



Do older parents' assistance needs deter parent-child geographic divergence in Norway?

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ABSTRACT

The role of intergenerational geographic proximity in individuals' migration decisions has been well-established. The circumstances under which parents and their adult children move away from or remain close to each other are, however, less clear. Drawing on Norwegian register data for 2014–2016 and three-level logistic regression models, we examine whether formal care needs of older parents (aged ≥ 65) deter parent-child geographic divergence and whether variation in the likelihood of divergence is associated with municipal-level characteristics. After accounting for location-specific capital and parents' and children's sociodemographic characteristics, parents and children were less likely to diverge after the onset of parental care needs. Utilising in-home nursing decreased the likelihood of divergence for mothers while utilising institutionalised care decreased the likelihood of divergence for fathers. The use of in-home nursing care among single mothers further reduced the likelihood of divergence. Parents and adult children living in central areas were the least likely to diverge geographically. The likelihood of intergenerational divergence was lower for fathers and children living in municipalities with high healthcare spending.

1. Introduction

Even in countries with a developed welfare state, family members are important for the provision of emotional and practical support (Brody 1981; Lloyd et al., 2014). The regularity and amount of this support are facilitated by geographic distance between them (Knijn and Liefbroer, 2006; Lawton et al., 1994). The geographic distance between parents and their children (denoted as 'intergenerational geographic proximity') might be particularly important in situations of a greater need or desire for contact, as may be the case for elderly dealing with health problems and subsequent difficulties with performing daily tasks. 'Ageing in place' might be challenging without adequate support networks (Pani-Harreman et al., 2020). Second to partners, adult children are usually most likely to become caregivers for frail parents (Cantor 1991). The preference for being physically nearby might lead parents and children to refrain from geographic divergence as it may result in a barrier to the provision of informal care (Silverstein 1995; Hjälml 2014; Thomassen 2020) and challenges related to long-distance caregiving (Hicks et al., 2018). However, potential triggers for internal migration are common, possibly so individuals can improve their living conditions, albeit the nature of these triggers varies across the life course stages. For

elderly, lifestyle considerations after retirement, a desire for more suitable housing, and/or better access to professional care services might motivate migration (Litwak and Longino 1987, van der Pers et al., 2015a,b, Artamonova et al., 2020). Young adults, however, might want to move to pursue a better education or position in the labour market, or relocate to a more family friendly environment if they have small children (Lin and Rogerson 1995; Bernard et al., 2014). Consequently, the desire to maintain family solidarity (Bengtson 2001) might compete with choices oriented towards achieving more individualistic goals through migration.

A growing body of literature on internal migration has shown that living close to family members decreases the likelihood of migrating (Clark et al., 2017; Kan, 2007; Mulder and Malmberg, 2011, 2014; Mulder and Wagner, 2012). Some studies have focused on relocations of older parents relative to their adult children's proximity (van der Pers et al., 2015a,b; Artamonova et al., 2021), whereas others have emphasised that having parents nearby deters the mobility of adult children (Ermisch and Mulder 2019; Hünteler and Mulder 2020). While the importance of intergenerational geographic proximity for migration decisions is well-established in the literature, less is known about specific *circumstances* under which parents and their adult children are

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likely to stay geographically close to each other.

In a Nordic welfare state, elderly in need of care often receive extensive public support, which could increase their independence from family-based support networks. One important question, then, is whether there is an association between receiving public eldercare and the respective location decisions of parents and their adult children. Additionally, contextual factors, such as municipal characteristics, might further deter or motivate parent-child geographic divergence.

We address these gaps in the literature by examining: (a) how the older parent's formal care needs (and an increase in such needs) are associated with the likelihood of intergenerational geographic divergence; (b) how the parent's utilisation of different public care services is associated with the likelihood of intergenerational geographic divergence; (c) whether such an effect is moderated by the presence of a partner; and (d) whether between-municipality differences in the likelihood of divergence can be explained by the centrality of the municipality and/or the share of the municipality budget spent on health care.¹ Consequently, the target group of our study is represented by older parents and their adult children who are potential recipients and providers of intergenerational care, i.e. the elderly parent-adult child dyads. A marked and increasing share of elderly without children nearby might have implications for both informal and formal care availability. Unfortunately, we do not have information about the provision of informal intergenerational care and hence use only information about older parents' formal care needs. The needs of elderly have been officially assessed at the individual level by municipal health care providers. In addition, we also use information on the actual uptake of the formal care services that are most commonly used in later life in Norway – e.g. practical assistance, in-home nursing, and institutionalised residential care. Our findings shed light on the dynamics of the spatial distribution of intergenerational family networks in different municipal contexts and are thus relevant for policymakers interested in optimising both informal and formal care provision to elderly while also accounting for possible preferences for 'ageing in place'.

To answer our research questions, we employ three-level logistic regression models on linked register data for complete cohorts of older Norwegian individuals and their adult children between 2014 and 2016. We also account for location-specific capital and sociodemographic characteristics of parents and their adult children.

2. The Norwegian setting

Norway provides an interesting social and spatial context for this study. It is a welfare state with free or low-cost health care (including heavily subsidised eldercare), currently accounting for more than 10 percent of the nation's Gross Domestic Product (Statistics Norway 2020a). Eldercare services are organised and provided at the municipal level, and residents' rights are determined by need. Consequently, municipalities decide the type and scope of service warranted to meet the corresponding individual needs of their residents (Molven and Ferkis, 2011). Adult children have no legal obligation to help care for parents (Kotsadam 2012). The needs assessment should be made irrespective of the specific geographic location of the home and independent of the municipality's resource situation. In 2015, there were 428 municipalities in Norway, ranging in size, level of centralisation and urbanity, access to infrastructure, labour market, education, housing, leisure, and public care provision (Statistics Norway 2020b). Norway is a sparsely populated country, wherein the average number of inhabitants per square kilometre (km) is only around 14. The population is heavily concentrated in urban areas (Syse et al., 2018a), although long distances between parents and children, as well as between the elderly and formal care facilities, can be an issue for intergenerational support exchange

¹ The term 'effect' is used to denote a statistical association, without necessarily implying a causal relationship.

and formal care service delivery in many municipalities.

3. Research background and hypotheses

The role played by ties to non-resident family in internal migration is understudied, although notable exceptions are beginning to surface (Mulder 2018). As Coulter et al. (2016) have argued, the theoretical approach to residential (im)mobility should be extended to incorporate the 'linked lives' principle of the life course approach (Elder 1994), acknowledging that individuals are inherently tied to next-of-kin. They state that there are two types of connections between this principle and (not) moving. First, at the micro-level, the concept of 'linked lives' indicates that residential moves and periods of residential stability tie people into kinship and social networks extending beyond the household unit. Second, at the meso- and macro-level, residential (im) mobility may connect the life courses of individuals to the influences of structural forces, for example, local government institutions in individuals' current of desired locations of living.

At the micro-level, residential (im)mobility may be a strategy to provide or receive support and facilitate the exchange of care within social relationships (Coulter et al., 2016). Ties between close family members are especially important because of the strong solidarity between them (Bengtson 2001). According to the family ties perspective, introduced by Mulder (2018) to complement classical theoretical models of migration, having family members living nearby might increase the likelihood of staying. The influence of family ties on immobility may depend on both the need and preference for geographical proximity to family. People can decide to stay when particular linked life events, for instance a family member's health deterioration, occur.

The family is an essential source of informal care for frail elderly persons, both in terms of practical and emotional support (Brody, 1981; Lloyd et al., 2014). The most likely providers of informal health-related help and care are spouses and children (Connidis and Barnett 2018). As parents age and their social circle of friends and relatives narrows, children become increasingly important. Common events at this point of the parents' life cycle, such as a longstanding illness or a disability, may further heighten their dependence. Whether or not an adult child takes on care or help tasks is strongly linked to the parent-child geographic distance (Knijn and Liefbroer 2006; Leopold et al., 2014). Distances between parents and children tend to be rather short in many European countries (Hank 2007). Therefore, close geographic proximity to family members is often best achieved through immobility, although some parents and children might move closer to each other in anticipation of—or in response to—increasing care needs.

