Genus

The impact of grandchild care provision on grandparents' depressive symptoms across Europe using multi-level analysis: do the grandchild caring patterns and the country's economy matter?

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article

Abstract

Little research has examined the cross-national differences in the impact of grandchild care provision on the grandparents' depression, by taking into account of both macro- and micro-level factors. This study used a unique grandchild caring pattern variable in order to examine the effect of the changes in the intensity of grandchild caring on the grandparents' depressive symptoms in European countries, and whether the grandparents' country level economy influenced such effect. Longitudinal data derived from the Survey of Health, Ageing, and Retirement in Europe 2010–2018 covered 13 countries and 24,656 grandparents aged 50–90. Multi-level linear regression analyses with REML estimation were used. This study found that providing grandchild care had a protective effect against grandparents' depressive symptoms in both lower and higher income countries. Moreover, providing more intensive grandchild care reduced the grandparents' depressive symptoms to a greater extent in lower income countries than higher income countries. In addition, grandmothers benefited more from grandchild caring than grandfathers, and the gender gap in the effects of grandchild care provision on one's depressive symptoms was wider in lower income countries than higher income countries in Europe. Future research can further investigate the mechanisms behind such results. The research findings can be used to develop targeted interventions aimed at grandparents providing childcare of different intensity.

Keywords: Grandparent, Grandchild care, Intensity, Depressive symptoms, Europe, SHARE

Introduction

People are living longer and as a result, individuals are increasingly likely to become grandparents during their life course. In European countries, the proportion of grandparents among people aged 50 or over ranges between 50 and 67% (e.g. 67% in Denmark and 53% in Italy) (Glaser et al., 2010), and about 58% of grandmothers and almost half of grandfathers have the experience of providing grandchild care (Moore & Rosenthal,

2016). As elaborated in existing literature, grandchild care provision is an important factor affecting the grandparents' health, and such effect varies across European countries (Bordone & Arpino, 2019; Di Gessa et al., 2016). Recent evidence has underlined the need for examining the cross-national differences in the relationship between grandchild caring and grandparents' depressive symptoms, and suggested the importance of examining macro-level factors to better understand such patterns (Arpino & Gomez-Leon, 2020; Chung & Park, 2018).

To date, most research examining the effect of grandparenthood on grandparents' depressive symptoms has investigated different dimensions of grandparenthood from a relatively static perspective, such as becoming a grandparent, having additional grandchildren, and providing (intensive) grandchild care (Bordone & Arpino, 2019; Condon et al., 2018; Di Gessa et al., 2016). However, there has been little research examining the direct effect of grandchild caring patterns, which capture the *changes and transitions* in the provision of grandchild care (e.g. having previously provided grandchild care but currently not providing such care) (Zhou et al., 2017). Moreover, the role of macro-level factors in determining the relationship between grandchild care provision and grandparents' depressive symptoms has been relatively understudied (Bordone & Arpino, 2019; Di Gessa et al., 2016; Neuberger & Haberkern, 2014). A country's culture and public policies (e.g. family norms, public childcare availability, parental leave regulation and women labour force participation) have been shown to have a moderating effect on the relationship between grandparenting and late-life depression, for example it has been shown that such factors can change the direction and strength of this relationship (Di Gessa et al., 2016; Jappens & Van Bavel, 2012; Schwarz et al., 2010). At the same time, little attention has been paid in previous research to the role of a country's economy on the relationship between providing grandchild care and the grandparents' wellbeing (Yang, 2021).

In order to address the two research gaps mentioned above, this paper seeks to investigate grandchild caring patterns and their impact on the grandparents' depressive symptoms across Europe, and the extent to which a country's economy can moderate this relationship, based on multi-level analyses and using the four waves of the Survey of Health, Ageing, and Retirement in Europe (SHARE) data collected between 2012 and 2018.

Grandchild caring and depressive symptoms in Europe

Depression is one of the most prevalent mental illnesses among the older population in Europe (Copeland et al., 2004). Existing literature has highlighted that grandchild care provision influences depressive symptoms among grandparents, although such literature has shown inconsistent findings (Arpino & Gomez-Leon, 2020; Bordone & Arpino, 2019; Brunello & Rocco, 2019). For example, Brunello and Rocco (2019) focused on the time European grandparents spent providing grandchild care using the SHARE data Waves 1–2, and found that the more time grandparents dedicated to grandchild care, the higher the probability that they developed depressive symptoms. Using the same dataset, Arpino and Gomez-Leon (2020) found that providing grandchild care reduced the risk of being depressed among European grandmothers, and further pointed out that such effect disappeared if the respondents combined grandchild care with caring for

other persons. Bordone and Arpino (2019) examined the cross-national differences in the role of transitioning to grandparenthood, having additional grandchildren, and providing grandchild care on older people's depressive symptoms in Europe, by conducting fixed models with interaction terms between the explanatory variable and the country dummies. The authors concluded that the impact of grandchild caring on the grandparents' depressive symptoms varied across Europe, and indicated the need for further research to understand such patterns (Bordone & Arpino, 2019).

The inconsistent findings of the previous research may be related to the different research methods used (Danielsbacka et al., 2019). Specifically, Brunello and Rocco (2019) used an instrumental variables strategy in order to identify the causal effect of grandchild caring on the grandparents' depressive symptoms, whilst Arpino and Gomez-Leon (2020) assessed the effect of caregiving on the carers' depression status with a lagged outcome model. As argued by Danielsbacka et al. (2019), the associations between grandchild caring and the health of grandparents were due to between-person differences, hence the fixed effects models which estimated the within-individual variations did not produce significant findings. This argument was partly supported by the research findings by Bordone and Arpino (2019), who found no significant effect of the change in providing grandchild care on the grandparents' depressive symptoms using linear fixed-effects models based on the overall model including 15 European countries. However, by examining interactions between the country dummies and the grandchild caring variable, the researchers further pointed out that the effect of grandchild care provision on the grandparents' depressive symptoms varied by European country, and showed significant results in certain contexts such as France and Spain. However, the researchers were unable to examine the exact country differences in this study, as fixed-effects estimation restricted the ability to assess the effect of invariant variables such as the country respondents resided in (Bordone & Arpino, 2019).

The role of grandchild caring patterns
To date, only few studies have focused on the dynamic pattern of grandchild care provision (Di Gessa et al., 2016; Musil et al., 2011; Zhou et al., 2017). The study by Musil et al. (2011) examined the impact of transitioning in grandparenting roles (e.g. moving in or out of caregiving) on the wellbeing of grandparents, and showed that switching to a higher caring burden (e.g. from non-caregiving to caregiving) was associated with worsening physical health and perceptions of increased stress among grandparents. Nevertheless, the study sample was collected in the state of Ohio and only included female participants (grandmothers), which could limit its relevance to other contexts. Di Gessa et al. (2016) used a seven-category measure assessing the stability and change in grandchild care provision between baseline and Wave 2, and suggested that non grandparent carers at both waves were associated with poorer self-rated health at Wave 4 compared to their counterparts who continued to provided non-intensive grandchild care between baseline and Wave 2. Another study using data from rural areas of China found that compared to non-carers, repeated grandparent carers and previous grandparent carers had better self-rated health (Zhou et al., 2017). As pointed out by Zhou et al. (2017), research on grandchild caring has mostly compared current carers with non-carers or simply measured the intensity of grandchild caring, and overlooked the change in

grandchild caring status. These studies shed light on the importance of examining the change in the intensity of grandchild care provision on the grandparents' health.

