Published in final edited form as:

Aging Ment Health. 2013 ; 17(8): 915–923. doi:10.1080/13607863.2013.799116.

Correlates of Cognitive Impairment in Older Vietnamese

Amanda Leggett,

The Pennsylvania State University

Steven H. Zarit,

The Pennsylvania State University

Chuong N. Hoang, and

National Technical College of Medicine 2

Ha T. Nguyen

Wake Forest School of Medicine

Abstract

Objectives—This study examined correlates of cognitive functioning and possible cognitive impairment among older adults living in Da Nang, Vietnam and surrounding rural areas.

Methods—The analytic sample consisted of 489 adults 55 and older stratified by gender, age, and rural/urban status. The sample was 46% rural, 44% women, with a mean age of 69.04. Interviews were conducted in individuals' homes by trained interviewers. The dependent variable was a Vietnamese version of the MMSE. A multiple linear regression was run with the MMSE continuous scores reflecting cognitive functioning, while a binary logistic regression was conducted with an education-adjusted cut-off score reflecting possible cognitive impairment. Age, gender, education, material hardship, depressive symptoms (CES-D), war injury, head trauma, diabetes, cardiovascular and cerebrovascular disease conditions served as correlates, controlling for marital status and rural/urban residence.

Results—About 33% of the sample scored below the standard cutoff of 23 on the MMSE. However only 12.9% of the sample would be considered impaired using the education-adjusted cutoff score. Cognitive functioning and possible cognitive impairment as indicated by MMSE scores were significantly associated with being older, completing fewer years of education, and material hardship. Gender, depressive symptoms, and cerebrovascular disease were associated with cognitive functioning, but not cognitive impairment.

Conclusion—These results show that social characteristics, physical illness, and mental health are associated with cognitive functioning. The study also raises questions about the need for standardization of screening measures on Vietnamese populations.

Keywords

social context; cognitive functioning; cognitive impairment; Vietnam

Many low income countries are experiencing a rapid increase in their older population. With this increase comes a growing prevalence of late life disorders such as dementia. Though low income countries may have a lower prevalence of dementia than developed countries, this could be due to a lack of systematic documentation, as well as lower rates of survival to old age than in Western countries (Ferri et al., 2005). The 10/66 Dementia Research Group has found that the majority of the world's demented population falls within low income countries (Ferri et al.; Van Der Poel & Pretorius, 2009), and continuing improvements in economic conditions and health care will contribute to further increases.

One such low income country, Vietnam, is undergoing rapid growth in its elderly population as a result of improvement in its economic situation and health care, as well as declining birth rates. Vietnam's average lifespan has increased by 33 years in the past 50 years to 72.41, a faster growth rate than the world average (CIA World Factbook, 2012; Minh, 2011). The rates of cognitive impairment in Vietnam and the implications for functioning and care of older adults have not been examined. A literature search in PubMed revealed no studies focusing on prevalence or correlates of dementia and/or cognitive impairment in Vietnam. Documenting the prevalence and correlates of cognitive impairment in Vietnam is important as it can place burden on families and the medical system, and can also complicate the treatment of medical problems. These documentations could have important implications, namely in the form of targeted interventions or strategies to reduce cognitive impairment or dementia. Information on prevalence and correlates may also be used by policy makers and clinicians as they plan health services for the growing older population in Vietnam.

Though risk factors of cognitive impairment and dementia have been widely studied, an understanding of social and health correlates of cognitive impairment in Vietnam would help health services identify people at greatest risk, as well as potentially modifiable conditions that increase likelihood of cognitive impairment. For example, socio-demographic characteristics such as increasing age and low levels of education are known risk factors for cognitive impairment (Ferri et al., 2005; Ott et al., 1995). Mental and physical health problems such as depression, stroke, cardiovascular disease, and diabetes have also been associated with cognitive impairment (Jorm, 2000, 2001; Steffens & Potter, 2008; Verhaeghen, Borchelt, & Smith, 2003). Some correlates, such as depression, may be treatable whereas others may be prevented, such as type 2 diabetes. Further, today's elders in Vietnam may have unique risk factors for cognitive impairment, having lived through long periods of war and great social and economic upheaval. It is important, therefore, to test whether these factors also underlie cognitive impairment in Vietnam. As cognitive impairment can lead to significant disability, services targeting people with these factors may help reduce the medical and societal burden of caring for individuals with cognitive impairment.

Depressive Symptoms as a Correlate of Cognitive Impairment

Comorbid presence of both mild cognitive impairment and depression ranges from 25 to 50 percent in older adults with the percentage increasing with age (Adler, Chwalek, & Jajcevic, 2004; Arve, Tilvis, Lehtonen, Valvanne, & Sairanen, 1999; Lee, Potter, Wagner, Welsh-

Bohmer, & Steffens, 2007; Lopez et al., 2003). Many studies now indicate that late-onset depression increases risk or may be a prodromal symptom for dementia (Broe et al., 1990; Green et al., 2003; Steffens et al., 1997). One meta-analysis found that dementia risk is almost doubled in older adults who had depressive symptoms (Jorm, 2001) and similar results have been found for risk of cognitive impairment (Barnes, Alexopoulos, Lopez, Williamson, & Yaffe, 2006). Sapolsky's (1992) "glucocorticoid cascade" hypothesis posits that the extended stress faced by individuals with depression dysregulates the hypothalamic-pituitary-adrenal (HPA) axis, and one potential outcome of this process is an atrophied hippocampus (Steffens & Potter, 2008). However, though it is recognized that brain changes such as a smaller hippocampus are associated with both cognitive impairment and depression, it is difficult to determine the directionality of whether depression predicts cognitive impairment or the reverse and a direct link between the two has not been found (Jorm, 2000).

Depression has also been found to impact cognitive test performance. A meta-analysis found that depressed individuals had a .63 standard deviation reduction in cognitive test performance in comparison with non-depressed individuals (Christensen, Griffiths, Mackinnon, & Jacomb, 1997). One reason individuals with depressive symptoms may score lower on cognitive exams is reduced motivation and attention/concentration (Berger, Fratiglioni, Forsell, Winblad, & Backman, 1999; Steffens & Potter, 2008).

