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*Descriptive Finding*

### **Geographic proximity to siblings in older adulthood**

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## **Geographic proximity to siblings in older adulthood**

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### **Abstract**

#### **BACKGROUND**

Research on older adults' geographic proximity to their family has focused almost exclusively on intergenerational distances, while factors associated with intragenerational proximity have received little attention.

#### **OBJECTIVES**

We explore associations between (1) having at least one sibling nearby and characteristics of older adults (aged 65–84), and (2) proximity to siblings and characteristics of dyads of siblings.

#### **METHODS**

Drawing on Swedish population register data from 2016, we use multi-level logistic regression models to investigate individual-, dyad-, and family-level determinants of close proximity to siblings.

#### **RESULTS**

Based on information about 987,486 individuals nested within 475,644 family groups, nearly 35% of Swedish older adults have their closest sibling living within 10 km. The likelihood of living close to at least one sibling is higher for those with a parent nearby, without partners and children, the less-educated, and living in urban areas and/or their counties of birth. This likelihood decreases with age. At the family level, having more than one sibling, same-gender siblings, and only full siblings are associated with living near a sibling. Based on information about 814,506 dyads, the propensity of close intragenerational distance is higher for those with a parent nearby, without partners or children, brothers, full siblings, the less-educated, and those living in counties of birth and urban areas.

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## **CONTRIBUTION**

This study contributes to the knowledge about the geography of siblings – the family members that might emerge as more active players in older adults' family networks.

## **1. Introduction and background**

Spatial proximity between family members is a fundamental structural characteristic that shapes kin contact and support provision (Knijn and Liefbroer 2006). Knowledge about older adults' geographic access to kin is important because of the growing care needs of aging societies in many European countries. A large number of studies have explored intergenerational geographic proximity (e.g., Hank 2007; Malmberg and Pettersson 2007; Michielin and Mulder 2007; Gillespie and van der Lippe 2015; Gillespie and Treas 2017), while researchers have only occasionally looked at geographic distance between older adults and other family members, such as siblings (see White 2001 and Lundholm 2015 for notable exceptions).

This lack of research on intragenerational proximity in later life is unfortunate, given the evidence suggesting that interactions with sisters and brothers can take on new meaning at this life stage (White 2001). While sibling contact declines in adulthood and middle life (when spouses and children take precedence), it tends to increase when children leave home and partners are lost through divorce or death (Connidis 2005; Van Volkom 2006). Research indicates that close intragenerational distance becomes a desirable feature of family life in older adulthood (Artamonova and Gillespie 2022; Ghosh et al. 2019; Gold 1987). In this life stage, siblings tend to have emotionally close bonds (Connidis 2005; Stocker et al. 2020) and can provide both emotional and instrumental support when needed (Campbell, Connidis, and Davies 1999; Eriksen and Gerstel 2002; Jensen, Nielson, and Yorgason 2020; Sýkorová 2023).

In the literature on the family landscape of older adults, researchers often consider either the proximity to the closest family member of interest (e.g., Malmberg and Pettersson 2007) or the distance between the dyad of an older person and the family member of interest (e.g., van der Pers and Mulder 2013). In this descriptive study, we explore associations between (1) having at least one sibling nearby and characteristics of older adults (aged 65–84) and (2) proximity to siblings and characteristics of dyads of siblings. Drawing on Swedish population registers, we use multi-level logistic regression to investigate the individual-, dyadic-, and family-level determinants of close geographic distances to siblings.

Explanations of close geographic proximity between family members are often developed from the life course approach and emphasize (1) solidarity between family

members as interdependent individuals and (2) migration and immobility in the past. We broadly frame our descriptive analyses based on these notions.