Cross-national differences in Europe

The study by Bordone and Arpino (2019) and other recent research have shown cross-national differences in the relationship between grandparenthood and grandparents' wellbeing in Europe (Bordone & Arpino, 2019; Di Gessa et al., 2016; Yang, 2021). As there has been little comparative empirical research directly examining the differences in the relationship between grandchild caring and grandparents' depression across Europe, this section broadly reviews the studies on the cross-national differences in grandparenting and grandparents' health in Europe. Up to now, the literature on this topic has investigated the effect of the welfare state, cultural norms, contextual–structural factors and other country-specific factors on the provision of grandchild care (Bordone & Arpino, 2019; Conde-Sala et al., 2017; Igel & Szydlik, 2011; Neuberger & Haberkern, 2014; Yang, 2021).

One of the most common typologies to contextualise the differences in grandparenthood in European society is the welfare state. Previous research has established that grandparents in Southern European countries are less likely than their counterparts in Northern European countries to provide grandchild care (Hank & Buber, 2009; Igel & Szydlik, 2011; Neuberger & Haberkern, 2014). However, once providing grandchild care, grandparents in Southern Europeans countries are more likely to provide intensive care compared to their counterparts in Northern European countries (ibid). Igel and Szydlik (2011) pointed out that the welfare state in Nordic countries 'crowded in' grandchild care provision, but 'crowded out' the intensity of such care provision. Recent studies have further shown that grandchild caring was associated with better quality of life in the Southern European regime only (Spain and Italy), and not in any other European countries (Conde-Sala et al., 2017; Neuberger & Haberkern, 2014).

Other researchers have examined the role of cultural norms, which are highly correlated with the welfare state (Arpino et al., 2018; Jappens & Van Bavel, 2012; Neuberger & Haberkern, 2014). The research by Jappens and Van Bavel (2012) showed that in countries with stronger family ties, grandchild care was the main source of childcare even when the availability of formal childcare was controlled. Neuberger and Haberkern (2014) pointed out that in European countries with high expectations for grandparent obligations such as Italy and Spain, grandparents who did not provide grandchild care had a lower quality of life compared to their counterparts who provided such care. Consistent with this finding, Arpino et al. (2018) found that grandparents who did not provide grandchild care reported lower life satisfaction in countries where intensive grandparental childcare was socially expected.

Another dimension focuses on the contextual–structural factors, such as formal childcare provision, female labour market structure and parental leave policy (Bordone et al., 2017; Di Gessa et al., 2016). Di Gessa et al. (2016) found that the variation in grandchild caring across Europe was mostly determined by the female labour market structure and formal childcare provision, in particular low labour force participation among younger and older women, and low formal childcare provision were related to more intensive grandchild care provision. Bordone et al. (2017) argued that the effect of

grandparenthood on grandparents' depression varied between three country categories, using the classification of defamilialisation, familialism by default, and supported familialism to distinguish between contexts based on the division of intergenerational responsibilities between the state and the family. Furthermore, one recent study by Lakomý (2020) interestingly suggested that the beneficial effect of grandchild caring on loneliness reduced with the increasing availability of formal childcare services.

Some research findings have gone beyond the contextual factors mentioned above, and examined the role of country-specific factors directly (Bordone & Arpino, 2019; Yang, 2021). For example, it was found that more intensive grandchild care was associated with a higher number of depressive symptoms among grandmothers in Spain and Sweden, while the opposite was true in Italy and Greece (Bordone & Arpino, 2019). Either the role of the welfare state or cultural norms fails to explain the similar results in Spain and Sweden, suggesting the need to explore other country-specific factors in affecting the relationship between grandchild caring and the grandparents' depressive symptoms. One recent study by Yang (2021) examined the role of a country's economy in moderating the impact of transitioning to grandparenthood on the grandparents' depressive symptoms across England, Europe and China. The author demonstrated that becoming a grandparent reduced the number of depressive symptoms among men and women in lower income countries, but had an adverse effect in higher income countries, controlling for baseline health (Yang, 2021).

To our knowledge, there has been no research examining how a country's economy can influence the relationship between grandchild caring patterns and the grandparents' depressive symptoms, which is the focus of the current study.

Conceptual model

Ambivalence as a concept to understand intergenerational relationships and family ties was developed by Connidis and McMullin (2002), which has encouraged multi-level analysis linking individual behaviour and macro-level environment, such as economic, social and political systems (Connidis, 2015). Structured ambivalence was firstly used by Neuberger and Haberkern (2014) in order to understand how cultural norms can influence the effect of grandchild care provision on the grandparents' quality of life. The authors found that in countries with high expectations for grandparenting, grandparents who did not provide grandchild care reported low quality of life, which was explained by the contradictions between individual behaviour and societal expectations (Neuberger & Haberkern, 2014). Similarly, studies by Arpino and Bordone found that in countries with strong filial norms, not providing grandchild care had negative effects on the life satisfaction and depressive symptoms of the grandparents, providing further evidence for the structural ambivalence theory (Arpino et al., 2018; Bordone & Arpino, 2019).

Connidis (2015) highlighted that it is crucial to examine multi-level ambivalence in order to advance the concept and its application in research on intergenerational relationships. Previous research has mainly concentrated on the negotiation between grandchild caring and cultural norms, and yet overlooked the interconnection between individual experience/behaviours and macro-economic environment. The study by Yang (2021) was the first to investigate the role of a country's economy in moderating the relationship between the transition to grandparenthood and the

grandparents' depressive symptoms. However, this study only examined the effect of *becoming* a grandparent on the grandparents' depressive symptoms, suggesting that further analysis needs to be conducted in order to understand the relationship between grandchild care provision and depressive symptoms using multi-level models. Another study by Neuberger and Preisner (2018) in a related research area investigated the role of a country's economy in affecting the relationship between having children and the parent's quality of life based on the SHARE and ELSA data. It was found that people aged 50 + living in countries with lower gross domestic product per capita benefited the most from the transition to parenthood (Neuberger & Preisner, 2018).

