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The association between resilience and diabetic neuropathy by socioeconomic position: Cross-sectional findings from the KORA-Age study

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Abstract

We investigated whether older adults with diabetes mellitus and lower resilience have an increased risk of diabetic neuropathy as compared to older adults with higher resilience, and whether this association varies by socioeconomic position. In total, 3942 individuals took part in a health survey in Augsburg, Germany, in 2008–2010 (KORA-Age study). We found that among participants with low socioeconomic position, those with higher resilience had a lower probability of suffering from neuropathy as compared to participants with lower resilience (absolute risk reduction = 10%). Adjusted odds ratio with 95% confidence intervals for the outcome diabetic neuropathy also showed that lower resilience scores had an independent effect in increasing the risk of diabetic neuropathy among elderly individuals with a low socioeconomic position (odds ratio: 1.83; confidence interval: 1.09–3.08). Health-promoting strategies focussing on resilience should be further explored.

Keywords

elder, health education, health promotion, risk, socioeconomic status

Introduction

More than 300 million people worldwide have diabetes mellitus (DM) (World Health Organization (WHO), 2013). The highest prevalence is among people over 65 years (Van Dieren et al., 2010) and among socially deprived individuals (Agardh et al., 2011). Several studies also reported increased prevalence of type 2 diabetes and adverse health outcomes among

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people with diabetes in the most deprived areas of residence (Connolly et al., 2000; Fano et al., 2012). Diabetes complications, which include retinopathy, kidney failure and neuropathy, are likely to lead to disabilities and reduced quality of life. An association between socioeconomic position (SEP) and diabetes complications has also been reported by several studies (Bachmann et al., 2003; Mielck et al., 2005). In particular, socially disadvantaged individuals are more likely to suffer from neuropathy (Bihan et al., 2005), one of the most common diabetes complications.

Resilience, understood as a personality characteristic (Schumacher et al., 2004), has been associated with better physical health (Smith, 2006) and, among people with diabetes, with better glycosylated haemoglobin (HbA_{1c}) (Steinhardt et al., 2008; Yi et al., 2008). Some studies found that resilience (mastery), used as a personal resource, was a very strong correlate of health-related functioning among patients with diabetes (Mertens et al., 2011). Positive emotional health, including resilience, has also been found to improve health outcomes among persons with diabetes (Robertson et al., 2012). Among people belonging to a low SEP, high resilience has been associated with better nutritional choices (Perna et al., 2011). Building on this literature, this study aimed to explore whether high resilience was associated with a decreased risk of diabetic neuropathy and whether this association varied by SEP.

Method

Study population

The study population consists of four samples recruited in Augsburg, Germany, at 5-year intervals starting in 1984/1985 (the MONICA study and the subsequent KORA study). The age range was 25–74 years at baseline. The response rate varied between 79% and 67% (Löwell et al., 2005). In 2008/2009, information on health status was assessed via a follow-up questionnaire ($N = 4565$); participants aged ≥64 were additionally invited to a telephone interview focusing on multi-morbidity and mental health (KORA-Age cohort study: $N = 4127$) (Lacruz et al., 2010; Peters et al., 2011). Our sample is composed of participants of the KORA-Age cohort study who conducted the telephone interview personally and provided information in the 2008/2009 follow-up questionnaire ($N = 3942$). The KORA-Age study was approved by the Ethics Committee of the Bavarian Medical Association. Participants gave written informed consent.

Resilience

Resilience was measured in the follow-up survey (KORA-Age cohort study), but it was not assessed at baseline. Details of the instrument used to measure resilience, a short version (RS-11) of the resilience scale developed by Wagnild and Young (1993), have been given elsewhere (Schumacher et al., 2004). Briefly, the concept of resilience, as identified by the RS-11, refers to a protective personality factor enabling people to adapt positively to adversity. The possible answers to the 11 resilience items ranging from strongly disagree (= 1) to strongly agree (= 7) were obtained through telephone interview and then summed up across all 11 questions in order to build a resilience score. Participants with more than two missing items were excluded ($N = 32$). Resilience scores were then divided into thirds derived from the distribution of the data. Those participants with a score in the upper third were considered to have high resilience (Hardy et al., 2004).

