ISSN: 2281-1346

UNIVERSITÀ DI PAVIA
Department of Economics and Management

DEM Working Paper Series

From Care Gaps to Mental Health Strain

Joan Costa Font
(London School of Economics and Political Science)

Cinzia Di Novi
(Università degli Studi di Pavia)

Cristina Elisa Orso
(Università degli Studi dell'Insubria)

 # 231 (10-25)

Via San Felice, 5
I-27100 Pavia

https://economiaemanagement.dip.unipv.it/it

From Care Gaps to Mental Health Strain*

Joan Costa-Font[1], Cinzia Di Novi[2], Cristina Elisa Orso[3]

[1]*Department of Health Policy, London School of Economics and Political Science*
[3]*Department of Economics and Management, University of Pavia*
[4]*Department of Law, Economics, and Cultures, University of Insubria*

Abstract

Adults in need of care in Europe heavily rely on informal support and experience some unmet care needs, which can undermine their mental health later in life and increase future reliance on healthcare. This study draws on longitudinal data from a sample of Europeans before and during COVID-19 to examine this question. We employ an instrumental variable approach and a causal mediation analysis. We show that unmet care needs following the COVID-19 pandemic give rise to cognitive decline and depressive symptoms, and that such effect is mediated by exposure to loneliness during the pandemic among those with unmet care needs.

Keywords: loneliness, mental health, caregiving arrangements, informal care, adult care

JEL Codes: J14, J22, I13

*An earlier version of this paper was presented at the inaugural conference of the CAMrisk Research Centre, University of Pavia, Italy; at the workshop *Health Needs and Resources: Allocation and Measurement Issues*, Department of Economics, Society, Politics, University of Urbino Carlo Bo, Italy; and at the CERGAS seminar series, Bocconi University, Milan, Italy. We also benefited from comments received at the 2025 ROMe Health Economics Workshop (ROMHEW), Rome; the 2025 Annual Conference of the Society of Economics of the Household (SEHO), Zaragoza, Spain; and the 2025 Seminar at the School of Public Health, University of Pavia. We are grateful to all participants for their valuable feedback, with special thanks to Domenico Lisi, Gianluca Mazzarella, and Maurizio Malpede. The usual disclaimers apply.

1 Introduction

Europe is experiencing a rapid demographic shift that could significantly impact its economies and welfare systems, all of which are already under considerable strain, thereby influencing the organization of long-term care (LTC) services and potentially exacerbating disparities in access, as well as the unmet LTC care needs of the elderly, which are not always adequately addressed (Garca-Gmez et al., 2015). Even in countries with extensive formal care systems, families have traditionally played a crucial role in caring for the elderly. Informal care provided by family members has predominated, particularly in supporting frail elderly individuals who have often relied on younger relatives for their daily needs (Gannon and Davin (2010); Di Novi et al. (2015), Brenna and Di Novi (2016)). The family tie between adult children and elderly parents, along with the informal care provided by them, has long been an essential support system for the elderly, serving as both a substitute for and a complement to formal care (Bergeot and Jusot, 2024). However, the gradual weakening of family ties and the increasing participation of women in the labor market are challenging this informal care model (Carrieri et al. (2017), Spasova et al. (2018), Costa-Font and Vilaplana-Prieto (2022)). Moreover, the demographic changes, characterized by a sharp rise in the elderly dependency ratio, will result in a smaller labor force available to care for the aging population. By 2050, Eurostat (2019) projects that more than two-thirds of European countries will have an elderly dependency ratio exceeding 50%, meaning fewer than two working-age individuals for every person over 65 (see Figure 1). Mediterranean countries are expected to reach the highest dependency ratios, with Italy at 66.5%, Greece at 68.1%, and Portugal at 68.8%. These countries also invest the least in public LTC services and offer limited coverage for non-self-sufficiency provided by public institutions. Figure 2 shows LTC expenditure (health and social care) as a percentage of GDP in OECD countries (OECD, 2023). The Netherlands leads among European countries, allocating 4.4% of GDP to LTC spending, followed by Norway (3.5%), Sweden (3.4%), and Denmark (3.2%). In contrast, Southern and Eastern European countries spend approximately 1% or less of GDP, with Greece, Poland, and Latvia allocating only 0.5% or less.

Many European countries are expected to face similar challenges in the coming years, particularly in ensuring access to adequate LTC services. The underdevelopment of publicly funded LTC systems, coupled with the shrinking availability of informal caregiving, often due to demographic shifts and the growing pressure on informal caregivers to balance work and other caregiving responsibilities, may make it difficult for many older adults to receive the support they need. This situation is raising concerns about potential unmet LTC care needs among the elderly, which could significantly impact their overall well-being.

As Europes population continues to age and the prevalence of disability increases, the number of older adults who may face difficulties managing independently is expected to rise. Research indicates that older adults, particularly those with disabilities and unmet LTC needs, are more vulnerable to various health problems, including increased medical visits, emergency room admissions,

hospitalizations, and even higher mortality rates (Momtaz et al. (2012); Marrero et al. (2019)). Furthermore, the interplay of unmet needs and unwanted dependency, often exacerbated by disability, can contribute to heightened feelings of isolation and loneliness (Dykstra et al., 2005). Loneliness among the elderly is linked to accelerated cognitive decline, exacerbation of existing comorbidities, and an increased risk of depression Heinrich and Gullone (2006); Cacioppo et al. (2010); Boss et al. (2015); Rico-Uribe et al. (2018); Casabianca and Kovacic (2024).

The COVID-19 pandemic has further intensified these challenges. Lockdown measures implemented across nearly all European countries to curb the virus's spread and protect the elderly from severe infection significantly disrupted social interactions (Bu et al., 2020). This disruption exacerbated feelings of isolation, especially among older adults with preexisting health conditions, who were more vulnerable to infection and faced a higher risk of severe illness and complications. Many elderly individuals experienced heightened loneliness, compounding the existing vulnerabilities linked to inadequate LTC provision (Brugiavini et al. (2022), Di Novi et al. (2023)).

Despite the potential implications of the connection between unmet LTC needs and loneliness, and its possible impact on long-term cognitive impairment and depressive symptoms, this relationship remains relatively unexplored. There is also limited evidence on how pre-existing unmet LTC needs, combined with the social restrictions imposed during the pandemic, have influenced feelings of loneliness and long-term health outcomes (Bergeot and Jusot, 2024).

This paper investigates whether unmet LTC needs among older adults with disabilities have a lasting impact on the onset of cognitive decline and depressive symptoms. It also explores whether loneliness resulting from social isolation during the COVID-19 pandemic exacerbated this effect by acting as a potential mediating factor particularly for those lacking adequate formal and informal support to cope with the crisis. The pandemic serves as a natural experiment for studying the onset of loneliness, as it constituted an exogenous shock that frequently increased isolation among older adults. In this context, loneliness may both mediate and amplify the long-term impact of unmet LTC needs on cognitive decline and depressive symptoms. While significant insights have been gained from existing research on unmet needs, feelings of loneliness, and mental health during the lockdown (see, for instance, (Bello et al., 2024)), several key questions remain unanswered. The first pertains to the role of preexisting unmet needs in shaping older adults' vulnerability to loneliness during periods of imposed social isolation, such as the COVID-19 pandemic. Additionally, it raises the question of whether unmet needs impact individuals' mental health and cognitive decline over the long term and whether this effect occurs also through an increased sense of loneliness. The second question concerns timing: whereas most studies focus on the COVID-19 period itself, our research examines the year following the pandemic to assess its long-term consequences on the mental and cognitive well-being of older adults.

To this end, we used data from the eighth and ninth waves of the SHARE survey (Survey of Health, Aging and Retirement in Europe) and the first and

second waves of the SHARE Corona Survey. To estimate the relationship between unmet LTC needs and the onset of cognitive impairment and depressive symptoms in the post-COVID period, as well as to assess the causal mediation effect of loneliness, we employed the novel method proposed by (Dippel et al., 2020). This approach enables the estimation of the causal effect of a treatment, unmet LTC needs in our case, on a specific outcome, namely the long-term onset of cognitive impairment and depressive symptoms. It also allows us to assess the extent to which this effect operates through a mediator variable, specifically the emergence of feelings of loneliness during the pandemic, using an instrumental variable (IV) framework. Since both the treatment and the mediator may be endogenous to the outcome this method makes it possible to identify both the direct causal effect and the mediation effect with a single instrument.

Our findings show that adults aged 65 and over with disabilities or functional limitations who experience unmet LTC needs are at increased risk of developing cognitive decline and depressive symptoms over time. A substantial part of this effect is mediated by the rise of loneliness during the COVID-19 pandemic, underscoring the pivotal role of social isolation in shaping older adults' long-term cognitive and emotional health.

To our knowledge, this is the first study to systematically investigate the interplay between unmet LTC needs, pandemic-related loneliness, and long-term cognitive and mental health outcomes.

The rest of the paper is organized as follows. Section 2 describes the data and variables used in this study and the empirical strategy deployed, including the estimation method. The results are discussed in Section 3. Finally, Section 4 concludes the paper.

2 Methods

2.1 Data Source and Sample Description

The data used in this study come from the eighth and ninth waves of the SHARE survey (Survey of Health, Aging and Retirement in Europe) and the SHARE Corona Survey (first and second wave).

SHARE is a biannual, cross-national, and longitudinal research project that collects data on individuals aged 50 and older and their younger partners. Supervised by the Mannheim Research Institute for the Economics of Aging (MEA), SHARE is the most comprehensive European survey on aging. It is organized into modules, each identified by two letters, which gather detailed information on various aspects, including health status and socioeconomic characteristics of individuals over 50 in Europe.

The eighth and ninth waves of the SHARE survey were conducted using computer-assisted personal interviews (CAPI) based on a standardized questionnaire. The eighth wave took place between October 2019 and March 2020 but was suspended due to the COVID-19 pandemic and associated restrictions, which made face-to-face interviews impractical. Between June and Septem-

ber 2020, a sub-sample of the eighth wave (approximately 70% of the original sample) was re-interviewed via computer-assisted telephone interviews (CATI) to collect additional information on participants' living conditions during the pandemic (first wave of the SHARE Corona Survey). The data gathered provide a comprehensive overview of COVID-19's impact on the adult and elderly population, including information on COVID-19 infections, life changes during lockdown, physical and mental health, medical treatments, social networks, and economic changes caused by the pandemic. The same sub-sample was re-interviewed a year later, from June to August 2021, for the second wave of the SHARE Corona Survey. Finally, the ninth wave of SHARE was conducted between October 2021 and October 2022.

