

Inequality in Health: Correlation Between Poverty and Injury – A Comprehensive Analysis Based on Income Level in Taiwan: A Cross-sectional Study

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Abstract

Background For better health promotion in Taiwan, it needs an action to reduce health inequality; therefore a comprehensive monitoring on social determinants and health is urgent. Is income the obstacle to influence the health after Taiwan instituted national health insurance in 1995? We compared the characteristics of accident injuries for patients classified with low-income and non-low-income who required inpatient care.

Methods We collected accident injury inpatient cases from 1998 to 2015 from the Health and Welfare Data Science Center, Ministry of Health and Welfare and categorized the patients as low-income and non-low-income. Chi-square tests, Fisher exact tests, an independent samples t-test, and percentages were used to identify differences in demographics, cause for hospitalization, and other hospital care variables.

Results Between 1998 and 2015, there were 74,337 low-income accident injury inpatients, which represented 1.6% of all injury event inpatients. The hospitalization mortality rate for the low-income group was 1.9 times higher than that of the non-low-income group. Further, the average length of hospital stay (9.9 days), average medical expenses (1,681 USD), and mortality rate (3.6%) for the low-income inpatients were higher than those of the non-low-income group (7.6 days, 1,573 USD, and 2.1%, respectively). Among the common injury causes, the percentage of injuries from “medical malpractice,” “fall,” “suicide,” and “homicide” were higher for the low-income group than that for the non-low-income group.

Conclusions Despite National Health Insurance coverage, we found a higher hospitalization rate, longer average length of hospital stay, and a higher mortality rate in the low-income group. These findings support our hypothesis that there is a correlation between health and income level, resulting in health inequality. Achieving health care equality may require collaboration between the government and private and nonprofit organizations to increase awareness of this phenomenon.

Background

In the past several decades, many countries have experienced different levels of economic growth under free commerce, leading to a growing income gap between the wealthy and the poor. Poverty heavily influences individuals’ ability to obtain health care, which can lead to increased health problems in disadvantaged social groups [1, 2, 3].

In 1995, Taiwan instituted National Health Insurance (NHI), which requires mandatory participation for all citizens from birth and provides a basic level of medical care for all citizens. NHI greatly increased medical care accessibility, reduced the financial obstacles to obtaining medical services, prevented financial hardship caused by the cost of medical care, and encouraged those without money to seek medical care [4].

Previous research revealed that while low-income individuals comprise 0.7% of the total population, their inpatient care claims represent 4.8% of national inpatient costs. Additionally, although only 4.3% of the low-income population receives social welfare assistance, their NHI expenses account for 14.4% of the total NHI costs [5]. Other research showed that hospitalization rates for low-income individuals (14.1%) was 8.5% higher than that of non-low-income individuals, indicating that the low-income population utilized more medical resources than the national average [6].

However, previous research has focused on either low-income families without a control group or on overall medical care expenses rather than medical care costs associated solely with accident injuries. Therefore, the purpose of our research was to compare characteristics of “low-income” and “non-low-income” accident injury inpatients and evaluate correlations between income level and health inequality.

Materials And Methods

Data source

Implemented in 1995, NHI currently covers 99% of all Taiwan citizens. The Health and Welfare Data Science Center, Ministry of Health and Welfare (HWDC, MOHW) collects all emergency room and hospitalization data. Further, the law requires medical facilities to submit claims for emergency room and hospitalization expenses on a monthly basis. Therefore, the HWDC is the most authoritative data source for medical and healthcare related research [7]. We used the original inpatient and outpatient medical claims data collected between 1998 and 2015.

