

METHOD AND DEVICE FOR PREDICTING DEMENTIA BY USING DEMENTIA RISK FACTOR ACCORDING TO SEX OF PATIENT

[Technical Field]

[1] The present disclosure relates to a dementia prediction method and apparatus using dementia risk factors according to patient's gender, and more particularly, to a dementia prediction method and apparatus capable of more accurately predicting dementia through different dementia risk factors according to patient's gender.

[Background Art]

[2] Research for treatment of dementia has been conducted worldwide for over 20 years, but the dementia is a symptom for which there is still no complete treatment method. Since the dementia may not be completely cured at the current level of medical care, the only solution is to early predict the dementia early and slow down a progression of the dementia using drugs. Various drugs may be used as a treatment method for dementia, but these drugs have only an effect of slowing down the progression of dementia, not a fundamental treatment for dementia. However, when the treatment of dementia is progressed by receiving a prescription for treatment in an early stage of dementia, the treatment has a relatively high effect.

[3] Therefore, early prediction and early diagnosis of dementia may play a decisive role in alleviating dementia symptoms. When the dementia symptoms are alleviated through the early prediction of dementia, unnecessary social and economic costs may be reduced. In order to solve a rapid increase in dementia

patients and high social costs, the early prediction of dementia is a very urgent problem.

[4] As such, in order to early predict dementia, it is necessary to accurately identify dementia risk factors, but risk factor/biomarker analysis of dementia requires a long time and cost. Therefore, when new risk factor candidates for dementia as well as the dementia risk factors are detected, it may be possible to build a model for discovering new biomarkers through such detection, thereby saving the time and cost.

[5] Through previous studies, it has been found that risk factors of cardiovascular metabolism and risk factors of depression are different according to gender. For example, when a correlation between depression and hippocampus atrophy (shrinkage) is examined, it is found that the depression affected hippocampus atrophy in women and did not affect hippocampus atrophy in men. Since dementia is also associated with brain disease, it has been speculated that men and women may have different dementia risk factors, similarly to other diseases.

[6] In Korea, a prevalence rate of dementia in women is 69.7% among all men and women, and worldwide, the prevalence rate of dementia in women is 61%. Therefore, it has been speculated that there is a possibility that dementia may also have differences in expression factors between men and women, but exactly what risk factors for manifesting dementia according to gender have not been identified in the past. As such, even in the case of dementia, a problem that men and women may have different dementia risk factors has been raised.

[7] However, unlike other diseases, studies on dementia risk factors regardless of gender have been intensively conducted in the field of dementia.

Accordingly, it is possible to develop more efficient dementia prediction technology by analyzing different dementia risk factors according to male and female genders by analyzing the dementia risk factors according to gender differences between men and women.

[Disclosure]

[Technical Problem]

[8] Aspects of the present disclosure provide a dementia prediction method and apparatus using dementia risk factors according to patient's gender capable of not only analyzing a difference in dementia risk factors between men and women, but also finding new biomarker candidates that have not been previously identified.

[9] Aspects of the present disclosure also provide a dementia prediction method and apparatus capable of increasing an accuracy and reliability of dementia prediction by predicting dementia by intensively analyzing dementia risk factors according to gender among various data of test subjects.

[10] However, aspects of the present disclosure are not restricted to those set forth herein. The above and other aspects of the present disclosure will become more apparent to one of ordinary skill in the art to which the present disclosure pertains by referencing the detailed description of the present disclosure given below.

[Technical Solution]

[11] According to an embodiment of the disclosure to achieve the above objects, a dementia prediction method according to patient's gender is provided. The

dementia prediction method comprises obtaining data corresponding to dementia risk factors according to gender from a test subject and predicting dementia of the test subject by inputting the data corresponding to the dementia risk factors according to the gender of the test subject into a dementia prediction model. The dementia prediction model may be a model that learns the dementia risk factors according to the gender by extracting features of men's dementia risk factors and women's dementia risk factors from cohort data collected from a normal group and a dementia patient group.

[12] According to an embodiment of the disclosure to achieve the above objects, a dementia prediction apparatus according to patient's gender is provided. The dementia prediction apparatus comprises a processor, a network interface, a memory that is executed by the processor and loads a computer program and a storage for storing the computer program. The computer program includes instructions of: obtaining data corresponding to dementia risk factors according to gender from a test subject, and predicting dementia of the test subject by inputting the data corresponding to the dementia risk factors according to the gender of the test subject into a dementia prediction model. The dementia prediction model may be a model that learns the dementia risk factors according to the gender by extracting features of men's dementia risk factors and women's dementia risk factors from cohort data collected from a normal group and a dementia patient group.