Physical Health and Illness Correlates of Cognitive Impairment

Cardiovascular and metabolic diseases including congestive heart failure, stroke, diabetes, and coronary heart disease have been found to be associated with poorer cognitive performance and risk for dementia (Elias & Elias, 1993; Greveson, Gray, French, & James, 1991; Haan, Shemanski, Jagust, Manolio, & Kuller, 1999; Hertzog, Schaie, & Gribbin, 1978; Perlmutter et al., 1984; Schaie, 1996; Schaie, Croxson, & Jagger, 1995; Starr, Whalley, Inch, & Shering, 1993; Verhaeghen et al., 2003; Waldstein & Elias, 2001). One common mechanism across these conditions is atherosclerosis which may be linked to cognitive impairment through genetic, hemodynamic, and/or metabolic mechanisms (Everson, Helkala, Kaplan, & Salonen, 2001; Vingerhoets, 2001). Diabetes may operate by increasing other risk factors such as depression, hypertension and cerebrovascular disease or through a direct effect due to cortical atrophy and hyper or hypo-glycemia (Kumari, Brunner, & Fuhrer, 2000; Ryan, 2001; Croxson, & Jagger, 1995). In the current study diagnoses of cardiovascular disease, cerebrovascular disease, and diabetes will be considered as correlates of cognitive functioning and cognitive impairment.

Social-Economic Context and Cognitive Impairment

Low levels of education, female gender, and increasing age all put individuals at greater risk for the development of dementia (Azad, Al Bugami, Loy-English, 2007; Ferri et al., 2005; Launer et al., 1999; Ott et al., 1995; Ruitenberg, Ott, van Swieten, Hofman, & Bretler, 2001; van Duijn & Hofman, 1991). The association of education and cognitive impairment may reflect the "disuse" or "use it or lose it" hypothesis which posits associations found among life experiences, education and risk of dementia (Hultsch, Hertzog, Small, & Dixon, 1999;

Salthouse, 1991; Salthouse & Somberg, 1982; Stern et al., 1995). Lack of education may reflect a lack of cognitive reserve and therefore may lead to an earlier expression of dementia symptoms. Low education may also predispose people to score lower on cognitive tests, thereby being misclassified as having dementia and/or being identified earlier in the disease process. Marital status has also been found to be a risk factor for dementia with unmarried individuals at greater risk (Hemler et al., 1999). Married individuals may have greater social interaction and cognitive stimulation as a result of having a spouse, putting them at reduced risk for the development of dementia.

A social-contextual factor that individuals in low income countries face, in particular, is difficulty in attaining basic daily necessities such as food, water, or transportation, or what can be called “material hardship”. Though material hardship has been assessed in various forms, greater economic disadvantage has commonly been associated with greater cognitive impairment. For example, food insecurity, disadvantaged conditions such as living in a rural area during childhood, illiteracy, insufficient income or unskilled occupation, and community level deprivation have all been associated with cognitive impairment (Basta et al., 2007; Gao et al., 2009; Nguyen, Couture, Alvarado, & Zunzunegui, 2008). Some researchers have speculated that material deprivation’s association with cognitive impairment may be due to a lack of mental stimulation experienced by individuals in impoverished settings (Nguyen et al., 2008). This association, as with education, may also relate to the “disuse” or “use it or lose it” hypothesis (Hultsch et al., 1999; Salthouse, 1991; Salthouse & Somberg, 1982; Stern et al., 1995). However, older individuals living in deprived areas or with few economic resources may also be more at risk due to their reduced access and proximity to community health care and medical resources. Considering the social-economic context of Vietnam as a low income nation, material hardship is an important construct to consider in association with cognitive impairment.

An additional social-contextual factor to be examined is whether individuals suffered head trauma or other war injury. Living through a period of war is an incredible stressor that may be prolonged by the suffering of an injury. Injury may serve as a proxy for the incredible stress faced by many in the current generation of older adults in Vietnam. As discussed with depression, Sapolsky’s (1992) “glucocorticoid cascade” hypothesis posits that extended stress may (Steffens & Potter, 2008) lead to hippocampal atrophy and resulting cognitive impairment. As the experience of social turmoil and a war injury may be a severely stressful, this hypothesis may be one mechanism through which a war injury is associated with cognitive impairment.

The present study examined correlates of cognitive functioning and cognitive impairment in a representative sample of Vietnamese 55 years and older in the city of Da Nang and surrounding rural areas. The prevalence of cognitive impairment and levels of general cognitive functioning were examined along with social-contextual, mental and physical health correlates. Based on prior research, we hypothesized that poorer cognitive functioning and cognitive impairment would be associated with being female, not married, older, less educated, more depressed, having greater material hardship, cardiovascular disease, cerebrovascular disease, diabetes, head trauma, and a war injury.

Methods

The research was built on an educational partnership between the National Technical College of Medicine 2, Da Nang, Vietnam and the Institute of Gerontology, Jönköping University, Jönköping, Sweden. The research team included Chuong N. Hoang from the National Technical College of Medicine 2 and Stig Berg from Jönköping University. Joining the research initiative were Steven Zarit of the Pennsylvania State University, Ngoc H. Nguyen of Duy Tan University, and Ha Nguyen of Wake Forest School of Medicine.

Procedure

Participants for this project were based on a representative sample recruited from two districts, one rural and one urban. Within each district, three subdistricts were clustered by their demographic characteristics, and were selected based on the demographic characteristics. Households within the selected subdistricts were randomly selected. Home interviews were conducted by teams of students and faculty from the National Technical College of Medicine No 2 in Da Nang. Participants were given a small gift valued at approximately three US dollars for completing the interview.

