

A 10-Year Experience with Universal Health Insurance in Taiwan: Measuring Changes in Health and Health Disparity

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Background: Universal national health insurance, financed jointly by payroll taxes, subsidies, and individual premiums, commenced in Taiwan in 1995. Coverage expanded from 57% of the population (before the introduction of national health insurance) to 98%.

Objective: To assess the role of national health insurance in improving life expectancy and reducing health disparities in Taiwan.

Design: A before-and-after comparison of the decade before the introduction of national health insurance (1982–1984 to 1992–1994) with the decade after (1992–1994 to 2002–2004).

Setting: Taiwan.

Patients: All townships ($n = 358$) in Taiwan were ranked according to overall mortality rates before the introduction of national health insurance and then ranked into 10 health class groups in descending order of health (groups 1 [healthiest] to 10 [least healthy]).

Measurements: Health improvement (change in life expectancy after the introduction of national health insurance) and health disparity (reduction in the difference in life expectancy between the highest- and lowest-ranked health class groups).

Results: After the introduction of national health insurance, life expectancy increased more in health class groups that had higher mortality rates before the introduction of national health insurance

and health disparity narrowed, reversing an earlier trend toward widening disparity. The major contributors to the reduction in disparity were relatively larger reductions in death from cardiovascular diseases, ill-defined conditions, infectious diseases, and accidents in the lower-ranked health class groups. However, death from cancer increased more in the lower-ranked health class groups. Utilization of medical services increased, whereas cost remained at 5% to 6% of the gross domestic product. The per capita average annual number of visits to the physician's office was 14.

Limitation: The interpretation of comparisons before and after the introduction of national health insurance assumes that the changes were entirely due to the effect of national health insurance rather than secular trends.

Conclusion: Life expectancy after the introduction of national health insurance improved more for lower-ranked health classes, resulting in narrowed health disparity. The magnitude of the reduced disparity was small compared with the size of the remaining gaps. Relying on universal insurance alone to eliminate health disparity does not seem realistic. To further reduce health disparity, universal insurance programs should incorporate primary prevention, focusing on lifestyle risk reductions.

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Taiwan's national health insurance has attracted worldwide attention (1–6) because of stable costs (as a proportion of gross national product) and short waiting times (7, 8). National health expenditure increased modestly from 5.1% of gross national product before the introduction of national health insurance to 6.2% 10 years later (9), which is in sharp contrast with the United States (16% of gross national product) (10). People worldwide have been demanding universal health insurance (11, 12). It has broad political and social appeal. For some, it is an issue of societal equity; for others, it offers the promise of better health (13). The lack of insurance has been associated with increased morbidity and mortality (14–16). Taiwan implemented national health insurance in 1995, which provided

a rare opportunity for a natural experiment: to see whether universal insurance would improve health or reduce disparity—a twin outcome expected by the public.

National health insurance was incorporated into the existing free market system in Taiwan and offered free choice of providers to consumers and free choice of practice methods for providers under a single governmental payer. National health insurance extended existing insurance coverage (provided primarily by large employers) from 57% of the population to everyone, providing insurance to children, the elderly, and nonworking adults (17). Copayments are required: roughly 10% for inpatient and 20% for outpatient (18). These copayments, as well as income-based individual premiums, are waived for the very poor, veterans, and natives of the region. Encouraged by the ease of access, an average person made 14 visits to physicians in 2004, which is nearly 4 times the U.S. average (19). Office visits accounted for nearly two thirds of national health insurance expenditure, compared with one third in the United States (19). Office visits averaged 4 prescriptions per visit. Although Taiwan has had a culture of relying on physician visits and medications to get well, utilization increased substantially after national health insurance was introduced, particularly by elderly and poor persons.

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At the start of national health insurance, the public expected that health would improve and health disparities would decline. This study aims to test this assumption based on the first 10 years of national health insurance.

METHODS

Study Overview

We divided the country into 10 health class groups according to the rank-ordering of the mortality rates of 358 individual townships before the introduction of national health insurance. We measured the change in health in each of the 10 groups during the 10 years (1995 to 2004) after national health insurance was introduced compared with the previous 10 years to see whether differences in health between the highest- and lowest-ranked health class groups narrowed after national health insurance. Life expectancy was used to measure health because it is inversely correlated with overall death (20), and higher-ranked health class groups were considered healthier than lower-ranked groups.

Study Population

With the entire Taiwanese population as the reference, we calculated standardized mortality ratios for all-cause mortality in 1992–1994 for each of the 358 townships in Taiwan. We then rank-ordered the townships by standardized mortality ratios and grouped them in descending order into 10 health class groups, each with a population of approximately 2 million. The townships in health class group 1 (with the best health) had standardized mortality ratios ranging from 0.57 to 0.77, whereas those in group 10 (with the worst health) had standardized mortality ratios of 1.17 to 3.19 (Appendix Table 1, available at www.annals.org).

Data Sources

The basic data in this study are the standardized mortality ratios and life expectancy in each health class group. The data sources are the official records of the population by township, age, and sex from the Ministry of the Interior. The registered deaths, including causes of death, came from computerized files assembled by the Department of Health. Taiwan used the same method to count population and register deaths during the study period. We obtained information on health care utilization and expenditure from the official publications of the Department of Health (9) and the Bureau of National Health Insurance (17).

Outcomes

The change after introduction of national health insurance was the difference in life expectancy in each of the 10 health class groups at the beginning and end of the periods before (between 1982–1984 and 1992–1994) and after (between 1992–1994 and 2002–2004) the introduction of national health insurance. “Change before the introduction of national health insurance” is the term for the change during the period before national health insurance

Context

The effects of implementing universal national health insurance are largely unknown.

Contribution

Taiwan implemented national health insurance in 1995. In the decade before national insurance, differences in life expectancy between the healthiest and least healthy regions were increasing. Afterward, they decreased, but the gaps in life expectancy between the healthiest and least healthy regions remained large. Utilization and expenditures on health care increased, whereas the percentage of gross domestic product spent on health care remained at 5% to 6%.

Caution

The authors could not prove that universal national health insurance alone reduced health disparities.

Implication

Universal national health insurance may reduce health disparities, but only by a small amount.

—The Editors

was implemented (between 1982–1984 and 1992–1994). “Disparity” is the difference in life expectancy between health class group 1 and each of the remaining 9 health class groups.

We compared changes in life expectancy in the periods before and after the introduction of national health insurance. The following example illustrates our calculation. The life expectancies at birth for men in health class group 2 in 1982–1984, 1992–1994, and 2002–2004 were 71.87, 74.68, and 76.65 years, respectively (Table 1). The difference (−0.84 years) was the improvement in life expectancies after the introduction of national health insurance (74.68 years to 76.65 years) minus the improvement before the introduction of national health insurance (71.87 years to 74.68 years).

