	2.50	-2.44	-2.55	0.55	0.05
France	73	25.22	32.87	22.06	2.58	-2.38	-2.38	0.40	0.05
Spain	64	26.68	34.16	28.25	3.53	-2.21	-2.30	0.45	0.06
Denmark	34	31.21	34.60	24.04	4.12	-2.30	-2.32	0.45	0.08

Source: SHARE Wave 8 release 8-0-0

Appendix 19: ENMO and IG by country and self-reported activity

Country	Self-reported activity	N	Median ENMO	Mean ENMO	SD ENMO	SE ENMO	Median IG	Mean IG	SD IG	SE IG
Germany	More than once a week vigorously active	39	26.73	27.26	2.20	2.20	-2.34	-2.39	0.27	0.04
Germany	Medium	62	22.78	24.83	1.71	1.71	-2.37	-2.35	0.31	0.04
Germany	Hardly ever, or never moderately active	6	23.48	24.47	6.74	6.74	-2.45	-2.56	0.25	0.10
Sweden	More than once a week vigorously active	25	23.87	26.79	2.86	2.86	-2.25	-2.26	0.39	0.08
Sweden	Medium	37	18.98	22.88	2.32	2.32	-2.25	-2.26	0.34	0.06
Sweden	Hardly ever, or never moderately active	1	3.44	3.44	.	.	-3.16	-3.16	.	.
Spain	More than once a week vigorously active	20	28.14	39.24	6.93	6.93	-2.11	-2.12	0.23	0.05
Spain	Medium	32	22.55	31.44	4.82	4.82	-2.27	-2.32	0.47	0.08
Spain	Hardly ever, or never moderately active	12	28.47	32.95	7.91	7.91	-2.39	-2.54	0.56	0.16
Italy	More than once a week vigorously active	22	25.85	30.20	3.24	3.24	-2.33	-2.37	0.27	0.06
Italy	Medium	35	22.92	27.05	2.23	2.23	-2.52	-2.51	0.37	0.06
Italy	Hardly ever, or never moderately active	9	21.87	19.15	3.69	3.69	-2.63	-2.71	0.60	0.20
France	More than once a week vigorously active	16	30.40	34.67	5.24	5.24	-2.31	-2.27	0.42	0.10
France	Medium	52	22.79	31.79	3.09	3.09	-2.39	-2.39	0.39	0.05
France	Hardly ever, or never moderately active	5	29.57	38.33	12.12	12.12	-2.71	-2.61	0.34	0.15
Denmark	More than once a week vigorously active	15	32.22	38.50	6.75	6.75	-2.11	-2.09	0.31	0.08
Denmark	Medium	16	25.23	32.15	5.78	5.78	-2.34	-2.47	0.45	0.11
Denmark	Hardly ever, or never moderately active	3	38.57	28.18	13.05	13.05	-2.52	-2.71	0.55	0.32
Belgium	More than once a week vigorously active	20	25.34	34.01	5.57	5.57	-2.38	-2.36	0.33	0.07
Belgium	Medium	43	20.40	27.02	2.72	2.72	-2.37	-2.35	0.38	0.06
Belgium	Hardly ever, or never moderately active	10	27.09	33.85	8.26	8.26	-2.54	-2.57	0.44	0.14
Czech Rep.	More than once a week vigorously active	36	19.66	23.44	1.71	1.71	-2.29	-2.31	0.28	0.05
Czech Rep.	Medium	58	19.75	21.85	1.58	1.58	-2.50	-2.45	0.44	0.06
Czech Rep.	Hardly ever, or never moderately active	5	13.09	14.55	3.13	3.13	-2.41	-2.74	0.78	0.35
Poland	More than once a week vigorously active	19	27.64	37.69	5.05	5.05	-2.27	-2.27	0.31	0.07
Poland	Medium	89	21.43	32.12	3.12	3.12	-2.46	-2.49	0.38	0.04
Poland	Hardly ever, or never moderately active	14	10.13	10.47	1.47	1.47	-3.00	-3.29	0.98	0.26
Slovenia	More than once a week vigorously active	33	23.32	24.92	2	2	-2.29	-2.33	0.34	0.06
Slovenia	Medium	58	20.04	22.42	1.71	1.71	-2.57	-2.58	0.38	0.05
Slovenia	Hardly ever, or never moderately active	6	32.60	34.65	5.42	5.42	-2.30	-2.51	0.51	0.21

