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Developing a self-reported comorbidity index to predict mortality of community-dwelling older adults

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ABSTRACT

Current common comorbidity measures have poor to moderate predictive validity of mortality of community-dwelling older adults. Hence, our aim is to develop a simpler resource-efficient self-reported comorbidity index in the prediction of survival. 113 older adults in Greater Manchester, United Kingdom attended a routine medical examination whereby information gathered was used to construct Charlson Comorbidity Index (CCI). They completed the Cornell Medical Index (CMI) questionnaire and reported the number of medication prescribed to them. We compared the ability of CCI, CMI, number of medication, age and sex to predict mortality of the sample over 7-year period using Cox-regression and Kaplan–Meier plot and rank test. None of the variables individually was significant when tested using either Cox-regression via ENTER method or Kaplan–Meier test. Remarkably, by means of forward stepwise Cox-regression, two variables emerged significant: (i) number of medicine (beta coefficient = 0.229, SE = 0.090 and $p = 0.011$) and (ii) age (beta coefficient = 0.106, SE = 0.051 and $p = 0.037$). We demonstrated that simple count of medication predicted mortality of community-dwelling older adults over the next 7 years more accurately than CMI or CCI. Further works involving a larger scale of subjects is needed for use in epidemiological study of survival where cost and resources are concerned.

1. Introduction

Comorbidity is a term used to describe the patient's variety of illnesses or burdens that may affect the clinical outcomes such as health care cost, utilization and survival (Lezzoni, 1997). Researchers and others often compare the outcomes of a specific condition between groups of population. However, this is made difficult when dealing with population with variety comorbid conditions like the older adults.

CCI is a popular risk adjustment tool that claimed to predict short-term outcomes such as in-hospital mortality, blood transfusion, length of stay and hospitalization charges (Charlson et al., 1987; Deyo et al., 1992; Hartz et al., 1992; D'Hoore et al., 1993). However, this index necessitates in-patient medical records and requires physician's efforts. Hence, there is a call for developing a rather simpler resource-efficient comorbidity index in predicting mortality of community-dwelling older adults (Schellevis et al., 1993; Skinner et al., 2005).

Nonetheless, little success was achieved in developing self-reported measures to predict survival of older adults (Selim et al., 2004; Chaudhry et al., 2005). In one study, Perkins et al. compared the common comorbidity measures (ambulatory care groups (ACG), CCI, chronic disease score (CDS), number of prescribed medication and number of chronic disease) in predicting 1-year mortality. The study found that current comorbidity measures have poor to moderate predictive validity of mortality over 1 year (Perkins et al., 2004). Remarkably, neither number of prescribed medication nor number of chronic illnesses was significantly different from other complex diagnostic-based measures in predicting survival.

The purpose of our study is to develop a new comorbidity index to predict mortality of community-dwelling older adults. CMI is a health questionnaire comprises 195 yes–no questions. An answer of 'yes' to a question indicates a deviancy from a normal physiological or emotional health state (Brodman et al., 1949). Several studies have shown its reliability as a self-reported tool in detecting a specific disease in community which was comparable to detection by means of biochemical screening (Weaver et al., 1980; Pendleton et al., 2005). Hence, we compare the ability of CCI, self-reported CMI and number of prescribed medications to predict mortality of community-swelling older adults over 7-year period.

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2. Methods

2.1. Data source

Data were obtained from the Age and Cognitive Performance Research Centre (ACPRC) volunteer panel, a group of over 6000 older adults across Greater Manchester, the United Kingdom. This group involved in a 20-year longitudinal study of aging process from 1983 to 2003 and was still active at the time of study (Rabbitt et al., 2004). This study was approved by The University of Manchester Ethics Committee.

2.2. Study sample

We invited the volunteers to take part in our study in which 113 participants agreed to participate. They aged 64 years old and above, lived independently and were able to travel to the ACPRC for routine medical assessment. Basic demographic data describing this sample is shown in Table 1.

2.3. Measures

The 113 participants recruited undergone medical assessment by two clinicians at the ACPRC in August 2000. The assessment includes history taking, systemic clinical examination and investigations such as blood sample analysis, urinalysis, lung function test, blood pressure measurement and 12-lead electrocardiogram (ECG) record. The information gathered was used to construct the CCI.

