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Cognitive trajectories in relation to hospitalization among older Swedish adults

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ABSTRACT

Introduction: Research indicate that cognitive impairment might be related to hospitalization, but little is known about these effects over time.
Objective: To assess cognitive change before and after hospitalization among older adults in a population-based longitudinal study with up to 25 years of follow-up.
Method: A longitudinal study on 828 community living men and women aged 50–86 from the Swedish Adoption/Twin Study of Ageing (SATSA) were linked to The Swedish National Inpatient Register. Up to 8 assessments of cognitive performance (general cognitive ability, verbal, spatial/fluid, memory, and processing speed) from 1986 to 2010 were available. Latent growth curve modelling was used to assess the association between cognitive performance and hospitalization including spline models to analyse cognitive trajectories pre- and post-hospitalization.
Results: A total of 735 persons (89%) had at least one hospital admission during the follow-up. Mean age at first hospitalization was 70.2 (± 9.3) years. Persons who were hospitalized exhibited a lower mean level of cognitive performance in general ability, processing speed and spatial/fluid ability compared with those who were not hospitalized. The two-slope models revealed steeper cognitive decline before hospitalization than after among those with at least one hospitalization event, as compared to non-hospitalized persons who showed steeper cognitive decline after the centering age of 70 years.
Conclusions: Persons being hospitalized in late life have lower cognitive performance across all assessed domains. The results indicate that the main decline occurs before the hospitalization, and not after. This might indicate that when you get treatment you also benefit cognitively.

1. Introduction

Older people admitted to the hospital are at risk of experiencing adverse effects following their hospitalization, such as functional decline and increased risk of nosocomial infections (Klevens et al., 2007). Research has suggested that hospitalization *per se* is associated with not only functional and medical adverse outcomes but also the development of cognitive decline (Ehlenbach et al., 2010; Mathews, Arnold, & Epperson, 2014; Pandharipande et al., 2013; Wilson et al., 2012) and an increased risk of dementia (Ehlenbach et al., 2010). Conditions that are common among hospitalized persons, e.g. functional decline (Boyd, Xue, Simpson, Guralnik, & Fried, 2005; Volpato et al., 2007) and frailty (Buchman, Boyle, Wilson, Tang, & Bennett, 2007), as well medical conditions common in the general population such as diabetes mellitus and chronic pulmonary disease (Arvanitakis, Wilson, Bienias, Evans, & Bennett, 2004; Hung, Wisnivesky, Siu, & Ross, 2009) are associated with cognitive decline. Loss of cognitive ability may increase individuals' likelihood of experiencing comorbid medical conditions because cognitive impairments are associated with a lower level of health literacy (Baker, Wolf, Feinglass, & Thompson, 2008) and health-related behaviours such as medication adherence (Insel, Morrow, Brewer, & Figueredo, 2006).

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However, whether the effect of hospitalization simply is a marker of cognitive decline or accelerates the progression of cognitive decline or both, remains unknown.

Previous studies have shown that cognitive impairment might be related to hospitalization immediately at discharge and several months post-discharge (Chen, Chiu, Chen, Cheng, & Huang, 2011; Mathews et al., 2014; Volpato et al., 2007). Whether these effects are transient, persistent, or even accelerate over time is unknown. A study conducted by Wilson et al. (2012) suggested that persons who had experienced hospitalization had a greater likelihood of displaying general cognitive decline than those who had not been hospitalized. Another study found greater cognitive decline in persons with acute care- and critical illness hospitalizations (Ehlenbach et al., 2010) compared to persons not hospitalized. Furthermore, few studies have analysed the association between hospitalization and different cognitive domains (Mathews et al., 2014). Those that have, observed declines in global cognition, executive function, memory, and processing speed post-hospitalization, but these studies did not employ objective pre-hospital cognitive measurements, (Pandharipande et al., 2013; Rothenhäusler, Ehrentraut, Stoll, Schelling, & Kapfhammer, 2001) or they used data from a restricted geographical area within one city (Wilson et al., 2012).

Cognitive impairment after hospitalization may be a growing health problem given the demographic trend of an increased proportion of older people, who are at an increased risk of diseases and disabilities and potentially greater health care use. An understanding of the change in older persons' different cognitive domains before and after hospitalization can improve care and direct further investigations of these potential associations. Hence, this population-based longitudinal study of cognitive functions with up to 25 years of follow-up aimed to examine changes in older adults' cognition before and after hospitalization.