[Description of Drawings]

[13] FIG. 1 is an illustrative diagram of a dementia prediction system according to patient's gender according to some embodiments of the present disclosure.

[14] FIG. 2 is a flowchart of a dementia prediction method according to patient's gender according to some embodiments of the present disclosure.

[15] FIG. 3 is a diagram for explaining detailed contents of Senior Cohort DB.

[16] FIG. 4 is a diagram for explaining detailed items of PIE-DB, MT-DB, and GHE-DB among Senior Cohort DB.

[17] FIG. 5 is a diagram for explaining sampling rates of data of dementia seniors and normal seniors from Senior Cohort DB.

[18] FIG. 6 is a diagram for explaining a configuration of a neural network of a dementia prediction model according to some embodiments of the present disclosure.

[19] FIG. 7 illustrates the results of performance according to gender of the dementia prediction model through experiments.

[20] FIG. 8 illustrates a list of dementia risk factors that develop men's dementia.

[21] FIG. 9 illustrates a list of factors excluding some factors among the risk factors that develop men's dementia of FIG. 8.

[22] FIG. 10 illustrates a list of dementia risk factors that develop women's dementia.

[23] FIG. 11 illustrates a list of factors excluding some factors among the risk factors that develop women's dementia of FIG. 10.

[24] FIG. 12 illustrates a hardware configuration diagram of a dementia prediction apparatus according to patient's gender according to another embodiment of the present disclosure.

[Mode for Invention]

[25] Hereinafter, preferred embodiments of the present disclosure will be described with reference to the attached drawings. The advantages and features of the present disclosure and methods of accomplishing the same may be understood more readily by reference to the following detailed description of preferred embodiments and the accompanying drawings. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete and will fully convey the concept of the disclosure to those skilled in the art, and the present disclosure will only be defined by the appended claims. Throughout the present specification, the same reference numerals are designate to the same components.

[26] Unless otherwise defined, all terms used in the present specification (including technical and scientific terms) may be used in a sense that can be commonly understood by those skilled in the art. In addition, the terms defined in the commonly used dictionaries are not ideally or excessively interpreted unless they are specifically defined clearly. The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of the disclosure. In this specification, the singular also includes the plural unless specifically stated otherwise in the phrase.

[27] Hereinafter, some embodiments of the present disclosure will be described in detail with reference to the accompanying drawings.

[28] FIG. 1 is an illustrative diagram of a dementia prediction system according to patient's gender according to some embodiments of the present disclosure.

[29] Referring to FIG. 1, in a dementia prediction system according to patient's gender, a dementia prediction apparatus 100 may predict dementia of a test

subject by obtaining data corresponding to dementia risk factors according to gender from the test subject, and inputting the dementia risk factors into a dementia prediction model.

[30] The dementia risk factors according to gender are biomarkers that may develop dementia due to gender differences between men and women in a process of performing the dementia prediction model. The dementia prediction model may more efficiently predict dementia by intensively analyzing the dementia risk factors according to gender, which are biomarkers that develop dementia.

[31] The dementia prediction model may machine-learn dementia prediction by collecting datasets from Cohort DB including male and female medical records. The dementia prediction model may be learned by repeatedly reducing errors generated by comparing results obtained through the dementia prediction model and whether patients stored in the Cohort DB are actually dementia patients or normal groups. The dementia prediction model may select the dementia risk factors according to gender, which have been found to have a significant effect on dementia, in the process of repeating such learning, as features and intensively learn such features.

[32] The dementia risk factors according to gender were found in 7 types for men and 11 types for women. The dementia prediction system according to the patient's gender may more accurately predict the dementia of the test subject by intensively analyzing the dementia risk factors according to the gender.

[33] The men's dementia risk factors may include at least one of diseases of thymus, other disorders of adrenal gland, other disorders of male genital organs, hemiplegia, somnolence, stupor, and coma, urethral stricture, and symptoms and

signs involving appearance and behavior.

