

An Integrated Biostatistical Approach To Reveal The Health Status Among Elderly People At Receiving Home Care

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Abstract: This paper examines the factors influencing the health status among the elderly at Rumah Seri Kenangan (RSK), Pengkalan Chepa, Kelantan and RSK Bedong, Kedah. Correlation Analysis (CA), Decision Tree Analysis (DTA), Multilayer Perceptron (MLP), and Principal Component Analysis (PCA) were used to determine the factor that might be associated with the health among the elderlies in both RSK. Through these methodologies, the health status factor will be assessed and validate simultaneously. Results from these analyses will be used as a benchmark for the decision making especially among the decision-maker to improve the level of quality which given to the elderly. The utmost finding from this study, it provides very useful information to the health caregiver for future management action plan and to improve the existing management system of an elderly.

Index Terms: Multilayer perceptron, principle components analysis, correlation analysis, and decision tree analysis.

1. INTRODUCTION

HEALTH status includes physical, social, and mental health. Assessment of disease, such as signs, symptoms, and physiological stress measures, and determine the illness, like functional status, are embedded in the concept of health status [12]. Assessment of the health status has been suggested as a pivotal health determinant, specifically in primary care centre, with preference being given to health promotion and prevention [6]. Even though aging is an extremely individual process which effects the health status of elder individual, there is copious evidence that their health status is correlated with a combination of risk factors of recession in functional status, like psychological stress, comorbidities, cognitive impairment, smoking, less physical activity, high body mass index (BMI), and less social contact [14]. Psychological stress is a pathological process in elderly people, not a physiological reaction to growing elder. The mostly people confront with ageing, and many feel glad and satisfied. However, there is a not agreement among health experts and the society in broad spectrum to accept reduced functioning and high incidence of symptoms in elder people [1]. It is publicly accepted that elderly people have high burden of depression, but some studies shown younger have higher level of psychological stress [2]. Identification of elderly people with high and low risk for prospective dementia has appeared as an essential clinical and public health issue [7]. To address these concerns, we assessed health status which includes the psychological stress, neuropsychological disorders and other factors in elderly individuals in Kelantan, Malaysia. Many studies had been conducted especially on improving the

existing management of the elderly. Most of the study is emphasizing on the factor related to health care. There are many statistical analysis tools that had been used to determine the factor as such Multi-layer perceptron (MLP), Principal Component Analysis (PCA) and Correlation Analysis (CA) and Decision Tree Analysis (DTA) and many more. The artificial neural network paradigm has systematically demonstrated its efficacy as a reliable nonlinear classification technique [10]. Multi-layer perceptron (MLP), is a class of feedforward artificial neural network (ANN) used for data classification, requires the class labels needed for each sample to be compared to the actual output produced by MLP [9]. The term MLP is used vaguely, sometimes loosely to refer to feedforward ANNs, sometimes strictly to refer to networks consisting of multiple layers of perceptrons (with threshold activation) [5]. MLP consists of at least three layers of nodes: an input layer, a hidden layer, and output layer. Except for input nodes, each node is a neuron that uses a non-linear activation function. MLP uses a supervised learning technique called backpropagation for training [11] [13]. Multiple layers and non-linear activation distinguish MLPs from linear sensing. It can distinguish data that cannot be separated in a linear way [3]. Principal component analysis (PCA) is a mathematical procedure that converts several numbers of (possibly) correlated variables into a (smaller) number of uncorrelated variables called principal components. PCA calculates a small number of orthogonal directions that contain most of their variability. Proper solutions for PCA have long been used [8]. PCA on correlation is much more informative and reveals some structure in the data and relationships between variables. Correlation analysis is a statistical method used to study the strength of the relationship between two, numerical and continuous variables such as height and weight. This particular type of analysis is useful when wants to determine if there is a possible relationship between variables [4].

2 MATERIAL AND METHODS

The source of population comprises of an elderly which age more than 60 years old and living in Rumah Seri Kenangan (RSK) in Pengkalan Chepa, Kelantan and RSK Bedong, Kedah. RSK is government funded public sheltered home for elderly suffered from lack of financial and family support.

