

M. V. Zunzunegui · A. Rodriguez-Laso · A. Otero
S. M. F. Pluijm · S. Nikula · T. Blumstein · M. Jylhä
N. Minicuci · D. J. H. Deeg · CLESA Working Group

Disability and social ties: comparative findings of the CLESA study

Published online: 4 March 2005
© Springer-Verlag 2005

Abstract The associations between prevalence, incidence and recovery from activities of daily living (ADL) disability and social ties among community-dwelling persons over 65 in Finland, The Netherlands and Spain are examined. Data were harmonized in the CLESA study. The baseline sample was composed of 3,648 subjects between 65 and 85 years old, living in Finland, The Netherlands and Spain. Disability in four activities of daily living was determined at baseline and at follow-up. Social participation, number of family ties and presence of friends were added to obtain a social ties index. Logistic regressions were fitted to the prevalence, incidence and recovery data to estimate the associations between disability and social ties, adjusting for education, comorbidity and self-rated health. The modifying effects of country, age and sex were tested in all models. For every country, the social ties index, having friends and social

participation were negatively associated with ADL disability prevalence. ADL incidence was negatively related to the number of family ties, with a stronger relationship in Spain than in The Netherlands or Finland. ADL recovery was associated with the social ties index. No age or gender differences in these associations were found. Social ties appear to generate a beneficial effect on the maintenance and restoration of ADL function. While social ties play an important role in maintaining and restoring function in all three countries, family ties appear to generate a stronger effect on protection from disability incidence than does social participation, and the strength of this effect varies by culture.

Keywords Longitudinal studies · Aging · Disability · Social ties

M. V. Zunzunegui (✉)
Département de Médecine Sociale et Préventive,
Faculté de Médecine, Université de Montréal,
Succursale Centre-ville, Montréal, Québec, H3C 3J7, Canada
E-mail: maria.victoria.zunzunegui@umontreal.ca
Tel.: +1-514-3436086
Fax: +1-514-3435645

A. Rodriguez-Laso · A. Otero
Centro Universitario de Salud Pública,
Universidad Autonoma de Madrid, Madrid, Spain

S. M. F. Pluijm · D. J. H. Deeg
Institute for Research in Extramural
Medicine (EMGO Institute),
VU University Medical Center (VUMC),
Amsterdam, The Netherlands

S. Nikula · M. Jylhä
School of Public Health, University of Tampere,
Tampere, Finland

T. Blumstein
The Gertner Institute for Epidemiology
and Health Policy Research,
Chaim Sheba Medical Center, Tel Hashomer, Israel

N. Minicuci
Institute of Neuroscience, Aging Unit,
National Council Research, Padova, Italy

Introduction

The beneficial effects of social relations have been identified in studies on several health outcomes, such as mortality, cognitive function, depression and self-rated health (Seeman 1996; House et al. 1998). The theoretical model of Berkman and colleagues allows one to define concepts such as social engagement, social networks and social support (Berkman et al. 2000). Social engagement is defined as community involvement, e.g., membership in neighborhood associations, religious groups or nongovernmental organizations. Social networks are defined by their structure (number of ties, proximity of relationship) and function (frequency of contact, reciprocity, duration). Networks can be further classified into sub-networks according to the nature or specific role of the relationship in question (friends, relatives, children, spouse). Both the structural characteristics of the network and the nature of the relationships may generate significant, yet distinct effects on aging—as proposed by Glass and colleagues—and these effects explain the relationship between social relations and health status (Glass et al.

1997). Networks may generate support and strain. Social support may be a mediating factor between network ties and health. A network's effect on health may depend totally or partially on its ability to provide support.

Some studies on the effects of social relations on health have focused on disability risk (Bisschop et al. 2003; Avlund et al. 2004b) and recovery of ADL ability (Liu et al. 1995). Strong positive evidence emerged from the 8-year longitudinal data collected at the New Haven EPESE site, where total social ties were associated with a significantly reduced risk of developing activities of daily living (ADL) disability, and a significantly increased probability of recovery (Mendes de Leon et al. 1999). In addition, networks composed of friends and relatives were significantly associated with reduced risk of disability, while networks made up of subjects' children generated no effect (Mendes de Leon et al. 1999). Slightly different results were obtained at the Duke EPESE site, where network size and social interaction indicated significant negative associations with disability incidence, and social interaction with friends was associated with reduced disability incidence, but social interaction with relatives or children was not related to disability (Mendes de Leon et al. 2001). More recently, two studies conducted in northern Europe have found that diversity of social contacts and high social participation predict maintenance of function (Avlund et al. 2004a, 2004b). Associations between social support and disability risk have been less conclusive (Unger et al. 1997, 1999; Mendes de Leon et al. 1999; Bisschop et al. 2003; Peek et al. 2003).

As for recovery from disability, a study on the elderly population of Japan indicated increased probability of recovery of function among those who were highly socially engaged and received emotional support (Liu et al. 1995).