[34] The women's dementia risk factors may include at least one of inflammatory disease of uterus, except cervix, unspecified urinary incontinence, other disorders of adrenal gland, enlarged lymph nodes, polyp of female genital tract, symptoms and signs involving appearance and behavior, other symptoms and signs involving general sensations and perceptions, hypofunction and other disorders of pituitary gland, systemic inflammatory response syndrome, diseases of thymus, and urethral stricture.

[35] As the dementia prediction system according to some embodiments of the present disclosure predicts dementia using the found dementia risk factors according to the gender, there was an effect of increasing the accuracy and reliability compared to the model as shown in the experimental results described later.

[36] In particular, 'diseases of the thymus', which is a factor that has not been previously known as a dementia risk factor, among the men's dementia risk factors and the women's dementia risk factors has been discovered as the dementia risk factor in the experimental process of the dementia prediction system. As such, the dementia prediction system according to some embodiments of the present disclosure may also generate new dementia risk factor candidates that have not been previously identified.

[37] The dementia prediction apparatus 100 may predict dementia of the test subject by obtaining data corresponding to the dementia risk factors according to gender from the test subject and inputting the dementia risk factors into the dementia prediction model. The dementia prediction model may output a result of whether the test subject has a possibility of developing dementia or whether

the test subject is normal without a possibility of developing dementia by intensively analyzing the dementia risk factors according to gender, which are biomarkers that may cause dementia in the test subject.

[38] FIG. 2 is a flowchart of a dementia prediction method according to patient's gender according to some embodiments of the present disclosure.

[39] In step S100 of FIG. 2, data corresponding to dementia risk factors according to gender may be obtained from a test subject. Data corresponding to dementia risk factors previously discovered by the dementia prediction model may be collected from the test subject. In this case, only the data corresponding to the dementia risk factors may be collected, or data including comprehensive medical information of the test subject may also be collected.

[40] In step S200, dementia of the test subject may be predicted by inputting the data corresponding to the dementia risk factors according to the gender of the test subject into the dementia prediction model. In this case, the information of the test subject collected from the test subject may include various data in addition to the data corresponding to the dementia risk factors. In this step, the dementia risk factors of the test subject among various data may be intensively analyzed.

[41] So far, schematic operations of the dementia prediction system according to some embodiments of the present disclosure have been described with reference to FIGS. 1 and 2. In the dementia prediction method according to the present embodiment, the results of model performance may be derived through the experimental process of DB analysis, feature selection, and dementia prediction. Hereinafter, a process of discovering a dementia risk factor according to gender and an experimental result of predicting dementia by a

dementia prediction model using the dementia risk factor will be described with reference to FIGS. 3 to 11.

[42] FIG. 3 is a diagram for explaining detailed contents of Senior Cohort DB, and FIG. 5 is a diagram for explaining detailed items of PIE-DB, MT-DB, and GHE-DB among Senior Cohort DB.

[43] The Cohort DB(1) of FIG. 3 may be collected from the National Health Insurance Corporation (KNHIS) and the National Health Insurance Sharing Service (NHIS), which are senior cohort data distribution institutions and services. The National Health Insurance Corporation (NHIS) is an institution that operates health insurance and long-term care insurance for senior citizens, and the National Health Insurance Sharing Service (NHIS) is a national medical information database. 2.1 trillion data held by the National Health Insurance contains the information of 50 million citizens accumulated during the course of the corporation's work, such as health insurance, long-term care insurance, and four major insurance collection tasks. Of these, 313.2 billion national health information DB was established to produce information necessary for disease prevention and health promotion of the people, health care policy establishment, and medical quality improvement. There are sample cohort, health checkup cohort, senior cohort, infant checkup cohort, and working women cohorts, which are categories of this national health information DB. Among the categories, the senior cohort may be utilized.

[44] PIE-DB is demographics, socio-economic level, and other data, MT-DB is treatment item and treatment disease data, GHE-DB is a medical examination history from body measurements to past medical records, MCI-DB is data such as type, area and installation period of medical institution, number of beds,

number of doctors, equipment availability of medical institution, and the like, and LCI-DB is long-term care application and decision-making results, doctors' opinions such as recognized necessity surveys, and long-term care facility data.