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Initially there was a total of 174 respondents who participated in this research. They are consist of 87 elderly from RSK Pengkalan Chepa and 87 elderly in RSK Bedong.

3 RESULTS

Phase I: Correlation Analysis

TABLE 1
DATA DESCRIPTION OF THE SELECTED VARIABLE IN THE STUDY

Num.	Variables	Explanation of user variables
1.	Psychological Stress or Acute Disease	0 = Yes 1 = No
2.	Neuropsychological Problem	0 = Severe Dementia/ Depression 1 = Mild Dementia 2 = No Psychological Problem
3.	Weight Loss	0 = Weight loss more than 3 Kg 1 = Don't know 2 = Weight Loss Between 1 to 3 Kg 3 = No Weight Loss
4.	Health Self-Assessment	0 = Healthy 1 = Not Healthy

Figure 1 has proposed the structural framework of the analysis. Several variables have been identified as a dependent variable and an independent variable. The aim of this research to find out the most factor which having a high association with the health of the elderly. The structural framework of the proposed analysis is given in Figure 1 as follows:

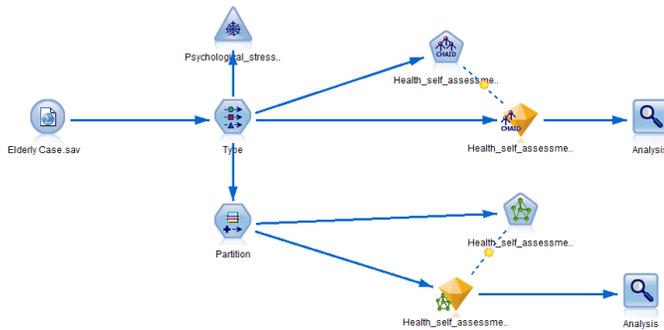


Fig. 1. Structure framework of the propose analysis using SPSS Modeller

These framework structures consist of three main analyses. The first analysis is focused on the method of correlation by the plot. Second analysis referring to the decision tree analysis. Through this analysis, there are three major factors were identified as the main contribution toward health status. The third analysis is the multilayer perceptron. This methodology discovers the relationship between the target variable and the predictors and to assess the ability of neural networks as an assistant tool for assessing health status among the elderlies. The principal component analysis (PCA) method will be applied to the selected variable for validation purposes. Through this analysis, the associated factor will be group closely according to their characteristics.

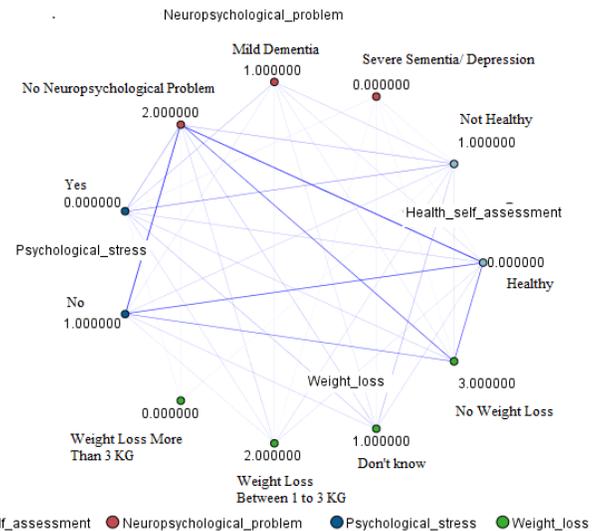


Fig. 2. Correlation analysis plot

Figure 2 shows that the correlation analysis for all possible pairs of the potential variables among the elderly at Rumah Seri Kenangan (RSK) Pengkalan Chepa, Kelantan and RSK Bedong, Kedah. From the correlation analysis plot, the thick line describes the strong association between the studied variable and the non-thick line reflect the weak association. It is observed that an elderly with no neuropsychological problem, no weight loss, no psychological stress have a strong association toward good health status. This finding gives very good information to the caregiver about the health status indicator. Through the plot, it reveal that four sub-items have a strong correlation in giving the health status among the elderly.