The association between longevity and strong social relationships appears universal, but associations are weaker in cultures with high social cohesion, compared to individualistic cultures (Seeman et al. 1993; Liu et al. 1995; Berkman et al. 2004). Most studies on the health effects of social relationships have focused on the diversity of social networks and frequency of contact, without further distinguishing between formal versus informal, or intimate networks versus organized social action. The weight of formal and informal relations in the social life of the older population depends on culture. Country differences in the associations between self-rated health and social networks seem to surpass the well-known socio-economic factors (Turner and Marino 1994; Grundy and Slogett 2003). In particular, emotional support from children is associated with good physical and mental health in older people from Spain, while the role of networks made up of subjects' children and support from such children is much weaker among the French-speaking Canadian population (Zunzunegui et al. 2001b, 2004). However, having friends and social participation are strongly associated with good health status in French-speaking Canadian older subjects

(Zunzunegui et al. 2004). The ways in which older people participate in social life may depend on culture, but the evidence suggests that regardless of whether the social life of an elderly person involves contacts with children, grandchildren and siblings, or is based mainly on friends and community organizations, frequent contact with people leads to an active life.

Recent studies are focusing on social engagement, participation in social and productive activities, such as leisure activities that do not require physical exercise, and volunteer or paid work (Glass et al. 1999). Leisure activities involving contact with people were found to protect against cognitive decline and dementia (Fabrigoule et al. 1995; Verghese et al. 2003), reduce disability risk (Mendes de Leon et al. 2003) and increase survival (Glass et al. 1999). However, few studies have examined the effects of activities centered on family life, which are the most common activities among the elderly in family-centered societies, such as those in southern Europe, Africa, Asia and Latin America.

Some studies indicate that the beneficial effects of social ties on longevity are stronger among men than women (Wilkins 2003). In addition, some gender differences in the nature of social relationships that protect against cognitive decline have also been reported, e.g., friends appear to benefit women's cognitive function more than men's, while family networks appear to benefit men's cognitive function more than women's (Zunzunegui et al. 2003). Regarding disability, two recent northern European studies have examined whether the beneficial effects of social ties differ for men and women, and whether they vary with age (Avlund et al. 2004a, 2004b). Frequency of contact and social participation were more strongly associated with delayed onset of disability in women than in men. These results are at odds with previous results produced by Seeman regarding North American populations, where the protective effects of social relationships on the ability to perform ADL appeared stronger among men than in women (Seeman 1996). However, the limited sample size of the Finnish and Danish samples limits the significance of these gender-specific findings.

With respect to aging, few studies have examined whether the beneficial effects of social networks on health are maintained within the older elderly population. Evidence on this issue is scant, but it appears that such benefits decrease among those over 80 (Fabrigoule et al. 1995; Bassuk et al. 1999). In particular, Avlund and colleagues report that the associations between social networks and disability are no longer significant in either men or women over 80 (Avlund et al. 2004b).

The purpose of this study is to examine the associations between social ties and ADL disability in a sample of community-dwelling elderly Europeans, and to explore cross-country differences in the nature of social ties and their effects on disability prevalence, incidence and recovery among older men and women. Our research questions are (1) do associations exist between social ties and ADL disability prevalence, incidence and recovery?

Do such associations vary by the nature of the social tie? (2) Do associations between social ties and ADL disability prevalence, incidence and recovery differ by country? (3) Do such associations vary according to the age or gender of the elderly person?

Methods

Study sample

Data originate from the Cross-national Determinants of Quality of Life and Health Services for the Elderly (CLESA) study, including six population-based samples involving community-dwelling subjects aged 65 and over (Minicuci et al. 2003). All data were collected during face-to-face interviews in the subjects' homes, using structured questionnaires. Data from the following longitudinal studies on aging were used: TamELSA (Tampere Longitudinal Study on Aging), conducted in Finland (Jylhä et al. 1992); LASA (Longitudinal Aging Study Amsterdam), conducted in The Netherlands (Deeg et al. 2002); and the Leganés study conducted in Spain (Béland and Zunzunegui 1999; Zunzunegui et al. 2001a). The remaining three longitudinal CLESA studies (Israel, Italy and Sweden) lacked comparable information on social ties (Minicuci et al. 2003). For CLESA, we aimed to harmonize baseline data around 1990, by using data that had been collected in each center in approximately that year. TamELSA began earlier and therefore, for the CLESA baseline, we used the first study follow-up, conducted in 1989. The follow-up date for TamELSA was 1999. With respect to LASA and Leganés, the baseline coincided with the CLESA baseline (1992/1993 for LASA and 1993 for Leganés). Follow-up was carried out in 1995/1996 for LASA and in 1997 for Leganés. The sample and data collection procedures of each study, as well as a detailed description of the CLESA project methodology (Minicuci et al. 2003), have been discussed in greater detail elsewhere (Jylhä et al. 1992; Zunzunegui et al. 2001a). The cross-sectional sample for this work encompassed a total of 3,648 subjects between 65 and 85 years old, living in Finland, The Netherlands or Spain. Of these, 3,488 provided complete data on the variables considered for this study, as follows: 515 subjects from Tampere (Finland), 1,838 from The Netherlands and 1,135 subjects from Leganés (Spain).