We also measured changes in health disparities before and after the introduction of national health insurance. Disparity reduction for each health class group was the difference in disparity between the period before (disparity in 1992–1994) and that after (disparity in 2002–2004) the introduction of national health insurance. To calculate the reduction in disparity for men in health class group 2, we used the life expectancies at birth for men in health class group 2 (74.68 and 76.65 years) in 1992–1994 and 2002–2004, respectively, and the life expectancies for health class group 1 (77.63 and 79.62 years, respectively) (Table 1). The change in disparity (−0.02 years) was the disparity (the difference in life expectancy between health class groups 1 and 2) at the end of the period before the introduction of national health insurance (77.63 years to 74.68 years) minus the difference after the

Table 1. Difference between Life Expectancy at Birth before and after the Introduction of National Health Insurance and Change in Disparity*

HCG	LE (\pm SE), y			10-Year Change in LE, y		Difference in 10-Year Change in LE before and after NHI	10-Year Change in Disparity after NHI
	1982–1984	1992–1994	2002–2004	Before NHI†	After NHI‡		
Men							
1	74.13 \pm 0.24	77.63 \pm 0.21	79.62 \pm 0.19	3.50	1.99	–1.51§	–
2	71.87 \pm 0.26	74.68 \pm 0.22	76.65 \pm 0.19	2.81	1.97	–0.84	–0.02
3	71.12 \pm 0.24	73.62 \pm 0.21	75.95 \pm 0.18	2.50	2.33	–0.17	0.34
4	70.17 \pm 0.25	72.84 \pm 0.21	74.60 \pm 0.18	2.67	1.76	–0.91§	–0.23
5	69.94 \pm 0.23	71.94 \pm 0.20	74.13 \pm 0.18	2.00	2.19	0.19	0.20
6	69.12 \pm 0.23	71.55 \pm 0.20	74.12 \pm 0.18	2.43	2.57	0.14	0.58
7	68.92 \pm 0.21	71.13 \pm 0.19	73.50 \pm 0.18	2.21	2.37	0.16	0.38
8	68.85 \pm 0.21	70.51 \pm 0.19	72.91 \pm 0.18	1.66	2.40	0.74	0.41
9	68.11 \pm 0.21	69.90 \pm 0.19	72.16 \pm 0.17	1.79	2.26	0.47	0.27
10	65.76 \pm 0.19	66.98 \pm 0.18	69.59 \pm 0.18	1.22	2.61	1.39§	0.62
Women							
1	78.22 \pm 0.28	82.01 \pm 0.23	83.72 \pm 0.19	3.79	1.71	–2.08§	–
2	76.23 \pm 0.30	79.64 \pm 0.25	81.62 \pm 0.20	3.41	1.98	–1.43§	0.27
3	75.76 \pm 0.27	78.40 \pm 0.23	81.09 \pm 0.19	2.64	2.69	0.05	0.98
4	74.79 \pm 0.27	77.60 \pm 0.22	80.14 \pm 0.19	2.81	2.54	–0.27	0.83
5	74.84 \pm 0.24	77.50 \pm 0.21	80.26 \pm 0.18	2.66	2.76	0.10	1.05
6	74.21 \pm 0.25	76.98 \pm 0.21	79.76 \pm 0.19	2.77	2.78	0.01	1.07
7	74.22 \pm 0.23	76.77 \pm 0.21	79.91 \pm 0.19	2.55	3.14	0.59	1.43
8	73.87 \pm 0.23	76.42 \pm 0.20	79.48 \pm 0.18	2.55	3.06	0.51	1.35
9	73.87 \pm 0.22	75.97 \pm 0.19	78.96 \pm 0.18	2.10	2.99	0.89§	1.28
10	71.94 \pm 0.21	74.23 \pm 0.19	76.83 \pm 0.19	2.29	2.60	0.31	0.89
Taiwan							
Men	69.56 \pm 0.07	71.83 \pm 0.06	74.22 \pm 0.06	2.27	2.39	0.12	–
Women	74.58 \pm 0.08	77.31 \pm 0.07	80.09 \pm 0.06	2.73	2.78	0.05	–

* HCG = health class group; LE = life expectancy; NHI = national health insurance.
 † Increased between 1982–1984 and 1992–1994.
 ‡ Increased between 1992–1994 and 2002–2004.
 § $P < 0.050$ for difference before and after NHI in 10-year change in LE.
 || $P < 0.050$ for difference relative to HCG 1 in 10-year change in LE after NHI.

introduction of national health insurance (79.62 years to 76.65 years).

Statistical Analysis

We used the Chiang life-table method to calculate and compare life expectancy (21). To examine the contribution of causes of deaths to life expectancy change before and after the introduction of national health insurance, we used a modified cause–deletion life-table method (22, 23). This method assumes independence for each cause of death and calculates the contributions of a cause of death to a change in overall life expectancy by incorporating the change in mortality rates for 1 particular cause at a time between 2 periods. For example, to estimate the contribution of cancer to the difference in life expectancy between 2 periods (1982–1984 and 1992–1994), we first obtained the age-specific mortality rates from cancer in 1982–1984. We then added the age-specific change in deaths from cancer between the 2 periods to the age-specific overall mortality rate in 1982–1984 and calculated life expectancy accordingly. The difference between this life expectancy and overall life expectancy in 1982–1984 was the contribution of

cancer to life expectancy. We used a customized FORTRAN program to calculate cause-specific life expectancies. Other investigators have used this method (23–26), which is commonly referred to as “a decomposition of life expectancy by causes” (27–31). We used linear regression to test whether changes in life expectancy between the periods before and after the introduction of national health insurance, increased or decreased linearly by health class group.

Additional Analysis

We also did several analyses in which we pooled the original 10 health class group categories into 3 broader health class groups: high (groups 1 to 3), medium (groups 4 to 7), and low (groups 8 to 10). We minimized the effect of the decrease in accidental death rates at younger ages after the introduction of national health insurance by calculating life expectancies at age 45 years in the high, medium, and low health class groups.

Role of the Funding Source

Investigators received no outside funding.

