# The association of household income, healthcare utilization, and survival of catastrophic illnesses patients: using ESRD and cancer as examples

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**Objectives:** To investigate the association of household income and healthcare utilization as well as survival status of patients with catastrophic illnesses under the NHI system in Taiwan. **Methods:** Data from the "Survey of Family Income and Expenditure" (2003 to 2006) and the "Registry of patients with catastrophic illness" were first linked to identify subjects. Patients with cancer or end stage renal disease (ESRD) holding only one NHI catastrophic illness card were included in this study. Information related to healthcare utilization was obtained from NHI claims data (2002 to 2007) and survival data was obtained from the "National Registry of Deaths" (2003 to 2009). Negative binominal regression, multiple regression, and the Cox proportional hazard model were used to analyze the relationships among healthcare utilization, survival, and socioeconomic variables. **Results:** Regarding the healthcare utilization, the average length of stay (ALOS) of ESRD patients in the highest income bracket was 8.987 days longer than that of patients in the lowest bracket ($p<0.05$). Hemodialysis usage, the number of outpatient visits and hospitalizations presented no correlation with household income. Among cancer patients in the highest income bracket, the IRRs of outpatient visits and hospitalization were 1.18 ($p<0.05$) and 2.11 ($p<0.001$), respectively. The ALOS of those in the highest income bracket was 11.36 days longer than that of patients in the lowest income bracket ($p<0.001$). With respect to survival status, male ESRD patients had a higher mortality than females (HR=1.82, $p<0.05$). Among cancer patients, being males (HR=1.66, $p<0.05$) and in the highest income bracket had higher mortality (HR=1.6, $p<0.05$), those with the highest education level had lower mortality (HR=0.52, $p<0.05$). **Conclusions:** The relationship between household income and healthcare utilization varied according to type of diseases. Income level was positively associated with healthcare utilization among cancer patients while patients in the highest income bracket had higher mortality. But the association was not significant among ESRD patients. Future researchers can conduct further analyses on other catastrophic illnesses. (*Taiwan J Public Health. 2013;**32**(**4**):331-345*)

***Key Words:** National Health Insurance, catastrophic illness, household income, healthcare utilization, survival*

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## INTRODUCTIONS

Providing all citizens with equal access to medical services is the goal of health officials in most nations [1,2]. A common and important principle is that medical care should be provided according to need rather than

the ability to pay [3-5]. The National Health Insurance (NHI) program was implemented in Taiwan in 1995 and has the following goals: to provide the population of Taiwan with equal and affordable health care services; to prevent disadvantages associated with poverty from leading to illness and to prevent illness from leading to poverty; to reduce inequity in healthcare utilization; and to enhance the overall health status of the populace.

As in many other countries, Taiwan's NHI has introduced a copayment system to reduce the abuse of resources. However, healthcare utilization is negatively influenced by copayment rates. The relationship between copayment rates and healthcare utilization is most pronounced among those in lower income brackets [6-8]. To avoid this dilemma, the NHI implemented a policy related to catastrophic illness in 1995 which dictates that patients holding a catastrophic illness card are exempt from copayments for related medical care. The purpose of this policy is to ensure eliminating heavy burden of medical costs to patients with catastrophic illnesses.

Only a few studies have conducted long-term analysis of the resources used by catastrophic illness patients under the NHI in Taiwan. Most of these studies have simply assessed the catastrophic illness policy or focused on the healthcare utilization for specific catastrophic illnesses [9-12].

Most of the medical resources for catastrophic illnesses in Taiwan are used to treat cancer patients and individuals with end stage renal disease (ESRD) who require regular dialysis treatment. These two groups of patients account for 36.81% (cancer patients) and 28.7% (ESRD patients) of total expenditures for catastrophic illnesses [13]. The purpose of this research was to determine whether the implementation of the NHI catastrophic illness policy has eliminated the correlation between household income, healthcare utilization, and survival of ESRD and cancer patients.

With regard to healthcare utilization, several foreign studies observed that higher socioeconomic status for ESRD patients had more frequent and higher quality dialysis treatments [14]. Most studies have shown that healthcare utilization of cancer patients are significantly correlated with socioeconomic status [15,16]. Regarding the mortality, studies have examined the associations of socioeconomic factors, such as personal income or household income, and survival status in cancer patients, but the results are inconclusive [17,18]. Most frequently examined factors associated with mortality in ESRD patients are race and ethnicity while the relationship with socioeconomic status was seldom discussed [19]. In Taiwan, research regarding the association of household income, healthcare utilization, and survival of catastrophic illnesses patients is limited.

In this study, we combined the socioeconomic and demographic variables of patients suffering from catastrophic illnesses with healthcare utilization data and death registry. We then evaluated the healthcare utilization and survival of these patients under the NHI system.

