**Appendix 1：**

**Survey on the health status and quality of life of the population**

**Dear Sir/Madam：**

**We, the research team of Xiangya Second Hospital of Central South University, are conducting research on the health status and quality of life of the population. Thank you for filling out the questionnaire in your busy schedule, please fill out the questionnaire according to your actual situation and true feelings. Please be assured that this questionnaire is anonymous and your answers will be completely confidential. Thank you for your assistance and support!**

Basic Information：

1. Your common form of consultation：

A: Outpatient

B: Hospitalization

C: Telemedicine

1. Your gender:

A: Male

B: Female

1. Your age: ( ) years；

Ethnicity: ( )；

Height ( ) cm；

Body weight ( ) kg

1. Your marital status：

A: Unmarried

B: Married

C: Divorce

D: bereaved spouse

1. Your level of education：

A: Junior high school and below

B: High school/junior high school

C: College/bachelor’s degree

D: Master’s degree and above

1. Your employment status

A: On-the-job

B: Unemployed

C: Retirement

1. Your health insurance type：

A: Employee Basic Medical Insurance

B: Basic medical insurance for urban and rural residents

C: Other medical insurance

D: Without any insurance

1. Your current monthly income level (Unit: RMB)

A：Less than 1000

B: 1000-4999

C: 5000-9999

D: 10000 and above

1. Your smoking status in the past year：

A：Never smoked

B：Occasional smoking

C: Regular Smoking

D：Have quit smoking

1. Your drinking in the past year：

A: Never attend

B：Sometimes control

C: Often drink

D: Have quit drinking

1. Your exercise in the past year：

A: Never attended

B: Sometimes attend

C: Regular participation

1. Your dietary control in the last year：

A: Never controlled

B: Sometimes controlled

C: Frequently controlled

**Chinese Health Status Scale measurement**

**We are concerned with how you felt in the past week. Please answer according to your own criteria and situation. If you are unable to give an affirmative answer to a question, please choose the one that is most recent to your own criteria.**

**These issues are all related to your energy：**

13.

A: Full of spirit

B: Poor mental health

C: Mental exhaustion

D: Mental depression

14.

A: Eyes with a glow

B: Eyes more luminous

C: Eyes are less alert

D: Eyes without focus



A: Sensitive reaction

B: Poor response

C: Slower response

D: Slow response

16.

A: Normal physical strength

B: Poor physical strength to keep up with daily tasks and activities

C: Easily fatigued, can barely keep up with daily tasks and activities

D: Loss of labor and inability to perform daily tasks and activities

17.

A: Good memory

B: Poor memory, occasionally forgets things, can still remember

C: Memory loss, frequent forgetfulness, and difficulty in remembering things

D: Very poor memory, forgetting in the blink of an eye, unable to recall

18.

A: Not easily tired and sluggish

B: Tired and sluggish easily after activity, can recover

C: Tiredness and fatigue easily after activity and difficulty recovering

D: Poor memory, forgetfulness in the blink of an eye, inability to recall

19.

A: Normal activity

B: Tendency to get out of breath after strenuous activity

C: Tends to get out of breath after general activity

D: Slightly Tend to get out of breath after activity

20.

A: No dizziness

B: Slight dizziness, can keep up with daily work and activities

C: Dizziness and inability to walk

D: Dizziness and inability to stand

**The following problems are associated with physical pain：**

21.

A: No pain

B: Pain free, no medication needed, can keep up with normal daily work and life

C: Pain that can be relieved by taking medication

D: Unbearable pain that is difficult to relieve with normal medication

22.

A: No pain

B: Occasional episodes of pain

C: Recurrent episodes of pain

D: Persistent episodes of pain that are not easily relieved

**The following issues are all related to your dietary tastes：**

23.

A: Normal appetite

B: Poorer than normal appetite

C：No appetite (basically unable to eat)

D: Anorexia (prolonged inability to eat)

24.

A: Normal food intake

B: Reduction in food intake by about 1/4

C: Reduction in food intake by about 1/2

D: Reduction in food intake by about 1/2 or more

25.

A: No dry mouth

B: Mouth slightly dry, no need for water

C: Dry mouth, need to drink water

D: Dry mouth and the need to keep drinking water

26.

A: No bitterness in the mouth

B: Bitter mouth in the morning

C: Bitter mouth all day long

D: Bitterness in the mouth and lack of taste all day long

27.

A: No blandness in the mouth

B: Bland taste, poor palate

C: Boring mouth, tasteless meals

D: Poor taste and lack of appetite

**The following problems are related to your bowel movements:**

28.

A: Normal bowel movements.

B: Dry stools

C: Dry, hard stools that are difficult to relieve

D: Dry, hard, pellet-like stools that are difficult to remove and require medication to relieve

29.

A: Stools once every 1-2 days

B: Stools once every 3-4 days

C: Stools once every 4-5 days

D: One stool for more than 5 days

30.

A: Smooth bowel movement

B: Slight bowel irregularity

C: Poor bowel movement and prolonged bowel movement

D: Difficult to pass stools and significantly longer bowel movement times

**The following problems are all related to your urine：**

31.

A: Normal urination

B: Yellowish urine

C: Dark yellow urine

D: Yellow urine like strong tea

32.

A: Nocturia 0-1 times

B: Nocturnal urination 2-3 times

C: Nocturnal urination 4 -5 times

D: More than 5 nocturnal urinations

33.

A: Urine flowing freely

B: Slightly uncomfortable urination

C: Poor urination and a feeling of incompleteness

D: Difficulty in urination

**The following issues are all relevant to your sleep：**

34.

A: Sleeping normally

B: Difficult to sleep

C: Need to sleep with the help of medication

D: Difficult to sleep even with medication

35.

A: Normal sleep

B: Restless sleep, can fall asleep upon awakening

C: Restless sleep, waking easily, and difficulty falling asleep after waking

D: Poor sleep quality and disruption of work and life the next day

36.

A: Normal sleep

B: There are dreams and restless sleep

C: Excessive dreaming, which affects the quality of sleep

D: Excessive dreaming that interferes with daily work and life

**The following relate to your body type：**

37.

A: Normal physique

B: Up to 6 colds per year

C: More than 6 colds per year, not easily cured by itself

D: Persistent colds that are difficult to cure

38.

A: Normal physique

B: Nighttime fever in the heart of the hands and feet

C: Overall warmth in the heart of the hands and feet

D: Burning of the heart of the hands and feet

39.

A: Normal physique

B: Fear of cold than the average person, do not need to add clothes

C: More than the average person is obviously afraid of cold, need to add clothes

D: Obviously afraid of cold, need to add clothes

40.

A: Weight as usual

B: Weight loss

C: 20% weight loss

D: Weight loss of 20% or more

**The following relate to your emotions：**

41.

A: No distractions

B: Occasionally upset for no reason

C: Often upset

D: Frequent distractions, affecting daily life

42.

A: Emotionally normal

B: Impatient and irritable, but I can control myself

C: Irritable temperament and difficulty in self-control

D: Anger on the move

43.

A: Emotionally normal

B: Slightly disturbed

C: A little restlessness and fidgeting

D: Emotional disturbance and rumination

44.

A: Emotionally normal

B: Depressed mood and reduced speech

C: Silent and indifferent expression

D: Pessimism and disappointment, all thoughts are lost

**Do you feel that your general health is：**

45.