A prosperous society can provide grandparents with economic resources, suitable housing, assistive technologies and alternatives to grandchild care provision, which interact with grandchild care provision (Haberkern et al., 2011). Therefore, in wealthier countries, the provision of grandchild care or more intensive grandchild care result in the contradiction with the sufficient resources accompanied with the country's economy, exerting a negative impact on grandparents' depressive symptoms. Conversely, in less wealthy countries, the provision of grandchild care or more intensive grandchild care are consistent with the country's low income and relatively insufficient public resources, and can bring benefits for grandparents' health. Based on this, it is hypothesised that in less wealthy countries, the provision of grandchild care or more intensive grandchild care can reduce depressive symptoms among grandparents (Hypothesis 1), but increase grandparents' depressive symptoms in higher income countries (Hypothesis 2).

Gender can also play an important role in influencing the relationship. Women often undertake more family responsibilities than men especially in lower income countries (Powell & Greenhaus, 2010), hence they may experience more health benefits than men from grandparenting as this fulfils cultural expectations (Arpino et al., 2018; Chen & Liu, 2012). Specifically, it is hypothesised that grandmothers report fewer depressive symptoms than grandfathers when caring at the same intensity and patterns (Hypothesis 3). In addition, based on previous research (Yang, 2021), another hypothesis is that the gender gap of the effect of grandchild care patterns on depressive symptoms is wider in lower income countries than higher income countries (Hypothesis 4).

Research hypotheses
Based on the evidence reviewed here, this study proposes the following hypotheses:

Hypothesis 1   In less wealthy countries, the provision of grandchild care or more intensive grandchild care reduces depressive symptoms among grandparents.

Hypothesis 2   In wealthier countries, the provision of grandchild care or more intensive grandchild care increases depressive symptoms among grandparents.

Hypothesis 3   Providing grandchild care can be more protective for the depressive symptoms among grandmothers than grandfathers.

Hypothesis 4 The gender gap of grandmothers being more likely to experience depressive symptoms from grandchild caring than grandfathers is wider in less wealthy countries than in wealthier countries.

Data and methods

Data

The SHARE dataset provides quality information about the health, social and economic aspects of middle-aged or older European individuals (Program on Global Aging, 2021). The first wave of the SHARE data was collected in 2004, and the latest wave of the SHARE was collected in 2018 and released in 2020 (Wave 7). As has been done in previous research on grandparenthood in Europe, the SHARE data are used for the analysis (Bordone & Arpino, 2019; Di Gessa et al., 2016). A Harmonised version of the SHARE data has been developed to provide research-ready variables derived from the original datasets and used in ageing research focusing on international comparisons. As the variable reflecting the intensity of grandchild care provision in Waves 1–3 is measured differently compared to Waves 4–7, the current study only uses Waves 4–7 for the analysis in order to reduce the potential measurement bias (Beaumaster et al., 2018; Phillips et al., 2021). Multi-level modelling methods are used in this study due to the hierarchical structure of the data (observations are nested within individuals, which are nested within countries) (Hox, 2002).

Measures

Depressive symptoms

The depressive symptoms of respondents are measured by the 12-item EURO-D depression scale in the SHARE in each wave. The scale contains information about the respondent's self-reported status in terms of their depressive symptoms, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment and tearfulness (Munich Center for the Economics of Aging (MEA), 2020). Each item is measured with a binary answer (1=yes, 0=no), and the total depression score reflects the number of depressive symptoms reported by respondents, which is a discrete variable ranging between 0 and 12 in the SHARE (Phillips et al., 2021).

Grandchild caring patterns

In Waves 4–7 of the SHARE, the respondents were asked whether they gave care to their grandchildren in the previous year (1=yes, 0=no). For respondents who provided grandchild care, they were further asked about their frequency of grandchild care provision (1=about daily, 2=about every week, 3=about every month, and 4=less often). In line with previous research, this study distinguishes the intensity of grandchild care provision with a threshold of 2, and intensive grandchild care provision in this paper refers to care provided by respondents on a daily or weekly basis in the SHARE (Bordone & Arpino, 2019; Hank & Buber, 2009). Based on these two variables, a three-category variable capturing whether grandparents provided intensive grandchild care in the previous year was created: 0=No care, 1=Non-intensive care, and 2=Intensive care (Bordone & Arpino, 2019; Liao et al., 2021).

Previous research has highlighted that researching grandchild caring patterns can elucidate the health effect of grandchild care provision (Musil et al., 2011; Zhou et al., 2017). Grandparents starting to provide care or providing more intensive care may experience stress and burden, which has a negative effect on their psychological health, for example resulting in the report of depression (Burton et al., 2003; Goodman & Silverstein, 2006). In order to research the effect of grandchild caring patterns, and more specifically the transition between more or less demanding roles, a four-category variable is created to reflect the respondents' grandchild caring status: non-carers, repeated carers, previous or less intensive carers, and new or more intensive carers.

Table 1 shows how the four categories of this grandchild caring status variable were derived from the three-category caring intensity variable. This study does not distinguish between previous carers and less intensive carers (and likewise new carers and more intensive carers, repeated non-intensive and repeated intensive carers), as classifying the number of respondents providing less intensive/more intensive/repeated intensive grandchild care in a single group would result in too small a sample size in the analysis, especially when such analysis is further stratified by gender and country (e.g. there are only 42 repeated intensive male carers in Denmark). It is also notable that a non-carer may have provided grandchild care between waves not captured by the SHARE, likewise repeated carers may have had breaks between waves in terms of grandchild caring.

Other covariates

The macro-level factor examined in this study is the natural log of Gross domestic product (GDP) per capita based on purchasing power parity (PPP) (constant 2015 US$) provided by World Bank, ranging between 5 and 12 (World Bank, 2021).

Two sets of covariates have been controlled for based on existing literature (Bordone & Arpino, 2019; Silverstein & Zuo, 2020; Wang & Mutchler, 2020). First, it is essential to include the respondents' health at baseline, as this is strongly associated with their health at follow-up (Di Gessa et al., 2016). Three baseline physical health indictors are selected to account for initial selection into grandchild care provision, namely ADL functional score (ranging from 0 to 6, the higher the score, the more ADL items the respondent has difficulties with), IADL functional score (ranging from 0 to 5, the higher the score, the

Table 1 Classification of the change in the grandchild caring intensity variable. Source: Harmonised SHARE Waves 4–7

Grandchild caring pattern	Intensity of grandchild care provision in the previous wave	Intensity of grandchild care provision in the current wave
Non-carers	0	0
Repeated carers	1	1
	2	2
Previous or less intensive carers	1	0
	2	0/1
New or more intensive carers	0	1/2
	1	2

0 = no grandchild care, 1 = non-intensive grandchild care, and 2 = intensive grandchild care

more IADL items the respondent has difficulties with), and self-reported health (excellent to poor: ranging from 1 to 5).

