Belief about the future possibility of national aging security system and its association with mortality

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Abstract

In line with well-known subjective measures of health, such as self-rated health and subjective life expectancy, an individual’s belief about future security provided by the government could also be an important factor affecting his life expectancy. The aim of this study was to use the response of the elderly Korean population in regards to the National Aging Security System (NASS), and assess its association with the risk of mortality even with SRH included in the analysis. Data from the Korean Longitudinal Study of Ageing (KLoSA) from 2006 to 2016 were assessed using longitudinal data analysis and 10,254 research subjects were included at baseline in 2006. To analyze the association between belief about future possibility of NASS and all-cause mortality, Cox proportional hazards model was used. In terms of the future possibility of NASS, people who thought more negatively displayed greater risk of mortality at the end of the follow-up. With the Positive group as reference: Moderate group showed a 18% increase (HR = 1.178, 95% CI: 1.022, 1.357), and Negative groups showed a 19% increase (HR = 1.192, 95% CI: 1.043, 1.362). The results of our study showed that people’s belief regarding future security could be associated with mortality rates. Our finding is important, because it provides additional support to the importance of considering subjective measures of health in epidemiological research. Furthermore, the findings of our research could be useful in terms of future policy making.

Introduction

Increasing number of studies are considering subjective measures of health in addition to the traditional measures of health in association with mortality [1, 2]. This is a newer trend in this area of research, because in the past, researchers often used more objective measures of health such as smoking status, blood pressure level, and history of congestive heart failure [3]. The reason for the use of subjective measures of health can be seen in studies such as the one by
Strawbridge and Wallhagen [4] that demonstrated the independent effect of self-rated health (SRH) on the risk of mortality. Likewise, subjective measures concern the belief about one’s own health or state of well-being, which could concern the past, the present or the future.

SRH is mainly used as a measure of current health state, and the predictability of SRH on the risk of mortality was demonstrated throughout studies in the past. For example, Fried et al. [3] assessed various risk factors in terms of mortality, and worse SRH was associated with higher risk of mortality in the unadjusted model as well as the fully adjusted model. Also, Idler et al. [5] found similar predictability of SRH on the risk of mortality, but it was only observed in participants suffering from circulatory system disease. Therefore, effects of SRH on different groups of people need to be considered.

Another subjective health measure that is often used in research is subjective life expectancy (SLE). SLE is an individual’s subjective opinion of remaining length of life, and it has shown to be associated with mortality risk [6], even with SRH in consideration [2]. Hence, SRH and SLE both affect mortality and are conceptually similar, but they also show independent effects on mortality. Several factors, such as emotional support [7], health status [8], and feeling secure about one’s future [9] could influence an individual’s SLE. Furthermore, people’s sense of future security could be affected by their level of confidence in regards to their government.

Previously, reduction in mortality in relation to improvements in government provided social services was observed. For example, the Social Security in the United States [10] and The Estrategia de Saude da Familia in Brazil [11] were both associated with reduced mortality. Similar government provided social security systems, such as the Universal health insurance as well as the Medical Aid program provided by the government, exist in Korea [12]. These programs are important, because Korea has one of the fastest growing elderly population as well as the highest elderly poverty rate among OECD countries [13]. Considering previous studies [10, 11] these government programs could improve the health status and reduce the mortality rate of Koreans, but how confident people feel about those programs is a different matter. We hypothesized that people’s level of confidence in the National Aging Security System (NASS) could be a good indicator of how secure people felt about their future, and aimed to study the association between the response of the elderly Korean population in regards to the National Aging Security System (NASS) and mortality.

Methods

Study sample

Data were obtained from the 2006, 2008, 2010, 2012, 2014 and 2016 waves of the Korean Longitudinal Study of Ageing (KLoSA). Sampling was conducted by sorting the population surveyed in a given area and 15 residential type according to the order of the administrative codes, and then extracting the assigned number by applying a systematic extraction method (the multistage and stratified randomized sampling method). As per the KLoSA study protocol, trained surveyors collected informed consents from participants and conducted face-to-face interviews using a computer-assisted personal interviewing program.