In this paper, the sample includes 14.210 individuals from 25 European countries, namely: Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Luxembourg, Malta, Poland, Romania, Slovakia, Slovenia, Spain, Sweden, and Switzerland. Although the survey also included Israel, it was excluded from our analysis as it is not part of Europe. The Netherlands was also excluded due to missing information on key variables relevant to the model.

The sample consists of elderly individuals aged 65 and older who require LTC due to disabilities or functional limitations, including difficulties in activities of daily living (ADL) or instrumental activities of daily living (IADL). ADL variables include difficulties in performing essential activities of daily living, such as dressing, eating, using the toilet, bathing and showering, getting in and out of bed, walking across a room. IADLs encompass instrumental activities like preparing a hot meal, making telephone calls, taking medications, managing money, such as paying bills and keeping track of expenses. Regarding mobility limitations, SHARE assesses the ability to: walk 100 meters, sit for about 2 hours, get up from a chair after sitting for a long time, climb several flights of stairs without stopping to rest, climb a single flight of stairs without stopping, bend down, kneel or squat, reach or stretch arms above shoulder height, drag or push bulky objects (like a living room chair), lift or carry weights over 5 kilograms (such as a heavy shopping bag), and pick up a coin from a table.

2.2 Methodology

The objective of this paper is to examine whether unmet LTC needs among individuals aged 65 and over, specifically those with disabilities or functional limitations, have had a persistent effect on the onset of cognitive impairment and depressive symptoms. In addition, we investigate whether this relationship has been amplified by the experience of loneliness during the COVID-19 pandemic, potentially acting as a mediating factor.

To explore this mechanism, we conduct a causal mediation analysis. Mediation analysis aims to estimate a transmission pathway by which a treatment T and a mediator M jointly influence an outcome Y. Specifically, the total effect of T on Y (TE) is decomposed into the indirect effect, which operates exclu-

sively through M, and the direct effect, which represents the residual impact of T on Y when holding M constant.

Standard mediation analysis assumes random assignment of the treatment, an assumption that does not hold in our setting. Although we leverage multiple waves of the SHARE survey to temporally separate the measurement of unmet LTC needs, loneliness, cognitive decline, and depressive symptoms, thereby mitigating concerns about reverse causality, endogeneity may still arise due to unobserved confounding factors, potentially biasing the estimated effects. To address this issue, we adopt the methodology proposed by (Dippel et al., 2020), which is specifically designed for settings involving an outcome Y (long-term cognitive and mental health outcomes, i.e., onset of cognitive decline and depressive symptoms), a potentially endogenous treatment T (unmet LTC needs), a potentially endogenous mediator M (onset of loneliness), and an instrumental variable Z.

Following Dippel et al. (2020), under the assumptions of linearity and a valid instrument, the causal relationships among T, M, and Y can be formally identified as follows:

$$Z = \varepsilon_z \tag{1}$$

$$T = \beta_T^Z Z + \varepsilon_T \tag{2}$$

$$M = \beta_M^T T + \varepsilon_M \tag{3}$$

$$Y = \beta_Y^T T + \beta_Y^M M + \varepsilon_Y \tag{4}$$

The estimation strategy relies on two two-stage least squares 2SLS procedures. The first identifies the causal effect of T (unmet LTC needs) on M (onset of loneliness) formalized in the following system of equations:

$$\text{First stage: } T \textit{ (unmet LTC needs)} = \beta_T^Z Z + \varepsilon_T \tag{5}$$

$$\text{Second stage: } M \textit{ (onset of loneliness)} = \beta_M^T \hat{T} + \varepsilon_M \tag{6}$$

where $\hat{T}$ denotes the predicted value of T from Equation (5).

The second 2SLS procedure identifies the causal effect of M on Y, conditional to T, which allows the disentanglement of the direct and indirect effect of T on Y:

$$\text{First stage: } M \textit{ (onset of loneliness)} = \gamma_M^Z Z + \gamma_M^T T + \varepsilon_M \tag{7}$$

$$\text{Second stage: } Y \textit{ (onset of cognitive decline/depression)} = \beta_Y^M \hat{M} + \beta_Y^T T + \varepsilon_Y \tag{8}$$

where $\hat{M}$ denotes the predicted value of M from Equation (7).

By substituting (6) into (8) yields, it becomes clear the link between the two estimation procedures:

$$\begin{aligned} Y \textit{ (onset of cognitive decline/depression)} &= \beta_Y^M(\beta_M^T T + \varepsilon_M) + \beta_Y^T T + \varepsilon_Y \\ &= \underbrace{(\beta_Y^M \beta_M^T + \beta_Y^T)}_{\text{Total effect of } T} T + \underbrace{\beta_Y^M \varepsilon_M + \varepsilon_Y}_{\omega_Y} \end{aligned} \tag{9}$$

In equation (9), the mediated effect of T on the outcome is given by $\beta_Y^M \beta_M^T$ (indirect effect), the residual effect of T on the outcome is given by β_Y^T (direct effect), and the total effect (TE) is the sum $\beta_Y^M \beta_M^T + \beta_Y^T$.

This algebraic equivalence holds for a scalar instrument Z, but may not hold when using a vector of instruments Z'.

2.3 Key Variables

Following the approach of Dippel et al. (2020), we identify four key variables for the empirical model: the treatment T (unmet LTC needs), the mediator M (onset of loneliness), the outcome Y (onset of depressive symptoms), and an instrumental variable Z.

2.3.1 Treatment: Unmet LTC needs

In this study, we employ two alternative definitions of unmet LTC needs consistent with those commonly used in the existing literature. This approach allows us to assess the sensitivity of our findings to the their specific definition.

A central challenge in measuring unmet LTC needs lies in the absence of a universally accepted definition. Typically, needs are assessed based on health status, with unmet needs defined as the failure to receive available and effective care that could improve well-being (Vlachantoni et al. (2011), Smith and Connolly (2020)). Following this framework, we identify unmet LTC needs using three commonly accepted dimensions of functional impairment in geriatrics: limitations in activities of daily living (ADLs), instrumental activities of daily living (IADLs), and mobility (LaPlante et al. (2004), Caldern-Jaramillo and Zueras (2023)). We assume that the presence of such functional limitations

indicates an objective need for LTC. The first indicator we construct is therefore based on this more objective, although self-reported, assessment: it takes the value one if an individual with at least one reported functional limitation (thus an objectively defined need) reports not receiving any assistance, either formal or informal, and zero otherwise. This captures unmet need in terms of the absence of received support among those identified as needing care (see also Garca-Gmez et al. (2015)).

In contrast, the second indicator adopts a more subjective approach. It is based directly on respondents' answers to the question: *"Thinking about the activities you have difficulty with, does anyone ever assist you with these activities (including a partner or other household members)?"* Here, unmet LTC need takes value one if respondents report not receiving any help despite perceiving a need for assistance.

Thus, the first indicator reflects an externally defined, function-based unmet need, while the second captures the respondent's own perception of receiving or not receiving help.

2.3.2 Mediator: Onset of loneliness

Loneliness can be defined as the negative experience resulting from a discrepancy between the desired and actual personal network of relationships (Cacioppo and Patrick, 2008). Several studies have suggested that loneliness is associated with cognitive decline and poor mental health outcomes, including depression in the long term (Heinrich and Gullone (2006), Cacioppo et al. (2010), Boss et al. (2015), Rico-Uribe et al. (2018)).

In the eighth wave of SHARE, participants were asked: *"How often do you feel lonely?"* with response options: "often," "some of the time," and "almost never or never." This same question was posed in the SHARE Corona Survey (first and second wave). By combining data from the eighth wave of the SHARE Survey with data from the first and the second wave of the SHARE Corona Survey, a dichotomous variable was created to evaluate the onset of loneliness during the pandemic. This variable takes value one if the respondent reported feeling lonely "almost never or never" in the eighth wave of SHARE but "often" in the first or second wave of SHARE Corona Survey or both, or if she or he reported feeling lonely "some of the time" in the eighth wave but "often" in the first or second wave of SHARE Corona Survey or both. It takes value zero otherwise.

2.3.3 Outcomes: cognitive decline and onset of depressive symptoms

In this study, we also employ two alternative outcomes to examine the impact of unmet LTC needs, potentially mediated by the onset of loneliness, on long-term cognitive impairment and depressive symptoms.

Onset of cognitive decline

Cognitive impairment constitutes a major determinant for older-aged adults' health, functionality, and well-being. Cognitive decline is an important risk factor for neurocognitive disorders, such as dementia, particularly among older adults. In this study, cognitive decline was assessed by comparing individual performance across four cognitive tasks: temporal orientation, numeracy, episodic memory, and verbal fluency between Waves 8 and 9 of SHARE. According to existing literature, these tasks are widely recognized as reliable and sensitive indicators for distinguishing cognitively healthy older individuals from those experiencing cognitive impairment. (Dewey and Prince (2005), Formanek et al. (2019), Barbosa et al. (2021)).

Temporal orientation was measured through four questions that assessed awareness of date and time: "What day of the month is it?", "Which month is it?", "Which year is it?", and "Can you tell me what day of the week it is?". Scores ranged from 0 to 4, based on the number of correct answers. A binary indicator was constructed, taking the value 1 if the respondent scored 4 in wave 8 and 3 or less in wave 9, reflecting the onset of disorientation and early signs of cognitive decline (Tractenberg et al. (2007), Feter et al. (2021)).

Numeracy was assessed through a five-step subtraction task, where respondents were asked to subtract 7 from 100 and continue subtracting 7 from each subsequent result. The score ranged from 0 to 5 and accounted for correct answers. A binary variable was coded as 1 for individuals who scored 4 or 5 in wave 8 and 3 or less in wave 9, capturing a decline in arithmetic ability (Schneeweis et al. (2014), Amin et al. (2025)).