A: Very good

B: General

C: Slightly worse

D: Very poor

46.

Mobility ( )

A: I can walk around without any difficulty

B: I was walking around a bit inconvenienced

C: I can't walk.

47.

A: I can take care of myself without any difficulty

B: I have some difficulty in washing my face, brushing my teeth, bathing, etc. in dressing

C: I can't wash my face, brush my teeth, take a shower or get dressed by myself

48.

A: I can perform daily activities without any difficulty

B: I can perform daily activities with some difficulty

C: I am unable to perform daily activities

49.

A: I don't have any pain or discomfort

B: I feel moderate pain or discomfort

C: I feel extreme pain or discomfort

50.

A: I don't feel anxious or depressed

B: I feel moderate anxiety or depression

C: I feel extremely anxious or depressed

Table 1. 2014 Edition of China’s Utility Scoring System

|  |  |  |
| --- | --- | --- |
| **Dimensionality** | **Coefficient** | |
| Constant term | 0.039 | |
|  | Level2（ some difficulties） | Level3（serious difficulties） |
| Ability to act | 0.099 | 0.246 |
| Self-care | 0.105 | 0.208 |
| Daily Activities | 0.074 | 0.193 |
| Pain or discomfort | 0.092 | 0.236 |
| Anxiety or depression | 0.086 | 0.205 |
| N3 |  | 0.022 |

**Appendix 2：**

Alternative Model Type：

(1) Main effect (total score of Chinese Health Status Scale);

(2) Main effect (total score of Chinese Health Status Scale) + covariates (gender, age, BMI index);

(3) Main effect (Chinese Health Status Scale total score) + covariates (gender, age, BMI index, smoking status, alcohol consumption, exercise status, diet control status);

(4) Main effects (scores on various aspects of the Chinese Health Status Scale);

(5) Main effect (score on each aspect of the Chinese Health Status Scale) +Covariates (gender, age);

(6) Main effects (Chinese Health Status Scale scores for each aspect) + covariates (gender, age, BMI, smoking status, alcohol consumption, exercise status, diet control status)

Table 2. Information on the demographic characteristics of the study population

|  |  |  |
| --- | --- | --- |
| **Variables** | **Number of people** | **Percentage（%）** |
| Gender |  |  |
| Male | 453 | 37.7 |
| Female | 747 | 62.3 |
| Age |  |  |
| 8 years old - 25 years old | 212 | 17.7 |
| 26 - 35 years old | 212 | 17.7 |
| 36 - 50 years old | 264 | 22 |
| 51 - 65 years old | 324 | 27 |
| Age 66-97 | 188 | 15.6 |
| Ethnicity |  |  |
| Han Chinese | 1192 | 99.3 |
| Ethnic Minorities | 8 | 0.7 |
| Marital Status |  |  |
| Unmarried | 294 | 24.5 |
| Married | 849 | 70.7 |
| bereaved spouse | 33 | 2.8 |
| Divorce | 24 | 2 |
| Education level |  |  |
| Junior high school and below | 342 | 28.5 |
| High school/junior high school | 298 | 24.8 |
| College | 182 | 15.2 |
| Bachelor | 310 | 25.8 |
| Master and above | 68 | 5.7 |
| Employment |  |  |
| On-the-job | 652 | 54.3 |
| Unemployed | 250 | 20.8 |
| Separation/Retirement | 298 | 24.8 |
| Type of medical insurance |  |  |
| Employee Basic Medical Insurance | 754 | 62.8 |
| Basic medical insurance for urban and rural residents | 360 | 30 |
| Other medical insurance | 52 | 4.3 |
| Without any insurance | 34 | 2.8 |
| Monthly income level |  |  |
| Less than 1000 | 228 | 19 |
| 1000-4999 | 520 | 43.3 |
| 5000-9999 | 342 | 28.5 |
| 10000 and above | 110 | 9.2 |

Table 3. Information on health behavior characteristics of study participants

|  |  |  |
| --- | --- | --- |
| **Variables** | **Number of people** | **Percentage（%）** |
| Common forms of consultation |  |  |
| Outpatient | 700 | 58.3 |
| Hospitalization | 500 | 41.7 |
| Smoking |  |  |
| Never smoked | 928 | 77.3 |
| Occasional smoking | 118 | 9.8 |
| Regular Smoking | 106 | 8.8 |
| Have quit smoking | 48 | 4 |
| Alcohol consumption |  |  |
| Never drink alcohol | 714 | 59.5 |
| Occasional  alcohol consumption | 390 | 32.5 |
| Regular alcohol consumption | 58 | 4.8 |
| Have quit drinking | 38 | 3.2 |
| Exercise |  |  |
| Never attend | 230 | 19.2 |
| Sometimes attend | 784 | 65.3 |
| Regular participation | 186 | 15.5 |
| Diet control |  |  |
| Never control | 286 | 23.8 |
| Sometimes control | 638 | 53.2 |
| Frequent control | 276 | 23 |

Table 4. Relevant health status information of the study subjects

|  |  |  |
| --- | --- | --- |
| **Variables** | **Number of people** | **Percentage（%）** |
| BMI |  |  |
| thin<18.5 | 78 | 6.5 |
| Normal 18.5-23.9 | 666 | 55.5 |
| obese 24-27.9 | 348 | 29 |
| Obesity≧28 | 108 | 9 |

Table 5. Results of the Chinese Health Scale for the study participants

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Variables** | **Theoretical range** | **Mean ± standard deviation** | **Median** | **Maximum value** | **Minimum value** |
| Total Scale Score | 0-27 | 2.72±0.12 | 1.79 | 19.43 | 0 |
| Dimension Score |  |  |  |  |  |
| Energetic | 0-3 | 0.62±0.21 | 0.5 | 2.5 | 0 |
| Pain | 0-3 | 0.45±0.26 | 0 | 3 | 0 |
| Diet | 0-3 | 0.30±0.02 | 0.2 | 2.6 | 0 |
| Poop | 0-3 | 0.27±0.02 | 0 | 2.67 | 0 |
| Pee | 0-3 | 0.17±0.01 | 0 | 1.67 | 0 |
| Sleep | 0-3 | 0.33±0.02 | 0 | 3 | 0 |
| Physique | 0-3 | 0.20±0.01 | 0 | 2.25 | 0 |
| Emotions | 0-3 | 0.37±0.02 | 0.25 | 2.25 | 0 |
| Overall health status | 0-3 | 0.67±0.69 | 1 | 3 | 0 |

Table 6. Distribution of total scores on the Chinese Health Scale among the study participants

|  |  |  |  |
| --- | --- | --- | --- |
| **Total Score** | **Number of people (person)** | **Percentage(%)** | **Cumulative percentage (%)** |
| 0- | 966 | 80.5 | 80.5 |
| 5- | 204 | 17 | 97.5 |
| 10- | 24 | 2 | 99.5 |
| 15- | 6 | 0.5 | 100 |
| Total | 600 | 100 | 100 |

