The influence of differing social ties on decline in physical functioning among older people with and without chronic diseases: The Longitudinal Aging Study Amsterdam

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ABSTRACT. Background and aims: Global social support measures have been shown to be related to several health outcomes. However, little is known about the effects of differing social ties and their support on the risk for decline in physical functioning among older people, without as compared with those with chronic diseases. This study examines whether differing types of social ties and support differentially mitigate the negative effects of chronic diseases on decline in physical functioning. **Methods:** Using data from two cycles of the Longitudinal Aging Study Amsterdam (N=2357), logistic regression analyses adjusted for baseline functioning, age, gender, and incidence of chronic diseases were conducted, to assess the effect of differing social ties for subgroups with different numbers of chronic diseases. Information about the presence of differing social ties included partner status and numbers of daughters, sons, other family members, and non-kin relationships. Social support included instrumental and emotional support, and the experience of loneliness. Decline in physical functioning was determined by substantial change after three years on a 6-item self-report scale. **Results:** Although having a partner had a protective effect on decline in physical functioning in people without chronic diseases at baseline, this was not the case for those with chronic diseases. Total network size had an adverse effect in older people without chronic diseases, but a positive effect when chronic diseases were present, mainly due to a positive effect of the number of daughters and non-kin relationships. **Conclusions:** Our results

provide evidence that differing types of social relationships and the support they provide, differentially influence decline in physical functioning in older people, with or without chronic diseases.

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INTRODUCTION

Chronic diseases have been demonstrated to be associated with decline in physical functioning (1-5). Moreover, the presence of a higher number of chronic diseases has been shown consistently to be associated with both higher prevalence (6-8) and higher incidence of limitations in physical functioning (1, 9, 10). However, variability with regard to the presence of limitations in physical functioning among older people is large, even among those with the same chronic diseases of comparable severity.

Although disease severity is an important determinant of functional limitations, other factors also play a role in explaining the variability of limitations in physical functioning among people with a comparable burden of disease. Differences in the quantity and quality of social relationships are considered important in this respect (11-15).

In this study, the influence of the quantity and quality of social relationships is examined by using a conceptual model which integrates the 'disablement process' as developed by Verbrugge and Jette (16) and a model of the impact of social support on the relationship between stress and health (17). According to the 'disablement process', pathology (here defined as the presence of chronic disease) may cause impairment in specific body

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systems, which may, in turn, cause limitations in physical functioning and, further on in the causal chain, disability and death. However, the likelihood of transition from one stage of the process to the next is modified by personal and environmental factors, including social support (16). With regard to the impact of social support on health, two theoretical approaches can be distinguished in the literature. According to the 'stress buffer model', a high level of social support may mitigate the negative impact of stress on health. Thus, this model implies exposure to stressful circumstances. The 'direct-effect hypothesis' states that an optimal amount of social support has a beneficial effect on health regardless of the presence of stressful circumstances (17). There is sufficient empirical evidence in favor of both approaches (14, 15, 17, 18), although most studies do not make a distinction between 'buffer' and 'direct' effects, and the results of previous studies are often conflicting and appear to depend on how social support characteristics are measured and on the types of health outcomes that are studied (19-22).

Many studies, consistently demonstrating a positive effect (23), have focused on the associations between overall measures of structural and functional characteristics of the social network (such as total network size, number of social interactions, and total amounts of instrumental and emotional support) and mortality (24-27). However, mortality represents the most extreme negative end of the spectrum of disablement. The results of studies focusing on early decline in physical functioning are less consistent (10). In a study among subjects with chronic diseases, no effects of social support on physical functioning were found (28). Instead, studies in community-based samples of older people provide some evidence that having a larger social network and having a partner are associated with reduced risks of decline in physical functioning (13, 29). In one of the few studies in which the effects of differing types of social ties were distinguished, ties with relatives other than children and ties with friends were shown to protect against decline in physical functioning. However, this protective effect was found only in the development of disability in activities of daily living and not in that of less severe limitations in physical functioning (13). In addition, more instrumental support was shown to be associated with an increased risk for development of disability in activities of daily living (ADL), whereas no effects were observed for emotional support (13). Because the effects of social ties on decline in physical functioning were adjusted for physical health, it is impossible to determine whether the effects that were found were direct or buffer effects of social support.