In reviewing the literature, the gender, age, marital status, educational attainment, employment status, household income of grandparents, number of grandchildren, socio-demographic characteristics of children and grandchildren, living arrangements, intergenerational support have been shown to be important factors which affect the respondents' depressive symptoms (Di Gessa et al., 2016; Jadhav & Weir, 2018; Silverstein & Zuo, 2020; Van de Velde et al., 2010). Hence, another set of covariates include socio-demographic variables, namely age (centred at 60 years old), quadratic age, whether married or partnered (1 = yes, 0 = no), educational attainment (1 = less than lower secondary, 2 = upper secondary & vocational training, and 3 = tertiary), whether employed or self-employed (1 = yes, 0 = no), the number of grandchildren, whether co-residing with children (1 = yes, 0 = no), and the logarithms of respondents' household income (the sum of individual income and take-home pay, after any taxes and contributions) (Bordone & Arpino, 2019; Di Gessa et al., 2016). Gender has been entered as a control variable in Models 1, 2 and 5, while Models 3 and 6 have focused on grandfathers and Models 4 and 7 have examined grandmothers.

Sample

The analysis was restricted to 13 countries with valid information about the respondents' depressive symptoms and grandchild care provision in at least two survey years, including Austria, Belgium, Czech Republic, Denmark, Estonia, France, Germany, Italy, Netherlands, Slovenia, Spain, Sweden and Switzerland. The analytical sample included grandparents who had at least one grandchild aged 16 or less and who were aged between 50 and 90. In total, 24,656 grandparents, 9,524 grandfathers, 15,132 grandmothers, 66,504 observations, 25,102 males, 41,402 females were included in the analysis. Notably, a large sample in Wave 7 focuses on retrospective information (SHARELIFE), and is not included in the analysis as the variables of the SHARELIFE are different from the core data. The sampling weights used in the Harmonised dataset account for both the individual and the household, and are calculated as the inverse probability of being included in the sample at each wave (Phillips et al., 2021).

Analysis

Taking into account the small number of countries included, multi-level linear regression models were conducted with Restricted Maximum Likelihood (REML) estimation. This is because REML estimates are less biased than Maximum Likelihood (ML) estimates, particularly when the number of groups is small (Elff et al., 2016; McNeish & Stapleton, 2016; Yang, 2021). A three-step analysis as detailed below were conducted using Stata V.16 (StataCorp, 2019).

First, the appropriateness of using multi-level modelling was examined by fitting a three-level intercept-only model (Model 1) (Sascha et al., 2020). The intraclass correlation coefficient (ICC) calculated from the estimates helped to determine whether there were cross-country and cross-individual differences in the report of depressive symptoms (Rabe-hesketh & Skrondal, 2012).

Next, the explanatory variable (grandchild caring patterns) and the country- and individual-level factors as described in the Measures section were entered at each level of analysis. The analysis was conducted based on the overall sample, and further stratified by gender (Models 2–4). As the average respondent had less than three measurement occasions, independent residuals were assumed in order to avoid over-complication (Rabe-hesketh & Skrondal, 2012). Notably, the REML likelihood depends on the fixed effects in the model, which are not comparable if the fixed effects change (Boedeker, 2017; Faraway, 2016: p.156). In this study, Models 1–7 differed in their fixed components, therefore a comparison of model fit indices with REML estimation was not appropriate (Boedeker, 2017; Zuur et al., 2009: p. 122). This study addressed this issue by comparing model fit with ML estimation, based on the Log-likelihood deviance, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC), and then fitting the best model using REML estimation for the final inference and reporting (Zuur et al., 2009: p. 122).

Models 5–7 further included cross-level interactions between grandchild caring patterns and the country's gdp, in order to examine whether a country's economy modifies the impact of grandchild caring patterns on grandparents' depressive symptoms. The equation for the final model (Model 5) can be written as below:

$$
\begin{aligned}
Depress_{ijk} = &\beta_0 + \beta_1 Carer_{1jk} + \beta_2 Carer_{2jk} + \beta_3 Carer_{3jk} \\
&+ \beta_4 Age_{ijk} + \beta_5 Age_{ijk} \times Age_{ijk} + \beta_6 Sex_{jk} \\
&+ \beta_7 Mstat_{jk} + \beta_8 Edu_{2jk} + \beta_9 Edu_{3jk} \\
&+ \beta_{10} Work_{ijk} + \beta_{11} Grandchildno_{ijk} \\
&+ \beta_{12} Coreside_{ijk} + \beta_{13} Shlt_{ijk} + \beta_{14} ADL_{ijk} \\
&+ \beta_{15} IADL_{ijk} + \beta_{16} \ln\_income_{ijk} + \beta_{17} \ln\_gdp_k \\
&+ \beta_{18} \ln\_gdp_k \times Carer_{1jk} + \beta_{19} \ln\_gdp_k \times Carer_{2jk} \\
&+ \beta_{20} \ln\_gdp_k \times Carer_{3jk} + v_{0k} + v_{1k} \ln\_gdp_k \\
&+ \mu_{0jk} + \mu_{1jk} Carer_{jk} + e_{ijk},
\end{aligned}
\tag{1}
$$

where $Depress_{ijk}$ represents the number of depressive symptoms for observation i in respondent j in country k, β_0- β_{20} are the fixed effects regression parameters, v_{0k}, μ_{0jk} and e_{ijk} are the between-country variance, the between-individual variance and the within-individual variance, respectively.

Results

Descriptive analysis

Table 2 provides the descriptive sample statistics at baseline. Between 2012 and 2014, more than 42% of grandparents were non-carers, and about 27% were repeated carers (respondents who provided the same intensity of grandchild care in the two waves). About 16% of grandparents provided less-intensive grandchild care or stopped grandchild caring, while about 14% started to provide grandchild care or provided more intensive care by the next wave. On average, grandparents had 2.6 depressive symptoms at baseline, and non-carers had more depressive symptoms compared to those who had the experience of providing grandchild care.

Table 2 Descriptive statistics of the study sample at baseline. Source: Authors' analysis of the Harmonised SHARE Waves 4–5

Variables	Total sample	Non-carers	Previous or less intensive carers	New or more intensive carers	Repeated carers	F or χ²
	N = 14,831	N = 6,298	N = 2,399	N = 2,125	N = 4,009	
	M (SD) or %	M (SD) or %	M (SD) or %	M (SD) or %	M (SD) or %	
Outcome (baseline)						
Number of depressive symptoms	2.6 (2.3)	3.0 (2.4)	2.6 (2.3)	2.4 (2.2)	2.2 (2.0)	113***
Explanatory						
Caring status between 2012 and 2014						
Non-carers	42.5					
Previous or less intensive carers	16.2					
New or more intensive carers	14.3					
Repeated carers	27.0					
Factors (baseline)						
GDP (log)	10.4 (0.4)	10.4 (0.4)	10.4 (0.4)	10.3 (0.4)	10.5 (0.4)	65***
Control (baseline)						
Age (centred at 60)	9.8 (9.3)	15.4 (9.0)	8.9 (8.2)	6.7 (8.2)	5.6 (6.9)	1385***
Gender (female)	64.0	65.4	66.1	64.0	66.5	4
Educational attainment						518***
Less than lower secondary	44.0	54.6	43.1	37.7	33.9	
Upper secondary and vocational training	37.3	32.1	37.9	40.7	42.0	
Tertiary	18.7	13.3	19.0	21.6	24.1	
Currently married or partnered	62.0	43.6	62.3	65.4	70.1	828***
Current employed or self-employed	23.8	12.3	23.5	32.6	31.1	668***
Annual household income (log)	9.2 (1.2)	9.0 (1.2)	9.2 (1.4)	9.1 (1.1)	9.4 (1.2)	14***
Number of grandchildren	3.9 (2.8)	4.1 (3.0)	4.1 (2.8)	3.9 (2.7)	3.9 (2.5)	10***
Whether living with children	12.5	12.1	12.8	13.4	12.2	3

