REVIEW PAPER

Support provided by elderly in Italy: a hierarchical analysis of ego networks controlling for alter–overlapping

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Abstract

Providing support outside the household can be considered an actual sign of an active social life for the elderly. Adopting an ego–network perspective, we study support Italian elders provide to kin or non–kin. More specifically, using Italian survey data, we build the ego–centered networks of social contacts elders entertain and the ego–networks of support elders provide to other non–cohabitant kin or non–kin. Since ego–network data are inherently multilevel, we use Bayesian multilevel models to analyze variation in support ties, controlling for the characteristics of elders and their contacts. This modeling strategy enables dealing with sparseness and alter–alter overlap in the ego support network data and to disentangle the effects related to the ego (the elder), the dyad ego–alter, the kind of support provided, as well as social contacts and contextual variables. The results suggest that the elderly in Italy who provide support outside their household — compared to all elders in the sample — are younger, healthier, more educated, and embedded in a more diversified ego–network of social contacts. The latter also conveys both the type and the recipient of the support, with the elderly who entertain few relationships with kin being more prone to provide aid to non–kin. Further, a "peer homophily" effect in directing elder support to a non–kin is also found.

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1 Introduction

Population ageing has become a global and worldwide phenomenon. In Italy, this process is particularly strong and unquestionable, due to increasing longevity and sustained low fertility. The population pyramid is reversing and, for the first time in human history, the elderly population will be a consistent part of the total population (Golini and Rosina 2011; Istat 2018). These demographic changes, along with the reduction in households' size and the increase in marital breakdowns, may have several consequences for the social relationships and supportive behavior that involve the elderly population. In fact, higher longevity — although not always without impairments (Istat 2018) — may allow the elderly population to have a more active participation in social life, with more time to dedicate to others (House et al. 1988; Istat 2020). However, the elderly population may also find themselves living with fewer family members, due to the reduction in household sizes (Blangiardo and Rimoldi 2014), the increase in one–person families (De Rose and Strozza 2015), and, particularly for fathers, possibly reduced contacts with biological children after a marital breakdown (Albertini and Saraceno 2007; Tomassini et al. 2004). In this scenario, numerous efforts have been devoted towards ensuring active participation of the elderly in economic, political, and social life, thereby enhancing opportunities of active behavior in the area of employment, participation in civil society, and independent living. This process is widely referred to as "active ageing" (WHO 2002). To be active, particularly for older people, is considered as one of the means to prevent mental and physical decline, to sustain health and well–being and to enhance quality of life as people age (Adams et al. 2011).

In this paper, we focus on a specific domain of active ageing —namely "participation in society". In particular, we consider a specific characterization of social participation —that is, social support—which typically refers to useful functions performed for an individual by significant others (House et al. 1988; Song et al. 2011). Social support, along with the interaction with other individuals that naturally derives from it, has the potential to protect individuals who are facing difficulties (e.g. financial, emotional, instrumental, or material) and to promote positive personal and social development, thereby reducing stress (Halpern 2005; Myers 2000) and increasing the ability of coping with it.

While most of the literature has focused on support received by the elderly population (among others, see Shor et al. 2013), in this contribution, we study the social support with a shift in focus from received support to provided support and with a focus on support provided to non–kin members. Several studies have shown the beneficial effects of providing support, including in older ages (De Jong Gierveld and Dykstra 2008; Hilbrand et al. 2017; Rodrigues et al. 2014; Szabó et al. 2019; Trevisan et al. 2018). The choice to focus on support provided to non–kin is justified by the fact that it can be considered a form of a wider social engagement and a stronger sign of an active social life. Indeed, the support provided by elders to their kin can be explained by blood and affection links, occasionally driven by social obligations (Arpino et al. 2018), while the support provided to non–kin can

be an individual choice, driven by the real desire to experience interactions with other people in everyday life. Providing support to non–kin members has been recognized to have positive effects on older people's well–being since they are often characterized by reciprocity, the positive feeling of being needed, and may enhance self–esteem (Brown et al. 2003; Hunter and Linn 1981; Rodrigues et al. 2014). These interactions may enable the older person to feel a sense of competence in her/his ability, without the feeling of obligation that may come with assistance given and received within their kin relationships. Moreover, recent analyses on individual potential support ego networks in Italy provide evidence of the existence of sources of potential support that extend beyond the family circle, with friendship playing a major role in life satisfaction at all ages (Amati et al. 2017, 2018). Last, exchanges with non–kin may gain increasing importance in the future due to, as mentioned above, the increase in the number of one–person families (De Rose and Strozza 2015), the reduction in family size (Blangiardo and Rimoldi 2014) and the reduced interactions with children in older age (Albertini and Saraceno 2007; Tomassini et al. 2004). The support provided outside the family is not sufficiently explored, particularly in the context of familistic societies, which include the Southern European countries that are characterized by strong family ties (Dalla Zuanna 2001).

In this contribution, we analyze support provided through an "ego–centered network" perspective, as commonly used in the social support literature. In this perspective, if ego (the elder) provides support to certain alters, there exists a "supportive" tie between them. We use the ego–centered perspective to highlight which features of ego affect the supportive ties with kin (siblings, children, grandchildren, other relatives) or non–kin recipients (neighbors, friends). We construct ego–centered networks using data from the Family and Social Subjects (FSS) survey conducted in 2009 by the Italian National Statistical Institute. As ego–network data are inherently multilevel—with the lower–level units of alters or ego–alter tie clustered within the higher–level units of ego or ego–networks—we use a multilevel (or hierarchical) model to estimate the probability of observing support tie provided to kin or non–kin. Hierarchical models have been applied to a wide variety of studies to analyze ego–alter tie outcomes (Snijders et al. 1995; Vacca 2018). The dataset we analyzed is sparse (mainly due to the presence of few ties) and—in this case—a Bayesian approach is by far the most appropriate. Further, hierarchical models for ego–networks assume no alter–alter overlap (i.e., ego–networks have no alters in common, Snijders et al. 1995; Vacca 2018). Since this assumption is not tenable in our dataset, we propose a model specification to accomplish the issue.

The remainder of the article is organized as follows: in Sect. 2, we briefly review the main literature on the effects and correlates of providing support, seen as a social activity. In Sect. 3, we present data and descriptive findings on elders and their ego–networks of contacts and provided support. In Sect. 4, we describe the modeling strategy we adopted to analyze the provided support ego–networks of elderly to account for the alter–alter overlapping and the sparseness in our dataset. In Sect. 5, we end the paper with a few concluding remarks.

2 Providing support: beneficial effects and individual correlates

In this section, we first review the beneficial effects of social interaction with a focus on providing support to non–kin; second we discuss the correlates of providing support.

The active participation of older adults into society recalls both an individual and a social dimension. The former, which refers to the individual's choice of playing an active role, draws upon the physical, psychological, and relational resources available to the individual. Through this choice, the elderly also experience a social dimension (Lemon et al. 1972; Litwin and Shiovitz–Ezra 2006; Rossi et al. 2014): they interact with other people or participate in social activities, either informal (such as children's care, contacts, talks with friends, relatives, and neighbors) or formal (such as engagement in courses, attendance at senior centers and churches, and volunteering).

The beneficial effects of social interaction on the well–being of the elderly has been largely documented in the literature (see Adams et al. 2011 for a review). For example, talking with others was found to be associated with lower depression levels (Steptoe et al. 2013) and the frequency of visits to friends has been found to be positively related to psychological well–being (Ritchey et al. 2001). Both for younger and older adults, social contacts with friends, neighbors, and others are a "crucial ingredient" for enhancing their personal integration into society (De Jong and Perlman 2006). Moreover, the perception of social activities as insufficient and reporting loss of abilities in engaging in social interactions were found to be associated with higher levels of depression (Hong et al. 2009; Katz and Yelin 2001). Being socially well integrated—especially for older adults— appear to make individuals less prone to disease and less likely to require health and care services (Berkman et al. 2000). O'Campo et al. (2015) measuring the beneficial effects of social cohesion in the neighborhood network found that those who live in a neighborhood where people are willing to help, reported better health outcomes. These studies suggest the importance of considering social relationships beyond the family.