Variable definitions

Variables include: Low-Income (Yes, No), Gender (Male, Female), Age (1–4, 5–14, 15–24, 25–44, 45–64, and ≥ 65 years), Charlson Comorbidity Index (CCI), Intentionality of Injury (ICD-9-CM E-Code, E800-E949 unintentional, E950-E979 intentional, and E980-E989 unspecified and unable to determine), Cause of Injury (ICD-9-CM E-Code, E800-E848 transport injuries, E850-E869 poisoning, E870-E879 medical malpractice, E880-E888 falls, E890-E899 burns, E900-E909 natural and environmental factors, E910 drowning, E911-E915 suffocation, E916-E920 crushing, cutting and piercing, E921-E949 others unintentional, E950-E959 suicide, E960-E979 homicide, E980-E989 undetermined), Surgical Operation (Yes, No), Level of Care (medical center, regional hospital, local hospital), Hospitalization Area (northern, central, southern, eastern, outer islands), Length of Hospital Stay (day), Medical Expense (USD), and Prognosis (survival, mortality). The low-income qualification was stipulated by Article 4 of the Public Assistance Act [8] of Taiwan with the following conditions: 1) individuals must submit an application and be approved by their local municipality authority, 2) the average monthly income per person in the household must fall below the poverty line, and 3) the total household assets must not exceed the specific amount set by the central and municipality authorities in the year the application is submitted. The poverty line is based on the standard published by the central department of budget, accounting and statistics, and is defined by the central and municipality authorities as 60% of the median personal expenditure in the household’s local area in the past year.

The CCI [9] selects the first five diagnostic codes (ICD-9-CM N-Code), weighs them according to scoring criteria defined by Charlson, and calculates the total score. Higher scores indicate more complications or a more severe diagnosis. Additionally, the “prognosis” for the deceased includes deaths in the hospital and voluntary discharge for the terminally-ill.

Statistical analysis

IBM SPSS Statistics 20.0 was used to conduct all statistical analyses. Statistical significance was set at $p < 0.05$. Univariate statistics and multivariate logistic regression were used to compare mortality rates during hospitalization between the low-income and the non-low-income groups, with survival as the dependent variable (survived, deceased), and demographics, hospitalization cause, and other hospitalization care measures as independent variables. We then compared the mortality rate during hospitalization between the low-income and the non-low-income groups.

Results

Data from 4,647,058 accident injury inpatients between 1998 and 2015 were collected. Patient characteristics are summarized in Table 1. In all, 74,337 inpatients (1.6%) were low-income and 4,572,721 (98.4%) were non-low-income. The male-to-female ratio for the low-income group (1.74) was significantly higher than that of the non-low-income group (1.41). The highest hospitalization rates occurred in patients aged 65 years and older both of the low-income group and non-low-income group. Hospitalization rates were also significantly different between the two groups for the 5–14 and 25–44 age groups. Low-income inpatients scored higher on the CCI measure than non-low-income inpatients (0.6 and 0.5, respectively), indicating that the number or severity of injury complications was much higher for the low-income inpatients.

Table 1
Demographic variables of accident injury inpatients between 1998 and 2015 by income in Taiwan (n = 4,647,058)

Variables	Low-income (n = 74,337)		Non-low-income (n = 4,572,721)		P value
	N	%	N	%	
Gender					< 0.001
Male	47,184	63.5	2,674,428	58.5	< 0.001
Female	27,153	36.5	1,898,293	41.5	< 0.001
Age					< 0.001
1–4	1,805	2.4	180,605	3.9	0.001
5–14	6,902	9.3	231,217	5.1	< 0.001
15–24	9,816	13.2	657,796	14.4	0.090
25–44	15,739	21.2	1,154,947	25.3	< 0.001
45–64	19,980	26.9	1,166,918	25.5	0.044
≥ 65	20,095	27.0	1,181,238	25.8	0.012
CCI	0.6 ± 1.5		0.5 ± 1.6		< 0.001
P value: Chi-square/Fisher exact test on category variables, t-test on continue variables, and percentage test on % of each item					

Patients intentionally injured themselves at a higher rate in the low-income group (5.4%) compared to the non-low-income group (4.2%). Certain unintentional incidents, such as medical malpractice and falls, were also more frequent in the low-income group (13.0% vs 10.9% and 26.5% vs 23.7%, respectively), whereas transport injuries and crushing, cutting and piercing injuries were more frequent in the non-low-income group (29.9% vs 38.5% and 3.8% vs 5.5%, respectively). In non-fatal cases, the two groups also differed significantly on medical malpractice, falls, transport injuries, and crushing, cutting, and piercing. Fatal injuries differed significantly by group only for transport injuries (20.9% vs 27.9%) (Table 2).