In a previous cross-sectional study, Kriegsman et al. (30) found a protective effect of having a partner on the presence of limitations in physical functioning among older people with one chronic disease, but not among those with more than one chronic disease. This protective

effect was independent of the amount of instrumental and emotional support received from the partner. It was postulated that a buffer effect among people with a higher burden of disease could not be demonstrated because of the cross-sectional design of the study (30). However, another explanation is that the effects of social ties are modified by the number of chronic diseases. It may well be that, among people with a higher number of chronic diseases, the negative influence of these diseases on physical functioning exceeds the potential positive (or buffer) effects of social ties.

The present study focuses on the influence of quantity and quality of social relationships on the risk for decline in physical functioning across three years among older people without or with differing numbers of chronic diseases. The present study is distinguished from previous studies as regards two important aspects. First, because the effect of the social network may be modified by the number of chronic diseases, the influence of social support characteristics among subjects with differing chronic diseases is examined explicitly. Second, we examined whether the influence of daughters and sons differs from that of other kin and non-kin network members, and a further distinction is made according to whether these relationships are 'active' or 'non-active'.

The following research questions are addressed:

- Do social support characteristics differentially influence the risk for decline in physical functioning among older people without, with one, or with more than one chronic disease?
- Do daughters and sons in the network have a more beneficial effect on the risk for decline in physical functioning than other kin or non-kin network members among older people without, with one, or with more than one chronic disease, and does it matter whether these relationships are actually 'active' or 'non-active' in providing support?

METHODS

Sample

For this study, data collected within the first two measurement cycles of the Longitudinal Aging Study Amsterdam (LASA) were analyzed. LASA is a prospective study on predictors and consequences of changes in the physical, cognitive, emotional and social functioning of persons aged 55 to 85 years at baseline. The sampling and data collection procedures and non-response have been described in depth elsewhere (31). In short, a random sample, stratified by age and gender, was drawn from the population registries of 11 municipalities in the Netherlands. The cohort was recruited for the study "Living arrangements and social networks of older adults" (LSN; N=3805, response rate=62%; for full details on the sampling procedure, see 32). After 11 months, between September 1992 and September 1993, LSN participants were approached for

the first LASA measurement (T1): 3107 participated in face-to-face interviews (response rate=82%). Non-response was associated with age but not with sex (31). In the present analyses, respondents living in nursing or residential homes (N=126) were excluded because their social support cannot be compared with that of independently living older people. Because of incomplete data on chronic disease status, social support, and physical functioning at baseline, 182 subjects were lost to subsequent analyses.

Three years after the baseline interview, between September 1995 and September 1996, all respondents were approached for a follow-up interview (T2). Of the 2799 subjects with complete baseline data, 315 (11%) had died, 13 (0.5%) could not be contacted, 74 (3%) refused to participate, and 32 (1%) were not able to participate because of severe cognitive or physical impairment. Another 8 subjects were not able to complete the interview because of severe cognitive or physical impairment, and these were excluded because of incomplete data on physical functioning. The resulting sample for analyses consisted of 2357 subjects.

Measures

Physical functioning. As an indicator of physical functioning, questions were asked about the degree to which the respondent was limited in the performance of 6 usual daily activities (ADL): going up and down stairs, getting (un)dressed, sitting down and rising from a chair, cutting own toenails, walking 400 m, and using own or public transport (33). Respondents indicated whether they were able to perform the activity without difficulty, with some difficulty, with much difficulty, only with help, or not at all. These response categories were scored 5, 4, 3, 2 and 1, respectively, and sumscores (range 6-30) were calculated. Lower scores indicate more limitations in physical functioning. The sumscores at T1 and T2 were used to measure changes between the two measurements.

Changes in physical functioning. To determine the amount of change in physical functioning between T1 and T2, for each respondent we computed whether a change had occurred by means of the Edward Nunnally index (EN-index). In contrast with difference scores indicating the amount of change, the EN-index determines the probability of substantial individual change and avoids the problem of regression to the mean. The EN-index (see Appendix) computes on the basis of the scale reliability of the six items at T1 (Cronbach's $\alpha = 0.85$) and the 90% confidence interval (CI) of the mean sumscore at T1 (mean=27.98, SD=3.82), if a significant change in scores between T1 and T2 has occurred. Because we are dealing with individual changes, the 90% CI is used as the cut-off value. Using the EN-index implies that whether or not decline is significant depends on the baseline score. For example, respondents with a baseline score of 30 (maximum) need to decline by at least 2.7 points to be classified as declined, while respondents with a score of 20 on-

ly need to decline 1.2 points on the scale score. In our sample, 1750 (74%) respondents did not experience significant change in physical functioning between T1 and T2, 494 respondents (21%) experienced a significant decline, while only 113 (5%) experienced an improvement in physical functioning, according to the EN-index. Because of the small number of respondents who reported an improvement in physical functioning, these respondents were taken together with those who did not change.