[45] Referring to FIG. 4, Table 2 of detailed items of PIE-DB, GHE-DB, and MT-DB is illustrated, and a feature may be selected from the detailed items. Feature selection was based on items in the senior cohort data. The reason why feature selection was performed only for PIE-DB, GHE-DB, and MT-DB among the Senior Cohort DB is that the remaining MCI-DB and LCI-DB are the limited number of seniors related to long-term care and the number of test subjects is insufficient. Therefore, a rich data set for learning may be secured by using PIE-DB, GHE-DB, and MT-DB with many test subjects. Each feature may be divided and classified by each year from 2002 to 2013 to identify a time series pattern.

[46] Here, PIE-DB, MT-DB, and GHE-DB may be feature-grouped in several ways. In the PIE-DB, gender is grouped into male and female, age is grouped into 7 levels, income quintile is grouped into 3 levels, and the disease information in the MT-DB is used by mapping with International Classification of Diseases (ICD) code, which is the international standard. A structure of an original ICD code is constructed by 7 digits, but in the present study, a data sparseness problem is avoided by performing the grouping by upper 3 digits. In the GHE-DB, a height is classified into 11 levels in 10 cm increments and weight in 11 levels in 5 kg increments. A waist, a body mass index, a blood test, and a urine test are classified as normal and abnormal according to the criteria of health examination standards (Health and Welfare Notification No. 2016-11).

[47] FIG. 5 is a diagram for explaining sampling rates of data of dementia seniors and normal seniors from Senior Cohort DB.

[48] As illustrated in FIG. 5, 31,443 seniors who had health checkups in 2011 to 2013 are classified into dementia seniors and normal seniors based on the International Classification of Disease (ICD) code, and 3,000 dementia seniors and 3,000 normal seniors are then randomly sampled. That is, the dementia prediction model may be learned using cohort data collected from a normal group and a dementia patient group within the last 3 years.

[49] FIG. 6 is a diagram for explaining a configuration of a neural network of a dementia prediction model according to some embodiments of the present disclosure.

[50] A neural network 3 of the dementia prediction model may be configured with a multi-layer perceptron including a plurality of hidden layers. The dementia prediction model may calculate an error value by comparing a result of predicting dementia of the test subject predicted using the dementia risk factors determined by the dementia prediction model with whether or not the test subject actually has dementia. The dementia prediction model may be learned by back-propagating the calculated error value.

[51] Vectorized Top 100 diseases may be input into an input layer of the dementia prediction model by an onehot encoding method. Nodes of the hidden layer of the dementia prediction model may calculate weight values as operators. In the last output layer, a result value is classified as a final value by probability. The dementia prediction model may output Dementia when a probability of developing dementia is high, and output Normal when a probability of developing dementia is low.

[52] The dementia prediction model may use the Leaky-ReLu function as an activation function that converts the sum of input signals input into individual neurons of a neural network into an output signal. Accordingly, as the dementia prediction model uses Leaky-ReLu, the dementia prediction model may more activate learning in the hidden layer by overcoming a disadvantage that a gradient unconditionally becomes 0 when x is negative in ReLu.

[53] The dementia prediction model may optimize weight parameters of the neural network using Adam Optimizer. In this case, the dementia prediction model may use an L2 loss function instead of an L1 loss function. Here, since a square of the error is intuitively added, the L1 loss function is more robust to an outlier than the L2 loss function, and may be more affected by the L2 loss function outlier.

[54] In addition, the dementia prediction model may avoid overfitting by using cross validation divided into 10 folds.

[55] FIG. 7 illustrates the results of performance according to gender of the dementia prediction model through experiments.

[56] When the neural network of the dementia prediction model is configured with multi-layer perceptron (MLP) as illustrated in FIG. 7, precision for men was measured to be 75.3%, recall for men was measured to be 81.5%, and F-score for men was measured to be 78.3%, and precision for women was measured to be 71.5%, recall for women was measured to be 74.2%, and F-score for women was measured to be 72.8%. When the dementia prediction model is configured with a support vector machine (SVM), precision for men was measured to be 81.7%, recall for men was measured to be 66.4%, and F-score for men was measured to be 77.3%, and precision for women was measured to

be 70.7%, recall for women was measured to be 58.6%, and F-score for women was measured to be 65.3%. In addition, when the dementia prediction model is configured with a convolution neural network (CNN), precision for men was measured to be 68.6%, recall for men was measured to be 62.4%, and F-score for men was measured to be 65.4%, and precision for women was measured to be 55.8%, recall for women was measured to be 75.3%, and F-score for women was measured to be 64.1%. Through these experimental results, it was confirmed that when the neural network of the dementia prediction model is configured with the MLP, excellent effects are produced. In addition, in the dementia prediction model, it was possible to optimize the input data to the last 3 years for meaningful history information analysis modeling and history period, f measuresms is measured at 80.9% when deep learning is applied, and a longitudinal model was evaluated to perform better than a baseline model.