A fairly large proportion of Swedes have siblings – around 88% (Kolk et al. 2021). The average number of siblings born between 1940 and 2004 is around two, although the proportion of individuals with only one sibling increased starting in 1985 (Kolk et al. 2021). Sweden is also a country known for a relatively weak tradition of intergenerational care and therefore has one of the lowest propensities of individuals living in close proximity to family (Hank 2007). Moreover, older adults tend to rely on formal care provision rather than kin support in later life (Haber Kern and Szydlik 2010; Svallfors 2004), making this country an interesting case for our study. While little is known about intragenerational solidarity in the Swedish context, compared to the average European parent aged 50 and over, Swedish older adults have lower levels of intergenerational solidarity and these relationships are more likely to be supportive-at-a-distance or largely autonomous (Dykstra and Fokkema 2011). We expect only modest proportions of older adults to have siblings living nearby.

We expect siblings to group around their older parents if they are alive (Artamonova, Gillespie, and Brandén 2020). Older adults might be more likely to live closer to siblings in the absence of a partner or adult children because they rank their sources of support (Cantor 1991), and siblings tend to be chosen if partners and/or children are not available (Fihel, Kalbarczyk, and Nicińska 2021). The type of ties between siblings might matter, because full biological siblings tend to have more contact than half-siblings (Gilligan, Stocker, and Jewsbury Conger 2020). Since sibling's gender matters for contact frequency (Connidis 2005; Ge and Jiang 2021) and women in Sweden tend to live farther from their families (Malmberg and Pettersson 2007), we also consider gender differences. Older ages might correspond to individuals' need for care (Eriksen and Gerstel 2002) and therefore proximity to kin, including siblings. We expect higher education to be associated with longer intragenerational distances, since highly educated individuals are more likely to move (Chiswick 2000). We consider regional urbanicity since urban residents (often with more job opportunities) live closer to their family members than do inhabitants of sparsely populated regions (Malmberg and Pettersson 2007). Finally, we account for living in the county of birth, assuming that living there is associated with a higher likelihood of having other family members, including siblings, nearby.

## **2. Data and methods**

We draw on data from several Swedish population and administrative registers containing information on individuals born in Sweden from 1932 onward. We denote the main person in a group or a dyad as the index person. Annually updated socioeconomic

information about index persons and their kin was derived from the Longitudinal Integration Database for Health Insurance and Labor Market Studies. Because residents of Sweden are registered within approximately 9,200 Small Areas for Market Statistics (SAMS), it was possible to identify the distances between households of non-resident family members. Distance was measured by the Euclidean distance between the geographic centroids of the index person's and the sibling's SAMS-areas, loosely approximating neighborhoods.

People were identified as siblings if they had the same mother (Raab et al. 2014). The first requirement for inclusion in the sample is that the index person's age was 65 or over in 2016. Because of restrictions in the Swedish register system, we could only observe index persons until age 84. Older adults who were born outside Sweden and did not have siblings, or those whose siblings lived outside Sweden, were excluded from the study. All analyses are based on information about (1) 987,486 older adults and (2) 814,506 older-adult–sibling dyads nested within 475,644 family groups.

We focused on index persons in order to explore the characteristics of older adults with at least one sibling living nearby (Model 1). We used index-person–sibling dyads in order to explore the characteristics of dyads of siblings living close to each other (Model 2). For Model 2, we focused on the interplay between the characteristics of the index person and sibling to account for the composition of each sibling dyad. Where there were several siblings from the same family who met the criteria for inclusion in the sample, the index person was randomly selected. Because the units of analyses were nested within sibling groups in all models, we employed multi-level models.

The outcome variables included two categories in all models. In Model 1, the categories were 0 (the reference category), where all siblings were outside the 10 km radius, and 1, where at least one sibling lived within 10 km. In Model 2, the categories were 0 (the reference category), where the index person and sibling lived more than 10 km from each other, and 1, where they lived within 10 km. We considered the distance of 10 km or less as close because this distance can be travelled in less than 30 minutes, thereby enabling relatively frequent contact and exchange of support (Thomas and Dommermuth 2020). However, several sensitivity checks using alternative distance thresholds confirmed our results.

Descriptive statistics of the variables of interest are provided in Table 1.