RESULTS

Improvement in Life Expectancy at Birth after National Health Insurance

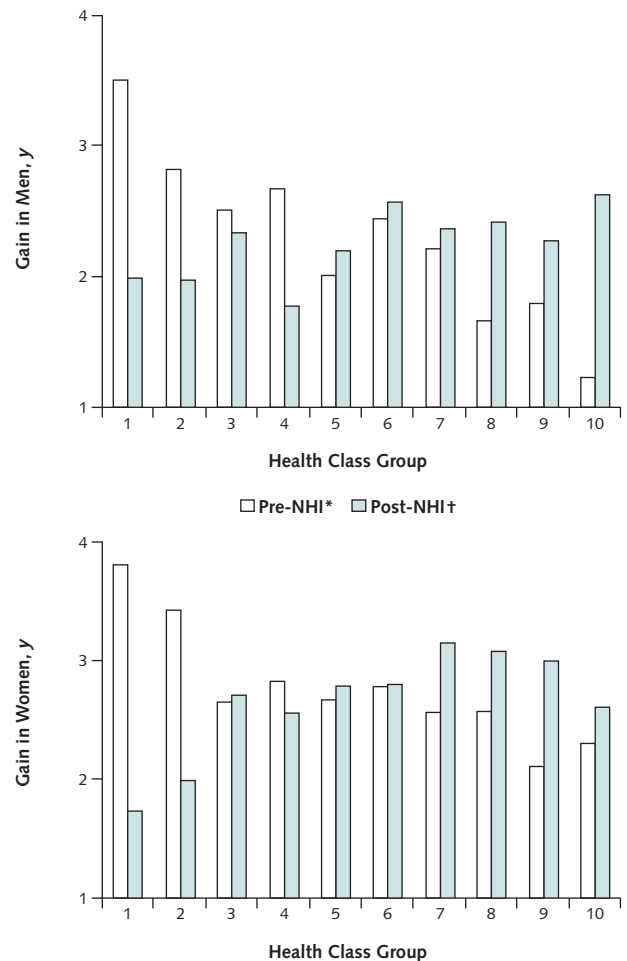
Life expectancy in all 10 health class groups substantially improved both before and after the introduction of national health insurance (Table 1 and Appendix Figure, available at www.annals.org). For Taiwan as a whole, the 2.39-year gain in life expectancy for men during the period after the introduction of national health insurance (from 71.83 years in 1992–1994 to 74.22 years in 2002–2004) was larger than the 2.27-year gain during the period before the introduction of national health insurance (from 69.56 years in 1982–1984 to 71.83 years in 1992–1994.) This overall 0.12-year (95% CI, –0.13 to 0.37 year) gain in men after the introduction of national health insurance did not differ statistically from no change. Similarly, the overall 0.05-year (CI, –0.22 to 0.32 year) gain in women did not differ statistically from no change.

Although the rate of gain in life expectancy did not change in the country as a whole after national health insurance, life expectancy increased faster in lower health class groups than in higher health class groups. For the bottom 3 to 4 health class groups (groups 7 to 10), the rate of gain in life expectancy was higher during the period after the introduction of national health insurance than during the period before. In addition, the rate of gain in the top 4 health class groups (groups 1 to 4) slowed considerably (Table 1 and Figure 1). For example, in health class group 8, the 2.40-year gain during the period after the introduction of national health insurance in men was greater than the 1.66-year gain during the period before the introduction of national health insurance. Figure 2 shows gains in life expectancy before and after the introduction of national health insurance. The change in life expectancy after the introduction of national health insurance increased linearly, with an increase in health class group mortality rates (groups 1 to 10) ($P < 0.001$ for men, $P = 0.002$ for women [test for linear trend]). The patterns remained the same after exclusion of health class groups 1 and 10.

Reduction in Disparities

The gap in life expectancy in men in health class group 1 (the healthiest) and health class group 10 (the least healthy) was 8.37 years in 1982–1984. The gap increased to 10.65 years in 1992–1994 but decreased to 10.03 years in 2002–2004 (Figure 3). This 0.62-year reduction during the period after national health insurance constituted 6% of the existing gap (10.03 years). This pattern of first widening and then narrowing before and after national health insurance was also observed for the gaps between health class group 1 versus the remaining health class groups, except for health class groups 2 and 4. A similar pattern was also seen for women. The size of reduction in disparity during the period after national health insurance was larger for women than for men (Table 1 and Figure 3).

Figure 1. Gain in life expectancy during the period before (1982–1984 to 1992–1994) and after (1992–1994 to 2002–2004) the introduction of national health insurance (NHI).



*Increase in life expectancy during the period before NHI (from 1982–1984 to 1992–1994). †Increase in life expectancy during the period after NHI (from 1992–1994 to 2002–2004).

Additional Analysis

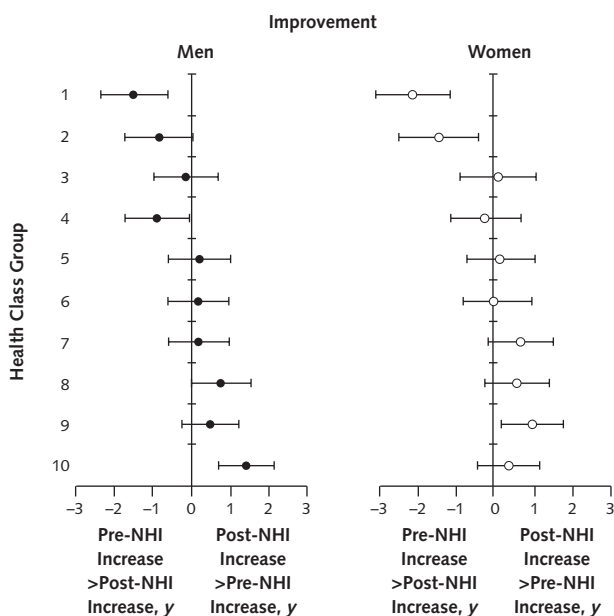
The patterns of the effect of national health insurance (faster gain in life expectancy and greater reduction in disparity in the least healthy health class groups) remained the same when we formed 3 broad health class groups (Table 2) from the 10 health class groups shown in Table 1. Calculated through use of data on life expectancy at birth, changes in life expectancy after the introduction of national health insurance were substantially greater than those before the introduction of national health insurance for the low health class groups (groups 8 to 10) for both men and women, but the gain in life expectancy slowed for the high health class groups (groups 1 to 3). At age 45 years, the same pattern persisted.

Similarly, the disparity reduced substantially for both sexes in groups 8 to 10. The gap for groups 4 to 7 also reduced substantially for women. Men had a much smaller reduction in disparities when we calculated life expectancy among those who survived to age 45 years, presumably because injury deaths, which are more common in younger men, contributed substantially to disparity reduction.