Sample

The sample included 600 individuals aged 55 and older from Da Nang, Vietnam and surrounding rural areas. The sample was stratified on three dimensions: age, gender, and rural or urban residence. The sample was recruited to produce approximately equal numbers of men and women and urban and rural residents within each of 7 age categories (55–59, 60–64, 65–69, 70–74, 75–79, 80–84, and 85 and over). Three participants declined participation with difficulty scheduling the interview being cited as the main reason for refusal. In the current study the analytical sample consisted of 489 participants as 111 participants did not have a score on the MMSE. Interviewers reported that they were not able to test these individuals. A full comparison of people who completed and did not complete the MMSE is presented in the results (Table 1.).

Measures

Vietnamese language versions of measures were used where available. Translations were made, where necessary, from English language measures. Back translations were then performed and checked by two bilingual members of the research team.

Outcome measure—Cognitive impairment was measured using the Mini Mental Status Examination (MMSE) (Folstein, Folstein, & McHugh, 1975). The MMSE is a thirty point scale that assesses several domains of cognition including memory, orientation, and arithmetic. A lower score indicates greater cognitive impairment.

We used the total MMSE score to indicate overall cognitive functioning and also used a cut-off score to indicate possible cognitive impairment. Standardized cut-offs for cognitive impairment have been developed primarily in Western countries. No normative studies have been conducted in Vietnam, and so use of the Western cut-off of 23 or less is potentially problematic due to cultural differences in item difficulty and low formal education levels.

This could result in misclassification of cases (Tiwari, Tripathi, & Kunmar, 2009). Given these concerns, varying cut-off scores on the MMSE have been used in both Western and Asian countries (Murden, McRae, Kaner, & Bucknam, 1991; Xu, Meyer, Huang, Du, Chowdhury, & Quach, 2003).

An education-adjusted cut-off score has been suggested to reduce misclassification of cases. Based on a large study conducted in the United States that examined the relation of education to MMSE scores, Murden and colleagues (1991) suggest using a cut-point of 17 for individuals with low levels of education (e.g., grade school only or less). The study found that the ability to answer MMSE questions correctly was partly based on education and people with lower education will score below the usual cut-off for possible cognitive impairment (23 or less) without actually having cognitive impairment. We used an education-adjusted cut-off score as suggested by Murden et al. for participants with low levels of formal education (grade school only or less), while other participants were evaluated with the standard score of 23 or less. We recognize that the use of the cut-point to indicate possible cognitive impairment should be viewed as exploratory, and requires more systematic testing to determine optimal scores that suggest true cognitive impairment in Vietnam.

Correlates

Social Demographic Characteristics: Age, gender (1=female and 0=male), and education level were examined as demographic correlates. Education level consisted of five categories increasing in attainment: no education, primary school, lower secondary school, upper secondary school or vocational school, and college or higher degree. Rural/urban residence and marital status were examined as demographic controls. Marital status was dichotomized with married equaling 1 and unmarried, which included widowed, divorced, separated and single, as zero.

Depression: Depressive symptoms were measured with the Center for Epidemiologic Studies- Depression Scale (CES-D; Radloff, 1977). Past research has shown the CES-D to be reliable and valid for use in older populations and to have an acceptable fit in confirmatory analysis for use with Vietnamese Americans (Hertzog et al., 1990; Tran, Ngo, & Conway, 2003). Only 19 of the 20 items were administered as the item 'I talked less than usual' was inadvertently omitted from the interview schedule. As a result, scores were prorated for comparison purposes to reflect a full score on the CES-D. Each participant's mean item score was added in replacement of the 20th item such that scores were reflective of the full scale. The alpha for the scale was .85.

Physical Health Conditions: We selected conditions including cardiovascular disease, cerebrovascular disease and diabetes that have been associated with cognitive function as correlates. We used a standard illness checklist that is based on recall of doctor diagnoses and has been widely used in studies of older populations (Gold et al., 2002). As might be expected, there is only a moderate degree of correspondence of reported diagnosis with medical records, but also self-reports have been found to identify problems not captured in medical records (Nilsson, Johansson, Berg, Karlsson, & McClearn, 2002). Further, these

scales have been used with samples that included people with low formal education (Nilsson et al.). The cardiovascular variable was dichotomized where 1 indicated a diagnosis of heart disease, high blood pressure, and/or cholesterol problems and 0 indicated no heart disease diagnosis. The cerebrovascular variable was dichotomized where 1 indicated a diagnosis of a stroke with mild symptoms and/or a stroke with paralysis or other severe symptoms and zero indicated no stroke diagnosis. Finally, the diabetes variable was dichotomized where 1 indicated a diagnosis of diabetes and/or complications from diabetes (eye, foot, vascular) and 0 indicated no diagnosis of a diabetic condition.

Material Hardship: The material hardship scale consisted of 8 items including access to water and food, and whether the individuals owned consumer items including a television, bicycle, motorbike, radio, phone, and cell-phone. Possible scores range from zero to eight with a higher score indicating greater material hardship ($\alpha = .74$).

War Injury and Head Trauma: One item asked participants whether they had a war injury and one item questioned whether participants had received a diagnosis of head trauma. Both variables were dichotomous items from the illness checklist previously described (Gold et al., 2002) with participants reporting whether they had this injury (1) or not (0). War injury was a residual item on the checklist.

Statistical Analysis

First, t-tests and chi-square analyses were run to compare the analytical sample with the 111 participants who did not have a score on the MMSE. Next, descriptive statistics were run on all variables. Finally regression analyses were run to examine correlates of cognitive functioning and possible cognitive impairment. Three participants that had an MMSE score of 12 or below (scores were 4, 10, and 12) were excluded from the regression analyses. Prior work by Feinburg & Whitlatch (2001) has found that individuals who have a MMSE score ranging between 13–26 (i.e. mild to moderate cognitive impairment) are able to reliably report on their care, daily living, and demographic information. Therefore we felt that participants with an MMSE score of 12 or lower may not have provided reliable data to be included in regression analyses. First, a multiple linear regression with total MMSE score as the outcome was run to examine correlates of the full range of cognitive functioning. Social-demographic variables (gender, rural/urban, age, marital status, and education) were entered into the regressions in an initial step and depression (CES-D score), social-contextual variables (material hardship, head trauma, and war injury), and physical illness (cerebrovascular conditions, cardiovascular conditions, and diabetes) were entered into the models in the second step. A logistic regression was also performed to examine correlates of possible cognitive impairment. This analysis used the education-adjusted cut-off score indicating possible cognitive impairment. We recognize that the two analyses overlap, but each provides a somewhat different perspective. The linear regression has the advantage of using the full range of scores on the MMSE, but the cut-off carries public health significance by indicating people who likely have special needs due to low cognitive functioning.