Comparison of subjects on whom complete data were obtained ($n = 3,488$) to those excluded from the analysis ($n = 260$) due to incomplete data revealed that those excluded were significantly older and more ADL-disabled than those included. They were more likely to be male, and had a slightly higher number of chronic health conditions. Those excluded had significantly lower numbers of social ties, family ties, and friends, and participated in social activities at lower rates than those included in the analysis.

There were no significant differences in education and self-rated health between those for whom complete data were obtained and those for whom data were incomplete.

Measurements

All subjects providing information on ability in four ADLs at baseline (dressing, taking a shower or bath, toileting and transferring) were included. The harmonized four-item ADL measure appears to be a reliable and valid instrument for comparing ADL disability among older people across countries, with high internal consistency ranging from 0.81 to 0.92, and good construct validity (Pluijm et al. 2005). The response rate for ADL questions was 95% or higher, for all three countries. ADL disability prevalence was defined as requiring assistance with, or being unable to perform any of the four ADLs at baseline. ADL disability incidence was defined as requiring assistance with, or being unable to perform any of the four ADLs at the end of the follow-up period, given that the person in question had been able to perform all four activities at baseline. ADL disability recovery was defined as being able to perform all four ADLs at the end of the follow-up period, given that the person in question had been unable to do so, or required assistance with any of these four activities, at baseline.

Three indices measure social ties—social participation, the number of family ties, and having friends. Social participation is measured by asking subjects if they are members of a club or organization, visit a social center for seniors and/or are involved in religious activities, and this index ranges from 0 to 3. Family ties include spouses, children and siblings, and the number of family ties ranges from 0 to 3. In order to obtain a measure of diversity in social contacts, an overall social ties index was constructed, adding together the variables regarding social participation, number of family ties, and having friends. This index ranges from 0 to 7. The construction of this index is based on the original work of Berkman and Syme in Alameda County (cf. Seeman and Berkman 1998), and the work of Cohen et al. (1997), which are related to three levels of closeness—intimate, informal and formal relations.

Control variables are age, sex, country, education (less than primary, primary, and more than primary), number of chronic conditions and self-rated health (SRH). This study used some of the chronic diseases included in the CLESA database, as follows: stroke, musculoskeletal diseases, Parkinson's disease, diabetes, heart disease, cancer, and respiratory diseases. SRH was ascertained by asking the respondent to make a general statement about his/her health. For CLESA, the response categories were harmonized at three levels, i.e., "excellent/very good/good", "fair", and "poor/very poor".

Statistical analysis

To assess ADL disability prevalence correlates, logistic regression models were fitted for each country and for the pooled sample.

Nominal multivariate logistic regressions were used to estimate the determinants of incidence of, and recovery from ADL disability, using the pooled sample. For the ADL disability incidence analysis, the dependent variable included four categories—no ADL disability (used as reference category), disability in any of the four activities, loss to follow-up, and deceased. Regarding the recovery from ADL disability analysis, the dependent variable categories were ADL disabled (reference category), recovered from ADL disability, loss to follow-up, and deceased.

Table 1 Descriptive statistics for the sample used in the multivariate analysis of ADL dependence and social networks in Finland (Tampere), The Netherlands and Spain (Leganés)

	Means (standard deviations) or percentages			
	Totals (n = 3,488)	Finland (n = 515)	The Netherlands (n = 1,838)	Spain (n = 1,135)
Age****	74.8 (6.3)	73.5 (6.6)	74.4 (5.7)	75.5 (6.8)
Sex**				
Women	51.7%	58.1%	50.9%	50.1%
Men				
Education***				
Less than primary	33.3%	16.1%	11.4%	79.9%
Primary	36.2%	75.0%	36.5%	18.0%
More than primary	30.5%	8.9%	52.1%	2.1%
Number of chronic conditions***	1.4 (1.2)	1.3 (0.9)	1.1 (1.0)	2.1 (1.3)
Self-rated health***				
Very good or good	47.1%	34.8%	61.4%	29.6%
Fair	34.3%	37.5%	25.5%	47.0%
Poor or very poor	16.2%	26.4%	13.0%	16.7%
Unknown	2.4%	1.4%	0.1%	6.7%
Social ties index**	4.1 (1.4)	4.0 (1.3)	4.2 (1.3)	4.0 (1.5)
Family ties index***	2.3 (0.8)	2.1 (0.8)	2.3 (0.7)	2.4 (0.7)
Friends***				
Yes	51.0%	86.0%	43.1%	48.6%
No				
Social participation index**	1.3 (1.0)	1.1 (0.9)	1.4 (1.0)	1.2 (1.0)
Belongs to club or community organization***				
Yes	62.2%	66.2%	74.3%	40.8%
No	37.8%	33.8%	25.7%	59.2%
Attends neighborhood seniors' center at least monthly***				
Yes	30.7%	24.3%	30.3%	34.3%
No	69.3%	75.7%	69.7%	65.7%
Attends religious center at least monthly***				
Yes	37.4%	19.4%	37.9%	44.8%
No	62.6%	80.6%	62.1%	55.2%

***, $p < 0.01$; **, $p < 0.001$

Modifying effects of country were tested. When non-significant, pooled data analysis was performed, and age and sex interactions were tested for all final models concerning social ties and disability.