Providing support can be considered a specific type of social interaction. Research on the involvement of the elderly population as support providers has focused on the manner in which they may serve other family members, friends and neighbors, or, more generally, their community. These activities may include providing emotional support or providing help with housekeeping, care for other family members, grandparenting for family or beyond the family, or financial aid (De Jong Gierveld and Dykstra 2008; Rodrigues et al. 2014; Szabó et al. 2019). Serving the community, may include volunteering, youth tutoring and mentoring, literacy enhancement, refugee assistance, after–school programs, and respite care for older adults (Sugar 2019).

Given the importance of considering the elderly population as playing a more "active" part in society, a growing body of literature has focused on the beneficial effects of providing support. In particular, evidence suggests that grandparenting beyond the family, also known as non–kin grandparenting, is associated with less

cognitive impairment and decline, lowered risk for depression (Trevisan et al. 2018), reduced mortality (Hilbrand et al. 2017), and reduced social loneliness (Szabó et al. 2019), thereby suggesting that non–kin grandparenting has psychosocial benefits for older adults. Moreover, older adults who volunteer report higher levels of well–being, with no significant differences among the type of organization, nor differential benefits according to the personal characteristics of the volunteer (Morrow–Howell et al. 2003). Mortality has also been shown to be significantly reduced for older individuals who provide instrumental support to friends and neighbors as well as to relatives (Brown et al. 2003). In a comparative study among European countries, while finding an overall positive effect of providing childcare, Arpino et al. (2018) argued that in countries where it is socially expected for grandparents to have a role as providers of childcare, not taking on such a role may negatively influence subjective well–being. These findings reinforce the importance of studying non–kin support, which may be driven by the real desire to experience interactions with other people. Findings based on data from the Generations and Gender Surveys in different European countries indicate that older adults that are primarily on the receiving side are more lonely, while older adults who were primarily on the giving side were generally less lonely (De Jong et al. 2012). Although the aim of our contribution is not to juxtapose receiving and providing support, these findings reinforce the argument that providing support externally to non–kin, instead of receiving it, can be considered a sign of an active lifestyle and participation in social life.

Although studied less often, the correlates of providing social support have also been highlighted in the literature. The presence of multimorbidity does not appear to alter the engagement in specific activities. In particular, a recent study focusing on care provision to non–cohabiting grandchildren and older non–cohabiting relatives, found that the presence of multimorbidity does not significantly alter the engagement in caregiving activities though it reduces the social participation, as measured by participation in volunteering, educational, and leisure activities (Schmidt et al. 2016). Age and education appear to play a role, with well–educated young–elderly generally more involved both in caregiving (Schmidt et al. 2016; Zamberletti et al. 2018) and volunteering (Principi et al. 2016, 2012). Moreover, participating in formal activities, such as educational courses and religious groups, was found to be positively associated both with volunteering and providing care (Principi et al. 2016; Schmidt et al. 2016). The effect of gender and marital status remains under debate. The relationship between providing support and gender differs according to the type of support, with care to older relatives outside the household being less gender–dependent than care provision to grandchildren, which is typically found to be an activity that is generally limited to grandmothers (Schmidt et al. 2016). Moreover, the traditional gender roles tend to be weakened in the presence of health problems, as highlighted by a lack of gender differences in care provision among people with severe health problems or multimorbidity (Schmidt et al. 2016; Principi et al. 2016). Moreover, its association with volunteering is not univocal (Principi et al. 2012). Being married, compared to being widowed or divorced, increases the probability of providing care for grandchildren, with a stronger effect for those without multimorbidity (Schmidt

et al. 2016). However, Principi et al. (2016) found a positive association of being widowed (rather than married) with volunteering in older people with particularly poor health, thereby indicating that variables associated with volunteer participation partially differ between older people depending on their health status. With regard to childcare, it is possible to identify different correlates based on the types of childcare (e.g. intensive or occasional or during school holidays, Zamberletti et al. 2018). Unmarried males tend to be less likely to provide intensive childcare. However, when examining the probability of providing childcare occasionally or during holidays, Zamberletti et al. (2018) found that the individual characteristics of grandparents are less significant compared to intensive childcare, thereby implying that grandparents provide non–intensive care regardless of their individual characteristics —this is particularly true for grandmothers. In addition to these findings, specific results on the case of Italy reveal that the level of social participation and active engagement of the elderly is characterized by a large and stable geographical gap, with higher participation in Northern regions (Istat 2018, 2020).

3 Data on ego–centered networks of elderly in Italy

3.1 The Family and Social Subject (FSS) survey and network information

In this study, we exploit data drawn from the "Family and Social Subjects" (FSS) survey carried out by the Italian National Statistical Institute in 2009. Since 1998, the FSS is part of the Multipurpose Survey Program on Italian households and represents the primary statistical source collecting information on socio–demographic characteristics of Italian households and their dynamics over time.

Although the FSS survey adopts only for a few items conventional formats to collect relational data (such as the name generator approach or the role generator approach[1], it provides information that can be used in a network perspective (Amati et al. 2015, 2017; Dykstra et al. 2016). More specifically, as reported below, mining the FSS data allows us to derive two different types of ego–centered networks for each respondent: the ego–centered network of contacts and the ego–centered network of provided support.

An ego–centered (or egocentric, or personal) network (Marsden 1990; Wellman 2007) is defined by "looking at relationships from the orientation of a particular person" (Breiger 2004, p. 509). This focal person is usually referred with the term "ego", while the persons or institutions to which the ego is related by certain relationships of interest are referred to as "alters". The ego–centered network design can be easily embedded as part of a large population survey — usually based on a probability sample as in the FSS — thus providing representative information of the social environments surrounding people (Crossley et al. 2015; Marsden 2011; McCarty et al. 2019; Perry et al. 2018).

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[1] According to the name generator approach, respondents are asked to list a certain number of alters (persons embedded in their network). Conversely, the role generator approach allows respondents to list their own alters in terms of role relationship (see, among others, Marsden 1990; Wellman 2007).

In order to construct the *ego–centered network of contacts* (hereafter, ego–network of contacts) in which Italian elders are embedded, we adopt the methodological approach proposed by (Amati et al. 2015, pp. 812–813). In particular, we combined the FSS data — collected for each respondent — on the presence, the frequency of contacts[2] and the residential proximity with non–cohabitant kin[3], and on the presence of non–kin (asked only as number of neighbors and number of not–cohabitant friends) that the respondent "can count on if necessary".

The ego–network of contacts can be regarded as the privileged group of alters with whom the respondent can potentially entertain or exchange relationships, although—due to the FSS format —the content of the relationships is not specified for all alter types (Amati et al. 2015, p. 813). Further, the FSS questions on parents are limited to respondents aged up to 69 years. Since our research interest is the Italian elderly (i.e. individuals aged 65 years and over) and only 0.01% of respondents had living parents at the time of the interview, we do not consider parents in the ego–centered network construction. Analogously, we exclude grandparents because of the age of the target respondents. Thus, the resulting ego–network of contacts for each elder (ego) involved in the FSS survey is composed of a maximum of six different alter's categories (alter roles): children, siblings, grandchildren, relatives, neighbors, and friends (see Fig. 1). With the aim to better characterizing network results on the basis of the kin (non–kin) role of the alters in the ego–network, we also aggregate the six identified alter's categories into groups: *Kin* composed of alters (at least one) in the ego family (children) and/or in the extended family (siblings, grandchildren and relatives); *Non–kin* composed of (at least one) neighbors and/or friends. The *Comprehensive* network typology is composed of at least one alter in each group (family, extended family, and non–kin, as shown in Fig. 1).

The second type of ego–centered network, the *ego–centered network of provided support* (hereafter, support network), is obtained from questions regarding support provided by respondents — in the four weeks prior to the interview—to kin or non–kin living outside the house. More specifically, respondents indicate the type of support provided (if any) from a list of 11 different modalities, covering a wide range of possibilities[4]. An additional role relationship question allows respondents to mention up to eighteen recipients (alters) of the "unique or main" aid provided. In particular, the first fifteen categories are specific to kinship roles (i.e. father, mother, brother, sister, son, daughter, etc.) while the last three are devoted, respectively, to friends, neighbors and other (not specified) persons. This

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[2] A time period is provided in the answer categories: 1. Everyday; 2. A few times a week; 3. Once a week; 4. A few times a month (less than 4); 5. A few times a year; 6. Never.