Phase II: Decision Tree Analysis

A decision tree analysis is a way of classification, prediction and facilitating decision making in sequential decision problems [5]. Nowadays, decision tree analysis had been used widely across many fields. This is because it allows the researcher to have a clear picture of the characteristics of the whole data.

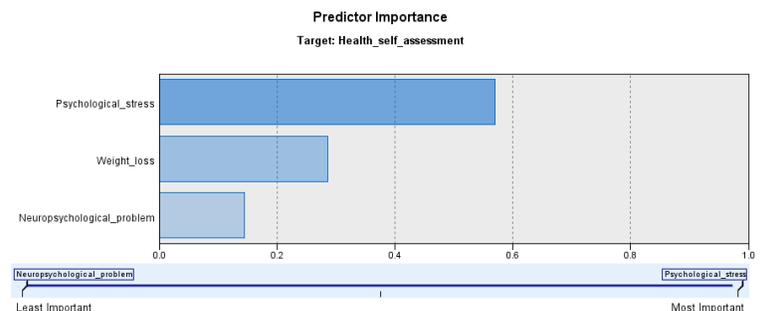


Fig. 3. Predictor important

It is proven that three variables had been justified for health status. Psychological stress is the main factor which influences the health status among the elderly. The second factor is on weight loss, elderly who have more weight loss, also being neuropsychological at a mild and severe stage. These three factors had shown their relationship. At the level of correlation analysis, it has proven that three three-factor has a connection to each other.

analysis, 73.8% was obtained from the level of accuracy.

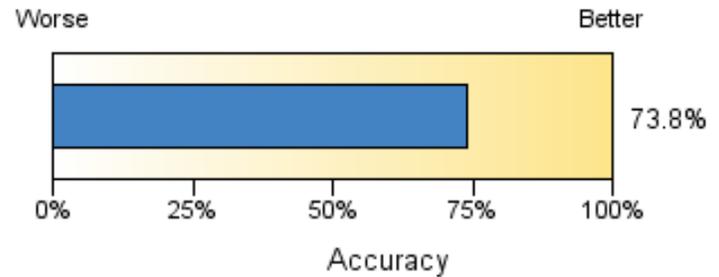


Fig. 5. The accuracy of radial basis function (RBF)

The MLP architecture is composed of the number of input, hidden and output nodes. There are three selected variables, which were psychological stress, weight loss, and neuropsychological problem. The output node in this study is one node since we have one dependent variable which is referred to health status. Data were partitioned into three which is training (60%), testing (30%) and validation (10%). Below is the MLP result of the health status.