[57] FIGS. 8 and 9 illustrate lists of dementia risk factors that develop men's dementia.

[58] In other experiments, differences in the causes of disease in men and women were found, for example, differences in the causes of reduced cortical thickness were found. In another study by the present applicant, an association between cardiometabolic syndrome and low weight-related diseases was revealed. Low weight in men and obesity, hypertension, and type 2 diabetes in women could be identified as the causes. There are eating disorders No. 6, other disorders of thyroid No. 27, and malnutrition-related diabetes mellitus No. 37, and Nos. 27 and 37 were related to weight. In this experiment, the men and women's Top 50 dementia risk factors were used, excluding previously identified dementia-related diseases.

[59] In FIG. 9, a dementia risk factor list 6 excluding low weight-related diseases among the men's Top 50 dementia risk factors was used. In the dementia prediction model, it was confirmed that 7 major factors have a very large effect on the expression of men's dementia through a process of learning characteristics of the remaining dementia risk factors excluding the low weight-related diseases.

[60] The men's major dementia risk factors have been identified as diseases of thymus, other disorders of adrenal gland, other disorders of male genital organs, hemiplegia, somnolence, stupor, and coma, urethral stricture, and symptoms and signs involving appearance and behavior.

[61] From the experimental results of the present applicant, it could be found that when the test subject is male, a result value of dementia prediction is output very well when the 7 characteristics are input to the dementia prediction model. In particular, from the experimental results of the present applicant, when the test subject is male, dementia could be predicted even when at least one value of the 7 characteristics are input, and dementia could be predicted with very good performance when all of the 7 features are input.

[62] FIGS. 9 and 10 illustrate lists of dementia risk factors that develop women's dementia.

[63] The women's Top 50 dementia risk factors 7 in FIG. 10 may include factors different from the men's Top 50 dementia risk factors 5 in FIG. 8. In FIG. 11, a dementia risk factor list 8 was used, excluding obesity, hypertension, and type 2 diabetes in women.

[64] In the dementia prediction model, it was confirmed that 11 major factors have a very large effect on the expression of women's dementia through a

process of learning characteristics of the remaining dementia risk factors excluding diseases of obesity, hypertension, and type 2 diabetes.

[65] The men's major dementia risk factors have been identified as inflammatory disease of uterus, except cervix, unspecified urinary incontinence, other disorders of adrenal gland, enlarged lymph nodes, polyp of female genital tract, symptoms and signs involving appearance and behavior, other symptoms and signs involving general sensations and perceptions, hypofunction and other disorders of pituitary gland, systemic inflammatory response syndrome, diseases of thymus, and urethral stricture.

[66] From the experimental results of the present applicant, it was found that when the test subject is female, a result value of dementia prediction is output very well when the 11 characteristics are input to the dementia prediction model. In particular, from the experimental results of the present applicant, when the test subject is female, dementia could be predicted even when at least one value of the 11 characteristics are input, and dementia could be predicted with very good performance when all of the 11 features are input.

[67] FIG. 12 is an exemplary hardware configuration diagram illustrating the computing device 500.

[68] As illustrated in FIG. 12, the computing device 500 may include one or more processors 510, a bus 550, a communication interface 570, a memory 530 for loading a computer program 591 executed by the processor 510, and a storage 590 for storing the computer program 591. However, only the components related to the embodiments of the present disclosure are illustrated in FIG. 12. Accordingly, those skilled in the art to which the present disclosure pertains may see that other general-purpose components other than the

components illustrated in FIG. 12 may be further included.

[69] The processor 510 controls the overall operation of each component of the computing device 500. The processor 510 may be configured to include at least one of a central processing unit (CPU), a micro processor unit (MPU), a micro controller unit (MCU), a graphic processing unit (GPU), or any type of processor well known in the art. In addition, the processor 510 may perform a calculation on at least one application or program for executing the methods/operations according to various exemplary embodiments of the present disclosure. The computing device 500 may include one or more processors.