Cause-Specific Contribution to Change in Life Expectancy

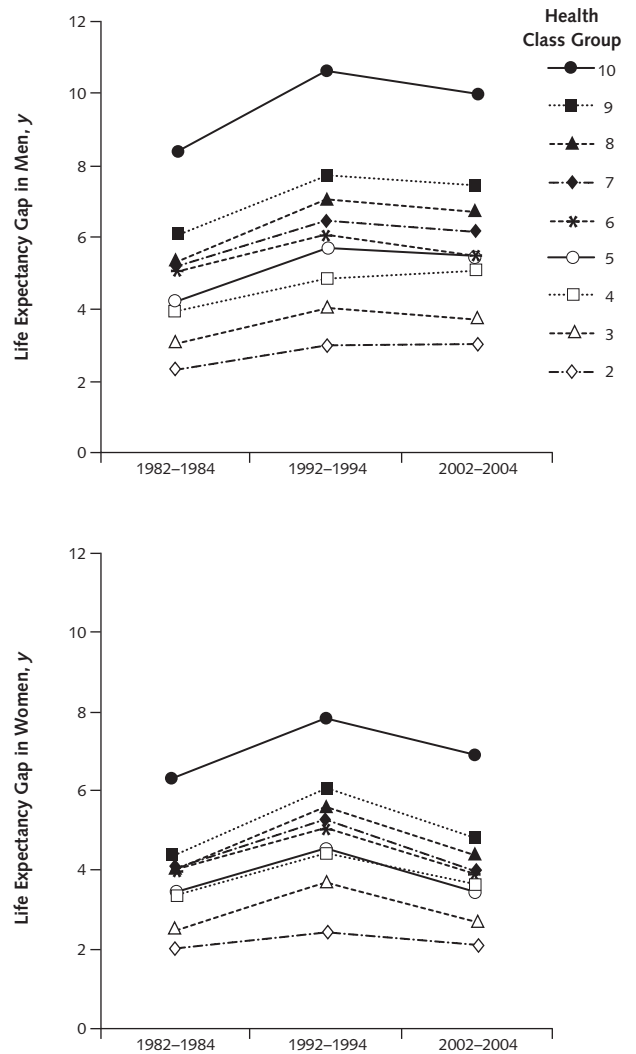
We evaluated the net change in death attributable to various causes of death in the high, medium, and low health class groups after the introduction of national health insurance (Figure 4; detailed data in Appendix Tables 2 and 3, available at www.annals.org). The gain from reduced deaths because of a decline in cardiovascular disease was smaller for health class groups 1 to 3 after the introduction of national health insurance but increased for health class groups 8 to 10. Other causes of death that showed similar patterns were accidental deaths and ill-defined conditions. On the other hand, death from cancer increased in all 3 groups but increased more for the lowest-ranked health class groups and offset some of the gains from other causes. The patterns were similar for women but with a larger positive contribution from cardiovascular diseases and smaller negative contribution from cancer deaths.

Figure 2. Difference between changes in life expectancy at birth before and after the introduction of national health insurance (NHI).



Pre-NHI was 1982–1984 to 1992–1994, and post-NHI was 1992–1994 to 2002–2004. Error bars represent 95% CIs.

Figure 3. Gaps in life expectancy for health class groups 2 to 10 versus health class group 1.



Socioeconomic and Lifestyle Differences between the Healthiest and Unhealthiest Groups

To examine why health class group 10 continued to have poorer health, we compared the socioeconomic and lifestyle factors in health class groups 1 and 10 (Table 3). The per capita income for residents in health class group 10 (\$8085) was about half that of health class group 1 (\$15 679). The lifestyle risk factors, including smoking (51% vs. 36%), betel quid chewing (33% vs. 6%), and obesity (9% vs. 5%), were more prevalent among male residents in health class group 10 than among their counterparts in health class group 1. They also consumed 4 times as much alcohol and had 4 times higher mortality rates from accidental injuries. In addition, health class group 10 used more health care services than health class group 1, with 31% more office visits (14.0 vs. 10.7 visits

per person) and 9% more hospital admissions (14.2 vs. 13.0 hospital admissions per 100 persons).

National Health Insurance: Utilization and Expenditures

Averaging 14.2 visits in 2004, Taiwanese people made 12.6 visits to Western medicine facilities and 1.6 visits to traditional Chinese or herbal medicine practitioners, an independent practice from Western medicine. Women made 21% more visits than men, and elderly persons made more than twice the average number of visits (**Appendix Tables 4 and 5**, available at www.annals.org). National health insurance also covers dental services. Outpatient services accounted for nearly two thirds (60%) of national health insurance expenditure. Each visit generated an average of 4.1 prescriptions. The length of hospital stay increased slightly from 9.4 days to 9.7 days, and inpatient admission rates increased by 35%, from 10.1 to 13.6 admissions per 100 persons, during the 10-year period. Admission rates after the introduction of national health insurance nearly tripled for those who were uninsured before the introduction of national health insurance and remained stable among those who were insured before the introduction of national health insurance (1–3).

With an average income of \$15 170 in 2004, the average Taiwanese person spent \$926 on health care, an increase from \$548 the year before the introduction of national health insurance (**Table 4**). Health care expenditures comprised 5.1% of gross national product in 1994 and

6.2% in 2004. The sources of national health insurance revenues were individual premiums (38%), employer contributions (35%), and government subsidies (26%). Expenditures under national health insurance were 57% of national health expenditure in 1995 and 53% in 2005.

DISCUSSION

This study shows that people in poorer health improved more than people in good health after the introduction of national health insurance, narrowing the disparity and reversing an earlier widening trend. However, the amount of narrowing was small (for example, 0.62 year or 6% for men in health class group 10) compared with the size of the existing gap (10.03 years). Expecting national health insurance to eliminate the remaining gap (94%) is not realistic.

When universal health insurance was first introduced in Taiwan, public health and medical professionals assumed that national health insurance would achieve its twin goals of accelerating health improvement and reducing health disparity (1, 4). The 10-year experience showed that the rate of health improvement increased, but only in the lower health classes, and health disparity decreased, but not by very much. Although the lowest health class group used more medical services and had larger gains in life expectancy—seemingly an accomplishment of national health insurance—we need to be cautious about conclud-

Table 2. Difference between Life Expectancy at Birth and at Age 45 Years before and after the Introduction of National Health Insurance and Change in Disparity for 3 Broad Health Classes (High, Medium, and Low)*

Broad Health Class	LE (±SE), y			10-Year Change in LE, y		Difference in 10-Year Change in LE before and after NHI	10-Year Change in Disparity after NHI
	1982–1984	1992–1994	2002–2004	Before NHI†	After NHI‡		
At birth							
Men							
High (HCG 1–3)	72.42 ± 0.14	75.34 ± 0.12	77.39 ± 0.11	2.92	2.05	–0.87§	–
Medium (HCG 4–7)	69.50 ± 0.11	71.85 ± 0.10	74.09 ± 0.09	2.35	2.24	–0.11	0.19
Low (HCG 8–10)	67.44 ± 0.12	69.04 ± 0.11	71.54 ± 0.10	1.60	2.50	0.90§	0.45
Women							
High (HCG 1–3)	76.77 ± 0.16	80.05 ± 0.14	82.19 ± 0.11	3.28	2.14	–1.14§	–
Medium (HCG 4–7)	74.51 ± 0.12	77.21 ± 0.11	80.02 ± 0.09	2.70	2.81	0.11	0.67
Low (HCG 8–10)	73.18 ± 0.13	75.51 ± 0.11	78.42 ± 0.11	2.33	2.91	0.58§	0.77
At age 45 y							
Men							
High (HCG 1–3)	30.48 ± 0.14	33.25 ± 0.12	34.74 ± 0.10	2.77	1.49	–1.28§	–
Medium (HCG 4–7)	28.48 ± 0.11	30.39 ± 0.09	31.98 ± 0.08	1.91	1.59	–0.32	0.10
Low (HCG 8–10)	27.20 ± 0.11	28.52 ± 0.10	30.23 ± 0.09	1.32	1.71	0.39§	0.22
Women							
High (HCG 1–3)	33.75 ± 0.16	36.76 ± 0.13	38.62 ± 0.11	3.01	1.86	–1.15§	–
Medium (HCG 4–7)	31.94 ± 0.12	34.13 ± 0.10	36.64 ± 0.09	2.19	2.51	0.32	0.65
Low (HCG 8–10)	30.99 ± 0.12	32.79 ± 0.10	35.37 ± 0.09	1.80	2.58	0.78§	0.72

* HCG = health class group; LE = life expectancy; NHI = national health insurance.