Source: SHARE Wave 8 release 8-0-0

Appendix 20: Full table: Objective measures determinants with regions included

	Mean ENMO			IG		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Gender: Female (Ref: Male)	-1.250	-0.891	-0.838	-0.150***	-0.120***	-0.118***
	-1.494	-1.515	-1.531	(0.030)	(0.030)	(0.030)
Age: 65-79 (Ref: 50-64)	-4.250***	-3.694**	-3.705	-0.155***	-0.107***	-0.063
	-1.597	-1.679	-2.647	(0.028)	(0.030)	(0.046)
Age: 80+ (Ref: 50-64)	-4.242*	-3.840	-1.329	-0.300***	-0.229***	-0.038
	-2.423	-2.569	-3.745	(0.059)	(0.054)	(0.063)
East	-2.648	-1.929	-1.178	-0.099***	-0.101***	-0.002
	-1.648	-1.768	-2.640	(0.034)	(0.036)	(0.046)
South	1.287	-0.814	-1.123	-0.039	-0.029	0.015
	-2.302	-2.372	-3.230	(0.042)	(0.045)	(0.048)
North	-0.269	-1.977	0.669	0.108**	0.042	0.117*
	-2.302	-2.482	-5.554	(0.046)	(0.049)	(0.065)
65-79 # East			-0.051			-0.105*
			-3.495			(0.063)
65-79 # South			0.756			0.021
			-5.000			(0.080)
65-79 # North			-2.733			-0.075
			-6.260			(0.088)
80+ # East			-6.130			-0.298**
			-5.173			(0.130)
80+ # South			2.103			-0.452**
			-9.664			(0.200)
80+ # North			-5.212			-0.230
			-8.359			(0.143)
Number of valid days		-1.318*	-1.255		0.002	0.000
		(0.787)	(0.763)		(0.013)	(0.013)
OxCGRT stringency index		0.069	0.063		-0.002	-0.002
		(0.079)	(0.079)		(0.002)	(0.002)
OxCGRT not leaving house:		-3.148	-3.448		-0.048	-0.047
Recommendation (Ref: No)		-3.096	-3.053		(0.070)	(0.072)
OxCGRT not leaving house:		-2.242	-2.157		0.007	-0.005
Requirement (Ref: No)		-4.503	-4.443		(0.102)	(0.101)
Month: Dec. 2019 (Ref: Nov. 2019)		10.358***	10.550***		0.061	0.057
		-2.788	-2.862		(0.058)	(0.059)
Month: Jan. 2020 (Ref: Nov. 2019)		4.140*	4.332*		0.051	0.053
		-2.215	-2.263		(0.062)	(0.061)
Month: Feb. 2020 (Ref: Nov. 2019)		2.325	2.542		0.103*	0.106*
		-2.168	-2.229		(0.059)	(0.060)
Month: Mar. 2020 (Ref: Nov. 2019)		0.382	0.941		0.105	0.110
		-3.182	-3.237		(0.083)	(0.085)
Month: Apr. 2020 (Ref: Nov. 2019)		-21.647***	-20.436***		-0.284*	-0.275*
		-6.126	-6.000		(0.147)	(0.152)
Education: Medium (Ref: low)		-2.541	-2.477		0.077	0.085
		-2.444	-2.595		(0.053)	(0.053)
Education: High (Ref: low)		-0.636	-0.630		0.086	0.096*
		-2.827	-2.880		(0.057)	(0.058)
Make ends meet: Some difficulties		-0.749	-0.753		0.075	0.068
(Ref: Great difficulties)		-3.488	-3.502		(0.068)	(0.066)
Make ends meet: Fairly easily		1.242	1.344		0.095	0.088
(Ref: Great difficulties)		-3.315	-3.344		(0.064)	(0.063)
Make ends meet: Easily		-0.905	-0.947		0.071	0.068
(Ref: Great difficulties)		-3.334	-3.338		(0.067)	(0.066)
Health: Very good (Ref: Excellent)		-4.807	-4.729		-0.002	-0.004
		-3.708	-3.735		(0.055)	(0.056)
Health: Good (Ref: Excellent)		-6.085*	-6.081*		-0.013	-0.029
		-3.621	-3.589		(0.054)	(0.056)
Health: Fair (Ref: Excellent)		-5.363	-5.360		-0.094	-0.103*

		-3.775	-3.752		(0.060)	(0.062)
Health: Poor (Ref: Excellent)		-7.572*	-7.576*		-0.272***	-0.286***
		-4.530	-4.550		(0.099)	(0.099)
Limitation in mobility: 1 (Ref: 0)		-3.106	-3.197		-0.078**	-0.079**
		-1.923	-1.942		(0.035)	(0.035)
Limitations in mobility: 2+ (Ref: 0)		-5.431***	-5.460***		-0.131***	-0.125***
		-1.749	-1.771		(0.037)	(0.036)
Constant	32.251***	47.632***	46.540***	-2.174***	-2.317***	-2.350***
	-1.765	-7.982	-7.907	(0.031)	(0.151)	(0.153)
R-Sq.	0.018	0.078	0.081	0.102	0.201	0.217
Observations	798.000	798.000	798.000	798.000	798.000	798.000

*** *p<.01, ** p<.05, * p<.1*

Note: OLS coefficients shown. Robust standard errors in parenthesis.