## MATERIALS AND METHODS

### Data

The data sources in this study included the "Survey of Family Income and Expenditure" in Taiwan (2003 to 2006) [20-23], "Registry for Catastrophic Illness Patients" (2003 to 2006) from the NHI database, and the "National Registry of Deaths" (2003 to 2009). National survey information from each year was combined with NHI data related to catastrophic illness for the same year. Patients with two or more catastrophic illness cards were excluded

from this study. For ESRD patients, only those who were receiving hemodialysis during study period were included. Those who ever received kidney transplantation or peritoneal dialysis were excluded. To obtain data related to healthcare utilization and comorbidities, we combined the "Expenditures for Ambulatory Care by Visit", the "Details of Ambulatory Orders", the "Inpatient Expenditures by Admissions", and the "Details of Inpatient Orders" for the period of 2002 to 2007. We obtained individual inpatient and outpatient healthcare utilization data by following each subject from the first usage record of a catastrophic illness card in a given year through a follow-up period of one year. Survival status was determined by linking to the "National Register of Deaths" (2003 to 2009) and was determined by following each subject for four years.

This study applied Charlson's Comorbidity Index (CCI) to adjust for the comorbidities of subjects and to investigate the relationship between the severity of comorbidities, healthcare utilization, and survival status among patients with catastrophic illnesses. A study by Chu suggested that the Dartmouth-Manitoba's CCI has better predictive performance for a smaller sample size and weighted model [24]. Thus, this study employed the Dartmouth-Manitoba's CCI to calculate CCI scores using inpatient and outpatient data from the previous year. The subjects were divided into three groups according to CCI scores (0-2, 3-5, and 6 or more) to calibrate the disease severity of each patient.

The independent variables include gender, age, urbanization, educational level, marital status, family size, and household income. Age was based on the year the patients were interviewed and divided into three groups: 0-44, 45-64, and >65. Educational level was based on the most recent record of formal schooling and divided into three groups: illiterate or less than primary school, junior/senior high school, and higher than college level. Marital status was divided into four groups: unmarried, married/with partner, divorced, and separated/widowed. Urbanization was based on the definition given by the "Survey of Family Income and Expenditure", which provides two categories: urban and non-urban [20-23]. Household income was divided into five levels from lowest to highest. All demographic information was collected from the "Survey of Family Income and Expenditure" (2003 to 2006).

Dependent variables included the number of hemodialysis (per ESRD patient per year), the number of outpatient visits (per patient per year), the number of hospitalizations (per patient per year), the length of stay (per patient per year), and the survival status of all subjects.

### Statistical analysis

This study used the SAS 9.1 software package for data analysis. ANOVA was used to analyze the relationship between healthcare utilization and socioeconomic variables among ESRD and cancer patients. However, the variance in healthcare utilization was greater than the means, which suggests that the data was over dispersed, making it unsuitable for Poisson regression. Outpatient visits and hospitalizations during the period of observation were analyzed using negative binomial regression in order to calculate the incidence rate ratio (IRR) of each demographic variable with hemodialysis treatments, outpatient visits, and hospitalizations. Multiple regression was used to explore the correlation between each demographic variable and length of hospital stay. Finally, the Cox proportional hazard model was employed to assess the relationship between household income and the survival of patients after adjusting for age, sex,

urbanization, educational level, marital status, and family size. Regression analyses were performed separately on the groups of ESRD patients and cancer patients.

## RESULTS

Table 1 summarizes the demographic characteristics of the study population. There were 397 ESRD patients who received only hemodialysis and 2,175 cancer patients identified for this study. Among them, 52.6% of ESRD patients were female and 53.0% of cancer patients were female. The mean ages of ESRD and cancer patients were 59.8, and 60.6 years, respectively. The age group of >45 years accounted for 88.2% of the ESRD patients and 86.6% of the cancer patients. Approximately 80% of research subjects were living in urban areas. The educational level of illiterate or less than primary school accounted for 63.2% of the ESRD patients and 54.4% of the cancer patients. Additionally, most ESRD patients (71.8%) and cancer patients (76.9%) were married/with partner. Household disposable income was divided into five levels and the proportion of subjects in each level was similar, at approximately 20%.

Table 2 presents the data related to healthcare utilization. The average number of hemodialysis treatments was 141.1 per person per year. The mean number of outpatient visits was 39.5 per person per year for ESRD patients and 16.0 for cancer patients. The average number of hospitalizations was 1.5 per person per year for ESRD patients and 1.2 for cancer patients. Finally, the average length of stay (ALOS) was 7.7 days per person per year for ESRD patients and 10.0 days for cancer patients.

Table 3 shows the results from the negative binomial regression of outpatient visits, hemodialysis treatments, and hospitalizations for ESRD patients. No statistically significant difference was observed between any socioeconomic factors and number of outpatient visits. Moreover, after adjusting for other variables, no significant difference was observed among the levels of household income with regard to hemodialysis and hospitalizations Our results also reveal that among patients who were married or live with a partner used more hemodialysis than unmarried patients, the incidence rate ratio (IRR) was 0.93 ($p<0.001$). ESRD patients aged >45 years old used more hemodialysis treatments than younger patients (IRR=1.09, $p<0.05$). Additionally, after adjusting for other variables, ESRD patients lived in urban areas had more hospitalizations than those lived in non-urban areas (IRR=0.4, $p<0.001$). CCI scores was also positively correlated with hospitalization among ESRD patients ($p<0.001$). The estimate of power for this model was 0.988.