Decisions to stay (including staying close to family) may change over the life course (Hjälml 2014; Stockdale et al., 2018). Even though non-resident family members living close by may be viewed as a type of location-specific capital, i.e., "assets that are more valuable in their current location than they would be elsewhere" (DaVanzo 1981, p. 45), family ties to a current location often compete with access to public services, educational and job opportunities located elsewhere (Mulder 2018). There is some empirical evidence that both parents and adult children may 'sacrifice' their own interests and choose to maintain close intergenerational geographic proximity. In a qualitative study by Hjälml (2012), elderly parents mentioned that living close to an adult child might be convenient and provides a sense of security. They would thus refrain from relocating to a more convenient place to avoid feelings of physical and emotional distancing resulting from a geographic separation from their children. Quantitative research shows that parents with marked functional disabilities are less likely to move away from their children than those who are healthier (Silverstein 1995). Parents are also more likely to age in place (as compared to relocating to institutionalised care facilities or elsewhere) if children live nearby (van der Pers et al., 2015a,b). This is observed even if parents have severe health issues (Artamonova et al., 2021). In a study by Thomassen (2020), highly educated young adults who tend to benefit most from migration

(Korpi and Clark 2015) considered how their residential decisions would affect the well-being of family members. A noted deterrent to migration was having parents who required care. This is in line with findings by Rainer and Siedler (2009), who found that adult children refrained from migration out of the home region in anticipation of parents' future care needs. Although research suggests that long-distance caregiving is possible, studies also emphasize difficulties in communicating with both the care recipient and the formal care provider, the burden of traveling, and added emotional strain (Cagle and Munn 2012; Hicks et al., 2018). It might therefore be considered undesirable. Based on the assumption that the stability of, or change in, intergenerational geographic proximity is the intended outcome of the parents' and/or child's migration decisions in a response to older individuals' increasing needs, we hypothesise:

Older parents and their adult children will be less likely to diverge geographically if parents have formal care needs than if they do not (H1a) and the likelihood of divergence will be lower following the onset of formal care needs than after the needs have existed for a prolonged time (H1b).

In countries with a developed welfare state, the elderly may receive necessary assistance from both family members and public eldercare (Connidis and Barnett 2018). According to the 'task-specificity' model (Litwak 1985), support activities are selectively subdivided between informal and formal sources. How the tasks are divided might depend on the availability of care services funded by the state, the legal obligation to support relatives in need, and opinions on whether the state or family members should be responsible for the care of elderly (Haber Kern and Szydlik 2010). In the familial welfare states in Southern Europe, where little professional support is available, provision of care by children is more likely, while parents in Northern Europe are more likely to receive help from children in the household or in dealings with the authorities (Brandt et al., 2009). In such settings, professional providers commonly perform medically-demanding and ongoing physical care, while the family is more likely to provide less demanding, spontaneous help. Accordingly, when older parents in Nordic countries develop severe health problems, they are likely to apply for public care services and, depending on the level of need, might be offered various options including, among others, practical assistance, in-home nursing, and institutionalised care. Thus, utilising care services may be seen as another indicator of care needs. Even if the services are provided, parents and adult children might want to remain close to each other, so children can extend socioemotional support. Moreover, the expansion of welfare state services is creating new roles for family members in 'overseeing' the quality of services (Daatland and Herlofson 2003). Performing these roles might also require close proximity. Therefore, we hypothesise:

Older parents and their adult children will be less likely to diverge geographically if parents utilise formal care services than if they do not (H2).

The impact of utilisation of formal care services may differ by parental relationship status. Children tend to assume the caregiving role if a parent's partner is unavailable (Cantor 1991). A partner, generally considered the major provider of support and company (Cantor 1991), may be the one who makes sure that the warranted services from professional carers are obtained and may also provide assistance in everyday life tasks. Close intergenerational proximity may therefore be less urgent for elderly persons with a partner than for those without a partner. Hence, we hypothesise:

Older parents who receive formal care services and their adult children will be less likely to diverge geographically if the parent does not have a partner than if the parent is partnered (H3).

We assume that the desire and ability to maintain familial proximity is likely to vary in different localities in line with the meso-level

relationship between 'linked lives' and (im)mobility (Coulter et al., 2016). This assumption resonates with the family ties perspective, according to which being geographically close to family members is likely to be more important in contexts where welfare arrangements and support systems place more emphasis on family resources (Mulder 2018).

Like in many other countries, there is an ongoing centralisation in Norway and the least central communities with the lowest population densities are losing population through internal migration (McArthur and Thorsen 2011). Although the direction of migration is towards denser and more central places, this is mainly a product of young adult migration (Syse et al., 2018a). Around one-fifth of the elderly reside in rural areas where labour market and educational opportunities for their adult children might be limited, thereby driving the younger generation to consider migrating away. Therefore, we hypothesise:

Older parents and their adult children living in less central areas will be more likely to diverge geographically than those who live in more central areas (H4a).

Since Norwegian municipalities are responsible for eldercare, such services consume a large share of the municipal budget (Magnussen and Martinussen 2013). However, there is considerable municipal variation in the quality and availability of the services (Gautun 2008; Huseby and Paulsen 2009). Because migration decisions may be affected by the quality of local public services (Andersson and Carlsen 1997), families located in less resourceful municipalities might experience more locational trade-offs than those in more resourceful ones and may thus consider relocating away from municipalities with lower budgetary allotments for health care services. Therefore, we hypothesise:

Older parents and their adult children living in municipalities with a lower share of the budget spent on health care will be more likely to diverge geographically than those who live in municipalities with a higher share of the budget spent on health care (H4b).

Besides formal care needs, the utilisation of care services, the presence of the partner, and the context of the municipality, older parents and their adult children's decision to stay close or to diverge geographically might be associated with other determinants. Compared with sons, daughters generally provide more care (Silverstein et al., 2006; Haber Kern et al., 2015). Adult children with siblings are known to be more mobile (and move farther away) from their parents than only children (Rainer and Siedler 2009). Research also shows that only children might be more inclined to adjust their living arrangements to parents' severe health limitations than children with siblings (van den Broek and Dykstra 2017). Furthermore, people who have location-specific capital in the area are more likely to stay (DaVanzo 1981; Fischer and Malmberg 2001). The presence of an adult child's partner and proximity to parents-in-law, the presence of dependent children in the adult child's household and residing in the birth municipality may all deter migration and are thus accounted for.

Migration is more common in young adulthood than later in life (Bernard et al., 2014), and age may thus impact geographic proximity. People with higher educational attainment are more likely to move (Chiswick 2000). Having fewer financial resources is associated with closer geographic proximity between older parents and adult children (Silverstein 1995). We thus account for adult children's employment (DaVanzo 1978) and retirement status (Sander and Bell 2014). Finally, we control for parent's immigrant status since intergenerational distances tend to be shorter for people with an immigrant background (Malmberg and Pettersson 2007).

4. Data and methods

4.1. Dataset

We used linked register data on complete cohorts of elderly individuals aged 65 years and older with data on their adult children aged 16 years and older, residing in Norway between 2014 and 2016. The inclusion criteria were that the parent-child dyads had to live within 10 km of each other and in the same municipality in the baseline year. A recent Norwegian study employed a 10 km cut-off when defining local family ties (Thomas and Dommermuth 2020). An intergenerational proximity of a maximum of 10 km is considered 'nearby' because this distance can typically be travelled in less than 30 min. Moreover, Chou et al. (2001) has noted how a travel time of approximately 20 min can be deemed optimal for facilitating frequent contact and support exchange between the caregiver and receiver. Still, we employed several sensitivity checks using alternative distance thresholds (cf. Appendix A3).

Information on individual-level sociodemographic and residential characteristics were obtained from various population registers at Statistics Norway. Information about parents' formal care needs and utilisation of such care was derived from the IPLOS register, an individual-based pseudonymous register that contains information on everyone who has applied for or received municipal health and care services in Norway. Consequently, the measures of needs for care are likely conservative, since there are elderly with some functional limitations who do not apply for such care services. Information on municipalities were extracted from KOSTRA, a national information system that provides aggregate information on municipal activities, including long-term care services (Statistics Norway 2020b).

Due to the high sensitivity of health and care data, several restrictions were placed on the setup of the dataset.² First, both parents and children were assigned age groups instead of exact ages to ensure confidentiality. Second, detailed information was only made available for the first, second, and third child (in birth order). A variable indicating the total number of children shows that we observe 82 percent of all children in our study. Third, children were nested within their parents and the children's identification numbers were suppressed. As a result, we were not able to analyse completed family groups and instead had to focus on child-mother and child-father dyads. Finally, the distance between parents and children (measured as the linear distance between the geographic coordinates of their residential dwellings) was included as a categorical variable.³ The categorical nature of this variable made tracking the exact moving distance impossible. As such, distinguishing parent-child co-residence was also not possible. Finally, municipal ID numbers were substituted prior to the delivery of data but random identifiers grouping parents into municipalities enabled multi-level analyses.

We traced the intergenerational geographic divergence between 2015 (t) and 2016 ($t + 1$). At t we measured the baseline characteristics of the study population. We used information about parental needs in 2014 ($t-1$) and 2015 (t) to estimate the stability of parental formal care needs.

² A licensure to link sociodemographic data to information from the pseudonymised municipal care use register (IPLOS) was provided by the National Data Inspectorate in Norway after ethical review by the Norwegian Board of Medical Ethics. Around 1 percent of the observations were excluded before delivery, to avoid potential identifiable data. However, for all practical purposes the resulting data set may be considered complete and representative of the elderly Norwegian population.