Table 7. Distribution of severity levels of problems in the health dimension (N/%)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Dimension** | **No difficulties** | **Some difficulties(%)** | **Extremely difficult(%)** | **Difficulties exist(%)** |
| Mobility | 1102/91.8 | 64/5.3 | 34/2.8 | 98/8.2 |
| Self-care | 1134/94.5 | 34/2.8 | 32/2.7 | 33/5.5 |
| Daily Activities | 1104/92.0 | 64/5.3 | 32/2.7 | 98/8.0 |
| Pain/Discomfort | 964/80.3 | 232/19.3 | 4/0.3 | 234/19.7 |
| Anxiety/Depression | 1000/83.3 | 194/16.2 | 6/0.5 | 200/16.7 |

Table 8. EQ-5D health utility value conversion results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **System** | **Theoretical scope** | **Mean±standard deviation** | **Median（Q1,Q3)** | **Maximum value** | **Minimum value** |
| China | -0.149—1 | 0.923±0.158 | 1.000（0.875，1） | 1 | -0.03 |

Table 9. Distribution of EQ-5D health utility values among study participants

|  |  |
| --- | --- |
| **EQ-5D Health utility value** | **Number of people (percentage %)** |
| <0 | 2/0.2 |
| 0- | 8/0.7 |
| 0.2- | 24/2.0 |
| 0.4- | 18/1.5 |
| 0.6- | 106/8.8 |
| 0.8- | 238/19.8 |
| 1 | 804/67.0 |

Table 10. Construction set and validation set splits

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Variables** | **Build set** | **Validation set** | **Statistical quantities** | **P** |
| **Median（Q1,Q3)** | **Median（Q1,Q3)** |
| Number of examples (n) | 800 | 400 |  |  |
| Gender: Male to female ratio | 0.63：1 | 0.55：1 | χ²=0.600 | P=0.439 |
| Age | 41（28.25，58） | 43（29.25，57） | Z=-0.128 | P=0.898 |
| BMI | 22.86（20.81，25.39） | 23.13（20.68，26.14） | Z=-0.592 | P=0.554 |
| Total Scale Score | 1.87（0.50，4.19） | 1.35（0.38，4.16） | Z=-0.685 | P=0.494 |
| Score for each dimension |  |  |  |  |
| Energetic | 0.50（0.25，1.00） | 0.50（0.13，0.88） |  |  |
| Pain | 0.00（0.00，1.00） | 0.00（0.00，1.00） |  |  |
| Diet | 0.20（0.00，0.40） | 0.20（0.00，0.40） |  |  |
| Poop | 0.00（0.00，0.33） | 0.00（0.00，0.33） |  |  |
| Pee | 0.00（0.00，0.33） | 0.00（0.00，0.33） |  |  |
| Sleep | 0.00（0.00，0.67） | 0.00（0.00，0.67） |  |  |
| Physique | 0.00（0.00，0.25） | 0.00（0.00，0.25） |  |  |
| Emotions | 0.25（0.00，0.50） | 0.25（0.00，0.50） |  |  |
| Overall health status | 1.00（0.00，1.00） | 1.00（0.00，1.00） |  |  |
| EQ-5D Effectiveness value | 1.00（0.88，1.00） | 1.00（0.87，1.00） | Z=-0.685 | P=0.493 |

Appendix 3

Model 1: 𝐸𝑄- 5𝐷-3𝐿=𝛼 + 𝛽1 ∗ 𝑇𝑜𝑡𝑎𝑙........................................................ (Formula 3-1).

Model 2: 𝐸𝑄-5𝐷- 3𝐿=𝛼 + 𝛽1 ∗ 𝑇𝑜𝑡𝑎𝑙 + 𝛽2 ∗ 𝐴𝑔𝑒 + 𝛽3 ∗ 𝑆𝑒𝑥 + 𝛽4 ∗ 𝐵𝑀𝐼.......(Formula 3-2 ).

Model 3: 𝐸𝑄-5𝐷-3𝐿 = 𝛼 + 𝛽1 ∗ 𝑇𝑜𝑡𝑎𝑙 + 𝛽2 ∗ 𝐴𝑔𝑒 + 𝛽3∗𝑆𝑒𝑥+𝛽4 ∗𝐵𝑀𝐼 +𝛽5 ∗𝑆𝑚𝑜𝑘𝑖𝑛𝑔+𝛽6∗𝐷𝑟𝑖𝑛𝑘𝑖𝑛𝑔+ 𝛽7 ∗ 𝐸𝑥𝑐𝑖𝑠𝑖𝑛𝑔 + 𝛽8 ∗ 𝐷𝑖𝑒𝑡𝑖𝑛𝑔.......................... (Formula 3-3).

Model 4: 𝐸𝑄-5𝐷-3𝐿 =𝛼 + 𝛽1 ∗ 𝐸𝑛𝑇 + 𝛽2 ∗ 𝑃𝑎𝑇 + 𝛽3 ∗ 𝐷𝑖𝑇 + 𝛽4 ∗ 𝑆𝑡𝑇 +𝛽5 ∗ 𝑃𝑖𝑇 +𝛽6 ∗ 𝑆𝑙𝑇 + 𝛽7 ∗ 𝑃ℎ𝑇 + 𝛽8 ∗ 𝑀𝑜𝑇 + 𝛽9 ∗ 𝐺ℎ𝑇..................................(Formula 3-4).

Model 5: 𝐸𝑄-5𝐷-3𝐿 = 𝛼 + 𝛽1 ∗ 𝐸𝑛𝑇 + 𝛽2 ∗ 𝑃𝑎𝑇 + 𝛽3 ∗ 𝐷𝑖𝑇 + 𝛽4 ∗ 𝑆𝑡𝑇 + 𝛽5 ∗ 𝑃𝑖𝑇 +𝛽6 ∗ 𝑆𝑙𝑇 + 𝛽7∗𝑃ℎ𝑇+𝛽8∗𝑀𝑜𝑇+𝛽9∗𝐺ℎ𝑇+𝛽10∗𝐴𝑔𝑒+𝛽11∗𝑆𝑒𝑥+𝛽12\*𝐵𝑀𝐼...........................................................(Formula 3-5).

Model 6: EQ -5D -3L = α + β1 ∗ EnT + β2 ∗ PaT + β3 ∗ DiT + β4 ∗ StT + β5 ∗PiT +β6 ∗ SlT + β7 ∗ PhT + β8 ∗ MoT + β9 ∗ GhT + β10 ∗ Age + β11 ∗ Sex + β12 ∗ BMI + β13 ∗Smoking + β14 ∗ Drinking + β15 ∗Excising + β16 ∗ieting.............................................................................................................(Formula 3-6).