Table 2
Admission causes of injury inpatients for various incomes during 1998–2015 in Taiwan (n = 4,647,058)

Prognosis	Overall				P value	Non-fatal (Survival)				P value	Fatal (Mortality)				P value
	Low-income (n = 74,337)		Non-low-income (n = 4,572,721)			Low-income (n = 71,640)		Non-low-income (n = 4,477,412)			Low-income (n = 2,697)		Non-low-income (n = 95,309)		
Incomes	N	%	N	%		N	%	N	%		N	%	N	%	
Causes of injury															
Without E-Code (n = 1,582,244)	28,400		1,553,844			27,167		1,513,036			1,233		40,808		
With E-Code (n = 3,064,814)	45,937		3,018,877			44,473		2,964,376			1,464		54,501		
Unintentional	42,897	93.4	2,871,022	95.1	< 0.001	41,566	93.5	2,821,399	95.2	< 0.001	1,331	90.9	49,683	91.2	0.173
Transport injuries	13,723	29.9	1,162,189	38.5	< 0.001	13,417	30.2	1,146,981	38.7	< 0.001	306	20.9	15,208	27.9	< 0.001
Poisoning	783	1.7	42,254	1.4	0.571	754	1.7	40,966	1.4	0.511	29	2.0	1,288	2.4	0.785
Medical malpractice	5,973	13.0	307,619	10.9	< 0.001	5,623	12.6	294,536	9.9	< 0.001	350	23.9	13,083	24.0	0.896
Falls	12,184	26.5	714,467	23.7	< 0.001	11,810	26.6	701,304	23.7	< 0.001	374	25.5	13,163	24.2	0.771
Burns	201	0.4	9,790	0.3	0.683	184	0.4	9,505	0.3	0.981	17	1.2	285	0.5	0.483
Natural and environmental factors	451	1.0	29,904	1.0	0.997	446	1.0	29,768	1.0	0.995	5	0.3	136	0.2	0.982
Drowning	1,221	2.7	166,939	5.5	0.408	1,210	2.7	166,262	5.6	0.372	11	0.8	677	1.2	0.996
Suffocation	358	0.8	18,964	0.6	0.703	317	0.7	17,627	0.6	0.783	41	2.8	1,337	2.5	0.934
Crushing, cutting, and piercing	1,763	3.8	165,598	5.5	< 0.001	1,744	3.9	164,976	5.6	< 0.001	19	1.3	622	1.1	0.890
Others unintentional	6,240	13.6	253,298	8.4	< 0.001	6,061	13.6	249,414	8.4	< 0.001	179	12.2	3,884	7.1	0.061
Intentional	2,479	5.4	125,816	4.2	0.001	2,371	5.3	121,942	4.1	0.196	108	7.4	3,874	7.1	0.042
Suicide	1,137	2.5	52,533	1.7	0.029	1,049	2.4	49,173	1.7	0.185	88	6.4	3,360	6.1	0.047
Homicide	1,342	2.9	73,283	2.4	0.040	1,322	3.0	72,769	0.7	0.036	20	1.0	514	1.0	0.975
Unspecific and unable to determined	561	1.2	22,039	0.7	0.262	536	1.2	21,095	0.7	0.124	25	1.7	944	1.7	0.916
P value: percentage test															

Table 3 shows the distribution of treatment outcomes for unintentional and intentional injuries by group. Low-income inpatients were less likely than non-low-income inpatients to receive surgery for unintentional and intentional injuries (47.4% vs 55.2% and 28.2% vs 30.4%, respectively). Fewer low-income inpatients sought treatment in medical center for unintentional and intentional injuries (19.5% vs 25.7% and 22.8% vs 24.5%, respectively). More low-income inpatients sought treatment in eastern Taiwan, tended to stay longer in the hospital and incurred higher medical expenses than non-low-income inpatients. Low-income inpatients also had a higher mortality rate than that of non-low-income inpatients for both unintentional and intentional injuries (3.1% vs 1.7% and 4.4% vs 3.1%, respectively).