Episodic memory was measured via immediate and delayed verbal recall tests. After hearing a list of ten words, participants were asked to recall as many as possible immediately, and again after a delay of 5–10 minutes. Scores ranged from 0 to 10 for each test, based on the number of correctly recalled words. Two binary indicators were created: one taking the value 1 if immediate recall declined from ≥ 5 in wave 8 to < 5 in wave 9, and another if delayed recall declined from ≥ 4 to < 4, in line with established impairment thresholds (Sterniczuk et al. (2015), Bonsang et al. (2012)).

Verbal fluency, reflecting executive functioning and language ability, was assessed by asking participants to name as many different animals as possible in 60 seconds. Valid animal names were counted, excluding repetitions and proper nouns. A binary variable was assigned a value of 1 if the participant scored above 15 in wave 8 and 15 or less in wave 9, indicating a decline in verbal fluency (Sterniczuk et al. (2015),Barbosa et al. (2021)).

To derive a synthetic, continuous measure of cognitive decline, we extracted the first common factor from a correlation matrix estimated using polychoric correlations among the above binary indicators (Olson and Dover (1979)). This factor score, reflecting the overall onset of cognitive impairment across multiple domains, was standardized to range from 0 to 1 to facilitate interpretation.

Onset of depressive symptoms

Depression is one of the most common disorders in older adults and, with

the rapid expansion of the aging population, is considered today a major public health concern due to its high prevalence and associated mortality risk, even before the COVID-19 pandemic (Abdoli et al. (2022); Song et al. (2023)). The pandemic likely contributed to the onset of symptoms or worsened mental health-related disabilities, particularly among the most vulnerable older individuals. Loneliness and unmet needs, exacerbated by social isolation and care interruptions, may have further exacerbated their condition (Santini and Koyanagi (2021)).

The onset of depressive symptoms was assessed using the EURO-D scale, developed and validated by the EURODEP Concerted Action Programme. This scale comprises 12 items related to psychological health: depression, pessimism, suicidal ideation, guilt, sleep difficulties, lack of interest, irritability, lack of appetite, fatigue, difficulty concentrating, anhedonia (inability to experience pleasure), and a tendency to cry. Each item is equally weighted, with a score of 0 indicating the absence of the symptom and a score of 1 indicating its presence.

We relied on the clinical definition of depression as outlined by the EURO-D scale, where a clinically defined cut-off point of four symptoms indicates severe mental health issues (Prince et al. (1999)). To analyze the onset of depression, we created a binary variable that takes value of one if respondents reported fewer than four symptoms in the eighth wave of SHARE but reported four or more symptoms in the ninth wave of SHARE.

2.3.4 Instruments

Following Dippel et al. (2020), we use a single IV to address the endogeneity of the treatment and the mediator. This approach enables the identification of both the total treatment effect and the mediated effect through a causal pathway. By introducing an exogenous instrument, we can isolate the transmission mechanism and separately estimate the direct effect of unmet LTC needs on the onset of depressive symptoms, as well as the indirect effect mediated by loneliness.

Social network strength index

We started by constructing an indicator capturing the quality of respondents' social network ties drawing information from the "Social Network" (SN) module. The quality of respondents' social network ties is an important dimension that may affect access to social support, and, in turn, the likelihood of receiving care and experiencing loneliness (see Bello et al. (2024)).

Specifically, social network strength was evaluated using two measures: satisfaction with one's social network and perceived closeness to network members. In the SHARE survey, social network satisfaction, defined as the degree to which individuals are satisfied with their interpersonal relationships, was measured by first asking participants to identify up to six individuals with whom they had discussed important matters over the past 12 months. This was done using the question: "Over the last 12 months, who are the people with whom you most

often discussed important things? These people may include your family members, friends, neighbors, or other acquaintances." For those who named at least one individual, satisfaction was then assessed with the item: "Overall, on a scale from 0 to 10, where 0 means completely dissatisfied and 10 means completely satisfied, how satisfied are you with the [relationship you have with the person] we have just talked about?" (Brsch-Supan (2022)). Individuals who did not report any social ties (i.e., a score of 0 on the network inventory) were classified as network-less and assigned a satisfaction score of zero (Yang et al. (2022)).

The perceived closeness to network members was assessed by asking respondents: "How close do you feel to...?", with response options of 'not very close', 'somewhat close', 'very close', and 'extremely close'. Based on this, we constructed a variable indicating the number of network members to whom the respondent felt very close or extremely close.

To create a synthetic, continuous indicator of social network ties, we extracted the first common factor from a correlation matrix estimated using polychoric correlations based on the aforementioned categorical indicators (see Olson and Dover (1979)). This yielded a single factor score reflecting the overall strength of an individuals social network, which was then standardized to range from 0 to 1 to ease interpretation.

Extended social network strength index with personality traits

Social relationships may also be influence by individuals' personality traits that can affetct the ability and propensity to form and maintain such ties. SHARE includes the 10-item Big Five Inventory (BFI-10), a self-report questionnaire developed by Rammstedt and John (2007) to assess five personality traits: openness, conscientiousness, extraversion, agreeableness, and neuroticism, with two items per trait. Respondents rated each item on a Likert scale from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating a stronger presence of the trait.

In this study, we focused on extraversion, as it captures a predisposition toward social interaction and greater social engagementboth of which are closely linked to social support and informal caregiving networks (Soto (2021); Swickert et al. (2010)). Extraversion was measured using two items: I see myself as someone who is reserved (reverse-coded) and I see myself as someone who is outgoing, sociable. These were combined to create an extraversion index ranging from 1 (low) to 5 (high).

Because personality traits like extraversion are relatively stable over time and exogenous to short-term shocks, including those induced by the pandemic, they can serve as valid instruments in mediation models. Extraverted individuals are more likely to receive informal care from family, friends, or community members, thereby reducing their risk of experiencing unmet LTC needs. At the same time, they may also be more vulnerable to loneliness under social restrictions due to their higher baseline need for interpersonal contact (Bello et al. (2024); Tapia-Munoz et al. (2024)).

To incorporate this dimension into our measure of social network ties, we

constructed a new synthetic, continuous indicator that integrates both observed network characteristics (satisfaction and closeness) and the extraversion index. This extended indicator was derived again by extracting the first factor from a polychoric correlation matrix including all three variables. The resulting index captures a broader concept of social engagement capacity, encompassing both structural (network) and dispositional (personality) components.[1]

2.4 Additional explanatory variables

In our model, we controlled for a set of individual-level covariates, including demographic, household size and socio-economic characteristics, and country-specific factors collected from the eight wave of SHARE. Demographic controls included sex (coded as 0=male, 1=female) and age. Educational attainment was classified according to the International Standard Classification of Education (ISCED) into three categories: low education (no formal qualifications, primary, or lower secondary education), medium education (upper secondary or high school diploma), and high education (university degree or postgraduate qualifications). Marital status was coded as a binary variable distinguishing between individuals living with a spouse or partner in the same household and those living alone (reference category). Household income was measured as total annual net income, calculated by summing various components reported in the survey such as labor income, public pensions, and income from assets after deductions for taxes and social or national insurance contributions and divided into quintiles. Lastly, all models include country fixed effects to account for unobserved heterogeneity across national contexts, such as differences in LTC systems, pandemic policy responses, and welfare structures.

A detailed description of all variables included in the analysis is provided in Table A1 in the Appendix.

3 Results

Table 1 presents a simple descriptive analysis, reporting sample means and standard deviations for the variables included in the model. Approximately 55% of the study sample (58% of whom are women, with a mean age of 74 years) reported having at least one disability or functional limitation but not receiving any form of formal or informal care. Furthermore, 33% of the sample reported not receiving help despite perceiving a need for assistance.

[Table 1 about here]

About 21% of respondents reported the onset of depressive symptoms, as indicated by changes in their EURO-D scores between waves 8 and 9 of SHARE.

[1] To mitigate concerns about reverse causality, we also reconstructed the indicators capturing the quality of respondents' social network ties and their level of extraversion using lagged values from the previous waves of SHARE. See the subsetion 3.1 Robustness Checks.

The prevalence of depressive symptoms was considerably higher among individuals with unmet LTC needs: 26% based on the objective indicator and 24% using the subjective one, compared to 14% and 19%, respectively, among those without such needs. Approximately 7% of the sample also reported the onset of loneliness during the first or second wave of the SHARE Corona Survey, with a higher incidence among those with unmet LTC needs (about 10% compared to 5% when considering the objective indicator, and about 9% compared to 7% when considering the subjective one).

Focusing specifically on the subsample of individuals who experienced unmet LTC needs (objective or subjective) (see Table A2 and Table A3 in the Appendix), and further distinguishing between those who reported the onset of loneliness and those who did not, a notable difference emerges: among those who became lonely, about 41% also reported depressive symptoms when considering the objective indicator of unmet LTC needs, and 39% when considering the subjective one, compared to 25% and 23% among those who did not report loneliness during the pandemic, according to the objective and subjective indicators of unmet LTC needs, respectively.

It is noteworthy that between wave 8 and wave 9, there was a general decline in individual performance across all four cognitive tasks considered, affecting a substantial portion of the sample. Memory performance declined in over half of the sample (52.5%), as did numeracy (53%), followed by verbal fluency (approximately 32%), and orientation, which worsened in about 12% of respondents. Once again, when dividing the sample between those who reported unmet LTC needs and those who did not, significant differences emerge. Among individuals reporting unmet LTC needs according to the objective definition, 59% experienced a decline in memory performance and 58% in numeracy. Additionally, the share of those reporting a decline in verbal fluency rose to 39.5%, while the proportion experiencing deterioration in orientation reached around 15% of the subsample. Among individuals reporting unmet LTC needs according to the subjective definition, 55% experienced a decline in memory performance and 55% in numeracy; the share of those reporting a decline in verbal fluency rose to 36%, while the proportion experiencing deterioration in orientation reached around 12% of the subsample.

It is also interesting to observe that, when dividing the sample between those who reported unmet LTC needs alone and those who also experienced the onset of loneliness, cognitive performance declines further. This is particularly evident in verbal fluency, where the proportion of individuals showing a decline increases from 39.5% among those with unmet LTC needs only to 57% among those who also reported the emergence of loneliness, when considering the objective indicator of unmet LTC needs, and from 36% to 51.5% when considering the subjective indicator, representing a difference of more than 15 percentage points in both cases.