Neuropathy

In the 2008–2009 follow-up questionnaire, participants were asked whether they suffered from DM and from its complications, including neuropathy, and to provide the year of diagnosis. Participants who reported to suffer from neuropathy as a consequence of diabetes – and who reported a year of diagnosis for neuropathy following that of diabetes – were classified as affected by diabetic neuropathy. Nine participants who reported neuropathy diagnosis for a year prior to diabetes were excluded.

SEP

We defined SEP by the level of school education reached by the participant, categorizing the variable 'educational level' according to the standard grouping in Germany: 'low' (*Hauptschulabschluss*) and 'higher' (*Mittlere Reife, Fachabitur, Abitur*).

Other variables

Body weight, physical activity and healthy nutrition are lifestyle factors important for controlling blood glucose levels and preventing diabetes complications. We controlled for these factors in multivariate analyses.

Body mass index (BMI). Height and weight were obtained from written health questionnaires. A BMI equal to 25 kg/m^2 or higher was considered a risk factor.

Physical activity. Participants were asked to answer two questions on how often they exercised per week in summer and winter. Possible answers were (1) > 2 hours, (2) 1–2 hours, (3) <1 hour and (4) none. We considered those who had a total score < 5, obtained by summing the numbers (1)–(4) relating to winter and summer, to be 'physically active'. In addition, those who used to walk at least 30 minutes to 1 hour a day were also considered 'physically active'.

Nutrition. The telephone interview included information on the amount of fruit and vegetables the participants used to eat every day; we considered participants to have healthy nutrition if they consumed ≥4 servings/day of fruit and vegetables (Centers for Disease Control and Prevention (CDC), 2012).

Statistical analysis

Descriptive statistics was used to show the distribution of the relevant variables, and a two-sided Wilcoxon test for statistical significance was performed in order to compare mean resilience scores between those with neuropathy and those without neuropathy. Odds ratios (ORs) were calculated for the outcome variable 'diabetic neuropathy'. The statistical analysis was conducted with the software package SAS® version 9.1 (SAS Institute, Inc., Cary, NC, USA).

Results

The majority of study participants (60%) was <75 years with a median age of 66 years for both men and women. There were more women than men (52% vs 49%) and women were slightly more resilient than men (52% vs 48%), but this difference was not significant (p = 0.4907). Therefore, we did not conduct further analyses stratified by sex. Most participants belonged to the group with low educational level (69%), reflecting the distribution commonly seen in this age group in Germany (Bundesministerium für Bildung und Forschung (BMBF), 2006). The prevalence of DM (N = 666, 17%) also corresponded to that of the general population in Germany for people older than 60 years (Heidemann et al., 2011), underlining the representativeness of our study sample. Among patients with diabetes and information on neuropathy (N = 641), 26% (N = 167) suffered from neuropathy; among participants with neuropathy and available information on resilience (N = 162), 22% were resilient. Further detailed information about the distribution of such variables is presented in Figure 1.

There was a statistically significant difference (p = 0.0143) between mean resilience scores of those suffering from neuropathy and those without neuropathy. In the group with low educational level, the overall prevalence of resilience was significantly lower than in the group with higher educational level (31% vs 37%; p = 0.0002). Also, in the group with low educational level, the percentage affected by neuropathy was significantly lower among resilient than among non-resilient persons (18% vs 28%; p = 0.0225) and participants with lower resilience scores had approximately a 60% increased risk of suffering from neuropathy as compared to participants with higher resilience scores. The absolute risk reduction was 10%. In