Table 4 reports the results of negative binomial regression of outpatient visits and hospitalizations for cancer patients. Higher CCI scores was associate with more outpatient visits and hospitalizations ($p<0.001$). Male patients had more outpatient visits than female patients (IRR=1.09, $p=0.016$) and patients in families of greater than 5 had fewer outpatient visits (IRR=0.80, $p=0.021$). Patients in the middle 20%~3rd quintile household income bracket used significantly more outpatient visits than patients in the lowest bracket (IRR=1.17, $p=0.018$), and patients in the highest household income bracket used more outpatient visits than those in the lowest (IRR=1.18, $p=0.020$). The number of hospitalizations is inversely correlated with educational level ($p<0.001$). Furthermore, the 2nd to the 5th quintile household income brackets were positively correlated with hospital admission rates. In particular, the IRR of hospitalizations for the highest income level among cancer patients was 2.11 ($p<0.001$).

Table 1 Description of demographic characteristics of the study population

| Variables | | ESRD patients (n=397) No. (%) | Cancer patients (n=2,175) No. (%) |
|---|---|---|---|
| Sex | | | |
| | Female | 209 (52.6) | 1,153 (53.0) |
| | Male | 188 (47.4) | 1,022 (47.0) |
| Age | mean±SD | 59.8±12.8 | 60.6±14.6 |
| | 0-44 | 47 (11.8) | 292 (13.4) |
| | 45-64 | 186 (46.9) | 936 (43.0) |
| | 65 and over | 164 (41.3) | 947 (43.6) |
| Urbanization | | | |
| | Non-urban | 79 (19.9) | 438 (20.1) |
| | Metropolis | 318 (80.1) | 1,737 (79.9) |
| Educational level | | | |
| | Illiterate or less than primary school | 251 (63.2) | 1,183 (54.4) |
| | Junior high school or senior high school | 116 (29.2) | 708 (32.6) |
| | Higher than college | 30 (7.6) | 284 (13.0) |
| Family size | | | |
| | 1 | 23 (5.8) | 121 (5.5) |
| | 2 | 90 (22.7) | 598 (27.5) |
| | 3~4 | 149 (37.5) | 878 (40.4) |
| | more than 5 | 135 (34.0) | 578 (26.6) |
| Marital status | | | |
| | Unmarried | 34 (8.6) | 113 (5.2) |
| | Married or partners | 285 (71.8) | 1,673 (76.9) |
| | Divorced or disparate | 14 (3.5) | 64 (2.9) |
| | Widowed | 64 (16.1) | 325 (15.0) |
| Household income | | | |
| | Lowest 20% | 86 (21.6) | 416 (19.1) |
| | Lower 20%~2nd quintile | 67 (16.9) | 410 (18.9) |
| | Middle 20%~3rd quintile | 96 (24.2) | 400 (18.4) |
| | Higher 20%~4th quintile | 71 (17.9) | 446 (20.5) |
| | Highest 20%~5th quintile | 77 (19.4) | 503 (23.1) |
| Place of residency | | | |
| | Taipei | 93 (23.5) | 647 (29.7) |
| | Northern | 49 (12.3) | 271 (12.5) |
| | Central | 49 (12.3) | 336 (15.4) |
| | Southern | 83 (20.9) | 367 (16.9) |
| | Kaoping | 109 (27.5) | 465 (21.4) |
| | Eastern | 14 (3.5) | 89 (4.1) |
| Year | | | |
| | 2003 | 98 (24.7) | 459 (21.1) |
| | 2004 | 88 (22.2) | 509 (23.4) |
| | 2005 | 101 (25.4) | 548 (25.2) |
| | 2006 | 110 (27.7) | 659 (30.3) |

Table 2 Health care utilizations of the study population

| Variables | ESRD patients (n=397) | | | Cancer patients (n=2,175) | | |
|---|---|---|---|---|---|---|
| | Mean | SD | Min/Max | Mean | SD | Min/Max |
| Hemodialysis treatments per person per year | 141.1 | 33.9 | (2,163) | | | |
| Outpatient visits per person per year | 39.5 | 50.6 | (1,158) | 18.3 | 10.5 | (1,51) |
| Hospitalizations per person per year | 1.5 | 4.2 | (1,38) | 0.9 | 1.5 | (1,29) |
| Hospital length of stay per person per year | 7.7 | 19.8 | (1,196) | 9.6 | 22.9 | (1,292) |

Table 5 shows the results of multiple regression analysis regarding the correlation between the ALOS and the socioeconomic demographic factors of ESRD and cancer patients. These results reveal that CCI scores were positively correlated with the number of inpatient days. Among ESRD patients, after adjusting for other variables, the ALOS among patients in the highest income bracket was 8.987 days longer than that of patients in the lowest level ($p<0.05$). Among cancer patients, educational level and marital status were significantly associated with the number of inpatient days. Specifically, those with higher education used fewer inpatient days and married patients used 9.275 fewer days than unmarried patients ($p<0.001$). It is interesting to note that 3rd to the 5th quintile household income was positively associated with ALOS. Patients in the 4th quintile household income bracket had 6.968 days longer than that in the lowest income bracket ($p<0.001$), and the highest income bracket had 11.360 days longer than that in the lowest income bracket ($p<0.001$).