In the first baseline survey in 2006, 10,254 individuals in 6,171 households (1.7 per household) were interviewed. There were 292 individuals with cancer. The second survey, in 2008, followed up with 8,675 subjects, who represented 86.6% of the original panel. The third survey, in 2010, followed up with 8,229 subjects, who represented 81.7% of the original panel, the fourth survey, in 2012, followed up with 7,813 subjects, who represented 80.1% of the original panel and the fifth survey, in 2014, followed up with 8,387 subjects (including 920 new participated sample), who represented 80.4% of the original panel. The sixth survey, in 2016, followed
up with 9,913 subjects (including 878 new participated sample), who represented 79.6% of the original panel.

Independent variables
Belief about the future possibility of National Aging Security System (NASS) measures a continuum of subjective probabilities using responses to a statement “I believe that the government will provide security in my later years.” The response to the question ranges from 0 to 100, where 0 means that you think there is absolutely no chance, and 100 meaning that you think the event is absolutely sure to happen. Belief about the future possibility of NASS was divided into three groups: negative, moderate and positive using SAS Rank function.

Control variables
From the first wave, covariates were collected: age (45–49, 50–59, 60–69, ≥70), gender (male and female), education (elementary, middle, high school, and ≥college), residential region (Urban: administrative divisions of a city: Seoul, Daejeon, Daegu, Busan, Incheon, Kwangju, or Ulsan, Rural: not classified as administrative of a city), income level (<100, 100–199, 200–299, and ≥300 in thousand won), smoking status (non-smoker, former smoker, and smoker), alcohol consumption (nothing, former drinker, and drinker), Marital status (married and single which includes ‘separated’, ‘divorced’, ‘widowed or disappeared’, and ‘never married’). The type of medical insurance (National Health Insurance beneficiary or Medical Aid beneficiary), free national health screening (Yes or No), self-rated health (very good, good, fair, poor, very poor), government pension (Yes or No), number of hospitalization before 1 year, number of outpatient use before 1 year and comorbidity of hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, heart disease, cerebrovascular diseases and mental illness (0, 1, and ≥2). Social engagement was measured using five variables. Briefly, (1) frequency of contacts of friends (4: every day, 3: once a month–two or three per week, 2: once a year–five or six a year or almost nothing); (2) frequency of contacts within a mutual benevolence group meeting (4: every day, 3: once a month–two or three per week, 2: once a year–five or six a year or almost nothing); (3) frequency of attendance at leisure, culture, and sports activities (4: every day, 3: once a month–two or three per week, 2: once a year–five or six a year or almost nothing); (4) frequency of religious attendance (4: every day, 3: once a month–two or three per week, 2: once a year–five or six a year or almost nothing); and (5) frequency of contacts at an alumni meeting or hometown alumni and clan gathering (4: every day, 3: once a month–two or three per week, 2: once a year–five or six a year or almost nothing). The variables were summed, with totals ranging from 4 to 20. Social engagement was ranked from lowest to highest, and four groups were analyzed using the SAS rank function.

Dependent variables

All-cause mortality. All-cause mortality during the time interval from year 2006 to the end of follow-up was the main outcome of the study. Death over a maximum follow-up period of 10 years was determined by death certificates and coroner’s report.

Analytical approach and statistics
First, we employed descriptive statistics to describe general characteristics of the sample through chi-square test. Then, we used the Cox proportional hazards model to investigate the associations between belief about the future possibility of NASS and all-cause mortality. For all analyses, the criterion for statistical significance was p <0.05, two-tailed. All analyses were
conducted using the SAS statistical software package, version 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

Sample characteristics

Baseline characteristics of participants are shown in Table 1. Of the total of 9,374 participants, there were 1,347 (14.4%) mortality at the end of the follow-up. In terms of the future possibility of NASS, there were 366 (11.4%) mortality in the Positive group, 412 (14.6%) mortality in the Moderate group, and 569 (17.0%) mortality in the Negative group. In terms of SRH, there were 251 (39.2%) mortality in the Very insufficient group, 504 (22.6%) mortality in the Insufficient group, 356 (12.2%) mortality in the Normal group, 218 (6.7%) mortality in the Sufficient group, and 18 (5.6%) mortality in the Very sufficient group.

Adjusted effects of future possibility of NASS on death

In terms of the future possibility of NASS, people who thought more negatively displayed greater risk of mortality at the end of follow-up. With the Positive group as reference: Moderate group showed an 18% increase (HR = 1.178, 95% CI: 1.022, 1.357), and Negative groups showed a 19% increase (HR = 1.192, 95% CI: 1.043, 1.362). Kaplan-Meier curve for all-cause mortality is shown in S1 Fig. SRH was also significantly associated with the risk of mortality, where as participants felt more poorly about their health at baseline, their risk of mortality increased at the end of follow-up. However, with the Very good group as reference, only the Very poor group (HR = 2.288, 95% CI: 1.395, 3.753) showed a significant increase in the risk of mortality (Table 2).