Table 11: Names and descriptions of variables in this study

|  |  |  |
| --- | --- | --- |
| **Variables** | **Variable name** | **Assignment and data types** |
| Group | Group | Building Sets： Group=0 ； Validation set：Group=1 |
|
| Age | Age |  |
| Sex | Sex | Dichotomous variables:Male=0，Female=1 |
| BMI | BMI |  |
| Smoking | Smoking | 4 Categorical variables；Never smoked=0，Occasionally Smoking = 1,Regular smoking = 2,Quit smoking = 3 |
|
| Drinking | Drinking | 4 Categorical variables；Never drink alcohol = 0，Occasionally Alcohol consumption = 1,Regular alcohol consumption = 2,Sober = 3 |
|
| Exercise physical condition | Excising | 3 Categorical variables；Never attended = 0，Sometimes Participate = 1,Regular participation = 2 |
|
| Dietary control | Dieting | 3 Categorical variables；Never control = 0，Sometimes Control = 1,Regular control = 2 |
|
| EQ-5D-3L Health utility values | U | Continuous variable, non-normal |
| Negative utility (1 - utility value) | U1 |  |
| Chinese Health Status Scale total score | Total |  |
| Chinese Health Status Scale total score squared items | Total2 |  |
| Score in pain | PaT |  |
| Score for taste in food | DiT |  |
| Score on stool | StT |  |
| Score in urine | PiT |  |
| Score for sleep | SlT |  |
| Score in physical fitness | PhT |  |
| Emotional aspects score | MoT |  |
| Health assessment aspects score | GhT |  |
| Aspect score squared items | EnT2/PaT2/DiT2 etc. |  |
| Two cross-tabulations of aspect scores | EnT PaT/EnT DiT etc. |  |
| Energetic score | EnT |  |

Appendix 4

Results of alternative model construction

**Model 1**: All four econometric regression fits show that the regression of the total Chinese Health Status Scale (Total) on the dependent variable health utility (U) is significant, with *P*-value < 0.01. Among the OLS measures, the more positive R2 (A-R2) for Model 1 was 0.2421 and the RMSE was 0.01. The positive R2 (A-R2) for model 1 was 0.2421 and the RMSE was 0.13763.

**Model 2**: After adding age, BMI, and gender as covariates to the total Chinese Health Status Scale (Total), the Total Chinese Health Status Scale (Total) was still significant for the dependent variable among the four econometric methods, the covariate age was significant except for the QR method, and the covariates BMI and gender were not significant among the four methods. The covariates BMI and gender were not significant in any of the four methods. Compared with model 1, model 2 showed an improved fit and a decrease in RMSE. The positive R2 (A-R2) for model 2 increased to 0.2851 and the RMSE decreased to 0.13367 in the OLS method.

**Model 3**: After adding smoking, alcohol consumption, physical activity, and dietary control as covariates to model 2, the regression fit for the dependent variable was still significant for the Chinese Health Status Scale total score (Total) for all four econometric methods; the covariate age was significant for all but the QR method, and the covariate physical activity category. The covariate age was significant except for the QR method, and the covariate physical activity category 2 (regular physical activity) was significant except for the QR method. Category 1 of the covariate smoking (occasional smoking) was only significant in the Tobit model. Compared with model 2, model 3 had an improved fit and a reduced RMSE, such as in the OLS approach, the more positive R2 (A-R2) for model 3 increased to 0.2914 and the RMSE decreased to 0.13308.

**Model 4**: All four econometric regression fits showed that the regression of the pain score on the dependent variable health utility value (U) was significant, with *P*-values < 0.01. The regression of the urine score on the dependent variable health utility value (U) was significant for all but the QR method. (U) were significant for all regressions except the QR method. In the OLS method, model 4 had an R2 = 0.3852, a positive R2 (A-R2) = 0.3711 and an RMSE = 0.12537.

**Model 5**: After adjusting for age, BMI, and gender as covariates on top of the nine-spectrum score variables, the regression of the pain score on the dependent variable health utility value (U) remained significant in all four econometric methods, with *P*-values < 0.01. The health evaluation score was also significant in the OLS method and Tobit model, but none of the three covariates were significant. The health evaluation scores were also significant in the OLS and Tobit models, but none of the three covariates were significant. Compared with model 4, model 5 showed improved fit and a decrease in RMSE, such that the positive R2 (A-R2) for model 5 increased to 0.3767 and the RMSE decreased to 0.12481 in the OLS approach.

**Model 6**: The regression of pain scores on the dependent variable health utility value (U) was significant in all four econometric approaches, with *P*-values < 0.01, after adding smoking, alcohol consumption, physical activity, and dietary control as covariates to model 5. The emotional scores were also significant in the Tobit model and the QR approach. The covariates gender and smoking status were also significant. The covariates gender and smoking status category 3 (quit) were significant in the OLS method and Tobit model, respectively. Compared with model 5, model 6 showed improved fit and a decrease in RMSE, such as the more positive R2 (A-R2) for model 6 increased to 0.3773 and the RMSE decreased to 0.12475 in the OLS approach.

Table 12. Alternative model construction (1)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Models**  **Variables** | | **OLS1** | | **OLS2** | | **OLS3** | | **OLS4** | | **OLS5** | | **OLS6** | |
| Dependent variable Y | | U | | U | | U | | U | | U | | U | |
| Total | | -0.0266\*\* | | -0.0254\*\* | | -0.0245\*\* | |  | |  | |  | |
| EnT | |  | |  | |  | | -0.0193 | | -0.0205 | | -0.0190 | |
| PaT | |  | |  | |  | | -0.0580\*\* | | -0.0537\*\* | | -0.0537\*\* | |
| DiT | |  | |  | |  | | -0.0380 | | -0.0359 | | -0.0341 | |
| StT | |  | |  | |  | | -0.0237 | | -0.0261 | | -0.0242 | |
| PiT | |  | |  | |  | | -0.0722\*\* | | -0.0497 | | -0.0435 | |
| SlT | |  | |  | |  | | -0.0008 | | 0.0013 | | -0.0035 | |
| PhT | |  | |  | |  | | -0.0647\* | | -0.0642\* | | -0.0652\* | |
| MoT | |  | |  | |  | | 0.0007 | | -0.0091 | | -0.0124 | |
| GhT | |  | |  | |  | | -0.0287\* | | -0.0279\* | | -0.0240 | |
| Cons | | 0.9966\*\* | | 0.9752\*\* | | 0.9205\*\* | | 1.0226\*\* | | 1.0228\*\* | | 0.9723\*\* | |
| Age | |  | | -0.0018\*\* | | -0.0017\*\* | |  | | -0.0007 | | -0.0007 | |
| BMI | |  | | 0.0035 | | 0.0041\* | |  | | 0.0006 | | 0.0012 | |
| Sex | |  | | 0.0235 | | 0.0454\* | |  | | 0.0229 | | 0.0476\*\* | |
| Smoking1 | |  | |  | | 0.0385 | |  | |  | | 0.0183 | |
| Smoking2 | |  | |  | | 0.0289 | |  | |  | | 0.0252 | |
| Smoking3 |  | |  | | 0.0580 | |  | |  | | 0.0546 | |
| Drinking1 |  | |  | | 0.0099 | |  | |  | | 0.0216 | |
| Drinking2 |  | |  | | -0.0102 | |  | |  | | 0.0162 | |
| Drinking3 |  | |  | | -0.0676 | |  | |  | | -0.0439 | |
| Excising1 |  | |  | | 0.0348 | |  | |  | | 0.0221 | |
| Excising2 |  | |  | | 0.0596\* | |  | |  | | 0.0412 | |
| Dieting1 |  | |  | | -0.0261 | |  | |  | | -0.0227 | |
| Dieting2 |  | |  | | -0.0174 | |  | |  | | -0.0146 | |
| R2 | 0.244 | | 0.2922 | | 0.3162 | | 0.3852 | | 0.3955 | | 0.4116 | |
| A-R2 | 0.2421 | | 0.2851 | | 0.2914 | | 0.3711 | | 0.3767 | | 0.3773 | |
| Pseudo-R2 |  | |  | |  | |  | |  | |  | |
| RMSE | 0.13763 | | 0.13367 | | 0.13308 | | 0.12537 | | 0.12481 | | 0.12475 | |
| AIC | -449.40 | | -469.79 | | -463.58 | | -516.14 | | -516.84 | | -507.68 | |
| BIC | -441.42 | | -449.83 | | -403.70 | | -476.22 | | -464.96 | | -415.87 | |
| N | 800 | | 800 | | 800 | | 800 | | 800 | | 800 | |