Table 2 (continued)

Variables	Total sample	Non-carers	Previous or less intensive carers	New or more intensive carers	Repeated carers	F or χ²
	N = 14,831	N = 6,298	N = 2,399	N = 2,125	N = 4,009	
	M (SD) or %	M (SD) or %	M (SD) or %	M (SD) or %	M (SD) or %	
Self-reported health (1–5, excellent to poor)	3.3 (1.0)	3.6 (1.0)	3.3 (1.1)	3.2 (1.0)	3.0 (1.0)	311***
ADL functional status (0–6, excellent to poor)	0.3 (0.8)	0.5 (1.1)	0.2 (0.7)	0.2 (0.6)	0.1 (0.4)	215***
IADL functional status (0–5, excellent to poor)	0.2 (0.8)	0.5 (1.1)	0.1 (0.6)	0.1 (0.5)	0.04 (0.3)	297***
Country						467***
Estonia	100	51.8	14.8	16.1	17.3	
Spain	100	50.5	19.4	12.4	17.7	
Austria	100	48.3	12.9	13.9	24.9	
Slovenia	100	45.6	17.4	13.4	23.6	
Germany	100	44.1	14.4	14.3	27.2	
Czech Republic	100	40.3	17.7	18.1	23.9	
France	100	40.3	15.4	12.6	31.7	
Italy	100	38.9	17.0	16.0	28.1	
Switzerland	100	38.4	18.0	12.4	31.2	
Belgium	100	36.9	15.3	11.6	36.2	
Sweden	100	36.2	19.5	13.9	30.4	
Denmark	100	35.3	13.4	14.2	37.1	
Netherlands	100	30.6	17.9	14.1	37.4	

M mean, *SD* standard deviations, *ADL* Activities of Daily Living, *IADL* Instrumental Activities of Daily Living

*** significant at the 0.1% level

Notably, the average age of non-carers was 75.4 at baseline, which was significantly higher than grandparents who had ever provided grandchild care (previous or less intensive carers (68.9), new or more intensive carers (66.7), and repeated carers (65.6). There was no significant association between the grandparents' gender and their caring status. The proportions of respondents with higher educational qualifications, being married or partnered, currently working, having a higher household income, having better self-reported health, and with ADL and IADL difficulties were significantly higher among repeated carers than non-carers. Finally, grandparents in Estonia, Spain were more likely to be non-carers than grandparents in Netherlands, Denmark and Sweden.

As shown in Fig. 1, respondents who did not provide grandchild care were more stable in terms of caring status compared to grandparents who provided non-intensive or intensive grandchild care. For example, among grandparents who did not provide grandchild care in 2012, about 80% remained in such status in 2014, while about 12% provided non-intensive grandchild care and 8.0% provided intensive grandchild care in 2014; and among those who did not look after their grandchildren in 2014, about 88% remained in

Fig. 1 Grandchild caring transitions in the 13 countries, 2012–2018 (Source: Authors' analysis of the Harmonised SHARE Waves 4–7)

Fig. 2 Predicted country effect on depressive symptoms in the 13 countries, 2012–2018 (Source: Authors' analysis of the Harmonised SHARE Waves 4–7)
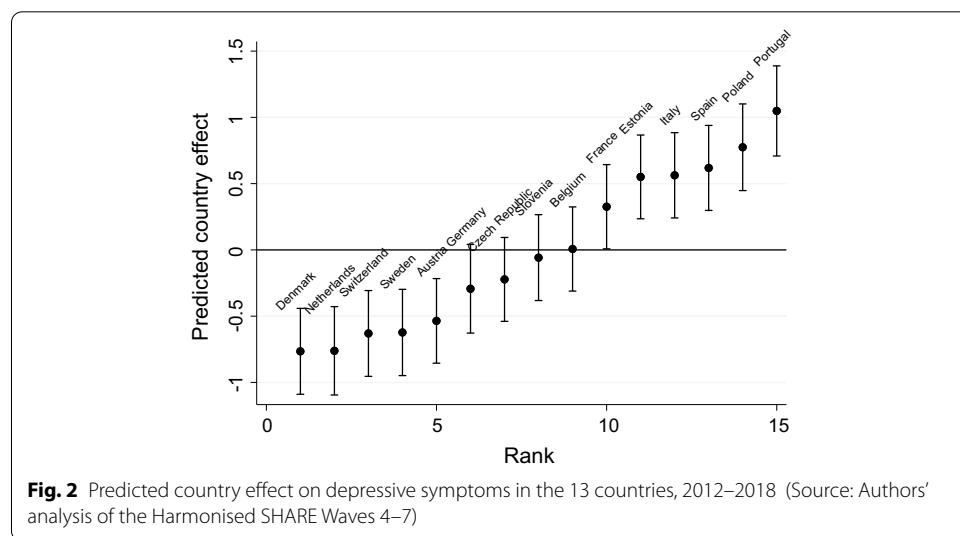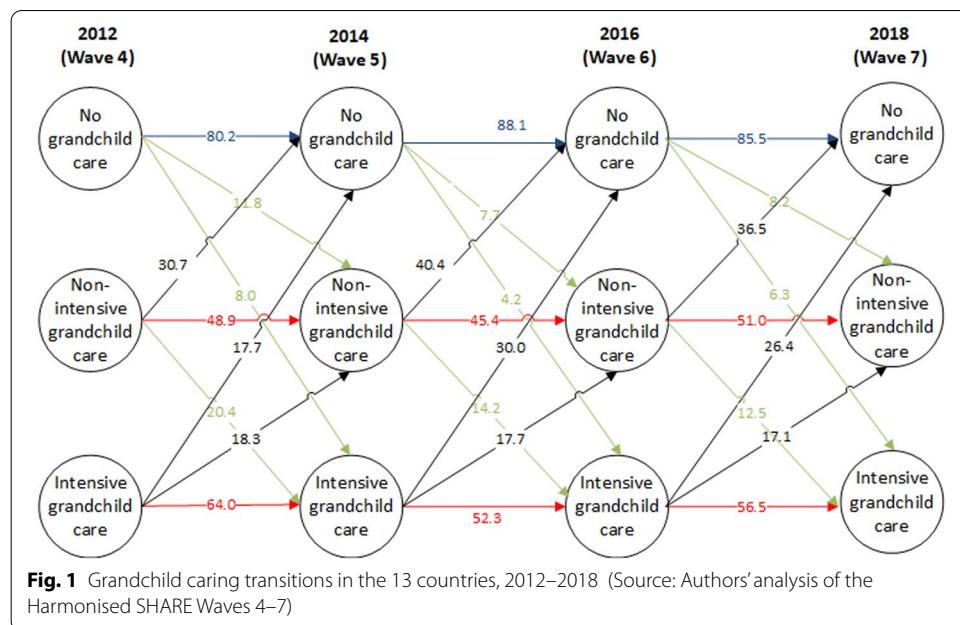
such status, whist about 12% provided either non-intensive or intensive grandchild care in 2016.

