National health insurance and life satisfaction in late life: longitudinal findings from a natural experiment in Taiwan

Chi Chiao1, Kate Ksobiech2, Chia-Yi Wei3

1Institute of Health and Welfare Policy and Research Center for Health and Welfare Policy, College of Medicine, National Yang-Ming University, No. 155, Sec. 2, Li-Nong St., 112, Taipei, Taiwan, ROC
2Communication Department, College of Arts and Communication, University of Wisconsin-Whitewater, Whitewater, WI, USA
3Institute of Health and Welfare Policy, College of Medicine, National Yang-Ming University, Taipei, Taiwan, ROC
Address for correspondence: Chi Chiao, E-mail: cchiao@ym.edu.tw

ABSTRACT

Background To determine whether the availability of National Health Insurance (NHI) is associated with a longitudinal increase in life satisfaction among older Taiwanese adults.

Methods This study used data from the Taiwan Longitudinal Study on Aging, a nationally representative sample (n = 3778) of older adults aged 60 and above. Participants were interviewed prior to the establishment of NHI and on multiple occasions thereafter over the next 18 years. Growth curve models were employed to estimate the NHI effects on life satisfaction across various pre-NHI insurance groups over time while taking concurrent medical care utilization and health status into consideration.

Results While somewhat complex and explained in detail herein, multivariate analyses found a significant increase in life satisfaction among older Taiwanese adults over the 12-year period since the establishment of NHI. Further, while the pre-NHI uninsured had a significantly lower level of life satisfaction than the pre-NHI insured government employees ($b = -1.78, P < 0.05$), even after controlling for concurrent medical care utilization and health status, the difference in life satisfaction was significantly reduced by NHI over time.

Conclusions NHI reduces the barriers to medical care utilization and improves life satisfaction among older Taiwanese adults, particularly for individuals who were uninsured prior to NHI.

Keywords life satisfaction, longitudinal analysis, national health insurance program, older adults

Introduction

Among public health experts, implementation of National Health Insurance (NHI) has long been seen as a top priority to reduce health disparities, provide universal health coverage and lower economic barriers to healthcare access.1 Taiwan’s NHI has attracted worldwide attention due to its success in both stabilizing medical expenses2,3 and narrowing health gaps across various socioeconomic groups.4–6 However, better medical coverage, greater access to health care and increased lifespan do not necessarily improve life satisfaction. Maintaining and/or improving the quality of life is critical as NHI seeks to meet a range of broad political and social goals. Determining how much, or how little, NHI contributes to perceptions of well-being or life satisfaction is therefore of particular concern. Furthermore, examining whether NHI narrows the gap in perceived well-being between insured and uninsured groups is of major interest to both public health officials and scholars.

Life satisfaction is one of most common measures of subjective well-being.7–9 Its stability and validity have been well documented.10–14 The higher the life satisfaction of a population, the better the quality of life for that population.12 To aid in social development and promote happiness among its people, governments need to examine their level of life satisfaction. Such is the case with people over the age of 65 in
Taiwan and the government's introduction of NHI. As the proportion of citizens over 65 has steadily increased in recent decades, government officials, in Taiwan and elsewhere, need to know how satisfied this particular group of people is with life in general and with NHI in particular. Understanding life satisfaction within the aging population is an essential element in determining whether government policies such as NHI are effective.

Taiwan has had its NHI program since 1995. Before NHI, about half of Taiwan's population was uninsured with children and adults over 65 accounting for the majority of the uninsured group. Using data from the Taiwan Longitudinal Study on Aging (TLSA) gave the researchers the opportunity to examine whether NHI was associated with improved life satisfaction and helped to close the gaps over time across various pre-NHI insurance groups among older adults via a natural experiment. TLSA began collecting data in 1989 prior to the initiation of NHI; data collection continued until 2007, covering a 12-year period during which NHI was available. The present study thus aimed to address whether NHI played a contributing role in changes regarding life satisfaction among older Taiwanese adults within and between various pre-NHI insurance groups. The goal of this study was to specifically examine the overall trend of life satisfaction as well as estimate the life satisfaction trajectories, both before and after implementation of NHI. We also evaluated whether NHI narrowed the gaps in life satisfaction between various insurance groups over time after taking medical utilizations and health status into consideration.