Table 3

Unintentional and intentional injury hospitalization related variables for various incomes during 1998–2015 in Taiwan (n = 4,647,058)

Causes of injury	Overall				P value	Unintentional				P value	Intentional				P value
	Low-income (n = 74,337)		Non-low-income (n = 4,572,721)			Low-income (n = 42,897)		Non-low-income (n = 2,871,022)			Low-income (n = 2,479)		Non-low-income (n = 125,816)		
Variables	N	%	N	%		N	%	N	%		N	%	N	%	
Surgical operation					< 0.001					< 0.001					0.001
Yes	30,930	41.6	2,351,342	51.4		20,338	47.4	1,584,918	55.2		699	28.2	68,243	30.4	
No	43,407	58.4	2,221,379	48.6		22,559	52.6	1,286,104	44.8		1,780	71.8	87,573	69.6	
Level of care					< 0.001					< 0.001					0.005
Medical center	15,804	21.3	1,330,952	29.1		8,352	19.5	737,443	25.7		566	22.8	30,812	24.5	
Regional hospital	33,283	44.8	1,900,118	41.6		21,786	50.8	1,379,969	48.1		1,165	47.0	58,342	46.4	
Local hospital	25,250	34.0	1,341,651	29.3		12,759	29.7	753,610	26.2		748	30.2	36,662	29.1	
Hospitalization area					< 0.001					< 0.001					< 0.001
Northern	24,020	32.3	1,628,638	35.6		12,784	29.8	858,501	29.9		768	31.0	38,818	30.9	
Central	18,358	24.7	1,406,942	30.8		12,654	29.5	1,063,826	37.1		686	27.7	44,496	35.4	
Southern	21,881	29.4	1,239,379	27.1		12,056	28.1	759,659	26.5		716	28.9	33,892	26.9	
Eastern	9,359	12.6	273,914	6.0		5,034	11.7	178,115	6.2		298	12.0	8,380	6.7	
Outer islands	719	1.0	23,848	0.5		369	0.9	10,921	0.4		11	0.4	230	0.2	
Medical care utilization															
Length of stays (day)	9.9 ± 11.5		7.6 ± 8.9		< 0.001	9.1 ± 10.4		7.1 ± 7.9		< 0.001	7.2 ± 9.6		5.4 ± 7.0		< 0.001
Medical expenses (USD)	1,681.5 ± 2,880.3		1,573.9 ± 2,873.5		< 0.001	1,638.9 ± 2,742.3		1,484.8 ± 2,592.6		< 0.001	1,179.3 ± 2,248.1		1,068.5 ± 2,294.9		< 0.001
Prognosis					< 0.001					< 0.001					< 0.001
Survival	71,640	96.4	4,477,412	97.9		41,566	96.9	2,821,399	98.3		2,371	95.6	121,942	96.9	
Mortality	2,697	3.6	95,309	2.1		1,331	3.1	49,683	1.7		108	4.4	3,874	3.1	
P value: Chi-square/Fisher exact test on category variables and t-test on continue variable															

Table 4 shows the distribution of treatment outcomes for non-fatal and fatal injuries by group. Low-income inpatients were less likely to receive surgery for non-fatal injuries (41.6% and 51.4%, respectively). Low-income inpatients were also less likely to receive medical care in major hospital centers (21.3% vs 29.1%) and were more likely to receive medical attention in regional hospitals (44.8% vs 41.6%). Moreover, low-income inpatients tended to stay longer in the hospital and incur higher medical expenses (9.9 days vs 7.6 days and USD \$1,681.5 vs USD \$1,573.9, respectively). The comparative results for fatal injuries between the low-income group and the non-low-income group were consistent with those in non-fatal injuries.