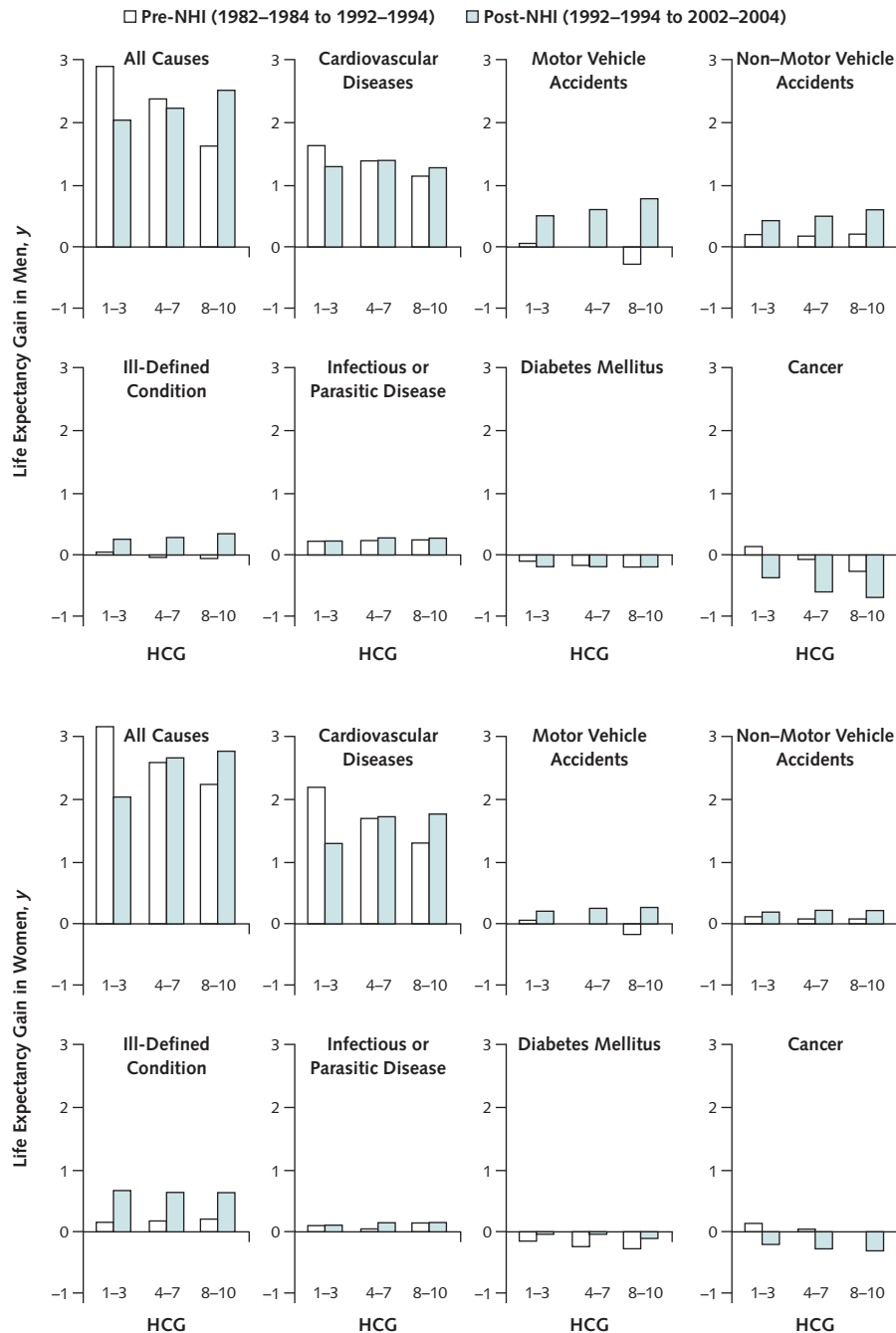
† Increased between 1982–1984 and 1992–1994.

‡ Increased between 1992–1994 and 2002–2004.

§ *P* < 0.05 for difference before and after NHI in 10-year change in LE.

|| *P* < 0.050 for difference relative to HCG 1 in 10-year change in LE after NHI.

Figure 4. Cause-specific contribution to gain in life expectancy during the period before and after the introduction of national health insurance (NHI).



HCG = health class group. Results are based on a modified cause-deletion life-table method, which assumes independence for each cause of death. Not all possible causes of death are included. Bars extending below the horizontal axis indicate that deaths from those causes contributed to reduced life expectancy, whereas bars extending above the horizontal axis contributed to improved life expectancy.

ing that national health insurance caused these changes. For example, it is difficult to link changes in mortality rate from specific causes to purported effects of national health insurance, such as improving access and quality of care. Death from ill-defined conditions, infectious diseases, and

cardiovascular diseases decreased, as expected. It is reassuring that the lower-ranked health class groups had greater improvement in cardiovascular diseases (Figure 4), which is the major contributor to the reduction in disparity. However, death from cancer and diabetes increased. In

Table 3. Comparison of Selected Statistics between Health Class Groups 1 and 10 in 2004

Statistics	Taipei City (Surrogate for Health Class Group 1)	Taitung County (Surrogate for Health Class Group 10)
Life expectancy at birth (2002–2004), y	79.62*	69.59*
Per capita income, \$†	15 679	8085
Average physician visits per person, n‡	10.7	14.0
Hospital admission rate per 100 persons‡	13.0	14.2
Smoking prevalence, %§		
Men	35.9	51.4
Women	5.6	15.2
Alcohol consumption per person (men), units/mol	28.5	120.8
Betel quid–chewing prevalence, %§		
Men	6.0	32.6
Women	0.1	19.6
Obesity (body mass index ≥ 30 kg/m ²), %¶		
Men	4.9	7.3
Women	3.6	7.2
Accident mortality rates per 100 000 population**		
Men	21.5*	98.3*
Women	9.1*	34.1*

* Data from health class group 1 and health class group 10.

† Data from national income in Taiwan area of the Republic of China, 2004. Exchange rate is \$1.00 = 31.36 yuan (Taiwan dollar) as of 31 December 2004.

‡ Data from National Health Insurance Annual Statistical Report 2004.

§ Data from references 43, 44, and 48 and the 2001/2005 National Health Interview Survey, Taiwan.

|| Data from reference 32. 1 unit = 8 g for pure alcohol; 284 mL for beer of 3.5%; and 25 mL for liquor of 40%.

¶ Data from 2005 National Health Interview Survey, Taiwan.