Note: \*\* denotes *P* < 0.01, \* denotes *P* < 0.05; R2 and A-R2 denote the coefficient of determination and the more positive coefficient of determination; Sex denotes female; Cons denotes constant; Smoking1 to Smoking3 denotes occasional smoking category, regular smoking category, and quit smoking category, respectively; Drinking1 to Drinking3 denotes occasional drinking category, regular drinking category, and quit drinking category, respectively; Excising1 and Excising2 denotes occasional exercise category and regular exercise category, respectively; Dieting1 and Dieting2 denotes occasional diet category and regular diet category, respectively. The categories Excising1 and Excising2 indicate occasional exercise participation and regular exercise participation, respectively; Dieting1 and Dieting2 indicate occasional diet control and regular diet control, respectively.

Table 12. Alternative model construction (2)

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Models**  **Variables** | **Tobit1** | | | **Tobit2** | **Tobit3** | **Tobit4** | | **Tobit5** | | **Tobit6** |
| Dependent variable Y | U | | | U | U | U | | U | | U |
| Total | -0.0595\*\* | | | -0.0556\*\* | -0.0540\*\* |  | |  | |  |
| EnT |  | | |  |  | -0.0605 | | -0.0594 | | -0.0524 |
| PaT |  | | |  |  | -0.1390\*\* | | -0.1291\*\* | | -0.1314\*\* |
| DiT |  | | |  |  | -0.0301 | | -0.0250 | | -0.0170 |
| StT |  | | |  |  | -0.0542 | | -0.0585 | | -0.0562 |
| PiT |  | | |  |  | -0.1377\* | | -0.0973 | | -0.0945 |
| SlT |  | | |  |  | -0.0064 | | -0.0052 | | -0.0085 |
| PhT |  | | |  |  | -0.0466 | | -0.0432 | | -0.0733 |
| MoT |  | | |  |  | -0.0671 | | -0.0885\* | | -0.0935\* |
| GhT |  | | |  |  | -0.0866\*\* | | -0.0811\* | | -0.0640 |
| Cons | | | 1.3167\*\* | 1.2694\*\* | | 1.1653\*\* | 1.3868\*\* | 1.4061\*\* | | 1.3111\*\* | |
| Age | | |  | -0.0044\*\* | | -0.0045\*\* |  | -0.0017 | | -0.0017 | |
| BMI | | |  | 0.0089 | | 0.0109\* |  | 0.0009 | | 0.0024 | |
| Sex | | |  | 0.0292 | | 0.0684 |  | 0.0393 | | 0.0920 | |
| Smoking1 | | |  |  | | 0.1558\* |  |  | | 0.0834 | |
| Smoking2 | | |  |  | | 0.0186 |  |  | | 0.0154 | |
| Smoking3 | | |  |  | | 0.2214 |  |  | | 0.2368\* | |
| Drinking1 | | |  |  | | 0.0161 |  |  | | 0.0506 | |
| Drinking2 | | |  |  | | -0.0943 |  |  | | 0.0094 | |
| Drinking3 | | |  |  | | -0.1696 |  |  | | -0.1205 | |
| Excising1 | | |  |  | | 0.0509 |  |  | | 0.0139 | |
| Excising2 | | |  |  | | 0.1711\* |  |  | | 0.1110 | |
| Dieting1 | | |  |  | | -0.0640 |  |  | | -0.0505 | |
| Dieting2 | | |  |  | | -0.0365 |  |  | | -0.0409 | |
| Pseudo-R2 | | | 0.2511 | 0.3069 | | 0.3502 | 0.477 | 0.4882 | | 0.52 | |
| AIC | | | 297.38 | 281.67 | | 284.84 | 225.47 | 227.15 | | 234.78 | |
| BIC | | | 309.36 | 305.62 | | 348.70 | 269.38 | 283.03 | | 330.58 | |
| LL | | | -145.69 | -134.84 | | -126.42 | -101.74 | -99.57 | | -93.39 | |
| N | | | 800 | 800 | | 800 | 800 | 800 | | 800 | |

Note: \*\* denotes *P* < 0.01, \* denotes *P* < 0.05; Sex indicates female; Cons indicates constant term; LL indicates Log likelihood; Smoking1 to Smoking3 indicates occasional smoking category, regular smoking category, and quit smoking category respectively; Drinking1 to Drinking3 indicates occasional drinking category, regular drinking category, and quit drinking category, respectively. Excising1 and Excising2 indicate the categories of Occasional exercise participation and Regular exercise participation, respectively; Dieting1 and Dieting2 indicate the categories of Occasional controlled eating and Regular controlled eating, respectively.

Table 12. Alternative model construction (3)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Models**  **Variables** | **GLM1** | | **GLM2** | **GLM3** | **GLM4** | **GLM5** | **GLM6** | |
| Dependent variable Y | U1 | | U1 | U1 | U1 | U1 | U1 | |
| Total | 0.2162\*\* | | 0.2319\*\* | 0.2890\*\* |  |  |  | |
| EnT |  | |  |  | 0.4625 | 0.42813 | 0.1885 | |
| PaT |  | |  |  | 0.8729\*\* | 0.8146\*\* | 1.0132\*\* | |
| DiT |  | |  |  | -0.3579 | -0.3966 | -0.5550 | |
| StT |  | |  |  | 0.4335 | 0.4431 | 0.8341 | |
| PiT |  | |  |  | 1.5463\* | 1.4036 | 1.7756\* | |
| SlT |  | |  |  | -0.1347 | -0.0699 | 0.1035 | |
| PhT | | |  |  |  | 0.2909 | 0.3106 | | 1.0000 |
| MoT | | |  |  |  | 0.4144 | 0.5253 | | 0.6251 |
| GhT | | |  |  |  | 0.4305 | 0.4601 | | 0.0854 |
| Cons | | | -3.4343\*\* | -4.0222\*\* | -4.5746\*\* | -4.6602\*\* | -5.5144\*\* | | -6.1608\*\* |
| Age | | |  | 0.0208\*\* | 0.0215\*\* |  | 0.0053 | | 0.0135 |
| BMI | | |  | -0.0153 | -0.0024 |  | 0.0300 | | 0.0321 |
| Sex | | |  | -0.2198 | -0.1046 |  | -0.1684 | | -0.1454 |
| Smoking1 | | |  |  | -0.7895 |  |  | | -1.7669 |
| Smoking2 | | |  |  | 0.2133 |  |  | | 0.3459 |
| Smoking3 | | |  |  | -0.9123 |  |  | | -2.3437 |
| Drinking1 | | |  |  | -0.0379 |  |  | | -0.2116 |
| Drinking2 | | |  |  | 0.8427 |  |  | | 1.2189 |
| Drinking3 | | |  |  | 0.0187 |  |  | | 0.9631 |
| Excising1 | | |  |  | -0.0479 |  |  | | 0.3030 |
| Excising2 | | |  |  | -1.3759\*\* |  |  | | -1.1343 |
| Dieting1 | | |  |  | 0.1434 |  |  | | 0.0962 |
| Dieting2 | | |  |  | 0.5239 |  |  | | 0.7871 |
| AIC | | | -3.68 | -3.89 | -4.07 | -4.49 | -4.51 | | -4.79 |
| BIC | | | -2034.34 | -2009.66 | -1919.62 | -1903.66 | -1883.73 | | -1772.48 |
| LL | | | 737.20 | 782.19 | 828.64 | 907.93 | 915.37 | | 981.50 |
| N | | | 800 | 800 | 800 | 800 | 800 | | 800 |