³ The categories included: 0 km (that could mean living in one household, or in different apartments of a multi-story building or in a neighbouring dwelling), 1 km, 2 km, 3 km, 4–5 km, 6–7 km, 8–9 km, 10–13 km, 14–16 km, 17–19 km, 20–24 km, 25–34 km, 35–44 km, 45–59 km, 60–79 km, 80–99 km, 100–149 km, 150–199 km, 200–299 km, 300–499 km, and more than 499 km.

Intergenerational geographic proximity did not exceed 10 km in 53 percent of dyads. In total, our analyses are based on 763,239 parent-child dyads who lived within 10 km of each other and in the same municipality in 2015, of which 430,852 (56.5 percent) were child-mother dyads.

4.2. Variables

The primary outcome variable of interest was *intergenerational geographic divergence*. The binary variable takes the value 1 if the distance between the older parent and adult child reaches 45 km or more at $t+1$, and is 0 if they remain within 45 km. A distance of 45 km corresponds to an average travel time of 1 h in Norway at which, according to some studies, caregiving becomes challenging (Cagle and Munn 2012). We acknowledge that drawing the line between long-distance and short-distance divergence is subjective and might be affected by transport facilities. Analysing moving distances conditional on moving as a sensitivity check could be helpful (Ermisch and Mulder 2019). However, due to the categorical nature of our intergenerational geographic distance variable, we could only examine whether our results changed in comparison to other distance thresholds (cf. Appendix A3).

The main explanatory variables include parental characteristics such as *formal care needs*, *an increase in such needs*, *utilisation of formal care services*, *the presence of a partner*, and the characteristics of the municipalities where parents and adult children lived in year t (i.e. *centrality* and *the share of the municipal budget spent on health care*).

To calculate *formal care needs*, we followed the standardized groupings and coding used in official statistics in Norway (Mørk et al., 2018). Three levels of needs were defined: 'low'; 'middle'; and 'high'. A minor share was registered with needs, but the level was not specified ('unknown'). Those who were not registered in IPLOS were classified as having no formal care needs. Changes in needs were calculated by comparing between the scores in $t-1$ and in t . An increase in needs was defined as a transition to a higher-score category. The needs levels rarely decrease among elderly, so the few with reduced needs were coded as 'no increase'. The resulting variable consisted of eight categories: (0 - reference category) no needs in $t-1$ and no increase between $t-1$ and t ; (1) no needs and increase; (2) low and no increase; (3) low and increase; (4) middle and no increase; (5) middle and increase; (6) high needs; (7) unknown level of needs.

Utilisation of care services is defined as an uptake of practical assistance, in-home nursing, or institutionalised care in line with the standardized coding in IPLOS. Institutionalisation could be a short- or a long-term stay, and a short-term stay usually precedes a long-term stay. Based on these indicators, we created a summary variable that indirectly reflected the increasing type and/or number of services given to a parent. It distinguishes between those who do not receive any of these services (reference category); those who receive only practical assistance; only in-home nursing; both practical assistance and in-home nursing; or institutionalised care. The institutionalised care category also included those who received practical assistance or in-home nursing but became institutionalised within the t -year.

For the first set of models, we controlled for *parent's partnership status* and distinguished between parents who were partnered (reference category), never-married, widowed, and divorced/separated. For models exploring interaction effects with partnership status, the measure was dichotomised into having a partner or not (reference category).

A measure of municipal *centrality* was included because it often reflects better access to infrastructure, a relative ease of family connectivity, better access to formal health and care provision; and dynamic labour market, housing, and educational opportunities (Thomas and Dommermuth 2020). This measure described how urban/rural and central/less central each municipality was. Rural and less central municipalities (reference category) had an average of 6889 inhabitants (SD = 5071.4) and were not within a commuting distance to regional centres. We distinguished between municipalities with *shares of the budget*

spent on health care below or above the median (31 percent), with the reference category ‘below median’. These two variables can be considered independent ($\chi^2(1) = 0.0004, p > 0.001$).

Parent level controls included age group, education, and immigrant background. For adult children, we controlled for the child’s gender, number of siblings, age group, ties to partners and parents-in-law, living in the municipality of birth, children in the household, education, employment state, income and pension uptake.

Detailed description of control variables and summary statistics for independent variables are presented in the Appendix Table A1.

4.3. Analytical strategy

In the main analyses, we employed logistic regression models to assess the propensity for the emergence of intergenerational geographic divergence. To avoid double counting and correlated outcomes between partners, we ran separate models for mother-child and father-child dyads. To adequately account for clustering of children within parents and parents within municipalities, we applied multilevel random intercepts models with three levels: the dyadic level, the parental level, and the municipal level.

We first assessed the existence of between-family and between-municipality variation in the likelihood of intergenerational divergence using variance component models (null models) and intra-class correlation coefficients (ICC). We then compared the model with child- and parent-level independent variables, wherein formal care needs and an increase in such needs are the key variables of interest, with the model that also includes municipality-level variables. The latter is presented as Model 1 and provides results for the tests of Hypotheses 1, 4a, and 4b. Since the measure for needs is closely related to the utilisation of public care services (Appendix Table A2a and A2b), we did not include both variables in the same model. The results of tests of Hypotheses 2 and 3 are presented in Models 2 and 3, respectively.

Sensitivity analyses with different restrictions regarding age and the number of children were performed. Furthermore, we critically examined how different initial and resulting parent-child geographic distance thresholds influenced our findings. The results of all sensitivity checks are discussed in the Appendix (A3).

5. Results

Intergenerational geographic proximity did not change between 2015 and 2016 for the vast majority of parents and children. Out of 430,853 mother-child dyads and 332,387 father-child dyads, 4383 (1.0 percent) mothers and children and 4185 (1.3 percent) fathers and children ended up between 11 and 44 km of each other in $t + 1$. Only in 2711 (0.6 percent) of mother-child and 3427 (1.0 percent) of father-child dyads did the new intergenerational distance exceed 44 km in t

+ 1.

The intra-class correlation coefficients (ICC) of the null models (Table 1) showed that around 60 percent (63.6 for mother-child and 60.5 for father-child) of the variance in the likelihood of parent-child divergence was attributable to the parental level and around 3.7 percent (2.7 for mother-child and 4.6 for father-child) to the municipality level. According to Merlo et al. (2019), the geographic-level ICC not exceeding five percent indicates rather small differences between geographic units. Still, these results mean that there are statistically significant between-municipality differences in the likelihood of parent-child divergence.

Table 2 presents the results of the multilevel models with all level predictors separately for mothers and fathers.

Hypothesis 1a stated that older parents and their adult children would be less likely to diverge geographically if parents have formal care needs or experience an increase in such needs. Our results show partial support for this hypothesis. Relative to dyads in which fathers did not have these needs by t , fathers (but not mothers) and their children were less likely to diverge when fathers had mid-level needs without an increase ($B = -0.408, p < .05$). In line with Hypothesis 1b, the transition from no needs to any needs (relative to the stable absence of needs) was associated with a decreased likelihood of geographic divergence ($B = -0.325, p < .05$ for mothers and $B = -0.369, p < .05$ for fathers).

Partly in line with Hypothesis 2, compared with not using practical assistance, in-home nursing, and institutionalised care, utilising in-home nursing decreased the likelihood of divergence for mothers ($B = -0.268, p < .05$), while utilising institutionalised care decreased the likelihood of divergence for fathers ($B = -0.354, p < .05$).

Relative to dyads in which the parent was married, children and mothers were more likely to diverge if the mother was unmarried or divorced (but not a widow), while children and fathers without partners were more likely to diverge regardless of the type of singlehood. In general, the presence of the parent’s partner, which in most cases in this cohort of elderly may be assumed to be the child’s other parent, was associated with lower likelihood of parent-child divergence ($B = -0.268, p < .05$ for mothers and $B = -0.268, p < .05$ for fathers).

The interaction terms in Table 3 contrast parents’ utilisation of care services according to whether the parent was partnered or single. In partial support of Hypothesis 3, our results demonstrated that among dyads where the mother received in-home nursing support, divergence was less common in cases where the mother was partnered ($B = -0.497 + 0.546, p < .05$) than single ($B = -0.497, p < .01$). We did not find evidence of variation in mothers’ utilisation of other care services or fathers’ utilisation of any care services and the likelihood of parent-child divergence by partner presence.

The last set of the hypotheses concerned the municipal-level effects on the likelihood of parent-child divergence. When we included the municipality-level variables, the municipality-level ICC decreased from

Table 1
Estimates (and standard errors) of three-level models of intergenerational geographic divergence.

