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Determinants of rate of change in functional disability: An application of latent growth curve modeling

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ABSTRACT

Our aim was to identify disablement factors, including predisposing, intra-individual, and extra-individual factors, which predict the rate of change in general functional disability (GFD) in older adults. This study utilized the Taiwan Longitudinal Study on Aging Survey in 1996–2007 ($N = 3{,}186$). Multiple-indicator latent growth curve modeling was used to examine how 12 disablement factors predicted the rate of change in GFD. GFD trajectories were modeled using Nagi's functional limitations, activities of daily living, and instrumental activities of daily living. Greater age ($B = .025$), female gender ($B = .114$), and greater numbers of comorbidities ($B = .038$) were associated with faster increase in GFD. Education ($B = -.005$) and participation in physically active leisure time activities ($B = -.031$) were associated with slower increase in GFD. Our findings add to the understanding of how disablement factors contribute to the rate of change in GFD. Predisposing factors played the main role. However, the factors we found to be associated with the rate of change in GFD in older adults were slightly different from the factors reported in the literature. Decreasing the number of comorbidities and increasing the level of physically active leisure time activity should be considered priorities for preventing disability as people age.

1. Introduction

In many modern societies, including Taiwan, longer life spans have contributed to aging populations. Successful aging and decreases in functional disability have become key public health priorities in Taiwan as well as in many other aging societies (Fried, Ferrucci, Darer, Williamson, & Anderson, 2004). Identifying factors that speed up or slow down the process of disability has greatly attracted researchers' attention. Although factors that predicted disability have been well studied in the literature, there is still a lack of understanding of what factors might contribute to the rate of change in the disablement process (Tak, Kuiper, Chorus, & Hopman-Rock, 2013).

The disablement process model, which has frequently been used to describe an individual's transition to disability, emphasizes factors that can speed up or slow down this transition (Leng & Wang, 2013; Verbrugge & Jette, 1994). Predisposing factors include those features that exist at or before the development of the disablement process, such as demographic and pathological factors. Evidence has shown that older age, female gender, lower educational attainment, greater numbers of comorbidities, and depressive symptoms are commonly found as predictors of functional disabilities and are likely to be found among older adults with functional disabilities (Barry, Murphy, & Gill, 2011; Chen et al., 2012; Hung, Ross, Boockvar, & Siu, 2012; Liang et al., 2010).

The disablement process literature has also asserted that intra- and extra-individual factors serve as buffers, which may increase the individual's capacity or decrease environmental demands and retard or reverse the process. Intra-individual factors, including better social relations, a healthier lifestyle, and leisure time activities, play roles in increasing older adults' functional capacities and preventing physical deterioration (Artaud et al., 2013; Boyle, Buchman, Wilson, Bienias, & Bennett, 2007; James, Boyle, Buchman, & Bennett, 2011; Mendes de Leon, Gold, Glass, Kaplan, & George, 2001; Tak et al., 2013). According to a meta-analysis by Tak et al. (2013), physical activity has been shown to reduce disability and prevent new-onset disability in activities of daily living (ADL) among older adults. They have further suggested that the primary role of physical activity could be to delay the disablement process, but further study is required.

Extra-individual factors, such as using assistive devices and technology, are viewed as external supports that help older adults

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achieve better function (Martin, Zimmer, & Hurng, 2011). Yu, Chen, Chiang, Tu, & Chen (2015) have shown that disablement process factors significantly predicted older adults' progression into different patterns of disability trajectories. They have reported that predisposing factors such as younger age, higher education levels, fewer depressive symptoms, and better health conditions are protective and lead to a healthier trajectory of maintained function in later years. Intra-individual factors such as participation in leisure time activity (LTA) were found to be predictive of a maintained function trajectory, whereas a number of comorbidities were found to predict trajectories of progressively increasing and consistent disability. Yu et al. (2015) also reported that use of assistive devices, an extra-individual factor, was significantly related to a trajectory of consistent disability. These findings point to the importance of further studies on the effect these factors have on the rate of change in functional disability.

In the past few decades, researchers have advocated using latent growth curve modeling (LGCM) as a better method for answering questions about individual change over time by providing estimates of an individual growth curve for each subject, including estimated intercepts (i.e., baseline values) and slopes (i.e., rates of change), while also taking individual variations into consideration (Muthen & Muthen, 2009; Rogosa, Brandt, & SZimowski, 1982). In addition, LGCM is able to establish nonlinear growth trajectories (i.e., show increases and decreases over time), which gives researchers more flexibility to estimate patterns of changes (Duncan, Duncan, & Strycker, 2006; Muthen & Muthen, 2009). Our aim was to identify disablement process factors, including predisposing, intra-individual, and extra-individual factors, which predict the rate of change in functional disability in older adults by using multiple-indicator LGCM. We hope to provide insights for future targets of care.

