Higher Vulnerable Elders Survey Scores Predict Death and Functional Decline in Vulnerable Older People

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OBJECTIVES: To examine whether the Vulnerable Elders Survey (VES-13) score predicts risk of death and functional decline in vulnerable older adults.

DESIGN: Longitudinal evaluation with mean follow-up of 11 months (range 8–14 months).

SETTING: Two managed care organizations in the United States.

PARTICIPANTS: Four hundred twenty community-dwelling older people identified as having moderate to high risk of death and functional decline based on a VES-13 score of 3 or higher. These older people were enrolled in the Assessing Care of Vulnerable Elders observational study.

MEASUREMENTS: Baseline: VES-13 score, sex, income, cognitive score, and number of medical diagnoses. Outcome measures: functional decline and death.

RESULTS: VES-13 scores strongly predicted death and functional decline (P < .001, area under the receiver operating curve = 0.66). The estimated combined risk of death and decline rose with VES-13 score, increasing from 23% for older people with a VES-13 score of 3 to 60% for those with a score of 10. Other measures (sex, comorbidity) were not significant predictors of death or decline over this period after controlling for VES-13 score.


Key words: mortality; functional decline; screening tool.
METHODS

Participants
The validation sample was drawn from a population of 3,207 community-dwelling older people (≥65) enrolled in two large managed care organizations. The Assessing Care of Vulnerable Elders (ACOVE) Study successfully contacted 88% (n = 2,810) by telephone, and 90% of these (n = 2,521) agreed to be screened (cumulative response rate = 79%). Ten percent (n = 243) did not meet ACOVE Study inclusion criteria: not health plan members (n = 54), subject or proxy unable to participate in screening due to poor health (n = 18) or non-English speaking (n = 122), receiving cancer therapy (n = 49).

Nonclinical interviewers conducted screening telephone interviews with the remaining 2,278 eligible older people to determine functional status and VES-13 score (average VES-13 interview time = 4 minutes). Twenty-one percent (n = 475) of these older people were identified as vulnerable (VES-13 score ≥3), of whom 88% (n = 420) consented to participate in a comprehensive assessment of the quality of their medical care. The 55 who refused at this stage did not significantly differ from the 420 participants in terms of age, sex, or baseline VES-13 score.

Data
This study included a 13-month medical record review and a subsequent in-depth interview that queried functional status items identical to the screening interview. Medical records were the source of information for chronic illness and were reviewed for the 89% of patients (n = 372) with adequate records and at least some medical care beyond influenza vaccination. The National Death Index (NDI) provided death information for the entire sample. Because of variation in respondent availability, the follow-up interview was conducted 8.4 months to 13.8 months (mean ± standard deviation = 10.6 ± 1.2 months) after the baseline interview.

Outcomes
Patients’ health outcomes were represented in the same manner as in the derivation of the VES-13 survey, as a multinomial outcome with three categories: death before the end of the field period (10/20/00), functional decline among those surviving until the end of the data collection period (defined as change from no functional disability to any functional disability, an increase of two or more in the total disability count, or admission to a nursing home), or no death or decline. In additional logistic regression models, outcome was defined as death or decline versus no death or decline, combining the first two categories. Twelve functional disabilities were considered for the functional decline outcome: requiring assistance with bathing, feeding, toileting, transfer, walking, dressing, shopping, managing finances, light housework, using the telephone, managing medications, and preparing meals. The outcome of one individual who completed a follow-up interview and later died before October 20, 2000, was classified as a death.

The VES-13 and Other Candidate Predictors
The main predictor of interest, baseline VES-13 score, was computed from age (75–84 = 1 point, ≥85 = 3 points), self-rated health (fair or poor = 1 point), difficulty with one or more physical activities (stooping, crouching, or kneeling; walking one quarter of a mile; lifting 10 pounds; heavy housework; reaching above shoulder level; writing or grasping small objects = 1 point for each activity, maximum of 2 points), and requiring assistance with any of five activities (shopping, light housework, finances, walking across room, or bathing = 4 points). VES-13 scores can range from a minimum of 0 (no risk factors for decline) to a maximum of 10 (greatest number of risk factors for decline). Because those with scores of 0 to 2 were excluded from the study, the scoring range for this analysis was 3 to 10. VES-13 was tested in the model as a linear variable after preliminary exploration, because a set of indicator variables suggested a monotonic relationship with outcome.