	Mothers-Children			Fathers-Children		
	Null model	With child- and parent-level predictors	With all level predictors	Null model	With child- and parent-level predictors	With all level predictors
Log Likelihood	-16150.024	-14609.113	-14598.036	-18584.177	-16237.707	-16217.357
Constant	-7.480 (0.151)	-4.166 (0.171)	-3.874 (0.183)	-6.483 (0.107)	-4.369 (0.144)	-3.916 (0.160)
Var(Const.) parent	5.506 (0.359)	4.608 (0.366)	4.665 (0.367)	4.653 (0.249)	4.339 (0.302)	4.345 (0.304)
Var(Const.) municipality	0.246 (0.048)	0.244 (0.048)	0.165 (0.044)	0.385 (0.054)	0.344 (0.051)	0.280 (0.054)
ICC parent	0.636 (0.015)	0.596 (0.019)	0.595 (0.019)	0.605 (0.012)	0.587 (0.016)	0.584 (0.016)
ICC municipality	0.027 (0.005)	0.030 (0.006)	0.020 (0.005)	0.046 (0.006)	0.043 (0.006)	0.035 (0.007)
N of dyads	430,852			332,383		
N of parents	281,617			216,688		
N of municipalities	428			428		

Note: Standard errors are noted in parentheses next to the estimates.

Table 2
Estimated three-level binary response regression coefficients and standard errors.

	Model 1			
	Mothers		Fathers	
	Coef.	SE	Coef.	SE
Parent's characteristics				
Changes in overall formal care needs (ref: no needs and no increase)				
No needs and increase	-0.325*	0.148	-0.369*	0.161
Low and no increase	-0.032	0.106	-0.106	0.151
Low and increase	-0.085	0.229	-0.221	0.355
Middle and no increase	0.046	0.125	-0.408*	0.183
Middle and increase	-0.095	0.287	0.068	0.347
High	-0.181	0.169	0.020	0.191
Unknown level of needs	-0.211	0.351	0.372	0.303
Parent's age group (ref: 65–69)				
70-74	-0.222**	0.065	-0.193**	0.058
75-79	-0.425***	0.089	-0.437***	0.083
80-84	-0.538***	0.114	-0.495***	0.112
85-89	-0.800***	0.152	-0.651***	0.158
90+	-0.654***	0.194	-1.411***	0.303
Parent's partnership state (ref: married/partnered)				
Never-married	0.417*	0.190	0.466**	0.161
Widow/widower	-0.071	0.065	0.189*	0.091
Divorced/separated	0.474***	0.063	0.577***	0.062
Parent's higher education (ref: no)				
Yes	0.496***	0.061	0.484***	0.052
Parent's immigrant background (ref: no)				
Yes	-0.374**	0.127	-0.151	0.105
Child's characteristics				
Child's gender (ref: woman)				
Man	0.001	0.047	-0.011	0.044
Number of siblings (ref: 0)				
1	0.109	0.097	0.171	0.094
2	0.269**	0.097	0.298**	0.094
3+	0.251*	0.108	0.453***	0.104
Child's age group (ref: 16–29)				
30-39	-1.423***	0.108	-1.206***	0.067
40-49	-2.130***	0.114	-1.845***	0.077
50-59	-2.337***	0.135	-2.253***	0.115
60+	-2.527***	0.188	-2.402***	0.246
Ties to partners and their families (ref: no partner)				
Partner, no parents-in-law nearby	-0.535***	0.101	-0.418***	0.096
Partner, only mother-in-law nearby	-1.461***	0.364	-.903**	0.277
Partner, only father-in-law nearby	-0.978*	0.434	-1.293**	0.470
Partner, both parents-in-law nearby	-1.794***	0.134	-1.664***	0.126
No parents-in-law or unknown location	-0.832***	0.062	-0.717***	0.065
Living in the municipality of birth (ref: no)				
Yes	-0.196***	0.054	-0.147*	0.055
Children in the household (ref: no)				
Yes	-0.624***	0.069	-0.886***	0.066
Another household	0.592***	0.071	0.367***	0.069
Employment (ref: no)				
Yes	-0.432***	0.065	-0.171**	0.060
Income (ref: lowest quartile)				
Second quartile	-0.147*	0.067	-0.157*	0.061
Third quartile	-0.235**	0.072	-0.223**	0.065
Highest quartile	-0.154*	0.075	-0.294***	0.070
Higher education (ref: no)				
Yes	0.582***	0.069	0.755***	0.0484
Unknown	-0.162	0.071	-0.389	0.474
Receiving pension (ref: no)				
Yes	-0.190†	0.099	-0.113	0.123
Municipality characteristics				
Centrality (ref: rural or less central)				
Urban or central	-0.400***	0.081	-0.500***	0.085
Share of spending on health care (ref: below median)				
Above median	-0.070	0.081	-0.243*	0.094
Constant	-3.874***	0.183	-3.916***	0.160
Variance of random effect:				
parent level	4.665	0.367	0.280	0.054

Table 2 (continued)

	Model 1			
	Mothers		Fathers	
	Coef.	SE	Coef.	SE
Variance of random effect:	0.165	0.044	4.325	0.304
municipality level				
ICC: parent level	0.595	0.019	0.035	0.007
ICC: municipality level	0.020	0.005	0.584	0.016
Log likelihood	-14598.036		-16217.357	
Wald chi2(42), Prob > chi2	1845.14, p < .001		2290.73, p < .001	

Note: *p < 0.05; **p < 0.01; ***p < 0.001.

3.0 to 2.0 percent for mothers and from 4.3 to 3.5 percent for fathers while parent-level ICC remained quite stable: around 60 percent for mothers and 58 percent for fathers (Table 1). The LR test indicated that the inclusion of these variables improved the models (LR chi2 (2) = 22.2, prob > chi2 < 0.001 for mothers and LR chi2 (2) = 40.7, prob > chi2 < 0.001 for fathers). As such, the inclusion of municipal characteristics helped to explain some of the remaining between-municipality variation in the likelihood of parent-child divergence. Furthermore, in support of Hypothesis 4a, parents and their adult children living in more central areas were less likely to diverge geographically than those who lived in less central areas (B = -0.399, p < .001 for mothers and B = -0.500, p < .001 for fathers). Hypothesis 4b was only partly confirmed. For fathers, living in municipalities with a higher share of the budget spent on health care led to a lower likelihood of intergenerational divergence (B = -0.243, p = .01) relative to living in municipalities with a lower share of the budget spent on health care. This finding, however, did not hold for mothers (B = -0.070, p = .390).

The results for control variables were generally in line with our expectations (Table 2). Older parents and adult children had higher propensities to diverge if the child had two or more siblings. The results did not, however, point to statistically significant differences in the likelihood of parent-child divergence by child's gender.

Furthermore, adult children who had partners were less likely to diverge from parents, while close geographic proximity of parents-in-law had an even stronger effect in reducing the likelihood of divergence. A similar effect was found for having a dependent child. Living in the municipality where the adult child was born was also negatively associated with the likelihood of parent-child divergence.

Concerning sociodemographic characteristics, both parents and children in older age groups were less likely to diverge than those in the youngest age groups (65–69 years for parents and 16–29 years for adult children). Mothers' immigrant background was associated with a lower likelihood of divergence, but this association was not statistically significant for fathers. For both parents and children, higher education was associated with a higher likelihood of divergence. Employed children and those in the higher quartiles of the income distribution were less likely to diverge than the unemployed and those in the lowest quartile.

6. Discussion and concluding remarks

We examined the role of older parent's formal care needs for parent-child (im)mobility in Norway. In virtually complete register data, we found that an onset of needs is associated with the lowest likelihood of intergenerational geographic divergence. In line with the family ties perspective on internal migration and immobility (Mulder 2018), this finding suggests that the proximity of a child is particularly important as parents begin to embark on the path to older age-related dependency. Families likely need to adapt to the uncertainty and confusion related to the onset of parents' care needs (Moral-Fernández et al., 2018), and the closest child might assume responsibility for a pronounced share of care (Johansson 1991). These responsibilities might later be renegotiated and redistributed among other family members and/or comprehensive formal care services (Szinovacz and Davey 2007; Moral-Fernández et al.,

Table 3
Estimated three-level binary response model by the presence of the parent’s partner, regression coefficients and standard errors.