In addition, almost half of grandparents who provided non-intensive grandchild care in 2012 also did so in 2014, and the equivalent percentages between the following waves were similar. About 30–40% of grandparents who provided non-intensive grandchild care did not provide grandchild care in the next wave. Moreover, respondents who provided intensive grandchild care were relatively stable between waves, with more than half continuing to do so in the next wave (e.g. 64% of grandparents who provided intensive grandchild care in 2012 continued doing so in 2014). As the

analysis was based on the longitudinal SHARE dataset, grandparents were less likely to continue providing intensive grandchild care between 2014 and 2016 (52%) and between 2016 and 2018 (57%), compared to between 2012 and 2014 (64%). This may be due to the fact that respondents were older in the following waves and consequently less likely to provide intensive grandchild care.

Multi-level modelling analysis

The Caterpillar plot created based on Model 1 clearly shows significant national differences in the report of depressive symptoms (Fig. 2). For example, respondents in Denmark, the Netherlands, Switzerland, Sweden and Austria reported significantly fewer depressive symptoms compared to their counterparts in Portugal, Poland, Spain, Italy, Estonia and France. In Belgium, Slovenia, Czech Republic and Germany, the country effects on reporting depressive symptoms were not statistically significant.

The ICC estimates from Model 1 further prove the substantial country and individual-level clustering, which indicates that almost 7% of the variation in reporting depressive symptoms lies between countries and 53% of the variation in reporting depressive symptoms lies between individuals (Table 3).

Models 2–4 provide the REML estimates of the random-intercept model. Compared to non-carers, previous or less intensive carers and repeated carers reported lower depressive symptoms among grandfathers, holding all other covariates constant ($\beta_1 = -0.08$, $p < 0.05$ and $\beta_3 = -0.12$, $p < 0.01$, Model 3). Compared to non-carers, repeated carers reported lower depressive symptoms among grandmothers (with a slightly lower effect size compared to the result among grandfathers), holding all other covariates constant ($\beta_3 = -0.10$, $p < 0.05$, Model 4). Being male, being married, having a higher education attainment, currently working, having a lower number of grandchildren, reporting good self-rated health, having a good ADL functional status, having a good IADL functional status, having a higher individual income, and living in wealthier country were associated with fewer depressive symptoms among grandparents (Model 2).

Models 5–7 report the results with the inclusion of the cross-level interactions between the country's GDP and grandchild caring patterns. Similar to the results shown in Models 3–4, grandfathers and grandmothers who had the experience of providing grandchild care reported significantly fewer depressive symptoms compared to non-carers (Models 6–7). Specifically, compared to grandfather non-carers, previous or less intensive carers had 2.3 fewer depressive symptoms, and such positive effect was more pronounced among grandmothers than grandfathers ($\beta_1 = -2.76$, $p < 0.001$, Model 7). For both grandfathers and grandmothers, new or more intensive carers reported about one fewer depressive symptom than non-carers, and repeated carers reported about 1.4 fewer depressive symptoms compared to non-carers.

Interestingly, the beneficial effect of being previous or less intensive carers on the grandparents' depressive symptoms weakened by 0.24 as the country's GDP increased by one unit (Model 5). Similarly, the beneficial effect of being a new or more intensive carer on the grandparents' depressive symptoms weakened by 0.11 as the country's GDP increased by one unit (Model 5). Moreover, the beneficial effect of being a repeated carer on one's depressive symptoms weakened by 0.12 as the country's GDP increased by one

Table 3 Multi-level estimates of grandchild caring patterns on the depressive symptoms of grandparents, 2012–2018. Source: Authors' analysis of the Harmonised SHARE Waves 4–7

Response: Depressive symptoms

Parameter		Intercept-only model		Random-intercept models						Random-intercept models with cross-level interactions					
		Model 1: Full sample		Model 2: Full sample		Model 3: Grandfathers		Model 4: Grandmothers		Model 5: Full sample		Model 6: Grandfathers		Model 7: Grandmothers	
		Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err
Fixed part															
β_0	Intercept	2.61***	0.16	1.54	2.16	1.04	1.70	2.69**	2.54	2.49	2.18	1.48*	1.75	3.75***	2.57
β_1	Previous or less intensive carers (ref: non-carers)	–		−0.07**	0.03	−0.08*	0.04	−0.06	0.04	−2.59***	0.63	−1.09**	0.05	−2.76***	0.85
β_2	New or more intensive carers (ref: non-carers)	–		−0.03	0.03	−0.04	0.05	−0.03	0.04	−1.34*	0.76	−0.98***	0.44	−1.42***	1.01
β_3	Repeated carers (ref: non-carers)	–		−0.11	0.03	−0.12**	0.04	−0.10*	0.04	−0.74	0.67	−0.69***	0.42	−1.46***	0.87
β_4	Age (centred at 60)	–		−0.02***	0.00	−0.03***	0.01	−0.02***	0.01	−0.02**	0.01	−0.03***	0.01	−0.02***	0.01
β_5	Age squared	–		0.001***	0.00	0.001***	0.00	0.001*	0.00	0.001***	0.01	0.001***	0.00	0.001***	0.00
β_6	Gender (ref: male)	–		0.69***	0.03	–	–	–	–	0.69***	0.03	–	–	–	–
β_7	Marital status (ref: not married)	–		−0.21***	0.03	−0.30***	0.04	−0.18***	0.03	−0.21***	0.03	−0.32***	0.04	−0.18***	0.03
β_8	Education attainment: Upper secondary (ref: less than lower secondary)	–		−0.19***	0.03	−0.12**	0.04	−0.23**	0.04	−0.19***	0.03	−0.12**	0.01	−0.23***	0.04
β_9	Education attainment: Tertiary (ref: less than lower secondary)	–		−0.20***	0.04	−0.14**	0.05	−0.25**	0.05	−0.20***	0.04	−0.14**	0.01	−0.25***	0.05
β_{10}	Currently working (ref: not working)	–		−0.07*	0.03	−0.04	0.05	−0.10	0.04	−0.07*	0.03	−0.07	0.05	−0.10*	0.04
β_{11}	Number of grandchildren	–		0.01**	0.00	0.02**	0.01	0.01	0.01	0.01*	0.00	0.02***	0.01	0.01	0.01
β_{12}	Co-residing with children (ref: no)	–		0.01	0.03	0.06	0.05	−0.01	0.04	0.01	0.03	0.03	0.05	−0.02	0.04
β_{13}	Self-rated health	–		0.70***	0.01	0.62***	0.02	0.75***	0.02	0.70***	0.01	0.63***	0.02	0.75***	0.02