Results

We compared the 111 individuals who did not have a score on the MMSE to the 489 people with scores. Individuals who did not complete the MMSE were significantly more likely to be women, rural, older, unmarried, less educated, dealing with more material hardship, depressed, and to have suffered from a stroke or diabetes. Demographic characteristics and full sample comparison statistics are summarized in Table 1.

The participants in the analytic sample had a mean score of 24.69 on the MMSE ($SD = 4.38$; range 4 - 30). Using the standard cut-off score of 23, 33.5% of the sample would be considered cognitively impaired. In contrast, 10.2% of the sample scored perfectly (30) on the MMSE. Using the educational-adjusted cut-off scores, a 12.9% of the sample would be considered cognitively impaired. Depressive symptoms, physical illness, and material hardship were also common in the sample. Symptoms of depression were found to be highly prevalent with an average score of 17.12 ($SD = 10.2$; range 3–47) on the CES-D. Individuals also experienced a moderate amount of material hardship with an average score being 3.1 out of a possible 8 ($SD = 2.1$; range = 0 - 8). A war injury was reported by 21.7% of participants and head trauma by 8.3%. In regards to physical illness, 8.4% of participants had experienced some type of stroke, 49.2% had one or more diagnoses indicative of cardiovascular disease, and 4.4% had diabetes and/or complications with diabetes.

Next a multiple linear regression was run to examine the associations of social-demographic characteristics, depression, socio-contextual hardship, and physical illness with the full range of cognitive functioning (Table 2). The model was significant at the $p < .001$ level ($R^2 = .42$, $F(12, 444) = 26.53$). Demographic characteristics were associated with cognitive functioning with women ($\beta = -.16$), people with less education ($\beta = .27$) and older individuals ($\beta = -.17$) having significantly lower MMSE scores. Additionally, more depressive symptoms ($\beta = -.12$, $p < .01$), greater material hardship ($\beta = -.18$, $p < .001$), and a diagnosis of stroke ($\beta = -.09$, $p < .05$) were associated with lower MMSE scores. Diabetes, cardiovascular disease, head trauma, and a war injury did not have a significant association with cognitive functioning. As seen in Table 2, the overall F value declined when additional predictors were added to the basic demographic model. Though the explained variance increased, the residual variance decreased, and there was a change in R^2 , the overall F went down given that the increase in variance explained wasn't large relative to the number of additional predictors added. As we were aiming to test specific hypotheses about factors found to be associated with depression, we maintained the insignificant predictors in the model.

Next a binary logistic regression (1 = possible cognitive impairment and 0 = not impaired) was run to examine correlates of possible cognitive impairment (Table 2). Education was omitted from this analysis due to the educational adjustment of the MMSE. The model was significant at the $p < .001$ level ($X^2 = 49.40$, $df = 11$). Age ($e^B = 1.07$, $p < .01$) was a significant demographic correlate of cognitive impairment. Age had a significant odds ratio above 1 which indicates that age increases the likelihood of the outcome having a value of 1 (cognitively impaired). Greater material hardship ($e^B = 1.27$, $p < .05$) was also a significant correlate. Depressive symptoms, head trauma, war injury, cardiovascular disease,

cerebrovascular disease and diabetes were not significant correlates of possible cognitive impairment.

Discussion

We examined correlates of cognitive functioning and possible cognitive impairment in this unique sample of older adults in Da Nang, Vietnam and surrounding areas. The initial estimates in our sample show high levels of possible cognitive impairment among older community dwelling Vietnamese which is unusual for a low income country. The high prevalence estimate of possible cognitive impairment using the established cut-off of 23 and below likely reflects in part the low-level of education and literacy in the sample. A prevalence estimate of 12.9%, obtained from the educational-adjusted cut-off, is more in line with dementia estimates reported in developed and low income countries. A review of dementia prevalence around the world estimated the prevalence of dementia in the Western Pacific region to range from 0.6% in the 60–64 age range through 26.2% in the 85 plus age group (Ferri et al., 2005). However, our estimates should be regarded as provisional. Further studies are needed to pair cognitive assessment with more thorough clinical examinations to determine appropriate screening strategies for cognitive impairment in Vietnam.

Results of the regression models were similar to findings on associations in Western countries and varied somewhat across the linear and logistic model. As expected, the socio-demographic correlates of age, gender, and education were highly significant. One difference across the two models, however, relates to depressive symptoms and cerebrovascular disease. Depressive symptoms and cerebrovascular disease were significantly associated with poorer cognitive functioning, but did not present as significant correlates of cognitive impairment. It may be that a small association does exist between depressive symptoms and cognitive functioning, but not enough to be a clear prodrome of cognitive impairment. Depression has been found to impact cognitive test performance (Berger et al., 1999; Christensen et al., 1997; Steffens & Potter, 2008), however apathy or a lack of motivation may not affect performance to an extent that it is associated with true cognitive impairment. Longitudinal data that tracks depressive symptoms, the experience of a stroke and cognitive functioning over time may better elucidate these associations.