Stratification analysis of future possibility of NASS

Final analysis of the study included stratification of variables, which were statistically significant in the previous model. In terms of gender, future possibility of NASS was no longer significantly associated with the risk of mortality for males. Significant association remained in the Female group, but it was only significant in the Negative group (HR = 1.268, 95% CI: 1.047, 1.536) compared to the Positive group. The future possibility of NASS was not significantly associated with the risk of mortality in the group with private health insurance, but for those without it, the risk of mortality was higher in the Moderate group (HR = 1.175, 95% CI: 1.011, 1.365) as well as the Negative group (HR = 1.205, 95% CI: 1.048, 1.386) compared to the Positive group. Also, the future possibility of NASS was not significantly associated with the risk of mortality for people with free national health screening, but for those without it, the association was significant for both the Moderate group (HR = 1.297, 95% CI: 1.081, 1.556), and the Negative group (HR = 1.247, 95% CI: 1.051, 1.478). Finally, significant association between the future possibility of NASS and the risk of mortality was not observed in those under the age of 60, but the risk of mortality was significantly higher in the Negative group compared to the Positive group for those aged 60 years and older (HR = 1.214, 95% CI: 1.051, 1.402), as well as those in a more specified age group, 60–79 years old, (HR = 1.203, 95% CI: 1.01, 1.433) (Table 3).

Discussion

In this study considering the factors that could affect the risk of mortality, people’s thoughts on their future security was significantly associated with the risk of mortality. The risk of mortality was 19% higher for people in the Negative group, in terms of the future possibility of
Table 1. General characteristics of participants at baseline.

|                              | Total               | Death               | P-value |
|------------------------------|---------------------|---------------------|---------|
|                              | N/mean %/SD         | N/mean %/SD         |         |
| Future possibility of national aging security system |                    |                     | < .0001 |
| Negative                     | 3,349 35.7          | 2,780 83.0          | 569 17.0|
| Moderate                     | 2,825 30.1          | 2,413 85.4          | 412 14.6|
| Positive                     | 3,200 34.1          | 2,834 88.6          | 366 11.4|
| Age                          |                     |                     | < .0001 |
| 45–54                        | 1,749 18.7          | 1,705 97.5          | 44 2.5  |
| 55–64                        | 2,829 30.2          | 2,691 95.1          | 138 4.9 |
| 65–74                        | 2,358 25.2          | 2,081 88.3          | 277 11.8|
| >74                          | 2,438 26.0          | 1,550 63.6          | 888 36.4|
| Gender                       |                     |                     | < .0001 |
| Male                         | 3,900 41.6          | 3,216 82.5          | 684 17.5|
| Female                       | 5,474 58.4          | 4,811 87.9          | 663 12.1|
| Education                    |                     |                     | < .0001 |
| < Elementary                 | 4,361 46.5          | 3,410 78.2          | 951 21.8|
| Middle school                | 1,538 16.4          | 1,392 90.5          | 146 9.5 |
| High school                  | 2,498 26.7          | 2,321 92.9          | 177 7.1 |
| >College                     | 977 10.4            | 904 92.5            | 73 7.5  |
| Residential region           |                     |                     | < .0001 |
| Urban                        | 6,121 65.3          | 5,336 87.2          | 785 12.8|
| Rural                        | 3,253 34.7          | 2,691 82.7          | 562 17.3|
| Income level (thousand won)^*|                     |                     | < .0001 |
| <100                         | 8,142 86.9          | 6,843 84.1          | 1,299 16.0|
| 100–199                      | 582 6.2             | 557 95.7            | 25 4.3  |
| 200–299                      | 289 3.1             | 276 95.5            | 13 4.5  |
| >300                         | 361 3.9             | 351 97.2            | 10 2.8  |
| Smoking status               |                     |                     | < .0001 |
| Non-smoker                   | 6,772 72.2          | 5,921 87.4          | 851 12.6|
| Former smoker                | 845 9.0             | 647 76.6            | 198 23.4|
| Smoker                       | 1,757 18.7          | 1,459 83.0          | 298 17.0|
| Alcohol consumption          |                     |                     | < .0001 |
| Nothing                      | 3,488 37.2          | 3,074 88.1          | 414 11.9|
| Former drinker               | 583 6.2             | 417 71.5            | 166 28.5|
| Drinker                      | 5,303 56.6          | 4,536 85.5          | 767 14.5|
| Marital status               |                     |                     | < .0001 |
| Married                      | 7,307 78.0          | 6,495 88.9          | 812 11.1|
| Single (including separated, divorced) | 2,067 22.1         | 1,532 74.1          | 535 25.9|
| Social engagement^**         |                     |                     | < .0001 |
| Low                          | 2,450 26.1          | 1,891 77.2          | 559 22.8|
| Middle low                   | 1,049 11.2          | 875 83.4            | 174 16.6|
| Middle                       | 2,434 26.0          | 2,155 88.5          | 279 11.5|
| Middle high                  | 1,268 13.5          | 1,136 89.6          | 132 10.4|
| High                         | 2,173 23.2          | 1,970 90.7          | 203 9.3 |
| National health insurance    |                     |                     | < .0001 |
| National health insurance beneficiary | 8,782 93.7        | 7,581 86.3          | 1,201 13.7|
| Medical aid beneficiary      | 592 6.3             | 446 75.3            | 146 24.7|