Chronic disease status. The presence of chronic diseases was determined by asking the respondents whether they had the following diseases: chronic non-specific lung disease (asthma, chronic bronchitis, pulmonary emphysema), cardiac disease (including myocardial infarction), peripheral arteriosclerosis, cerebrovascular accident, diabetes mellitus, arthritis (rheumatoid arthritis, osteoarthritis) and malignant neoplasm. In addition, respondents were asked if they had any other chronic diseases which had been present for 3 months or longer, for which they are being treated or regularly checked by a physician. This was coded as 0 when no additional chronic disease was reported, and as 1 when one or more additional diseases were reported. Compared with information obtained from general practitioners, these self-reports of chronic diseases were found to be sufficiently accurate (34). The number of chronic diseases was determined and in order to retain sufficient numbers across strata, the number of diseases was coded as 0 when no diseases were reported, 1 if only one disease was reported, and 2 when two or more diseases were reported.

At follow-up after three years, chronic disease status was assessed by applying the same procedure. In view of the types of chronic diseases that were asked about, those which were reported at baseline were also defined as present at follow-up. Incident chronic diseases were defined as present when, compared with the baseline chronic disease status, one or more of the chronic diseases described above were reported as present at follow-up but not reported at baseline.

Social support measures

Partner status. The partner relationship, if present, is generally considered the most important relationship in the social network. As expected, among those living together with a partner, little variability was present in contact frequency (which was almost always daily) and the amount of instrumental and emotional support provided by the partner (which was almost always often). Therefore, the partner relationship was not further characterized and partner status was used and coded as 0 for those without a partner, and as 1 for those with a partner.

Structural and functional characteristics of the social support network. Several of these, excluding the presence of a partner, were measured: type of relationship, contact frequency, traveling time, and emotional and instrumen-

tal support received. The variables used in this study were constructed according to this information.

Social network size. The method used for identification of members of respondents' social network was derived from Cochran et al. (35) and is described in depth elsewhere (36, 37). For different formal types of social relationships, respondents were asked to identify the persons with whom they had frequent contacts and who were important to them. Only persons above age 18 could be identified. The maximum number of names was set at 80, but none reached this limit. A respondent's social network size is the total number of all persons identified by this procedure.

For each network member, the type of relationship with the respondent, gender, and contact frequency (ranging from 1= less than once a year to 8= daily) were recorded.

Types of social relationships. The types of relationships distinguished in this study are those with daughters, sons, other kin (such as siblings) and non-kin (such as neighbors and friends). These differing types of social relationships may be assumed to have different functions within the social support networks of older people, with and without chronic diseases. The resulting variables used in the analyses are number of daughters, number of sons, number of other kin, and number of non-kin relationships.

Instrumental and emotional support. A maximum of 9 network members (excluding partners) was selected on the basis of the highest contact frequency with the respondent. For these 9 network members (or fewer, if fewer had been named), information was gathered with respect to traveling time (in minutes), and the exchange of instrumental and emotional support between network member and respondent. For instrumental support, respondents were asked how often each of these 9 members helped with chores in and around the house. For emotional support, the question was how often they talked about personal experiences and feelings with each of the network members. The response categories for instrumental and emotional support were never, seldom, sometimes, and often, which were assigned values ranging from 0 to 3. For each respondent, the amount of instrumental and emotional support received was computed as the mean of instrumental and emotional support, respectively, received from the 9 network members. Values for these variables could range from 0 (if none of the nine network members provided any support) to 3 (if all nine provided support often).

'Active' and 'non-active' social relationships. Within the various types of relationships (daughters, sons, other kin, and non-kin relationships), members were further distinguished according to contact frequency, traveling time, and the minimum amount of instrumental support provided to the respondent. Emotional support was not used in this distinction because, in preliminary analyses, no association had been observed between emotional support and decline in physical functioning, and emotional

support did not vary among the categories based on instrumental support and traveling time. For each type of social relationship, two variables were computed using the additional information. In this way, the numbers of 'active' and 'non-active' network members within each type of relationship were determined. For daughters and sons, the variables were computed as: 1) the number of daughters and sons, respectively, who lived within 30 minutes' traveling time and with whom the respondent reported having contacts at least once a month and from whom s/he received at least some instrumental support (rarely, sometimes, often); and 2) the number of daughters and sons, respectively, who did not meet these criteria. For other kin and non-kin relationships, the variables were computed as: 1) the number of persons who lived within 15 minutes' traveling time and with whom the respondent reported having contacts at least once a month and from whom s/he received at least some instrumental support (rarely, sometimes, often); and 2) the number of network members within these types of relationships who did not meet these criteria. Respondents who did not mention any network members within a specific type of social relationship were assigned a value of 0 on both variables.