Table 4
Fatal and non-fatal injury hospitalization related variables by income level between 1998–2015 in Taiwan (n = 4,647,058)

Prognosis	Overall				P value	Non-fatal (Survival)				P value	Fatal (Mortality)				P value
	Low-income (n = 74,337)		Non-low-income (n = 4,572,721)			Low-income (n = 71,640)		Non-low-income (n = 4,477,412)			Low-income (n = 2,697)		Non-low-income (n = 95,309)		
Variables	N	%	N	%		N	%	N	%		N	%	N	%	
Surgical operation					< 0.001					< 0.001					0.002
Yes	30,930	41.6	2,351,342	51.4		41,699	58.2	2,163,734	48.3		1,708	63.3	57,645	64.1	
No	43,407	58.4	2,221,379	48.6		29,941	41.8	2,313,678	51.7		989	36.7	37,664	35.9	
Level of care					< 0.001					< 0.001					< 0.00
Medical center	15,804	21.3	1,330,952	29.1		15,127	21.1	1,291,532	28.8		677	25.1	39,420	41.4	
Regional hospital	33,283	44.8	1,900,118	41.6		31,987	44.6	1,859,108	41.5		1,296	48.1	41,010	43.0	
Local hospital	25,250	34.0	1,341,651	29.3		24,526	34.2	1,326,772	29.6		724	26.8	14,879	15.6	
Hospitalization area					< 0.001					< 0.001					< 0.001
Northern	24,020	32.3	1,628,638	35.6		22,906	32.0	1,588,596	35.5		1,114	41.3	40,042	42.0	
Central	18,358	24.7	1,406,942	30.8		17,798	24.8	1,381,480	30.9		560	20.8	25,462	26.7	
Southern	21,881	29.4	1,239,379	27.1		21,151	29.5	1,215,061	27.1		730	27.1	24,318	25.5	
Eastern	9,359	12.6	273,914	6.0		9,081	12.7	268,672	6.0		278	10.3	5,242	5.5	
Outer islands	719	1.0	23,848	0.5		704	1.0	23,603	0.5		15	0.6	245	0.3	
Medical care utilization															
Length of stays (day)	9.9 ± 11.5		7.6 ± 8.9		< 0.001	9.7 ± 11.3		7.5 ± 8.7		< 0.001	13.8 ± 15.9		13.1 ± 15.4		< 0.001
Medical expenses (NT\$)	1,681.5 ± 2,880.3		1,573.9 ± 2,873.5		< 0.001	1,551.2 ± 2,520.1		1,480.3 ± 2,565.4		< 0.001	5,968.6 ± 8,201.8		5,143.0 ± 6,896.0		< 0.001

P value: Chi-square/Fisher exact test on category variables and t-test on continue variables

To further examine the factors associated with the accident injury hospitalization mortality rate, income, demographics (i.e., gender, age), CCI scores, intentionality of injury, cause of injury, and other hospitalization medical care related measures (surgical operation, level of care, hospitalization area, medical care utilization) were transformed into ratios using a variable within each respective group as a reference (Table 5). The mortality rate during hospitalization for the low-income group was almost twice (adjusted OR 1.888 [1.766, 2.018], $p < 0.001$) that of the non-low-income group, indicating a strong correlation between mortality rate and income level. Older adults (65 years and older) in the low-income group had a higher mortality rate with respect to intentional injuries and surgery.

Table 5
Influencing factors of injury hospitalization mortality rate between 1998 and 2015

Variables	Overall			Low-income		
	Adjusted OR	95% CI	P value	Adjusted OR	95% CI	P value
Incomes						
Non-low-income	Reference			-	-	-
Low-income	1.888	1.766–2.018	< 0.001	-	-	-
Gender						
Male	1.482	1.451–1.520	< 0.001	1.284	1.211–1.379	< 0.001
Female	Reference			Reference		
Age						
1–4	Reference			Reference		
5–14	0.501	0.431–0.569	< 0.001	0.767	0.620–0.885	0.001
15–24	1.083	0.980–1.186	0.088	1.120	1.013–1.271	0.032
25–44	1.421	1.318–1.554	< 0.001	1.338	1.291–1.498	< 0.001
45–64	2.125	1.973–2.339	< 0.001	2.231	1.997–2.364	< 0.001
≥ 65	5.076	4.452–5.561	< 0.001	2.695	2.372–3.196	< 0.001
CCI	1.142	1.133–1.142	< 0.001	3.299	3.218–3.571	< 0.001
Causes of injury						
Unintentional	Reference			Reference		
Intentional	3.006	2.873–3.162	< 0.001	3.171	2.886–3.384	< 0.001
Unspecific and unable to determined	1.155	0.922–3.005	0.398	1.276	0.938–3.111	0.372
Surgical operation						
Yes	2.311	2.228–2.378	< 0.001	2.380	2.246–2.674	< 0.001
No	Reference			Reference		
Level of care						
Medical center	1.412	1.370–1.465	< 0.001	1.518	1.443–1.659	< 0.001
Regional hospital	1.566	1.521–1.619	< 0.001	1.497	1.430–1.601	< 0.001
Local hospital	Reference			Reference		
Length of stays (day)	0.953	0.952–0.954	< 0.001	0.989	0.987–0.990	0.038
Adjusted OR (Odds Ratio): Adjusted variables listed in the table; CI = confidence interval						
Hospitalization area had collinearity with level of care, and medical expenses had collinearity with length of stays						
Nagelkerke R ² = 0.271 (Overall), 0.234 (Low-income)						