[3] Non–cohabitant kin in the FSS are asked only by role: siblings, children, grandchildren (up to a maximum of three), parents and grandparents, as well as other relatives (if any) respondent "is close to" or "to whom can count on".

[4] Typologies of support are classified into: (1) economic aid; (2) medical care; (3) adult care; (4) childcare; (5) housekeeping; (6) companionship; (7) administrative procedures; (8) help doing work outside home; (9) help doing homework; (10) free consumption goods (i.e., meals and clothes); (11) other.
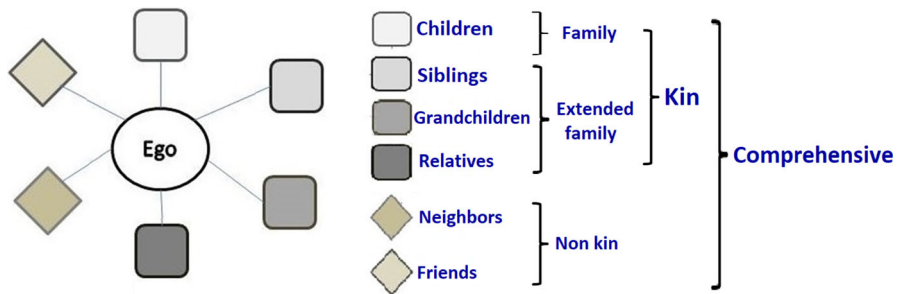
Fig. 1 Ego–centered network of contacts by the role of the alters

classification enables us to distinguish whether the support is provided within or outside the kin circle.

Because of such a specific format adopted in the FSS to collect data on the support provided by respondent[5], the support network is defined only for respondents who declare to have provided at least one supportive tie to non–cohabiting alters in the four weeks prior to the interview and it represents the "set of not–cohabiting people (along with their role relationship with ego) who have received support from the respondent".

3.2 Italian elders and their networks: descriptive findings

The 2009 FSS edition involved 43850 individuals grouped in approximately 24000 household units. We focus on Italian individuals aged 65 years and over ($n = 9202$, representing the 21% of the total sample size). Main socio–demographic and network characteristics of elderly are shown in Table 1 (second column): 57% are females and 43% are males; 61% live in couple (married or unmarried), most of them without cohabiting children; 28% live as single (without other members), 11% share other living arrangements including also single–parents. Nearly three out of four are aged 79 years or less. With respect to the area of residence, 43% of elders live in the North of Italy, 38% in the South or Islands, and the remaining 19% in the Center. Looking at the perceived health, 34% declare to have good health conditions, while 43% perceives their own health status as fair. Confirming their good health conditions, the percentage of older who declare to have used external aid services — not shown in the Table 1 — is lower than 15%.

With regard to the ego–network of contacts, the most widespread network typology in which the elderly are embedded is the kin network, with alters only

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[5] Information on support received in the four weeks prior to the interview (multiple responses on the same list of provided support) are collected as well, but in the "household" section of the questionnaire, indicating if the support receiver is: (1) the single component for respondents living alone, (2) the whole family or (3) up to three specific household members. The answers to these items were provided by the head of the household—usually identified as the female partner of the main nuclear family in the household —who provided information regarding the household as a whole. No questions are devoted to collecting information on support providers, thereby undermining the construction of an ego–network of received support.

Table 1 Socio–demographic and network of contacts characteristics of elderly respondents and elderly support providers (average network size in parentheses), Istat, FSS 2009

	Elders (%)	Support Providers (%)
Gender		
Male	43	45
Female	57	55
Age		
≤ 79	73	87
80–84	15	9
85+	12	4
Children		
Yes	87	90
No	13	10
Area of residence		
North	43	51
Center	19	19
South/Islands	38	30
Type of municipality		
Metropolitan	17	18
Other	83	82
Living arrangement		
Singles	28	24
Couples	61	67
Other	11	9
Education		
High	4	7
Medium	11	18
Low	85	75
Health		
Good	34	47
Fair	43	40
Bad	23	13
Network of contacts		
Comprehensive	31 (9.7)	44 (10.8)
Kin	42 (5.1)	35 (5.4)
Other	27 (3.8)	21 (5.4)

from their family and/or extended family (42%), followed by the comprehensive one (31% of elders) composed of alters inside their family, extended family, and non–kin. For the elderly, the residual category labelled "other" in Table 1, includes the 9% of elderly respondents declaring no contacts, the 6% having only friends and/or neighbors (non–kin) in their personal network, as well as other mixed networks with alters from family and friends and/or neighbors (6%) or from extended–family and friends and/or neighbors (6%).

Additional tables in the Appendix A (Tables 6, 7 and 8) provide further details on size and compositional characteristics of ego–networks of contacts, both for elderly and elderly who provide support.

With respect to support provided, 26% of elders (of which 55% are females and 45% are males) declare to have provided support to non–cohabiting people within or outside their family circle[6]. The socio–demographic and network characteristics of those providing support are reported in the third column of Table 1.

If compared with the total number of elder respondents in the FSS, Italian elders providing support outside their own household, on average, are younger, residing in the North of Italy, living in couples, healthier[7], more educated and more embedded in a comprehensive network[8]. Slight differences can be noted according to the gender and the presence of children.

Focusing on the 26% of elders who provided support ($n = 2386$), the most important aids they provided (Table 2) are childcare (37%), economic help (14%), and companionship (13%). Other types of aid—aggregated in the "Material/Other" category in Table 2 (i.e, administrative procedure, adult care, housekeeping, etc., as listed in the footnote 4) – have been provided, respectively, by no more than 6% of elders[9]. The elderly support providers activated a total of 3140 support ties—that is, 3140 non–cohabiting alters have received at least one aid, with an average of 1.3 support ties given by each elder ego (with a 1–7 range). Moreover, 70% of these support ties (Table 2) are directed to kin alters and the 30% are in favor of non–kin alters (neighbors and/or friends and/or other "not specified" persons). In the strong Italian familistic sentiment, where informal transfers— mainly intergenerational— within the family members still remain one of the most important sources of dealing with the lacks of the national welfare system, the latter percentage is not negligible and it reveals a general positive disposition of elders to be active and supporting people beyond their kin circle as well (Dalla Zuanna and Micheli 2006).

Examining the socio–demographic and network of contact characteristics of elders providing support ties to kin as opposed to non–kin, some differences can be noted (Table 3). In particular, higher values than the above average of 30% of support ties directed to non–kin are found among elders aged 80–84 and 85+ years, and among elders who are highly educated. Living not in couples or to be without children are both conditions favoring ties to non–kin, as is not being embedded in a comprehensive or kin network of contacts. Conversely, gender, area of residence,

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[6] Only 4% of elderly respondents declare to have both received and provided support, while 16.6% of them (35% of which are males and 65% are females) declare to have received support from non–cohabiting people in the previous four weeks before the interview. The most important support (multiple responses) that the elderly have received is help in domestic activities (23.8%), health services (20%), home care (18.9%) and companionship (15.5%), while less frequent are paperwork and economic aid (11.8% and 4.7%, respectively).

[7] No differences are noted according to the use of external aid services.

[8] For the support providers, the "other" category in Table 1, includes the 3% of elder respondents declaring no contacts, the 5% having only friends and/or neighbors (non–kin) in their personal network, as well as other mixed networks with alters from family and friends and/or neighbors (6%) or from extended–family and friends and/or neighbors (7%).

[9] In the FSS, a specific question is also devoted to volunteer activities. Only, 8.6% of elders who are support providers declare that help has been provided within a volunteer group.

Table 2 Distribution of alters to whom support is provided and the type of support

		%			%
Type of support	Childcare	37	*Alters*		
	Economic	14		Kin	70
	Companionship	13		Non-kin	30
	Material/Other	36			

type of municipality and health conditions of the elders do not appear as characteristics differentiating the above average tendency. Further, the type of support provided plays a role as well (see Table 4). With respect to the total companionship ties provided, 55% are devoted to non–kin. For economic and material/other ties, 34% and 41% are respectively provided to non–kin. As expected, childcare ties are mainly provided to kin members, with only 9% to non–kin.