Table 6 presents the results from the Cox proportional hazard regression analysis, which was used to analyze the survival of the study subjects. Among ESRD patients, males had higher mortality (hazard ratio [HR] =1.82, 95% CI: 1.177-2.825, $p<0.01$). Comorbidity was also associated with a higher risk of mortality. The HR for patients with 6 or more comorbidities was 3.27 (95%CI: 1.873-5.717, $p<0.001$). No differences in mortality rate were observed for other socioeconomic variables, in particular, household income level. Among cancer patients, males also had higher mortality (HR=1.66, 95%CI: 1.374-2.007, $p<0.001$) Cancer patients with an education higher than college level had lower mortality (HR=0.52, 95%CI=0.359-0.757, $p<0.001$). Comorbidity was also correlated to a higher mortality among cancer patients, for 3-5 comorbidities (HR=1.73, 95%CI: 1.372-2.189, $p<0.001$) and for 6 or more comorbidities (HR=6.72, 95%CI: 5.421-8.336, $p<0.001$). Unexpectedly, cancer patients in the highest income bracket had higher mortality than patients in the lowest bracket (HR=1.60, 95%CI: 1.121-2.289, $p<0.01$).

## DISCUSSIONS

In some countries, patients with catastrophic illnesses have been defined as individuals with chronic diseases requiring long-term medical care. Treatments for these illnesses are usually costly. In cases where medical expenditures exceed the maximum amount of self-payment or copayments, then retrospective subsidies or medical aid are provided [10,11]. However, in Taiwan, catastrophic illness is defined by the category of disease. The insured of NHI can obtain a catastrophic illness card after the condition has been diagnosed by a medical professional. Card holders are exempt from copayment of related

Table 3 Results of negative binominal regression of health care utilizations of the ESRD patients and cancer patients

| Variables | | Hemodialysis per person per year | | Outpatient visits per person per year | | Hospitalizations per person per year | |
|---|---|---|---|---|---|---|---|
| | | IRR | (95% CI) | IRR | (95% CI) | IRR | (95% CI) |
| Intercept | | 4.55 | (4.25, 4.87) | 13.49 | (8.08,22.52) | 0.62 | (0.12, 3.23) |
| Sex | (ref.=female) | 1.00 | | 1.00 | | 1.00 | |
| | Male | 0.99 | (0.97, 1.02) | 0.92 | (0.79, 1.09) | 1.40 | (0.88, 2.25) |
| Age | (ref.=0-44) | 1.00 | | 1.00 | | 1.00 | |
| | 45-64 | 1.09* | (1.01, 1.17) | 1.25 | (0.92, 1.69) | 0.77 | (0.33, 1.81) |
| | 65 and over | 1.09* | (1.01, 1.18) | 1.24 | (0.89, 1.71) | 1.01 | (0.42, 2.44) |
| Urbanization | (ref.=non-urban) | 1.00 | | 1.00 | | 1.00 | |
| | Metropolis | 1.01 | (0.96, 1.05) | 0.89 | (0.74, 1.08) | 0.4*** | (0.24, 0.69) |
| Education | (ref.=Illiterate or less than primary school) | 1.00 | | 1.00 | | 1.00 | |
| | Junior high school or senior high school | 1.01 | (0.98, 1.04) | 1.03 | (0.85, 1.24) | 0.71 | (0.41, 1.22) |
| | Higher than college level | 1.00 | (0.92, 1.08) | 1.19 | (0.86, 1.66) | 0.37 | (0.14, 1.03) |
| Family size | (ref.=1) | 1.00 | | 1.00 | | 1.00 | |
| | 2 | 0.99 | (0.94, 1.06) | 1.19 | (0.81, 1.74) | 1.85 | (0.61, 5.60) |
| | 3~4 | 1.03 | (0.95, 1.11) | 0.87 | (0.58, 1.29) | 2.00 | (0.65, 6.23) |
| | more than 5 | 1.03 | (0.95, 1.11) | 0.95 | (0.62, 1.45) | 1.53 | (0.48, 4.85) |
| Marital status | (ref.=Unmarried) | 1.00 | | 1.00 | | 1.00 | |
| | Married or partners | 0.93*** | (0.89, 0.97) | 0.84 | (0.60, 1.19) | 0.99 | (0.36, 2.73) |
| | Divorced or disparate | 0.96 | (0.90, 1.03) | 0.79 | (0.47, 1.34) | 1.16 | (0.26, 5.30) |
| | Widowed | 0.93* | (0.88, 0.99) | 0.79 | (0.53, 1.17) | 1.45 | (0.43, 4.86) |
| Household income | (ref.=Lowest 20%) | 1.00 | | 1.00 | | 1.00 | |
| | Lower 20%~2nd quintile | 1.00 | (0.94, 1.06) | 1.07 | (0.82, 1.39) | 0.76 | (0.35, 1.66) |
| | Middle 20%~3rd quintile | 1.01 | (0.95, 1.07) | 1.13 | (0.87, 1.47) | 0.87 | (0.40, 1.86) |
| | Higher 20%~4th quintile | 0.98 | (0.93, 1.04) | 1.00 | (0.74, 1.35) | 1.10 | (0.50, 2.42) |
| | Highest 20%~5th quintile | 1.00 | (0.95, 1.06) | 1.00 | (0.73, 1.38) | 1.22 | (0.54, 2.76) |
| Comorbidity | (ref.=0~2) | 1.00 | | 1.00 | | 1.00 | |
| | 3~5 | 1.01 | (0.98, 1.04) | 1.08 | (0.92, 1.27) | 3.01*** | (1.77, 5.12) |
| | 6 and more | 1.03 | (0.99, 1.07) | 1.00 | (0.80, 1.25) | 13.96*** | (7.13, 27.31) |
| Residency | (ref=Taipei) | 1.00 | | 1.00 | | 1.00 | |
| | Northern | 0.98 | (0.92, 1.04) | 0.94 | (0.72, 1.23) | 0.75 | (0.35, 1.59) |
| | Central | 0.99 | (0.94, 1.05) | 0.87 | (0.67, 1.13) | 0.38* | (0.18, 0.83) |
| | Southern | 1.01 | (0.97, 1.05) | 0.83 | (0.66, 1.04) | 0.48* | (0.25, 0.93) |
| | Kaoping | 1.01 | (0.98, 1.04) | 0.88 | (0.71, 1.09) | 0.87 | (0.46, 1.65) |
| | Eastern | 0.94 | (0.83, 1.06) | 0.62* | (0.40, 0.97) | 1.27 | (0.35, 4.57) |
| Year | (ref=2003) | 1.00 | | 1.00 | | 1.00 | |
| | 2004 | 1.00 | (0.95, 1.04) | 1.55*** | (1.25, 1.93) | 0.98 | (0.51, 1.87) |
| | 2005 | 1.01 | (0.97, 1.06) | 2.17*** | (1.75, 2.69) | 0.92 | (0.48, 1.77) |
| | 2006 | 0.99 | (0.95, 1.04) | 8.02*** | (6.55, 9.82) | 1.06 | (0.58, 1.94) |
| Number of observations | | | | 397 | | | |
| Full Log Likelihood | | -233.310 | | -1,675.721 | | -521.927 | |