Discussion

Health inequality

Between 1998 and 2015, an average of 237,877 citizens were classified as low-income [10], and their accident injury hospitalization rate was 1.74 per 100. In comparison, an average of 22,611,119 were classified as non-low-income [11], and their accident injury hospitalization rate was 1.12 in 100. That the accident injury hospitalization rate for the low-income group was twice as high as that of the non-low-income group implies poverty and injury are correlated. In addition, low-income inpatients had more complicated injuries than non-low-income inpatients (2.3 vs 1.9) and the hospitalization mortality rate for low-income inpatients was 1.888 times higher than that of non-low-income inpatients, showing that health inequality exists between the low-income and non-low-income groups. The high hospitalization mortality rate for low-income inpatients is primarily driven by intentional injuries as it was 2.014 times higher for non-low-income inpatients.

Many researchers have attributed the more complicated and severe injuries in low-income individuals to their lower socioeconomic status, which may compel them to accept high-risk entry-level jobs that require heavy labor. Consequently, they are more susceptible to injuries, which may develop into severe and

chronic conditions if left untreated. This is especially true for those who must work to support their families regardless of illness or injuries. These individuals have a higher risk of harm due to poor physical condition [12, 13].

Serious injuries require more comprehensive care at an advanced medical facility. Our results showed that a significantly lower proportion of the low-income inpatients received treatment in medical centers compared to non-low-income inpatients, providing additional evidence of health inequality. Figure 1 illustrates differences between low-income inpatients and non-low-income inpatients in hospitalization payment processes under Taiwan's NHI program, where the cost of a doctor visit includes medical expenses plus a registration fee—a processing or administration fee set by the medical institution that typically corresponds to the level of care. Therefore, the registration fees at medical centers are higher compared to those at regional and local hospitals. Also, while Taiwan's NHI program covers most medical expenses, inpatients are still required to pay a small portion of the medical expenses as a co-payment. To reduce health inequity, low-income inpatients are exempt from the co-payment. However, the NHI program does not cover the registration fees. Therefore, unless the local government or hospital social welfare measures (SWM) provide relief for low-income inpatients, they have to pay the registration fee. In addition, postoperative patients may also be required to pay living costs and caregiver expenses during hospitalization, and/or pay for other medical equipment or prescription drug expenses that are not covered by NHI. In general, non-low-income inpatients have private health insurance to help pay those costs; however, low-income inpatients can only rely on minimum support from the government's SWM since they cannot afford private health insurance. Low-income inpatients' hospitalization costs also tend to be higher than those of non-low-income inpatients because they are hospitalized longer and are more seriously injured (Table S1). Thus, low-income inpatients are more reluctant to receive surgery despite having higher CCI scores. Moreover, the out-of-pocket medical expenses are generally proportional to the level of care received; the higher the level of care, the greater the expense. In Taiwan, the highest level of medical certification accreditation is the medical center. Consequently, low-income inpatients generally lean toward regional or local hospitals because of lower expenses. However, when taking the severity of the injury into consideration, low-income inpatients are more willing to receive care in medical centers for fatal injuries as opposed to non-fatal injuries.

Figure 1. Comparison of medical costs between low-income and non-low-income inpatients under the NHI program in Taiwan.

