Prognostic Factors and Prediction of Residual Survival for Hospitalized Elderly Patients

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Abstract: The aim of this study, corresponding to a research project on functional decline and mortality of frail elderly patients, is to build a predictive survival process that takes into account the functional and nutritional evolution of the patients over time. We deal with both survival data and repeated measures, but the usual statistical methods for the joint analysis of longitudinal and survival data are not appropriate in this case. As an alternative, we use the multistate survival model approach to evaluate the association between mortality and the recovery, or not, of normal functional and nutritional levels. Once the model is estimated and the prognostic factors of mortality identified, a predictive process is computed that allows predictions to be made of a patient’s survival based on his or her history at a given time. This provides a more exact estimate of the prognosis for each group of patients that may be very helpful to clinicians in the making of decisions.

Keywords and phrases: Survival analysis, longitudinal data, predictive process, prognostic factors

11.1 Introduction

In any medical specialty, the regular measurement of health and quality of life indicators is known to be an effective tool that allows the perception of the function and patients’ capacities to be incorporated into clinical decisions. This is particularly relevant in geriatrics, where evaluations of impairment and disability play a fundamental clinical role.

The goal of this work, which corresponds to a research project on the functional decline and mortality of frail elderly patients, is to build a predictive process that includes the functional and nutritional evolution of the patients
over time as prognostic factors of mortality. The data set includes survival times and repeated observations (the functional and nutritional levels of the patients at each visit) and their analysis requires a specific statistical methodology. The problem is that most available methods for the joint analysis of longitudinal and survival data, such as those used by Faucett and Thomas (1996), Wulfsohn and Tsiatis (1997), and Henderson, Diggle, and Dobson (2000), are not appropriate for our data. The reasons are, firstly, that these methods do not allow for the use of multivariate markers and, secondly, that due to the mortality of the patients, for many of them we have fewer than three measurements, insufficient for the proper use of the mixed model.

As an alternative, we propose to focus our analysis on two clinically relevant aspects of the health progression: whether the normal levels of functional and nutritional status are recovered, and the speed of recovery of these normal levels. We use a multistate survival model to evaluate the association of these two aspects with mortality. Once the model is estimated and the prognostic factors of mortality identified, we can obtain a predictive process of a patient’s survival based on his or her history at a given time. These predictive probabilities are computed as described in Klein, Keiding, and Copelan (1994) and Klein and Moeschberger (1998, pp. 289–294).

The paper is organized as follows: In Section 11.2, we describe the cohort study and the follow-up process. In Section 11.3, we propose specific multistate models for the analysis of our data set. The resulting predictive process is developed in Section 11.3.1. A concluding discussion appears in Section 11.4.

11.2 Cohort Description and Follow-Up

For many elderly patients, an acute medical illness requiring hospitalization is followed by a progressive decline, resulting in high rates of mortality in this population during the year following discharge. However, few prognostic indices have focused on predicting posthospital mortality in older patients. In order to know more about this question, we analyze a cohort of frail elderly patients older than 75, who have had an acute disease and that, after being treated in an acute care unit, were admitted to the geriatric rehabilitation unit.

A multidimensional geriatric assessment was performed at baseline visit including information on demographics (age, sex, education, living site prior to admission and after discharge, etc.); cognitive, functional (measured by Barthel index), and nutritional (measured by Mini nutritional assessment) status; presence of depression; co-morbidity; and quality of life level. For any patient, information for all assessments was collected either from the patient himself or herself (when cognitive performance was intact) or from a knowledgeable informant.