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Original Article

Social network effect on self-rated health in type 2 diabetic patients – results from a longitudinal population-based study

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Summary

Objectives: The aim is to analyse the association between social network and self-rated health in a longitudinal design for persons with type 2 diabetes, comparing them with persons without diabetes.

Methods: The analyses are based on data from the population-based 'KORA-A study' conducted in the region of Augsburg (Germany), with data from 1990/1995 (t_0) and 1998 (t_1), including 164 persons with type 2 diabetes and 207 persons without diabetes. The social network was assessed by the Berkman/Syme index.

Results: For the type 2 diabetes group, the multivariate analyses show that a high score of social network at t_0 is associated with good self-rated health at t_1, even if self-rated health at t_0 is included in the model (OR 2.69; 95 % CI: 1.21–5.98). For the non-diabetes group, no such association was found.

Conclusions: The results point towards a 'buffer effect' of the social network, indicating that the positive effect on health can be seen mostly among those who are exposed to a high level of burden, in this case exposed to a chronic disease such as type 2 diabetes.

Keywords: Social network – Self-rated health – Diabetes.

Research on the association between social relations and health has attracted much attention over the past 25 years. Public health research on the effects of social network and social support was strongly influenced by the prospective study of a random sample comprising 6,928 adults living in Alameda County, California[1]. Even after controlling for physical health status at baseline, for socioeconomic and behavioural factors as well as for the utilization of health services, people with few social ties were more likely to die after nine years than those with more ties.

Numerous studies were able to confirm this finding, e. g. with data from the USA[2,3] and from Europe[4,5]. Concerning Germany, there are two comparable studies, and they show very similar associations[6,7]. Other outcomes than mortality have been analysed as well, such as quality of life[8] and onset of dementia[9]. However the association between social network and self-rated health has been analysed only in few studies[10].

While the terms "social relations" and "social ties" are mostly used synonymously, there is a difference between these terms and the term "social network", as the latter refers to a whole system of social relations between individuals. One also has to distinguish between "social network" and "social support": the network is the premise for the perception, availability and receipt of "social support"[11].

The question whether social support directly affects physical health and mental well-being ("*main effect*") or indirectly protects health through buffering the damaging effects of stressors ("*buffer effect*") remains an issue of debate. Some studies have shown the existence of a main effect, and there is also some empirical evidence for a buffer effect[8].

The association between a *change* in the social network and health has been examined primarily in terms of marital transition[12]. Comparing social network indices measured at different time points, Eng et al.[3] found that the level of social ties can change over time to a rather large extent (correlation coefficient = 0.57).

There are some studies on the association between social network and health that have focused on persons with dia-

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betes. Most of them look at the influence of social support on diabetes-specific health behaviour and compliance[13,14.15]. According to Toljamo et al.[16] this disease-specific behaviour can best be referred to as "self management" (i.e. "an active, responsible and flexible process of self-care, in which the patient works to maintain his or her health in close collaboration with health care staff, instead of simply following rules that are prescribed")[17]. It is important to point out that most of these studies are based on a cross-sectional design. Thus, the direction of the causal relationship remains unclear, as social networks may influence self management, but as it is also possible that self management has an impact on social networks. The few longitudinal studies published to date focus on the association between social network and HbA1c as an indicator of self management, but the results are ambiguous[18,19].

Also, differences in network size and amount of support have been found between persons with diabetes and those without diabetes: the latter are more likely to be part of a large network than persons with diabetes[20] and they receive a greater amount of support[21]. Last but not least, it is important to point out that most studies mentioned above deal with type 1 diabetes. Although type 2 diabetes is much more common, only few of these studies focus on persons with type 2 diabetes[21].

In the study presented here, the health outcome is assessed by self-rated health. Self-rated health has been shown to be a good overall indicator of health status, comprising the perception of symptoms, diagnoses and health behaviours[22]. Some studies have also shown that self-rated health is a significant predictor for future morbidity and mortality, independent of more objective (i.e. physician reported) health conditions[6,23]. Most studies focus on the relation between self-rated health and overall mortality, and only few have looked at the association between self-rated health and social network[10].

The objective of our study is to look at the association between social network and self-rated health in more detail, by focussing on persons with type 2 diabetes, by using a longitudinal design, and by comparing these results with results for persons without diabetes. We are not aware of a publication reporting results from a similar study. Two hypotheses are tested: (a) self-rated health is positively influenced by the social network, i.e. a large social network at t_0 is associated with good self-rated health at t_1. (b) This effect is stronger for persons with type 2 diabetes than for persons without diabetes. This second hypothesis relates to the buffer hypothesis, stating that people exposed to a high level of burden (in this case: having diabetes) profit more from a large social network than other people.