** Age-adjusted to 2000 Taiwan population.

fact, national health insurance was not designed to reduce disease incidence, such as cancer, and people in the lower-ranked health class group had more cancer or diabetes risk factors. Furthermore, a reduction in motor vehicle accidents was an important contributor to the disparity reduction. The implementation of the helmet law for motorcyclists in 1997 (33, 34) has primarily affected people in the lower socioeconomic groups (35).

Health care expenditure grew at a pace similar to the growth of the economy, despite a substantial increase in

utilization of medical services (8). Cost containment (spending at a rate equivalent to one seventh of that of the United States), while keeping abreast of state-of-the-art technology, has been acclaimed as a remarkable achievement for Taiwan (7), especially as life expectancy in Taiwan is similar to the United States (19). Access to health care expanded without causing long waiting times.

Frequent office visits, averaging 14 visits a year, are a hallmark of the period after the introduction of national health insurance in Taiwan. Expenditures for outpatient

Table 4. National Health Care Expenditures in Taiwan*

Items	1994†	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NHEs											
Per capita NHE, \$	548	619	663	706	749	802	818	841	871	908	926
NHE relative to gross domestic product, %	5.1	5.5	5.4	5.4	5.5	5.7	5.7	6.0	6.0	6.2	6.2
National health insurance											
Population enrolled, %	57	90	93	94	95	95	96	97	97	97	98
Expenditures, \$											
Per capita	212	293	373	388	419	446	442	459	496	514	580
Outpatient	–	192	251	263	286	305	298	307	327	326	359
Inpatient	–	101	122	125	133	142	144	152	169	189	221
Revenue											
Individual premium, \$ (%)	–	117 (33)	145 (37)	151 (38)	158 (39)	161 (39)	168 (39)	170 (40)	173 (39)	183 (38)	186 (38)
Employer contribution, \$ (%)	–	131 (37)	132 (34)	129 (33)	133 (33)	136 (33)	142 (33)	138 (32)	148 (33)	170 (35)	173 (35)
Government subsidy, \$ (%)	–	107 (30)	113 (29)	111 (29)	113 (28)	115 (28)	120 (28)	120 (28)	121 (27)	128 (27)	130 (26)
Total revenue, \$	–	355	390	391	404	412	430	428	442	481	489

* National health expenditure data are from Statistics of Final Expenditure for Health, 1991 to 2004. National health insurance data are from Financial Status of the Bureau of National Health Insurance, 1995 to 2005. All expenditures are at exchange rates of \$1.00 = 31.36 yuan (Taiwan dollar) as of 31 December 2004 and are adjusted by consumer price index with year 2001 as base (www.dgbas.gov.tw/public/data/dgbas03/bs3/inquire/cpisp1.xls). NHE = national health expenditure.

† Before national health insurance.

care exceed inpatient care expenditures by a 2:1 ratio. The increase in office visits may be a reflection of the Taiwanese public's perception of how to stay well, by relying more on office visits and medicines than on pursuing a healthier lifestyle. McKeown (36) reported the limited contribution of "medical care" to population health a quarter century ago. His unorthodox concept has received increasing support over the ensuing years (37–40), and the experience in this study and in a recent elderly cohort (6) after national health insurance was implemented adds additional evidence. Ensuring medical care for all, through adopting universal insurance, remains an unrealized goal for countries like the United States. However, traditional medical care per se has only a limited effect on life expectancy, perhaps 10% to 15%, when other determinants of a developed nation's health are taken into account (41). Compared with lifestyle factors (42), medical care has a limited effect on disease incidence, especially for cancer.

The disparity gap decreased more for women (13%) than for men (6%) after the introduction of national health insurance. This difference could be due to sex difference in lifestyle risk factors. Two risk behaviors among men in Taiwan, smoking and betel quid chewing, remained high after the introduction of national health insurance. Every second middle-aged man is a smoker (43) and every fourth is a chewer (44, 45). The rates of smoking and chewing remained much higher in health class group 10 than in health class group 1, which could account for the large increases in lung and oral cancer in the lower socioeconomic groups and the relatively small reduction in health disparities after national health insurance (46, 47). National health insurance did not provide incentives to stop smoking or chewing. We hope that Taiwan adopts policies to promote disease prevention as a key strategy to reduce health disparities (48). We believe that a government policy of universal health insurance has the distinct advantage of being able to devote resources to prevention and other long-term goals without pressure to respond to short-term financial results.

Our study has important limitations. First, it used the methods of observational research, which means that we cannot be certain that changes after the introduction of national health insurance were due to national health insurance. Second, more than half (57%) of the population had medical insurance at the start of national health insurance, which may have diluted the effect of national health insurance, although those who gained insurance were mainly the elderly and the vulnerable, many of whom were in the least healthy health class groups. Third, in some instances, we did not have similar data before and after the introduction of national health insurance to adjust for the possible effects of unrelated social changes on life expectancy. For example, social changes, such as the helmet law for motorcyclists, probably improved life expectancy. Fourth, quality of care after the introduction of national health insurance varied across health class groups: Higher-

ranked health class groups were primarily found in urban areas, which have superior health care facilities (49). Fifth, life expectancy is an imperfect health indicator. It is widely used and easily understood (20) but not sufficiently sensitive to the effect of specific causes of deaths, forcing us to use analytic methods that assume that causes of death are independent of one another. In addition, income, education, and the environment all contribute to life expectancy, and the contribution of access to health care in Taiwan to improvements in life expectancy is unknown. Therefore, using life expectancy as a summary measure may miss effects of improved access to care due to national health insurance. Sixth, the value of national health insurance goes far beyond prolongation of life, which is the only indicator of health in this study. It can relieve pain and suffering, improve quality of life, provide emotional security, and increase human dignity. Finally, a 10-year period may be too brief to measure the full effect of national health insurance. However, this shortcoming is partially offset by comparing the period after the introduction of national health insurance with an additional 10 years before its introduction.

In conclusion, health improved countrywide after the introduction of national health insurance in Taiwan, but the change was small when superimposed on a rising secular trend. National health insurance had strong support from the public (50), and utilization of health services increased after the introduction of national health insurance. Life expectancy increased more rapidly in the lower-ranked health class groups than in the higher ones, and therefore narrowed the gaps in disparity, albeit by a small proportion of the entire gap. The groups with poorer health had a relatively greater reduction in death from cardiovascular diseases, followed by ill-defined conditions, infectious diseases, and accident trends that were somewhat offset by increased cancer deaths as a result of a higher prevalence of lifestyle-related risk factors. To further reduce health disparity, universal insurance programs should incorporate primary prevention, focusing on lifestyle risk reductions.