All analyses were performed using SPSS v. 10.0.

Results

ADL disability prevalence and social ties

Baseline characteristics of the study sample for each country are shown in Table 1. Spanish elderly had lower levels of education than did Finnish or Dutch older persons. ADL disability prevalence was 11.8% in the Finnish sample, 5.5% in the Dutch sample, and 27.1% in the Spanish sample. The number of chronic conditions was higher with the Spanish sample than within the Finnish or Dutch samples. The Finnish subjects indicated the poorest self-reported health. The Dutch older people were the healthiest, according to both health indicators.

The mean value for family ties was 2.3 of a maximum of 3. Approximately half the sample reported having friends, and 62% belonged to a community organization, 32% visited a social center for seniors, and 37% visited a religious center at least once a month. The mean value for all ties was 4.1 of a maximum of 7. However, these overall values hide important differences in the nature of social ties. While in Finland 86% of older people reported having friends, only 43% of those in The Netherlands, and 49% of those in Spain reported this. In Finland, however, 25% reported only one family tie or no family ties, while in The Netherlands the corresponding value was 14%, and in Spain 13%. Membership in club or community organizations was more common in The Netherlands (74%) and Finland (66%) than in Leganés (41%). Attending religious services was more common in Spain (45%) and The Netherlands (38%) than in Finland (19%). More elderly in Spain (34%) visited their neighborhood seniors' center than did those in The Netherlands (30%) or Finland (24%). Differences across countries for all variables shown in Table 1 were statistically significant.

Table 2 illustrates the odds ratio of ADL disability prevalence according to social ties in each country. In model 1, the social ties index was included after controlling for age, sex, education, self-rated health and co-morbidity. In model 2, the three components of the index were entered simultaneously into the equation. The social ties component was negatively associated (to a significant degree) with ADL disability prevalence in each country, and this association appeared stronger for social participation and having friends than for family ties. Since interactions between social network variables and country were not significant, the results from the pooled data are shown in the right column of Table 2. Gender and age did not seem to modify this association.

Table 2 ADL disability prevalence odds ratios (95% CI) for social ties estimated by multiple logistic regression. CLESA countries: Finland, The Netherlands, Spain^a

	Finland	The Netherlands	Spain	All three countries
Model 1: all social ties (0–7)	0.62 (0.46, 0.83)	0.77 (0.65, 0.92)	0.80 (0.71, 0.90)	0.79 (0.72, 0.87)
Model 2: including each type of tie				
Family ties (0–3)	0.91 (0.57, 1.44)	0.80 (0.58, 1.11)	0.99 (0.78, 1.25)	0.94 (0.79, 1.13)
Having friends (0–1)	0.40 (0.17, 0.96)	0.50 (0.29, 0.86)	0.87 (0.63, 1.21)	0.74 (0.57, 0.96)
Social participation (0–3)	0.49 (0.28, 0.84)	0.79 (0.63, 0.99)	0.67 (0.57, 0.80)	0.75 (0.65, 0.85)

^aControlling for age, sex, education, self-rated health, and number of chronic conditions. Reference values are: no ties, no family ties, no friends, no social participation. OR values refer to an increase of one unit in social ties measure

Table 3 Cohort dynamics in the three countries for the ADL disability incidence analysis ($n = 3,062$)

Country		Status at follow-up				
		Losses	Deceased	Incident cases	Able for ADL	Total
Finland	<i>n</i> (%)	25 (5.3%)	234 (49.3%)	23 (4.8%)	193 (40.6%)	475
The Netherlands	<i>n</i> (%)	78 (4.4%)	248 (14.1%)	157 (8.9%)	1,277 (72.6%)	1,760
Spain	<i>n</i> (%)	225 (27.2%)	128 (15.5%)	47 (5.7%)	427 (51.6%)	827
Total	<i>n</i> (%)	328 (10.7%)	610 (19.9%)	227 (7.4%)	1,897 (62.0%)	3,062

Overall, ADL disability prevalence decreased with increasing diversity of ties; for each unit increase in diversity, an average decrease of 20% in the prevalence odds of ADL disability was estimated (OR = 0.79; 95% CI 0.72, 0.87). Interaction between gender and the social ties index closely approached significance ($p = 0.055$), suggesting a stronger association for men as compared to women. Family ties were not significantly associated with lower disability prevalence (OR = 0.94; 95% CI 0.79, 1.13). However, having friends (OR = 0.74; 95% CI 0.57, 0.96) and being socially active (OR = 0.75; 95% CI 0.65, 0.85) were associated with a major and significant reduction in disability prevalence.