Table 2 and Table 3 present the results of the instrumental variable (IV) model, estimated using two-stage least squares (2SLS). The instruments employed are an indicator of the quality and strength of the respondents social network, and an extended social network index incorporating personality traits,

specifically individual extraversion. The treatment variable is unmet LTC needs, measured using either the objective indicator or the subjective indicator.

The outcome variables include the onset of depressive symptoms and a composite cognitive decline index, constructed as a summary measure of cognitive deterioration between wave 8 and wave 9 of SHARE. This index is based on four cognitive domains: temporal orientation, numeracy, episodic memory, and verbal fluency. Given the substantial performance gap in the verbal fluency task between individuals who experienced unmet LTC needs and those who did not, particularly between those who also reported the onset of loneliness and those who did not, the model was also estimated using verbal fluency as a separate outcome.

Table 2 reports the second-stage regression models in which unmet LTC needs are modeled as a function of the quality and strength of the respondents social network, used as an instrument. The coefficient on the social network ties indicator is consistently statistically significant at conventional levels across both definitions of unmet LTC needs and yields first-stage F-statistics ranging from a minimum of 14.41 to a maximum of 24.93 (see Table A4 in the Appendix). These values consistently exceed the conventional threshold of 10, commonly used to detect weak instruments (see, e.g., Stock et al., 2002). According to the results presented in Tables 2 and 3, suffering from at least one form of disability, such as mobility limitations or limitations in ADLs or IADLs, without receiving any form of formal or informal support (i.e., experiencing unmet LTC needs, as defined objectively above), or perceiving a lack of help despite needing care (i.e., subjective unmet LTC needs), nearly doubles the risk of the onset of depression and cognitive decline compared to individuals who receive care.

[Table 2 about here]

Similar results are obtained in Table 3, which present the coefficients of the 2SLS models in which the first-stage regressions model for unmet LTC needs is a function of an extended social network index. This index captures both the quality and strength of respondents' social ties, combined with a specific personality traitnamely, extraversion. In these models, the first-stage F-statistics range from a minimum of 22.5 to a maximum of 27.11 (see Table A5 in the Appendix).

[Table 3 about here]

The results of the IV mediation analysis are presented in Table 4 and 5. The estimation strategy is based on the 2SLS approach. As previously discussed, identification relies on a single instrumental variable and assumes that the main source of endogeneity in estimating the causal effect of treatment (T) on the outcome (Y) operates primarily through the mediator (M). This framework enables the decomposition of the total effect into direct and indirect (mediated) components, thereby clarifying the causal pathway linking unmet LTC needs, loneliness, and outcomes such as cognitive decline and depressive symptoms.

As noted earlier, the model is estimated using two indicators of unmet LTC needs. The first is a more objective, though still self-reportedmeasure, which captures unmet LTC needs in terms of the absence of received support among individuals identified as requiring care (panel A). The second relies on respondents' self-reports of not receiving any help despite perceiving a need for assistance (panel B). The model is estimated using also two different instruments: the social network strength index (Table 4) and the one extended to the respondent personality traits specifically extraversion (Table 5). Our main findings, reported in Tables 4 and 5, indicate that unmet LTC needs significantly increase the likelihood of experiencing both cognitive decline and the onset of depressive symptoms in later life.

[Table 4 and 5 about here]

The total effect of unmet LTC needs on the onset of depressive symptoms, cognitive decline, and, in particular, verbal fluency decline is consistent with the results previously shown in Tables 2 and 3. Specifically, among individuals aged 65 and older with disabilities or functional limitations, having unmet LTC needs nearly doubles the long-term probability of developing depressive symptoms, cognitive impairment, and fluency decline. However, while the direct effect is relatively modest, ranging from a 0.8% increase in fluency decline, 1.7% in overall cognitive impairment, and 5% in the likelihood of depression onset, it is statistically significant for the onset of depressive symptoms only when considering the subjective indicator of unmet LTC needs. When considering the objective indicator, the direct effect is not statistically significant. In contrast, the indirect effects, mediated by loneliness, are substantially larger. Notably, the mediated effect accounts for more than 95% of the total impact of unmet LTC needs on depression, cognitive decline, and verbal fluency deterioration, highlighting the central role of loneliness in shaping long-term cognitive and mental health outcomes among older adults. Tables 9 and 10 also report that the first-stage F-statistics for the regression of the treatment variable (T) on the instrument (Z), and for the regression of the mediator (M) on the instrument conditional on T, consistently exceed the conventional threshold of 10, commonly used to rule out weak instruments (see, e.g., Stock et al., 2002).

3.1 Robustness Checks: Alternative Specifications

In this subsection, we explore alternative specifications of the model to assess the sensitivity of our estimates to changes in model.

First, to mitigate concerns about reverse causality, we reconstructed the indicator capturing the quality of respondents' social network ties by using information from the "Social Network" (SN) module in Wave 6 of the SHARE survey (2015), as this module was not included in Wave 7. The analysis was restricted to a subsample of respondents who participated in both Waves 6 and 8, resulting in a total of 9,900 observations.[2] The results of this sensitivity test

[2]For the part of the analysis that uses social network strength as an instrument, the sample

are presented in Table 6 and are consistent with those obtained in the baseline model.

[Table 6 about here]

Next, we recomputed the extended social network ties index by incorporating a lagged indicator of extraversion too. As previously discussed, extraversion is generally considered a stable personality trait over the life course and is thus unlikely to be affected by short-term shocks. Nevertheless, as a robustness check and to further address potential reverse causality, we conducted a sensitivity analysis using the measure of extraversion collected in Wave 7 of the SHARE survey (2017). The correlation between the extraversion indices from Waves 7 and 8 is very high (89%), confirming the temporal stability of the trait. The results of this test are presented in Table 7 and again align closely with the baseline findings.

[Table 7 about here]

Social network ties and individuals perceptions of their networks, in terms of both closeness and satisfaction, may vary not only across countries but also across generations. To account for this heterogeneity, we included birth year dummies in our model in addition to country fixed effects. The results of this further empirical exercise are shown in Tables 8 and 9. As with the previous models, we first differentiate by treatment type (i.e., objective vs. subjective definitions of unmet LTC needs) and then by the instrument used: Table 8 employs the original indicator of social network ties, while Table 9 uses the extended social network index, which also incorporates the respondents level of extraversion. As shown, the results remain consistent with previous specifications, thereby reinforcing the robustness of our findings.

[Table 8 and 9 about here]

Overall, these findings, which appear to be robust under different model specifications, underscore the significant impact of unmet LTC needs in increasing the likelihood of long-term cognitive impairment and the onset of depressive symptoms. They also highlight the pivotal role of loneliness as a mediating factor in the relationship between unmet LTC needs and adverse cognitive and mental health outcomes in later life.

3.2 Discussion

Older individuals with disabilities are likely to face increasing challenges in accessing adequate care in the coming years. Demographic and social changes, such as the decline of extended families and the rise of nuclear family structures,

is limited to countries that participated in both Waves 6 and 8 of SHARE: Austria, Belgium, Croatia, the Czech Republic, Denmark, Estonia, France, Germany, Greece, Italy, Luxembourg, Poland, Slovenia, Spain, Sweden, and Switzerland.

have contributed to a weakening of inter-generational proximity, thereby reducing the availability of informal support for older adults. The decline in informal caregiving, combined with underdeveloped public LTC systems, is contributing to widening disparities in care provision and leaving a growing number of older adults with unmet LTC needs. These challenges may be particularly acute among those from lower socioeconomic backgrounds, who frequently encounter both financial and structural barriers to accessing formal LTC services. In many countries, such services remain unaffordable. According to the (**?**), in most of the countries included in our sample, the total cost of formal LTC accounts for a substantial portion of an older adults disposable income, with significant cross-national variation. For instance, in Northern European countries such as Finland and Denmark, out-of-pocket costs are kept below 5% of median income. In contrast, in countries like Croatia, Poland, Italy, and Estonia, these costs can exceed 100%, often pushing older adults into poverty or leaving their care needs unmet.

Our findings highlight the serious consequences of such unmet LTC needs. Older adults without access to adequate care are significantly more likely to experience cognitive decline and the emergence of depressive symptoms over time. They are also susceptible to social isolation due to life-course factors such as retirement, widowhood, and reduced mobility. By leveraging the COVID-19 pandemic, and the consequent increase in social isolation, our analysis further emphasizes the mediating role of loneliness in the relationship between unmet LTC needs and the long-term onset of cognitive impairment and mental health issues. We exploit the pandemic-related restrictions as a natural experiment, as they exacerbated older adults isolation by limiting in-person interactions. Our analysis indicates that feelings of loneliness substantially intensify the negative impact of unmet LTC needs on both cognitive function and mental well-being. Among the various cognitive domains assessed, verbal fluency appears especially sensitive. This vulnerability may stem from its reliance on executive functioning, working memory, and lexical retrievalprocesses that are highly dependent on both social interaction and emotional stability. Prolonged loneliness, when combined with insufficient care, may lead to deterioration in these interrelated functions, rendering verbal performance particularly prone to decline.

We do not find evidence of significant long-term effects on physical health outcomes, such as gpt visits, hospital admissions or the onset of new chronic conditions (see Tables A6-A15 in the Appendix). Arguably, while our observation window of approximately three years is relatively long, it may still be insufficient to detect more gradual physical health consequences, particularly among already frail individuals. Thus, the most pronounced medium- to long-term impacts appear to be concentrated in the cognitive and psychological domains. Nevertheless, we cannot entirely rule out the possibility that cascading effects on physical health may emerge over a longer follow-up period.

Overall, these findings underscore the critical importance of addressing LTC deficits among older adults with functional limitations and the crucial role of loneliness in later life.

4 Conclusions

This study investigates the complex relationship between unmet LTC needs, loneliness, and long-term cognitive and psychological decline among older adults in Europe. Europe provides an interesting context for this analysis, given its ongoing demographic transition. As the population ages rapidly, the traditional role of the family as a key actor and primary source of support is being challenged: demographic changes, the process of de-familiarization (i.e., the gradual weakening of the family-based care model), and the significant rise in female labor force participation have all contributed to a reduced capacity for informal caregiving. At the same time, the growing demand for care is placing increasing pressure on formal LTC systems. In many countries, however, these services remain financially inaccessible to a large share of the population. This gap risks exacerbating socioeconomic inequalities in access to essential support, particularly in countries where public LTC coverage is limited. These structural challenges are contributing to a growing number of older adults whose medical, personal, and social care needs remain unmet.