Perceived support. For perceived support, the respondent's sense of loneliness was measured. Loneliness is the unpleasant experience which occurs when a person's network of social relationships is perceived to be deficient, either quantitatively or qualitatively (38). Loneliness was measured by a scale developed by De Jong-Gierveld and Kamphuis (39), which consists of 5 positive items assessing feelings of belonging and 6 negative items applying to aspects of missing relationships. The total range is from 0= no loneliness to 11= severe loneliness. The scale has been used in several surveys and has proven to be a robust, reliable and valid instrument (40), which was also confirmed in the LASA sample (reliability coefficient=0.83; Loevinger's H=0.34).

Statistical analysis

In the analyses, three subgroups were distinguished consisting of persons without, with one, or with more than one chronic disease at baseline, respectively. These three subgroups were compared for demographic characteristics (gender, age), levels of physical functioning at T1 and T2 and decline in physical functioning between T1 and T2, incidence of chronic diseases between T1 and T2, and measures of structural and functional characteristics of the social support network and loneliness at T1.

The effects of baseline levels of social support, perceived support and partner status on decline in physical functioning were examined by using multivariate logistic regression analyses, stratified according to baseline chronic disease status. Because the sample was stratified according to age and gender, adjustments were made for these variables in the analyses. In addition, all analyses were ad-

justed for baseline levels of physical functioning and incident chronic diseases. Partner status (living with partner vs no partner) was included in all analyses. First, the effects of partner status, total network size, mean amount of instrumental and emotional support received, and loneliness on decline in functioning were examined. Second, the total network was specified according to types of social relationships, in order to examine the effects of numbers of daughters, sons, other kin and non-kin relationships in the network on decline in physical functioning. Third, within each type of social relationship, a further specification was made in numbers of 'active' and 'non-active' network members within that type of relationship. In this way, the effects of 'active' and 'non-active' network members within each type of social relationship on decline in physical functioning could be assessed.

In order to determine the statistical significance of differences between the chronic disease subgroups with regard to the effects of social support measures, interaction effects between social support measures and chronic disease status were studied separately using the total sample. In these analyses, in addition to the variables included in the stratified models, chronic disease status was also included as a first-order term.

The logistic regression models were extended with product terms between number of chronic diseases (cat-

egorized as 0, 1 and ≥ 2 chronic diseases) and social support measures, using the backward removal method ($p_{\text{out}} \geq 0.15$). To avoid multicollinearity between first-order terms and product terms, product terms were computed using the centered (deviation from the mean) scores from social support measures (41).

RESULTS

Complete follow-up data were available for 2357 respondents. As compared with these subjects, those who were interviewed in 1992 but not included in the present study were significantly older (mean age at baseline 74.2 vs 69.0 years) and more often men (58 vs 47%). As far as data were present, they also reported more limitations in physical functioning (mean score at baseline 25.5 vs 28.0, with a lower value indicating more limitations), smaller social networks (11.7 vs 13.6 network members), more often not having a partner (37 vs 30%), and more chronic diseases (30 vs 36% for having one, and 47 vs 32% for having two or more diseases).

Respondents with a partner living outside their household ($N=70$; 3% of 2357) were excluded from this study, leaving 2287 respondents, because of the heterogeneity within this subgroup resulting from the different reasons why they were not living together with their partner. No differences were observed between these 70 re-

Table 1 - Background characteristics of study population ($N=2156$) according to number of chronic diseases.

