Full Length Article

The linear relationship between the Vulnerable Elders Survey-13 score and mortality in an Asian population of community-dwelling older persons

Jye Wang[a], Wender Lin[a], Ling-Hui Chang[b],*

[a] Department of Health Care Administration, Chang Jung Christian University, No.1 Changda Rd., Gueiren District, Tainan City 71101, Taiwan, ROC
[b] Department of Occupational Therapy & Institute of Allied Health Sciences, College of Medicine, National Cheng Kung University, No.1 University Road, Tainan City 701, Taiwan, ROC

ARTICLE INFO

ABSTRACT

Background: The Vulnerable Elders Survey-13 (VES-13) has been used as a screening tool to identify vulnerable community-dwelling older persons for more in-depth assessment and targeted interventions. Although many studies supported its use in different populations, few have addressed Asian populations. The optimal scaling system for the VES-13 in predicting health outcomes also has not been adequately tested. This study (1) assesses the applicability of the VES-13 to predict the mortality of community-dwelling older persons in Taiwan, (2) identifies the best scaling system for the VES-13 in predicting mortality using generalized additive models (GAMs), and (3) determines whether including covariates, such as socio-demographic factors and common geriatric syndromes, improves model fitting.
Materials and methods: This retrospective longitudinal cohort study analyzed the data of 2184 community-dwelling persons 65 years old or older from the 2003 wave of the national-wide Taiwan Longitudinal Study on Aging. Cox proportional hazards models and Generalized Additive Models (GAMs) were used.
Results: The VES-13 significantly predicted the mortality of Taiwan's community-dwelling elders. A one-point increase in the VES-13 score raised the risk of death by 26% (hazard ratio, 1.26; 95% confidence interval, 1.21-1.32). The hazard ratio of death increased linearly with each additional VES-13 score point, suggesting that using a continuous scale is appropriate. Inclusion of socio-demographic factors and geriatric syndromes improved the model-fitting.
Conclusions: The VES-13 is appropriate for an Asian population. VES-13 scores linearly predict the mortality of this population. Adjusting the weighting of the physical activity items may improve the performance of the VES-13.

1. Introduction

According to a 2015 World Health Organization report, the number of older adults aged 65 years and older worldwide is projected to exceed two billion by 2050 (World Health Organization, 2015). By then, more than 434 million older adults will be aged 80 years or older (United Nations Department of Economic and Social Affairs, Population Division, 2015). As people get older, they are at risk of adverse health outcomes, such as falls, hospitalization, disability, and mortality.

Comprehensive geriatric assessment (CGA), a multidisciplinary process that includes diagnosis, care planning, and case management, is often regarded as the best approach to healthcare for frail older adults. Nevertheless, organizational, professional, practical, and financial barriers have impeded widespread implementation of CGA in clinical settings (Gladman, Conroy, Ranhoff, & Gordon, 2016). Several short

screening tools have been developed for clinicians to quickly identify candidates for more in-depth CGA and targeted interventions (Hamaker et al., 2012).

The Vulnerable Elders Survey-13 (VES-13), one such screening instrument, is specifically designed to screen vulnerable community-dwelling older persons for treatment (Saliba et al., 2001). It takes less than five minutes to administer and can easily be completed by a non-clinician in person or over the phone. The instrument was originally derived from retrospective analysis of data from the Medicare Current Beneficiary Survey (MCBS), a representative sample of Medicare enrollees in the United States (Saliba et al., 2001). Its score ranges from 0 to 10 and contains questions on age, self-rated health, six physical activities, and five activities of daily living. The VES-13 score predicts functional decline, mortality, health services utilization, and hospital complications for community-dwelling older persons (McGee et al.,

2008; Min, Elliott, Wenger, & Saliba, 2006; Min et al., 2009, 2011; Ng et al., 2014; Saliba et al., 2001) and has been used to screen vulnerable older cancer patients for treatment (Manokumar et al., 2016; Molina-Garrido and Guillen-Ponce, 2011).

However, several points regarding the VES-13 require further investigation. First, the predictive studies were done in the United States and Ireland, so most of the participants were white. Although VES-13 has since been translated into other languages (Carneiro, Sousa, Azevedo, & Saliba, 2015; Kenig, Richter, Zychiewicz, & Olszewska, 2014; Luz, Santiago, Silva, & Mattos, 2015; Ugolini et al., 2015), it has not been vigorously tested in the ethnic groups speaking those languages. It is unclear whether the VES-13 can be used to predict mortality in other ethnic or cultural groups, or in Asians in particular.

The original study by Saliba and her colleagues proposed a dichotomous scale with a cut-off point of 3 (Saliba et al., 2001). Participants with a score of 3 or higher were defined as "vulnerable older persons" and had a risk 4.2 times higher than the risk of those with a score of less than 3 for functional decline or death within two years. Most subsequent studies adopted this scoring system. When the VES-13 was used as a continuous scale to predict functional decline or death, risk ratios were 1.23, 1.37, and 1.36 respectively, for each one-point increase in the VES-13 score (Min et al., 2006, 2009; Ng et al., 2014).

The original study proposed using the VES-13 as a population-based screening-tool. Yet, there exists continued interest in using the VES-13 for prognostic purposes in older populations. The added value of a continuous scale as opposed to a dichotomous scale has been argued from a statistical standpoint of power to detect differences. To the best of our knowledge, other than the original study, no other study has specifically investigated whether it is more appropriate to use the VES-13 as a continuous scale or with cut-off points.