**Table 1: Sample characteristics: Percentage or mean (SD)**

	Model 1	Model 2
	Index	Index Sibling
<b>Parental vital state and location</b>		
No parent alive	86.66	
At least one parent alive but far	10.36	
At least one parent nearby	2.98	
<b>Parental vital state and location</b>		
Neither has biological parents alive		83.30
At least one parent alive but far from both		9.12
A parent near at least one of the siblings		7.58
<b>Parenthood state</b>		
At least one child	87.57	87.80
No children	12.43	12.20
<b>Marital state</b>		
Unmarried	11.70	12.41
Married/partnered	58.13	58.28
Divorced/separated	18.02	18.44
Widowed	12.15	10.87
<b>Age</b>	71.8 (4.86)	70.9 (4.75)
<b>Gender</b>		67.8 (7.64)
Men	48.81	49.00
Woman	51.19	51.00
<b>Education</b>		
Primary	30.38	30.08
Secondary	41.81	42.45
Post-secondary	27.55	27.21
No information	0.26	0.26
<b>Origin</b>		
Lives in a birth county	53.16	53.03
Does not live in a birth county	46.84	46.97
<b>Urbanity</b>		
Metropolitan area	29.19	28.19
Smaller town or suburb	44.34	44.59
Sparsely populated area	26.47	27.22
<b>Type of sibling ties</b>		
Half		5.86
Full		94.14
<b>Size of a sibling group</b>		
2	45.98	
3	28.53	
4	13.79	
5 or more	11.70	
<b>Gender composition of a sibling group</b>		
Mixed	67.74	
Only brothers	15.32	
Only sisters	16.94	
<b>Type of sibling in a group</b>		
At least one half-sibling	5.55	
All full siblings	94.45	
<b>Total N observations</b>	987,486	814,506
<b>Total N sibling groups</b>		475,644

### **3. Findings**

The estimated average distance to the closest sibling was 91.2 km (SD = 153.6 km), with a median distance of 22.7 km. Around 35% had at least one sibling within 10 km of their neighborhood.

The first step of our analyses explored the characteristics of older adults living near at least one sibling (Model 1 in Table 2). Compared with those with no living parents, those with at least one parent alive and living nearby were more likely to live close to their sibling. Those without children were more likely to have a sibling nearby than those with at least one child. Similar results were found for the absence of a partner: relative to the married or partnered, unmarried, widowed, and, to a lesser extent, divorced/separated older adults were more likely to live close to at least one sibling.

The likelihood of close sibling proximity decreased with age (within the age range of 65–84 years). Higher-educated older adults were less likely to have at least one sibling nearby than those with lower levels of education. Gender differences in the likelihood of having at least one sibling within 10 km were very small (OR = 0.982).

Residing in the county of birth increased the likelihood of living close to a sibling. Living in less urbanized environments (i.e., smaller towns and suburbs as well as sparsely populated areas) was associated with a lower likelihood of older adults having at least one sibling nearby.

The intra-class correlation coefficient (ICC) indicated that around 86% of the variance in the likelihood of living close to at least one sibling was attributable to family characteristics. Having two, three, or four or more siblings (relative to only one); having only sisters or only brothers (relative to a mixed gender group of siblings); and only full siblings (relative to at least one half-sibling) increased the likelihood of living within a 10 km radius of the closest sibling's neighborhood.

The second step of our descriptive analysis aimed to explore the characteristics of dyads of siblings living close to each other. The estimated average distance between older adults and siblings in dyads was 122.9 km (SD = 184.7), with a median distance of 38.3 km. In a quarter of dyads the distance between siblings' SAMS areas was less than 10 km. The results (Model 2 in Table 3) suggest that siblings were more likely to live close to each other if there was a parent nearby. Siblings were more likely to live nearby when both or one of them did not have a partner compared to cases where both had partners. The absence of a child was also associated with an increased likelihood of close intragenerational proximity, and the effect was especially pronounced when both the older person and their sibling had no children.

Siblings who were around the same age had a lower likelihood of living nearby, but the OR was very close to one. Compared to full siblings, when siblings in a dyad had different fathers they were less likely to live close to each other. For dyads where one or



both siblings were women, there was a lower likelihood of geographic closeness than with brother–brother dyadic configurations.