	0 diseases N=755	1 disease N=805	≥ 2 diseases N=727	p-value
Male (%)	415 (55.0%)	377 (46.8%)	276 (38.0%)	<0.001
Age at T0 (SD)	66.7 (8.3)	68.5 (8.4)	71.2 (8.2)	<0.001
Physical functioning at T0 (SD) (range 0-30)	29.4 (1.7)	28.3 (3.4)	26.1 (4.9)	<0.001
Physical functioning at T1 (SD) (range 0-30)	28.9 (2.7)	27.2 (4.8)	24.6 (5.9)	<0.001
Decline in physical functioning between T0 and T1 (%)	78 (10.3%)	163 (20.2%)	242 (33.3%)	<0.001
Incident chronic diseases between T0 and T1 (%)	276 (36.6%)	332 (41.2%)	302 (42.5%)	NS
Living with partner (%)	567 (75.1%)	559 (69.4%)	461 (63.4%)	<0.001
Total social network size (SD)	14.0 (8.5)	13.6 (8.2)	13.2 (8.2)	NS
Number of daughters (SD)	1.3 (1.2)	1.3 (1.2)	1.3 (1.2)	NS
'active' (SD)	0.5 (0.8)	0.5 (0.8)	0.5 (0.9)	NS
'non-active' (SD)	0.8 (1.0)	0.8 (1.0)	0.8 (1.0)	NS
Number of sons (SD)	1.3 (1.2)	1.4 (1.3)	1.3 (1.2)	NS
'active' (SD)	0.6 (0.8)	0.6 (0.9)	0.5 (0.7)	NS
'non-active' (SD)	0.8 (1.0)	0.8 (1.0)	0.8 (1.0)	NS
Number of other kin (SD)	6.1 (5.0)	5.7 (4.4)	5.6 (4.2)	<0.10
'active' (SD)	0.6 (1.1)	0.6 (1.0)	0.6 (1.0)	NS
'non-active' (SD)	5.5 (4.9)	5.1 (4.3)	5.0 (4.0)	<0.10
Number of non-kin (SD)	5.4 (4.8)	5.3 (5.1)	5.0 (5.2)	NS
'active' (SD)	0.8 (1.4)	0.8 (1.4)	0.8 (1.4)	NS
'non-active' (SD)	4.6 (4.5)	4.5 (4.8)	4.2 (4.9)	NS
Mean instrumental support (SD) (range 0-3)	0.7 (0.7)	0.8 (0.7)	0.9 (0.8)	<0.001
Mean emotional support (SD) (range 0-3)	1.8 (0.7)	1.7 (0.7)	1.8 (0.8)	<0.10
Loneliness (SD) (range 0-11)	1.5 (2.1)	1.9 (2.4)	2.3 (2.7)	<0.001

spondents and those included with regard to any of the variables used in this study.

Table 1 illustrates that, although our sample is clearly a survival sample, the stratified sampling frame guarantees the inclusion of a sufficient number of subjects with limitations in physical functioning.

The characteristics of the study sample according to baseline chronic disease status (three subgroups with no, one, or two or more chronic diseases, respectively) are presented in Table 1. The subgroups consisted of 755 respondents without any chronic disease at baseline, 805 respondents who reported having one chronic disease, and 727 with two or more chronic diseases. These subgroups differ on a number of characteristics. The subgroup with two or more diseases had the highest mean age and the highest percentage of women, whereas the subgroup with no diseases had the lowest of each. The highest baseline levels of physical functioning were found for the subgroup without any chronic diseases, whereas the lowest baseline levels of physical functioning were found for the subgroup with two or more diseases. Decline in physical functioning was also found to occur more often in the subgroups with diseases.

The majority of respondents were living together with a partner, but this percentage was significantly lower among respondents with chronic diseases. There was no association between number of chronic diseases at baseline and total network size and the mean amount of emotional support received. There was a significant association between the number of chronic diseases at baseline and the mean amount of instrumental support received ($p < 0.001$) and loneliness ($p < 0.001$): those with more chronic diseases reported receiving more instrumental support and had more feelings of loneliness. The only difference among the subgroups with regard to numbers of network members according to type of social relationship was observed for other kin relationships. The number of 'non-active' network members in this

category declined with the number of diseases ($p < 0.10$), whereas the number of 'active' network members did not differ. With regard to the distribution between 'active' and 'non-active' network members, there was a clear difference between daughters and sons on one hand, and other kin and non-kin relationships on the other: the numbers of 'active' and 'non-active' daughters and sons were approximately equal, whereas the numbers of 'non-active' other kin and non-kin relationships were 5-8 times higher than the numbers of 'active' relationships.

To answer the question of which structural and functional characteristics of the social support network are associated with decline in physical functioning, logistic regression analyses were performed. Table 2 shows the results, adjusted for baseline level of physical functioning, age, gender and incident chronic diseases, in which partner status (living with a partner *vs* no partner), total network size, mean amount of instrumental and emotional support received, and loneliness were entered simultaneously. Among respondents with one chronic disease, no significant effect was observed for any of the social network characteristics. However, among respondents without any chronic disease at baseline, those living together with a partner were at considerably lower risk of decline in physical functioning than those without a partner. Instead, a higher mean amount of instrumental support received was associated with a higher risk of decline in physical functioning. In the subgroup with two or more diseases, the risk of decline in physical functioning was associated with network size: a larger network was associated with a lower risk of decline in physical functioning. Emotional support and loneliness were not associated with the risk of decline in physical functioning in any of the subgroups.