Note: *p＜0.05; **p＜0.01; ***p＜0.001

Table 4 Results of negative binominal regression of health care utilizations of cancer patients

| Variables | | Outpatient visits per person per year | | Hospitalizations per person per year | |
|---|---|---|---|---|---|
| | | IRR | (95% CI) | IRR | (95% CI) |
| Intercept | | 14.51 | (11.34, 18.55) | 1.41 | (0.74, 2.69) |
| Sex | (ref.=female) | 1.00 | | 1.00 | |
| | Male | 1.09* | (1.02, 1.17) | 1.08 | (0.90, 1.30) |
| Age | (ref.=0-44) | 1.00 | | 1.00 | |
| | 45-64 | 1.05 | (0.93, 1.18) | 0.83 | (0.61, 1.15) |
| | 65 and over | 0.92 | (0.80, 1.05) | 0.71 | (0.50, 1.01) |
| Urbanization | (ref.=non-urban) | 1.00 | | 1.00 | |
| | Metropolis | 0.91* | (0.83, 1.00) | 1.00 | (0.79, 1.27) |
| Education | (ref.=Illiterate or less than primary school) | 1.00 | | 1.00 | |
| | Junior high school or senior high school | 0.97 | (0.89, 1.05) | 0.68*** | (0.55, 1.19) |
| | Higher than college level | 0.91 | (0.81, 1.02) | 0.48*** | (0.35, 1.54) |
| Family size | (ref.=1) | 1.00 | | 1.00 | |
| | 2 | 0.92 | (0.77, 1.10) | 0.80 | (0.51, 1.26) |
| | 3~4 | 0.83* | (0.69, 1.00) | 0.66 | (0.41, 1.05) |
| | more than 5 | 0.80* | (0.66, 0.97) | 0.67 | (0.41, 1.09) |
| Marital status | (ref.=Unmarried) | 1.00 | | 1.00 | |
| | Married or partners | 1.00 | (0.84, 1.19) | 0.52** | (0.33, 1.25) |
| | Divorced or disparate | 0.90 | (0.70, 1.16) | 0.62 | (0.32, 1.19) |
| | Widowed | 0.92 | (0.76, 1.12) | 0.41*** | (0.25, 1.47) |
| Household income | (ref.=Lowest 20%) | 1.00 | | 1.00 | |
| | Lower 20%~2nd quintile | 1.00 | (0.89, 1.13) | 1.39* | (1.02, 1.89) |
| | Middle 20%~3rd quintile | 1.17* | (1.03, 1.33) | 1.48* | (1.07, 2.04) |
| | Higher 20%~4th quintile | 1.13 | (0.99, 1.29) | 1.59** | (1.14, 2.23) |
| | Highest 20%~5th quintile | 1.18* | (1.03, 1.35) | 2.11*** | (1.50, 2.97) |
| Comorbidity | (ref.=0~2) | 1.00 | | 1.00 | |
| | 3~5 | 1.32*** | (1.22, 1.43) | 1.62*** | (1.31, 1.99) |
| | 6 and more | 1.91*** | (1.74, 2.10) | 6.98*** | (5.57, 8.73) |
| Residency | (ref=Taipei) | 1.00 | | 1.00 | |
| | Northern | 0.95 | (0.84, 1.06) | 1.06 | (0.79, 1.41) |
| | Central | 1.35*** | (1.21, 1.50) | 1.36* | (1.04, 1.79) |
| | Southern | 1.08 | (0.97, 1.20) | 1.09 | (0.82, 1.45) |
| | Kaoping | 1.05 | (0.95, 1.15) | 0.78 | (0.60, 1.01) |
| | Eastern | 0.97 | (0.81, 1.16) | 1.19 | (0.75, 1.88) |
| Year | (ref=2003) | 1.00 | | 1.00 | |
| | 2004 | 1.04 | (0.94, 1.15) | 1.08 | (0.83, 1.40) |
| | 2005 | 0.98 | (0.89, 1.08) | 0.87 | (0.67, 1.13) |
| | 2006 | 0.91 | (0.83, 1.00) | 1.03 | (0.81, 1.31) |
| Number of observations | | 2,175 | | | |
| Full Log Likelihood | | -8044.751 | | -2709.318 | |