**Methods**

**Data and sample**

Data for this analysis were from the TLSA, a nationally representative survey designed to study the impact of socioeconomic development on the physical and emotional health of older Taiwanese adults. Data were collected by the Bureau of Health Promotion of the Taiwan Public Health Department from 1989 to 2007. The baseline sample was derived using a three-stage sampling procedure. A total of 4049 older adults was first interviewed in person in 1989, with four follow-up interviews conducted between 1996 and 2007 for surviving participants. Information on TLSA can be found at www.bhp.doh.gov.tw. Additional details on the TLSA sampling procedure and design are reported elsewhere. For this study, the analytic sample was restricted to the 3778 older adults with complete data on insurance status and life satisfaction at the baseline in 1989. The sample flow is shown in Fig. 1. The study protocol was approved by the Ethical Committee of National Yang-Ming University.

**Measures**

The life satisfaction index (LSI) is a 10-item adaptation of the original 20-item LSI. The LSI has been shown to be valid and reliable when used with older Taiwanese populations. Each of 10 items, available in the Appendix, was dichotomously answered yes or no by the respondents. Items were reverse scored when necessary and summed so that higher LSI scores corresponded with greater life satisfaction (range: 0–10; Cronbach’s alpha = 0.73–0.81).

Pre-NHI insurance status was assessed by pre-NHI surveys in 1989 and/or 1993. Taiwan had three separate, occupation-based insurance programs before 1995: government employee insurance, farmers insurance and labor insurance. Information on health insurance was not collected until 1993, but prior research established the stability of an older adult’s insurance status between 1989 and 1993, thereby allowing us to use 1989 occupations to assign pre-NHI insurance status for those without 1993 reports. Four categories of pre-NHI insurance status were identified: pre-NHI insured (government employee insurance, farmers’ insurance and labor insurance) and pre-NHI uninsured.

Year of measurement was critical to this inquiry. This study explored longitudinal trends in life satisfaction by using five population-based surveys conducted over an 18-year timeframe (1989–2007). Data from pre-NHI (baseline), 1996, 1999, 2003 and 2007 were utilized and a categorical variable was created to distinguish data collected from each of these five surveys.

**Covariates**

Analyses were adjusted for time-varying covariates of concurrent medical utilizations and several indicators of health status. Medical utilizations included whether respondents used outpatient care, pharmacy services and/or emergency room services in the past year as measured by a dichotomous response for each. Health status was measured by the item which asked individuals to rate their health as ‘poor’, ‘fair’, ‘good’, ‘very good’ or ‘excellent’ on a scale from 1 to 5. The instrumental activities of daily living scale (IADL) was used to assess the presence of a physical disability, based upon responses to five items: difficulty with shopping, managing money, using transportation, doing heavy housework or using telephone. The IADL score ranged from 0 to 5, and was based on approaches used in prior studies. Evidence of a cardiovascular-related disease (CVD-related disease), if one has ever smoked cigarettes (yes/no) and if a respondent ever participated in social activities (yes/no) were also assessed. For CVD-related disease, respondents were coded as having a history of cardiovascular disease (CVD) if they reported: (i) a doctor telling them they had suffered a heart attack, had coronary heart disease, or had other heart problems; (ii) having had a stroke or (iii) having diabetes. Any one
or more of these conditions generated a dichotomous code of 1; absence of CVD was coded as 0.29

**Statistical analyses**

All analyses were conducted using Stata 11.30 Two-level growth curve models were employed in which the models were specified with age at Level 1 and nested within individuals at Level 2 to assess the effects of pre-NHI insurance status on trajectories of life satisfaction.31 In the growth curve, the intercept and the slope represent the pre-NHI level and change rate of life satisfaction for an individual. The interaction of the slope with pre-NHI insurance status at Level 2 describes group differences with respect to pre-NHI insurance status regarding changes in life satisfaction. To assess our research questions, a sequential modeling strategy was used for the multivariate portion of the analyses, progressively adjusting the growth curve models.

The first null model was created to explore whether life satisfaction varies across individuals over time. The gross variance in life satisfaction associated with individuals was estimated with a null model containing only random persons and random variation within these persons over time (i.e. an intercept and a slope term).31 As suggested by prior research23,32 life satisfaction decreased with age as health-related experiences increased with age; therefore, we included a linear term in all growth curve models. Model 1 also included pre-NHI insurance status, its interaction with slope, time period (year of measurement) and time-varying utilizations of medical care to examine life satisfaction changes across various pre-NHI insurance groups from pre-NHI to post-NHI assessments. In analyses not shown
here, we tested for interactions between four categories of pre-NHI insurance status and slope to see if age effects varied by various pre-NHI insurance groups. A significant effect was only found in the pre-NHI uninsured group; thus, due to parsimoniousness, we only included this interaction in the models. Of particular interest is assessing whether changes in life satisfaction differ across various groups of pre-NHI insurance status, controlling for a set of time-related variables in medical care utilization. The final Model 2 adds another set of time-related variables regarding personal health status to determine how much, if any, of the effect of pre-NHI insurance status in life satisfaction is accounted for by these health-related variables.