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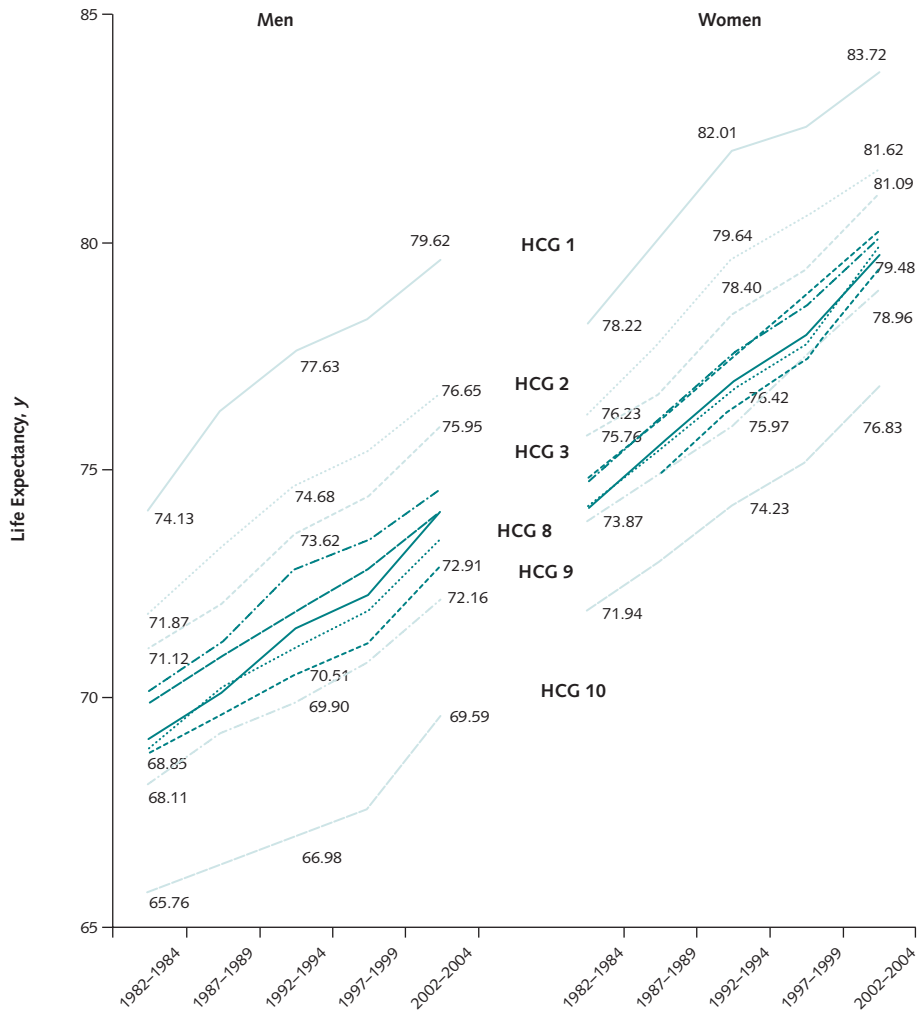
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*Appendix Table 1. Population, Number of Townships, and Range of Standardized Mortality Ratios for the 10 Health Class Groups**

HCG	Townships, <i>n</i>	Average Population in 1992–1994, <i>n</i>	Average Population in 2002–2004, <i>n</i>	SMR Range of All Causes of Death in 1992–1994
1	9	2 189 663	2 169 871	0.57–0.77
2	15	2 089 741	2 284 894	0.78–0.86
3	15	2 288 714	2 680 124	0.86–0.91
4	27	2 114 742	2 505 384	0.92–0.96
5	31	2 123 385	2 332 915	0.96–1.00
6	35	2 026 956	2 210 821	1.00–1.04
7	34	2 037 641	2 118 030	1.04–1.06
8	40	2 011 970	2 135 985	1.06–1.10
9	55	2 024 168	2 132 872	1.10–1.17
10	97	2 031 454	1 963 017	1.17–3.19
Taiwan	358	20 938 432	22 533 914	1.00

* HCG = health class group; SMR = standardized mortality ratio.

Appendix Figure. Secular trends of life expectancy at birth for the 10 health class groups (HCGs), 1982–1984 to 2002–2004.



Appendix Table 2. Decomposition of Gap during the Period before the Introduction of National Health Insurance, 1982–1984 to 1992–1994*

Variable	Men			Women		
	HCG 1–3	HCG 4–7	HCG 8–10	HCG 1–3	HCG 4–7	HCG 8–10
Life expectancy at birth in 1992–1994, y	75.34	71.85	69.04	80.05	77.21	75.51
Life expectancy at birth in 1982–1984, y	72.42	69.50	67.44	76.77	74.51	73.18
Life expectancy increase from 1982–1984 to 1992–1994, y (%)	2.92 (100)	2.35 (100)	1.60 (100)	3.28 (100)	2.70 (100)	2.33 (100)
Major causes of death contributing to gap (ICD-9 codes), y (%)						
Infectious/parasitic diseases (001–139)	0.21 (7.1)	0.18 (7.8)	0.22 (14.0)	0.10 (3.0)	0.06 (2.3)	0.15 (6.6)
Cancer (140–208)	0.14 (4.9)	−0.06 (−2.6)	−0.23 (−14.6)	0.11 (3.3)	0.03 (1.1)	0.01 (0.4)
Diabetes mellitus (250)	−0.10 (−3.4)	−0.14 (−6.1)	−0.16 (−10.2)	−0.16 (−5.0)	−0.24 (−8.8)	−0.28 (−11.9)
Nervous system or sense organs diseases (320–389)	0.03 (1.1)	0.02 (0.9)	0.01 (0.6)	0.04 (1.3)	0.03 (1.1)	0.04 (1.8)
Cardiovascular diseases (390–459)	1.65 (56.3)	1.40 (59.6)	1.16 (72.6)	2.32 (70.6)	1.79 (66.4)	1.36 (58.4)
Respiratory system diseases (460–519)	0.26 (9.0)	0.21 (9.1)	0.24 (15.3)	0.26 (7.9)	0.26 (9.5)	0.38 (16.4)
Digestive system diseases (520–579)	0.20 (6.7)	0.17 (7.4)	0.09 (5.7)	0.10 (3.0)	0.12 (4.6)	0.10 (4.4)
Genitourinary system diseases (580–629)	0.02 (0.7)	0.07 (3.0)	0.04 (2.5)	−0.03 (−1.0)	0.04 (1.5)	0.05 (2.2)
Symptoms, signs, and ill-defined conditions (780–799)	0.04 (1.5)	−0.02 (−0.9)	−0.04 (−2.5)	0.14 (4.3)	0.18 (6.5)	0.20 (8.4)
Accidents (E800–E949)	0.27 (9.3)	0.15 (6.5)	−0.05 (−3.2)	0.16 (5.0)	0.04 (1.5)	−0.10 (−4.4)
Motor vehicle accidents (E810–E825)	0.07 (2.2)	0 (0)	−0.24 (−15.3)	0.05 (1.7)	−0.02 (−0.8)	−0.18 (−7.5)
Non-motor vehicle accidents (E800–E809, E826–E949)	0.21 (7.1)	0.15 (6.5)	0.19 (12.1)	0.11 (3.3)	0.06 (2.3)	0.07 (3.1)
Intentional self-harm (E950–E959)	0.11 (3.7)	0.17 (7.4)	0.20 (12.7)	0.10 (3.0)	0.18 (6.5)	0.23 (9.7)
Other	0.09 (3.0)	0.18 (7.8)	0.11 (7.0)	0.15 (4.6)	0.21 (7.6)	0.19 (8.0)

* HCG = health class group; ICD-9 = International Classification of Disease, Ninth Revision.