	Mothers				Fathers			
	Model 2		Model 3		Model 2		Model 3	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Presence of a partner (ref: without a partner)								
With partner	-0.173**	0.052			-0.400***	0.057		
Utilisation of care services (ref: none of listed below)								
Only practical assistance	-0.010	0.172			-0.336	0.325		
Only in-home nursing	-0.270*	0.130			-0.168	0.136		
Both in-home care and practical assistance	-0.011	0.134			0.149	0.191		
Institutionalised care	-0.046	0.117			-0.354*	0.154		
Presence of a partner (ref: without a partner), main effect								
With partner			-0.197***	0.054			-0.428***	0.060
Utilisation of care services (ref: none of listed below), main effect								
Only practical assistance			-0.018	0.199			-0.405	0.385
Only in-home nursing			-0.497**	0.176			-0.245	0.238
Both in-home care and practical assistance			-0.107**	0.152			-0.051	0.231
Institutionalised care			-0.025	0.135			-0.531*	0.251
Presence of a partner*Utilisation of care services, interaction term								
With partner*Only practical assistance			-0.014	0.716			0.201	0.716
With partner*Only in-home nursing			0.546*	0.286			0.112	0.286
With partner*Both in-home care and practical assistance			0.419	0.395			0.655	0.395
With partner* Institutionalised care			-0.147	0.311			0.282	0.311
Constant	-3.613***	0.179	-3.597***	0.179	-3.439***	0.158	-3.419***	0.159
Variance of random effect: parent level	0.166	0.044	0.165	0.044	0.280	0.054	0.280	0.054
Variance of random effect: municipality level	4.679	0.368	4.672	0.368	4.363	0.304	4.369	0.304
ICC: parent level	0.020	0.005	0.020	0.005	0.035	0.007	0.035	0.007
ICC: municipality level	0.596	0.019	0.595	0.019	0.585	0.016	0.586	0.017
Log likelihood	-14627.003		-14623.707		-16238.791		-16,237.039	
Wald chi2(df), Prob > chi2	1832.89 (37), p < .001		1834.96 (41), p < .001		2284.40 (37), p < .001		2282.93 (41), p < .001	

Note: *p < 0.05; **p < 0.01; ***p < 0.001. The control variables are the same as in Model 1.

2018), thereby making close intergenerational proximity less urgent. A possible reason for why high parental needs for formal care did not reduce the propensity of parent-child geographic separation might be related to the fact that frail parents could move in search of other sources of support, for instance to institutionalised care facilities (Silverstein, 1995) or to live near another adult child (Artamonova et al., 2020).

The use of in-home nursing reduced the likelihood of intergenerational divergence for mothers, while institutionalised care reduced the likelihood of divergence for fathers. Furthermore, the negative effect of mothers’ in-home nursing care utilisation on the divergence was strengthened by mothers’ singlehood. We did not find any evidence that the association between fathers’ utilisation of any care services and the likelihood of divergence varied by the presence of the father’s partner. These findings support the idea of the gendered nature of life experiences (Settersten 2003), including the experience of receiving help and care from the state, a partner, and children (Dwyer and Coward 1992).

Previous research suggests that women receive a substantial proportion of their care from adult children in addition to spousal care, while men tend to rely more on their partners and less on adult children (Katz et al., 2000). When in poor health, women might receive in-home nursing care combined with help from a spouse and children, likely through some form of social support and ‘oversight’ of the quantity and quality of professional care. Adult children’s role as service managers for elderly mothers might, however, be less salient when partners are available and able to perform this function. A similar effect was not found for elderly fathers and children, perhaps because men are likely to receive care from their wives for a longer period of time and possibly at greater levels of disability (Miller 1990). Additionally, spousal care strongly reduces men’s risk of institutionalisation (Freedman et al., 1994). These explanations seem relevant for Norway where wives are on average younger than their husbands and there are more widowed women than men (Statistics Norway 2018). When the level of disability is high and a father has to move to an institutionalised care facility, a child might want to stay nearby to perform a managing function if the father does not have a partner and/or to remain closer to the father’s partner (likely, the adult child’s mother) who may need to learn how to

live alone and thus likely requires extra support from a child.

Our analyses further demonstrated how residential (im)mobility connects the lives of elderly and their adult children to the structural conditions of their place of residence. Specifically, older parents and their adult children living in more central areas were less likely to diverge geographically than those who lived in less central areas. Living in municipalities with a higher share of the budget spent on health care significantly decreased the likelihood of intergenerational divergence only for fathers and children. One explanation is that competition between parents’ and/or adult children’s desire to stay close and yet have access to public services, educational, and job opportunities in less central municipalities with low health care costs is high. In these cases, individuals might be prone to relocate elsewhere which means sacrificing their intergenerational proximity. The increase in intergenerational geographic distance in these municipalities might have several adverse consequences for those who have to move elsewhere. First, it might worsen parental well-being which is positively associated with geographic closeness of adult children (van der Pers et al., 2015a,b). Second, it may also worsen adult children’s well-being since geographic separation between caregivers and care recipients tends to exacerbate care-related stressors (Cagle and Munn 2012). In relation to this, living more than 30 min from a care recipient is associated with high level of caregiver social isolation, while a shorter physical distance may be ideal for family caregivers to provide needed care and avoid being overwhelmed by care-related responsibilities (Li and Wister 2021). Third, it may increase inequality among the elderly as the opportunity to remain in their own homes for as long as possible may differ across municipalities. Finally, it might become costlier and more complicated to provide the necessary services (including medical care) to sustain a community and support a labour market in less central municipalities that people leave (McArthur and Thorsen 2011). A failure to uphold sustainability could accelerate centralisation. If this is not what the Norwegian policymakers aim for, a more proactive approach might be needed to reduce the competition between individuals’ family ties and the advantages of other municipalities. Having viable support networks enables ageing in place (Pani-Harreman et al., 2020). Consequently,

equal opportunities to stay close to family irrespective of the municipality of residence can be considered important for both the elderly and their adult children's wellbeing. By identifying municipalities in which older parents and adult children find it difficult to remain geographically close, authorities are better placed to direct their efforts.

Although the data we used have several strengths, some limitations are worth noting. We based our analyses on short parent-child distances as a proxy for frequent intergenerational contact and support exchange. However, the quality of the parent-child relationship remains unknown. Furthermore, the reliability of registered parent-child distance depends on both older and younger generations living at their recorded residential address. This might not always be the case, particularly shortly after institutionalisation when parents may remain registered at their former residence. In cases like this, there might be imprecise distances between institutionalised parents and their children in our data. Furthermore, we measured geographic divergence within a two-year window, in line with other studies on changes in intergenerational geographic proximity (cf. e.g. Michielin et al., 2008; Pettersson and Malmberg 2009; Thomas and Dommermuth 2020). This resulted in a limited number of divergences since the annual relocation rate in Norway is around 13 percent in total, and only 5 percent between municipalities (Statistics Norway, 2020c). The potential drawback of this was balanced against a desire to restrict the time-span between the potential divergence and the change in formal care needs as health can deteriorate rapidly at older ages. For instance, the mean survival time in Norwegian nursing homes is only around two years (Vossius et al., 2018).

To access sensitive information about needs for formal care and uptake of formal care services, restrictions were placed on the available data. First, we were unable to identify who—a parent, an adult child, or both—moved away. It would be valuable to analyse who initiates divergence when a parent needs care, how far parents and children move from each other, and the factors that might be associated with the moving distance. Second, we were only given information about the three oldest children. However, only a limited number of the elderly in our data have more than three children. Third, we could not link mothers and fathers of adult children. Our analysis examined only the presence of a parent's partner and assumed that she or he is healthy and able to care for the impaired respondent. We could not explore what locational choices parents and their close children make in response to the health problems of both parents. To the extent that it is possible, future analyses should consider treating disability as a characteristic of the parental household.

Going forward, facilitating conditions that enable adult children or other potential informal caregivers to balance caregiving or care management tasks and labour force participation will be vital to ensure the

health and welfare of individuals across all age groups and geographic locations. Thus, the role of geographic proximity in the interplay between informal and formal eldercare will become increasingly relevant, both at family and societal levels. As distance caregiving has an adverse impact on employment (Li and Wister 2021), policies directed to increase female labour market participation and extending working lives might further imply that fewer people will be willing or able to provide informal care in the future. In instances where retaining close intergenerational proximity is not possible, intervention programmes can be designed to reduce the burden of long-distance caregiving and its effect on labour market participation. Such measures could include, for instance, increased flexibility for workers involved in long-distance caregiving and tax benefits to compensate travels towards a care recipient (Li and Wister 2021).

Population ageing, centralisation, and an increase in more diverse family structures are trends that are likely to continue, and they present fundamental challenges for future eldercare provision both financially and in terms of labour supply (OECD 2019). Our findings suggest that older parents and their adult children prioritise intergenerational proximity when parental needs for formal care arise. Parental utilisation of formal care services does not appear to give parents and children more freedom to move far apart. Presumably, it happens because of challenges related to long-distance caregiving as well as the new role of family members as case managers and sources of emotional support, which is likely facilitated by geographical proximity. Between-municipality differences in the likelihood of divergence were rather minor in Norway. Attention should, however, be paid to a possible rising inequality between the elderly with and without a network of family caregivers in their proximity.

Declaration of competing interest

None.