[70] The memory 530 stores various data, commands, and/or information. The memory 530 may load one or more programs 591 from the storage 590 to execute the methods/operations according to various embodiments of the present disclosure. For example, when the computer program 591 is loaded into the memory 530, the logic (or module) as illustrated in FIG. 4 may be implemented on the memory 530. An example of the memory 530 may be a RAM, but is not limited thereto.

[71] The bus 550 provides a communication function between the components of the computing device 500. The bus 550 may be implemented as various types of buses, such as an address bus, a data bus, and a control bus.

[72] The communication interface 570 supports wired/wireless Internet communication of the computing device 500. The communication interface 570 may also support various communication methods other than Internet communication. To this end, the communication interface 570 may be configured to include a communication module well known in the art.

[73] The storage 590 may non-temporarily store one or more computer

programs 591. The storage 590 may be configured to include a non-volatile memory such as a read only memory (ROM), an erasable programmable ROM (EPROM), an electrically erasable programmable ROM (EEPROM), a flash memory, or the like, a hard disk, a removable disk, or any type of computer-readable recording medium well known in the art.

[74] The computer program 591 may include one or more instructions in which the methods/operations according to various embodiments of the present disclosure are implemented. When the computer program 591 is loaded into the memory 530, the processor 510 may perform the methods/operations according to various embodiments of the present disclosure by executing the one or more instructions.

CLAIMS

1. A dementia prediction method according to patient's gender performed by a computing device for predicting patient's dementia, the dementia prediction method comprising:

obtaining data corresponding to dementia risk factors according to gender from a test subject; and

predicting dementia of the test subject by inputting the data corresponding to the dementia risk factors according to the gender of the test subject into a dementia prediction model,

wherein the dementia prediction model is a model that learns the dementia risk factors according to the gender by extracting features of men's dementia risk factors and women's dementia risk factors from cohort data collected from a normal group and a dementia patient group.

2. The dementia prediction method of claim 1, wherein the men's dementia risk factors include at least one of diseases of thymus, other disorders of adrenal gland, other disorders of male genital organs, hemiplegia, somnolence, stupor and coma, urethral stricture, and symptoms and signs involving appearance and behavior.

3. The dementia prediction method of claim 1, wherein the women's dementia risk factors include at least one of inflammatory disease of uterus, except cervix, unspecified urinary incontinence, other disorders of adrenal gland, enlarged lymph nodes, polyp of female genital tract, symptoms and signs involving appearance and behavior, other symptoms and signs involving general

sensations and perceptions, hypofunction and other disorders of pituitary gland, systemic inflammatory response syndrome, diseases of thymus, and urethral stricture.

4. The dementia prediction method of claim 1, wherein the dementia prediction model is learned using cohort data collected from a normal group and a dementia patient group within the last 3 years.

5. The dementia prediction method of claim 1, wherein the dementia prediction model calculates an error value by comparing a result of predicting dementia of the test subject predicted using the dementia risk factors determined by the dementia prediction model with whether or not the test subject actually has dementia, and is learned by back-propagating the calculated error value.

6. The dementia prediction method of claim 1, wherein the dementia prediction model is configured with a multi-layer perceptron including a plurality of hidden layers.

7. The dementia prediction method of claim 6, wherein the dementia prediction model uses the Leaky-ReLu function as an activation function of the multi-layer perceptron.

8. The dementia prediction method of claim 1, wherein the dementia prediction model searches for parameters that minimize a loss function using Adam Optimizer.

9. The dementia prediction method of claim 1, wherein the dementia prediction model voids overfitting by using cross validation divided into 10 folds.

10. A dementia prediction apparatus according to patient's gender, the dementia prediction apparatus comprising:

a processor;

a network interface;

a memory that is executed by the processor and loads a computer program; and

a storage for storing the computer program,

wherein the computer program includes instructions of:

obtaining data corresponding to dementia risk factors according to gender from a test subject; and

predicting dementia of the test subject by inputting the data corresponding to the dementia risk factors according to the gender of the test subject into a dementia prediction model, and

the dementia prediction model is

a model that learns the dementia risk factors according to the gender by extracting features of men's dementia risk factors and women's dementia risk factors from cohort data collected from a normal group and a dementia patient group.