Using longitudinal data from Waves 8 and 9 of SHARE and the SHARE Corona Survey, and a causal mediation analysis that draws on an instrumental variable approach, we find that older individuals with unmet LTC needs are significantly more likely to experience cognitive decline and psychological distress over time. Loneliness emerges as a key mediating factor in this relationship. Our findings show that reduced social engagement, together with insufficient care, are closely linked to faster cognitive deterioration and higher risks of depression. These results highlight how LTC is crucial to the wellbeing of older people and how unmet LTC needs and loneliness may undermine their emotional health.

References

Abdoli, N., Salari, N., Darvishi, N., Jafarpour, S., Solaymani, M., Mohammadi, M., and Shohaimi, S. (2022). The global prevalence of major depressive disorder (mdd) among the elderly: A systematic review and meta-analysis. *Neuroscience & Biobehavioral Reviews*, 132:1067–1073.

Amin, V., Behrman, J. R., Fletcher, J. M., Flores, C. A., Flores-Lagunes, A., and Kohler, H.-P. (2025). Does schooling improve cognitive abilities at older ages? causal evidence from nonparametric bounds. *Demography*, 62(2):515–541.

Barbosa, R., Mido, L., Almada, M., and Costa, E. (2021). Cognitive performance in older adults across europe based on the share database. *Neuropsychology, Development, and Cognition. Section B, Aging, Neuropsychology and Cognition*, 28(4):584–599.

Bello, P., Di Novi, C., Martini, G., and Sturaro, C. (2024). Alleviating loneliness during covid-19: The impact of neighbor cohesion and social connections in england. *Socio-Economic Planning Sciences*, 93:101913.

Bergeot, J. and Jusot, F. (2024). How did unmet care needs during the pandemic affect health outcomes of older european individuals? *Economics Human Biology*, 52:101317.

Bonsang, E., Adam, S., and Perelman, S. (2012). Does retirement affect cognitive functioning? *Journal of Health Economics*, 31(3):490–501.

Boss, L., Kang, D. H., and Branson, S. (2015). Loneliness and cognitive function in the older adult: a systematic review. *International Psychogeriatrics*, 27(4):541–553.

Brenna, E. and Di Novi, C. (2016). Is caring for older parents detrimental to womens mental health? the role of the european northsouth gradient. *Review of Economics of the Household*, 14:745–778.

Brugiavini, A., Di Novi, C., and Orso, C. E. (2022). Visiting parents in times of covid-19: The impact of parent-adult child contacts on the psychological health of the elderly. *Economics Human Biology*, 46:101152.

Bu, F., Steptoe, A., and Fancourt, D. (2020). Loneliness during a strict lockdown: Trajectories and predictors during the covid-19 pandemic in 38,217 united kingdom adults. *Social Science Medicine*, 265:113521.

Brsch-Supan, A. (2022). Survey of health, ageing and retirement in europe (share) wave 7. SHARE-ERIC. Data Set. Release Version: 8.0.0.

Cacioppo, J. T., Hawkley, L. C., and Thisted, R. A. (2010). Perceived social isolation makes me sad: 5-year cross-lagged analyses of loneliness and depressive symptomatology in the chicago health, aging, and social relations study. *Psychology and Aging*, 25:453–463.

Cacioppo, J. T. and Patrick, W. (2008). Loneliness: Human nature and the need for social connection. *Norton*.

Caldern-Jaramillo, M. and Zueras, P. (2023). Cared and uncared populations: understanding unmet care needs of older adults (65+) across different social care systems in europe. *European Journal of Ageing*, 20(1):11.

Carrieri, V., Di Novi, C., and Orso, C. E. (2017). Home sweet home? public financing and inequalities in the use of home care services in europe. *Fiscal Studies*, 38(3):445–468.

Casabianca, E. and Kovacic, M. (2024). Historical roots of loneliness and its impact on second-generation immigrants health. *Journal of Economic Behavior Organization*, 224:407–437.

Costa-Font, J. and Vilaplana-Prieto, C. (2022). Mental health effects of caregivers respite: Subsidies or supports? *The Journal of the Economics of Ageing*, 23:100398.

Dewey, M. E. and Prince, M. J. (2005). Cognitive function. In *Health, Ageing and Retirement in Europe: First Results from the Survey of Health, Ageing and Retirement in Europe*, pages 118–125. Mannheim Research Institute for the Economics of Aging (MEA).

Di Novi, C., Jacobs, R., and Migheli, M. (2015). The quality of life of female informal caregivers: From scandinavia to the mediterranean sea. *European Journal of Population*, 31(3):309–333.

Di Novi, C., Martini, G., and Sturaro, C. (2023). The impact of informal and formal care disruption on older adults psychological distress during the covid-19 pandemic in uk. *Economics Human Biology*, 49:101242.

Dippel, C., Ferrara, A., and Heblich, S. (2020). Causal mediation analysis in instrumental-variables regressions. *The Stata Journal*, 20(3):613–626.

Dykstra, P. A., Van Tilburg, T. G., and Gierveld, J. D. J. (2005). Changes in older adult loneliness: Results from a seven-year longitudinal study. *Research on Aging*, 27(6):725–747.

Eurostat (2019). Ageing europe looking at the lives of older people in the eu 2019 edition. *Publications Office*.

Feter, N., Dumith, S. C., Smith, E. C., da Cunha, L. L., Cassuriaga, J., Leite, J. S., Alt, R., Coombes, J. S., and Rombaldi, A. J. (2021). Physical activity attenuates the risk for dementia associated with aging in older adults with mild cognitive impairment. findings from a population-based cohort study. *Journal of Psychiatric Research*, 141:1–8.

Formanek, T., Kagstrom, A., Winkler, P., and Cermakova, P. (2019). Differences in cognitive performance and cognitive decline across european regions: A population-based prospective cohort study. *European Psychiatry*, 58:80–86.

Gannon, B. and Davin, B. (2010). Use of formal and informal care services among older people in ireland and france. *The European Journal of Health Economics*, 11:499–511.

Garca-Gmez, P., Hernndez-Quevedo, C., Jimnez-Rubio, D., and Oliva-Moreno, J. (2015). Inequity in long-term care use and unmet need: Two sides of the same coin. *Journal of Health Economics*, 39:147–158.

Heinrich, L. M. and Gullone, E. (2006). The clinical significance of loneliness: a literature review. *Clinical Psychology Review*, 26:695–718.

LaPlante, M. P., Kaye, H. S., Kang, T., and Harrington, C. (2004). Unmet need for personal assistance services: estimating the shortfall in hours of help and adverse consequences. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, 59(2):S98–S108.

Marrero, J., Fortinsky, R. H., Kuchel, G. A., and Robison, J. (2019). Risk factors for falls among older adults following transition from nursing home to the community. *Medical Care Research and Review*, 76(1):73–88.

Momtaz, Y. A., Hamid, T. A., and Ibrahim, R. (2012). Unmet needs among disabled elderly malaysians. *Social Science Medicine*, 75(5):859–863.

OECD (2023). Health at a glance, 2023. *OECD Indicators*.

Olson, J. C. and Dover, P. A. (1979). Disconfirmation of consumer expectations through product trial. *Journal of Applied Psychology*, 64(2):179–189.

Prince, M. J., Beekman, A. T., Deeg, D. J., Fuhrer, R., Kivela, S. L., Lawlor, B. A., and Copeland, J. R. (1999). Depression symptoms in late life assessed using the eurod scale: Effect of age, gender and marital status in 14 european centres. *The British Journal of Psychiatry*, 174(4):339–345.

Rammstedt, B. and John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the big five inventory in english and german. *Journal of Research in Personality*, 41(1):203–212.

Rico-Uribe, L. A., Caballero, F. F., Martn-Mara, N., Cabello, M., Ayuso-Mateos, J. L., and Miret, M. (2018). Association of loneliness with all-cause mortality: A meta-analysis. *PloS One*, 13(1):e0190033.

Santini, Z. I. and Koyanagi, A. (2021). Loneliness and its association with depressed mood, anxiety symptoms, and sleep problems in europe during the covid-19 pandemic. *Acta Neuropsychiatrica*, 33(3):160–163.

Schneeweis, N., Skirbekk, V., and Winter-Ebmer, R. (2014). Does education improve cognitive performance four decades after school completion? *Demography*, 51(2):619–643.

Smith, S. and Connolly, S. (2020). Rethinking unmet need for health care: introducing a dynamic perspective. *Health Economics, Policy and Law*, 15(4):440–457.

Song, M. S., Park, S. S., and Park, S. (2023). Factors influencing frontline screening nurses' depression as a long-term impact of covid-19. *Western Journal of Nursing Research*, 45(6):554–561.

Soto, C. J. (2021). Do links between personality and life outcomes generalize? testing the robustness of traitoutcome associations across gender, age, ethnicity, and analytic approaches. *Social Psychological and Personality Science*, 12(1):118–130.

Spasova, S., Baeten, R., Coster, S., Ghailani, D., Pea-Casas, R., and Vanhercke, B. (2018). Challenges in long-term care in europe. a study of national policies. Technical report, European Social Policy Network (ESPN), European Commission, Brussels.

Sterniczuk, R., Theou, O., Rusak, B., and Rockwood, K. (2015). Cognitive test performance in relation to health and function in 12 european countries: The share study. *Canadian Geriatrics Journal (CGJ)*, 18(3):144–151.

Swickert, R. J., Hittner, J. B., and Foster, A. (2010). Big five traits interact to predict perceived social support. *Personality and Individual Differences*, 48(6):736–741.

Tapia-Munoz, T., Ajnakina, O., Fancourt, D., and Steptoe, A. (2024). Personality traits and loneliness among older people in the uk: Cross-sectional and longitudinal analysis from the english longitudinal study of ageing. *European Journal of Personality*, 38(4):599–614.