Differences between the disease subgroups were further tested by multiple logistic regression analysis, using the total sample and including chronic disease status as covariate. Using the backward removal method ($p_{\text{out}} < 0.15$), the interaction terms of chronic disease sta-

Table 2 - Results of multiple logistic regression analysis of decline in physical functioning between T1 and T2 on partner status, social network size, mean instrumental and emotional support and loneliness, stratified according to number of chronic diseases and adjusted for age, gender, baseline physical functioning and incident chronic diseases.

	0 diseases		1 disease		≥2 diseases	
	OR	95% CI	OR	95% CI	OR	95% CI
Age (per year older)	1.11	1.07-1.14	1.06	1.04-1.09	1.07	1.04-1.09
Gender (female <i>vs</i> male)	1.56	0.87-2.78	1.52	1.01-2.28	1.15	0.79-1.68
Physical functioning at T1 (range 0-30)	1.21	1.04-1.40	0.92	0.87-0.97	0.96	0.93-0.99
Incident chronic diseases (yes <i>vs</i> no)	2.42	1.44-4.08	1.68	1.16-2.42	1.70	1.22-2.37
Living with partner (<i>vs</i> no partner)	0.48	0.26-0.89	1.03	0.67-1.60	1.21	0.80-1.82
Social network size (per member more)	1.00	0.97-1.03	0.99	0.96-1.02	0.97	0.95-1.00
Mean instrumental support (range 0-3)	1.64	1.16-2.32	1.13	0.87-1.47	1.07	0.85-1.34
Mean emotional support (range 0-3)	1.34	0.91-1.97	1.01	0.79-1.31	1.04	0.84-1.30
Loneliness (range 0-11)	0.99	0.88-1.12	1.03	0.96-1.11	1.05	0.98-1.12

Table 3 - Results of multiple logistic regression analysis of decline in physical functioning between T1 and T2 on partner status and numbers of daughters, sons, other kin and non-kin relationships and loneliness, stratified according to number of chronic diseases and adjusted for age, gender, baseline physical functioning and incident chronic diseases.

	0 diseases		1 disease		≥2 diseases	
	OR	95% CI	OR	95% CI	OR	95% CI
Living with partner (vs no partner)	0.40	0.22-0.73	1.00	0.65-1.54	1.18	0.79-1.77
Daughters (per daughter more)	1.22	1.00-1.52	1.03	0.88-1.20	0.89	0.78-1.03
Sons (per son more)	0.99	0.80-1.21	1.04	0.90-1.20	0.97	0.85-1.12
Other kin (per relationship more)	1.01	0.95-1.07	0.98	0.94-1.03	1.00	0.95-1.04
Non-kin (per relationship more)	1.00	0.94-1.06	0.99	0.94-1.03	0.97	0.93-1.00
Loneliness (range 0-11)	0.98	0.87-1.10	1.03	0.95-1.11	1.05	0.98-1.12

tus and living with a partner ($-2 \log LR=7.6$, $p=0.006$), network size ($-2 \log LR=3.6$, $p=0.06$) and mean amount of instrumental support ($-2 \log LR=3.3$, $p=0.07$) were retained in the final model. This confirmed the differences observed in the analyses stratified according to number of chronic diseases, as presented in Table 2.

To answer the question whether differing types of social relationships have different effects on decline in physical functioning, multivariate logistic regression analyses, adjusted for age, gender, baseline physical functioning, and incident chronic diseases, were performed with partner status and numbers of daughters, sons, other kin and non-kin relationships as independent variables. As in the previously described analysis, living with a partner was associated with a lower risk of decline in physical functioning when no chronic diseases were present at baseline (Table 3). Furthermore, having more

daughters was associated with a higher risk of decline in physical functioning for subjects with no chronic diseases, but not for subjects with one and those with two or more chronic diseases. Having more non-kin relationships was associated with a lower risk of decline in physical functioning in the subgroup with two or more diseases, but not in the other two subgroups. No effects were observed for numbers of sons and other kin relationships and for loneliness in any of the disease subgroups.