Appendix Table 3. Decomposition of Gap during the Period after the Introduction of National Health Insurance (NHI), 1992–1994 to 2002–2004*

Variable	Men			Women		
	HCG 1–3	HCG 4–7	HCG 8–10	HCG 1–3	HCG 4–7	HCG 8–10
Life expectancy at birth in 2002–2004, y	77.39	74.09	71.54	82.19	80.02	78.42
Life expectancy at birth in 1992–1994, y	75.34	71.85	69.04	80.05	77.21	75.51
Life expectancy increase from 1992–1994 to 2002–2004, y (%)	2.05 (100)	2.24 (100)	2.50 (100)	2.14 (100)	2.81 (100)	2.91 (100)
Major causes of death contributing to gap (ICD-9 codes), y (%)						
Infectious/parasitic diseases (001–139)	0.17 (8.5)	0.26 (11.7)	0.26 (10.5)	0.10 (4.5)	0.17 (5.9)	0.17 (5.8)
Cancer (140–208)	−0.34 (−16.4)	−0.53 (−23.8)	−0.62 (−24.7)	−0.20 (−9.4)	−0.28 (−10.0)	−0.30 (−10.4)
Diabetes mellitus (250)	−0.17 (−8.5)	−0.16 (−7.0)	−0.19 (−7.5)	−0.04 (−1.8)	−0.03 (−1.1)	−0.12 (−4.0)
Nervous system or sense organs diseases (320–389)	−0.03 (−1.5)	0 (0)	0.02 (0.8)	−0.04 (−1.8)	−0.01 (−0.4)	−0.01 (−0.4)
Cardiovascular diseases (390–459)	1.27 (62.2)	1.40 (62.6)	1.30 (51.9)	1.36 (63.7)	1.83 (65.2)	1.86 (64.0)
Respiratory system diseases (460–519)	0.00 (0)	−0.03 (−1.4)	−0.04 (−1.7)	0.06 (2.7)	0.04 (1.5)	0.09 (3.2)
Digestive system diseases (520–579)	0.13 (6.5)	0.14 (6.1)	0.20 (7.9)	−0.01 (−0.4)	0.07 (2.6)	0.14 (4.7)
Genitourinary system diseases (580–629)	0 (0)	0 (0)	0 (0)	−0.08 (−3.6)	−0.08 (−3.0)	−0.09 (−3.2)
Symptoms, signs, and ill-defined conditions (780–799)	0.25 (12.4)	0.27 (12.1)	0.36 (14.2)	0.70 (32.7)	0.67 (23.7)	0.69 (23.7)
Accidents (E800–E949)	0.90 (43.9)	1.09 (48.7)	1.37 (54.8)	0.40 (18.7)	0.48 (17.1)	0.51 (17.5)
Motor vehicle accidents (E810–E825)	0.50 (24.4)	0.61 (27.1)	0.79 (31.8)	0.18 (8.5)	0.24 (8.5)	0.26 (9.0)
Non-motor vehicle accidents (E800–E809, E826–E949)	0.40 (19.4)	0.48 (21.5)	0.58 (23.0)	0.22 (10.3)	0.24 (8.5)	0.25 (8.6)
Intentional self-harm (E950–E959)	−0.18 (−9.0)	−0.25 (−11.2)	−0.20 (−7.9)	−0.10 (−4.5)	−0.10 (−3.7)	−0.10 (−3.6)
Other	0.04 (2.0)	0.05 (2.3)	0.04 (1.7)	−0.02 (−0.9)	0.06 (2.2)	0.07 (2.5)

* HCG = health class group; ICD-9 = International Classification of Diseases, Ninth Revision.

Appendix Table 4. Outpatient and Inpatient Medical Care Utilization and Expenditure under National Health Insurance in Taiwan, 1995 to 2004*

Year	Outpatient†			Inpatient†				
	Total Physician Visits per Person‡	Expenditure per Visit, \$\$	Expenditure for Medication, %	Total NHI Expenditure, %¶	Admission Rate per 100 Persons	Average Length per Stay, d	Hospital Stays per 1000 Population	Expenditure per Admission, \$
1995	11.9 (1.2)**	15.9	–	62	10.1	9.4	1155**	938
1996	12.7 (1.3)	16.7	–	64	11.7	9.0	1058	1018
1997	13.3 (1.3)	16.9	35.1	65	11.6	8.8	1017	1045
1998	13.9 (1.3)	17.8	35.8	65	11.8	8.8	1039	1111
1999	14.2 (1.4)	18.4	37.5	64	12.3	8.7	1066	1151
2000	13.6 (1.3)	18.7	37.8	63	12.6	8.7	1097	1163
2001	13.4 (1.3)	19.6	37.4	62	13.0	8.8	1148	1185
2002	13.4 (1.3)	21.0	36.4	61	13.5	9.0	1219	1249
2003	13.2 (1.4)	22.0	36.7	61	12.4	9.6	1199	1382
2004	14.2 (1.6)	22.8	37.3	60	13.6	9.7	1319	1496

* All expenditures (claims) are in U.S. dollars at an exchange rate of \$1.00 = 31.36 yuan (Taiwan dollar) as of 31 December 2004. NHI = national health insurance.
 † Data from National Health Insurance Annual Statistical Report 1995–2004.
 ‡ Values in parentheses are numbers of visits to Chinese medicine clinics.
 § Physician fees, laboratory charges, and drugs are included in expenditures.
 || Prescribed medication included in percentage of total outpatient expenditure.
 ¶ Outpatient costs are part of the percentage of total expenditure.
 ** Data are estimates for 12 months.

Appendix Table 5. Number and Expenditure of Physician Visits per Person in 2004, by Age*

Age	Total		Men		Women	
	Average Physician Visits per Person, n	Average Expenditure per Visit, \$	Average Physician Visits per Person, n	Average Expenditure per Visit, \$	Average Physician Visits per Person, n	Average Expenditure per Visit, \$
0–4 y	25.5	13.8	26.6	14.1	24.3	13.4
5–9 y	15.0	14.8	15.6	15.3	14.4	14.2
10–29 y	9.0	18.6	7.8	20.4	10.1	17.2
30–49 y	11.6	24.9	9.3	28.6	13.9	22.4
50–64 y	17.5	34.9	15.0	38.1	20.0	32.5
≥65 y	28.5	38.8	27.9	39.6	29.0	38.1
Total	14.2	26.3	12.9	28.2	15.6	24.8

* All expenditures in U.S. dollars at exchange rate of \$1.00 = 31.36 yuan (Taiwan dollar) as of 31 December 2004.