Note: \*\* denotes *P* < 0.01, \* denotes *P* < 0.05; Sex denotes female; Cons denotes constant term; LL denotes log likelihood; U1 denotes negative utility i.e. 1-EQ-5D-3L health utility value; Smoking1 to Smoking3 denote occasional smoking category, regular smoking category, and quit smoking category, respectively; Drinking1 to Drinking3 denote occasional alcohol consumption, regular alcohol consumption, and abstinence from alcohol, respectively; Excising1 and Excising2 denote occasional exercise participation and regular exercise participation, respectively; Dieting1 and Dieting2 denote occasional diet control and regular diet control, respectively.

Table 12. Alternative model construction (4)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Models**  **Variables** | **QR1** | | | **QR2** | **QR3** | **QR4** | **QR5** | **QR6** |
| Dependent variable Y | U | | | U | U | U | U | U |
| Total | -0.0188\*\* | | | -0.0189\*\* | -0.0184\*\* |  |  |  |
| EnT |  | | |  |  | 0.0191\* | 0.0177 | 0.0171 |
| PaT |  | | |  |  | -0.0598\*\* | -0.0553\*\* | -0.0422\*\* |
| DiT |  | | |  |  | -0.0120 | -0.0129 | -0.0219 |
| StT | | |  |  | |  | -0.0072 | -0.0099 | -0.0088 |
| PiT | | |  |  | |  | -0.0238 | -0.0263 | -0.0362 |
| SlT | | |  |  | |  | -0.0072 | -0.0088 | -0.0061 |
| PhT | | |  |  | |  | -0.0442 | -0.0434 | -0.0423 |
| MoT | | |  |  | |  | -0.0420\*\* | -0.0404 | -0.0525\* |
| GhT | | |  |  | |  | -0.0024 | -0.0025 | -0.0017 |
| Cons | | | 1.0081\*\* | 0.9839\*\* | | 0.9819\*\* | 1\*\* | 0.9953\*\* | 1.0019\*\* |
| Age | | |  | -0.0001 | | -0.0001 |  | 5.13E-06 | 0.0000 |
| BMI | | |  | 0.0012 | | 0.0009 |  | 2.11E-04 | 0.0000 |
| Sex | | |  | 0.0045 | | 0.0084 |  | 1.71E-03 | 0.0087 |
| Smoking1 | | |  |  | | 0.0047 |  |  | 0.0117 |
| Smoking2 | | |  |  | | 0.0018 |  |  | 0.0145 |
| Smoking3 | | |  |  | | -0.0078 |  |  | 0.0159 |
| Drinking1 | | |  |  | | 0.0073 |  |  | 0.0064 |
| Drinking2 | | |  |  | | 0.0073 |  |  | -0.0067 |
| Drinking3 | | |  |  | | -0.0398 |  |  | -0.0537 |
| Excising1 | | |  |  | | 0.0014 |  |  | -0.0075 |
| Excising2 | | |  |  | | 0.0033 |  |  | -0.0001 |
| Dieting1 | | |  |  | | -0.0024 |  |  | -0.0015 |
| Dieting2 | | |  |  | | 0.0035 |  |  | 0.0079 |
| Pseudo-R2 | | | 0.075 | 0.0807 | | 0.0873 | 0.1809 | 0.1811 | 0.1959 |
| N | | | 800 | 800 | | 800 | 800 | 800 | 800 |

Note: \*\* denotes *P* < 0.01, \* denotes *P* < 0.05; Sex indicates female; Cons indicates constant; Smoking1 to Smoking3 indicates occasional smoking category, regular smoking category, and quit smoking category, respectively; Drinking1 to Drinking3 indicates occasional drinking category, regular drinking category, and quit drinking category, respectively; Excising1 and Excising2 indicates occasional exercise category and regular exercise category, respectively; Dieting1 and Dieting2 indicates occasional diet category and regular diet category, respectively. The categories Excising1 and Excising2 indicate occasional exercise participation and regular exercise participation, respectively; Dieting1 and Dieting2 indicate occasional controlled eating and regular controlled eating, respectively.

Table 13. Distribution of alternative model predictions (N=400)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **EQ-5D- 3L** | **Average value** | **25th** | **Median value** | **75th** | **Minimum value** | **Maximum value** | **AE > 0.05**  **(n/%)** | **AE > 0.1 (n/%)** |
| Actual observation  Measured values | 0.921 | 0.869 | 1.000 | 1.000 | -0.030 | 1.000 |  |  |
| OLS1 | 0.925↑ | 0.886↑ | 0.961↓ | 0.987↓ | 0.581↑ | 0.997↓ | 170/42.5 | 96/24 |
| OLS2 | 0.927↑ | 0.882↑ | 0.945↓ | 0.993↓ | 0.528↑ | 1.081↑ | 182/45.5 | 90/22.5 |
| OLS3 | 0.927↑ | 0.889↑ | 0.942↓ | 0.993↓ | 0.496↑ | 1.064↑ | 198/49.5 | 102/25.5 |
| OLS4 | 0.921↓ | 0.867↓ | 0.951↓ | 1.007↑ | 0.476↑ | 1.023↑ | 146/36.5 | 78/19.5 |
| OLS5 | 0.922↑ | 0.867↓ | 0.948↓ | 1.002↑ | 0.487↑ | 1.046↑ | 160/40 | 74/18.5 |
| OLS6 | 0.922↑ | 0.874↑ | 0.936↓ | 1.003↑ | 0.462↑ | 1.068↑ | 172/43 | 70/17.5 |
| Tobit1 | 1.157↑ | 1.070↑ | 1.237↑ | 1.294↑ | 0.388↑ | 1.317↑ | 388/97 | 350/87.5 |
| Tobit2 | 1.155↑ | 1.047↑ | 1.191↑ | 1.302↑ | 0.246↑ | 1.543↑ | 362/90.5 | 342/85.5 |
| Tobit3 | 1.155↑ | 1.059↑ | 1.183↑ | 1.302↑ | 0.166↑ | 1.630↑ | 376/94 | 320/80 |
| Tobit4 | 1.144↑ | 1.013↑ | 1.195↑ | 1.351↑ | 0.264↑ | 1.387↑ | 368/92 | 338/84.5 |
| Tobit5 | 1.144↑ | 1.010↑ | 1.180↑ | 1.334↑ | 0.245↑ | 1.429↑ | 366/91.5 | 330/82.5 |
| Tobit6 | 1.146↑ | 1.036↑ | 1.184↑ | 1.329↑ | 0.225↑ | 1.607↑ | 378/94.5 | 328/82 |
| GLM1 | 0.922↑ | 0.921↑ | 0.957↓ | 0.965↓ | 0.060↑ | 0.968↓ | 182/45.5 | 74/18.5 |
| GLM2 | 0.911↓ | 0.924↑ | 0.954↓ | 0.974↓ | -1.099↓ | 0.984↓ | 172/43 | 78/19.5 |
| GLM3 | 0.871↓ | 0.912↑ | 0.955↓ | 0.978↓ | -4.105↓ | 0.998↓ | 180/45 | 104/26 |
| GLM4 | 0.823↓ | 0.921↑ | 0.970↓ | 0.988↓ | -7.564↓ | 0.992↓ | 160/40 | 78/19.5 |
| GLM5 | 0.823↓ | 0.916↑ | 0.971↓ | 0.987↓ | -7.921↓ | 0.9934↓ | 158/39.5 | 88/22 |
| GLM6 | 0.604↓ | 0.899↑ | 0.974↓ | 0.990↓ | -26.448↓ | 0.999↓ | 156/39 | 108/27 |
| QR1 | 0.958↑ | 0.930↑ | 0.983↓ | 1.001↑ | 0.715↑ | 1.008↑ | 144/36 | 88/22 |
| QR2 | 0.959↑ | 0.930↑ | 0.979↓ | 1.003↑ | 0.704↑ | 1.036↑ | 148/37 | 88/22 |
| QR3 | 0.958↑ | 0.931↑ | 0.980↓ | 1.002↑ | 0.712↑ | 1.020↑ | 152/38 | 86/21.5 |
| QR4 | 0.946↑ | 0.908↑ | 0.973↓ | 0.998↓ | 0.696↑ | 1.019↑ | 104/31 | 62/15.5 |
| QR5 | 0.947↑ | 0.911↑ | 0.972↓ | 0.998↓ | 0.696↑ | 1.020↑ | 130/32.5 | 62/15.5 |
| QR6 | 0.948↑ | 0.917↑ | 0.965↓ | 0.999↓ | 0.684↑ | 1.032↑ | 138/34.5 | 70/17.5 |