More-educated index persons and their siblings were less likely to live close to each other than those with lower levels of education. When both the index person and their sibling lived in their county of birth, there was a higher likelihood of close distance between the siblings. Living in more-urban areas was associated with a higher likelihood of close proximity between siblings in a dyad.

**Table 2: Model 1: Characteristics of older adults and their sibling groups associated with living near at least one sibling**

	Odds ratio	95% conf. interval	
<b>Characteristics of older persons</b>			
<b>Parental vital status and location (ref: no parents alive)</b>			
At least one parent alive but far	0.360	0.344	0.376
At least one parent nearby	37.541	34.762	40.541
<b>Parenthood state (ref: at least one child)</b>			
No children	1.209	1.174	1.246
<b>Marital state (ref: married/partnered)</b>			
Unmarried/unpartnered	1.623	1.572	1.674
Divorced/separated	1.090	1.064	1.115
Widowed	1.110	1.080	1.141
<b>Age</b>	0.979	0.977	0.981
<b>Gender (ref: man)</b>			
Woman	0.982	0.964	1.001
<b>Education (ref: primary)</b>			
Secondary	0.658	0.645	0.672
Post-secondary	0.364	0.355	0.374
No information	0.487	0.411	0.578
<b>Living in a county of birth (ref: does not live in a birth county)</b>			
Lives in a birth county	10.129	9.881	10.383
<b>Urbanization of index's place of residence (ref: metropolitan area)</b>			
Smaller town or suburb	0.534	0.521	0.547
Sparsely populated area	0.372	0.362	0.383
<b>Characteristics of sibling groups</b>			
<b>Size of a sibling group (ref: 2)</b>			
3	4.955	4.791	5.125
4	13.425	12.781	14.102
5 or more	30.846	28.994	32.817
<b>Gender composition of a sibling group (ref: mixed)</b>			
Only brothers	1.561	1.501	1.625
Only sisters	1.359	1.308	1.412
<b>Type of sibling in the group (ref: at least one half-sibling)</b>			
All full siblings	1.938	1.827	2.056
<b>Constant</b>	0.048	0.041	0.057
<b>Variance of random effect: sibling group level</b>	20.395	0.218 (SE)	
<b>ICC: sibling group level</b>	0.861	0.001 (SE)	
<b>Log likelihood</b>	-491180.49		
<b>Wald chi2(20), Prob &gt; chi2</b>	51926.41, p < .001		
<b>N of observations</b>	987,486		
<b>N of groups</b>	475,644		

**Table 3: Model 2: Characteristics of dyads of siblings associated with living close to each other**

	Odds ratio	95% conf. interval	
<b>Parental vital status and location (ref: neither has biological parents alive)</b>			
At least one parent alive but far from both	0.796	0.769	0.824
At least one parent nearby	1.973	1.907	2.041
<b>Parenthood status composition (ref: both index person and a sibling have children)</b>			
Both without children	1.882	1.781	1.988
One without a child	1.195	1.170	1.222
<b>Partnership status composition (ref: both index person and a sibling with partners)</b>			
Both without partners	1.283	1.249	1.317
One without a partner	1.039	1.019	1.059
<b>Age composition of a dyad (ref: age difference &gt; 5 years)</b>			
Around the same age ( $\pm 5$ years)	0.964	0.948	0.979
<b>Gender composition of a dyad (ref: brother–brother)</b>			
Sister–sister	0.869	0.848	0.891
Different gender	0.757	0.739	0.770
<b>Type of sibling (ref: full)</b>			
Half	0.730	0.700	0.760
<b>Education composition (ref: both without higher education)</b>			
Both with higher education	0.517	0.502	0.533
One with higher education	0.603	0.590	0.616
No information for at least one sibling in a dyad	0.728	0.640	0.829
<b>Origin composition (ref: both live outside of the counties of birth)</b>			
Both live in counties of birth	3.901	3.810	3.993
One lives in a county of birth	0.227	0.220	0.233
<b>Urbanity composition (ref: both live in less urban areas)</b>			
Both live in more urban areas	4.713	4.594	4.834
One lives in a more urban area	0.026	0.025	0.027
<b>Size of a sibling group (ref: 2)</b>			
3	0.863	0.843	0.883
4	0.774	0.752	0.797
5 or more	0.646	0.625	0.667
Constant	0.250	0.242	0.259
Variance of random effect: sibling group level	3.360	0.040 (SE)	
ICC: sibling group level	0.505	0.003 (SE)	
Log likelihood	-340676.49		
Wald $\chi^2(20)$ , Prob > $\chi^2$	60327.70, $p < .001$		
N of observations	814,506		
N of groups	475,644		