For the group of elders who provide support to non–cohabiting alters, these results reveal that the positive disposition to answer a request for (or to offer) support can depend on the type of support requested but it can also be affected by both the provider (the elder ego) and the recipient (the alter) features as well as by the manner in which these features bind with each other.

4 Modeling elder's support network

4.1 Hierarchical structure of ego–network data and network overlap

Ego–network data — comprising information on egoes, alters, and ego–alters ties — can be regarded as a multilevel (hierarchical) structure in which alters or ego–alter ties (the first level or "level 1") are clustered within egos (the second level or "level 2"). Such data structures can be properly analyzed by multilevel models, a popular class of statistical models (see, among others, Gelman and Hill 2006; Goldstein 2011; Snijders and Bosker 2012).

An increasing body of empirical studies on ego–centered networks, particularly on social support networks, has adopted this hierarchical framework to model variations in characteristics of ego–alters ties (Bilecen and Cardona 2018; Bojarczuk and Mühlau 2018; Lubbers et al. 2010; Lumino et al. 2017; De Miguel and Tranmer 2010; Perry and Pescosolido 2015; Snijders et al. 1995; Vacca 2018; Van Duijn et al. 1999). Further, egos themselves can be clustered in higher hierarchical level, such as families, working places, or other organizations. In the model specification, the dependent variable of interest can be a characteristic of ties or alters (Vacca 2018; Van Duijn et al. 1999).

The standard hierarchical structure for ego–network data relies on the assumption that there is no overlap among personal networks of different egos (Vacca et al. 2019) or at least that the overlap is negligible (Lumino et al. 2017; De Miguel and Tranmer 2010; Snijders et al. 1995). Two kinds of overlap can be distinguished: *(i)* ego–alter overlap — that is, the same individual is ego for his/her own personal

Table 3 Support ties to kin and non–kin by ego (elder) characteristics

Non-kin (%)		Kin (%)
Gender		
Male	71	29
Female	70	30
Age		
≤ 79	72	28
80–84	55	45
85+	55	45
Children		
Yes	73	27
No	40	60
Area of residence		
North	70	30
Center	62	28
South/Islands	69	31
Type of municipality		
Metropolitan	72	28
Other	70	30
Education		
High	57	43
Medium	68	32
Low	72	28
Living arrangement		
Singles	60	40
Couples	75	25
Other	60	40
Health		
Good	70	30
Fair	70	30
Bad	70	30
Network		
Comprehensive	74	26
Kin	83	17
Other	51	49

network, but he/she is also present as an alter in other networks; *(ii)* alter–alter overlap — that is, alters embedded in a personal network may appear as alters in other networks (receiving ties from different egos). When the ego–centered network allows for overlap, its structure is no longer hierarchical.

Table 4 Support ties to kin and non–kin by type of support provided

Support	Kin (%)	Non-kin (%)
Childcare	91	9
Economic	66	34
Companionship	45	55
Material/Other	59	41

Due to the sampling scheme of the FSS survey[10] and since questions on support provided by respondents refer to non–cohabiting people, we excluded ego–alter overlap in our data on support networks. On the contrary, the assumption of the absence of alter–alter overlap is not satisfied. In the FSS, all household members are interviewed and, in general, a few non–cohabiting individuals (i.e., parents and parents–in–law, siblings and siblings–in–law, children and children–in–law, grand-children, etc.) can be jointly indicated by more household members as alters receiving support. Therefore, it is likely that elders who live with other elders (e.g., couples with both partners aged 65 years and more, parents with cohabiting children aged 65 years and more, cohabiting siblings, and so on) provide support to the same alters, as shown in Fig 2.

Unfortunately, the FSS information is not sufficient to check the entire magnitude of overlapping, as we are not able to precisely match alters in each network of cohabiting egos since the identity (first and last name) of the recipient is not questioned. Nevertheless, using data on the number and the role of the contacts the elders declared to entertain with non–cohabiting people, it is possible to approximately estimate the incidence of overlapping alters in the dataset of support networks. In particular, for such categories for which we know the role by gender (parents, parents–in–law, siblings, children and children–in–law), we are able to accurately identify alter–alter overlapping of parents and parents–in–law (by distinguishing the male and female parent/parent–in–law), of siblings (for ego with only one brother and /or one sister), children and children–in–law (for elders with only one child or two children of different gender). For the remaining categories of alters (grandchildren, relatives, friends, neighbors, and other), we can only check for the overlap between grandchildren and nephew/niece (when egos declared that they are the only one), while for other categories we do not have any data to match alters.

Finally, the estimated alter–alter overlapping ranges from approximately 8% to approximately 30%. The lower bound corresponds to the hypothesis that the alter–alter overlapping is limited only to the alters/ties we are able to check; the upper bound corresponds to the extreme case of alter–alter overlapping for all the other cases we were unable to check.

Vacca et al. (2019) propose cross–classified multilevel models (Goldstein 2011) to analyze the ego–centered networks with alter–alter overlap. Their proposal is
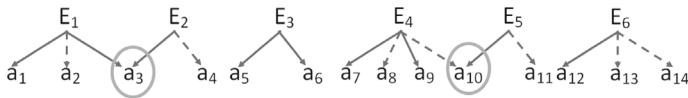

Fig. 2 Alter–alter overlap in the support network (solid line: tie to a kin alter; dotted line: tie to a non–kin alter)
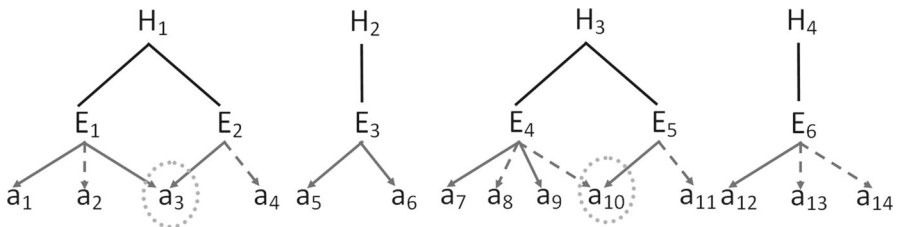

Fig. 3 Three–level structure to account for possible overlapping (solid line: tie to a kin alter; dotted line: tie to a non–kin alter)

based on the precise detection of overlapping alters using information on identity (first and last name) and other known attributes of the alters.

In our support network, the incidence of overlap is not negligible, but the imprecise detection of all the overlapping alters prevents the use of the cross–classified specification. Moreover, unlike other studies, there are 2386 egoes and only 3140 alters/ties in our application. The small number of cases (alters/ties) per level–2 units (egoes) characterizes the ego–network structure as rather sparse (i.e. not having enough data in the elderly support networks to accurately model the relationships between ego and alters).

4.2 Modeling strategy

With the aim of identifying the main factors related to a support tie directed to non–kin as opposed to kin members by elders who provided support, our dependent variable is the alter role in the support network, coded as $y = 1$ if the alter receiving the support belongs to the non–kinship circle of ego, and otherwise $y = 0$. The choice of the dependent variable is inspired by the analysis of De Miguel and Tranmer (2010) on the support ties immigrants to Spain exchanged with "Spaniards" than "non–Spaniards" (other immigrants).

We adopt a Bayesian approach (Gelman and Hill 2006) for the hierarchical model specification, since Bayesian analysis enables greater flexibility in the estimation of multilevel models as well as when data are characterized by a considerable sparseness. Further, it offers some advantages in terms of computational ease, as models can easily be estimated using the package "rstanarm" of the language Stan available in R (Stan Development Team 2017). Since alter–alter overlapping in the FSS is induced by household sampling, the "household" level is

explicitly modeled (as shown in Figure 3) to consider, although partially, possible variation due to alter–alter overlapping in the household.