(Continued)
NASS, compared to the Positive group, and this could be viewed in similar regards as feeling hopeless. Everson et al. [14] surveyed people's level of hopelessness in association with the risk of mortality and found a significant association. Likewise, it is possible that when people do not sense a promising future security, their level of hopelessness increases, and consequently increases the risk of mortality.

In our stratified analysis, thoughts on the future possibility of NASS was significantly associated with the risk of mortality for women, but not for men. The possible reason for this association could be due to the differences in health behaviors between men and women, when they feel similarly about the future. In a past study by Scott-Sheldon et al. [15], men and women, who felt similarly about their life expectancy, displayed different health behaviors. In terms of both private health insurance and free national health screening, elders without these benefits were more significantly affected by their belief about future possibility of NASS. This could also be associated with the fact that increased number of concurrent problems worsens the perception of one’s future [9]. Furthermore, association between NASS and mortality was only significant in elders aged 60 years and older.

### Table 1. (Continued)

|                                | Total       | Death        |  | P-value |
|--------------------------------|-------------|--------------|---|---------|
|                                | No          | Yes          |   |         |
|                                | N/mean %/SD | N/mean %/SD  |   |         |
| Private health insurance       |             |              |   | <.0001  |
| Yes                            | 3,049 32.5  | 2,933 96.2   | 116 3.8  |
| No                             | 6,325 67.5  | 5,094 80.5   | 1,231 19.5 |
| Free national health screening  |             |              |   | <.0001  |
| Yes                            | 4,197 44.8  | 3,708 88.4   | 489 11.7 |
| No                             | 5,177 55.2  | 4,319 83.4   | 858 16.6 |
| Self-rated health              |             |              |   | <.0001  |
| Very sufficient                | 323 3.5     | 305 94.4     | 18 5.6   |
| Sufficient                     | 3,256 34.7  | 3,038 93.3   | 218 6.7  |
| Normal                         | 2,924 31.2  | 2,568 87.8   | 356 12.2 |
| Insufficient                   | 2,231 23.8  | 1,727 77.4   | 504 22.6 |
| Very insufficient              | 640 6.8     | 389 60.8     | 251 39.2 |
| Government pension             |             |              |   | <.0001  |
| Yes                            | 2,041 21.8  | 1,963 96.2   | 78 3.8   |
| No                             | 7,333 78.2  | 6,064 82.7   | 1,269 17.3 |
| Number of hospitalization before 1 year | 0 0.7 | 0 0.6 | 0 1.0 |
| Number of outpatient use before 1 year | 6 15.8 | 6 15.3 | 8 18.2 |
| Number of chronic diseases***  |             |              |   | <.0001  |
| 0                              | 4,980 53.1  | 4,495 90.3   | 485 9.7  |
| 1                              | 2,681 28.6  | 2,239 83.5   | 442 16.5 |
| ≥2                             | 1,713 18.3  | 1,293 75.5   | 420 24.5 |
| Total                          | 9,374 100.0 | 8,027 85.6   | 1,347 14.4 |