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Appendix

Table A1

Descriptive statistics, percentage in the sample

	Mothers	Fathers		Mothers	Fathers
Parent's characteristics			Child's characteristics		
Overall formal care needs			Child's gender		
No needs and no increase	74.1	85.6	Woman	46.8	46.4
No needs and increase	4.3	3.5	Man	53.2	53.6
Low and no increase	8.4	3.6	Number of siblings		
Low and increase	1.8	0.8	0	6.7	5.9
Middle and no increase	5.8	3.1	1	36.2	38.4
Middle and increase	1.2	0.7	2	37.2	37.7
High	3.8	2.1	3+	19.9	18.0
Unknown level of needs	0.6	0.6	Child's age group		
Utilisation of care services			16–29	1.1	5.5
None of listed below	78.5	88.0	30–39	11.1	20.7
Only practical assistance	2.7	0.7	40–49	44.0	46.9
Only in-home nursing	5.5	4.6	50–59	33.7	23.2
Both in-home care and practical assistance	5.2	1.9	60+	11.1	3.7

(continued on next page)

Table A1 (continued)

	Mothers	Fathers		Mothers	Fathers
Institutionalised care	8.1	4.7	Ties to partners and their families^b		
Parent's age group			No partner	36.4	38.1
65–69	29.1	34.5	No parents-in-law nearby	7.5	9.1
70–74	23.5	26.6	Only mother-in-law nearby	0.9	1.2
75–79	17.9	17.8	Only father-in-law nearby	0.4	0.5
80–84	14.0	12.1	Both parents-in-law nearby	11.7	13.9
85–89	9.7	7.0	No parents-in-law or unknown location	43.1	37.3
90+	5.8	3.0	Children in the household^c		
Parent's higher education^a			No	52.0	44.3
No	85.8	77.4	Yes	41.5	49.4
Yes	14.2	22.6	Another household	6.5	6.4
Parent's partnership state			Living in the municipality of birth		
Married/partnered	51.3	78.8	No	53.6	54.9
Never-married	0.7	0.7	Yes	46.4	45.1
Widowed	35.2	10.3	Employment^d		
Divorced/separated	12.8	10.2	No	16.1	14.6
Parent's immigrant background			Yes	83.9	85.4
No	96.6	96.1	Income^e		
Yes	3.5	3.9	Lowest quartile	28.5	27.2
Municipality characteristics			Second quartile	25.6	25.7
Centrality			Third quartile	23.9	24.3
Urban or central	16.4	16.2	Highest quartile	22.0	22.8
Rural or less central	83.6	83.8	Higher education^a		
Share of spending on health care			No	65.4	62.0
Below median	49.5	50.5	Yes	34.5	37.9
Above median	50.5	49.5	Unknown	0.1	0.1
			Receiving pension^f		
			No	89.7	94.5
			Yes	10.3	5.5

Note: Frequencies refer to data in long form with multiple adult children nested within their older parent. Mothers sample n = 430,852, Fathers sample n = 332,387. ^aHigher education is defined as having any education past high school (i.e. at college or university level). For parents, the few 'unknowns' were categorised as having a low education. For children, the 'unknowns' were included in a separate category. ^bNearby is defined as within 10 km ^cLiving with children in the household ('yes') was defined as being registered in a household with at least one child under age 18 or not ('no'). An additional category comprised 'another type of household', from which no further information could be extracted about the household composition. ^dWe distinguished between those children who were registered as employed or not employed. At Statistics Norway, employed persons are defined as persons who performed income-generating work of at least 1 h's duration in a reference week, as well as persons who have such work, but who were temporarily absent due to illness, vacation, paid leave, etc. This definition follows the recommendations from the international labour organisation (ILO). ^eThe income quartiles were based on income after taxation (in ten-thousands of Norwegian crowns) adjusted for the child's age group and gender. ^fWe accounted for whether a child received an age-related pension or not as a proxy for a child's retirement state.

Table A2a

Level of formal care needs and services utilisation in a baseline year, mothers (row percentage)

		Utilisation of care services					Total
		None of listed	Only practical assistance	Only in-home nursing	Both in-home care and practical assistance	Institutionalised care	
Level of formal care needs	No needs	100.0	0.0	0.0	0.0	0.0	324,584
	Low	24.0	21.0	28.4	16.8	9.8	45,952
	Middle	5.9	4.7	23.0	32.1	34.4	34,700
	High	0.9	0.5	5.3	15.1	78.2	22,960
	Unknown	7.5	11.9	54.4	5.7	20.5	2656
Total		338,047	11,728	23,688	22,455	34,934	430,852

Table A2b

Level of formal care needs and services utilisation in a baseline year, fathers (row percentage)

		Utilisation of care services					Total
		None of listed	Only practical assistance	Only in-home nursing	Both in-home care and practical assistance	Institutionalised care	
Level of formal care needs	No needs	100.0	0.0	0.0	0.0	0.0	287,627
	Low	19.1	13.8	44.4	10.6	12.2	16,691
	Middle	8.0	2.5	34.4	20.2	34.9	15,634
	High	2.7	0.5	10.7	11.3	74.8	10,473
	Unknown	10.0	5.7	61.5	2.3	20.5	1962
Total		292,541	2865	15,108	6152	15,721	332,387

A3. Sensitivity analyses

To perform adequate three-level analyses, we limited the samples for the primary models to those parents and children who lived within 10 km of each other and in the same municipalities at the out-set. However, there were parents and children who lived within the required distance but in neighbouring municipalities. We ran the models without the requirement to live in the same municipality. The samples for these models included 472,786 mother-child dyads (out of which 2900 or 0.6 percent diverged) and 366,333 father-child dyads (out of which 3646 or 1.0 percent diverged). The estimates from these models were virtually identical to the estimates of more restrictive models, i.e., the direction and order of magnitude of the effects were consistent. The differences that need to be reported were in the effects of the share of the budget spent on health care on the likelihood of divergence for mothers and the municipality-level ICC estimates regardless of the parent's gender. According to the less restrictive model, those mothers who lived in the municipalities with the share of the budget spent on health care above-median were less likely to diverge from their children. The municipality-level ICC estimates of the less restrictive models were higher than those of the primary models (2.7 versus 2.0 percent for mothers and 5.2 percent versus 3.5 percent for fathers).

We additionally tested the stability of our results for parents and children who lived within 5 and 16 km of each other in a baseline year. The former threshold was chosen based on findings of [Knijn and Liefbroer \(2006\)](#) indicating that a parent-child geographic distance of more than 5 km relative to less than 5 km makes a difference in intergenerational instrumental support exchange in the Netherlands. The latter distance threshold was chosen because it corresponds to the 10 miles threshold that was used in the US Health and Retirement Study to distinguish between parents and children who live or do not live close to each other ([Zhang et al., 2013](#)). The results of models of a baseline distance of 5, 10, and 16 km were similar. The only exception was that the negative effect of living in municipalities with a higher share of the budget spent on health care on the likelihood of intergenerational geographic divergence did not reach statistical significance in the model where fathers and children lived within 5 km of each other at baseline. We thus opted to retain the 10 km threshold, in line with previous research in the Norwegian context ([Thomas and Dommermuth, 2020](#)).

As another sensitivity check, we explored different parent-child distance thresholds, where parent-child divergence meant living more than 10 km, 20 km, 35 km, and 60 km from each other in $t + 1$. The results of the models with the threshold of 10 and 20 km were different from the results of the models with other distances, pertaining primarily to the effects of the parental formal care needs on the likelihood of divergence. There were no effects of lower levels of needs, while the effects of middle and high needs on the likelihood of divergence were positive and statistically significant, which might indicate parental moves to institutionalised residential facilities. The results of models of a new distance of at least 35, at least 45, and at least 60 km were very similar. We retained the 45 km threshold as a more conservative option than the 35 km, which, at the same time, enabled us to observe slightly more events of interest than the 60 km option.

We also ran a single-level multinomial regression model with multiway clustering of SEs, by parents' and municipality identification numbers. The outcome variable included staying within 10 km (reference category), short-distance divergences with new intergenerational proximity of 11–44 km, and long-distance divergences with new proximity exceeding 44 km. The models revealed a positive effect of parental formal care needs on the likelihood of the short-distance divergence. The coefficients were highest for 'middle level of needs and increase' relative to 'no needs and no increase', again, potentially indicating parental moves to institutions. The effects of the independent variables on the likelihood of the long-distance divergence were very similar to the effects presented in [Table 2](#).

Since we had no information on children of birth order number four and higher, we ran a sensitivity check excluding elderly with more than three children. The estimates from the model for mothers were similar to those from Model 1. A difference was, however, observed for fathers: The negative effect of onset of needs on the likelihood of parent-child divergence (relative to 'no needs and no increase') did not reach statistical significance.