Note: ↑ indicates higher than the observed value, ↓ indicates lower than the observed value.

Table 14. Comparison of prediction accuracy across alternative models (N=400)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Models Indicators | MAE | RMSE | MSE | MAE  (High - Low) | RMSE (High – Low) | MAE and RMSE average ranking | MAE overall average ranking | RMSE overall average ranking | MAE vs. RMSE Combined average Sorting |
|
|
|
| OLS Methods |  |  |  |  |  |  | 17 | 20.8333 | 18.9167 |
| OLS1 | 0.07459 | 0.13398 | 0.01795 | 15 | 15 | 15 |  |  |  |
| OLS2 | 0.07501 | 0.12876 | 0.01658 | 14 | 20 | 17 |  |  |  |
| OLS3 | 0.07854 | 0.12846 | 0.0165 | 13 | 21 | 17 |  |  |  |
| OLS4 | 0.06607 | 0.11538 | 0.01331 | 21 | 22 | 21.5 |  |  |  |
| OLS5 | 0.06635 | 0.11341 | 0.01286 | 20 | 23 | 21.5 |  |  |  |
| OLS6 | 0.06796 | 0.11211 | 0.01257 | 19 | 24 | 21.5 |  |  |  |
| Tobit Method |  |  |  |  |  |  | 4.5 | 7.5 | 6 |
| Tobit 1 | 0.2518 | 0.28847 | 0.08321 | 3 | 7 | 5 |  |  |  |
| Tobit 2 | 0.25122 | 0.28977 | 0.08397 | 4 | 6 | 5 |  |  |  |
| Tobit 3 | 0.25661 | 0.29951 | 0.0897 | 2 | 5 | 3.5 |  |  |  |
| Tobit 4 | 0.24737 | 0.2824 | 0.07975 | 5 | 9 | 7 |  |  |  |
| Tobit 5 | 0.24607 | 0.2813 | 0.07913 | 7 | 10 | 8.5 |  |  |  |
| Tobit 6 | 0.24705 | 0.28286 | 0.08001 | 6 | 8 | 7 |  |  |  |
| GLM Method |  |  |  |  |  |  | 8.5 | 6.5 | 7.5 |
| GLM1 | 0.07891 | 0.12933 | 0.01673 | 12 | 18 | 15 |  |  |  |
| GLM2 | 0.08281 | 0.16902 | 0.02857 | 11 | 11 | 11 |  |  |  |
| GLM3 | 0.11551 | 0.37027 | 0.1371 | 10 | 4 | 7 |  |  |  |
| GLM4 | 0.15538 | 0.74773 | 0.5591 | 8 | 2 | 5 |  |  |  |
| GLM5 | 0.15521 | 0.73563 | 0.54116 | 9 | 3 | 6 |  |  |  |
| GLM6 | 0.3677 | 2.07891 | 4.32187 | 1 | 1 | 1 |  |  |  |
| QR Method |  |  |  |  |  |  | 20 | 15.1667 | 17.5833 |
| QR1 | 0.07034 | 0.14109 | 0.01991 | 17 | 12 | 14.5 |  |  |  |
| QR2 | 0.07053 | 0.1405 | 0.01974 | 16 | 13 | 14.5 |  |  |  |
| QR3 | 0.07019 | 0.13914 | 0.01936 | 18 | 14 | 16 |  |  |  |
| QR4 | 0.06138 | 0.13156 | 0.01731 | 24 | 16 | 20 |  |  |  |
| QR5 | 0.06155 | 0.13118 | 0.01721 | 23 | 17 | 20 |  |  |  |
| QR6 | 0.06301 | 0.12911 | 0.01667 | 22 | 19 | 20.5 |  |  |  |