Using the total sample, interaction terms were tested of network variables with number of chronic diseases. After backward removal, the interaction terms of the number of chronic diseases with partner status ($-2 \log LR=8.9$, $p=0.003$) and the number of daughters ($-2 \log LR=7.3$, $p=0.007$) remained in the model, confirming the differences observed in the stratified analysis presented in Table 3. However, the interaction term between number

Table 4 - Results of multiple logistic regression analysis of decline in physical functioning between T1 and T2 on partner status and numbers of 'active' and 'non-active' daughters, sons, other kin and non-kin relationships and loneliness, stratified according to number of chronic diseases and adjusted for age, gender, baseline physical functioning and incident chronic diseases.

	0 diseases		1 disease		≥2 diseases	
	OR	95% CI	OR	95% CI	OR	95% CI
Living with partner (vs no partner)	0.42	0.23-0.77	0.97	0.63-1.51	1.22	0.81-1.83
Daughters (per daughter more)						
'active'	1.40	1.03-1.90	1.07	0.85-1.35	1.03	0.84-1.27
'non-active'	1.10	0.84-1.45	1.01	0.84-1.23	0.79	0.65-0.96
Sons (per son more)						
'active'	0.92	0.66-1.27	1.11	0.89-1.38	0.91	0.72-1.16
'non-active'	1.02	0.80-1.32	1.00	0.83-1.20	1.02	0.86-1.21
Other kin (per relationship more)						
'active'	1.13	0.88-1.46	0.81	0.64-1.01	1.02	0.85-1.22
'non-active'	1.00	0.94-1.07	1.00	0.95-1.05	0.99	0.95-1.04
Non-kin (per relationship more)						
'active'	1.07	0.89-1.30	1.02	0.89-1.17	1.00	0.88-1.13
'non-active'	0.99	0.93-1.06	0.98	0.93-1.03	0.96	0.93-1.01
Loneliness (range 0-11)	0.99	0.88-1.11	1.03	0.95-1.11	1.05	0.98-1.12

of chronic diseases and number of non-kin relationships was removed from the extended model, indicating that there is no significant difference in the effect of the number of non-kin relationships among the disease subgroups.

The final set of analyses addressed the question whether there is a different effect of 'active' and 'non-active' network members within each type of social relationship (Table 4). The effect of living with a partner was the same as in previous analyses. Contrary to what was expected, among respondents with two or more chronic diseases at baseline, having a higher number of 'non-active' daughters was associated with a lower risk of decline in physical functioning. Instead, among respondents without any chronic diseases at baseline, a higher number of 'active' daughters was associated with a higher risk of decline in physical functioning. For sons, other kin and non-kin relationships, no effects were found when differentiating between 'active' and 'non-active' relationships.

The differences observed in the stratified analysis were confirmed in the total sample. Using the backward removal model, the interaction terms of number of chronic diseases with partner status ($-2 \log LR=9.3$, $p=0.002$), number of 'non-active' daughters ($-2 \log LR=5.3$, $p=0.02$) and number of 'active' daughters ($-2 \log LR=3.0$, $p=0.08$) remained in the model.

DISCUSSION

Our results provide some evidence that differing types of social relationships and the support they provide, influence decline in physical functioning differentially in older people, with or without chronic diseases.

The most pronounced result was that living together with a partner has a strong protective influence on the risk of decline in physical functioning among older people without any chronic diseases. Contrary to what was expected, having a partner did not decrease the risk of decline in physical functioning in people with chronic diseases. The partner is generally seen as the most important provider of support, especially among those with chronic diseases. Therefore, it was expected that living with a partner would mitigate the negative effects of chronic diseases on decline in physical functioning. Our findings, however, indicate that there is no effect of support from the partner when chronic diseases are present.

There may be two explanations for this finding. First, partner support may have a positive effect by promoting preventive behavior (better diet, health screening, etc.). However, this seems most effective in preventing decline in physical functioning when diseases are absent. Second, partners are limited in the amount of support they are able to provide, and this limit may be reached when the need for help exists for a longer period of time, as is the case when chronic diseases are present (overburden of the partner). Thus, having a partner may have a positive effect at the onset of limitations in physical functioning, slowing

down decline in functioning at the beginning; however, when diseases are present for a longer period, their influence on decline in physical functioning cannot be compensated for by the presence of a partner.

The finding that instrumental support seems to have adverse effects on physical functioning is consistent with the results of Seeman (42), who found negative effects of instrumental support on the risk of decline in physical functioning among older people who were initially without such limitations. In our study, the adverse effects of instrumental support seem to be confined to subjects without any chronic disease. When chronic diseases or limitations in physical functioning are present, instrumental support may or may not have a positive effect on the risk of decline in physical functioning.