Migration early in the adult life course is often driven by a pursuit of independence and for educational advancement and the formation of labour-market careers ([Dommermuth and Klüsener, 2019](#)). Consequently, parental needs may matter less for a child's migration propensities than when the child has reached independence across different life domains. As such, an additional sensitivity check explored the stability of our models for adult children at the age of 30 and 40 years and older. At the same time, parental needs are likely to increase with increasing age of both parents and children. However, the results did not differ substantially.

All sensitivity checks are available upon request.

References

- Andersson, K., Carlsen, F., 1997. Local public services and migration: educational change evidence from Norwegian municipalities. *Rev. Reg. Stud.* 27 (2), 123–142.
- Artamonova, A., Gillespie, B.J., Brandén, M., 2020. Geographic mobility among older people and their adult children: the role of parents' health issues and family ties. *Popul. Space Place*. 26, e2371. <https://doi.org/10.1002/psp.2371>.
- Artamonova, A., Brandén, M., Gillespie, B., Mulder, C., 2021. Adult children's gender, number and proximity and older parents' moves to institutions: evidence from Sweden. *Ageing Soc.* 1–31. <https://doi.org/10.1017/S0144686X21000556>.
- Bengtson, V.L., 2001. Beyond the nuclear family: the increasing importance of multigenerational bonds. *J. Marriage Fam.* 63, 1–16. <https://doi.org/10.1111/j.1741-3737.2001.00001.x>.
- Bernard, A., Bell, M., Charles-Edwards, E., 2014. Life-course transitions and the age profile of internal migration. *Popul. Dev. Rev.* 40 (2), 213–239. <https://doi.org/10.1111/j.1728-4457.2014.00671.x>.
- Brandt, M., Häberkern, K., Szydlík, M., 2009. Intergenerational help and care in Europe. *Eur. Socio Rev.* 25 (5), 585–601. <https://doi.org/10.1093/esr/jcn076>.
- Brody, E.M., 1981. "Women in the middle" and family help to older people. *Gerontol.* 21 (5), 471–480. <https://doi.org/10.1093/geront/21.5.471>.
- Cagle, J.G., Munn, J.C., 2012. Long-distance caregiving: a systematic review of the literature. *J. Gerontol. Soc. Work* 55 (8), 682–707. <https://doi.org/10.1080/01634372.2012.703763>.
- Cantor, M.H., 1991. Family and community: changing roles in an aging society. *Gerontol.* 31 (3), 337–346. <https://doi.org/10.1093/geront/31.3.337>.
- Chiswick, B.R., 2000. Are Immigrants Favorably Self-Selected. *Migration Theory. Talking across disciplines*, pp. 61–77.
- Chou, K.L., Yeung, S., Chi, I., 2001. Does physical distance make a difference in caregiving? *J. Gerontol. Soc. Work* 35, 21–37. https://doi.org/10.1300/J083v35n01_03.
- Clark, W.A.V., Duque-Calvache, R., Palomares-Linares, I., 2017. Place attachment and the decision to stay in the neighbourhood. *Popul. Space Place* 23 (2), e2001. <https://doi.org/10.1002/psp.2001>.
- Connidis, I.A., Barnett, A.E., 2018. *Family Ties and Aging*. Sage publications.
- Coulter, R., Van Ham, M., Findlay, A.M., 2016. Re-thinking residential mobility: linking lives through time and space. *Prog. Hum. Geogr.* 40 (3), 352–374. <https://doi.org/10.1177/0309132515575417>.
- Daatland, S.O., Herlofson, K., 2003. 'Lost solidarity' or 'changed solidarity': a comparative European view of normative family solidarity. *Ageing Soc.* 23 (5), 537–560. <https://doi.org/10.1017/S0144686X03001272>.
- DaVanzo, J., 1981. Repeat migration, information costs, and location-specific capital. *Popul. Environ.* 4 (1), 45–73. <https://doi.org/10.1007/BF01362575>.
- DaVanzo, J., 1978. Does unemployment affect migration? Evidence from micro data. *Rev. Econ. Stat.* 60 (4), 504–514. <https://doi.org/10.2307/1924242>.
- Dommermuth, L., Klüsener, S., 2019. Formation and realisation of moving intentions across the adult life course. *Popul. Space Place* 25 (5), e2212. <https://doi.org/10.1002/psp.2212>.
- Dwyer, J.W., Coward, R.T., 1992. *Gender, Families, and Elder Care*. Sage Publications, Inc.
- Elder Jr., G.H., 1994. Time, human agency, and social change: perspectives on the life course. *Soc. Psychol. Q.* 4–15. <https://doi.org/10.2307/2786971>.
- Ermisch, J., Mulder, C.H., 2019. Migration versus immobility, and ties to parents. *J. Popul.* 35 (5), 587–608. <https://doi.org/10.1007/s10680-018-9494-0>.

