Interrelationship between the general characteristics of Korean stroke patients and the variables of the sexual functions: random forest and boosting algorithm

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Abstract. [Purpose] The purpose of this study is to examine patient preferences for counseling related to sexuality post-stroke in Korea. [Subjects and Methods] A survey was conducted on 200 stroke patients. Among the 200 submitted questionnaires, 156 responded but 147 cases are available. The questionnaire is composed of 27 questions such as 8 independent variables related to the general characteristics of the patients, 7 dependent variables in conjunction with sexual intercourse and changed muscle tone, 6 questions regarding to changed sexual function, and 6 questions about a changed motor and a sensory function after stroke. To analyze the factors related to a sexual function after a stroke, we used the random forest, boosting algorithm and MANOVA. [Results] The most important variable in variable group 1 is VAR1, and then VAR22, VAR23, VAR26, VAR27, VAR25, VAR21 and VAR24 respectively. The most important variable in variable group 2 is VAR22, and then VAR26, VAR23, VAR25, VAR1, VAR27, VAR21 and VAR24. Finally, for variable group 3, VAR1 has the most important percentage, and we have the order as VAR26, VAR23, VAR27, VAR22, VAR25, VAR21 and VAR24 among the rest of variables. The result of variable importance in boosting algorithm is somehow the same as that of random forest. [Conclusion] As a result of our analysis, we figured out that duration of illness, age, and education level are important factors of sexual functions for Korean Stroke patients.

Key words: Survey, Sexual functions, Korean stroke patients

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INTRODUCTION

Sexuality is an integrant and essential part of quality of life (QoL), and patient affected by neurological disability, including stroke, should also be investigated and treated for sexual disorders1). Sexual dysfunction is common after stroke, but is frequently not addressed by healthcare providers2).

Post-stroke impaired sexual activity encompasses sexual dysfunction and/or impaired sexual satisfaction. The latter is defined as a decline in libido in both genders, erectile dysfunction and poor ejaculation in men and diminished lubrication and orgasm in women3, 4). Post-stroke patients reported a marked decline in all the measured sexual functions, ie, libido, coital frequency, erectile and orgasmic ability, and vaginal lubrication, as well as in their sexual satisfaction. The spouses also reported a significant decline in their libido, sexual activity, and sexual satisfaction as a consequence of stroke5). Sexual dysfunctions after stroke reported to be due to multiple etiologies, including both physical and psychosocial causes1, 2).

Sexual function relies on a complex network of peripheral and central pathways involving the participation of autonomic
and somatic nerves and the integration of numerous spinal and supraspinal sites in the central nervous system, with the hypothalamic and limbic regions playing a pivotal role.

Many studies have shown significant relationships between symptoms of depression and functional outcome in patients from 3 months to 2 years after stroke. Also, reduced quality of life after stroke appears to be related not only to the physical disability but also to psychologic factors influencing sexual function and, in particular, sexual desire. The role of psychological factors in poststroke sexual dysfunctions (SD) is further confirmed by the observation that sexual disorders are reported not only by the patients, but also by their spouses or partners. Nevertheless, most of the patients received little information about sexuality following stroke on sexual behavior and attitudes of the stroke patients’ spouses, although they are very important in terms of stroke survivors’ well-being.

The decreased sexual activities of the stroke patients in Korea mainly result from psychological burden and physical disability caused by a disorder, but most of them tend to avoid consultation with experts. Additionally, avoiding sexual intercourse and conversation is another important factor of decreasing sexual life due to a concern about aggravating a spouse’s condition.

Random Forest is a bagging algorithm which reduces variance of a large number of “complex” models with low bias. While boosting, which uses a set of week classifiers and combine them to derive a strong classifier, reduces bias of a large number of “small” models with low variance. We compared the result of some machine learning algorithms, among them random forest and boosting algorithm are the best for our purpose.

Many studies on changed psychological and physical health regarding rehabilitation after stroke have been conducted, but there are not enough comparative studies on the general characteristics of the patients and sexual index. The purpose of this study was to examine patient preferences for counseling related to sexuality of post-stroke patients in Korea by using the random forest, boosting algorithm and MANOVA. Studies about stroke patients’ sexual life which were unofficially discussed could be an important factor to improve the quality of patients’ life and family life including a spouse as well.

SUBJECTS AND METHODS

The survey was conducted by 147 patients who were diagnosed with stroke from university hospitals located in Seoul/Gyeonggi, South Korea. The survey procedure was sufficiently explained beforehand to the subjects who voluntarily participated by signing the survey consent form. This study was approved by the Institutional Ethics Committee of Namseoul University.

We firstly revised and used Brief Sexual Functioning Questionnaire for men (BSFQ) and Brief Index of Sexual Functioning for Woman (BISF-W). The revised BSFQ, BISF-W are used to diagnose a disorder of sexual behavior and function, according to the objective of this study. The revised questionnaire was then reviewed by an expert group consisting of three professors in the Department of Physical Therapy to examine content validity and suitability of the questions. The questionnaire was composed of 27 questions such as 8 independent variables related general characteristics of the patients, 7 dependent variables in conjunction with sexual intercourse and changed muscle tone, 6 questions regarding a changed sexual function, and 6 questions about a changed motor and a sensory function after stroke (Table 1). The alpha value of Cronbach was 0.688 which was used to indicate internal consistency of the dependent variables. Data for this study had been collected for 98 days: feasibility study for 8 days and main survey 90 days. A physical therapist at the hospital fully explained the objectives and procedures of this study to the patients, and the questionnaires were filled by voluntary patients. Total 156 questionnaires out of 200 were collected, and 147 questionnaires except 9 unsuitable questionnaires were used for final analysis.