Poorer cognitive functioning and cognitive impairment were both associated with material hardship. Material hardship is a reflection of living in impoverished conditions, working in low-income, unskilled jobs and without access to health care resources (Nguyen et al., 2008). As suggested in the “disuse” or “use it or lose it” hypothesis (Hultsch et al., 1999; Salthouse, 1991; Salthouse & Somberg, 1982; Stern et al., 1995), a materially deprived environment may not foster cognitive activity and engagement leading to a depletion of cognitive reserve and increased risk for cognitive impairment. Furthermore, chronic stress associated with living without access to daily necessities may negatively impact health and cognition (Lupien et al., 1999; Sapolsky, 1992). It is critical for health officials in low income countries to recognize that the socio-economic context of their elder population can contribute to low cognitive ability. As Vietnam continues to develop economically, health officials may need to take particular care in offering preventive health and treatment services

to individuals who may not otherwise have the ability to access or afford services and for whom low cognition might be a barrier to improved care.

While cerebrovascular disease was a significant correlate of cognitive functioning, none of the physical illnesses significantly predicted cognitive impairment. The illnesses were self-reported and based on recall of doctor diagnoses. This may have resulted in an underreporting of diagnoses particularly if the illnesses were asymptomatic such as hypertension. It may also be that these diagnoses were not reported reliably or under reported given the prevalence of cognitive impairment in the sample, however, as cited, prior work by Feinburg & Whitlatch (2001) has found that individuals who have a MMSE score ranging between 13–26 are able to reliably report on their care, daily living, and demographic information. As we excluded the three participants who fell below this threshold in our analyses, it is likely that the diagnoses were reported accurately. Alternatively, rural older adults with low education or greater material hardship may lack access to medical care, and therefore have fewer doctor visits for clinical assessments of cardiovascular disease or other illnesses. The under reporting or inability to access and receive a medical diagnosis may have resulted in the lack of associations seen.

There are several limitations in this study. First, the study is cross-sectional so causal inferences cannot be drawn between cognitive impairment and various correlates. Additionally, while the measures were chosen by a cross-national research team, they were initially developed for use in Western countries. More research needs to be done to confirm the validity of the MMSE for use in Vietnam and to develop culturally sensitive cut-off scores. Though based on prior research (Murden et al., 1991), we recognize that our use of the educational-adjusted cut-off on the MMSE is arbitrary; however, we felt that a cut-off of 23 or less was inappropriate given the low levels of education in the sample. Although cut-off scores have not been validated, a primary goal of this study was to provide information to policy makers about individuals with lower levels of cognitive functioning that need to be taken into account when planning health care services.

A further limitation of the current study is the number of participants who were missing scores on the MMSE ($n=111$). Descriptive analyses revealed that the missing sample was a more vulnerable group in comparison with our analytic sample. Consequently, it is likely that our prevalence estimates are not capturing the full range of possible cognitive impairment in the Vietnamese population. Additionally, the associations of correlates with cognitive functioning and impairment may have been stronger if the complete sample could have been examined.

Finally given the experience of the Vietnam War and resulting social and economic upheaval, it is likely that all participants experienced hardship and trauma in their lifetime. However these constructs were not assessed in ways other than an existing war injury and diagnosed head trauma in the study. It may be that long-term war injuries would be associated with cognitive impairment due to resulting stress, and the impact on daily activities and socio-economic status, whereas more transient injuries would have less impact. Our measure of war injury did not allow for this distinction.

In conclusion, Vietnam has a growing older population with high levels of cognitive impairment for a low income country. Demographic, physical illness, mental health, and social-contextual correlates of cognitive functioning identified in Western countries also appear to be underlying cognitive functioning and possible cognitive impairment in Vietnam. Individuals with cognitive impairment require assistance with activities of daily living which places economic and social burden on families and society and complicates the delivery of health care services. Improved screening for cognitive impairment can identify people with the greatest risk. Policy makers and clinicians should give special focus to individuals who are illiterate or have limited educational backgrounds to ensure that they are receiving accurate screening and support.

References

- Adler G, Chwalek K, Jajcevic A. Six-month course of mild cognitive impairment and affective symptoms in late-life depression. *European Psychiatry*. 2004; 19:502–505.10.1016/j.eurpsy.2004.09.003 [PubMed: 15589711]
- Angel, R.J.; Williams, K. Cultural models of health and illness. In: Cuellar, I.; Paniagua, FA., editors. *Handbook of multi-cultural mentalhealth: Assessment and treatment of diverse populations*. New York: Academic Press; 2000. p. 25-44.
- Arve S, Tilvis RS, Lehtonen A, Valvanne J, Sairanen S. Coexistence of lowered mood and cognitive impairment of elderly people in five birth cohorts. *Aging (Milano)*. 1999; 11:90–95. [PubMed: 10386168]
- Azad NA, Bugami MA, Loy-English I. Gender differences in dementia risk factors. *Gender Medicine*. 2007; 4(2):120–129.10.1016/S1550-8579(07)80026-X [PubMed: 17707846]
- Barnes DE, Alexopoulos GS, Lopez OL, Williamson JD, Yaffe K. Depressive symptoms, vascular disease, and mild cognitive impairment. *Archives of General Psychiatry*. 2006; 63:273–280.10.1001/archpsyc.63.3.273 [PubMed: 16520432]
- Basta NE, Matthews FE, Chatfield MD, Brayne C. Community-level socio-economic status and cognitive and functional impairment in the older population. *European Journal of Public Health*. 2007; 18(1):48–54.10.1093/eurpub/ckm076 [PubMed: 17631489]
- Berger AK, Fratiglioni L, Forsell Y, Winblad B, Backman L. The occurrence of depressive symptoms in the preclinical phase of AD: A population-based study. *Neurology*. 1999; 53(9):1998–2002.10.1212/WNL.53.9.1998 [PubMed: 10599771]
- Boone K, Lesser B, Millder B, Wohl M, Berman N, Lee A, Palmer B. Cognitive functioning in a geriatric depressed population: relationship of presence and severity of depression to neuropsychological scores. *Neuropsychology*. 1995; 9:390–398.10.1037/0894-4105.9.3.390
- Broe GA, Henderson AS, Creasey H, McCusker E, Korten AE, Jorm AF, Anthony JS. A case-control study of Alzheimer's disease in Australia. *Neurology*. 1990; 40:1968–1707.10.1212/WNL.40.11.1698
- Bronfenbrenner U. Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*. 1986; 22:723–742.10.1037/0012-1649.22.6.723
- Catindig JAS, Venketasubramanian N, Ikram MK, Chen C. Epidemiology of dementia in Asia: Insights on prevalence, trends and novel risk factors. *Journal of the Neurological Sciences*. 2012; 321(1–2):11–16.10.1016/j.jns.2012.07.023 [PubMed: 22877510]
- Christensen H, Griffiths K, Mackinnon A, Jacomb PA. A quantitative review of cognitive deficits in depression and Alzheimer-type dementia. *Journal of International Neuropsychological Sociology*. 1997; 3:631–651.
- CIA World Factbook. Vietnam. 2012. Retrieved from <https://www.cia.gov/library/publications/the-world-factbook/geos/vm.html>
- Croxxson SCM, Jagger C. Diabetes and cognitive impairment: A community-based study of elderly subjects. *Age and Ageing*. 1995; 24(5):421–424.10.1093/ageing/24.5.421 [PubMed: 8669347]