Note: *p<0.05; **p<0.01; ***p<0.001

Table 5 Results of multiple regression of length of stay of the ESRD patients and cancer patients

| Variables | | ESRD patients | | cancer patients | |
|---|---|---|---|---|---|
| | | coefficient | (95% CI) | Coefficient | (95% CI) |
| Intercept | | 2.771 | (-10.211,15.752) | 17.315 | (10.005,24.626) |
| Sex | (ref.=female) | 1.000 | | 1.000 | |
| | Male | -0.308 | (-4.419, 3.804) | 1.772 | (-0.346, 3.889) |
| Age | (ref.=0-44) | 1.000 | | 1.000 | |
| | 45-64 | -3.488 | (-11.319, 4.342) | -3.673* | (-7.257, -0.090) |
| | 65 and over | -1.560 | (-10.025, 6.905) | -3.514 | (-7.480, 0.451) |
| Urbanization | (ref.=non-urban) | 1.000 | | 1.000 | |
| | Metropolis | 1.759 | (-3.170, 6.689) | -0.791 | (-3.535, 1.952) |
| Education | (ref.=Illiterate or less than primary school) | 1.000 | | 1.000 | |
| | Junior high school or senior high school | -2.131 | (-6.981, 2.718) | -3.223** | (-5.672, -0.774) |
| | Higher than college | -1.547 | (-9.813, 6.719) | -4.400* | (-7.903, -0.898) |
| Family size | (ref.=1) | 1.000 | | 1.000 | |
| | 2 | -7.649 | (-17.211, 1.913) | -1.733 | (-6.859, 3.939) |
| | 3~4 | -9.020 | (-19.189, 1.150) | -3.632 | (-8.939, 1.675) |
| | more than 5 | -9.276 | (-19.975, 1.423) | -4.980 | (-10.643, 0.684) |
| Marital status | (ref.=Unmarried) | 1.000 | | 1.000 | |
| | Married or partners | 3.147 | (-5.624,11.917) | -9.275*** | (-14.402, -4.149) |
| | Divorced or disparate | 4.023 | (-9.200,17.245) | -10.245** | (-17.749, -2.741) |
| | Widowed | 6.489 | (-3.773,16.752) | -11.038*** | (-16.852, -5.225) |
| Household income | (ref. =Lowest 20%) | 1.000 | | 1.000 | |
| | Lower 20%~2nd quintile | 1.673 | (-5.080, 8.427) | 3.132 | (-0.356, 6.620) |
| | Middle 20%~3rd quintile | 4.129 | (-2.841,11.098) | 3.996* | (0.254, 7.739) |
| | Higher 20%~4th quintile | 5.785 | (-1.686,13.255) | 6.968*** | (3.110,10.825) |
| | Highest 20%~5th quintile | 8.987* | (0.938,17.036) | 11.360*** | (7.351,15.369) |
| Comorbidity | (ref.=0~2) | 1.000 | | 1.000 | |
| | 3~5 | 5.476* | (1.267, 9.685) | 4.260*** | (1.897, 6.623) |
| | 6 or more | 19.496*** | (13.817,25.175) | 25.456*** | (22.547,28.365) |
| Residency | (ref=Taipei) | 1.000 | | 1.000 | |
| | Northern | -0.570 | (-7.413, 6.273) | 3.997* | (0.574, 7.420) |
| | Central | 4.401 | (-2.386,11.187) | 3.027 | (-0.230, 6.284) |
| | Southern | 3.459 | (-2.453, 9.371) | 4.013 | (0.764, 7.262) |
| | Kaoping | 2.850 | (-2.638, 8.339) | 0.396 | (-2.495, 3.287) |
| | Eastern | 3.954 | (-7.147,15.054) | 4.188 | (-1.193, 9.568) |
| Year | (ref=2003) | 1.000 | | 1.000 | |
| | 2004 | 1.474 | (-3.990, 6.938) | -2.048 | (-5.030, 0.933) |
| | 2005 | -2.526 | (-7.921, 2.869) | -4.913*** | (-7.862, -1.966) |
| | 2006 | -0.270 | (-5.494, 4.954) | -3.311* | (-6.132, -0.490) |
| Number of observations | | 397 | | 2,175 | |
| Adj. R-square | | 0.119 | | 0.152 | |