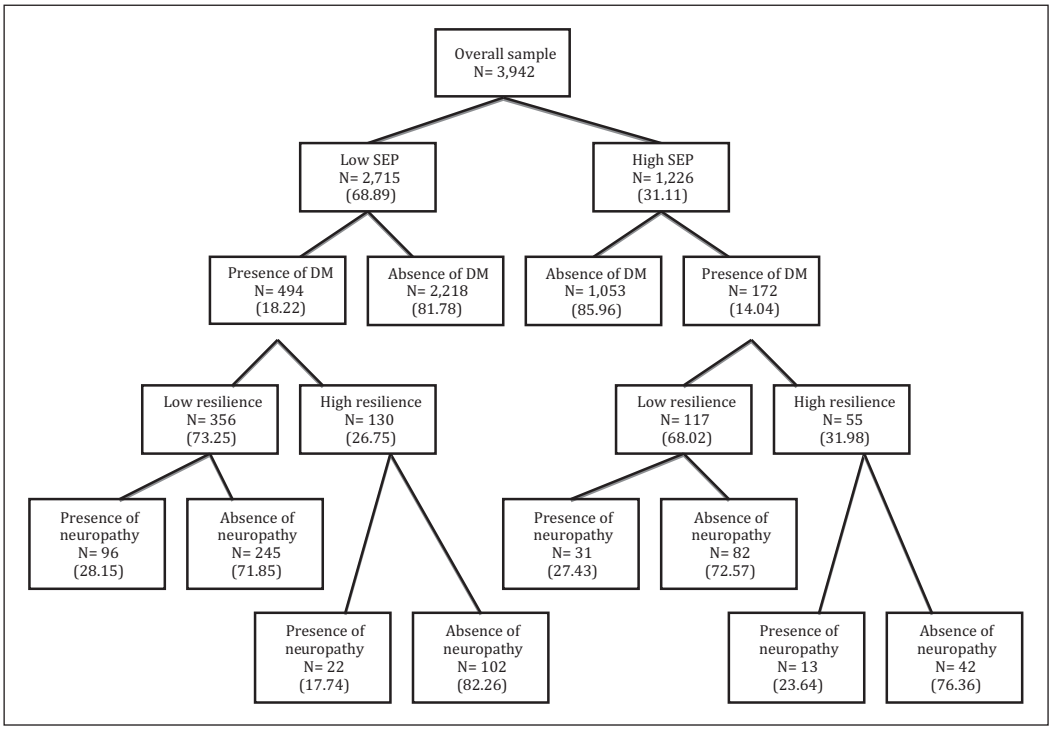

Figure 1. Participant characteristics.
N: absolute number of participants (percentage); SEP: socioeconomic position; DM: diabetes mellitus.

the subgroup of participants with higher educational level, no such difference could be found (24% vs 27%; $p = 0.5994$). The results of the multivariate analysis are in line with the bivariate analyses, indicating that resilience and neuropathy were closely related in the subgroup with low SEP in all models (Table 1).

Persons with diabetes belonging to a low SEP and with low resilience had approximately a twofold higher risk of suffering from diabetic neuropathy than people with diabetes, belonging to the same SEP, but with high resilience. Adjusted OR for diabetic neuropathy (independent variable: low resilience) was 1.83 with a confidence interval (CI) of 1.09–3.08 ($p = 0.0230$). No other variable included in the model reached the significance level of $p < 0.05$. Among participants belonging to a higher SEP, no significant association was observed. A further analysis (data not shown) including resilience scores as continuous variable and the SEP in the same model also showed that higher resilience scores might have a protective effect against the risk of developing neuropathy (OR = 0.98; CI = 0.96–1.00 with a p-value of 0.0183). By additionally including the interaction term resilience × SEP, the point estimate of the continuous resilience scores was −0.0328 with a standard error (SE) of 0.0172 ($p = 0.0559$); the point estimate of the interaction term was 0.0169 (SE = 0.0197; $p = 0.3916$).

Discussion

As far as we know, this is the first study that explores the association between resilience and diabetic neuropathy by SEP. Our major finding is that in the subgroup of patients with diabetes and with low educational level those who have high resilience have a reduced risk

Table 1. Association between resilience and diabetic neuropathy by educational level (KORA-Age, Germany – 2008–2010).

	Odds ratio (95% CI)	
	Low education	Higher education
Low resilience	1.83 (1.09–3.08)	1.17 (0.54–2.55)
Age	0.97 (0.64–1.49)	1.45 (0.71–2.97)
Sex	1.10 (0.72–1.67)	1.90 (0.85–4.24)
BMI	1.18 (0.64–2.16)	0.84 (0.36–1.93)
Physical activity	1.40 (0.84–2.34)	2.13 (0.91–4.96)
Consumption of fruit and vegetables	0.69 (0.42–1.16)	0.91 (0.41–2.02)

BMI: body mass index; CI: confidence interval.

of neuropathy, and that no similar association can be found among patients with higher educational level. This expands previous observations that mostly focussed on prevalence of DM, or complications other than neuropathy, and did not differentiate among different socioeconomic groups.