Source: SHARE Wave 8 release 8-0-0

Appendix 21: Full model: Subjective measures determinants with regions included

	Model 1	Model 2
Mean ENMO	-0.002	0.000
	(0.003)	(0.002)
IG Gradient	0.551***	0.252**
	(0.130)	(0.126)
Gender: Female (Ref: Male)	0.122	-0.127
	(0.101)	(0.089)
Age: 65-79 (Ref: 50-64)	0.138	-0.170*
	(0.108)	(0.096)
Age: 80+ (Ref: 50-64)	0.020	-0.572***
	(0.165)	(0.156)
East	0.098	0.058
	(0.125)	(0.117)
South	-0.235	0.024
	(0.155)	(0.151)
North	0.170	0.185
	(0.189)	(0.161)
Number of valid days	0.087**	0.037
	(0.043)	(0.042)
OxCGRT stringency index	-0.004	-0.005
	(0.005)	(0.005)
OxCGRT not leaving house: Recommendation (Ref: No)	0.110	0.139
	(0.279)	(0.269)
OxCGRT not leaving house: Requirement (Ref: No)	0.055	0.157
	(0.317)	(0.324)
Month: Dec. 2019 (Ref: Nov. 2019)	-0.346	-0.345
	(0.244)	(0.212)
Month: Jan. 2020 (Ref: Nov. 2019)	-0.353	-0.154
	(0.244)	(0.205)
Month: Feb. 2020 (Ref: Nov. 2019)	-0.395*	-0.132
	(0.239)	(0.206)
Month: Mar. 2020 (Ref: Nov. 2019)	-0.206	-0.000
	(0.297)	(0.259)
Month: Apr. 2020 (Ref: Nov. 2019)	-0.420	-5.264***
	(0.449)	(0.437)
Education: Secondary (Ref: Primary)	0.250*	0.222
	(0.136)	(0.140)
Education: Tertiary (Ref: Primary)	0.026	0.331**
	(0.167)	(0.161)
Make ends meet: Some difficulties (Ref: Great difficulties)	-0.192	0.152
	(0.173)	(0.186)
Make ends meet: Fairly easily (Ref: Great difficulties)	0.052	0.112
	(0.174)	(0.183)
Make ends meet: Easily (Ref: Great difficulties)	0.117	0.139
	(0.186)	(0.191)
Health: Very good (Ref: Excellent)	0.184	0.109
	(0.219)	(0.192)
Health: Good (Ref: Excellent)	-0.103	-0.149
	(0.202)	(0.180)
Health: Fair (Ref: Excellent)	-0.321	-0.449**
	(0.218)	(0.200)
Health: Poor (Ref: Excellent)	-0.462*	-0.887***
	(0.275)	(0.280)
Limitation in mobility: 1 (Ref: 0)	0.024	-0.006

	(0.146)	(0.123)
Limitations in mobility: 2+ (Ref: 0)	-0.471***	-0.397***
	(0.120)	(0.111)
cut1		
Constant	-2.554***	-0.862
	(0.626)	(0.564)
cut2		
Constant	-2.186***	-0.565
	(0.626)	(0.564)
cut3		
Constant	-1.595**	-0.140
	(0.621)	(0.564)
R-Sq.	0.097	0.085
Observations	798	798

*** p<.01, ** p<.05, * p<.1

Note: Probit coefficients shown. Robust standard errors in parenthesis.

Source: SHARE Wave 8 release 8-0-0

Appendix 22: Differences in self-reported health and BMI by region

Response Var	Factor Var.	d.f. b/w groups	d.f. w/in groups	F-stat	P-val.	Sign. Groups.	Diff.	P-val. (between seperate groups)
Self-reported health	Region	3	794	11.70	0.000	East / Central	-0.217	0.054
						South / East	0.280	0.037
						North / Central	0.440	0.001
						North / East	0.656	0.000
						North / South	0.376	0.026
BMI	Region	3	786	8.59	0.000	East / Central	1.203	0.022
						North / Central	-1.566	0.045
						North / East	-2.769	0.000
						North / South	-1.906	0.024

Source: SHARE Wave 8 release 8-0-0