Note: *p<0.05; **p<0.01; ***p<0.001

Table 6 Results of Cox proportional hazard model of ESRD patients and cancer patients

| Variables | | ESRD patients (n=397) Hazard ratio (95% CI) | | cancer patients (n=2,175) Hazard ratio (95% CI) | |
|---|---|---|---|---|---|
| Sex | (ref.=female) | | | | |
| | Male | 1.82** | (1.177, 2.825) | 1.66*** | (1.374, 2.007) |
| Age | (ref.=0-44) | | | | |
| | 45-64 | 0.83 | (0.298, 2.303) | 0.94 | (0.632, 1.391) |
| | 65 and over | 1.55 | (0.538, 4.475) | 1.47 | (0.974, 2.206) |
| Urbanization | (ref.=non-urban) | | | | |
| | Metropolis | 1.12 | (0.650, 1.923) | 0.92 | (0.733, 1.163) |
| Education | (ref.=Illiterate or less than primary school) | | | | |
| | Junior high school or senior high school | 0.60 | (0.335, 1.061) | 0.81 | (0.645, 1.010) |
| | Higher than college | 0.38 | (0.109, 1.333) | 0.52*** | (0.359, 0.757) |
| Family size | (ref.=1) | | | | |
| | 2 | 1.12 | (0.413, 3.020) | 0.93 | (0.594, 1.443) |
| | 3~4 | 0.99 | (0.334, 2.912) | 0.84 | (0.523, 1.341) |
| | more than 5 | 1.47 | (0.462, 4.678) | 0.76 | (0.459, 1.244) |
| Marital status | (ref.=Unmarried) | | | | |
| | Married or partners | 0.59 | (0.209, 1.642) | 1.38 | (0.724, 2.619) |
| | Divorced or disparate | 0.82 | (0.177, 3.679) | 2.07 | (0.946, 4.522) |
| | Widowed | 0.98 | (0.314, 3.084) | 1.34 | (0.679, 2.646) |
| Household income | (ref. =Lowest 20%) | | | 1.00 | |
| | Lower 20%~2nd quintile | 1.17 | (0.560, 2.442) | 0.84 | (0.606, 1.152) |
| | Middle 20%~3rd quintile | 1.04 | (0.475, 2.296) | 1.23 | (0.885, 1.709) |
| | Higher 20%~4th quintile | 1.01 | (0.439, 2.305) | 1.22 | (0.862, 1.713) |
| | Highest 20%~5th quintile | 0.61 | (0.231, 1.598) | 1.60** | (1.121, 2.289) |
| Comorbidity | (ref.=0~2) | | | | |
| | 3~5 | 1.35 | (0.817, 2.245) | 1.73*** | (1.372, 2.189) |
| | 6 or more | 3.27*** | (1.873, 5.717) | 6.72*** | (5.421, 8.336) |
| Residency | (ref=Taipei) | | | | |
| | Northern | 0.91 | (0.429, 1.938) | 1.66** | (1.222, 2.266) |
| | Central | 1.12 | (0.544, 2.312) | 1.61** | (1.197, 2.168) |
| | Southern | 1.13 | (0.624, 2.040) | 1.42** | (1.050, 1.907) |
| | Kaoping | 0.87 | (0.464, 1.612) | 1.58** | (1.211, 2.073) |
| | Eastern | 0.83 | (0.230, 3.015) | 1.94** | (1.239, 3.044) |
| Year | (ref=2003) | | | | |
| | 2004 | 0.66 | (0.349, 1.230) | 0.76* | (0.585, 0.989) |
| | 2005 | 1.12 | (0.644, 1.935) | 0.74* | (0.568, 0.951) |
| | 2006 | 0.84 | (0.471, 1.490) | 0.79* | (0.618, 0.999) |

Note: *p<0.05; **p＜0.01; ***p<0.001

medical costs. This system provides patients immediate and practical support to face high medical costs.

The association between socioeconomic factors and dialysis utilizations was seldom studied in Taiwan. This may be due to the fact that dialysis is included in the benefits package available to all of those who hold catastrophic illness cards. Our results show that hemodialysis and the number of outpatient visits by ESRD patients were not significantly related to household income. Only patients in the highest household income bracket had longer ALOS (8.987 days) than that of the lowest income bracket. Some studies found that patients who were older, poorer, or had more comorbidities, received less dialysis treatments [25-27].

Among cancer patients, our results indicate that household income had positive correlations with the number of hospitalizations, and ALOS. In particular, the IRR of hospitalizations in the highest income group was 2.11 times ($p<0.001$) than that of the lowest income group, while the ALOS in the highest income group was 11.36 days ($p<0.001$) longer than that of the lowest grout. Some population-based studies on the issue of healthcare utilization of cancer patients showed that healthcare utilization is unfavorable to the disadvantage of lower income groups [28-30]. Our results are in agreement with previous studies, showing that cancer patients with lower socioeconomic status used fewer hospitalization services.

The differences of healthcare utilization observed in this study may be attributed to the progression of the disease characteristics. Specifically, ESRD patients require regular dialysis treatment and this is not influenced by socioeconomic status. As for cancer patients, the disease progress is long and may change dramatically over time; consequently, socioeconomic status may have a greater influence on healthcare utilization.