- Elias MF, Elias PK. Hypertension affects neurobehavioral functioning: So what's new? *Psychosomatic Medicine*. 1993; 55:44–50. 1993-34125-001. [PubMed: 8446740]
- Everson, SA.; Helkala, E-L.; Kaplan, GA.; Salonen, JT.; Waldstein, SR.; Elias, MF. Neuropsychology of cardiovascular disease. Mahwah, NJ: Erlbaum; 2001. Atherosclerosis and cognitive functioning; p. 105-120.
- Feil D, Razani J, Boone K, Lesser I. Apathy and cognitive performance in older adults with depression. *International Journal of Geriatric Psychiatry*. 2003; 18:479–488.10.1002/gps.869 [PubMed: 12789667]
- Feinberg LF, Whitlatch CJ. Are persons with cognitive impairment able to state consistent choices? *The Gerontologist*. 2001; 41:374–382. [PubMed: 11405435]
- Ferri CP, Prince M, Brayne C, Brodaty H, Fratiglioni L, Ganguli M, Scazufca M. Global prevalence of dementia: a Delphi consensus study. *Lancet*. 2005; 366:2112–2117.10.1016/S0140-6736(05)67889-0 [PubMed: 16360788]
- Folstein MF, Folstein SE, McHugh PR. "Mini-mental state": A practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research*. 1975; 12(3):189–98. [PubMed: 1202204]
- Gao X, Scott T, Falcon LM, Wilde PE, Tucker KL. Food insecurity and cognitive function in Puerto Rican adults. *American journal of Clinical Nutrition*. 2009; 89:1197–1203.10.3945/ajcn.2008.26941 [PubMed: 19225117]
- Gold C, Malmberg B, McClearn GE, Pederson NL, Berg S. Gender and health: A study of older unlike-sex twins. *Journal of Gerontology: Social Sciences*. 2002; 57B:S168–S176.
- Green RC, Couples LA, Kurz A, Acerbic S, Go R, Sardonis D, Farer L. Depression as a risk factor for Alzheimer disease: The MIRAGE study. *Archives of Neurology*. 2003; 60:753–759.10.1001/archneur.60.5.753 [PubMed: 12756140]
- Greveson GC, Gray CS, French JM, James OFW. Long-term outcome for patients and careers following hospital admission for stroke. *Age and Ageing*. 1991; 20:337–344.10.1093/ageing/20.5.337 [PubMed: 1755389]
- Haan MN, Shemanski L, Jagust WJ, Manolio TA, Kuller L. The role of APOE ϵ 4 in modulating effects of other risk factors for cognitive decline in elderly persons. *Journal of the American Medical Association*. 1999; 282:40–46.10.1001/jama.282.1.40 [PubMed: 10404910]
- Hertzog C, Schaie KW, Gribbin K. Cardiovascular disease and changes in intellectual functioning from middle to old age. *Journal of Gerontology*. 1978; 33:872–883.10.1093/geronj/33.6.872 [PubMed: 744860]
- Hertzog C, Van Lating J, Usala PD, Hultsch DF, Dixon R. Measurement properties of the center for epidemiological studies depression scale (CES-D) in older populations. *Psychological Assessment: A Journal of Consulting and Clinical Psychology*. 1990; 2(1):64–72.10.1037/1040-3590.2.1.64
- Hultsch DF, Hertzog C, Small BJ, Dixon RA. Use it or lose it: Engaged lifestyle as a buffer of cognitive decline in aging? *Psychology and Aging*. 1999; 14(2):245–263.10.1037/0882-7974.14.2.245 [PubMed: 10403712]
- Jorm AF. Is depression a risk factor for dementia or cognitive decline? *Gerontology*. 2000; 46(4):219–227.10.1159/000022163 [PubMed: 10859462]
- Jorm AF. History of depression as a risk factor for dementia: An updated review. *Australian and New Zealand Journal of Psychiatry*. 2001; 35:776–781. [PubMed: 11990888]
- Kumari M, Brunner E, Fuhrer R. Minireview: Mechanisms by which the metabolic syndrome and diabetes impair memory. *Journals of Gerontology: Medical Sciences*. 2000; 55:228–232.10.1093/Gerona/55.5.B228
- Launer LJ, Andersen K, Dewey ME, Letenneur L, Ott A, Amaducci C, Brayne JRM, Hofman A. Rates and risk factors for dementia and Alzheimer's disease: Results from EURODEM pooled analyses. *Neurology*. 1999; 52:78–84.10.1212/WNL.52.1.78 [PubMed: 9921852]
- Lee JS, Potter GG, Wagner HR, Welsh-Bohmer KA, Steffens DC. Persistent mild cognitive impairment in geriatric depression. *International Psychogeriatrics*. 2007; 19:125–135.10.1017/S1041610206003607 [PubMed: 16834811]