Tractenberg, R. E., Weiner, M. F., Aisen, P. S., Kaye, J. A., and Fuh, J.-L. (2007). A simple method to rule out dementia with temporal orientation. *Alzheimer's Dementia*, 3(1):28–32.

Vlachantoni, A., Shaw, R., Willis, R., Evandrou, M., Falkingham, J., and Luff, R. (2011). Measuring unmet need for social care amongst older people. *Population Trends*, (145):56–72.

Yang, Y., Huang, R., Grol-Prokopczyk, H., and Torres, J. M. (2022). Social network change after new-onset pain among middle-aged and older european adults. *Social Science Medicine*, 310:115215.

Tables

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
Health Outcomes					
onset depression	0.206	0.404	0	1	14210
onset loneliness	0.073	0.261	0	1	14210
unmet needs	0.55	0.497	0	1	14210
unmet needs_subj.	0.327	0.469	0	1	14210
memory decline	0.525	0.499	0	1	14210
fluency decline	0.323	0 .468	0	1	14210
numeracy decline	0.53	0.499	0	1	14210
orientation decline	0.123	0.329	0	1	14210
cognitive index	0.399	0.328	0	1	14210
Control Variables					
age	74.115	6.53	65	100	14210
female	.579	.494	0	1	14210
couple	.677	.467	0	1	14210
low_education	0.327	0.469	0	1	14210
med_education	0.433	0.496	0	1	14210
high_education	0.24	0.427	0	1	14210
household size	1.941	.857	1	9	14210
1 income quintile	0.175	0.38	0	1	14210
2 income quintile	0.215	0.411	0	1	14210
3 income quintile	0.207	0.405	0	1	14210
4 income quintile	0.207	0.405	0	1	14210
5 income quintile	0.196	0.397	0	1	14210
Instruments					
extra version	3.501	0.925	1	5	14210
network satisfaction	9.044	1.154	0	10	14210
# of persons very close	1.142	1.262	0	7	14210
SN index	0.555	0.153	0	1	14210
SN index with extraversion	0.551	0.148	0	1	14210

Table 2: IV Estimates: Second-Stage Coefficients and First-Stage F-Statistics (SN Index)

	Objective Needs			Subjective Needs		
	Onset Dep.	**Cogn. Index**	**Fluency Decline**	**Onset Dep.**	**Cogn. Index**	**Fluency Decline**
2SLS Estimates						
Unmet Needs	1.152^{***}	0.927^{**}	1.373^{***}	0.892^{***}	0.718^{**}	1.063^{***}
(Std. Err.)	(0.355)	(0.273)	(0.409)	(0.242)	(0.184)	(0.273)
F-Stage Diagnostics						
F-statistic	14.41	14.41	14.41	24.93	24.93	24.93
Observations	14,210	14,210	14,210	14,210	14,210	14,210

Note: Each column reports estimates from a separate IV model. All models include controls for age, gender, education, household size, employment status, couple status, and country fixed effects. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 3: IV Estimates: Second-Stage Coefficients and First-Stage F-Statistics (SN Index with Extraversion)

	Objective Needs			Subjective Needs		
	Onset Dep.	**Cogn. Index**	**Fluency Decline**	**Onset Dep.**	**Cogn. Index**	**Fluency Decline**
2SLS Estimates						
Unmet Needs	1.109^{***}	0.810^{**}	1.236^{***}	1.020^{***}	0.746^{***}	1.137^{***}
(Std. Err.)	(0.279)	(0.200)	(0.306)	(0.251)	(0.180)	(0.273)
First-Stage Diagnostics						
F-statistic	22.15	22.15	22.15	27.11	27.11	27.11
Observations	14,210	14,210	14,210	14,210	14,210	14,210

Note: Each column reports estimates from a separate IV model. All models include controls for age, gender, education, household size, employment status, couple status, and country fixed effects. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table 4: IV Mediation analysis. Mediator: Onset Loneliness; Treatment: Unmet Needs; Instrument: SN index

	Depressed	Cognitive Index	Fluency
Panel A			
Indirect effect	1.100**	0.909**	1.365**
	(0.553)	(0.429)	(0.645)
Direct effect	0.052***	0.017	0.008
	(0.018)	(0.143)	(0.021)
Total effect	1.152***	0.927***	1.373***
	(0.350)	(0.270)	(0.408)
% effect mediated	**95.43**	**98.09**	**99.38**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	14.9	14.9	14.9
first stage two (M on Z | T):	14.32	14.32	14.32
N. Observations	14210	14210	14210
	Depressed	Cognitive Index	Fluency
Panel B			
Indirect effect	0.860**	0.724**	1.072**
	(0.389)	(0.318)	(0.472)
Direct effect	0.032***	-0.006	-0.009
	(0.011)	(0.009)	(0.013)
Total effect	0.822***	0.718***	1.063***
	(0.246)	(0.188)	(0.279)
% effect mediated	**96.41**	**100.93**	**100.86**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	24.5	24.5	24.5
first stage two (M on Z | T):	15.3	15.3	15.3
N. Observations	14210	14210	14210
Other controls:			
Age, gender, Marital status	Yes	Yes	Yes
Socio-economic	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes

Notes: *Mediation Analysis. Outcome variables measure onset between Wave 8 and Wave 9 (over a 2-year period). Cognitive Index: polychoric correlation of onset in verbal fluency, memory, numeracy, and orientation decline. Panel A refers to the objective definition of needs, while Panel B uses the subjective definition. Significance levels:* * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: IV Mediation analysis. Mediator: Onset Loneliness; Treatment: Unmet Needs; Instrument: SN index with extraversion

	Depressed	Cognitive Index	Fluency
Panel A			
Indirect effect	1.058**	0.790**	1.226**
	(0.437)	(0.323)	(0.498)
Direct effect	0.050***	0.019	0.010
	(0.017)	(0.012)	(0.019)
Total effect	1.109***	0.810***	1.236***
	(0.276)	(0.198)	(0.306)
% effect mediated	**95.42**	**97.54**	**99.18**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	22.8	22.8	22.8
first stage two (M on Z | T):	18.4	18.4	18.4
N. Observations	14210	14210	14210
	Depressed	Cognitive Index	Fluency
Panel B			
Indirect effect	0.989**	0.752**	1.146**
	(0.396)	(0.297)	(0.452)
Direct effect	0.031***	-0.006	-0.008
	(0.011)	(0.008)	(0.013)
Total effect	1.020***	0.746***	1.137***
	(0.253)	(0.185)	(0.278)
% effect mediated	**96.91**	**100.83**	**100.78**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	26.6	26.6	26.6
first stage two (M on Z | T):	19.8	19.8	19.8
N. Observations	14210	14210	14210
Other controls:			
Age, gender, Marital status	Yes	Yes	Yes
Socio-economic	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes

Notes: *Mediation Analysis. Outcome variables measure onset between Wave 8 and Wave 9 (over a 2-year period). Cognitive Index: polychoric correlation of onset in verbal fluency, memory, numeracy, and orientation decline. Panel A refers to the objective definition of needs, while Panel B uses the subjective definition. Significance levels:* * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: IV Mediation analysis. Mediator: Onset Loneliness; Treatment: Unmet Needs; Instrument: SN index (lagged, wave 6)

	Depressed	**Cognitive Index**	**Fluency**
Panel A			
Indirect effect	0.905***	0.569*	1.271**
	(0.494)	(0.322)	(0.644)
Direct effect	0.077***	0.035***	0.034
	(0.012)	(0.008)	(0.019)
Total effect	0.982**	0.605**	1.306**
	(0.403)	(0.258)	(0.484)
% effect mediated	**94.06**	**97.54**	**97.33**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	10	10	10
first stage two (M on Z | T):	17.6	17.6	17.6
N. Observations	10,419	10,419	10,419
	Depressed	**Cognitive Index**	**Fluency**
Panel B			
Indirect effect	0.701**	0.463*	0.986**
	(0.353)	(0.238)	(0.458)
Direct effect	0.039***	-0.007	-0.001
	(0.010)	(0.006)	(0.011)
Total effect	0.740***	0.456**	0.984***
	(0.270)	(0.183)	(0.320)
% effect mediated	**94.64**	**101.62**	**100.14**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	16.1	16.1	16.1
first stage two (M on Z | T):	18.3	18.3	18.3
N. Observations	10,419	10,419	10,419
Other controls:			
Age, gender, marital status	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes

Notes: *Mediation Analysis. Outcome variables measure onset between Wave 8 and Wave 9 (over a 2-year period). Cognitive Index: polychoric correlation of onset in verbal fluency, memory, numeracy, and orientation decline. Panel A refers to the objective definition of needs, while Panel B uses the subjective definition. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Table 7: IV Mediation analysis. Mediator: Onset Loneliness; Treatment: Unmet Needs; Instrument: SN index with extraversion (lagged, social network from wave 6, extraversion from wave 7).