The CMI questionnaire was distributed to the participants by post in August 2000 and to be returned to the ACPRC. The CMI is divided into 18 sections: the first 12 correspond to physical systems review while the last 6 address mental health state. A free text section was also added in the questionnaire for the participants to report the medication prescribed to them.

To evaluate the reliability of number of drugs as a self-reported index, we compared the number of medication informed in the free text section of the CMI questionnaire with both the data from the General Practitioners (GPs) and from the Personal Details Questionnaire (PDQ). PDQ is a tool used longitudinally in ACPRC containing a self-reported question asking for current total number of medication prescribed medicines taken (Rabbitt et al., 2004). We contacted 88 GPs who were responsible of the care of our participants in which 43 GPs (49%) responded to the study.

Follow-up was done by identification and monitoring of the individuals involved in this study through the Office of National Statistics. The Office of National Statistics provides reports on all volunteers as to their survival and, if deceased, a copy of the death certificate. This is done on a quarterly basis. For this research project, we set a quarterly report indicating volunteers as alive or deceased on 30 June 2007.

Table 1
Characteristics of the 113 participants studied, *n* (%) or mean ± S.D.

Gender	
Males	49 (43.4)
Females	64 (56.6)
Age at assessment date (August 2000)	75.27 ± 5.19
Range	64–85
Subject's current status as at June 2007	
Alive	93 (82.3)
Dead	20 (17.7)

2.4. Statistical analysis

Survival length (measured in days) was calculated from the date of medical assessment (August 2000) to either the date of death or the date of data updated (June 2007).

Information gathered from the medical assessment was used to construct the CCI. Nonzero weight is assigned to 19 different conditions (all other conditions are given a score of zero). The weights comprise values of 1, 2, 3 or 6 based on their mortality risk. The respective weights are then summed for each patient to estimate survival (Charlson et al., 1987). Two variables were produced for analysis: (i) weighted index (ii) combined condition and age-related score.

From the CMI responses, we divided them into two variables: (i) the total of 'yes' answers of the physical system sections (A–L) and (ii) the total of 'yes' answers of the mental health sections (M–R). Besides that, previous studies found that the total of 'yes' answers of $\geq$30 in all sections of the CMI has been shown to signify a patient with medically significant physical disorder (Brodman et al., 1952; Ryle and Hamilton, 1962; Seymour, 1976). Hence, we will account this as another variable in our analysis.

We were also interested in seeing whether simple count of medication prescribed to the patients, age and sex of the patients were significant in predicting survival. Survival analysis for continuously distributed variables: age of the patient, weighted index of CCI, combined condition and age-related score of CCI, the first total of CMI (sections A–L), the second total of CMI (sections M–R) and simple count of medication prescribed were calculated using Cox-regression proportional hazard survival analysis. While analysis for the categorically distributed variables: sex of the patient and total CMI of $\geq$30 'yes' responses were calculated using Kaplan–Meier plot and log-rank test.

All statistical analyses were performed using the statistics package SPSS version 14.0 for Windows.

3. Results

Of the 113 who participated in this study, 49 were males and 64 were females. The mean age of this group as at the beginning of the study (August 2000) was 75.27 ± 5.193. At the end of the study (June 2007), 93 were still alive while the remaining 20 were dead.

Table 2 presents the characteristic distribution of the variables produced from both CCI and CMI. All the 113 participants attended the medical assessment in August 2000. The mean of weighted index was 0.50 ± 0.825 while the mean of combined condition and age-related score was 3.57 ± 0.944.

107 out of 113 participants (95%) filled in all sections and returned the CMI health questionnaire. The mean of first total of CMI (sections A–L) was 17.72 ± 9.813 while the mean of second total of CMI (sections M–R) was 4.49 ± 5.025. There were 45

Table 2
Description of variables produced from CCI and CMI.

Variable	Number of participants	Min.	Max.	Mean ± S.D.
CCI				
Weighted index	113	0	3	0.50 ± 0.825
Combined condition and age-related score	113	2	6	3.57 ± 0.944
Estimated 10-year survival (%)	113	2	90	61.55 ± 23.1
CMI				
First total of CMI (A–L)	107	2	46	17.72 ± 9.81
Second total of CMI (M–R)	107	0	24	4.49 ± 5.03