Methods

The data for the analyses are taken from the KORA-A Study ("Kooperative Gesundheitsforschung in der Region Augsburg": Co-operative Health Research in the Region of Augsburg)[24–27]. As part of the WHO MONICA project (Monitoring Trends and Determinants in Cardiovascular Disease) in the region of Augsburg/Germany, KORA-A surveyed all diabetic and non-diabetic persons, identified from two previous MONICA studies in Augsburg: cross-sectional surveys conducted in 1989/90 (MONICA S1) and 1994/95 (MONICA S2) among a representative sample of residents aged 25–74 (about 5,000 persons per survey). The KORA-A study was granted full ethical approval by the ethics commission of the Bavarian Medical Association in February 1997.

In the KORA-A Study, all persons with diabetes mellitus who had been identified by the previous MONICA S1 and S2 surveys have been contacted again in 1997/98. A group of non-diabetic persons ("controls") was matched according to age and gender of the diabetic group. In the present analysis, only those persons are included in the diabetes group who have confirmed this diagnosis in the KORA-A Study. From the MONICA S1 and S2 surveys, 413 persons with diabetes have been identified, and 363 (87.9 %) have still been living in the study region. This prevalence may seem to be lower than expected, but we included only those who stated that the diagnosis of diabetes has been confirmed by a physician. Among these, 224 participated in the study, yielding a response rate of 61.7 %. Only those were included in the analyses who again stated in the KORA-A study to have diabetes and that this diagnosis has been confirmed by a physician. Concerning the control group, 459 persons have been identified and 425 were still living in the study region. Finally, 232 persons participated in the study, yielding a response rate of 54.6 %. In a next step, 60 persons from the diabetic group and 25 persons from the non-diabetic group have been excluded because of missing data or "don't know" in the statement about the existence of diabetes. Finally, the study population comprised 164 persons with diabetes and 207 persons without diabetes.

The Social Network Index

The extent of social network is measured by the Social Network Index of Berkman and Syme, as it has been used in the Alameda County Study[1] and since then in several other studies[3,28]. This index consists of four components: marital status, contacts with close friends and relatives, church group membership, group activities. Information on marital status was coded in the following way: single, separated, divorced or widowed (code 1), married or living together (code 2). The component 'close friends and relatives' was assessed by three

questions measuring the number and frequency of contact with close friends or relatives. Church group membership was assessed by a single question. Concerning the fourth component (i.e. group activities), the study participants could indicate whether they attend one or more of the following groups frequently, sometimes or never: athletics club, professional organisation, hobby club (e.g. bowling, chess, music), political group or party, health-related self help group. As proposed by Berkman & Syme[1], these four components are weighted in an algorithm resulting in four categories, ranging from 1 (low social support) to 4 (high social support. This index has a high construct validity (to predict mortality) as well as only a moderate correlation with other psychosocial constructs[29].

Measure of self-rated health

Self-rated health is assessed by the following question: "How would you rate your state of health in general?" with the categories "very good, good, satisfactory, less than good, poor". In the analyses, self-rated health is coded as a binary variable: code 1 for persons with at least satisfactory health (i.e. "good"), and code 2 for those with less than good or poor health (i.e. "poor").

Statistical analyses

Inferential analyses are used for showing potential differences between the diabetic and the non-diabetic group concerning self-rated health, social network and changes of those variables in the follow-up period (t_0: MONICA surveys in 1989/90 and 1994/95; t_1: KORA-A Study in 1997/98). In order to simplify the analyses, we combined the two baseline MONICA Surveys from 1989/90 (S1) and 1994/94 (S2) into a single baseline starting point (t_0). In the longitudinal analyses, we applied bivariate as well as multivariate logistic regression models. The outcome variable is self-rated health as assessed at the end of the follow-up period (t_1). To summarize, the following independent variables are included in the models: social network index at t_0 (dichotomized in 1 "fairly high or high" and 2 "fairly low or low"), self-rated health at t_0 (dichotomized in 1 "good" and 2 "poor"), age (dichotomised as below or above 70 years of age) and sex.

Results

Inferential analyses

The independent variables of the sample at t_1 are shown in Table 1. Overall, higher educational level is rare, as had to be expected in this sample with a mean age of about 67 years. Most participants are men. Also, the differences between persons with and without diabetes concerning age, sex and number of persons in the household are quite small (age and sex has been matched, see above). There are rather clear, but not significant differences concerning educational level, with the socioeconomic status being somewhat higher in the non-diabetes group. The difference concerning the percentages of persons being employed points into the same direction. Good health is significantly more prevalent in the non-diabetic group.