Table 3 (continued)

		Intercept-only model		Random-intercept models						Random-intercept models with cross-level interactions					
		Model 1: Full sample		Model 2: Full sample		Model 3: Grandfathers		Model 4: Grandmothers		Model 5: Full sample		Model 6: Grandfathers		Model 7: Grandmothers	
Response: Depressive symptoms															
Parameter		Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err	Estimate	Std. Err
β_{14}	ADL functional status	–		0.26***	0.02	0.28***	0.03	0.24***	0.02	0.26***	0.02	0.29***	0.03	0.24***	0.02
β_{15}	IADL functional status	–		0.18***	0.02	0.17***	0.03	0.18***	0.02	0.17***	0.02	0.16***	0.03	0.18***	0.02
β_{16}	Household income	–		−0.06**	0.02	−0.10***	0.03	−0.09***	0.03	−0.06**	0.02	−0.10***	0.03	−0.09**	0.03
β_{17}	GDP	–		−0.14*	0.08	−0.70**	0.28	−0.20*	0.11	−0.23*	0.10	−0.15*	0.08	−0.30**	0.24
β_{18}	GDP X Previous or less intensive carers	–		–		–		–		0.24***	0.03	0.13**	0.05	0.26***	0.04
β_{19}	GDP X New or more intensive carers	–		–		–		–		0.11**	0.04	0.12*	0.06	0.14*	0.05
β_{20}	GDP X Repeated carers	–		–		–		–		0.12*	0.04	0.08	0.05	0.13*	0.05
Random part															
σ_{v0}^2	Country variance	0.37	0.14	0.10	0.04	0.06	0.03	0.13	0.05	0.10	0.04	0.06	0.03	0.13	0.06
σ_{μ}^2	Individual variance	2.46	0.03	1.56	0.03	1.27	0.05	1.74	0.05	1.56	0.03	1.26	0.05	1.74	0.04
σ_e^2	Residual variance	2.56	0.02	2.25	0.03	1.97	0.04	2.44	0.04	2.25	0.03	1.97	0.04	2.44	0.03
Intraclass Coefficient (ICC)															
Country		6.9%		2.4%		1.8%		3.1%		2.5%		1.8%		3.1%	
Individual		52.5%		42.5%		40.2%		43.5%		42.4%		40.1%		43.4%	
AIC		282,393		165,796		59,410		106,067		165,799		59,419		106,074	
BIC		282,430		165,968		59,555		106,221		165,997		59,587		106,253	
Number of countries		13		13		13		13		13		13		13	
Number of respondents		24,656		24,656		9,524		15,132		24,656		9,524		15,132	
Number of observations		66,504		66,504		25,102		41,402		66,504		25,102		41,402	

All models were based on Restricted Maximum Likelihood (REML) estimation. Std Err: standard error; AIC: Akaike Information Criterion; BIC: Bayesian Information Criterion; Model 1 was based on the intercept-only model, Models 2–4 were based on the random-intercept models, and Models 5–7 were based on the random-intercept models with cross-level interactions. AIC and BIC were provided for information only and were not comparable between models under REML estimates.

*Significant at the 5% level; ** Significant at the 1% level; *** Significant at the 0.1% level.
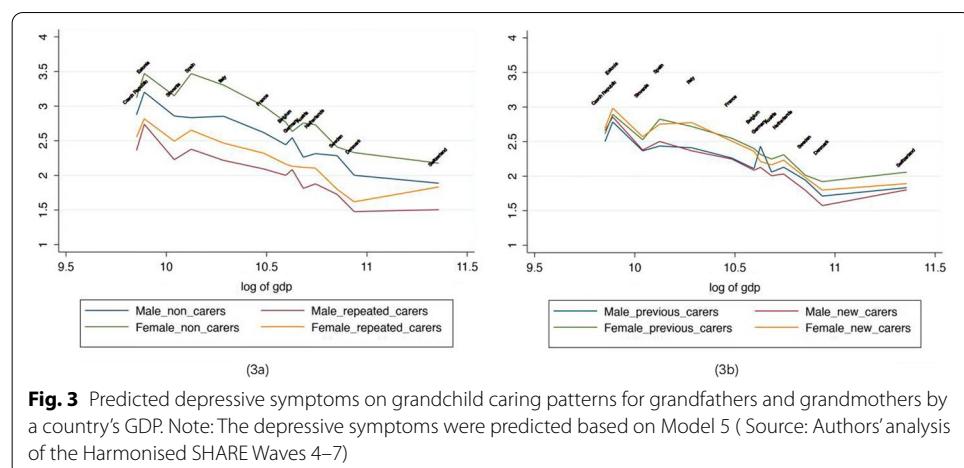
Fig. 3 Predicted depressive symptoms on grandchild caring patterns for grandfathers and grandmothers by a country's GDP. Note: The depressive symptoms were predicted based on Model 5 (Source: Authors' analysis of the Harmonised SHARE Waves 4–7)

unit (Model 5). Similar mediation effects of country level economy held when the same analysis was conducted by gender (Models 6–7).

Figure 3 shows how the grandfathers' and grandmothers' depressive symptoms depended on the grandchild caring patterns and a country's GDP. In all countries, grandmothers reported more depressive symptoms than grandfathers. Among both grandmothers and grandfathers, individuals who were non-carers reported more depressive symptoms, and those who were repeated carers reported fewer depressive symptoms.

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Furthermore, the relationship between grandchild caring patterns and the grandparents' depressive symptoms related to a country's GDP. For example, the difference in the report of depressive symptoms between grandmothers who were non-carers and repeated carers was larger in lower income countries (e.g. Czech Republic) than in higher income countries (e.g. Switzerland) (Fig. 3). The two groups of grandparents who had a change in the intensity of grandchild caring, specifically, new or more intensive carers, and previous or less intensive carers, reported a similar number of depressive symptoms, and this held for both grandfathers and grandmothers. In countries with relatively lower income including Spain, Italy, Czech Republic, Slovakia, Estonia and Slovenia, grandparents who had the same grandchild caring pattern reported more depressive symptoms than their counterparts in higher income countries, such as Switzerland, Denmark, Sweden, the Netherlands and Belgium. It was also shown that the gender difference in the relationship between grandchild caring patterns and grandparents' depressive symptoms depended on a country's GDP. For example, grandmothers who were non-carers reported more depressive symptoms than grandfathers who were non-carers, and such difference was larger in lower income countries (e.g. Spain and Italy) than higher income countries (Switzerland and Denmark) (Fig. 3).