Comorbidity was calculated as a count of 15 chronic medical conditions associated with mortality or functional decline in older adults: dementia, depression, diabetes mellitus, hearing loss, heart failure, hypertension, ischemic heart disease, osteoarthritis, osteoporosis, atrial fibrillation, urinary incontinence, chronic renal failure, chronic obstructive lung disease, and pressure ulcers. A missing indicator was used for 48 patients with inadequate medical records. The effect of comorbidity was evaluated using a joint test of the count and missing conditions indicator. Finally, age, measured continuously in years, was tested for its predictive ability beyond the three-category scoring employed by the VES-13.

To determine whether bias resulted from varying time to re-interview (i.e., patients with longer follow-up intervals may have had greater opportunity to decline or were more difficult to interview due to deterioration in health), time exposure was also tested as a covariate in the first multinomial logistic regression.

Loss-to-Follow-Up Weights
This analysis also applied weights to adjust for possible bias if selective loss to follow-up had occurred. These weights reflected the inverse probability of obtaining follow-up information and were derived using the full sample of 420 older people. Those who died before October 20, 2000, received a full weight of one because all deaths were obtained from the NDI. For the remaining 387 living participants, income, sex, cognitive status, and Mental Health Index score were used to estimate probability of re-interview.

Analysis
First, a multinomial logistic regression of the three-level health outcome (death, functional decline, or no decline) was performed to determine whether VES-13 score predicted death and functional decline outcomes independently in the patients for whom follow-up information (interview and death data) was available, weighting for
loss to follow-up. Bootstrapped 95% confidence intervals were calculated for predicted probabilities of each of the three outcomes for VES-13 scores from 3 to 10.

The effect of re-interview time exposure on functional decline was tested within this multinomial model. Because it was not statistically significant (β-coefficient = 0.0002, \(P = .95\)), it was excluded from subsequent models that considered functional decline as any part of the outcome.

Second, the overall predictive value of the VES-13 was evaluated in a logistic regression of the combined outcome of death or decline (vs no decline), because these two outcomes are not necessarily distinguishable (i.e., functional decline can precede death or re-interview), again weighting for loss to follow-up. A receiver operating characteristic curve was calculated for this model.

Third, to evaluate mortality effects in the full sample of 420 older people, a Cox proportional hazards survival analysis was performed to determine the effect of the VES-13 score on death at 13 months. Full information on this outcome was available through the NDI, so this model did not require weighting. Kaplan-Meier survival curves were plotted to examine whether high scorers dying early in the follow-up interval (i.e., older people in the midst of a rapid decline) could explain an observed effect of the VES-13 score.

Fourth, the potential for improvements in VES-13 scoring was assessed by adding continuous age, sex, and a count of comorbid conditions to the multinomial and survival analyses as predictors.

RESULTS

The mean baseline VES-13 score for the group identified as vulnerable was 5.3 (range 3–10). The mean number of conditions was 2.2 (range 0–7). The mean age of patients at baseline was 80.8, and two-thirds were female. Using the Blessed Orientation-Memory Concentration test\(^\text{26}\) to assess baseline cognitive status, 62% were rated good (score \(\geq 17\)) and 15% as poor (score \(\leq 17\)), and 23% were not tested because of representation by proxy respondent. At baseline, nearly all with VES-13 scores of 3 to 5 were free from activity of daily living (ADL) or instrumental activity of daily living (IADL) impairments (97% and 90%, respectively). For those with VES-13 scores of 6 or higher, half were independent in all ADLs, and 11% were independent in all IADLs.

Three hundred eight vulnerable older people were considered for the multinomial longitudinal outcome analysis; 33 (11%) had died by the end of the follow-up period, and 275 (71%) completed a follow-up interview. Seventy-two (26%) of the re-interviewed participants had functional decline, half of whom were free of any ADL or IADL impairments at baseline. Fifty-four interviews (20%) were conducted with a proxy respondent.

In the multivariable logistic model of loss to follow-up (using the full sample of 420 to determine loss-to-follow-up weights), low or missing income and male sex were associated with lower probability of follow-up (\(P < .05\) for all).

Higher VES-13 scores significantly predicted greater odds of decline and death in the multinomial logistic model. The odds of functional decline versus no decline were multiplied by 1.18 for each 1-point increase in VES-13 score

\(P = .008\), and the odds of death versus no decline were multiplied by 1.50 per 1-point increase in VES-13 score (\(P < .001\)).