We then specify a three–level logistic regression model for the presence of a support tie provided by the elder (ego) to a non–kin as opposed to a kin, where level 3 is represented by household (denoted by k subscript), level 2 is represented by ego (denoted by j subscript), and level 1 (denoted by i subscript) by the alter tie. The comparison in terms of looic[11] of the single (non hierarchical) alter–level null model, the two–level (standard hierarchical model for ego–network data) null model, and the three–level null model to account for household clustering reveals a remarkable improvement in the the fit of the three–level model (looic = 3229) with respect to the other two specifications (with looic values, respectively, 3831.3 and 3676.4[12]). Considering covariates at the ego and alter levels, the hierarchical model can be written as follows:

$$logit(\pi_{ij(k)}) = \beta_{j(k)} + \mathbf{x}'_{ij(k)}\beta, \tag{1}$$

where $\pi_{ij(k)}$ is the probability that the observed support tie between alter i and ego j within household k is directed to a non–kin alter; $\beta_{j(k)}$ is the intercept varying by level–two unit j, and level–three unit k and $\mathbf{x}'_{ij(k)}\beta$ are model fixed effects, which may be characteristics of the ego, alters, and the dyad ego–alter (Vacca et al. 2019), respectively. In particular, gender, age, area of residence, type of municipality, presence of children, education of the elderly as well as their health condition — classified as "Good" and "Other" (comprising the previous "Fair" and "Bad" categories in Table 3) — are considered as the characteristics of the ego. Socio–demographic characteristics of ego are usually considered important correlates in the literature on providing support (as cited in Sect. 2), particularly when dealing with the elderly population.

As well–known, in studying social support, either provided or received, the social network in which the individual is embedded plays an important role (Dykstra et al. 2016). Therefore, we include the ego–network of contacts as an additional ego's attribute to test the hypothesis that the type of personal network (comprehensive, kin, other) in which Italian "supportive" elders (egos) are embedded may affect the probability to observe a support tie to a non–kin as opposed to a kin alter. The type of support provided by egos, classified according the four categories — "Child-care", "Economic help", "Companionship", "Material and other types of help" — is included in the model as well.

Unfortunately, the FSS questionnaire collects very limited information on the characteristics of alters. The gender of alters cannot be considered since it can be

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[11] We use the leave–one–out information criterion (looic) to compare different specifications of the logistic regression model for the probability of a support tie provided by an elder to a non–kin versus a kin alter. Looic uses the log–likelihood evaluated at the posterior simulations of the parameter values (Gelman et al. 2014; Vehtari et al. 2017); note that the lower the value of looic, the higher the fit of the model.

[12] We also considered a fourth level (represented by the Italian Regions) in the multilevel structure to take into account possible variation due to geographical context. Since the looic improvement in the four–level model is rather negligible (looic = 3223 vs looic = 3229), we include geographical context as a fixed factor (through both area of residence and type of municipality) in the three–level model.

inferred as using information on alter roles only for the subset of alters (11 out of 18 alter categories) in the family of the elderly or in the family–in–law. Similarly, a few details are available to classify most of the alter categories as elder peers or not. It is well known that, in general, homophily between ego and alter characteristics is an important explanatory factor for the configuration of ego–networks (Louch 2000; Marsden 1988; McPherson et al. 2001). Thus, to take into account this aspect that characterizes ego–alter dyads, we construct the variable "peer homophily" comparing the birth generation of both ego and alter, where available. To gain insight into the determinants of providing support, we test the hypothesis of a "peer" effect in driving the elderly who provide support to direct the aid to a non–kin. It is assumed that intergenerational transfers occur more often within family members, particularly in familistic and traditional countries, whereas friends are likely to belong to the same generation of ego.

Lastly, since the alter–alter overlapping cannot be precisely detected in our data to accomplish a cross–classified model, in order to account for the overlapping status of alters (that is correctly verified in 8% of the cases and only hypothesised for the others), we introduced at the alter level, as an alter characteristic, a dummy variable $x_{ij(k)-over}$, coded as $x_{ij(k)-over} = 1$ if alter i in the support network of ego j in the household k, is the same (overlapped) alter i' in the support network of ego j', in the same household k, otherwise $x_{ij(k)-over} = 0$. This solution, which allows to check the robustness of the results obtained without the consideration of overlapping, can also help avoid computational problems in model estimation due to data sparseness.

In the analysis, our analytical model specifications are:

- Model 1: Ego characteristics (attributes)
- Model 2: Add peer homophily term between ego–alter to Model 1
- Model 3: Add type of support provided to Model 2
- Model 4a: Add the dummy variable for overlapping status of alters to Model 3 (minimun 8% of overlap)
- Model 4b: Add the dummy variable for overlapping status of alters to Model 3 (maximum 30% of overlap)

4.3 Model results

Parameter estimates and odds ratios (OR) for the estimated models are reported in Table 5. Not having sufficient information to make any hypothesis regarding the prior distributions to be utilized in the estimation process (Gelman and Hill 2006), in our analysis, we use standard weakly informative priors. In particular, the choice of normally distributed priors corresponds to the random mixed model with normality assumption for parameters in the classical (frequentist) approach (Goldstein 2011). Further, we performed a sensitivity analysis, fitting models with different priors from the Student, Hierarchical shrinkage, Laplace, and Product Normal families. The results reveal no differences in terms of parameter estimation as well as in terms of looic values. This can be interpreted as evidence of the robustness of our procedure with respect to the choice of prior distributions and that data are sufficient to overcome the lack of information regarding priors. Moreover,

Table 5 Parameter estimates for the probability of observing a tie to a non–kin (posterior quantiles at 2.5% and 97.5% in parentheses)

	Model 1		Model 2		Model 3		Model 4a		Model 4b	
	(looic: 3018.4)		(looic: 3005.4)		(looic: 2767.6)		(looic: 2719.4)		(looic: 2763.7)	
	Estimate	OR	Estimate	OR	Estimate	OR	Estimate	OR	Estimate	OR
(Intercept)	−1.53 (−2.4;−0.7)	0.22	−0.14 (−1;0.7)	–	−2.68 (−3.7;−1.7)	0.07	−2.45 (−3.4;−1.6)	0.09	−2.59 (−3.6;−1.6)	0.08
Gender (Ref:Male)										
Female	0.05 (−0.3;0.4)	–	0.05 (−0.2;0.3)	–	0.09 (−0.2;0.4)	–	0.09 (−0.2;0.4)	–	0.07 (−0.2;0.4)	–
Age (Ref: ≤79)										
80–84	1.13 (0.5;1.7)	3.09	1.12 (0.6;1.7)	3.05	0.77 (0.2;1.4)	2.16	0.67 (0.1;1.2)	1.95	0.77 (0.2;1.3)	2.16
85+	1.43 (0.5;2.4)	4.19	1.44 (0.6;2.3)	4.17	1 (0.2;1.9)	2.71	0.82 (0.1;1.7)	2.27	0.95 (0.1;1.8)	2.58
Children (Ref:Yes)										
No	2.03 (1.4;2.9)	7.5	1.57 (1;2.2)	4.18	1.22 (0.6;1.8)	3.39	1.04 (0.5;1.6)	2.83	1.19 (0.6;1.8)	3.29
Health (Ref:Good)										
Other	−0.08 (−0.5;0.3)	–	−0.07 (−0.4;0.3)	–	−0.14 (−0.5;0.2)	–	−0.17 (−0.5;0.2)	–	−0.13 (−0.5;0.2)	–
Area of residence (Ref:North)										
Center	0.03 (−0.5;0.5)	–	0.05 (−0.4;0.5)	–	0.09 (−0.4;0.6)	–	0.13 (−0.4;0.6)	–	0.09 (−0.4;0.6)	–
South/Islands	−0.08 (−0.5;0.4)	–	−0.07 (−0.5;0.3)	–	−0.31 (−0.8;0.1)	–	−0.30 (−0.7;0.1)	–	−0.31 (−0.8;0.1)	–
Type of municipality (Ref:Metropol.)										
Other	0.16 (−0.4;0.7)	–	0.17 (−0.3;0.6)	–	0.21 (−0.3;0.7)	–	0.21 (−0.3;0.7)	–	0.20 (−0.3;0.7)	–
Network of contacts (Ref:Compreh.)										
Kin	−0.54 (−1.0;−0.1)	0.59	−0.44 (−0.8;−0.1)	0.64	−0.47 (−0.9;−0.1)	0.62	−0.42 (−0.8;−0.1)	0.66	−0.48 (−0.9;−0.1)	0.62
Other	1.66 (1.2;2.2)	5.25	1.49 (1.0;2.0)	4.44	1.02 (0.6;1.5)	2.77	0.95 (0.5;1.4)	2.59	0.99 (0.5;1.5)	2.69
Education (Ref:High)										
Medium	−0.59 (−1.4;0.2)	–	−0.53 (−1.2;0.2)	–	−0.60 (−1.3;0.1)	–	−0.52 (−1.2;0.2)	–	−0.59 (−1.3;0.2)	–