We also observed a significant gender gap in the low-income group. The Ministry of Health and Welfare of Taiwan has reported that among low-income individuals, the number of single-person households is higher for men than for women [14]. Typically, men in Taiwan are the main source of income because of the patriarchal nature of Chinese families. Therefore, low income men are less likely to marry and more likely to accept jobs with a poor working environment, making them more vulnerable to injuries. In addition to the gender gap, the low-income and non-low-income groups differed significantly in the percentage of individuals in the 5 to 14 age group (9.3% vs 5.1%). Our findings were consistent with previous research reporting that adolescents from lower socioeconomic families were more likely to have serious injuries requiring hospitalization [15].

Cause of injury

With unintentional, non-fatal injuries, our results showed that hospitalization rates related to “medical malpractice” and “falls” were higher for the low-income group than the non-low-income group.

A multinational retrospective study on the global burden of disease (GBD) showed that, as a result of medical adverse events, disability-adjusted years (DALYs) equal 23 million globally every year, for which two-thirds come from low-income and mid-income countries [16]. Other research on these same countries also showed more medical accidents, lower patient safety, and lower medical care quality for the low-income group [17].

We further observed that falling injuries are more prevalent among low-income inpatients in the middle and older age groups (more than 45 years old), as shown in Table S2. Past research on fall risk in older adults found that low income is a contributing factor [18]. Other factors include socioeconomic status (low education, solitary living, and lack of care), living environment (inconvenient floorplan and insufficient light), and physical condition (poor vision, chronic illness, and aging) [18, 19, 20]. Accordingly, the low-income group may be more susceptible to falling and hospitalization because of poor living conditions, more living hazards, and lack of safety protection equipment [19].

Intentional injuries showed a significantly higher rate of hospitalization for “suicide” and “homicide” for low-income inpatients in both fatal and non-fatal injuries. Additionally, previous research has shown that unemployment and specific occupations were also associated with suicide and suicidal behavior [21, 22, 23, 24]. According to the low-income family study conducted by the Ministry of the Interior of Taiwan, 62% of low-income family members have suffered catastrophic illnesses in the past [12]. In addition, 47% of the breadwinners in these families are out of the workforce.

Previous research also found that poverty increases the risk of mental illness and suicide [25, 26]. Low-income individuals generally view themselves as a financial minority, and tend to feel powerless, helpless, and repressed when facing competition, factors that may be associated with contemplating suicide. Therefore, low-income individuals have a much higher risk of repeating suicide attempts that result in hospitalization [27]. Some studies also indicate that low-income and severe illness exacerbate the risk of suicide during hospitalization. Patients with both severe illness and low-income may suffer multiple complications that require long-term care. Without sufficient resources, these patients may become depressed and consider suicide as an escape and a relief for their families [28].

Furthermore, one comprehensive analysis that collected criminal data from 169 countries found a positive correlation between income inequality and homicide/injury. This is especially prevalent in low-income and mid-income countries [29]. One could use Durkheim's Anomie theory [30] to explain this pattern. As someone tries to thrive in a society where there are no legal avenues for achieving his goals, he feels pressure to deviate from his usual behavior and engage in illegal activities. Similarly, lower social class members tend to turn their efforts to criminal activities because financial rewards in the society are lacking, and criminal activities provide a means of obtaining financial rewards [30, 31].

In contrast, non-low-income inpatients were predominantly associated with transport injuries in both non-fatal and fatal injuries. According to official statistics [32], in 2010, 48.8% and 32.3% of traffic accidents were caused by motorcycle and private passenger cars, respectively. In Taiwan, motorcycles are the most popular means of transportation (64.1 motorcycles per 100 population) [33]. Most families have at least one motorcycle. Therefore, it is no surprise that our study found motorcyclist injuries to have the highest hospital admission rates for both the low-income and non-low-income groups. As shown in Table S3, motorcyclist injuries were more frequent in the low-income group than the non-low-income group. However, injuries suffered by the driver of a motor vehicle showed a more significant difference in hospital admission rates between the two groups compared to motorcyclist injuries. In general, low-income families are less likely to own a private passenger car because of costs or access barriers; therefore, they are less vulnerable to overall transport injuries.