Attrition is of special importance to longitudinal research because it is expected that older adults most at risk for poor life satisfaction were possibly those in the pre-NHI uninsured, making them lost as participants in the follow-up interviews. We thus assessed the differences in individual background, pre-NHI insurance status and life satisfaction between continuing participants and those who are not re-interviewed across waves (results not tabled). The analyses indicated that death was the major cause of the decline in sample size. The proportions of older adults who were older, male and in poorer health declined. There were also some differences between lost-to-follow participants and re-interviewed participants. The lost-to-follow participants were more likely than the re-interviewed to be separated, divorced or never married and, and during pre-NHI years, uninsured. Furthermore, compared with Taiwanese older adults overall, the study sample, by self-report, was younger, more educated, wealthier and more likely to live with family. The proportions of older adults with lower life satisfaction in the analytical samples decreased across the five waves (results not tabled).

Results

Table 1 shows individual characteristics of the analytic sample. As shown in the first column, the pre-NHI uninsured was one-fourth of the total sample, with 38% farmer insurance, 27% government employee insurance and 9% labor insurance comprising the rest. More than one-third utilized outpatient care and pharmacy services in the past year, and ~6% used emergency care. Over half of the sample (57%) was male, and >40% were illiterate. Sixty-three percent of the sample lived with family. The average level of life satisfaction was 6.21 with a standard deviation of 2.47 (range: 0–10).

Table 1 also shows these characteristics stratified by pre-NHI insurance status. The pre-NHI insured were more likely to utilize outpatient and emergency care; in contrast, the pre-NHI uninsured were the second largest group utilizing pharmacy services. While the average self-reported health status across groups was similar to the total sample, other indicators in health status were relatively poorer among the pre-NHI uninsured than the insured. For example, the pre-NHI uninsured group had the largest proportion of CVD-related disease (32%) and the lowest lifetime participation in social activities (26%). Socioeconomic backgrounds also differed among the pre-NHI insurance groups. About three-fourths of those with government employee insurance were male, compared with 40% of the pre-NHI uninsured. Less than 18% of those covered by government employee insurance were illiterate, compared with over half of the pre-NHI uninsured (56%). The pre-NHI insured group reported higher levels of life satisfaction (6.21) than the pre-NHI uninsured group (5.65).

Table 2 presents the growth curve models that sequentially elaborate the longitudinal NHI effects on life satisfaction among older adults. The null model showed significant variation in life satisfaction among older people over time and the overall shape of the satisfaction trajectories indicated life satisfaction gradually decreased with age ($\beta = -0.02; P < 0.001$). Model 1 included the following major explanatory variables: pre-NHI insurance status, time period, time-varying concurrent medical care utilizations and interactions of random slopes with the pre-NHI uninsured status. Life satisfaction still decreased with age. Independent of aging and covariates, older adults with a lower level of life satisfaction were more likely to be in the pre-NHI uninsured group at a given age than the pre-NHI insured with government employee insurance group ($\beta = -2.59; P < 0.001$). In contrast, an increase in life satisfaction over time was found among the previously uninsured greater than government employee insurance group at a rate of 0.02 per year ($\beta = 0.02; P < 0.05$). In addition, another major interest here was the life satisfaction trend before and after the establishment of NHI. These analyses showed significant overall increases in life satisfaction in 1996 ($\beta = 0.15; P < 0.05$), 2003 ($\beta = 0.19; P < 0.01$) and 2007 ($\beta = 0.51; P < 0.001$), after the establishment of NHI, even after adjusting for concurrent time-varying medical care utilizations.