Table 5 continued

	Model 1		Model 2		Model 3		Model 4a		Model 4b	
	(looic: 3018.4)		(looic: 3005.4)		(looic: 2767.6)		(looic: 2719.4)		(looic: 2763.7)	
	Estimate	OR	Estimate	OR	Estimate	OR	Estimate	OR	Estimate	OR
Low	−0.89 (−1.6;−0.2)	0.41	−0.85 (−1.5;−0.2)	0.43	−1.01 (−1.7;−0.3)	0.36	−0.95 (−1.6;−0.3)	0.39	−1.01 (−1.7;−0.3)	0.36
Peer Homophily (Ref:Yes)										
Not			−1.63 (−2.0;−1.3)	0.2	−0.99 (−1.4;−0.6)	0.37	−0.85 (−1.2;−0.5)	0.43	−0.98 (−1.4;−0.6)	0.38
Type of support (Ref:Childcare)										
Companionship					4.12 (3.4;4.9)	61.56	3.88 (3.2;4.6)	48.42	4.09 (3.3;4.9)	59.74
Material/Other					3.25 (2.6;3.9)	25.79	3.05 (2.5;3.6)	21.11	3.21 (2.6;3.9)	24.78
Economic					2.85 (2.2;3.6)	17.29	2.65 (2.0;3.3)	14.15	2.84 (2.2;3.6)	17.11
Overlapping (Ref:No)										
Minimum							−6.25 (−8.9;−4.2)	0.002		
Maximum									−0.35 (−0.8;0.1)	–

as is usual in Bayesian analysis, we monitored the Markov Chain convergence using the Gelman–Rubin statistic $\hat{R}$ (Gelman and Hill 2006): since the value of this statistic is below the recommended value of 1.1, we can conclude that chain convergence has been attained for all the estimated models, as is the confirmation of the suitability of the Bayesian approach also in the case of considerable sparseness of the hierarchical structure.

Model 1, which considers only ego characteristics (socio–demographic and network of contacts), provides a remarkable improvement in the fit with respect to the three–level null model (looic = 3018.4, compared with the previous value of 3229). Bearing in mind that the elders providing support are, on average, younger, healthier, more educated, more embedded in a comprehensive ego–network of contacts, etc. (as reported above in Table 1) than the total elderly population, parameter estimates show evidence that, for this selected group of elders, demographic and relational characteristics of ego affect the probability to direct support ties outside the "kin circle". As expected, elders without children are more likely to provide support to non–kin when compared with elders with at least one child, as indicated by the high value of the corresponding odds ratio (OR = 7.5). The increase in probability with the age of the ego is less expected (with respect to the age group reference category, about three times and four times for the age group 80–84 and the age group 85+, respectively, as shown by the OR values of 3.09 and 4.19). This positive effect is likely due to the presence of neighborhood relationships, which can ease support ties toward non–kin as opposed to kin, who do not necessarily live close to the elder egos.

With respect to egos in a comprehensive ego–network of contacts, "supportive" egos embedded in a kin network typology have a lower probability of providing support to a non–kin member (OR = 0.59), while this is more likely (more than five times more probable, given OR = 5.25) for ego embedded in the ego–network of contacts typology labelled as "other", which is a mix of kin and non–kin alters or not alters at all. Elders with a low level of education have a lower probability to provide support to non–kin (OR = 0.41). On the other hand, the perceived health condition as well as the gender, the area of residence, and type of municipality do not have an impact on the probability of observing a support tie outside the kin, as already found in the descriptive findings of Table 3.

According to the looic measure, adding the peer homophily term (Model 2) results in a good improvement in the model fit (looic = 3005.4). The associate parameter estimate indicates that peer homophily affects the probability, when support is provided, to direct the tie outside the kin sphere. More specifically, when alters belong to a different generation (not peer homophily) it is more likely that the aid is devoted to a kin member (OR = 0.2), thereby confirming that several intergenerational exchanges occur mainly within the family circle. It is worthy to note that parameter estimates of the previous covariates do not change in Model 2, except a reduced impact of the presence of children and the embeddedness in the "other" network of contacts type (OR = 4.18 and OR = 4.44, respectively).

Controlling also for the type of support provided by ego (Model 3), the model fit is still improved, with a looic = 2767.6. As expected, support ties to non–kin alters

are strongly affected by the kind of the support provided. In particular, childcare is more likely to be provided to a kin, while a non–kin is more likely to be involved with other types of support (Material/Other or Economic). Moreover, the odds ratio associated to the support categories are very high with respect to the other covariates with companionship showing the highest value (OR = 61.56).

The inclusion of the dummy variable for the overlapping status of alters (Models 4a e 4b) provides a further looic decrease with respect to Model 3, although with a higher improvement in the case of only 8% of alter overlap (looic = 2719.4 versus looic = 2763.7). In Model 4a, the negative parameter associated with the alter–alter overlapping status, thereby strongly reducing the probability of a support tie to a non–kin (as also reported by the extremely low OR value, OR=0.002), indicates that supportive ties connecting the same recipient to different egos (living in the same household) more likely involve members of the kin circle, thus reinforcing the role of the household–level grouping of egos. In Model 4b, the dummy variable hypothesizing an overlap for all the remaining doubtful cases (corresponding to the highest value of 30%) does not have an impact on the estimates. Since alter–overlap in our data is induced by household sampling, accounted for the three–level hierarchical structure, the result in the last model is probably due to the imprecise detection of the status of alters. More interesting, particularly in Model 4a, the results for the previous covariates does not change, thereby providing evidence of the robustness of our findings — particularly those related to demographic and contact network' characteristics — in addition to the better model fit.

Fig 4 displays the estimates, 50% intervals, and 95% intervals for the logistic regression coefficients of all the covariates in Model 4a (the model specification with the lowest looic value), which predicts the probability of observing a support tie to a non–kin alter.

5 Conclusions

In this contribution, we employed an ego–network perspective and proposed a statistical analysis of support provided by the elderly population in Italy. More specifically, the focus is on providing support to non–kin, as a sign of an active participation into society. Several aspects of novelty can be emphasized on this topic.

Social support is usually viewed as support received, particularly in the literature on elderly population. Only a few studies are devoted to support provided, an aspect that in the elderly population provides new insights on social interactions and active involvement in economic and social activities (active ageing). In addition, because the support to non–kin is rooted on an individuals' choice rather than on family obligations, this widens the discussion on the living conditions of the elderly population beyond the family circle.

We used data from the 2009 edition of the FSS to derive the ego–centered networks of contacts in which elders were embedded and their support networks. The FSS is the primary source in Italy that collects information on relationships through a wide probability sample survey, thereby allowing the highlighting of the
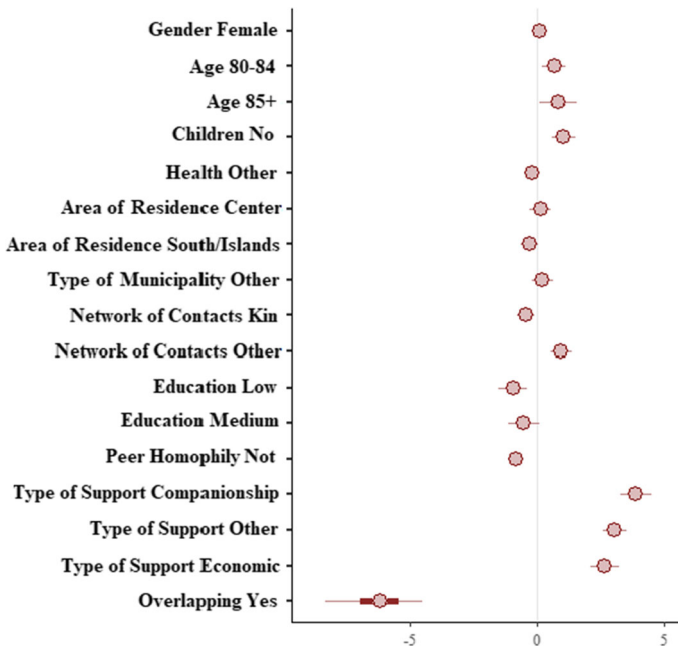
Fig. 4 The estimates, 50% intervals (in bold red line), and 95% intervals (red line) for the covariates in Model 4a

association between demographic and network characteristics of the elderly and the support they provide. However, since the FSS questionnaire only partially follows the conventional formats reported in the specialized literature to collect relational information (Marsden 1990), the analysis of the FSS data with network tools requires some methodological challenges.