Discussion

Scientific research on the complex health effect of grandparenthood is fundamental in terms of the global healthy ageing agenda. The main goal of the current study was to examine the cross-national difference in the effect of the change in grandchild caring intensity on grandparents' depressive symptoms in Europe, and to determine the role of the caring pattern and the country's economy.

The results of this study show that grandparents who do not provide grandchild care are more stable in terms of their caring status compared to grandparents who provide non-intensive or intensive grandchild care (Fig. 1). This can be at least partly explained by the descriptive results showing that the average age of non-carers (75.4 at baseline) is much higher compared to the average age of previous or less intensive carers (68.9), new or more intensive carers (66.7), and repeated carers (65.6) (Table 2). Generally, grandparents who are older are less likely to provide grandchild care compared to younger old individuals, mainly due to the decrease in their own physical or psychological health (Hadfield 2014). Another reason may be that compared to the younger old, the older old have grandchildren who are older on average, leading to less of a need for grandchild care. By contrast, repeated carers have the youngest average age (65.6) which is associated with relatively good health on average, and consequently are more able to look after their grandchildren continuously compared to older old individuals.

Figure 2 shows significant cross-national differences in reporting depressive symptoms among European grandparents aged 50–90. Respondents in Denmark, the Netherlands, Switzerland, Sweden and Austria report significantly fewer depressive symptoms than those in Portugal, Poland, Spain, Italy and Estonia. The results are consistent with the previous research based on 11 European countries, which showed that older people in Denmark, Switzerland and Sweden had fewer depressive symptoms than southern European countries such as Italy and Spain (Missinne et al., 2014). Based on the most recent SHARE data Waves 4–7, the results in this study also provide evidence in support of the research findings by Yang (2021), and indicate that the significant country variations in reporting depression need to be taken into account in future comparative research on grandparents' health.

An important finding is that both grandfathers and grandmothers who have the experience of providing grandchild care report fewer depressive symptoms compared to their counterparts who are non-carers, even when age and age squared are controlled (Models 5–7). Controlling the two age terms has avoided the potential bias caused by the higher average age among non-carers than other groups (as shown in Table 2). In addition, the positive effect of grandchild caring on reporting fewer depressive symptoms holds for both lower- and higher income countries, which supports Hypothesis 1 (in less wealthy countries, the provision of grandchild care has a protective effect against depression among grandparents), but is inconsistent with hypothesis 2 (in wealthier countries, the provision of grandchild care increases depressive symptoms among grandparents). This result may be related to the categorisation of grandchild caring patterns in this study. As suggested in previous research, providing non-intensive grandchild care enhances the health of grandparents, whilst providing intensive grandchild care has an adverse effect on the grandparents' health (Glaser et al., 2010). However, repeated carers in this study include both repeated non-intensive carers and repeated intensive carers. This is

because the number of repeated intensive carers is too small in some countries, resulting in the difficulty of treating it as a single category (see further discussion in the Methods section). Therefore, this study is unable to distinguish the health effect of repeated non-intensive carers and repeated intensive carers in higher income countries, which can contribute to the findings contrary with Hypothesis 2.

The research findings accord with H_1, showing that new or more intensive carers report fewer depressive symptoms compared to non-carers, and the protective effect of being new or more intensive carers on depressive symptoms among grandparents weakens as the country's GDP increases (Models 5–7). The results provide further evidence to existing studies showing that the increase of grandchild care is protective for the grandparents' depressive symptoms in Europe, and that the country's GDP is an important factor moderating the association between grandchild caring and grandparents' depressive symptoms (Neuberger & Haberkern, 2014; Yang, 2021). However, one unanticipated finding is that contrary to H_2, new or more intensive grandchild caring is associated with fewer depressive symptoms among grandparents in wealthier countries such as Switzerland, Denmark and Sweden. The findings demonstrate the beneficial health effect of grandchild caring in both lower and higher income European countries, however they also suggest that the role enhancement effect of grandchild caring on grandparents' depressive symptoms is significantly larger in lower income countries than higher income countries in Europe.

This study confirms significant gender difference in the impact of grandchild caring on reporting depressive symptoms, which also relates to a country's economy. In accordance with H_3, the research findings indicate that the beneficial effect of providing grandchild care on the grandparents' depressive symptoms is larger for grandmothers than grandfathers (Models 5–7). This is consistent with previous literature, which proposes that grandchild caring is more common among grandmothers than grandfathers which in turn reinforces society's higher grandparenting expectations for women, and therefore results in a greater beneficial health impact for women carers compared to men carers (Chen & Liu, 2012). In addition, the gender difference in the effect of grandchild caring on one's depressive symptoms is larger in less wealthy countries than wealthier countries. The result provides evidence for H_4, and reflects those of Yang (2021) who also found significant interactions between a country's economy and grandparent's gender which affected the impact of transitioning to grandparents on one's depression.

This paper contributes to existing knowledge of the relationship between grandchild caring and grandparents' depressive symptoms across Europe. A key strength of this study is that it has examined the role of grandchild caring patterns, which captures the dynamic characteristics of grandparenting. In addition, the empirical findings provide a new understanding of how a country's economy affects the relationship between grandchild caring and the grandparents' depressive symptoms with the use of multi-level models.

This study has limitations in terms of the data availability and the research methods used. First, this study only examines one macro-level factor—a country's GDP. Future research could investigate how other contextual–structural factors influence the relationship between grandchild caring and late-life depression, such as filial norms and welfare policies by combining multiple datasets (Di Gessa et al., 2016; Igel & Szydlik,

2011). Second, in order to avoid too small a sample size in each analytical category and reduce biases, this study has classified repeated non-intensive and repeated intensive carers as a group, and similarly, new/more intensive carers, and previous/less intensive carers. Such classification restricts the ability to examine the effect of grandchild caring patterns more specifically.

Nevertheless, this study is the first to examine grandchild caring patterns and grandparents' depressive symptoms in Europe using multi-level models. This study has provided a deeper insight into the changes in grandchild care provision and their effect on grandparents' depressive symptoms, and identified the important role of a country's economy in moderating such effect. The findings will be of interest to both researchers and policymakers in the area of population ageing and its implications for individuals and families. For researchers, multi-level models are useful research methods for understanding the cross-national differences in the health effect of grandparenting (Boedeker, 2017; Elff et al., 2016), and future research needs to be carried out in order to identify the mechanisms in terms of the moderating role of a country's economy (Yang, 2021). For policymakers in lower income countries, as grandmothers benefited more from grandchild caring than grandfathers, greater efforts are needed to reduce the gender gap in the positive effect of grandchild care provision on grandparents' depressive symptoms. Policymakers in higher income countries need to develop targeted interventions aimed at supporting grandparents who provide grandchild care of different intensity levels.

Declarations

Competing interests
The authors declare that they have no competing interests.

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