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Cognitive Reserve Mediates the Relation between Neighborhood Socio-Economic Position and Cognitive Decline

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Keywords

Cognitive decline · Cognitive reserve · Activity engagement · Neighborhood socio-economic position · Old age · Longitudinal study

Abstract

Introduction: We investigated the mediating role of leisure activity engagement as marker of cognitive reserve in the relation between neighborhood socio-economic position (SEP) and cognitive decline over 6 years. ***Methods:*** The study analyzed longitudinal data from 897 older adults who participated in the two waves (2011 and 2017) of the Vivre-Leben-Vivere (VLV) survey in Switzerland (M = 74.33 years in the first wave). Trail Making Test parts A and B were administered in both waves. Leisure activity engagement was assessed during interviews. Neighborhood SEP was derived from the Swiss Neighborhood Index of Socio-Economic Position (Swiss-SEP), provided by the Swiss National Cohort (SNC). ***Results:*** Latent change score modeling revealed that 42.5% of the relationship between higher neighborhood SEP and smaller cognitive decline was mediated via a higher frequency of leisure activities in the first wave. ***Conclusion:*** Neighborhood SEP constitutes an important contextual factor potentially influencing the pathways of cognitive reserve accumulation and, therefore, should be taken into account to better understand their effects on cognitive decline in old age.

Introduction

Leisure activity engagement has been proposed as a key marker for the build-up of cognitive reserve that is instrumental for maintaining cognitive functioning in

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aging [1]. Empirically confirming the predictions of the cognitive reserve concept, cross-sectional and longitudinal evidence showed that engaging in leisure activities in old age contributes to the accumulation of cognitive reserve and is related to better performance and reduced cognitive decline in old age [2–4].

From a broader perspective, it matters in which particular context, i.e., demographic, economic, or societal characteristics of the surrounding environment, individuals grow old [5]. In this regard, one fine-grained contextual factor, on which we want to focus in the present study, is neighborhood socio-economic position (SEP). It is indicated by data on income, education, occupation, and housing conditions in the individual's neighborhood [6]. Lower neighborhood SEP has, e.g., been found to be related to lower cognitive functioning [7, 8] and more generally, to increase in the risks of health degradation [9]. Besides, this important contextual factor may likely also influence the pathways of cognitive reserve accumulation and, hence, should be taken into account in cognitive reserve research. For instance, activity engagement is greater in individuals residing in districts with higher SEP [10].

Combining the interplay of the aforementioned relationships in one overarching framework, one could assume that activity engagement mediates the relation between neighborhood SEP on the one hand and cognitive functioning on the other. Yet, to the best of our knowledge, there is no longitudinal investigation to date regarding the mediating role of leisure activity engagement in the relation between detailed contextual data in terms of neighborhood SEP and cognitive decline. To address this major gap in the literature, we investigated whether leisure activity engagement as marker of cognitive reserve mediates the relation between a fine-grained measure of neighborhood SEP and cognitive decline over 6 years as measured through performance changes in the Trail Making Test (TMT), taking into account age, sex, and education (being an early-life marker of cognitive reserve [1, 2, 11]) as covariates.

Materials and Methods

Participants

We analyzed data from 897 individuals who participated in the two waves of the Vivre-Leben-Vivere (VLV) survey, a study on vulnerability in old age in Switzerland [12]. Respondents were first interviewed during 2011 (wave 1; W1) and again in 2017 (wave 2; W2) using face-to-face computer-assisted personal interviewing and paper-pencil questionnaires. For further details regarding the rationale, design, recruitment, materials, and procedures of the VLV survey, see references [12–18]. The mean age of these respondents in W1 was 74.33 years (SD = 6.50, range 64–96); 51.4% were men.

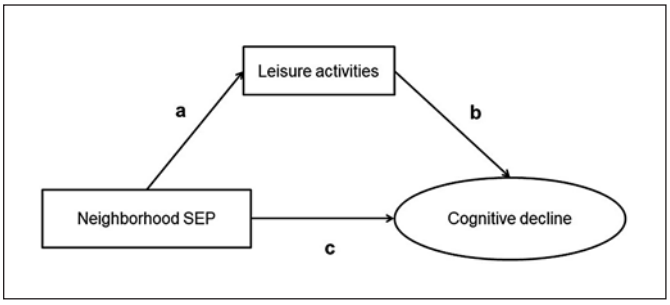

Fig. 1. General structure of the latent model applied to investigate whether the relation between neighborhood SEP and cognitive decline from wave 1 to wave 2 was mediated via frequency of leisure activities in wave 1 as a marker of cognitive reserve.

Materials

In both waves, we administered TMT parts A and B [19]. We asked participants in W1 about their engagement in 18 cognitive, social, physical, and cultural leisure activities. We calculated an overall measure of the frequency of leisure activity engagement in W1 [14]. To derive our measure of neighborhood SEP, we used the Swiss neighborhood index of SEP (Swiss-SEP), which is based on the 2000 census and road network data [6]. Using median rent per square meter, the share of households headed by a person with primary education or less, the proportion headed by a person in manual or unskilled occupation, and the mean number of persons per room, it defines a nationwide grid of neighborhood SEP at a resolution of 50 households. The Swiss-SEP has been validated as a strong predictor for epidemiological research on, e.g., health and mortality [20, 21]. We then created geographic coordinates for each participant of the VLV survey using their residential address. We then used ArcGIS to locate each individual in the Swiss-SEP grid, thus attributing each person the corresponding Swiss-SEP score.