There are also some rather large differences between persons with or without diabetes concerning the social network and its components, and some of these differences are statistically significant. Persons with diabetes have fewer close friends ($p = 0.08$), fewer close relatives ($p = 0.02$), less contact with them ($p = 0.15$), and they are less likely to have "group activities" ($p = .0001$). They are also less likely to live with a partner ($p = 0.32$) and to be member of a church group ($p = 0.18$) (not presented in tables). Consequently, persons with diabetes score lower on the social network index than persons without diabetes ($p = 0.08$) (see Table 1).

Stability over time

Looking at changes of self-rated health individually between t_0 and t_1, four groups can be differentiated: staying in poor health, changing from good to poor health, changing from poor to good health, and staying in good health. Concerning the persons with type 2 diabetes, 24% reported a change from good to poor health, while only a small percentage (6%) reported an improvement from poor to good health. Also, the percentage of persons with type 2 diabetes staying in poor health was clearly larger (19% vs. 8%; $p = 0.003$) and the percentage staying in good health was clearly smaller (51% vs. 70%; $p = 0.0004$) as compared with persons without diabetes. Overall, stability of self-rated health (i.e. staying in good or in poor health) is much more often than instability, in the type 2 diabetic group (70% vs. 30%) as well as in the non-diabetic group (78% vs. 22%) (not presented in tables).

The individual changes in the social network between t_0 and t_1 are also relevant. Stability in the social network is more prevalent than a change, for persons with type 2 diabetes (67% vs. 33%) as well as for persons without diabetes (72% vs. 28%). Comparing persons with and without type 2 diabetes, the results indicate that in the diabetes group significantly fewer persons are keeping a high score (22% vs. 35%; $p = .007$). Also, a reduction of the social network can be found significantly more often in the type 2 diabetic group (25% vs. 16%; $p = .04$).

Multivariate analyses

In the bivariate logistic regression analysis (see Table 2), self-rated health at t_1 is included as the dependent and social network at t_0 as the main independent variable. The results for

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Table 1. Basic characteristics of the sample at t_1.

	Persons with type 2 diabetes (n = 164) *	Persons without diabetes (n = 207) †	p-value (chi²- or t-test)
Age (in years)			0.2
– mean	67.8	66.7	
– standard deviation	8.4	9.1	
– range	44–83	33–83	
Gender (in %)			0.8
– women	42.1	40.6	
Educational level (in %)			0.06
– primary (≤ 9 yrs)	79.6	70.5	
– secondary (≤ 11 yrs)	15.4	18.4	
– tertiary (> 11 yrs)	5.0	11.1	
No. of persons in household			0.8
– mean	2.1	2.1	
– standard deviation	1.0	1.0	
– range	1–7	1–6	
Employed (in %)	13.0	20.3	0.06
Per capita income/month (in Euro)			0.3
– mean	871.4	930.2	
– standard deviation	45.2	45.8	
– range	89–2.665	55–3.250	
Health (in %)			
– good	57.4	74.7	0.001
Social Network Index (in %)			
– 1 (low)	25.6	19.6	0.08
– 2	42.8	35.3	
– 3	9.9	22.8	
– 4 (high)	21.7	22.3	

*) n = 76 from Survey 1989/90 and n = 88 from Survey 1994/95
†) n = 106 from Survey 1989/90 and n = 101 from Survey 1994/95

persons with diabetes show that a high social network index score at t_0 is associated with good self-rated health at t_1 (OR 2.10; 95 % CI 1.06–4.15). Even after controlling for self-rated health at t_0 and for age and sex, the odds ratio for a high social network index score at t_0 remains significant (OR 2.69; 95 % CI 1.21–5.98). As expected, self-rated health at t_1 is mostly influenced by self-rated health at t_0 (OR 7.92; 95 % CI 3.15–19.90). Concerning age and sex, no significant association could be found with self-rated health at t_1 in this sample of type 2 diabetic patients with a mean age of about 67 years.

In the non-diabetic group, self-rated health at t_1 is not significantly influenced by the social network at t_0. Again, self-rated health at t_1 is significantly associated with self-rated health at t_0 (OR 5.90; 95 % CI 2.18–16.0), and in this sample of non-diabetic persons, men more often than women report a good self-rated health (OR 5.06; 95 % CI 2.23–11.50). In further analyses not presented here, the socio-economic variables educational level and per capita income have been included in the multivariate analyses as well, but no significant associations with self-rated health at t_1 could be found. Also, separate analyses for the MONICA survey participants from 1989/90 on one hand and from 1994/95 on the other showed very similar associations. Therefore, the tables presented above just show the results for the joint dataset.

Discussion

The major result of our study is based on the longitudinal design looking at the effect of the social network at t_0 on self-rated health at t_1. They show that among persons with type 2 diabetes a larger social network at t_0 is associated with better self-rated health at t_1, even after controlling for age, sex and self-rated health at t_0 (see Table 2). Interestingly, this protective effect of the social network cannot be seen in the non-diabetes group. Thus the study supports the "buffer hypothesis", stating that the social network promotes health mostly among people exposed to a high level of burden. In this specific case, "burden" refers to having type 2 diabetes. In our analyses we also looked for associations with HbA1c and BMI, but we did not find any significant results.