Table 4 Odds ratio for the incidence of ADL disability by number of family ties and country ($n = 3,062$)^a

Number of family ties	Odds ratio	95% CI Lower limit	95% CI Upper limit
Leganés, Spain			
Three	0.08	0.05	0.12
Two	0.18	0.13	0.25
One	0.43	0.37	0.50
None	1.00		
The Netherlands			
Three	0.49	0.38	0.64
Two	0.63	0.52	0.74
One	0.79	0.72	0.86
None	1.00		
Tampere, Finland			
Three	0.56	0.33	0.94
Two	0.68	0.48	0.96
One	0.82	0.73	1.04
None	1.00		

^aNominal logistic regression controlling for deaths, losses to follow-up, and the following covariates: age, sex, education, self-rated health, and number of chronic conditions

ADL disability incidence and social ties

Follow-up data are available for 3,286 non-disabled older persons in the three countries. Of these, complete data on the covariates were included concerning 3,062 individuals (Table 3). Neither the overall social ties index, nor the friends or social participation variables were significantly associated with ADL disability incidence. The number of family ties protected against disability incidence, even after controlling for age, sex, education and health status variables (data not shown). A significant interaction also existed between the number of family ties and country with respect to ADL disability incidence (Table 4). The estimated odds ratios and their 95% confidence interval for the number of family ties by country are shown in Table 4, in order to illustrate the varying effect of family ties by country more clearly. In Spain, those with no family ties experienced ADL disability incidence more than 12 times higher than those with three types of family ties (OR = 12.5 = 1/0.08). In Finland, those with no family ties had almost twice the ADL disability incidence recorded in those with three types of family ties (OR = 1.8 = 1/0.56). Associations of family ties with ADL disability incidence in The Netherlands were strong and similar to those in Tampere. Even though 95% confidence intervals were wide, they did not include the value of one, indicating the presence of significant associations.

Associations among all other covariates leaned in the expected direction, although education did not reach statistical significance (data not shown). The disability risk was lower for men than for women. Lastly, the disability risk was higher among those who reported their health to be poor or fair at baseline. The number of chronic conditions was positively associated with disability risk. The risk of disability incidence was higher

Table 5 Cohort dynamics of the three countries for the recovery from ADL disability analysis ($n = 464$)

Country		Losses	Deceased	Recovery	No recovery	Total
Finland	n (%)	0 (0%)	35 (87.5%)	1 (2.5%)	4 (10.0%)	40
Netherlands	n (%)	4 (4.3%)	34 (37.0%)	5 (5.4%)	49 (53.3%)	92
Spain	n (%)	74 (22.3%)	115 (34.6%)	50 (15.1%)	93 (28.0%)	332
Total	n (%)	78 (16.8%)	184 (39.6%)	56 (12.1%)	146 (31.5%)	464

among Leganés subjects than among those in The Netherlands or Finland.

ADL disability recovery and social ties

In this sub-analysis, only subjects from The Netherlands and Spain were included, since very few people from Finland had recovered from ADL disability after the long follow-up period (10 years) of the Finnish study (Table 5).

The results from the nominal regression equation of ADL recovery on social ties, controlling for all covariates, are shown in Table 6. We obtained a significant result for the overall social ties index (OR = 1.37; 95% CI 1.08, 1.78; Table 6), indicating that those subjects with a high diversity of social ties were more likely to recover the ability to perform ADLs than were those subjects with little diversity in their social ties.

This result remained significant for the combined, two-country sample and for the Spanish sub-sample, even after controlling for age, sex, education and health covariates. Interactions between social ties and sex, age and country were not significant. In order to understand which component of the social network influenced the probability of recovery more clearly, we tested the three components simultaneously. Confidence intervals are wide, and statistical significance is lost for all associations.

Discussion

Results from this study confirm that social ties are protective factors in old age, helping to maintain and restore function. Social ties generate beneficial effects on prevalence of ADL disability, incidence of ADL dis-

ability, and recovery from ADL disability. The nature of the tie is shown to be specific for incidence, and some differences by country were observed.

ADL disability prevalence is associated with total social ties. The association does not vary by country or age. Although our data suggest that social ties may be more important for men than for women, the limited sample size do not allow further investigation of these interactions, since wide confidence intervals and multiple testing using small sub-samples would lead to inconclusive results. A possibly stronger protective effect of social ties for men than for women would be consistent with some American studies, and at odds with the studies conducted in northern Europe. However, only studies with sufficient sample sizes should be used if we are to examine the issue of gender differences with adequate precision.