The most important findings of this study indicate that, for older people without chronic diseases at baseline, living together with a partner gives a 58% lower risk, and having one additional daughter gives a 22% higher risk of decline in functioning (40% when she provides instrumental support). For example, a person who lives together with a partner and has no (active) daughters in the network has an almost 60% lower risk of declining significantly (see below for an indication of the level of decline required) in physical functioning during three years of follow-up than someone with the same baseline score in physical functioning but without a partner.

Our results confirm earlier findings showing that a larger social network reduces the risk of decline in physical functioning (13). Although it was expected that a larger network of potential providers of support would be protective against decline in physical functioning in all older people with diseases, this study shows that this is true only for those with two or more chronic diseases.

Somewhat contrary to expectations, a higher number of daughters is associated with a higher risk of decline in physical functioning among older people without chronic diseases. This effect may be attributed in particular to the number of 'active' daughters. This is remarkable because children are seen as the main resource of structural social support after the partner. Two explanations are possible. First, daughters who provide support to their parents when it is not needed may cause those parents to rely on the support, which may precipitate decline in physical functioning. Second, these daughters may also provide an adequate anticipatory reaction to any decline in physical functioning which has already started. The daughters then correctly expect this decline to continue or worsen over the subsequent three-year interval. In fact, there may be a transition from inactive to active which reflects early decline. Therefore, 'non-active' daughters may be a marker of good health and 'active' ones a marker of early decline, which is perhaps more sensitive than the somewhat crude measures of disability that we use.

The protective influence of non-kin relationships and 'non-active' daughters was found in older people with two or more chronic diseases, but not in those without or with only one disease. These findings were contrary to expectations based on the 'stress buffer model'. Tentative explanations are that the knowledge that additional support will be available if the need arises protects against decline in physical functioning to some extent, and that having a larger number of non-kin relationships motivates older people to remain physically active, thereby decreasing the risk of decline in physical functioning. These tentative mechanisms should be tested in further research.

Although in our study some specific differential effects of social ties and support on decline in physical functioning were observed for older people with different numbers of chronic diseases, some limitations should be examined. First, the presence of chronic diseases was assessed by self-reports from the respondents. Although this may have resulted in some misclassifications, it seems unlikely to have biased our results. Previously, it was shown that self-reports of chronic diseases were sufficiently accurate in comparison with general practitioner information (34). Second, the follow-up of three years in our study is relatively short when compared with other studies, which may partly explain the small effects we found. The proportions of subjects with decline in physical functioning were not very large, particularly among those who were initially without any chronic diseases. Longer follow-up may be necessary to detect the effects of other social ties and support than those reported in the present study. Third, we have not yet been able to include changes in the measures of social ties and support following the incidence of chronic diseases but preceding decline in physical functioning. In line with earlier results (43), it may well be that the effect of 'non-active' daughters among subjects with two or more chronic diseases is, in fact, caused by those daughters providing increasing support in the three years between the two LASA measurement cycles.

CONCLUSIONS

Our findings suggest that the influence on decline in physical functioning that is found when using global measures of social support, may be specified when a distinction is made between types and active supportiveness of social relationships. In addition, the effects of both global measures of social support and of specific types and active supportiveness of social relationships appear to be modified by the number of chronic diseases. Partner support appears to have its limitations, and effective support from other relationships is mainly provided by daughters. These specifications help to unravel the mechanisms of the relations between social ties and changes in physical health.

APPENDIX

Computation of the EN-Index:

Substantial change in physical functioning at the 10% level is computed for all subjects as follows:

EN=0 (no change) when $T2 \geq (\text{Cronbach's } \alpha * (T1 - \text{mean}) + \text{mean} - 1.645 * \text{se})$ and $T2 \leq (\text{Cronbach's } \alpha * (T1 - \text{mean}) + \text{mean} + 1.645 * \text{se})$

EN=-1 (decline) when $T2 < (\text{Cronbach's } \alpha * (T1 - \text{mean}) + \text{mean} - 1.645 * \text{se})$

EN=1 (improvement) when $T2 > (\text{Cronbach's } \alpha * (T1 - \text{mean}) + \text{mean} + 1.645 * \text{se})$

in which: - se= $SD * \sqrt{(1 - \text{Cronbach's } \alpha)}$

- T1, T2: physical functioning score at T1 and T2

- Cronbach's alpha: scale reliability for physical functioning at T1

- mean: mean physical functioning score at T1

- SD: standard deviation of physical functioning score at T1

- se: standard error

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