We are aware of a few comparable studies concerning the health promoting effect of social network among people with diabetes. One study has shown that those exposed to high levels of stress and low levels of social support have significantly

Table 2. Logistic regression models with "good self-rated health" at t_1 as the dependent variable.

	Persons with type 2 diabetes (n = 164) Odds ratios (95% conf. interv.)		Persons without diabetes (n = 207) Odds ratios (95% conf. interv.)	
	bivariate	**multivariate**	**bivariate**	**multivariate**
Social network (t_0)				
– low score †	1.00	1.00	1.00	1.00
– high score ‡	2.10*	2.69*	0.95	0.90
	(1.06–4.15)	(1.21–5.98)	(0.48–1.90)	(0.40–2.03)
Self-rated health (t_0)				
– poor	–	1.00	–	1.00
– good		7.92**		5.90**
		(3.15–19.9)		(2.18–16.0)
Age				
– ≥ 70 years	–	1.00	–	1.00
– ≤ 69 years		0.79		1.35
		(0.37–1.71)		(0.59–3.08)
Gender				
– female	–	1.00	–	1.00
– male		1.63		5.06**
		(0.75–3.51)		(2.23–11.5)

* $p < .05$; ** $p < .001$
†): fairly low or low social network score; ‡): fairly high or high social network score

higher blood glucose levels than those with the same level of stress having high social support[30]. This study is based on a cross-sectional design, though, and a rather small number of diabetic individuals (n = 80). In a prospective study with 256 Japanese outpatients with Type 2 diabetes the authors show that social support plays an important role in strengthening self-efficacy, rather than having a direct effect on adherence[19].

In order to analyse the "buffer effect" in more detail, it could be important to assess the level of stress among people with diabetes, and to be more precise concerning the size and the quality of the social network. We used the measure proposed by Berkman and Syme, as it is well established and very practical in a population based survey (it takes only 3–5 min to answer). It is a rather simple instrument, though, and it focuses on structural components of the social network, neglecting functional aspects (such as satisfaction with the current network). In a longitudinal design with healthy (!) participants, Melchior et al.[10] found that functional aspects are significantly associated with self-reported health, whereas no such association could be found for the structural components. Garay-Sevilla et al.[14] concluded that adherence to treatment in NIDDM patients is associated with functional aspects of social support. Future studies should assess whether the buffer effect is greater for functional than for structural components among persons with type 2 diabetes as well.

The other results of this study can be summarized as follows: Persons with type 2 diabetes have a smaller social network than persons without diabetes. Self-rated health is rather stable during this follow-up period of 4 to 8 years, in the type 2 diabetes group as well as in the non-diabetes group. Changing from good to poor health is more common among persons with diabetes. The social network is not quite as stable as self-rated health during this follow-up period. A reduction of the social network is more common in the type 2 diabetes group. In a longitudinal study of rural elders, Cerhan & Wallace[2] found that low levels of social ties at t_0 and t_1 are associated with greater mortality risks than changes of social ties between t_0 and t_1, independent of other variables such as chronic disease, age and sex. They concluded that keeping a low level of social network may be a more important mortality risk than changing this level. Based on their conclusion it is important to note that keeping a low level of social network is more common in the type 2 diabetes group, although this association does not reach the level of statistical significance ($p = 0.2$).

Several *strengths and limitations* of our study have to be taken into account: The major strength is that it is based on a longitudinal design (with a rather long follow-up period of 4 to 8 years). It is hardly possible to analyse the questions addressed here in a cross-sectional design[29,31]. Another strength is that it is based on a representative sample of the population[32]. Some other studies are based on very specific settings (e. g. employees of a specific company[10]), and it may be difficult to generalise the results. One major limitation of our study needs to be mentioned as well: The study population has been recruited from surveys, leading to problems of non-response in the previous MONICA surveys as well as in the present KORA-A

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study. It can be assumed that non-response is associated with severe sickness, among persons with or without diabetes. It is difficult, though, to assess the bias that could be introduced by this non-response.

Future studies should focus on different types of interventions aimed at supporting social networks for people with diabetes. These interventions could include, for example, the promotion of groups where the people with diabetes, their families and friends can meet. They could also include more information especially for the families and friends, so that they can better understand the disease and the chances given by social support. If these interventions are based on the participatory approach (i. e. planned and conducted mainly by the patients, their families and friends themselves), then they should provide a very good basis for health promotion. It would be important to test a whole range of specific interventions and to assess their health effects on the people with diabetes. Thus it would be possible to suggest specific types of interventions for specific groups of people with diabetes.

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