*Unit: 1,000KRW = $1*

**Social engagement was measured in five variables. (1) frequency of contacts in domains of friends (2) frequency of contacts in mutual benevolence group meeting (3) frequency of attendance in leisure, culture and sports activities (4) frequency of religious attendance (5) frequency of contacts in alumni meeting, hometown alumni and clan gathering

***Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, heart disease, cerebrovascular diseases, mental illness and arthritis or rheumatoid arthritis

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Table 2. Adjusted effect of future possibility of national aging security system on death.

|                                      | Death                                      |         |         |         |          |
|--------------------------------------|--------------------------------------------|---------|---------|---------|-----------|
|                                      |                                            | HR      | 95% CI  | P-value |           |
| Future possibility of national aging |                                            |         |         |         |           |
| security system                      |                                            |         |         |         |           |
| Negative                             |                                            | 1.192   | 1.043   | 1.362   | 0.010     |
| Moderate                             |                                            | 1.178   | 1.022   | 1.357   | 0.024     |
| Positive                             |                                            | 1.000   |         |         |           |
| Age                                  |                                            |         |         |         |           |
| 45–54                                |                                            | 1.000   |         |         |           |
| 55–64                                |                                            | 1.649   | 1.169   | 2.325   | 0.004     |
| 65–74                                |                                            | 2.722   | 1.935   | 3.830   | < .0001   |
| ≥74                                  |                                            | 7.095   | 5.049   | 9.970   | < .0001   |
| Gender                               |                                            |         |         |         |           |
| Male                                 |                                            | 2.324   | 1.977   | 2.731   | < .0001   |
| Female                               |                                            | 1.000   |         |         |           |
| Education                            |                                            |         |         |         |           |
| ≤Elementary                          |                                            | 1.292   | 0.998   | 1.673   | 0.051     |
| Middle school                        |                                            | 1.097   | 0.822   | 1.464   | 0.529     |
| High school                          |                                            | 1.053   | 0.798   | 1.389   | 0.714     |
| ≥College                             |                                            | 1.000   |         |         |           |
| Residential region                   |                                            |         |         |         |           |
| Urban                                |                                            | 1.000   |         |         |           |
| Rural                                |                                            | 1.264   | 1.129   | 1.415   | < .0001   |
| Income level (thousand won)          |                                            |         |         |         |           |
| <100                                 |                                            | 1.000   |         |         |           |
| 100–199                              |                                            | 0.666   | 0.442   | 1.005   | 0.053     |
| 200–299                              |                                            | 0.874   | 0.496   | 1.539   | 0.640     |
| ≥300                                 |                                            | 0.650   | 0.341   | 1.239   | 0.191     |
| Smoking status                       |                                            |         |         |         |           |
| Non-smoker                           |                                            | 1.000   |         |         |           |
| Former smoker                        |                                            | 1.334   | 1.108   | 1.607   | 0.002     |
| Smoker                               |                                            | 1.328   | 1.131   | 1.560   | 0.001     |
| Alcohol consumption                  |                                            |         |         |         |           |
| Nothing                              |                                            | 1.000   |         |         |           |
| Former drinker                       |                                            | 1.099   | 0.909   | 1.328   | 0.330     |
| Drinker                              |                                            | 1.113   | 0.961   | 1.288   | 0.153     |
| Marital status                       |                                            |         |         |         |           |
| Married                              |                                            | 1.000   |         |         |           |
| Single (including separated, divorced)|                                        | 1.632   | 1.432   | 1.860   | < .0001   |
| Social engagement***                 |                                            |         |         |         |           |
| Low                                  |                                            | 1.563   | 1.323   | 1.846   | < .0001   |
| Middle low                           |                                            | 1.188   | 0.966   | 1.462   | 0.103     |
| Middle                              |                                            | 1.189   | 0.990   | 1.428   | 0.064     |
| Middle high                          |                                            | 1.167   | 0.935   | 1.455   | 0.172     |
| High                                 |                                            | 1.000   |         |         |           |
| National health insurance            |                                            |         |         |         |           |
| National health insurance beneficiary|                                            | 1.000   |         |         |           |
| Medical aid beneficiary              |                                            | 0.968   | 0.810   | 1.156   | 0.719     |

