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Research Paper

Identifying Some Risk Factors for the Time to Death of the Elderly Using the Semi-Parametric Blended Model of Survival Analysis With Competing Risks

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ABSTRACT

Objectives As the population of elderly people in Iran is rising, determining the risk factors of their death is necessary. The purpose of this study was to identify the risk factors that reduce the survival time of elderly people.

Methods & Materials In a longitudinal retrospective study, data of 510 elderly people aged over 60 years, who were admitted to Kashan's Golabchi nursing home from 2000 to 2012 were collected and analyzed. To identify some risk factors of time to death in elderly, semi-parametric mixture competing risk model in survival analysis was fitted to the data. To estimate the model parameters, Expand-Maximize-Compress (EMC) algorithm was used and parameters and their 95% confidence intervals were estimated using R software (version 3.3.1).

Results In separate one-variable fitted models, the variables like high blood lipids ($\widehat{HR}$=1.04; CI =1.00, 1.31), history of myocardial infarction ($\widehat{HR}$=0.90; CI=1.04, 1.10), stroke history ($\widehat{HR}$=0.95; CI=1.00, 1.14), and deaths of elderly people with cardiovascular diseases were significant. In the fitted multivariate model, renal problems had a significant effect ($\widehat{HR}$=1.58; CI=1.77, 2.83) on time to death of elderly.

Conclusion In single-variable fitting, age, history of myocardial infarction, history of stroke, and kidney problems were identified to have significant effects on the time to death of the elderly. Based on one-variable semi-parametric competing risk mixture fitted models, more significant risk factors for the time to death of elderly was identified when compared with a fitted multivariate mode to the data. This implies that the role of some independent variables can be explained by other independent variables.

Key words:
Aging, Semi-parametric blended model, Competing risks, Survival analysis

Extended Abstract

1. Objectives

Because the elderly population is increasing in Iran, awareness of various causes of death in the elderly is necessary. Certainly, with an increase in the number of elderly people, the mortality rate in the community will be on the rise, followed by the increase in mortality rates in this age group [1].

The present study aims to identify the risk factors that reduce the survival time of the elderly so that preventive measures could be considered in the identification, clinical trials, and therapeutic measures to eliminate serious risks and increase survival time for the elderly. The main purpose of this study was fitting a semi-para-

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metric blended model of survival analysis with competing risks for the elderly living in the nursing home and then estimating the parameters. Deaths in the elderly people due to cardiovascular diseases and other causes have been considered as competing risks.

2. Methods & Materials

The research method was retrospective. Analysis of data was performed by studying 510 elderly people over 60 years of age, who were admitted to Kashan's Golabchi nursing home from 2000 to late 2012. Independent variables related to the time to death of the elderly included gender, age at the start of admission, blood pressure, blood lipids, mobility status, history of myocardial infarction, history of stroke, and kidney problems. The dependent variable was the length of stay at the nursing home, which was calculated from the difference between the admission date and the discharge date [2]. Heterogeneity of patients is often ignored in the analysis of medical data. On the other hand, individual treatment is often important in medical sciences; however, the use of blended statistical models to analyze data related to a sample of the heterogeneous population can lead us to a proper analysis [3]. Another feature of this method is the lack of the need for the presumption of the independence of competing risks and the simultaneous estimation of parameters [4-6]. A semi-parametric blended model of survival analysis with competing risks was used to analyze the data, and for this the expectation-conditional maximization (ECM) algorithm was applied to estimate the model parameters [7].

In the model, the decision criterion for the significance of indicators of odds ratio and risk ratio is confidence intervals. The collected data were first analyzed separately as single-variable for each independent variable and again as multivariate by entering all independent variables in the model. The target incident was the death of the elderly, and those elderly who had not died by the end of the study were considered as censored data based on the time variable. Deaths due to cardiac and non-cardiac causes were defined as competing risks. The present research was approved by the ethics committee of the University of Social Well-being and Rehabilitation Sciences (IR.USWR.REC.1394.241). Data analysis was performed using R 3-3-3 software.

3. Results

Of 510 elderly people living in Golabchi nursing home of Kashan, 29% (148 individuals) were men, and 71% (362 individuals) were women. Also, 19.4% (99 cases) of them had died of cardiac causes and 44.1% (225 cases) due to non-cardiac causes. The remaining 36.5% of the elderly (186 people) were either survived or discharged by the end of the study, which was considered as censored data in the study. The median age of the elderly was 11.18 years, which was used as the grouping level in the age variable. The mean age of the elderly was 80.35 years with a standard deviation of 18.19 years.

In the single-variable fitting of the models, factors such as blood lipids {(CI=1.00 / 1, 1.31); $\widehat{HR}$=1.04}, history of myocardial infarction {(CI=1.04, 1.10) =CI; 90.0=$\widehat{HR}$}, history of stroke {(CI=1.00, 1.14); $\widehat{HR}$ =0.95} had a significant effect on the time to death of elderly with cardiovascular diseases. The coefficients derived from the univariate models in the estimation of the target incidence ratio, the chance of dying of cardiac diseases in the elderly men were 60% more than the elderly women (OR=0.66), with a confidence interval for this odds ratio CI=0.55, 1.03. The risk of death due to cardiac diseases in elderly patients with the history of myocardial infarction was 2.61 times more than others (2.61=OR experience of myocardial infarction). In a single-variable model, for an elderly person with a history of heart attack, the probability of death due to cardiac causes is 0.52, and the probability of non-cardiac death in an elderly person with a history of heart attack is 48.0.

In the fitting of the multivariate model (fitting a model with 8 independent variables simultaneously), renal problems have a significant effect (CI=1.77, 2.83; $\widehat{HR}$ =1.58). The probability of cardiac and non-cardiac deaths was 0.17 and 0.83, respectively, in the elderly men under 81.11 years old who have high blood fat along with abnormal motor status, high blood pressure, and no history of myocardial infarction and renal failure. Also, the probability of death due to cardiac causes in elderly women with a minimum age of 81.11 years who have high blood fat along with abnormal motor status and high blood pressure and have no history of myocardial infarction and renal failure. It is while the probability of non-cardiac deaths in these women is 0.41.

In the fitting of a multivariate model with the constant effect of other variables, the probability of cardiac deaths is lower in men than in women (OR=0.79), with a confidence interval of 0.84, 0.97. In addition, with the constant effect of other variables, the risk of cardiac deaths in elderly with renal problems is 1. 58 times great-

er than the elderly without renal problem ($\widehat{HR}$=1.88) with a confidence interval of 1.77, 2.83.

4. Conclusion

In single-variable fittings, the effects of the factors including age, history of myocardial infarction, history of stroke, and renal problems on time to death of the elderly were identified. Also, the results of multivariate analysis showed that with the constant effect of other variables, the renal problems variable has a significant effect on the time to death of the elderly living in nursing home. Therefore, it is recommended to consider preventive processes in the identification, clinical trials, and therapeutic measures to eliminate serious risks and to increase survival time for the elderly.

In the current aging society, proper planning for preventing renal and motor problems as well as good nutrition can help the quality of life of the elderly. One of the limitations of this study was the lack of accurate patient information, which might have resulted in the insignificant effects of some important clinical variables.

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Conflict of Interest

The authors declared no conflicts of interest.