	Depressed	**Cognitive Index**	**Fluency**
Panel A			
Indirect effect	0.878**	0.412*	0.948**
	(0.409)	(0.222)	(0.438)
Direct effect	0.069***	0.032***	0.029*
	(0.014)	(0.009)	(0.015)
Total effect	0.947***	0.445**	0.978***
	(0.301)	(0.172)	(0.306)
% effect mediated	**92.70**	**92.64**	**96.98**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	16.3	16.3	16.3
first stage two (M on Z | T):	17.9	17.9	17.9
N. Observations	9900	9900	9900
	Depressed	**Cognitive Index**	**Fluency**
Panel B			
Indirect effect	0.911**	0.453*	0.983**
	(0.426)	(0.235)	(0.456)
Direct effect	0.034***	-0.008	-0.006
	(0.011)	(0.007)	(0.012)
Total effect	0.945***	0.444***	0.976***
	(0.320)	(0.183)	(0.324)
% effect mediated	**96.38**	**101.96**	**100.71**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	15.5	15.5	15.5
first stage two (M on Z | T):	18.9	18.9	18.9
N. Observations	9900	9900	9900
Other controls:			
Age, gender, marital status	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes

Notes: *Mediation Analysis. Outcome variables measure onset between Wave 8 and Wave 9 (over a 2-year period). Cognitive Index: polychoric correlation of onset in verbal fluency, memory, numeracy, and orientation decline. Panel A refers to the objective definition of needs, while Panel B uses the subjective definition. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Table 8: IV Mediation analysis. Mediator: Onset Loneliness; Treatment: Unmet Needs; Instrument: SN index (lagged, wave 6) + year of birth dummies

	Depressed	**Cognitive Index**	**Fluency**
Panel A			
Indirect effect	0.900*	0.580*	1.306**
	(0.495)	(0.327)	(0.659)
Direct effect	0.077***	0.036***	0.035**
	(0.012)	(0.008)	(0.014)
Total effect	0.978**	0.617**	1.341***
	(0.406)	(0.263	(0.497)
% effect mediated	**92.05**	**94.13**	**97.37**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	10	10	10
first stage two (M on Z | T):	18	18	18
N. Observations	10,419	10,419	10,419
	Depressed	**Cognitive Index**	**Fluency**
Panel B			
Indirect effect	0.705**	0.476*	1.021**
	(0.358)	(0.244)	(0.331)
Direct effect	0.039***	-0.006	-0.001
	(0.010)	(0.006)	(0.011)
Total effect	0.745***	0.469**	1.021***
	(0.285)	(0.188)	(0.331)
% effect mediated	**94.69**	**101.42**	**99.97**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	15.5	15.5	15.5
first stage two (M on Z | T):	18.6	18.6	18.6
N. Observations	10,419	10,419	10,419
Other controls:			
Age, gender, marital status	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes

Notes: *Mediation Analysis. Outcome variables measure onset between Wave 8 and Wave 9 (over a 2-year period). Cognitive Index: polychoric correlation of onset in verbal fluency, memory, numeracy, and orientation decline. Panel A refers to the objective definition of needs, while Panel B uses the subjective definition. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Table 9: IV Mediation analysis. Mediator: Onset Loneliness; Treatment: Unmet Needs; Instrument: SN index with extraversion (lagged, social network from wave 6, extraversion from wave 7) + year of birth dummies.

	Depressed	**Cognitive Index**	**Fluency**
Panel A			
Indirect effect	0.866**	0.423*	0.977**
	(0.406)	(0.225)	(0.447)
Direct effect	0.070***	0.032***	0.029*
	(0.014)	(0.008)	(0.015)
Total effect	0.936***	0.456***	1.007***
	(0.302)	(0.175)	(0.313)
% effect mediated	**92.52**	**92.79**	**97.05**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	16	16	16
first stage two (M on Z | T):	18.2	18.2	18.2
N. Observations	9900	9900	9900
	Depressed	**Cognitive Index**	**Fluency**
Panel B			
Indirect effect	0.917**	0.471*	1.028**
	(0.432)	(0.244)	(0.476)
Direct effect	0.034***	-0.007	-0.004
	(0.012)	(0.007)	(0.012)
Total effect	0.952***	0.463***	1.023***
	(0.329)	(0.190)	(0.339)
% effect mediated	**96.40**	**101.67**	**100.48**
Kleibergen-Paap F-statistic:			
first stage one (T on Z):	14.7	14.7	14.7
first stage two (M on Z | T):	19.2	19.2	19.2
N. Observations	9900	9900	9900
Other controls:			
Age, gender, marital status	Yes	Yes	Yes
Socio-economic controls	Yes	Yes	Yes
Country dummies	Yes	Yes	Yes

Notes: *Mediation Analysis. Outcome variables measure onset between Wave 8 and Wave 9 (over a 2-year period). Cognitive Index: polychoric correlation of onset in verbal fluency, memory, numeracy, and orientation decline. Panel A refers to the objective definition of needs, while Panel B uses the subjective definition. Significance levels: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.*

Figures

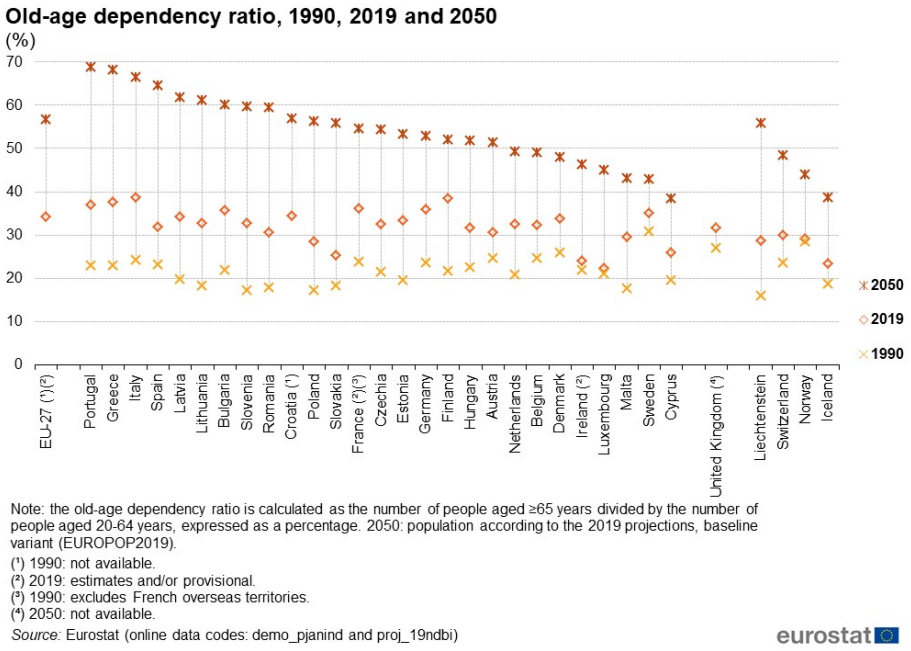
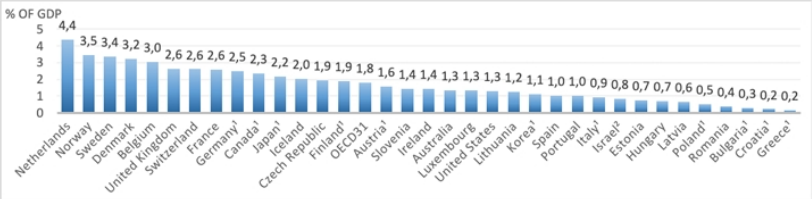


Figure 1: *Old-age dependency ratio in 1990, 2019, and 2050 for European countries. The old-age dependency ratio is calculated as the number of people aged 65 years divided by the number of people aged 2064 years, expressed as a percentage. 2050 values are projections according to the 2019 baseline variant (EUROPOP2019). Source: Eurostat (demo_pjanind and proj_19ndbi).*

Total long-term care spending as a share of GDP, 2021 (or nearest year)



1. Countries not reporting spending for LTC (social). In many countries this component is therefore missing from total LTC, but in some countries, it is partly included under LTC (health).
2. Country not reporting spending for LTC (health).

Source: OECD Health Statistics 2023.

Figure 2: *Source: Eurostat (demo_pjanind and proj_19ndbi).*

5 Appendix

Table A1: Variable Definitions

Variable	Definition
Health Outcomes	
unmet needs	1 if respondents reported at least one ADL, IADL, or mobility limitation and did not receive any care.
unmet needs_subj.	1 if the respondent reported receiving help with activities they have difficulty performing, 0 otherwise.
onset loneliness	1 if the respondent reported feeling lonely almost never or never in SHARE Wave 8 but often in the first/second SHARE Corona Survey wave(s).
onset depression	1 if respondents reported fewer than four symptoms in SHARE Wave 8 but four or more symptoms in Wave 9.
cognitive index	Range 01: polychoric correlationbased index across onset of verbal fluency, numeracy, memory, and orientation.
fluency decline	1 if respondents scored >15 in Wave 8 and ≤ 15 in Wave 9.
onset chronic	1 if respondents reported no chronic conditions in Wave 8 and at least one in Wave 9.
onset BMI	1 if BMI ≤ 25 in Wave 8 and > 25 in Wave 9.
onset hypertension	1 if no hypertension in Wave 8 and hypertension in Wave 9.
Health-care Outcomes	
hospital	1 if respondents stayed at least one night in a hospital in the past 12 months.
hospital times	Number of hospital admissions in the past 12 months.
hospital nights	Number of nights spent in hospital in the past 12 months.
doctor	Number of contacts with a doctor in the past 12 months.
Control Variables	
female	1 if respondent is female.
household size	Number of individuals in the household.
age	Age in SHARE Wave 8.
couple	1 if married or living as a couple, 0 otherwise.
1st income quintile	1 if respondent is in the first income quintile (reference category).
2nd income quintile	1 if respondent is in the second income quintile.
3rd income quintile	1 if respondent is in the third income quintile.
4th income quintile	1 if respondent is in the fourth income quintile.
5th income quintile	1 if respondent is in the fifth income quintile.
low_education	1 if low education level (reference category).
med_education	1 if medium education level.
high_education	1 if high education level.
Instrumental Variables	
Extraversion	Scale 1 (least) to 5 (most); higher values reflect greater extraversion.
SN index	Standardized index (01) based on satisfaction with social ties and perceived closeness to network members; higher values indicate greater satisfaction and a stronger/larger social network.