The effect of the VES-13 score on predicted probability of death and functional decline over mean follow-up time of

\begin{figure}[h]
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\includegraphics[width=\textwidth]{figure1.png}
\caption{Predicted probability of no decline, death, or decline at 8 to 14 months according to Vulnerable Elders Survey (VES-13) score (\(N = 308\)). Greater VES-13 score (x-axis) in the range of 3 to 10 (normal value = 0) is associated with greater predicted probability (y-axis) of death and decline in vulnerable older patients. Y-axis values corresponding to the curve drawn above the light gray middle zone represent the sum of the probability of decline and death because the zones have been “stacked” (i.e., at each level of the VES-13, the sum of the probabilities of all three outcomes equals 1). For example, an older person with a VES-13 score of 7 has a 14.0% predicted probability of death plus an additional 27.2% predicted probability of decline. The combined probability of death or decline is 14.0% + 27.2% = 41.2% (vs 58.8% for no decline). Bottom (dark gray) zone = predicted probability of death. Middle (light gray) zone = predicted probability of decline. Top (white) zone = predicted probability of no decline. Solid lines = smoothed curves drawn through predicted probabilities. Dotted lines = bootstrapped 95% confidence limits around predicted probabilities.}
\end{figure}
follow-up time of 11 months in a population of vulnerable community-dwelling older adults. The relationship between VES-13 score and the odds of death or decline increased linearly from scores of 3 through 10, and each additional point substantially increased the risk of health deterioration. This study found that VES-13, an easily administered tool (<5 minutes by telephone by a nonclinician), might further differentiate those at greater short-term risk of death and decline in an already at-risk population. For the purposes of screening a more-vulnerable population for deterioration, higher VES-13 scores effectively differentiate higher-risk from moderate-risk patients.

The VES-13 can serve as a screening tool for identifying vulnerability that is not already apparent to clinicians. It relies on information readily provided by patients: self-rated health, age, and ability to perform five ADLs and six physical tasks. Half of the patients who eventually underwent functional decline were free of any ADL or IADL impairments at baseline. In addition, functional status items such as those in the VES-13 are not routinely obtained or assessed during generalist office visits.28

This study extends current understanding of VES-13 scores. The original derivation study found that a VES-13 score of 3 or more identified older people who were vulnerable to death or decline at 2 years. The current study expands the potential use of this tool, showing that differentiating scores higher than 3 (e.g., scores from 5 to 10) can provide meaningful additional prediction of risk of functional decline and death. The differential risks associated with higher scores are observable over a shorter follow-up interval (mean of 11 months). In addition, the current study confirms an earlier finding that collecting additional medical condition information would not significantly improve the VES-13, thus avoiding added survey burden.

A recent analysis of quality of care also supports the clinical utility of identifying short-term risk of death or decline using the VES-13. In a population identified as vulnerable (VES-13 score ≥3), those who received better-than-average quality of medical and geriatric care experienced significantly lower mortality than those who received worse care. This difference was seen as soon as 1.5 years after the care was delivered.29 Thus, the VES-13 seems to identify older people likely to benefit over a short time from higher quality of care.

The current study has some limitations. First, this evaluation of the VES-13 score was performed on a sample frailer than the average community population, because those with VES-13 scores of 0 to 2 were excluded. Despite this restricted sample range, 1-point changes in this simple scoring system predict substantial differences in deterioration. Therefore, the current study findings are limited to persons who score 3 or higher on the VES-13 and serve primarily to differentiate among at-risk patients.

A second possible limitation is that some of the older people may have been experiencing an acute or rapid trajectory of decline that was readily apparent to clinicians at baseline, thus obviating the need for screening. This study did not test providers’ recognition of patients’ functional limitations, although other studies have shown this to be a problem.28 In addition, the survival analyses showed that the predictive ability of the VES-13 remains robust over the entire observation period.
A third limitation was that possible bias might have been introduced by loss to follow-up. To address this limitation, this study employed loss-to-follow-up weights and additional analyses using the death outcome only because this information did not rely on the follow-up interview.

Despite these limitations, this study provides useful insight into the potential use of the VES-13 in older people at greater baseline risk (i.e., those who score ≥3). For this population, increasing scores can discriminate risk for death or decline within approximately the next year. This ability to differentiate risk may be particularly useful for clinical practices or research samples that find a large number of vulnerable older people (i.e., VES-13 score ≥3) when baseline screening is conducted.

Future studies might compare the predictive ability, acceptability, and feasibility of the VES-13 with those of other prediction tools. The predictive ability of the VES-13 in different ethnic and language groups should also be evaluated. In addition, intervention trials could measure whether care quality improves if clinicians are aware of vulnerability or whether knowledge of VES-13 score improves the targeting of specific interventions such as comprehensive geriatric assessment.

In conclusion, this study demonstrated that the VES-13 predicted death and functional decline over a mean follow-up of 11 months in a group of older people who were independent of the original derivation (MCBS) study. This practical survey instrument can be used to identify which vulnerable older people are at the highest risk of decline in clinic and population-based settings.

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