The collected questionnaires were analyzed by R version 3.3.1. To figure out an interrelationship between the general characteristics of the patients and the variables of the sexual function, random forest, boosting algorithm and MANOVA were used for analysis. Statistical significance was accepted for values of $\alpha \leq 0.05$.

RESULTS

The general characteristics of 147 subjects are age, duration of illness, weight, gender, marital status, education level, income level and occupation. The mean age of our study population (97 men; 65.99% and 50 women; 34.00%) was 53.56 years. Highest frequency of age is 50’s with 60 patients (40.82%). The forty-six patients (31.30%) have more than 1 year but no longer than 3 years of a duration of illness, and it is examined the mean duration of illness is 3.18 years. For the weight factor, the most number of the patients are fifty-four (36.73%) whose weight is between 60 kg and 70 kg, and its mean is 67.05 kg. The general characteristics of the patients are age, duration of illness, weight, gender, marital status, education level, income level and occupation.
respectively. The most important variable in variable group 2 is VAR22, and then VAR26, VAR23, VAR25, VAR1, VAR27, VAR21 and VAR 24. Finally, for variable group 3, VAR1 has the most important percentage, and we have the order VAR26, VAR23, VAR27, VAR22, VAR25, VAR21 and VAR 24 among the rest of variables (Table 2).

The result of variable importance in boosting algorithm is somehow the same as that of random forest.

DISCUSSION

The purpose of this study was to examine patient preferences for counseling related to sexuality of post-stroke patients in Korea by using the random forest, boosting algorithm and MANOVA.

Random forest is an excellent method to determine variable importance, as it fits a number of decision tree classifiers on
various sub-samples of the dataset. It uses averaging to improve the predictive accuracy and control over-fitting, so there is no need for cross-validation to get better (or unbiased) estimation, since according what we said it is already done internally. However, it is difficult to interpret the result with multiple outcome variables in random forest, for this purpose using multivariate tree boosting that is a method for non-parametric regression is useful. In this study we are extending these three methods along with linear regression for one group of independent variable and three different groups of dependent variables to analyze the dataset and find the importance of group of independent variables to predict the group of dependent variables as well as illustrate the correlation between groups of dependent variables. This study is to realize the effect of sexual functions in stroke patients in computer science point of view. Moreover, we applied 10-fold cross-validation for getting better result in multiple linear regressions and compared the result of these three methods on our data that we conclude the best result from random forest and boosting algorithm.

As a result of questionnaire analysis, duration of illness, age, and education level among 8 independent variables strongly affect by other dependent variables which are sexual intercourse and changed muscle, changed sexual function, and changed motor & sensory function.

According to analysis the quality of life targeted at stroke patients who have less than 1 year duration of illness, the quantitative and qualitative measures of most patients related to sexual life were decreased. Patients who have more than 1 year duration of illness had the same result. This is due to the fact that most stroke patients did not enjoy traveling and an engaging in outdoor activities so that the quality of life was reduced. The sexual function of most stroke patients in this study was also reduced because patients and their spouses focused on rehabilitation for the first year after an illness occurred, and there was absence of sex education after one year. Forsberg-Wärleby et al. pointed out the necessity of sex education for stroke patients and their spouses in terms of the quality of life. Mild stroke patients especially needed such education after a stroke. Appropriate sexual life and sex education according to the duration of illness are also considered important factors to improve the quality of life, and it needs to examine a detailed sexual life and an education based on the seriousness of a stroke in the future.

Age is the second biggest independent variable that affects dependent variables. Approximately 60% of the stroke patients between 60s and 70s showed reduction of the sexual function with the erectile dysfunction, and it reported the high possibility of the erectile dysfunction as getting old. In this study, the sexual activity of the patients between 40s and 50s was reduced after a stroke occurred compared to patients between 60s and 70s. Since this referred to the physiological age-related characteristic and they had active sexual life compared to other age groups, variables related to a sexual function were proportionally lower than they were before illness occurred.

An education level is the third biggest independent variable that affects dependent variables. An education level is categorized according to graduation: before graduating elementary school, graduated from middle school, graduated from high school, and after graduating university. As an education level goes up, it shows that patients who graduated university tend to often have a conversation about the sexual topic, and this group also showed the high statistical result regarding the necessity of a sexual study, sexual intercourse status, and the number of sexual intercourse. This was due to the possibility that they might have more sexual education opportunities so that they could have more chances of sexual intercourse.

There was a research limitation. Patients between 60s and 70s did not respond to some questionnaire items due to passive attitude and repulsion. This limitation caused the low response rate so that we had a difficulty to generalize the research result. Yet, we found out that sexual education for disabled Koreans needed to be developed urgently and hopefully this study would be a good guideline for developing such sexual program.

In conclusion, this study found out that duration of illness, age, and education level were important factors that affected patients’ sexual life and function. It is required to make more specific descriptions of the questionnaire items and needs to complement a questionnaire for the future work.

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