Table A2: Summary Statistics by Unmet Needs Status (Objective definition)

Variable	Mean	Std. Dev.	Min	Max	Obs
Panel A: Unmet Needs = 0					
Onset Depression	0.135	0.341	0	1	6391
Onset Loneliness	0.045	0.207	0	1	6391
Memory Decline	0.447	0.497	0	1	6391
Fluency Decline	0.236	0.425	0	1	6391
Numeracy Decline	0.468	0.499	0	1	6391
Orientation Decline	0.087	0.282	0	1	6391
Panel B: Unmet Needs = 1					
Onset Depression	0.264	0.441	0	1	7819
Onset Loneliness	0.097	0.296	0	1	7819
Memory Decline	0.590	0.492	0	1	7819
Fluency Decline	0.395	0.489	0	1	7819
Numeracy Decline	0.580	0.494	0	1	7819
Orientation Decline	0.153	0.360	0	1	7819
Panel C: Unmet Needs = 1 (Onset Loneliness = 0)					
Onset Depression	0.248	0.432	0	1	7063
Memory Decline	0.581	0.493	0	1	7063
Fluency Decline	0.377	0.485	0	1	7063
Numeracy Decline	0.567	0.496	0	1	7063
Orientation Decline	0.149	0.356	0	1	7063
Panel D: Unmet Needs = 1 (Onset Loneliness = 1)					
Onset Depression	0.413	0.493	0	1	756
Memory Decline	0.669	0.471	0	1	756
Fluency Decline	0.556	0.497	0	1	756
Numeracy Decline	0.705	0.456	0	1	756
Orientation Decline	0.190	0.393	0	1	756

Table A3: Summary Statistics by Unmet Needs Status (Subjective definition)

Panel A: Unmet Needs = 0					
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**
Onset Depression	0.188	0.391	0	1	9561
Onset Loneliness	0.067	0.249	0	1	9561
Memory Decline	0.512	0.5	0	1	9561
Fluency Decline	0.307	0.461	0	1	9561
Numeracy Decline	0.521	0.5	0	1	9561
Orientation Decline	0.125	0.331	0	1	9561
Panel B: Unmet Needs = 1					
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**
Onset Depression	0.242	0.429	0	1	4649
Onset Loneliness	0.087	0.282	0	1	4649
Memory Decline	0.552	0.497	0	1	4649
Fluency Decline	0.356	0.479	0	1	4649
Numeracy Decline	0.549	0.498	0	1	4649
Orientation Decline	0.119	0.324	0	1	4649
Panel C: Unmet Needs = 1 (Subset: Onset Loneliness = 0)					
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**
Onset Depression	0.228	0.42	0	1	4243
Memory Decline	0.545	0.498	0	1	4243
Fluency Decline	0.341	0.474	0	1	4243
Numeracy Decline	0.537	0.499	0	1	4243
Orientation Decline	0.119	0.324	0	1	4243
Panel D: Unmet Needs = 1 (Subset: Onset Loneliness = 1)					
Variable	**Mean**	**Std. Dev.**	**Min**	**Max**	**Obs**
Onset Depression	0.392	0.489	0	1	406
Memory Decline	0.631	0.483	0	1	406
Fluency Decline	0.515	0.5	0	1	406
Numeracy Decline	0.67	0.471	0	1	406
Orientation Decline	0.121	0.326	0	1	406

Table A4: First-Stage IV Estimates: Instrumenting Unmet Care Needs with the Social Network Index

	Objective Needs	**Subjective Needs**
First-stage:		
SN index	-0.108^{***}	-0.140^{***}
	(0.028)	(0.028)
Controls:		
Age	0.016^{***}	0.001
	(0.001)	(0.001)
Female	0.147^{***}	0.056^{***}
	(0.008)	(0.008)
Med. Educ.	-0.033^{***}	-0.008
	(0.010)	(0.008)
High Educ.	-0.102^{***}	-0.034^{***}
	(0.011)	(0.011)
H size	-0.003	-0.019^{***}
	(0.006)	(0.005)
In Couple	-0.009	-0.044^{***}
	(0.011)	(0.011)
First-stage F-statistic (Kleibergen-Paap)	14.41	24.93
Observations	14,210	14,210

Note: Additional controls include dummies for countries and income. Robust standard errors in parentheses.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: First-Stage IV Estimates: Instrumenting Unmet Care Needs with the Social Network Index with Extraversion

	Objective Needs	**Subjective Needs**
First-stage:		
SN index	-0.135^{***}	-0.147^{***}
	(0.028)	(0.028)
Controls:		
Age	0.016^{***}	0.001
	(0.001)	(0.001)
Female	0.148^{***}	0.056^{***}
	(0.008)	(0.008)
Med. Educ.	-0.033***	-0.008
	(0.010)	(0.010)
High Educ.	-0.102^{***}	-0.034^{***}
	(0.012)	(0.012)
H size	-0.004	-0.019^{***}
	(0.006)	(0.006)
In Couple	-0.009	-0.044^{***}
	(0.011)	(0.012)
First-stage F-statistic (Kleibergen-Paap)	22.15	27.11
Observations	14,210	14,210

Note: Additional controls include dummies for countries and income. Robust standard errors in parentheses.
Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: IV Estimates: First-Stage and Second-Stage Coefficients SN Index - Objective Needs

	In hospital (2SLS)	**Times hosp.** (2SLS)	**Nights hosp.** (2SLS)
Panel A: First Stage			
SN index	-0.108^{***}	-0.108^{***}	-0.108^{***}
(Std. Err.)	(0.004)	(0.004)	(0.004)
First stage F-statistic	14.41^{***}	14.41^{***}	14.41^{***}
Panel B: Second Stage			
Unmet Needs	-0.028	-0.294	-1.039
(Std. Err.)	(0.200)	(0.616)	(4.472)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A7: IV Estimates: First-Stage and Second-Stage Coefficients SN Index - Subjective Needs

	In hospital (2SLS)	**Times hosp.** (2SLS)	**Nights hosp.** (2SLS)
Panel A: First Stage			
SN index	-0.140^{***}	-0.140^{***}	-0.140^{***}
(Std. Err.)	(0.060)	(0.060)	(0.060)
First stage F-statistic	24.93^{***}	24.93^{***}	24.93^{***}
Panel B: Second Stage			
Unmet Needs	-0.022	-0.228	-0.804
(Std. Err.)	(0.154)	(0.472)	(3.448)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A8: IV Estimates: First-Stage and Second-Stage Coefficients SN Index with extraversion - Objective Needs

	In hospital (2SLS)	**Times hosp.** (2SLS)	**Nights hosp.** (2SLS)
Panel A: First Stage			
SN index	-0.135^{***}	-0.135^{***}	-0.135^{***}
(Std. Err.)	(0.028)	(0.028)	(0.028)
First stage F-statistic	22.15^{***}	22.15^{***}	22.15^{***}
Panel B: Second Stage			
Unmet Needs	-0.026	-0.233	-0.798
(Std. Err.)	(0.161)	(0.495)	(3.602)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A9: IV Estimates: First-Stage and Second-Stage Coefficients SN Index with extraversion- Subjective Needs

	In hospital (2SLS)	**Times hosp.** (2SLS)	**Nights hosp.** (2SLS)
Panel A: First Stage			
SN index	-0.147^{***}	-0.147^{***}	-0.147^{***}
(Std. Err.)	(0.028)	(0.028)	(0.028)
First stage F-statistic	27.11^{***}	27.11^{***}	27.11^{***}
Panel B: Second Stage			
Unmet Needs	-0.024	-0.214	-0.734
(Std. Err.)	(0.148)	(0.453)	(3.306)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A10: IV Estimates: First-Stage and Second-Stage Coefficients SN Index

	GPs (obj.) (2SLS)	**GPs (subj.)** (2SLS)
Panel A: First Stage		
SN index	-0.108^{***}	-0.140^{***}
(Std. Err.)	(0.004)	(0.028)
First stage F-statistic	14.41^{***}	24.93^{***}
Panel B: Second Stage		
Unmet Needs	2.028	1.570
(Std. Err.)	(6.208)	(4.835)

Note: Each column reports results from a different IV model (first column with objective needs, second column with subjective needs). Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using GP outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A11: IV Estimates: First-Stage and Second-Stage Coefficients SN Index with extraversion

	GPs (obj.) (2SLS)	**GPs (subj.)** (2SLS)
Panel A: First Stage		
SN index	-0.135^{***}	-0.147^{***}
(Std. Err.)	(0.028)	(0.028)
First stage F-statistic	22.15^{***}	27.11^{***}
Panel B: Second Stage		
Unmet Needs	−0.371	−0.342
(Std. Err.)	(5.047)	(4.640)

Note: Each column reports results from a different IV model (first column with objective needs, second column with subjective needs). Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using GP outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A12: IV Estimates: First-Stage and Second-Stage Coefficients SN Index - Objective Needs

	Onset chronic (2SLS)	**Onset BMI** (2SLS)	**Onset hypertension** (2SLS)
Panel A: First Stage			
SN index	-0.108^{***}	-0.108^{***}	-0.108^{***}
(Std. Err.)	(0.028)	(0.028)	(0.028)
First stage F-statistic	14.41^{***}	14.41^{***}	14.41^{***}
Panel B: Second Stage			
Unmet Needs	-0.114	0.093	-0.196
(Std. Err.)	(0.145)	(0.258)	(0.283)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A13: IV Estimates: First-Stage and Second-Stage Coefficients SN Index - Subjective Needs

	Onset chronic (2SLS)	**Onset BMI** (2SLS)	**Onset hypertension** (2SLS)
Panel A: First Stage			
SN index	-0.140^{***}	-0.140^{***}	-0.140^{***}
(Std. Err.)	(0.028)	(0.028)	(0.028)
First stage F-statistic	24.93^{***}	24.93^{***}	24.93^{***}
Panel B: Second Stage			
Unmet Needs	-0.088	0.072	-0.153
(Std. Err.)	(0.114)	(0.201)	(0.215)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A14: IV Estimates: First-Stage and Second-Stage Coefficients SN Index with extraversion - Objective Needs

	Onset chronic (2SLS)	**Onset BMI** (2SLS)	**Onset hypertension** (2SLS)
Panel A: First Stage			
SN index	-0.135^{***}	-0.135^{***}	-0.135^{***}
(Std. Err.)	(0.028)	(0.028)	(0.028)
First stage F-statistic	22.15^{***}	22.15^{***}	22.15^{***}
Panel B: Second Stage			
Unmet Needs	-0.111	-0.153	-0.168
(Std. Err.)	(0.117)	(0.216)	(0.226)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

Table A15: IV Estimates: First-Stage and Second-Stage Coefficients SN Index with extraversion - Subjective Needs

	Onset chronic (2SLS)	**Onset BMI** (2SLS)	**Onset hypertension** (2SLS)
Panel A: First Stage			
SN index	-0.147^{***}	-0.147^{***}	-0.147^{***}
(Std. Err.)	(0.028)	(0.028)	(0.028)
First stage F-statistic	27.11^{***}	27.11^{***}	27.11^{***}
Panel B: Second Stage			
Unmet Needs	-0.102	-0.140	-0.156
(Std. Err.)	(0.109)	(0.197)	(0.207)

Note: Each column reports results from a different IV model. Panel A presents the coefficient on *SN Index* from the first-stage regression for *Unmet Needs*. Panel B reports the second-stage coefficient on *Unmet Needs* using hospitalization outcomes. Robust standard errors in parentheses.
Significance: $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.