If we examine the associations of family, friends, and social engagement in the community with ADL prevalence separately, we observe that the non-family ties generate stronger effects. The sense or meaning of life may be a mediator between active engagement (through friends and community activities) and disability (Sagy and Antonovsky 2000). In addition, embeddedness in the community may increase subjects' confidence regarding what they are able to manage in their daily life, through an increased sense of control over their lives (Mendes de Leon et al. 1999). Nevertheless, the cross-sectional nature of these associations with ADL prevalence does not rule out the alternative possibility that the appearance of disability has resulted in a shrinkage of non-familiar ties through a reduction in the amount of time individuals spend outside the home. A previous study conducted by Cerhan and Wallace (1993) in Iowa reported that the interaction between social relations and health is bi-directional, since health status decline induces a shrinkage of the social network, and a decrease in social networks predicts mortality.

Table 6 ADL disability recovery odds ratios (95% CI) for social ties estimated by nominal logistic regression. CLESA countries: The Netherlands, and Spain^a

	Total ($n = 424$)	The Netherlands ($n = 92$)	Spain ($n = 332$)
Model 1: all social ties (0–7)			
	1.37 (1.08, 1.78)	2.19 (0.81, 5.98)	1.37 (1.03, 1.82)
Model 2: including each type of tie			
Family ties (0–3)	1.26 (0.76, 2.07)	1.5 (0.20, 9.10)	1.15 (0.64, 2.04)
Having friends (0–1)	0.53 (0.26, 1.08)	0.36 (0.02, 6.4)	0.59 (0.20, 1.34)
Social participation (0–3)	1.23 (0.87, 1.75)	2.4 (0.71, 8.44)	1.26 (0.81, 1.96)

^aNominal logistic regression controlling for deaths, losses to follow-up, and the following covariates: age, sex, country, education, self-rated health, and number of chronic conditions. Reference values are: no ties, no family ties, no friends, no social participation. OR values refer to an increase of one unit in social ties measure

Results on the incidence of disability indicate a different picture—in fact, they support the latter interpretation of the cross-sectional results. Only family ties are associated with disability incidence, while neither friends nor community involvement appears to generate significant effects on disability risk. It may be that people who are involved in the lives of other members of their families are more likely to maintain their ADL ability than are people who do not. While in every country the protective effect of family ties was strong, for the older people of Leganés the strength of the association was remarkable—those with no family ties run a very high risk of disability, compared to those with three types of family ties. This result can be interpreted in light of the traditional family life of the elderly population in Spain, where the older person participates actively in the lives of all family members. Mendes de Leon and colleagues reported conflicting results with respect to the New Haven and Duke elderly populations, where ties with children were not significantly related to disability risk (Mendes de Leon et al. 1999, 2001). In a previous analysis of decline in physical function in the LASA study, total network size, and particularly the number of daughters in the network, generated a positive effect on older people with chronic diseases (Bisschop et al. 2003).

The number of social ties predicted ADL recovery, but lack of power limited the analysis of the specific effects of the three social ties components—formal ties, family ties, and friends—as indicated by the wide confidence intervals for all non-significant odds ratios. None of the results concerning associations between recovery and the specific components of social ties were significant. While results suggest that ties may provide the protection and support that generate the strength to recover from the disabled state, more research is needed to understand which components of, and by what mechanisms social ties may promote recovery from disability.

Cultural differences may partly explain why the prevalence data differ so significantly in the case of Spain (much higher rates) than in the case of Finland or The Netherlands, even after adjusting for health status and education. The ability to perform ADL independently may have different value in each of the three countries. While in northern Europe autonomy is highly valued, in southern Europe it is the availability of assistance from family members that is valued highly (Zunzunegui et al. 2001b). For a southern European person, having a son or a daughter willing to help his or her parents in need is a matter of pride and source of happiness. A southern European elderly person is willing to state that he or she needs help earlier in the disability process than does a northern European person. Nowadays in Spain, it is common to hear the elderly complain that “my children do not help me as much as I need”, since older people were raised in a world where filial obligation was widely accepted and children were responsible for the well-being of their parents, in exchange for the help they received during their life course. Today, in a rapidly

changing society, where women work outside the home and society no longer has a collectivist orientation, but an individualistic one, children do not meet their parents’ expectations (Valderrama-Gama et al. 2002). Despite these cultural differences, the associations observed between social ties and ADL disability are surprisingly similar.

Our study has some limitations, since it is based on an effort to harmonize data from ongoing studies. The main limitation of our study is the difference in follow-up times—3 years for The Netherlands, 4 years for Spain, and 10 years for Finland—which limits comparisons of disability incidence or recovery across countries in the longitudinal study. However, the inclusion in the multinomial models of the “deceased” and “lost to follow-up” corrects, to some extent, the differences in the follow-up span. The second limitation is that three of the six countries in CLESA provided only partial or no data on social ties. Although the CLESA study lacks information on potential mechanisms by which social ties may act on disability (social support, social influence, etc.), these longitudinal studies have been useful in determining the link between social ties and disability prevalence, incidence and recovery. Further studies on aging in Europe and elsewhere should include information on social support and other mediating mechanisms that would increase our understanding of the effects of social relations on health and disability. The study of mechanisms and modifying factors, such as culture, gender and age, should be the focus of future studies. Finally, the harmonization of ADL was based on the selection of items with different wording, and the merging of response categories that may have resulted in missing information (Pluijm et al. 2005).