(Continued)
Until now, various studies in this field of research have used SRH [16] and SLE [17] as subjective measures of health. Our study is similar to previous studies in the sense that it measures subjective measures, but it also includes a new concept, which is related to how positively people feel about their future. In the past, SLE was often used as a futuristic subjective perception of oneself[18]. Because, having a sense of security about one’s own future influences people’s SLE [9], ratings on the future possibility of NASS was used in our study. Our findings are important, because it provides indications to the importance of implementation of a better NASS as well as improved subjective ratings about oneself,. Benefits of providing better universal security system have been shown in previous studies [19, 20], and as important as it is to implement better systems at the government level, it could be equally important to educate people and provide information, so people understand the benefits provided by the government and feel a stronger sense of security regarding their future. Therefore, implementing a better system to elevate people’s well-being could improve the risk of mortality on its own, as well as by providing a more positive sense of future security.

The strengths of the current study are the use of a population-based representative sample with a 10-year follow-up. Also, the study was designed to analyze the prospective effects of SRH and the belief about the future possibility of NASS on the risk of mortality 10 years later.

Table 2. (Continued)

|                           | Death               |
|---------------------------|---------------------|
|                           | HR  | 95% CI     | P-value    |
| Yes                       | 1.000 |
| No                        | 1.398 | 1.128  | 1.734  | 0.002 |
| Free national health screening |       |
| Yes                       | 1.000 |
| No                        | 1.293 | 1.154  | 1.450  | < .0001 |
| Self-rated health         |       |
| Very sufficient           | 1.000 |
| Sufficient                | 0.940 | 0.580  | 1.523  | 0.802 |
| Normal                    | 1.107 | 0.686  | 1.787  | 0.677 |
| Insufficient              | 1.526 | 0.943  | 2.469  | 0.086 |
| Very insufficient         | 2.288 | 1.395  | 3.753  | 0.001 |
| Government pension        |       |
| Yes                       | 1.000 |
| No                        | 1.431 | 1.103  | 1.857  | 0.007 |
| Number of hospitalization before 1 year |       |
| 1.092                     |
| Number of outpatient use before 1 year |       |
| 0.997                     |
| Number of chronic diseases**|
| 1                         |
| ≥2                        |
| Unit: 1,000KRW = 1$        |

**Social engagement was measured in five variables. (1) frequency of contacts in domains of friends (2) frequency of contacts in mutual benevolence group meeting (3) frequency of attendance in leisure, culture and sports activities (4) frequency of religious attendance (5) frequency of contacts in alumni meeting, hometown alumni and clan gathering

***Hypertension, diabetes, cancer, chronic obstructive pulmonary disease, liver disease, heart disease, cerebrovascular diseases, mental illness and arthritis or rheumatoid arthritis

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Using a more specific measure of people’s subjective ratings was also beneficial in the sense that it narrowed down where our attention needs to be focused on.

Although, this study provides various strengths, certain limitations also need to be mentioned. First, the independent variable of the study was based on self-reports, which could sometimes be less accurate, compared to more objective measures. However, number of studies have demonstrated how subjective measures sometimes provide better explanation of people’s status compared to more objective measures [8, 21], making this problem less significant. Second, there could have been other confounding factors that were not accounted for in our study. However, given the nature of a secondary data, included variables were limited. Lastly, the cause of mortality was not specified in our study, and considering this factor in future studies could benefit this line of work.
This study provided additional results to the line of work considering subjective measures of health. Additionally, our study provided a new subjective rating that could assist in future policy making. Future studies considering better national security system as well as the level of confidence people have about the system would be beneficial in regards to the risk of mortality, even possibly the quality of life itself.

**Supporting information**

S1 Fig. Kaplan-meier curve for association between future possibility of national aging security system and all-cause mortality.

(TIF)

S1 File. “Data06.sas7bdat”.

(SAS7BDAT)

**Author Contributions**

Conceptualization: Jae-Hyun Kim.

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Formal analysis: Jae-Hyun Kim.

Funding acquisition: Jae-Hyun Kim.

Investigation: Jae-Hyun Kim.

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Writing – original draft: Doukyoung Chon, Jae-Hyun Kim.

Writing – review & editing: Doukyoung Chon, Ki Bong Yoo, Jae-Hyun Kim.