- Lee Y, Shinkai S. Correlates of cognitive impairment and depressive symptoms among older adults in Korea and Japan. *International Journal of Geriatric Psychiatry*. 2005; 20:576–586.10.1002/gps.1313 [PubMed: 15920709]
- Lopez OL, Jagust WJ, DeKosky ST, Becker JT, Fitzpatrick A, Dulberg C, Kuller LH. Prevalence and classification of mild cognitive impairment in the Cardiovascular Health Study Cognition Study: Part 1. *Archives of Neurology*. 2003; 60:1385–1389.10.1001/archneur.60.10.1385 [PubMed: 14568808]
- Lupien SJ, Nair NP, Briere S, Maheu F, Tu MT, Lemay M, Meaney MJ. Increased cortisol levels and impaired cognition in human aging: Implication for depression and dementia in later life. *Reviews in the Neurosciences*. 1999; 10(2):117–139.10.1515/REVNEURO.1999.10.2.117 [PubMed: 10658955]
- Mehta KM, Yaffe K, Langa KM, Sands L, Whooley MA, Covinsky KE. Additive effects of cognitive function and depressive symptoms on mortality in elderly community-living adults. *Journals of Gerontology. Series A, Biological Sciences and Medical Sciences*. 2003; 58:461–467.10.1093/Gerona/58.5.M461
- Minh, L. Vietnam: Average life span increases to 73. 2011. Retrieved from <http://english.vietnamnet.vn/en/society/16050/vietnam--average-life-span-increases-to-73.html>
- Murden RA, McRae TD, Kaner S, Bucknam ME. Mini-Mental State Exam scores vary with education in blacks and whites. *Journal of the American Geriatrics Society*. 1991; 39:149–155. 1991-21926-001. [PubMed: 1991947]
- Nguyen CT, Couture MC, Alvarado BE, Zunzunegui MV. Life course socioeconomic disadvantage and cognitive function among the elderly population of seven capitals in Latin America and the Caribbean. *Journal of Aging and Health*. 2008; 20(3):347–362.10.1177/0898264308315430 [PubMed: 18332188]
- Nilsson SE, Johansson B, Berg S, Karlsson D, McClearn GE. A comparison of diagnosis capture from medical records, self-reports and drug registrations: A study in individuals 80 years and older. *Aging Clinical and Experimental Research*. 2002; 14:178–184. [PubMed: 12387524]
- Ott A, Breteler MMB, van Horsham F, Claus JJ, van der Cammen TJM, Grobbee DE, Hofman A. Prevalence of Alzheimer's disease and vascular dementia: Association with education. The Rotterdam study. *British Medical Journal*. 1995; 310:970–973.10.1136/bmj.310.6985.970 [PubMed: 7728032]
- Palmer BW, Boone KB, Lesser IM, Wohl MA, Berman N, Miller BL. Neuropsychological deficits among older depressed patients with predominantly psychological or vegetative symptoms. *Journal of Affective Disorders*. 1996; 41:17–24.10.1016/0165-0327(96)00059-6 [PubMed: 8938201]
- Perlmutter LC, Hakami MK, Hodgson-Harrington C, Ginsberg J, Katz J, Singer DE, Nathan DM. Decreased cognitive function in aging non-insulin-dependent diabetic patients. *American Journal of Medicine*. 1984; 77:1043–1048.10.1016/0002-9343(84)90186-4 [PubMed: 6334441]
- Rabbitt P, Donlan C, Watson P, McInnes L, Bent N. Unique and interactive effects of depression, age, socioeconomic advantage, and gender on cognitive performance of normal healthy older people. *Psychology and Aging*. 1995; 10(3):307–313.10.1037/0882-7974.10.3.307 [PubMed: 8527052]
- Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*. 1977; 1(3):385–401.10.1177/014662167700100306
- Reischies FM, Neu P. Comorbidity of mild cognitive disorder and depression- A neuropsychological analysis. *European Archives of Psychiatry and Clinical Neuroscience*. 2000; 250(4):186–193.10.1007/s004060070023 [PubMed: 11009071]
- Ruitenberg A, Ott A, van Swieten JC, Hofman A, Breteler MMB. Incidence of dementia: Does gender make a difference? *Neurobiology of Aging*. 2001; 22:575–580.10.1016/S0197-4580(01)00231-7 [PubMed: 11445258]
- Ryan, CM. Diabetes-associated cognitive dysfunction. In: Waldstein, SR.; Elias, MF., editors. *Neuropsychology of cardiovascular disease*. Mahwah, NJ: Erlbaum; 2001. p. 61–82.
- Salthouse, TA. Theoretical perspectives on cognitive aging. Hillsdale: Erlbaum Associates; 1991.
- Salthouse TA, Somberg BL. Skilled performance: Effects of adult age and experience on elementary processes. *Journal of Experimental Psychology: General*, Ill. 1982:176–207.