2. Material and methods

2.1. Data and sample

The Taiwan Longitudinal Study in Aging (TLSA) was funded by the U.S. National Institute on Aging, the Taiwan Bureau of Health Promotion, and the Population Studies Center at the University of Michigan (Health Promotion Administration, 2007). The data from this survey have been used in numerous health-related analyses (Leng & Wang, 2013; Zimmer, Martin, Jones, & Nagin, 2014). The TLSA used a complex sampling survey design. The initial respondents were representative of the 9% of Taiwan's population in 1989 who were aged 60 and older and living in either the community or in institutions. Of the 4412 potential respondents approached for personal interviews, 4049 (91.9%) responded. Survivors were reinterviewed in 1993, 1996, 1999, 2003, and 2007. From the original 4049 respondents in 1989, a total of 2989 older adults survived to 1996. A second survey cohort of 2462 people aged 50–67 was added in 1996, and reinterviewed in subsequent waves. Response rates for both cohorts were very high.

Zimmer et al. (2014) have suggested that including deceased people may lead to sampling error and bias the estimation of the disability trajectory, particularly for those who experience early onset of disability. For this study, we analyzed older adults who survived to the 2007 survey and had completed at least three out of the four surveys between 1996 and 2007; this choice was due to the statistical requirements for trajectory estimations. Sample weights were included to ensure representativeness of Taiwan's population 50 and older as of 1996. Fig. 1 shows the flow diagram of the of the cohort sample included in our analysis, which accounts for those who completed the study, were missing, or dead. The current study has been approved by the Research Ethics

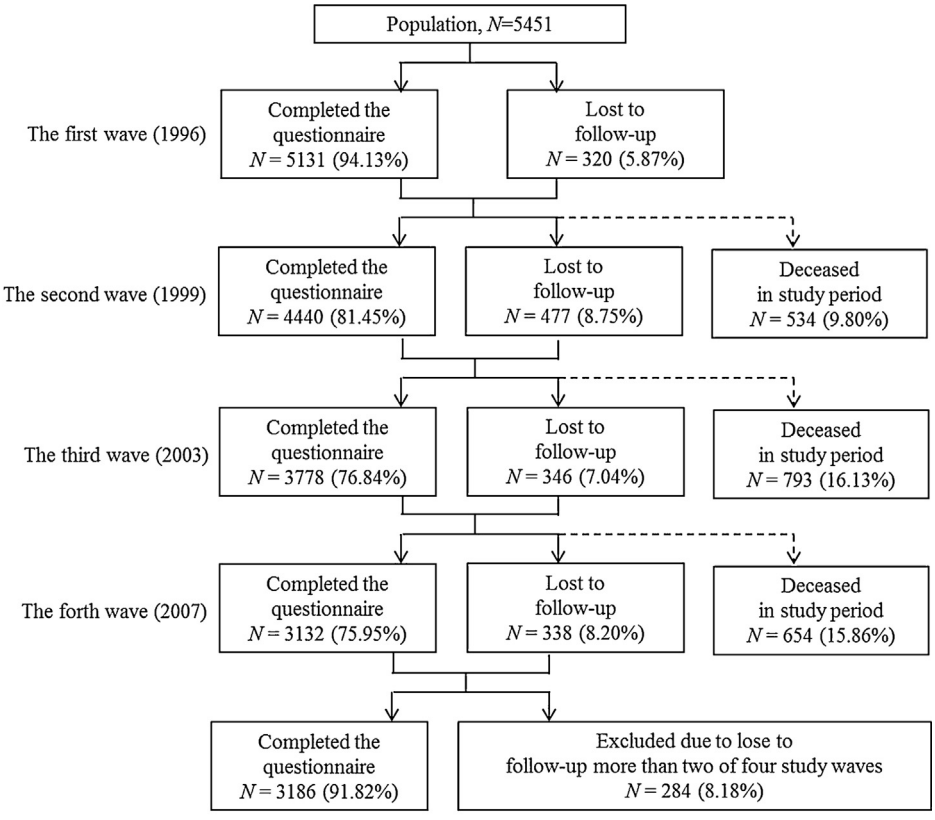

Fig. 1. Flow diagram of the cohort sample and follow-ups.