In conclusion, this study provides evidence that social ties are beneficial with respect to maintaining and restoring the ability to perform activities of daily living among older people in three countries representing three distinct European cultures. Some effects appear to be specific to the nature of the social engagement. Community involvement is largely beneficial, and should be encouraged through social policies. Family ties play a significant role in disability incidence reduction.

Acknowledgements The CLESA Working Group: *Finland* M. Jylhä (Principal Investigator), S. Nikula, V. Autio; *Israel* J. Gindin (Principal Investigator; First Principal Investigator—the late Modan Baruch of the Chaim Sheba Medical Center), T. Blumstein, A. Chetrit, A. Walter-Ginzburg, K. Shamay; *Italy* S. Maggi (Project Leader), N. Minicuci, M. Noale, C. Marzari; *The Netherlands* D.J.H. Deeg (Principal Investigator), S.M.F. Pluijm; *Spain* A. Otero (Principal Investigator), M.J. Garcia de Yébenes, A. Rodríguez-Laso, M.V. Zunzunegui; *Sweden* N.L. Pedersen (Principal Investigator), C. Bardage. The CLESA Project is supported by EU QoL2000-00664. LASA is supported by The Netherlands Ministry of Health, Welfare and Sports and the Vrije Universiteit. ILSA was supported by the CNR (National Research Council) and the Italian Department of Health—National Institutes of Health. Aging in Leganés is supported by the Spanish Health Research Fund (FIS), the Madrid Regional Research Fund and Private Foundations (La Caixa, BBVA). CALAS was supported by the US National Institute on Aging Grants R01-5885-03 and R01-5885-06. The

TamELSA is supported by the Academy of Finland, the Juho Vainio Foundation, the Yrjö Jahnsson Foundation and the Medical Research Fund of Tampere University Hospital. SATSA is supported by the US National Institute on Aging (AG 04563, 10175) and the Swedish Social Research Council.