**References**

1. Kim J-H, Kim J-M. Subjective life expectancy is a risk factor for perceived health status and mortality. Health and quality of life outcomes. 2017; 15(1):190. https://doi.org/10.1186/s12955-017-0763-0 PMID: 28969645

2. Siegel M, Bradley EH, Kasl SV. Self-rated life expectancy as a predictor of mortality: evidence from the HRS and AHEAD surveys. Gerontology. 2003; 49(4):265–71. https://doi.org/10.1159/000070409 PMID: 12792164

3. Fried LP, Kronmal RA, Newman AB, Bild DE, Mittelmark MB, Polak JF, et al. Risk factors for 5-year mortality in older adults: the Cardiovascular Health Study. Jama. 1998; 279(8):585–92. PMID: 9486752

4. Strawbridge WJ, Wallhagen MI. Self-rated health and mortality over three decades: results from a time-dependent covariate analysis. Research on Aging. 1999; 21(3):402–16.

5. Idler E, Leventhal H, McLaughlin J, Leventhal E. In Sickness but Not in Health: Self-ratings, Identity, and Mortality. Journal of Health and Social Behavior. 2004; 45:336–56. https://doi.org/10.1177/002214650404500307 PMID: 15595511
6. Kobayashi LC, von Wagner C, Wardle J. Perceived life expectancy is associated with colorectal cancer screening in England. Annals of Behavioral Medicine. 2016; 51(3):327–36.
7. Brouwer WB, van Exel NJA. Expectations regarding length and health related quality of life: some empirical findings. Social science & medicine. 2005; 61(5):1083–94.
8. Smith VK, Taylor DH, Sloan FA. Longevity expectations and death: Can people predict their own demise? American Economic Review. 2001; 91(4):1126–34.
9. Mirowsky J, Ross CE. Socioeconomic status and subjective life expectancy. Social Psychology Quarterly. 2000:133–51.
10. Arno PS, House JS, Viola D, Schechter C. Social security and mortality: The role of income support policies and population health in the United States. Journal of public health policy. 2011; 32(2):234–50. https://doi.org/10.1057/jphp.2011.2 PMID: 21326333
11. Hone T, Rasella D, Barreto M, Atun R, Majeed A, Millett C. Large reductions in amenable mortality associated with Brazil's primary care expansion and strong health governance. Health Affairs. 2017; 36(1):149–58. https://doi.org/10.1377/hlthaff.2016.0966 PMID: 28069858
12. Kang MS, Jang HS, Lee M, Park E-C. Sustainability of Korean national health insurance. Journal of Korean medical science. 2012; 27(Suppl):S21–S4.
13. OECD. Health at a Glance 2017: OECD Indicators, OECD Publishing, Paris. http://dx.doi.org/10.1787/health_glance-2017-en. 2017.
14. Everson SA, Goldberg DE, Kaplan GA, Cohen RD, Pukkala E, Tuomilehto J, et al. Hopelessness and risk of mortality and incidence of myocardial infarction and cancer. Psychosomatic Medicine. 1996; 58(2):113–21. PMID: 8849626
15. Scott-Sheldon LA, Carey MP, Varnable PA, Senn TE. Subjective life expectancy and health behaviors among STD clinic patients. American journal of health behavior. 2010; 34(3):349–61. PMID: 20001192
16. Woo H, Zajacova A. Predictive strength of self-rated health for mortality risk among older adults in the United States: does it differ by race and ethnicity? Research on aging. 2017; 39(7):879–905. https://doi.org/10.1177/0164027516637410 PMID: 26993957
17. Fv Nooten, Brouwer W. The influence of subjective expectations about length and quality of life on time trade-off answers. Health economics. 2004; 13(8):819–23. https://doi.org/10.1002/hec.873 PMID: 15322993
18. Mirowsky J. Age, subjective life expectancy, and the sense of control: The horizon hypothesis. The Journals of Gerontology Series B: Psychological Sciences and Social Sciences. 1997; 52(3):S125–S34.
19. Nazzal C, Frenz P, Alonso FT, Lanas F. Effective universal health coverage and improved 1-year survival after acute myocardial infarction: the Chilean experience. Health policy and planning. 2015; 31(6):700–5. https://doi.org/10.1093/heapol/czv120 PMID: 26674649
20. Jeon B, Noguchi H, Kwon S, Ito T, Tamiya N. Disability, poverty, and role of the basic livelihood security system on health services utilization among the elderly in South Korea. Social Science & Medicine. 2017; 178:175–83.
21. Jylhä M. What is self-rated health and why does it predict mortality? Towards a unified conceptual model. Social science & medicine. 2009; 69(3):307–16.