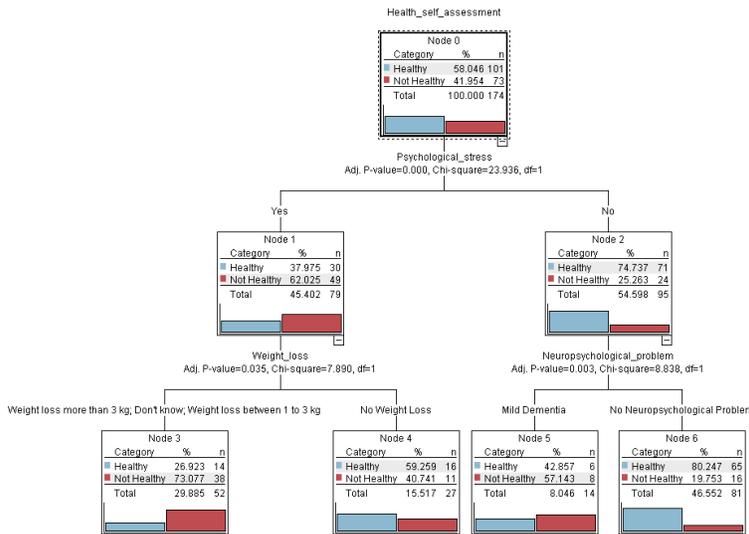


Fig. 4. Decision tree for health self-assessment

According to the decision tree analysis (Figure 3), the top three predictors are ranking to their contribution are psychological stress, weight loss and neuropsychological problem to health self-assessment. According to Figure 4, the total of an elderly health self-assessment among the elderly is about $n = 174$ where healthy 101(58.0%) and for unhealthy elderly about 73(41.95%). The first split was based on psychological stress, ($\chi^2(1) = 23.936, p < 0.05$), it was observed that those who are having psychological stress (healthy) is about 30(37.97%) and not healthy is about 49(62.03%). The second split is on the weight loss ($\chi^2(1) = 7.890, p < 0.05$). At this stage, the model has divided these patients into two sub- categories which is Nodes 3 and Nodes 4. Elderly which is not healthy having weight loss much higher compared to the elderly which having .no weight loss. The other split is for the neuropsychological problem ($\chi^2(1) = 8.838, p < 0.05$) which is given as Nodes 5 and Nodes 6. At this stage, the elderly do have a neuropsychological problem with having mild dementia and they are from healthy is about 6 (42.86%) and from not healthy is about 8 (57.14%).

Phase III: Multilayer Perceptron (MLP) Analysis

A MLP is a class of feedforward artificial neural networks (ANN). MLP was constructed based on the selected variable and also the recommendation proposed by IBM SPSS Modeler 18.0. This is to ensure that the MLP model obtained is precise and accurate (model fits the data). According to the

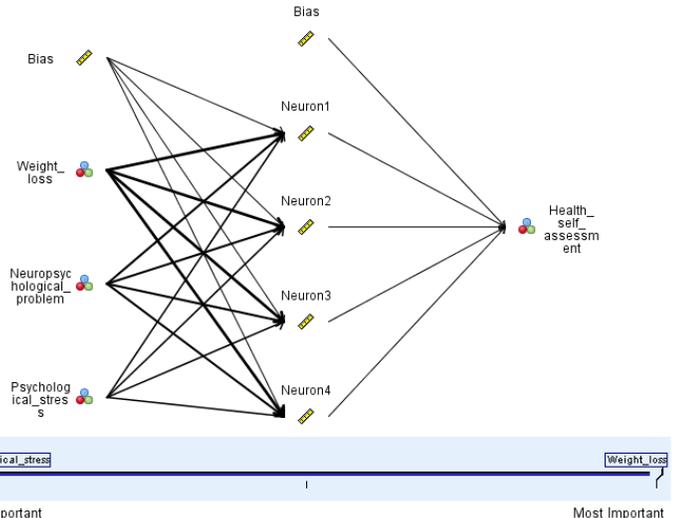


Fig. 6. The architecture of the best (MLP) model with one hidden layer, three input variables, seven hidden nodes and one output node

Figure 6 considers three independent variables as inputs for the MLP, then health status is considered as the output (output node). We then apply the MLP to find the best number of hidden nodes (automatically computer number of units).

TABLE 2
THE RESULTS OF CORRECT, WRONG, AND MEAN CORRECT FOR TRAINING, TESTING AND VALIDATION

Input Variables :	Training	Testing	Validation
Psychological Stress			
Weight Loss			
Neuropsychological Problem			
Correct	66.34%	73.91%	74.07%
Wrong	33.66%	26.09%	25.93%
Mean Correct	72.90%	71.80%	74.20%

This paper extended the idea of correlation to examine the significant variables that influencing the health status among

the elderlies. Table 2 summarizes the MLP model. To see the neural network generalize well or not, it can be measured through training, testing, and validation. In this case, the performance of the MLP was evaluated as shown in Table 2. Training dataset (66.34%), the measures of accuracy are relatively similar to the testing dataset (73.91%) and similar to validation (74.07%).