In Taiwan, most studies emphasized the relationship between clinical conditions or physiological indicators and mortality for ESRD patients. This study, however, examined the relationship between the socioeconomic status and survival status. Our results show that household income was not associated with the mortality of ESRD patients while adjusting for other variables. However, there are studies found that, after adjusting for clinical characteristics and socioeconomic variables, the mortality of lower income individuals is still associated with increased mortality [26,31,32]. This may be due to the catastrophic illness system in Taiwan exempts copayment so that ESRD patients can receive regular hemodialysis, regardless of their income levels, thus no significant difference of survival was observed across different household income brackets [26,31].

With regard to cancer mortality, our results found that, males and the group with lower educational level had a higher mortality rate and the group with the highest educational level was associated with a lower mortality. Many studies documented significant association of socioeconomic factors and cancer survival, while only few studies reported no association [33-35]. Possible reasons for survival differences among cancer patients were also reported, including tumor characteristics, psychosocial factors, and treatment received [17,18,36,37]. All these findings suggest that there is no single factor that can fully explain the difference observed in mortality. Therefore, there might be some confounding factors that caused patients in the highest income bracket had higher mortality than patients in the lowest income bracket. Further studies are warranted to investigate the association of mortality and variables that were not included

in this research, for example, cancer types or psychosocial characteristics.

According to the behavior model of healthcare utilization [38], the factors that influence the healthcare utilization include predisposing, enabling, and need. We obtained information from the household income survey and catastrophic illnesses system which could be considered as predisposing and the need factors. However, we did not include enabling factors such as medical resources and health behavior in our analysis. Another limitation is that the NHI datasets do not provide information of disease severity, such as the stage of cancer; therefore, we were unable to consider the disease progression or severity and use these variables as control factors for analysis.

Nevertheless, by obtaining socioeconomic data from a national survey, the death registry and NHI datasets, this study managed to avoid recall bias that has arisen in many previous studies which employed questionnaires to obtain data on health status and the use of medical services. Although there are studies suggesting that household income, as used in this study, may not present an accurate reflection of real income [39]. Nevertheless, we believe that the data obtained from the household income survey still provides a proxy of greater accuracy than self-reported income. Although the information provided by the national survey can be regarded as a representative of the population, there are more and more restrictions in using this dataset due to the enactment of the privacy protection law.

In conclusion, this study demonstrated that the catastrophic illness policy of NHI in Taiwan has succeeded in lower economic barriers of healthcare utilization. The results can serve as empirical evidence related to the catastrophic illnesses policy under the NHI in Taiwan. In particular, for ESRD patients, there was no significant difference in healthcare utilization across household income brackets. However, for cancer patients, higher income groups used a greater number of hospitalizations and had longer ALOS. In addition, patients in the highest household income bracket also had higher mortality than patients in the lowest income bracket.

This study used only ESRD and cancer as examples to examine the association of household income and healthcare utilization and survival. But there are still many other types of diseases included in the catastrophic illnesses system. Different diseases may have different characteristics of treatment types and disease progression. Some diseases do not present significant changes in progression and require long periods of treatment, while other diseases progress rapidly, leading to changes in the utilization of medical resources. We suggest that future researchers can examine the difference of healthcare utilization based on disease types or disease characteristics. Additionally, future research could also consider whether the system of exemption from copayment leads to inappropriate use of medical resources.

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# 重大傷病患者家戶所得與醫療利用、存活狀況之相關—以末期腎臟病與癌症為例

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**目標：**探討在全民健保重大傷病制度下，重大傷病患者的家戶所得與醫療利用及存活狀況之相關。**方法：**以2003-2006年「台灣地區家庭收支調查檔」串聯全民健保「重大傷病證明檔」，找出僅持有一張重大傷病卡之末期腎病定期血液透析病人或癌症病人為本研究之研究對象，另串聯2002-2007年全民健保申報檔以分別取得社經人口學變項與醫療利用資料。另再串聯2003-2009年「全國死因檔」取得研究對象觀察四年之存活狀況。運用負二項分配、複迴歸及Cox proportional hazards model分析社經變項對醫療利用、存活狀況之相關。**結果：**醫療利用方面，末期腎病病人最高所得者之住院日數較最低者多8.897日(p<0.05)，但門、住診次數與透析利用則與所得高低無關。癌症病人其最高所得者相對於所得最低者，門診利用IRR=1.18 (p<0.05)，住院利用IRR=2.11 (p<0.001)，以及住院日數高11.36天(p<0.001)。存活分析結果發現，末期腎病病人僅男性(HR=1.82, p<0.05)及共病數與死亡率顯著相關。癌症病人中男性(HR=1.66, P<0.05)及最高所得者死亡風險較高(HR=1.60, P<0.01)，教育程度最高者死亡風險較低(HR=0.52, p<0.05)。**結論：**家戶所得與醫療利用之相關性因疾病而異，癌症病人之家戶所得與醫療利用呈顯著正相關，另外所得最高組的癌症病人死亡率較高。但末期腎病病人之家戶所得與醫療利用及存活則無顯著相關。建議未來可針對不同重大傷病類別進行更深入之研究。(台灣衛誌 2013；**32**(**4**)：331-345)

關鍵詞：全民健康保險、重大傷病、家戶所得、醫療利用、存活狀況

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