The ICC indicated that around 51% of the variance in the likelihood of close geographic proximity between siblings in a dyad was attributable to the family level. Having more than one sibling was associated with a lower likelihood of living close to the sibling in a dyad. From a dyadic perspective, the likelihood of living close to at least one [of several] siblings is higher than living close to any specific sibling, while having several siblings increases the likelihood of having at least one sibling within 10 km of the neighborhood (Model 1).

## **4. Sensitivity analyses**

We ran a number of sensitivity analyses to confirm that our results were robust to different specifications (Online Appendix). First, we ran models with different distance thresholds, where living close by meant living within a 15 and 20 kilometer radius of a neighborhood. Comparing average marginal effects showed that the only difference concerned effects of divorce/separation and widowhood. While Model 1 revealed that divorce/separation and widowhood were associated with a higher likelihood of having at least one sibling living nearby, in both the 15 and 20 kilometer models these associations had notably wider 95% confidence intervals.

An alternative approach to exploring geographic proximity between older adults and their sibling is to treat distance as a numeric variable. We applied this approach and estimated the associations between the independent variables used in the analyses above and a logarithm of the distance to the closest sibling and the log of the dyadic distance between siblings. The characteristics associated with a higher likelihood of having at least one sibling nearby and with a short distance between siblings in a dyad are largely the same characteristics that are negatively associated with the logs of distance to the closest sibling and between siblings in a dyad.

## **5. Discussion and conclusion**

As people have fewer children, remain single, or choose not to have families, siblings might be more active players in the family networks of older people. Since living close by is an important precondition of frequent kin contact and support exchange, our approach provides a needed discussion of geographic proximity between siblings in later life. We draw on high-quality Swedish register data to go beyond exploring mere characteristics of older adults by also identifying the characteristics of their siblings – individually, in a dyadic composition, and as a group.

Almost 35% of older adults in Sweden have a sibling within 10 km. Siblings also tend to group around their older parents. Older adults without partners or children were more likely to live close to their siblings. They were also more likely to live close to those siblings who did not have a partner or a child. Importantly, all reasons for being unpartnered – having never been married/partnered, being divorced, separated, and widowed – were associated with a higher likelihood of living close to at least one sibling. Furthermore, the family-level characteristics were important: Belonging to sibling groups consisting of more than two siblings, only brothers or only sisters, and only full siblings increased the likelihood of having a sibling nearby. In line with the latter result, from the

dyadic perspective, full siblings were more likely to live close to each other than half-siblings.

The associations between intragenerational geographic closeness and socio-demographic characteristics are largely consistent with the family solidarity and internal migration literatures. The likelihood of living close to at least one sibling was higher among the lower-educated, those living in urban areas, and those residing in their county of birth. This likelihood decreased with age. In dyadic analyses, the propensity of close intragenerational distance was higher for brothers, the lower-educated, individuals living in their county of birth, and those in urban areas.

Due to limitations in the data landscape, we did not have information on health, which would be helpful to distinguish between older adults with and without care needs. Future studies might also focus on the role of siblings living nearby for older adults with core family members and those without children or partners – the group of older adults that experience the lowest level of support (Kjær and Siren 2021). Survey data with information about distances between siblings and other dimensions of solidarity between them would be well-suited for such a study.

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