A potential explanation for the beneficial effects of resilience among older people with diabetes could be that resilient individuals are more willing to comply with the challenges of an integrated treatment of diabetes, including medical and lifestyle demands. Psychosocial and affective factors are, in fact, instrumental in treating diabetes and its complications as they influence self-management tasks associated with the control of diabetes (Glasgow et al., 2001).

With our data, we conducted further analyses (data not shown) in order to better specify this possible explanation. We found that resilient and non-resilient persons had similar habits regarding important health-related variables such as smoking, health-care utilization and living status. Also, the additional inclusion of insulin treatment (as an indication for the severity of DM) in the regression models did not change the results for the variable resilience. Considering that physical activity and diet also did not alter the independent effect of resilience on neuropathy, our results seem to support the important role of positive emotional health (including resilience) per se in protecting patients from the negative consequences of lifelong tasks associated with the burden of chronic diseases (Robertson et al., 2012).

The protective effect of high resilience against the development of diabetic neuropathy is in line with other studies that showed a positive effect of high resilience on other diabetes complications, such as worsening glycosylated haemoglobin (Yi et al., 2008), and of resilience intervention on glycosylated haemoglobin and on self-management of diabetes (Bradshaw et al., 2007; Steinhardt et al., 2008). Furthermore, our findings support previous analyses showing that positive emotional health, including resilience, improves health outcomes among persons with diabetes (Robertson et al., 2012). They also confirm the findings of a recent study that, similarly to our analysis, used resilience as a personal resource and found that elderly people with type 2 diabetes and with a high level of mastery, a marker of resilience, had higher odds of relatively successful functioning, including health-related functioning, as compared to study participants with a low level of mastery (Mertens et al., 2011).

Our analysis expands existing observations by focusing on diabetic neuropathy and by differentiating the analysis according to socioeconomic groups. The finding that resilience might have a positive effect among persons with diabetes who belong to a low SEP is of particular relevance, as people with low SEP tend to engage more in health risk behaviour (Mielck,

2000), which has negative repercussions on demanding self-management tasks related to diabetes care. Also, a positive effect of resilience on neuropathy could be relevant especially for disadvantaged individuals during working age, as less educated people are more likely to have jobs requiring physical involvement (as compared to people with higher educational level), and reduced job performance caused by neuropathy could lead to job loss among people belonging to a lower SEP.

Our observation could be important for the decision-making process relating to public health programmes for disadvantaged individuals with diabetes (Richardson, 2012). It could be argued that the beneficial effect of resilience is especially pronounced in adverse life circumstances, and that special programmes would be needed to increase resilience for this group of patients. However, a model that included the interaction term resilience × SEP was just under the level of statistical significance of 0.05 for the variable resilience, and the interaction term itself was not significant. Thus, the observed difference among people with low and high SEP should be further explored also by using other instruments to determine resilience.

An important limitation of our study is the cross-sectional nature. Resilience was not assessed at baseline but in the follow-up survey when participants had already developed neuropathy. This prohibits the assessment of changes in resilience resources following the development of neuropathy. Since the RS-11 measures resilience as a personality characteristic that remains relatively stable throughout life (Roberts and DelVecchio, 2000), and as the stability of resilience over time has also been observed in several studies (Luthar et al., 2000), it seems to be rather plausible that high resilience could contribute to a decreased risk of neuropathy instead of the reverse causation. Also, a longitudinal study found that in patients with diabetes resilience buffered worsening HbA_{1c}, thus supporting the interpretation that excludes reverse causation (Yi et al., 2008). Another limitation is that the available information, including that on diabetes and neuropathy, was self-reported.

Our analysis stresses the importance of preventive measures aimed to increase resilience and the potential of these measures to reduce health inequalities. If our results are confirmed in other studies, the effectiveness of such interventions among socially disadvantaged people with diabetes should be assessed in much more detail.

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