- Fischer, P.A., Malmberg, G., 2001. Settled people don't move: on life course and (im-) mobility in Sweden. *Int. J. Popul. Geogr.* 7 (5), 335–371. <https://doi.org/10.1002/ijpg.230>.
- Freedman, V.A., Berkman, L.F., Rapp, S.R., Ostfeld, A.M., 1994. Family networks: predictors of nursing home entry. *AJPH (Am. J. Public Health)* 84 (5), 843–845. <https://doi.org/10.2105/AJPH.84.5.843>.
- Gautun, H., 2008. Arbeidstakere og omsorg for gamle foreldre—den nye tidsklemma. *FAFO Report* 40, 393–409.
- Haberkmern, K., Schmid, T., Szydlik, M., 2015. Gender differences in intergenerational care in European welfare states. *Ageing Soc.* 35 (2), 298–320. <https://doi.org/10.1017/S014686X13000639>.
- Haberkmern, K., Szydlik, M., 2010. State care provision, societal opinion and children's care of older parents in 11 European countries. *Ageing Soc.* 30 (2), 299–323. <https://doi.org/10.1017/S014686X09990316>.
- Hank, K., 2007. Proximity and contacts between older parents and their children: a European comparison. *J. Marriage Fam.* 69 (1), 157–173. <https://doi.org/10.1111/j.1741-3737.2006.00351.x>.
- Hicks, S.A., Horowitz, A., Jimenez, D., Falzarano, F., Minahan, J., Cimarolli, V.R., 2018. Unique challenges reported by long-distance caregivers. *Innovation in Aging* 2 (1), 201. <https://doi.org/10.1093/geroni/igy023.739>.
- Hjålm, A., 2014. The 'stayers': dynamics of lifelong sedentary behaviour in an urban context. *Popul. Space Place* 20 (6), 569–580. <https://doi.org/10.1002/psp.1796>.
- Hjålm, A., 2012. Because we know our limits': elderly parents' views on intergenerational proximity and intimacy. *J. Aging Stud.* 26 (3), 296–308. <https://doi.org/10.1016/j.jaging.2012.01.005>.
- Hünteler, B., Mulder, C.H., 2020. Geographic proximity to parents, intergenerational support exchange, and migration within Germany. *Eur. J. Popul.* 36, 895–918. <https://doi.org/10.1007/s10680-020-09558-w>.
- Huseby, B.M., Paulsen, B., 2009. Eldreomsorgen i Norge: Helt Utilstrekkelig—Eller Best i Verden.
- Johansson, L., 1991. Informal care of dependent elderly at home—some Swedish experiences. *Ageing Soc.* 11 (1), 41–58. <https://doi.org/10.1017/S014686X00003822>.
- Kan, K., 2007. Residential mobility and social capital. *J. Urban Econ.* 61 (3), 436–457. <https://doi.org/10.1016/j.jue.2006.07.005>.
- Katz, S.J., Kabeto, M., Langa, K.M., 2000. Gender disparities in the receipt of home care for elderly people with disability in the United States. *Jama* 284 (23), 3022–3027. <https://doi.org/10.1001/jama.284.23.3022>.
- Knijn, T.C.M., Liefbroer, A.C., 2006. More kin than kind: instrumental support in families. In: Dykstra, P.A., Kalmijn, M., Knijn, T.C.M., Komter, A.E., Liefbroer, A.C., Mulder, C.H. (Eds.), *Family Solidarity in the Netherlands*. Dutch University Press, Amsterdam, pp. 89–106.
- Korpi, M., Clark, W.A., 2015. Internal migration and human capital theory: to what extent is it selective? *Econ. Lett.* 136, 31–34. <https://doi.org/10.1016/j.econlet.2015.08.016>.
- Kotsadam, A., 2012. The employment costs of caregiving in Norway. *Int. J. Health Care Finance Econ.* 12 (4), 269–283. <https://doi.org/10.1007/s10754-012-9116-z>.
- Lawton, L., Silverstein, M., Bengtson, V., 1994. Affection, social contact, and geographic distance between adult children and their parents. *J. Marriage Fam.* 57–68. <https://doi.org/10.2307/352701>.
- Leopold, T., Raab, M., Engelhardt, H., 2014. The transition to parent care: costs, commitments, and caregiver selection among children. *J. Marriage Fam.* 76 (2), 300–318. <https://doi.org/10.1111/jomf.12099>.
- Li, L., Wister, A., 2021. Geographic distance and social isolation among family caregivers providing care to older adults in Canada. *Ageing Soc.* 1–26. <https://doi.org/10.1017/S014686X2100060X>.
- Lin, G., Rogerson, P.A., 1995. Elderly parents and the geographic availability of their adult children. *Res. Aging* 17 (3), 303–331. <https://doi.org/10.1111/jomf.12099>.
- Litwak, E., 1985. Complementary roles for formal and informal support groups: a study of nursing homes and mortality rates. *J. Appl. Behav. Sci.* 21 (4), 407–425. <http://doi:10.1177%2F002188638502100406>.
- Litwak, E., Longino, J., C.F., 1987. Migration patterns among the elderly: a developmental perspective. *Gerontol.* 27 (3), 266–272. <https://doi.org/10.1093/geront/27.3.266>.
- Lloyd, L., Calnan, M., Cameron, A., Seymour, J., Smith, R., 2014. Identity in the fourth age: perseverance, adaptation and maintaining dignity. *Ageing Soc.* 34 (1), 1–19. <https://doi.org/10.1017/S014686X12000761>.
- Magnussen, J., Martinussen, P.E., 2013. From centralization to decentralization, and back: Norwegian health care in a Nordic perspective. *Anonymous Federalism and Decentralization in European Health and Social Care*. Springer, pp. 101–120.
- Malmberg, G., Pettersson, A., 2007. Distance to elderly parents: analyses of Swedish register data. *Demogr. Res.* 17, 679–704. <http://doi:10.4054/DemRes.2007.17.23>.
- McArthur, D., Thorsen, I., 2011. Determinants of Internal Migration in Norway. Online at <https://www.econstor.eu/handle/10419/118913>.
- Merlo, J., Wagner, P., Leckie, G., 2019. A simple multilevel approach for analysing geographical inequalities in public health reports: the case of municipality differences in obesity. *Health Place* 58, 102145. <https://doi.org/10.1016/j.healthplace.2019.102145>.
- Michielin, F., Mulder, C.H., Zorlu, A., 2008. Distance to parents and geographical mobility. *Popul. Space Place* 14 (4), 327–345. <https://doi.org/10.1002/psp.509>.
- Miller, B., 1990. Gender differences in spouse caregiver strain: socialization and role explanations. *J. Marriage Fam.* 52 (2), 311–321. <https://doi.org/10.2307/353028>.
- Mørk, E., Beyrer, S., Haugstveit, F.V., Sundby, B., Karlsen, H.T., 2018. Kommunale Helse- Og Omsorgstjenester 2017. Statistikk Om Tjenester Og Tjenestemottakere.
- Molven, O., Ferkes, J., 2011. *Healthcare, Welfare and Law: Health Legislation as a Mirror of the Norwegian Welfare State*. Gyldendal Akademisk, Oslo.
- Moral-Fernández, L., Frías-Osuna, A., Moreno-Cámara, S., Palomino-Moral, P.A., Del-Pino-Casado, R., 2018. The start of caring for an elderly dependent family member: a qualitative metasynthesis. *BMC Geriatr.* 18, 228. <https://doi.org/10.1186/s12877-018-0922-0>.
- Mulder, C.H., 2018. Putting family centre stage: ties to nonresident family, internal migration, and immobility. *Demogr. Res.* 39, 1151–1180. <https://doi.org/10.4054/DemRes.2018.39.43>.
- Mulder, C.H., Malmberg, G., 2011. Moving related to separation: who moves and to what distance. *Environ. Plann.* 43 (11), 2589–2607. <https://doi.org/10.1068/a43609>.
- Mulder, C.H., Malmberg, G., 2014. Local ties and family migration. *Environ. Plann.* 46 (9), 2195–2211. <https://doi.org/10.1068/a130160p>.
- Mulder, C.H., Wagnier, M., 2012. Moving after separation: the role of location-specific capital. *Hous. Stud.* 27 (6), 839–852. <https://doi.org/10.1080/02673037.2012.651109>.
- OECD, 2019. *Health at a Glance 2019: OECD Indicators*. OECD Publishing, Paris. <https://doi.org/10.1787/4dd50c09-en>. Online at.
- Pani-Harreman, K., Bours, G., Zander, I., Kempen, G., Van Duren, J., 2020. Definitions, key themes and aspects of 'ageing in place': a scoping review. *Ageing Soc.* 1–34. <https://doi.org/10.1017/S014686X20000094>.
- Pettersson, A., Malmberg, G., 2009. Adult children and elderly parents as mobility attractions in Sweden. *Popul. Space Place* 15 (4), 343–357. <https://doi.org/10.1002/psp.558>.
- Rainer, H., Siedler, T., 2009. O brother, where art thou? The effects of having a sibling on geographic mobility and labour market outcomes. *Economica* 76 (303), 528–556. <https://doi.org/10.1111/j.1468-0335.2008.00696.x>.
- Sander, N., Bell, M., 2014. Migration and retirement in the life course: an event history approach. *J. Popul. Res.* 31 (1), 1–27. <https://doi.org/10.1007/s12546-013-9121-1>.
- Settersten, R.A., 2003. Age structuring and the rhythm of the life course. In: *Anonymous Handbook of the Life Course*. Springer, pp. 81–98.
- Silverstein, M., 1995. Stability and change in temporal distance between the elderly and their children. *Demography* 32 (1), 29–45. <http://doi:10.2307/2061895>.
- Silverstein, M., Gans, D., Yang, F.M., 2006. Intergenerational support to aging parents: the role of norms and needs. *J. Fam. Issues* 27 (8), 1068–1084. <https://doi.org/10.1177/0192513X06288120>.
- Statistics Norway, 2018. Women and Men in Norway. Online at: <https://www.ssb.no/en/befolkning/artikler-og-publikasjoner/attachment/347081?ts=1632b8bca0>.
- Statistics Norway, 2020a. Health Accounts. Online at: <https://www.ssb.no/en/nasjonale-egnskap-og-konjunkturer/statistikk/helsesat>.
- Statistics Norway, 2020b. KOSTRA - Municipality-State-Reporting. Online at: <https://www.ssb.no/en/offentlig-sektor/statistikk/kostrahoved>.
- Statistics Norway, 2020c. Migrations. Online at: <https://www.ssb.no/en/befolkning/statistikk/flytting>.
- Stockdale, A., Theunissen, N., Haartsen, T., 2018. Staying in a state of flux: a life course perspective on the diverse staying processes of rural young adults. *Popul. Space Place* 24 (8), e2139. <https://doi.org/10.1002/psp.2139>.
- Syse, A., Leknes, S., Lokken, S., Tonnessen, M., 2018a. Norway's 2018 population projections. Main results, methods and assumptions. Reports 2018/22. Oslo: Statistics Norway.
- Szinovacz, M.E., Davey, A., 2007. Changes in adult child caregiver networks. *Gerontol.* 47 (3), 280–295. <https://doi.org/10.1093/geront/47.3.280>.
- Thomas, M.J., Dommermuth, L., 2020. Internal migration and the role of intergenerational family ties and life events. *J. Marriage Fam.* 82, 1461–1478. <https://doi.org/10.1111/jomf.12678>.
- Thomassen, J.A., 2020. The roles of family and friends in the immobility decisions of university graduates staying in a peripheral urban area in The Netherlands. *Popul. Space Place*, e2392. <https://doi.org/10.1002/psp.2392>.
- van den Broek, T., Dykstra, P.A., 2017. The impact of siblings on the geographic distance between adult children and their ageing parents. Does parental need matter? *Popul. Space Place* 23 (6), 1–13. <https://doi.org/10.1002/psp.2048>.
- van der Pers, M., Kibele, E., Mulder, C.H., 2015a. Intergenerational proximity and the residential relocation of older people to care institutions and elsewhere. *Ageing Soc.* 35 (7), 1429–1456. <https://doi.org/10.1017/S014686X14000300>.
- van der Pers, M., Mulder, C.H., Steverink, N., 2015b. Geographic proximity of adult children and the well-being of older persons. *Res. Aging* 37 (5), 524–551. <https://doi.org/10.1177/0164027514545482>.
- Vossius, C., Selbæk, G., Benth, J.S., Bergh, S., 2018. Mortality in nursing home residents: a longitudinal study over three years. *PLoS One* 13 (9), e0203480. <https://doi.org/10.1371/journal.pone.0203480>.
- Zhang, Y., Engelman, M., Agree, E.M., 2013. Moving considerations: a longitudinal analysis of parent-child residential proximity for older Americans. *Res. Aging* 35 (6), 663–687. <https://doi.org/10.1177/0164027512457787>.