References

- Avlund K, Lund R, Holstein BE, Due P, Sakari-Rantala R, Heikkinen R-L (2004a) The impact of structural and functional characteristics of social relations as determinants of functional decline. *J Gerontol Soc Sci* 59:44–51
- Avlund K, Lund R, Holstein BE, Due P (2004b) Social relations as determinant of onset of disability in aging. *Arch Gerontol Geriatr* 38:85–99
- Bassuk SS, Glass TA, Berkman LF (1999) Social disengagement and incident cognitive decline in community dwelling elderly persons. *Ann Intern Med* 131:165–173
- Béland F, Zunzunegui MV (1999) Predictors of functional status in a population of community-dwelling elderly in Spain. *Age Aging* 28:153–159
- Berkman LF, Glass T, Brissette I, Seeman TE (2000) From social integration to health: Durkheim in the new millennium. *Soc Sci Med* 51:843–857
- Berkman LF, Melchior M, Chastang J, Niedhammer I, Leclerc A, Goldberg M (2004) Social integration and mortality: a prospective study of French employers of electricity of France-Gas of France: the GAZEL cohort. *Am J Epidemiol* 159:167–174
- Bisschop MI, Kriegsman DMW, Van Tilburg T, Penninx BWJH, van Eijk JTM, Deeg DJH (2003) The influence of differing social ties on decline in physical functioning among older people with and without chronic diseases. *Aging Clin Exp Res* 15:164–173
- Cerhan JR, Wallace RB (1993) Predictors of decline in social relationships in the rural elderly. *Am J Epidemiol* 137:870–880
- Cohen S, Doyle WJ, Skinner DP, Rabin BS, Gwaltney JM (1997) Social ties and susceptibility to the common cold. *JAMA* 24:1940–1944
- Deeg DJ, van Tilburg T, Smit JH, de Leeuw ED (2002) Attrition in the Longitudinal Aging Study Amsterdam: the effect of differential inclusion in side studies. *J Clin Epidemiol* 55(4):319–328
- Fabrigoule C, Letteneur L, Dartigues JF, Zarrouk M, Commenges D, Barberger-Gateau P (1995) Social and leisure activities and risk of dementia: a prospective longitudinal study. *J Am Geriatr Soc* 43:485–490
- Glass TA, Mendes de Leon C, Seeman TE, Berkman LF (1997) Beyond single indicators of social networks: a LISREL analysis of social ties among the elderly. *Soc Sci Med* 44:1503–1517
- Glass TA, Mendes de Leon CF, Marottoli RA et al. (1999) Population based study of social and productive activities as predictors of survival among elderly Americans. *BMJ* 319:478–483
- Grundey E, Slogett A (2003) Health inequalities in the older population: the role of personal capital, social resources and socioeconomic circumstances. *Soc Sci Med* 56:935–947
- House JS, Landis KR, Umberson D (1988) Social relationships and health. *Science* 241:540–545
- Jylhä M, Jokela J, Tolvanen E, Heikkinen E, Heikkinen RL, Koskinen S, Leskinen E, Lyra AL, Pohjolainen P (1992) The Tampere Longitudinal Study on Ageing. Description of the study. Basic results on health and functional ability. *Scand J Soc Med Suppl* 47:1–58
- Liu X, Liang J, Muramatsu N, Sugisawa H (1995) Transitions in functional status and active life expectancy among older people in Japan. *J Gerontol Soc Sci* 50B:S383–S394
- Mendes de Leon CF, Glass TA, Beckett LA, Seeman TE, Evans DA, Berkman LF (1999) Social networks and disability transitions across eight intervals of yearly data in the New Haven EPESE. *J Gerontol Ser B Psychol Sci Soc Sci* 54:S162–S172
- Mendes de Leon CF, Gold DT, Glass TA, Kaplan L, George LK (2001) Disability as a function of social networks and support in elderly African Americans and whites: the Duke EPESE 1896–1992. *J Gerontol Ser B Psychol Sci Soc Sci* 56:S179–S190
- Mendes de Leon CF, Glass TA, Berkman LF (2003) Social engagement and disability in a community population of older people. The New Haven EPESE. *Am J Epidemiol* 157:633–642
- Minicuci N, Noale M, Bardage C, Blumstein T, Deeg DJH, Gindin J, Jylhä M, Nikula S, Otero A, Pedersen NL, Pluijm SMF, Zunzunegui MV, Maggi S, CLESA Working Group (2003) Cross-national determinants of quality of life from six longitudinal studies on aging: the CLESA project. *Aging Clin Exp Res* 15:187–202
- Peek MK, Ottenbacher KJ, Markides KS, Ostir GV (2003) Examining the disablement process among older Mexican American adults. *Soc Sci Med* 57:413–425
- Pluijm SMF, Bardage C, Nikula S, Blumstein T, Jylhä M, Minicuci N, Zunzunegui MV, Pedersen NL, Deeg DJH, for the CLESA Study Working Group (2005) Harmonising a measure of ADL disability across six countries. *J Clin Epidemiol* (in press)
- Sagy S, Antonovsky H (2000) The development of the sense of coherence: a retrospective study of early life experiences in the family. *Int J Aging Hum Develop* 51:155–166
- Seeman T (1996) Social ties and health: the benefits of social integration. *Ann Epidemiol* 6:95–106
- Seeman TE, Berkman LF (1998) Structural characteristics of social networks and their relations with social support in the elderly: who provides support? *Soc Sci Med* 26:737–749
- Seeman TE, Berkman LF, Kohout F, Lacroix A, Blazer D (1993) Intercommunity variations in the association between social ties and mortality in the elderly: a comparative analysis of three communities. *Ann Epidemiol* 3:325–335
- Turner RJ, Marino F (1994) Social support and social structure: a descriptive epidemiology. *J Health Soc Behav* 35:193–212
- Unger JB, Johnson CA, Marks G (1997) Functional decline in the elderly: evidence for direct and stress-buffering protective effects of social interactions and physical health. *Ann Behav Med* 19:152–160
- Unger JB, McAvay G, Bruce ML, Berkman L, Seeman T (1999) Variation in the impact of social networks characteristics on physical functioning in elderly persons. McArthur Study of Successful Aging. *J Gerontol* 54:S245–S251
- Valderrama-Gama E, Damian J, Ruigomez A, Martin Moreno JM (2002) Chronic disease, functional status, and self-ascribed causes of disabilities among noninstitutionalized older people in Spain. *J Gerontol Med Sci* 57A:M716–M721
- Verghese J, Lipton RB, Katz MJ, Hall CB, Derby CA, Kuslansky G et al. (2003) Leisure activity and the risk of dementia in the elderly. *New Eng J Med* 348:2508–2516
- Wilkins K (2003) Social support and mortality of the Canadian older population. *Health Rep* 14:23–37
- Zunzunegui MV, Béland F, Gutierrez-Cuadra P (2001a) Loss to follow up in a longitudinal study of a community dwelling elderly population. *J Clin Epidemiol* 54:501–510
- Zunzunegui MV, Béland F, Otero A (2001b) Support from children, living arrangements, self-rated health and depression of the elderly in Spain. *Int J Epidemiol* 30:1090–1099
- Zunzunegui MV, Alvarado BE, Del Ser T, Otero A (2003) Social networks, social integration and social engagement are risk factors for cognitive deterioration among Spanish elderly. *J Gerontol Ser B Psychol Sci Soc Sci* 58:S93–S100
- Zunzunegui MV, Koné A, Johri M, Béland F, Wolfson C, Bergman H (2004) Social networks and self-reported health in two French-speaking Canadian community-dwelling populations over 65. *Soc Sci Med* 58:2069–2081