Dichotomizing a continuous variable leads to a loss of statistical power and, in some circumstances, biased results (DeCoster, Iselin, & Gallucci, 2009; MacCallum, Zhang, Preacher, & Rucker, 2002; Streiner, 2002). In theory, a cut-off point is appropriate only when the relationship between the scale of interest and an outcome increases non-linearly above the threshold value. Yet the linearity of the relationship between the VES-13 scores and the vulnerability of older persons to adverse health outcomes has not been adequately explored. In addition, while a dichotomous system has been used in previous studies, no other studies, except the original study, have explored the possibility of using cut-off points other than 3 (Saliba et al., 2001). This study used generalized additive models (GAMs) to examine the relationship between VES-13 scores and mortality, and to explore the effects of cut-off points other than 3 (Hastie & Tibshirani, 1986, 1990).

Previous studies showed a positive association between VES-13 scores and health outcomes. Some failed to control for the effects of some important covariates, e.g., gender, education, marital status, health behaviors, and common geriatric syndromes (dizziness, depression, incontinence, pain, falls, visual impairment, hearing impairment, low body mass index, and cognitive impairment) (McGee et al., 2008; Min et al., 2006, 2009, 2011; Ng et al., 2014; Saliba et al., 2001). Omitting these confounding variables may bias the estimation of the association between VES-13 scores and health outcomes.

The present study aimed [a] to assess the applicability of the VES-13 to an Asian population by analyzing whether the VES-13 score predicts the mortality of community-dwelling older persons in Taiwan within four years, [b] to identify the best scaling system for the VES-13 in the prediction of mortality, and [c] to determine whether the inclusion of covariates, such as socio-demographic factors and common geriatric syndromes, improves the model fitting.

2. Material and methods

2.1. Data source

Baseline data for this retrospective aging study came from the 2003

wave of the Taiwan Longitudinal Study on Aging (TLSA), previously known as the Survey of Health and Living Status of the Elderly in Taiwan, a multi-wave longitudinal study of the elderly in Taiwan conducted from 1989 to 2011 by the Health Promotion Administration in cooperation with the Population Studies Center, University of Michigan. Details of the methodology and sampling method can be found elsewhere (Chiu, Wray, & Ofstedal, 2011; Health Promotion Administration (TW), 2016; Ho, 2008; Zimmer, Martin, & Lin, 2005). Briefly, a three-stage probability sample of citizens aged 50 and over, living in institutions and the community in 1988, and from non-aboriginal townships was drawn from the Household Registry. Data on demographics, household composition, social relations, health and well-being, occupational history, and financial well-being were collected via face-to-face interviews in Mandarin or Taiwanese.

The first wave of the survey was conducted in 1989, with subsequent waves in 1993, 1996, 1999, 2003, 2007, and 2011. In 1996 and 2003, younger cohorts respectively aged between 50 and 66 and 50–56 were added to the sampling frame to maintain the representativeness of the overall sample and to expand the study population to those who were 50 years or older.

This study analyzed data from the 2003 wave of the survey. A total of 5377 participants completed the 2003 wave of the interviews (response rate: 87.5%). The survival data (with information on date of death and cause of death until the end of 2007) came from the death registry independently maintained by the Department of Health. The two datasets were merged into one analytical file using two unique linking variables provided by the Health Promotion Administration of Taiwan. Since the VES-13 was designed to screen for vulnerable community-dwelling elders who are older than 65 years, 2586 participants who were aged from 50 to 64 years were excluded, leaving 2751 participants who were 65 years old or older in 2003.

Among these 2751 participants, 567 participants were excluded from the analysis because the survey were completed by proxy respondents (a family member or caregiver), nursing home residents, or respondents with missing values in some variables. The majority of these 567 participants were proxy respondents. They were excluded because, by the design of the Taiwan Longitudinal Study on Aging (TLSA), all proxy respondents were not asked questions on depression and cognitive impairment, and therefore, for these 567 proxy respondents, these two variables were all missing values.

A comparison of the excluded participants (n = 567) with the study sample (n = 2184) showed that the excluded group had a higher percentage of females (58.48% vs. 45.42%), lower percentage of married individuals (44.57% vs. 61.72%), higher percentage with lower educational achievement (46.78% vs. 29.81% were illiterate, respectively), and a higher percentage with more than 3 comorbidities (47.37% vs. 39.47%).

This study used publicly-available and de-identified secondary data, and, following the ethical research guidelines in Taiwan, was exempt from review by an institutional review board.

2.2. Instrument

The VES-13 is a 13-item instrument that includes age ($65 \leq$ age ≤ 74: 0 points; $75 \leq$ age ≤ 84: 1 point; age ≥ 85: 3 points), self-rated health (good to excellent: 0 points; fair or poor: 1 point), difficulty with six physical activities (walking one-quarter of a mile, heavy housework, stooping, lifting a heavy object, reaching, and grasping small items; 1 point for difficulty with each task; maximum of 2 points) and five activities of daily living (bathing, walking across a room, light housework, money management, and shopping; 4 points for difficulty in one or more items). The total score for the VES-13 ranges from 0 to 10. A higher score suggests greater vulnerability (Saliba et al., 2001).

Some questions were adapted to the Taiwan context, two examples being the amount of weight lifted (12 kg) and walking distance