- Sapolsky, RM. Stress, the aging brain, and the mechanisms of neuron death. MIT Press; Cambridge: 1992.
- Schaie, KW. Intellectual development in adulthood: The Seattle Longitudinal Study. New York: Cambridge University Press; 1996.
- Starr JM, Whalley LJ, Inch S, Shering PA. Blood pressure and cognitive function in healthy older people. *Journal of the American Geriatrics Society*. 1993; 41:753–756. 1994-01365-001. [PubMed: 8315187]
- Steffens DC, Plassman BL, Helms MJ, Welsh-Bohmer KA, Saunders AM, Breitner JC. A twin study of late-onset depression and apolipoprotein E epsilon 4 as risk factors for Alzheimer's disease. *Biological Psychiatry*. 1997; 41:851–856.10.1016/S0006-3223(96)00247-8 [PubMed: 9099411]
- Steffens DC, Potter GG. Geriatric depression and cognitive impairment. *Psychological Medicine*. 2008; 38:163–175.10.1017/S003329170700102X [PubMed: 17588275]
- Stern Y, Alexander GE, Prohovnik I, Stricks L, Link B, Lennon MC, Mayeux R. Relationship between lifetime occupation and parietal flow: Implications for a reserve against Alzheimer's disease pathology. *Neurology*. 1995; 45:55–60.10.1212/WNL.45.1.55 [PubMed: 7824135]
- Tiwari SC, Tripathi RK, Kumar A. Applicability of the Mini-mental State Examination (MMSE) and the Hindi Mental State Examination (HMSE) to the urban elderly in India: A pilot study. *International Psychogeriatrics*. 2009; 21(1):123–128.10.1017/S1041610208007916 [PubMed: 18983719]
- Tran TV, Ngo D, Conway K. A cross-cultural measure of depressive symptoms among Vietnamese Americans. *Social Work Research*. 2003; 27(1):56–64.10.1093/swr/27.1.56
- Van Der Poel R, Pretorius C. Dementia in low and middle income countries: The need for research and advocacy. *Dementia*. 2009; 8:451–454.10.1177/1471301209350290
- Van Duijn CM, Hofman A. Risk factors for Alzheimer's disease: A collaborative re-analysis of case-control studies. *International Journal of Epidemiology*. 1991; 20(suppl 2):2–73.10.1159/000111000
- Verhaegen P, Borchelt M, Smith J. Relation between cardiovascular and metabolic disease and cognition in very old age: Cross-sectional and longitudinal findings from the Berlin aging study. *Health Psychology*. 2003; 22(6):559–569.10.1037/0278-6133.22.6.559 [PubMed: 14640852]
- Vingerhoets, G. Cognitive consequences of myocardial infarction, cardiac arrhythmias, and cardiac arrest. In: Waldstein, SR.; Elias, MF., editors. *Neuropsychology of cardiovascular disease*. Mahwah, NJ: Erlbaum; 2001. p. 143-163.
- Wada T, Ishine M, Sakagami T, Kita T, Okumiya K, Mizuno K, Matsubayashi K. Depression, activities of daily living, and quality of life of community-dwelling elderly in three Asian countries: Indonesia, Vietnam, and Japan. *Archives of Gerontology and Geriatrics*. 2005; 41:271–280.10.1016/j.archger.2005.03.003 [PubMed: 15979739]
- Waldstein, SR.; Elias, MF. *Neuropsychology of cardiovascular disease*. Mahwah, NJ: Erlbaum; 2001.
- Xu G, Meyer JS, Huang Y, Du F, Chowdhury M, Quach M. Adapting Mini-Mental State Examination for dementia screening among illiterate or minimally educated elderly Chinese. *International Journal of Geriatric Psychiatry*. 2003; 18:609–616.10.1002/gps.890 [PubMed: 12833305]

Table 1

Comparison of Sample Characteristics for Participants Missing a Score on the MMSE and the Analytical Sample with a MMSE Score

	Sample Missing MMSE Score (N = 111)	Sample with MMSE Score (N = 489)	p value
Gender (% female)	73.9	44.4	<.001
Age (mean, SD)	76.1, 9.4	69.0, 8.5	<.001
Rural (%)	68.5	46.0	<.001
Marital Status (% married)	46.4	75.9	<.001
Educational achievement (%)			<.001
None	54.6	6.6	
Primary School	38.9	44.5	
Lower Secondary School	2.8	18.4	
Upper Secondary or Vocational	2.8	20.9	
College or Higher	0.9	9.6	
Material Hardship (mean, SD)	5.0, 2.1	3.1, 2.1	<.001
War Injury (% injured)	21.2	21.7	.917
Head Trauma (% injured)	4.5	8.3	.122
CES-D score (mean, SD)	25.6, 10.1	17.1, 10.2	<.001
Cardiovascular disease (% with diagnosis)	54.55	49.17	.330
Cerebrovascular disease (% with diagnosis)	23.40	8.44	<.001
Diabetes (% with diagnosis)	10.53	4.42	.012

Comparisons utilize t-test and chi square analyses.

The Associations of Demographic Characteristics, Depressive Symptoms, Social Context and Physical Illness Correlates with Cognitive Functioning and Impairment

Table 2

	Total MMSE Score ¹						Educational-Adjusted MMSE (1 = Cognitive Impairment) ²					
	Step 1			Step 2			Step 1			Step 2		
	B	SE	B	SE	B	β	OR	CI 95%	OR	CI 95%	OR	CI 95%
Area ^a	-1.250	0.373	-0.147***	-0.414	0.416	-0.049	1.93*	1.07-3.47	0.97	0.45-2.10		
Gender ^b	-1.820	0.366	-0.215***	-1.382	0.369	-0.163***	2.58*	1.35-4.96	2.03*	0.99-4.14		
Age	-0.104	0.020	-0.208***	-0.087	0.019	-0.173***	1.07***	1.03-1.11	1.06**	1.02-1.10		
Marital Status ^c	0.867	0.420	0.088*	0.573	0.417	0.058	0.76	0.39-1.46	0.91	0.446-1.87		
Education	1.259	0.175	0.337***	0.996	0.117	0.266***	--	--	--	--		
Depression				-0.051	0.019	-0.122**			1.02	0.98-1.05		
Cerebrovascular ^d				-1.475	0.608	-0.092*			2.21	0.80-6.13		
Cardiovascular ^d				0.535	0.332	0.063			0.52	0.27-1.01		
Diabetes ^d				-1.478	0.773	-0.073			3.23	0.87-11.93		
Material Hardship				-0.378	0.109	-0.183***			1.27*	1.04-1.55		
War Injury ^d				0.154	0.399	0.015			1.04	0.48-2.27		
Head Trauma ^d				1.255	1.127	0.042			0.00	0.00-0.00		
F	51.397***			26.525***				--		--		
R ² (R ²)	0.369			0.424 (0.055)				--		--		
χ ² (df)	--			--			31.591***	(4)	49.396***	(11)		

* p < .05.

** p < .01.

*** p < .001.

¹ multiple linear regression analysis.

² logistic regression analysis.

^a rural = 1; urban = 0.

b *women* = 1; *men* = 0.
c *married* = 1; *not married* = 0.
d *diagnosis* = 1; *no diagnosis* = 0.