As first point, in the paper, we adopted an original and replicable approach to mine the FSS non–standard data in order to build ego–centered networks, thereby contributing to exploit at best the set of the FSS information in a network perspective. As second point, the sampling design of the 2009 FSS edition (as well as the previous editions) forced to deal with the issue of alter–overlapping in the modeling of support networks. With respect to several previous studies that mainly neglected this ego–network characteristic, despite the limited set of the FSS information on alter features, an estimate of the expected range of overlapping under different hypotheses has been provided. Moreover, we developed a simple solution to account for it in a standard multilevel model specification that can be used when it is not feasible – as in our case – to precisely ascertain the overlapping alters. Further, our proposal enables to evaluate the robustness of modeling results if the issue is not considered at all or only partially accomplished.

In order to disentangle the determinants of a supportive tie toward a non–kin while accounting for variation in ego–alters relationships, we examined the effects

related to the characteristics of the providing elder (ego), the dyad ego–alter, the type of support provided, and contextual variables as well. The proposed three–level Bayesian hierarchical model enabled us also to deal with the sparsity in the structure of the support network and the natural clustering of the elderly living in the same family, which is the main source of alter–alter overlapping in their support networks.

The results provided evidence that the demographic and contact network characteristics of target egos affect the probability of providing support outside the kinship. The older elderly are less likely to provide support ties to their family circle; among the types of support, childcare is the most likely to be provided to a family member. An "encapsulation" effect related to the characteristics of the elder's network of contacts can also be noted for egos embedded in a kin network, thereby showing a lower probability of directing their support ties to non–kin alters. This effect is further reinforced if the alter involved in the support relationship is not an elder peer and if the support is related to childcare (mainly provided to grandchildren). In other words, the ego–centered network of contacts conveys both the type of support and the support recipient. Peer homophily between ego and alters appeared to be an important explanatory factor in providing support, as revealed by our results. This can be interpreted as evidence of a positive disposition to provide aid to other non–kin members, particularly friends, also on the basis of the same life experiences and attitudes.

The fact that providing support to non–kin, particularly neighbors, is more common with the advancement of the age of the elderly, may be related both to the ease of providing help to residentially close people — as neighbors are by definition — and to the consideration that getting older reduces the ability, the physical resources, and the opportunity to provide the specific type of support required by family members. This could be the case of childcare (or home care), either because grandparents are not in the physical condition to provide it or because grandchildren have grown up. A further investigation of such phenomenon on the basis of more detailed information would be very useful to appropriately unravel the effects related to "proximity" factors (such as the social and cultural characteristics of residential districts) and individual and relational factors, such as the satisfaction with family ties or the meaning of social engagement (see Haggerty et al. 2019).

Although it improved the model fit, the inclusion of the covariate on alter–alter overlapping did not affect model results with no changes in the parameter estimates of the other covariates at alter and ego levels. This result could be interpreted as a sign of the robustness of the findings related to demographic and network characteristics.

Last, note that participation in society is a very broad term and, for the elderly, this may translate into the mere involvement in one's family's life. In this context, the focus on support provided by elders to non–kin becomes particularly relevant for studying the individual's elective choice rather than a duty in social participation. Moreover, our findings can provide a basis for analyzing changes in the habits and behaviours of the elderly to cohabit with the risk of Covid–19.

Appendix A Table 6 reports the distribution of the number of different alter roles in the ego–network of contacts for elders and support providers. For both groups, almost half of the respondents show no more than two or three different alter roles in their networks.

Table 7 reports the network size by alter role, providing insights on the size of the ego–network of contacts by the different roles. Support providers show slight higher frequencies as well as slight higher average sizes for all the alter categories than elderly respondents.

Focusing on the elderly who provide support, Table 8 reports the distribution of the support receivers by alter roles. Overall, more than half of the support receivers are children and grandchildren, while almost 30% belong to the non–kin sphere.

Table 6 Distribution of number of different alters' roles

	Elders (%)	Support providers (%)
0	9	3
1	14	7
2	25	22
3	23	26
4	15	21
5	10	14
6	4	7

Table 7 Network size by alters' roles

	Elders			Support Providers		
	%	Mean (sd)	Median	%	Mean (sd)	Median
Children	64.2	1.09 (1)	1	73.1	1.24 (0.97)	1
Siblings	32.7	0.54 (0.89)	0	37.2	0.62 (0.93)	0
Grandchildren	52.4	1.12 (1.22)	1	62.4	1.33 (1.22)	1
Other relatives	34.4	1.3 (3.39)	0	44.7	1.93 (4.09)	0
Friends	32.1	1.12 (2.79)	0	45.9	1.85 (4.03)	0
Neighbors	49.2		0	61.4		1

Table 8 Distribution of support receivers by alters' roles

	%
Parents	2.8
Parents–in–law	1.7
Siblings	5.4
Children	26.2
Children–in–law	2.0
Grandchildren	26.0
Other relatives	6.0
Non–kin	29.9

References

Adams KB, Leibbrandt S, Moon H (2011) A critical review of the literature on social and leisure activity and wellbeing in later life. Age Soc 31(4):683–712

Albertini M, Saraceno C (2007) Contact between adult children and their divorced parents: Italy in a comparative perspective. Tech. rep, WZB Discussion Paper

Amati V, Rivellini G, Zaccarin S (2015) Potential and effective support networks of young Italian adults. Social Indic Res 122(3):807–831

Amati V, Meggiolaro S, Rivellini G, Zaccarin S (2017) Relational resources of individuals living in couple: evidence from an italian survey. Social Indic Res 134(2):547–590

Amati V, Meggiolaro S, Rivellini G, Zaccarin S (2018) Social relations and life satisfaction: the role of friends. Genus 74(1):7

Arpino B, Bordone V, Balbo N (2018) Grandparenting, education and subjective well–being of older europeans. Eur J Age 15(3):251–263

Berkman LF, Glass T, Brissette I, Seeman TE (2000) From social integration to health: Durkheim in the new millennium. Social Sci Med 51(6):843–857

Bilecen B, Cardona A (2018) Do transnational brokers always win? a multilevel analysis of social support. Social Netw 53:90–100

Blangiardo GC, Rimoldi S (2014) Portraits of the Italian family: past, present and future. J Comp Family Stud 45(2):201–219

Bojarczuk S, Mühlau P (2018) Mobilising social network support for childcare: the case of polish migrant mothers in dublin. Social Netw 53:101–110

Breiger RL (2004) The analysis of social networks. In: Hardy M, Bryman A (eds) Handbook of data analysis. Oxford University Press, London

Brown SL, Nesse RM, Vinokur AD, Smith DM (2003) Providing social support may be more beneficial than receiving it: results from a prospective study of mortality. Psychol Sci 14(4):320–327

Crossley N, Bellotti E, Edwards G, Everett MG, Koskinen J, Tranmer M (2015) Social network analysis for ego–nets: social network analysis for actor–centred networks. Sage, California

Dalla Zuanna G (2001) The banquet of aeolus: a familistic interpretation of Italy's lowest low fertility. Demogr Res 4(5):133–162

Dalla Zuanna G, Micheli GA (2006) Strong family and low fertility: a paradox?: new perspectives in interpreting contemporary family and reproductive behaviour, vol 14. Springer Science & Business Media, New York

De Jong Gierveld J, Perlman D (2006) Long–standing nonkin relationships of older adults in the Netherlands and the united states. Res Aging 28(6):730–748

De Jong Gierveld J, Dykstra PA (2008) Virtue is its own reward? support–giving in the family and loneliness in middle and old age. Age Soc 28(2):271–287

De Jong Gierveld J, Dykstra PA, Schenk N (2012) Living arrangements, intergenerational support types and older adult loneliness in eastern and western Europe. Demogr Res 27:167–200