In summary, falling and transport injuries are the most common causes of injury in the low-income group. Typically, inpatients with injuries or older adults who are at an increased risk of falling often need to use mobility aids such as wheelchairs, canes, and walkers. However, these mobility aids are not covered by Taiwan's NHI, as per Article 51 of the National Health Insurance Act, and low-income inpatients are effectively denied access. The health inequality between low-income inpatients and non-low-income inpatients still exists despite the implementation of Taiwan's NHI. Government agencies should take actions and eliminate the health inequity for low-income patients.

Limitations

The data from HWDC did not provide any information on immigration status (natives, new immigrants), marital status, education level, or occupation. The low-income group reported in this research was sorted by those who qualified for insurance under the Public Assistance Act and not by actual income. The health inequality in the most vulnerable group is likely to be higher than those in a low-middle income group (income quintiles or deciles). Therefore, potential non-differential misclassification bias may exist and may have resulted in findings that favor the null hypothesis [34]. Therefore, this study may underestimate the differences between the low-income and the non-low-income groups.

Conclusions

The low-income group had (1) a higher accident injury hospitalization rate, (2) more severe injuries, and (3) a higher hospitalization mortality rate than the non-low-income group, supporting our hypothesis that health care inequality exists and is correlated with income despite mandatory, nation-wide, affordable medical insurance. Therefore, the government should collaborate with private and nonprofit organizations to create a more comprehensive system, including employment assistance, job fairs, public education, etc., to gradually eliminate health care inequality for low-income citizens. In addition, transport and falls injuries accounted for the majority of the injury cases in low-income inpatients. Therefore, mobility aids should be covered by the NHI program for low-income citizens.

Abbreviations

NHI
National Health Insurance
HWDC, MOHW
Health and Welfare Data Science Center, Ministry of Health and Welfare
CCI
Charlson Comorbidity Index
SWM
social welfare measures
GBD
global burden of disease
DALYs
disability-adjusted years

Declarations

Ethics approval and consent to participate

The data have been reviewed and approved by HWDC's Professional Peer Reviewer Committee (IRB NO. TSGHIRB 2-105-05-082). The patients' personal data have been encrypted and their privacy protected; thereby, conforming to the Declaration of Helsinki.

Consent for publication

Not applicable

Availability of data and materials

The data that support the findings of this study are available from the Health and Welfare Data Science Center, Ministry of Health and Welfare (HWDC, MOHW) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of HWDC.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Y-C Lin and W-C Chien conceived of the study, participated in its design and coordination, data interpretation, performed the statistical analysis, and drafted the manuscript. W-C Chien, C-H Chung, L Pai, C-S Tsai, and C-S Lin participated in the design of the study and data interpretation. Y-C Lin wrote the paper. All authors have read and approved the final manuscript as submitted.

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Figures

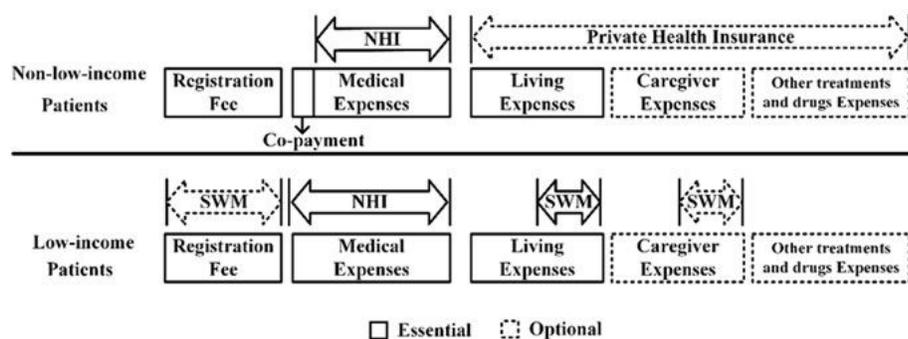


Figure 1

Comparison of medical costs between low-income and non-low-income inpatients under the NHI program in Taiwan.

Supplementary Files

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