Phase IV: Principal Component Analysis (PCA)

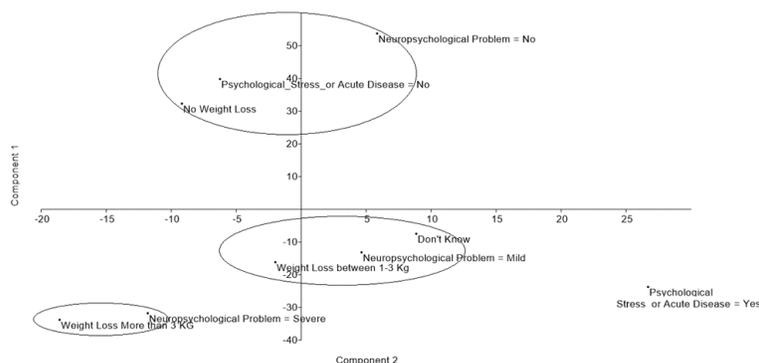


Fig. 7. PCA plot for health status among elderlies

Figure 7 shows the principal components analysis plot on both dimensions (level of the neuropsychological problem with a classification of weight loss and having psychological stress or acute disease). According to the result that suggested by the principal components analysis plot above, the neuropsychological problem is mild was near toward the weight loss between 1-3 kg. Then, the neuropsychological problem is severe was near the weight loss of more than 3 kg. In addition, no having a neuropsychological problem is near to no weight loss and not having psychological stress or acute disease. At the overall of an assessment, there was having psychological stress, or acute disease was found.

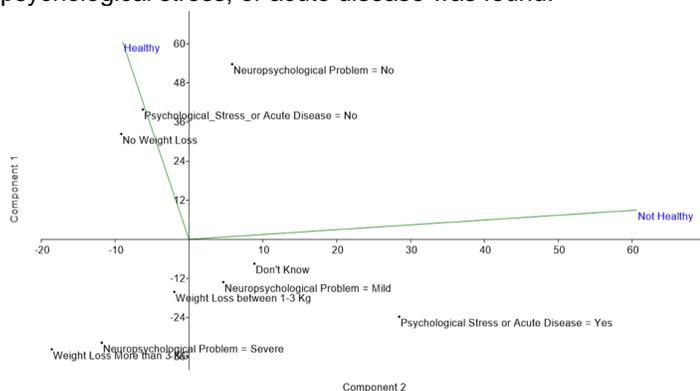


Fig. 8. Principle Component Analysis (PCA) plot according to the health status

The PCA plot based on the health status was shown in Figure 8. According to the result obtained from the plot above, not having a neuropsychological problem, no weight loss and not having psychological stress or acute disease are grouping together. This indicates that these variables having an association with each other. It's mean that the healthy elderly having no neuropsychological problem, having no psychological stress and no weight loss. The pattern in PCA also shown that the elderly who have a neuropsychological

problem at a severe and mild level more, having weight loss between 1-3kg, having psychological stress or acute disease and are close at each other which is near to unhealthy status.

4 SUMMARY AND DISCUSSION

The main objective of this research paper is to paper examines the factors influencing the health status among elderly at Rumah Seri Kenangan (RSK) Pengkalan Chepa, Kelantan and RSK Bedong, Kedah. The main focus of this paper is to illustrate the factor of psychological stress, neuropsychological problem and weight loss towards health status. Correlation analysis through the plot is being performed. Through this analysis, it is observed that an elderly with no neuropsychological problem, no weight loss, no psychological stress have a strong association toward good health status. Through this finding, the caregiver can use this finding as a benchmark for assessing the health status among the elderlies. The result for the decision tree shows that the path and classification of healthy and unhealthy and their related factors. Through this analysis, the important pattern of unhealthy elderly will be classified, and the related factor will easily be assessed. To validate the factor which had associated with the health status among the elderly, the MLP procedure is being applied through training procedure, testing procedure, and validation procedure, the accuracy of the MLP is given as 73.8%. This methodology discovers the relationship between the target variable and the predictors for assessing health status among the elderlies. Principal component analysis (PCA) plot illustrates the associate factor according to every each category. Through this technique, the studied factor can be seen clearly, and their pattern can be easily accessed. As conclusion, these promising techniques had led to successful research and give the best results for decision making especially for the decision-maker among the caregivers.

ACKNOWLEDGMENT

The authors would like to express their gratitude to Universiti Sains Malaysia (USM) for providing the research funding (Grant no. 1001/PPSG/8123051, School of Dental Sciences (PPSG), Health Campus, Universiti Sains Malaysia).

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