De Miguel Luken V, Tranmer M (2010) Personal support networks of immigrants to Spain: a multilevel analysis. Social Netw 32(4):253–262

De Rose A, Strozza S (2015) Rapporto sulla popolazione: l'Italia nella crisi economica. il Mulino

Dykstra PA, Bühler C, Fokkema T, Petrič G, Platinovšek R, Kogovšek T, Hlebec V (2016) Social network indices in the generations and gender survey: an appraisal. Demogr Res 34:995–1036

Gelman A, Hill J (2006) Data analysis using regression and multilevel/hierarchical models. Cambridge University Press, Cambridge

Gelman A, Hwang J, Vehtari A (2014) Understanding predictive information criteria for bayesian models. Statist Comput 24(6):997–1016

Goldstein H (2011) Multilevel statistical models, vol 922. Wiley, New York

Golini A, Rosina A (2011) Il secolo degli anziani. come cambierà l'italia. Il Mulino, Bologna

Haggerty KL, Griffith J, McGuire J, Molnar B (2019) Elder mistreatment and social network composition: an exploratory study. Social Netw 59:23–30

Halpern D (2005) Social capital. Polity Press, Cambridge

Hilbrand S, Coall DA, Gerstorf D, Hertwig R (2017) Caregiving within and beyond the family is associated with lower mortality for the caregiver: a prospective study. Evol Human Behav 38(3):397–403

Hong SI, Hasche L, Bowland S (2009) Structural relationships between social activities and longitudinal trajectories of depression among older adults. Gerontol 49(1):1–11

House JS, Umberson D, Landis KR (1988) Structures and processes of social support. Ann Rev Sociol 14(1):293–318

Hunter KI, Linn MW (1981) Psychosocial differences between elderly volunteers and non–volunteers. Int J Aging Human Develop 12(3):205–213

Istat (2018) Rapporto annuale 2018. La situazione del paese

Istat (2020) Invecchiamento attivo e condizioni di vita degli anziani in italia

Katz PP, Yelin EH (2001) Psychosocial differences between elderly volunteers and non–volunteers. Arthr Rheumatism: Off J Am College Rheumatol 44(5):1194–1202

Lemon BW, Bengtson VL, Peterson JA (1972) An exploration of the activity theory of aging: activity types and life satisfaction among in–movers to a retirement community. J Gerontol 27(4):511–523

Litwin H, Shiovitz–Ezra S (2006) The association between activity and wellbeing in later life: what really matters? Age Soc 26(2):225–242

Louch H (2000) Personal network integration: transitivity and homophily in strong–tie relations. Social Netw 22(1):45–64

Lubbers MJ, Molina JL, Lerner J, Brandes U, Ávila J, McCarty C (2010) Longitudinal analysis of personal networks the case of argentinean migrants in spain. Social Net 32(1):91–104

Lumino R, Ragozini G, van Duijn M, Vitale MP (2017) A mixed–methods approach for analysing social support and social anchorage of single mothers' personal networks. Qual Quantity 51(2):779–797

Marsden PV (1988) Homogeneity in confiding relations. Social Netw 10(1):57–76

Marsden PV (1990) Network data and measurement. Ann Rev Sociol 16(1):435–463

Marsden PV (2011) Survey methods for network data. SAGE Handb Social Netw Anal 25:370–388

McCarty C, Lubbers MJ, Vacca R, Molina JL (2019) Conducting personal network research: a practical guide. Guilford Publications, New York

McPherson M, Smith–Lovin L, Cook JM (2001) Birds of a feather: homophily in social networks. Annual Rev Sociol 27(1):415–444

Morrow–Howell N, Hinterlong J, Rozario PA, Tang F (2003) Effects of volunteering on the well–being of older adults. J Gerontol Ser B: Psychol Sci Social Sci 58(3):S137–S145

Myers DG (2000) The funds, friends, and faith of happy people. Am Psychol 55(1):56–67

O'Campo P, Wheaton B, Nisenbaum R, Glazier RH, Dunn JR, Chambers C (2015) The neighbourhood effects on health and well–being (nehw) study. Health Place 31:65–74

Perry BL, Pescosolido BA (2015) Social network activation: the role of health discussion partners in recovery from mental illness. Social Sci Med 125:116–128

Perry BL, Pescosolido BA, Borgatti SP (2018) Egocentric network analysis: foundations, methods, and models, vol 44. Cambridge University Press, Cambridge

Principi A, Chiatti C, Lamura G, Frerichs F (2012) The engagement of older people in civil society organizations. Educational Gerontol 38(2):83–106

Principi A, Galenkamp H, Papa R, Socci M, Suanet B, Schmidt A, Schulmann K, Golinowska S, Sowa A, Moreira A et al (2016) Do predictors of volunteering in older age differ by health status? Eur J Age 13(2):91–102

Ritchey LH, Ritchey LH, Dietz BE (2001) Clarifying the measurement of activity. Activities, Adaptation Aging 26(1):1–21

Rodrigues MMS, De Jong Gierveld J, Buz J (2014) Loneliness and the exchange of social support among older adults in Spain and the Netherlands. Age Soc 34(2):330–354

Rossi G, Boccacin L, Bramanti D, Meda SG (2014) Active ageing: intergenerational relationships and social generativity. Active Age Healthy Living: A Human Cent Approach Res Innov Sourc qual life 203:57

Schmidt AE, Ilinca S, Schulmann K, Rodrigues R, Principi A, Barbabella F, Sowa A, Golinowska S, Deeg D, Galenkamp H (2016) Fit for caring: factors associated with informal care provision by older caregivers with and without multimorbidity. Eur J Age 13(2):103–113

Shor E, Roelfs DJ, Yogev T (2013) The strength of family ties: a meta–analysis and meta–regression of self–reported social support and mortality. Social Netw 35(4):626–638

Snijders T, Bosker R (2012) Multilevel models. Sage, Thousand Oaks

Snijders T, Spreen M, Zwaagstra R (1995) The use of multilevel modeling for analysing personal networks: networks of cocaine users in an urban area. J Quantitat Anthropol 5(2):85–105

Song L, Son J, Lin N (2011) Social support. SAGE Handb Social Netw Anal 9:116–128

Stan Development Team (2017) Stan Modeling Language. User's Guide and Reference Manual

Steptoe A, Shankar A, Demakakos P, Wardle J (2013) Social isolation, loneliness, and all–cause mortality in older men and women. Proceedings of the National Academy of Sciences 110(15):5797–5801

Sugar JA (2019) Introduction to aging: a positive, interdisciplinary approach. Springer Publishing Company, New York

Szabó Á, Neely E, Stephens C (2019) The psychosocial benefits of providing non–kin childcare in older adults: A longitudinal study with older new zealanders. Journal of Health Psychology

Tomassini C, Kalogirou S, Grundy E, Fokkema T, Martikainen P, Van Groenou MB, Karisto A (2004) Contacts between elderly parents and their children in four european countries: current patterns and future prospects. Eur J Age 1(1):54–63

Trevisan C, Pamio MV, Curreri C, Maggi S, Baggio G, Zambon S, Sartori L, Perissinotto E, Crepaldi G, Manzato E et al (2018) The effect of childcare activities on cognitive status and depression in older adults: gender differences in a 44–year longitudinal study. Int J Geriatric Psychiatry 33(2):348–357

Vacca R (2018) Multilevel models for personal networks: methods and applications. Italian J Appl Stat 30(1):59–97

Vacca R, Stacciarini JMR, Tranmer M (2019) Cross–classified multilevel models for personal networks: detecting and accounting for overlapping actors. Sociol Methods Res. https://doi.org/10.1177/0049124119882450

Van Duijn MA, Van Busschbach JT, Snijders TA (1999) Multilevel analysis of personal networks as dependent variables. Social Netw 21(2):187–210

Vehtari A, Gelman A, Gabry J (2017) Practical bayesian model evaluation using leave–one–out cross–validation and waic. Stat Comput 27(5):1413–1432

Wellman B (2007) The network is personal: introduction to a special issue of social networks. Social Netw 29:349–356

WHO (2002) Active ageing: a policy framework. World Health Organization, Geneva

Zamberletti J, Cavrini G, Tomassini C (2018) Grandparents providing childcare in Italy. Eur J Age 15(3):265–275