Model 2 adds other time-varying indicators of concurrent health status (i.e. self-rated health, IADL, CVD-related disease, smoking cigarettes and participating in social activities). Compared with Model 1, the coefficient for the previously uninsured was still significant ($\beta = -1.78; P < 0.01$), but its magnitude was reduced by about 31%, indicating some effects of pre-NHI insurance status are redundant with personal health-related characteristics. This analysis also produced an appreciable change in significance for the year of measurement effect. After controlling for concurrent health.
variables, a moderate decrease in life satisfaction was found in 1999 at the significant level of 0.10 ($\beta = -0.15; \ P < 0.10$), and then an increase was observed in 2007 ($\beta = 0.27; \ P < 0.05$). Coefficients of concurrent medical care utilization largely decreased in magnitude; in contrast, significant associations with concurrent health status were also observed. Low levels of life satisfaction were associated with poor self-reported health, poor IADL and smoking cigarettes; participation in social activities was associated with a higher level of life satisfaction. Interestingly, the significant slope in the trajectories on life satisfaction was found to be positive ($\beta = 0.01; \ P < 0.05$); levels of life satisfaction increased gradually after controlling for concurrent health status.

**Discussion**

**Main finding of this study**

Our results appeared to suggest important NHI effects on life satisfaction among older Taiwanese adults in this natural experiment. When compared with pre-NHI baseline data, the analyses showed an overall decline in life satisfaction in 1999, no significant increase in 2003, but a significant jump in 2007, after controlling for aging, pre-NHI insurance status, concurrent medical care utilizations and individual concurrent health status.

The 1999 decrease in life satisfaction may be associated with either (i) the relative ‘youth’ of NHI in Taiwan or (ii) the
Chi-Chi earthquake which produced significant psychological distress throughout Taiwan. The 2003 non-significant increase in life satisfaction may have been mitigated by the decrease in medical care use resulting from the SARS epidemic. The significant, increased level of life satisfaction in 2007 may indicate a long-term beneficial NHI effect in terms of improved life satisfaction among older adults. While not conclusive, this study’s results offer modest support for the Taiwanese government’s policy of universal health insurance. Such government-sponsored coverage has the distinct advantage of being able to devote resources to promote population health and other long-term goals, without pressure to respond to short-term financial circumstances, unexpected natural disasters or infectious epidemics.

Further, growth curve models demonstrated the pre-NHI uninsured group had the lowest level of life satisfaction at baseline with the health disparity gap decreasing over time. There was a significant increase in life satisfaction among the pre-NHI uninsured versus the pre-NHI government employee insurance group, independent of aging and other covariates. In other words, the pre-NHI disparity gap significantly narrowed following the introduction of national health insurance. This trajectory provides empirical evidence for one of the top public health objectives in Taiwan: reducing the well-being disparity between pre-NHI insured and uninsured through implementation of an NHI program.

The present analysis employed two-level growth curve models with random-coefficient estimation. These random-coefficient models explored the relationships between life satisfaction and pre-NHI status by specifying a person-specific random intercept and a person-specific random slope for pre-NHI status. The inclusion of time-varying covariates

| Table 2 | Growth curve models of life satisfaction on pre-NHI insurance status, medical care utilization and health status at two levels, 1989–2007 TLSA |
|------------------|------------------|------------------|------------------|
|                  | Null Model       | Model 1          | Model 2          |
|                  | β       | SE       | β       | SE       | β       | SE       |
| Intercept, satisfaction level | 7.26*** | 0.25     | 8.47*** | 0.41     | 7.28*** | 0.39     |
| Slope, mean change rate      | −0.02*** | 0.003    | −0.02*** | 0.01     | 0.01*   | 0.01     |
| Major explanatory variables |         |           |         |           |         |           |
| Pre-NHI insurance status (ref = government employee insurance) |         |           |         |           |         |           |
| Farmer insurance           | −0.40**  | 0.12     | −0.24*  | 0.10     |         |           |
| Labor insurance            | −0.32**  | 0.08     | −0.09   | 0.07     |         |           |
| No pre-NHI insurance       | −2.59*** | 0.59     | −1.78** | 0.56     |         |           |
| No pre-NHI insurance × slope | 0.02**  | 0.01     | 0.02*   | 0.01     |         |           |
| Year of measurement (ref = before NHI period) |         |           |         |           |         |           |
| 1996                      | 0.15*    | 0.07     | 0.08    | 0.06     |         |           |
| 1999                      | −0.04    | 0.08     | −0.15   | 0.08     |         |           |
| 2003                      | 0.19     | 0.10     | 0.12    | 0.09     |         |           |
| 2007                      | 0.51***  | 0.12     | 0.27*   | 0.11     |         |           |
| Time-varying covariates    |         |           |         |           |         |           |
| Medical care utilization   |         |           |         |           |         |           |
| Outpatient care            | −0.30*** | 0.05     | −0.08   | 0.05     |         |           |
| Pharmacy                   | −0.31*** | 0.05     | −0.20** | 0.05     |         |           |
| Emergency                  | −0.52*** | 0.07     | −0.11   | 0.07     |         |           |
| Health-related variables   |         |           |         |           |         |           |
| Self-rated health          | −0.57*** | 0.02     |         |           |         |           |
| IADL                       | −0.28*** | 0.02     |         |           |         |           |
| CVD-related disease        | −0.08    | 0.05     |         |           |         |           |
| Cigarette smoking (ref = no) | −0.21*** | 0.06     |         |           |         |           |
| Participating in a social activity (ref = no) | 0.33*** | 0.05     |         |           |         |           |

IADL, instrumental activities of daily living.