Statistical Analyses

Using latent change score modeling, we modeled latent cognitive factors of TMT completion time in W1 (constructed from TMT parts A and B in W1) and W2 (constructed from TMT parts A and B in W2) as well as a latent cognitive change variable regarding change in TMT completion time from W1 to W2 [17, 18]. With this latent change score model, we investigated whether the relation between neighborhood SEP and cognitive decline from W1 to W2 was mediated via the frequency of leisure activities in W1 as marker of cognitive reserve (see Fig. 1 for a general illustration), taking into account age in W1, sex, and years spent for formal education as covariates. Importantly for evaluating mediation, the applied approach allowed simultaneously estimating the residual direct (non-mediated) relation between neighborhood SEP and cognitive decline (i.e., the coefficient of path c) and the indirect (mediated) relation via the frequency of leisure activities (i.e., the product of the coefficients for paths a and b), including their significance. For model estimation, we used full information maximum likelihood.

Results

With regard to descriptive statistics, mean completion time in TMT A was 55.23 s (SD = 24.40) in W1 and 56.03 s (SD = 24.37) in W2. Mean completion time in TMT B was 115.13 s (SD = 44.80) in W1 and 108.90 s (SD = 45.40) in W2. The mean leisure engagement score was 1.28 (SD = 0.38). Mean education was 13.46 years (SD = 3.96). The mean neighborhood SEP score was 62.73 (SD = 11.94).

In the latent change score model, a higher frequency of leisure activities in W1 significantly predicted a smaller increase in TMT completion time from W1 to W2 (i.e., smaller cognitive decline, $\beta = -0.13$, $p = 0.003$). Older age in W1 significantly predicted a larger increase in TMT completion time from W1 to W2 (i.e., steeper cognitive decline, $\beta = 0.31$, $p < 0.001$). Sex ($\beta = -0.05$, $p = 0.231$) and education ($\beta = 0.02$, $p = 0.639$) did not predict changes in TMT completion time. There was no residual direct (nonmediated) relation between neighborhood SEP and changes in TMT completion time ($\beta = -0.02$, $p = 0.682$). Yet, higher neighborhood SEP was related to a higher frequency of leisure activities in W1 ($\beta = 0.10$, $p = 0.003$). Importantly, 42.5% of the relation between higher neighborhood SEP and a smaller increase in TMT completion time from W1 to W2 (i.e., smaller cognitive decline) was exerted indirectly via a higher frequency of leisure activities in W1 as the mediator ($\beta = -0.01$, $p = 0.036$).

Discussion

With regard to the role of fine-grained contextual factors for cognitive reserve accumulation and cognitive aging, present longitudinal results have important implications. Using latent change score modeling (extracting measurement-error variance), we found that almost half of the relation between higher neighborhood SEP and smaller cognitive decline over 6 years (i.e., indicated by a smaller increase in TMT completion time) was mediated via a higher frequency of leisure activities in the first wave as marker of cognitive reserve.

Thus, neighborhood SEP constitutes an important contextual factor potentially influencing the pathways of cognitive reserve accumulation and, therefore, should be considered in cognitive reserve research. One underlying mechanism could be that areas with higher SEP benefit from more investments in local public sport and recreational centers and parks, and cultural life, assuring that individuals have opportunities in their neighborhood to pursue an active and stimulating lifestyle [9]. This dovetails with the idea that "people make places and places make people" ([22]: p. 1962). Concerning the latter role of the surrounding environment, there is evidence suggesting that individuals residing in a neighborhood with better community resources and proximity to public spaces in good condition show a smaller cognitive decline, presumably by enhancing opportunities for engaging in cognitive, social, cultural, and physical activities, or by providing access to places that promote engagement in such activities [23–26]. Therefore, our findings emphasize that the specific pathways of cognitive reserve build-up need to be considered with regard to the detailed characteristics of the surrounding environment in which they take place to better understand their effects on cognitive decline in old age.

Limitations of the present study include the correlative study design that does not allow drawing causal conclusions. We acknowledge that the cognitive assessments were limited to the TMT and thus call for a replication including a broader evaluation of cognitive performance. Moreover, future research might also focus on the particular role of potential confounders such as access to health services, air pollution, and the influence of the country's welfare regimes on individuals' income.

Statement of Ethics

All participants gave their written informed consent for inclusion in the study before participating. The present study was conducted in accordance with the Declaration of Helsinki, and the study protocol had been approved by the Ethics Committee of the Faculty of Psychology and Social Sciences of the University of Geneva (project identification codes: CE_FPSE_October 14, 2010, and CE_FPSE_April 05, 2017).

Conflict of Interest Statement

The authors have no conflicts of interest to disclose.

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Author Contributions

A.I. formulated the research question, conceptualized the study, analyzed the data, and wrote the manuscript. R.G., M.O., and M.K. formulated the research question, conceptualized the study, supervised the data collection, and participated in writing. E.R.G. and B.R.G. formulated the research question and helped with writing. A.M. and P.M. assisted in writing.

Data Availability Statement

Data are available as online supplementary material (Table S1) (see www.karger.com/doi/10.1159/000521905 for all online suppl. material).

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