2. Material and methods

2.1. Sample

Data from the population-based longitudinal Swedish Adoption/Twin Study of Ageing (SATSA) were used. The SATSA participants were drawn from the Swedish Twin Registries (STR) and included same-sex twin pairs either reared together or reared apart. The selection criteria has been described in detail elsewhere (Finkel & Pedersen, 2004). In brief, in 1984, the first SATSA Questionnaire (Q1) was administered to study the aetiology of individual differences in aging. Pairs of twins aged 50 years and above that participated in Q1 were invited to complete In Person Testing (IPT), which included biomedical and cognitive examinations, in 1986. On average, IPT was conducted every third year. A total of 859 persons participated in cognitive testing in at least one SATSA wave. Twins with complete data on the four included cognitive domains, i.e. verbal, spatial/fluid, memory, and processing speed, were included in this study (n = 828). This selection procedure was followed to assess the same N and individuals across all analyses.

2.2. Measures

2.2.1. Cognitive abilities

Four cognitive domains, verbal, spatial/fluid, memory and processing speed abilities, were assessed in the SATSA cognitive test battery (Nesselroade, Pedersen, McClearn, Plomin, & Bergeman, 1988; Pedersen, Plomin, Nesselroade, & McClearn, 1992). The study assessed verbal abilities using the Information Subtest (from the Wechsler Adult Intelligence Scale-Revised [WAIS-R] (Wechsler, 1981)), Synonyms, and Analogies, and memory using Digit Span (WAIS-R) and Thurstone's Picture Memory Task. Spatial/fluid abilities were assessed by Figure Logic, Block design (WAIS-R), and Card Rotation. Processing speed was assessed using Symbol Digit (an inverted version of the Symbol Digit Substitution task (Smith, 1982)), and Figure Identification.

Principal component analysis was used to create component scores for each of the four domains, verbal, spatial/fluid, memory and processing speed abilities. In addition, a global cognitive composite score was created by combining the cognitive scores of all subtests on each testing occasion (Finkel & Pedersen, 2004). Finally, for ease in interpretation, the cognitive component scores were transformed into T scores, with a mean of 50 and a standard deviation of 10, relative to scores at IPT1.

2.2.2. Dementia

Participants with low scores on the MMSE (below 25) or who evidenced a 10 percent decline in MMSE scores from the previous IPT were evaluated for dementia during consensus conferences. Likewise, we evaluated the following individuals for dementia: all those who scored low on the Block Design and Synonyms tests, those whose medical records included notes about cognitive problems, those suspected of having dementia by the research nurses, and/or those who had cognitive problems according to a proxy (Gatz & Pedersen, 2013). A consensus conference taking all available information into account from medical records, cognitive test scores and changes in cognitive test scores including MMSE scores, and nurses evaluations was conducted to define dementia cases (Bokenberger, Pedersen, Gatz, & Dahl, 2014; Gatz et al., 1997). Dementia was diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders (DSMM) dementia criteria at the time of diagnosis.

2.2.3. Hospitalization

The study sample was linked to The Swedish National Patient Register (NPR) (National Board of Health and Welfare, 2017), which contains information on the participants' hospital admissions during their participation in SATSA, up to 31 December 2012. The participants' first hospitalization for any reason after their entry in SATSA was included. Twins with hospital admissions before their entry in SATSA (n = 35) but not during the study follow-up were regarded as not being admitted to the hospital. Participants' mean number of admissions during their participation in SATSA (up to 25 years) was 5.3. (± 7.0)

2.2.4. Covariates

We included covariates that are known to be related to cognitive functions: age, sex, and education (dichotomised as upper secondary or university education (1) and compulsory or vocational education (0)). Covariates were drawn from the IPT prior to participants' first hospitalization. For participants without hospitalizations, the covariates were drawn from the baseline IPT. We controlled for number of illnesses (based on a sum of 13 domains of self-reported illnesses) (Harris, Pedersen, Stacey, McClearn, & Nesselroade, 1992) and depressive symptoms, as measured by the Center for Epidemiologic Studies Depression Scale (CES-D) (Gatz, Johansson, Pedersen, Berg, & Reynolds, 1993). We also included self-rated health, which was measured on a scale comprising individuals' current general health, current health versus health 5 years ago, own health compared with others' health and limitations in activities due to health. The total number of hospitalizations was extracted from the NPR. We included all of the participants' hospitalizations to the end of the study or death. We also included numbers of years from the first hospitalization to the subsequent IPT in SATSA (for the hospitalized participants).

2.3. Statistical analyses

Age-based latent growth curve modelling was used to measure change in cognitive performance over time and to explore the potential association between hospitalization and cognitive performance across different domains over time. The models included fixed effects and random effects (both within and between pairs to adjust for dependency) using age centred at first hospitalization for those who were hospitalized. For those who had not been hospitalized (n = 93), age