Table 15. Final mapping model adjustments

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Models  Variables | Step 1 | Step 2 | Step 3 | Step 4 |
| EnT | -0.0340\* | 0.0583 | 0.053 | 0.0401 |
| PaT | -0.0558\*\* | -0.0185 | -0.0199 | -0.0067 |
| DiT | -0.0609\*\* | 0.0194 | 0.0263 | 0.0333 |
| StT | -0.0423\*\* | 0.0547 | 0.0384 | 0.054 |
| PiT | -0.0522\*\* | -0.053 | -0.0718 | -0.0369 |
| SlT | 0.0084 | 0.0078 | -0.0251 | 0.0071 |
| PhT | -0.0601\*\* | -0.0588 | -0.1060\* | -0.1411\*\* |
| MoT | 0.0087 | -0.008 | -0.0215 | -0.0208 |
| GhT | -0.0172 | 0.0077 | 0.0437\* | 0.0368\* |
| EnT2 |  | -0.0572\*\* | -0.0759\*\* |  |
| PaT2 |  | -0.0274\*\* | -0.0357\*\* | -0.0312\*\* |
| DiT2 |  | -0.0460\* |  |  |
| StT2 |  | -0.0601\*\* | -0.0380\* | 0.0419\* |
| GhT2 |  | -0.0187\* |  |  |
| EnTPhT |  |  | 0.1650\*\* |  |
| EnTGhT |  |  | -0.0729\*\* | -0.0523\* |
| DiTGhT |  |  | -0.0829\*\* | -0.0908\*\* |
| StTPhT |  |  | -0.0809\* | -0.0627\* |
| PhTGhT |  |  | 0.1111\*\* | 0.0767\*\* |
| Cons | 1.0247\*\* | 0.9872\*\* | 0.9879\*\* | 1.0014\*\* |
| Age |  |  |  | -0.0007\* |
| BMI |  |  |  | -0.0003 |
| Sex |  |  |  | 0.0226 |
| Smoking1 |  |  |  | 0.0197 |
| Smoking2 | |  |  |  | 0.0181 |
| Smoking3 | |  |  |  | 0.0131 |
| Drinking1 | |  |  |  | -0.0002 |
| Drinking2 | |  |  |  | 0.0076 |
| Drinking3 | |  |  |  | -0.0293 |
| Excising1 | |  |  |  | 0.0031 |
| Excising2 | |  |  |  | 0.0265 |
| Dieting1 | |  |  |  | -0.0109 |
| Dieting2 | |  |  |  | -0.0078 |
| R2 | | 0.4178 | 0.4901 | 0.5603 | 0.5325 |
| A-R2 | | 0.4089 | 0.4743 | 0.5203 | 0.5078 |
| MAE | | 0.0698 | 0.0622 | 0.059 | 0.061714 |
| AE>0.05 | | 41.17% | 39.50% | 37.83% | 38.83% |
| AE>0.1 | | 20.83% | 17.67% | 17.33% | 16% |
| Range of predicted values | | 0.423~1.032 | 0.200~1.012 | 0.100~1.045 | 0.136~1.080 |

Note: \*\* denotes *P* < 0.01, \* denotes *P* < 0.05.

Table 16. Final mapping model results

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Independent variable** | | **Coefficient** | **SE** | **Statistical quantity t** | **P-value** | **95% confidence interval** | |
| EnT | | 0.0530 | 0.033 | 1.59 | 0.113 | -0.013 | 0.119 |
| PaT | | -0.0199 | 0.025 | -0.81 | 0.417 | -0.068 | 0.028 |
| DiT | | 0.0263 | 0.038 | 0.69 | 0.489 | -0.048 | 0.101 |
| StT | | 0.0384 | 0.034 | 1.13 | 0.258 | -0.028 | 0.105 |
| PiT | | -0.0718\* | 0.039 | -1.86 | 0.063 | -0.147 | 0.004 |
| SlT | | -0.0251 | 0.026 | -0.98 | 0.327 | -0.075 | 0.025 |
| PhT | | -0.1060\*\* | 0.046 | -2.30 | 0.022 | -.0196 | -0.015 |
| MoT | | -0.0215 | 0.033 | -0.64 | 0.52 | -0.087 | 0.044 |
| GhT | | 0.0437\*\* | 0.02 | 2.16 | 0.031 | 0.004 | 0.083 |
| EnT2 | | -0.0759\*\*\* | 0.028 | -2.69 | 0.007 | -0.131 | -0.02 |
| PaT2 | | -0.0357\*\*\* | 0.011 | -3.19 | 0.002 | -0.058 | -0.014 |
| StT2 | | -0.0380\*\* | 0.018 | -2.05 | 0.04 | -0.074 | -0.002 |
| EnTPhT | | 0.1650\*\*\* | 0.056 | 2.94 | 0.003 | .055 | 0.275 |
| EnTGhT | | -0.0729\*\*\* | 0.027 | -2.66 | 0.008 | -0.127 | -0.019 |
| DiTGhT | | -0.0829\*\*\* | 0.032 | -2.59 | 0.01 | -0.146 | -0.02 |
| StTPhT | | -0.0809\*\* | | 0.041 | -1.97 | 0.049 | -0.162 | 0 | |
| PhTGhT | | 0.1111\*\*\* | | 0.037 | 3.02 | 0.003 | 0.039 | 0.183 | |
| Cons | | 0.9879\*\*\* | | 0.009 | 109.63 | 0 | 0.97 | 1.006 | |

Note: \*\*\* denotes P < 0.01, \*\* denotes P < 0.05, \* denotes P < 0.1

Table 17. The statistical description of the final mapping model predictions

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EQ-5D- 3L | Distribution range | Very poor | Average value | 10th | 25th | 50th | 75th | 90th |
| Observations | -0.03~1 | 1.03 | 0.923 | 0.783 | 0.875 | 1 | 1 | 1 |
| Predicted value | 0.100~1.045 | 0.946 | 0.923 | 0.791 | 0.902 | 0.962 | 0.988 | 1.002 |

Table 18. Distribution of observed and predicted values for the final mapping model

|  |  |  |
| --- | --- | --- |
| EQ-5D-3L Effectiveness value | observations (number/%) | Forecast (number/%) |
| ≤0.2 | 14（1.17） | 6（0.50） |
| （0.2，0.40] | 20（1.67） | 4（0.33） |
| （0.4，0.6] | 18（1.50） | 22（1.83） |
| （0.6，0.8] | 106（8.83） | 94（7.83） |
| >0.8 | 1042（86.83） | 1074（89.50） |
| Total | 1200（100） | 1200（100） |

Table 19. Analysis of prediction error sign direction

|  |  |  |
| --- | --- | --- |
| **EQ-5D-3L**  **Measured value** | **e < 0**  **(Underestimation)** | **e > 0**  **(Overestimation)** |
| Full sample | 794 (66.16%) | 406 (33.83%) |
| ≤ 0.2 | 2 (0.17%) | 12 (1.00%) |
| (0.2, 0.40] | 0 (0) | 20 (1.67%) |
| (0.4, 0.6] | 4 (0.33%) | 14 (1.17%) |
| (0.6, 0.8] | 34 (2.83%) | 72 (6%) |
| (0.8, 1) | 70 (5.83%) | 168 (14%) |
| = 1 | 684 (57%) | 120 (10%) |
| Total | 1200 (100) | 1200 (100) |

Table 20. Final mapping model prediction accuracy analysis

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **EQ-5D-3L**  **Measured value** | **Frequency** | **ME** | **MAE** | **RMSE** | | **AE > 0.05(%)** | **AE > 0.1(%)** |
| Full sample | 1200 | -4.64e-09 | 0.0590 | | 0.10447 | 454 (37.83) | 208 (17.33) |
| ≤ 0.2 | 14 | 0.30350 | 0.30752 | | 0.42815 | 12 (85.71) | 10 (71.43) |
| (0.2, 0.40] | 20 | 0.40557 | 0.40557 | | 0.44547 | 20 (100) | 20 (100) |
| (0.4, 0.6] | 18 | 0.11870 | 0.14438 | | 0.20118 | 12 (66.67) | 8 (44.44) |
| (0.6, 0.8] | 106 | 0.05979 | 0.10591 | | 0.12870 | 84 (79.25) | 52 (49.06) |
| (0.8, 1) | 238 | 0.0212415 | 0.06799 | | 0.08226 | 136 (57.14) | 54 (22.69) |
| =1 | 804 | -0.03220 | 0.03531 | | 0.05538 | 190 (23.63) | 64 (7.96) |

Figure 1. The trend of three forecast accuracy indicators