*P < 0.05

**P < 0.01

***P < 0.001
(e.g. utilization and health-related factors) further allowed the effect of these covariates to vary between persons. Instead of defining random-coefficient models in a hierarchical way, we separately ran implied marginal models and obtained similar major findings. However, this marginal modeling approach relaxes the usual restriction that the covariance matrix of the random effects is positive semi-definite and that the residual variance at a time-point level is non-negative as long as the marginal covariance matrix is positive semi-definite. Although this relaxation makes the random-coefficient structure even more flexible, random intercepts and slopes of our research focus became uninterpretable.

**What is already known on this topic**

The results of this study supported the current public health and social science literature which suggests personal health factors are associated with life satisfaction. As expected, older adults who reported lower levels of life satisfaction were more likely to self-report poor health, the presence of functional disability and use of cigarettes. In contrast, social participation was associated with higher levels of life satisfaction. Furthermore, our findings demonstrate that medical care utilization was negatively correlated with life satisfaction. These results provide support for an argument raised in the Andersen Model in that increased medical care utilization may neither improve satisfaction nor be a major policy goal when there was no economic barrier to access medical care.

**Limitations of this study**

This study contributed to our understanding of NHI effects on older adults' life satisfaction as well as to the longitudinal relationship between pre-NHI insurance status and trajectory of life satisfaction. It did, however, have its limitations. First, we excluded non-responders because the outcome and explanatory variables are entirely based on self-reports. This exclusion may have yielded an analytical sample that is somewhat healthier, and perhaps introduces a health effect, even though we controlled for concurrent health status in multivariate models. Secondly, somewhat associated with the previous limitation, it is important to underline that the drop-out process in the cohort sample is likely to be dependent on both the quantity and the quality of life as people age. The prior literature suggests the introduction of NHI improved life expectancy particularly among lower health class groups but little empirical attention has been paid to the NHI impact on quality of life. Even though the present study focuses on life satisfaction research, exploring interlinked relationships between the quality of life and survival is a promising future research direction. Thirdly, the TLSA data are based on self-reported recall of medical care utilization, raising the possibility of recall bias. Fourthly, while previous studies have suggested the importance of major life events (e.g. loss of partner) and factors external to the health system (e.g. economical differences and trends) on life satisfaction, such data were not available in TLSA. Therefore, it is recommended future research investigate the role of major life events and factors external to the health system in later life and their impact, if any, on the relationship between insurance status.
and life satisfaction. Fifthly, education appears to be associated with both having one of the three types of insurance and the life satisfaction of older people. Almost 90% of the pre-NHI uninsured had complete primary education or lower, compared with pre-NHI insured groups with government employee insurance (49%) and labor insurance (72%). Education was positively associated with life satisfaction. However, the inclusion of education in multivariate analyses did not produce an appreciable change in the relationship that was the primary focus of this investigation.

Acknowledgements

The authors thank the Bureau of Health Promotion at the Department of Health in Taiwan for permission to analyze the data from the TLSA.

Funding

Support from the National Science Council in Taiwan under grants 100-2314-B-010-031 and 101-2410-H-010-005-MY2 is gratefully acknowledged. The conclusions herein are those of the authors and do not represent the viewpoint of the Bureau.

References


**Appendix: The 10 LSI items used across the waves in TSLA**

I would like to ask for your current views or feelings about your life. Please tell me whether you agree with the sentences I am about to read (Yes/No).

(i) Has your life been better than most people’s lives?
(ii) Are you satisfied with your life?
(iii) Do you find what you do interesting?
(iv) Have these few years been the best in your life?
(v) If it was possible (to do again or to do over), would you want to start over or live this life again?
(vi) Do you expect that in the future happy things will occur?
(vii) Should you live better than you do now?
(viii) Do you feel that most of what you do is monotonous and of no interest?
(ix) Do you feel old and tired?
(x) Would you say your life has matched your hopes?