BRIEF COMMUNICATION

Comparing Child Mortality in Taiwan and Selected Industrialized Countries

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This study compares the mortality rates of children in Taiwan with selected industrialized countries, and identifies the explanations of cross-national variations. We ranked all comparison countries by infant mortality rate (IMR) and under-five mortality rate (U5MR). Multiple regression models were used to examine the relationship of child mortality with gross domestic product, national health expenditure, public social expenditure, and Gini coefficient. For 2002, the IMR and U5MR in Taiwan were 6‰ and 8‰, respectively, both ranking 20th among 21 industrialized countries. In explaining cross-national differentials in child mortality, we found that Gini coefficient, an indicator of income inequality, was positively associated with IMR and U5MR, and that social expenditure was negatively associated with U5MR. Our study shows that prevention of child mortality in Taiwan has not yet reached the highest attainable standard, and underscores the importance of a fairer income distribution and social investment in child health care. [*J Formos Med Assoc* 2007;106(2):177–180]

Key Words: child mortality, cross-national comparison, Taiwan

Taiwan has witnessed substantial progress in child health. The infant mortality rate (IMR) in Taiwan declined from 9.8‰ in 1980 to 4.9‰ in 2003,[1] and under-five mortality rate (U5MR) from 11.0‰ to 5.2‰ during the same period.[2] Nonetheless, it remains unanswered as to whether or not Taiwan has attained a desirable level of child health compared to other industrialized countries. Further, Taiwan may learn policy implications for improving the health of children, from identifying the factors accounting for cross-national variations in child mortality. Therefore, we aimed to rank the child health position of Taiwan, relative to selected industrialized countries, and to examine macro-level factors possibly explaining the disparities in child health among countries under comparison.

Methods

We selected 20 industrialized countries for comparison based on the following criteria: (1) complete vital statistics, representing at least 95% of events occurring each year;[3] (2) Organization for Economic Cooperation and Development (OECD) members with per capita gross national income ≥ US$9076 in 2002; (3) > 50,000 births in 2002; and (4) U5MR < 10 per 1000 live births in 2002. The selected countries were Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, The Netherlands, New Zealand, Norway, Spain, Sweden, Switzerland, USA, and UK.

The child health indicators that we focused on were IMR and U5MR. IMR is the number of

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deaths occurring under 1 year of age per 1000 live births. U5MR refers to the probability of a child dying before reaching 5 years of age, expressed as rate per 1000 live births.

We collected a wide range of socioeconomic and health-related indicators at the national level that previous literature has found to be associated with the child health of a defined population. Taking into consideration the small number of study cases and the statistical problem of multicollinearity, we finally included four independent variables in the multivariate analysis to represent different dimensions of child health determinants. Our measure of economic development was the gross domestic product (GDP) per capita in international dollars at purchasing power parity rate (PPP), with a natural logarithmic transformation. Gini coefficient was adopted to reflect the level of income inequality within a country. A value of 0 represents perfect equality and 100 as perfect inequality. To capture the overall resources for health care, we considered the ratio of total health expenditure to GDP. With respect to public provision of benefits targeted at household and individuals during adverse circumstances, social expenditure as a percentage of GDP was obtained.

Data concerning health and social characteristics in the 20 countries came from several sources: UNICEF's *The State of the World's Children 2004*,[4] United Nations' *Demographic Yearbook* for IMR,[5] *The World Health Report 2004* for the U5MR and total expenditure on health,[6] United Nations' *The Human Development Report 2004* for Gini coefficient,[7] and OECD social expenditure database for public social expenditure.[8] All data were for 2002, except for the Gini coefficient for which we used the most recent estimates, ranging from 1998 to 2002. For Taiwan, data on mortality and total health expenditure were taken from the *2003 Health and Vital Statistics*;[9] estimates of GDP per capita at PPP from the *Bulletin of Statistics of Taiwan*,[10] and Gini coefficient and public social expenditure from the *2004 Taiwan Statistics Fact Book*.[11]

For the first objective of addressing the state of child health in Taiwan, we ranked IMR and U5MR respectively from the lowest to the highest among the 21 countries. To further examine what macro-level factors may possibly account for the variations in child mortality, two regression models were constructed by using PROC REG in SAS (SAS, Cary, NC, USA). We took the logit values of IMR and U5MR, which were further regressed on GDP per capita at PPP, total health expenditure and social expenditure in Model 1, with the Gini coefficient additionally included in Model 2. To avoid potential fluctuations in aggregated estimates resulting from differences in the annual number of live births, regression analyses were weighted by the number of live births.

Results

The current position of each country with regard to IMR and U5MR is presented in Table 1. The IMR ranged from 2.8‰ in Sweden to 6.7‰ in the USA. Taiwan ranked the 20th, with a rate of 6.0‰. In the case of U5MR, the range was 3–8‰, with Sweden in first place and Taiwan ranked last together with the USA.

Table 2 provides the results of the regression analyses. In Model 1, IMR was positively associated with total health expenditure ($p=0.03$) while U5MR was negatively associated with social expenditure ($p=0.01$). After introducing the Gini coefficient into the equation (Model 2), the relationship between IMR and health expenditure no longer existed, and Gini coefficient was found to be positively associated with IMR ($p<0.001$). Model 2 also revealed that U5MR was positively associated with Gini coefficient ($p=0.01$), and that its association with social expenditure remained significant but slightly reduced ($p=0.03$). In all models, GDP per capita and total health expenditures were not significantly associated with either IMR or U5MR.

Discussion

Despite Taiwan enjoying a very low IMR and U5MR, this study indicates that, compared with wealthy industrialized countries, there remains

Table 1. Ranking of child health in Taiwan and 20 comparison countries in 2002

Infant mortality rate			Under-five mortality rate		
Rank	Country	Rate (‰)	Rank	Country	Rate (‰)
1	Sweden	2.8	1	Sweden	3
2	Japan	3.0	2	Denmark	4
3	Finland	3.2	2	Norway	4
4	Norway	3.4	4	Austria	5
5	Spain	3.7	4	Finland	5
6	France	4.1	4	Germany	5
6	Germany	4.1	4	Greece	5
8	Belgium	4.4	4	Japan	5
8	Denmark	4.4	4	The Netherlands	5
8	Switzerland	4.4	10	Australia	6
11	Austria	4.5	10	Belgium	6
12	Australia	4.7	10	France	6
13	Italy	4.8	10	Ireland	6
13	The Netherlands	4.8	10	Italy	6
15	Ireland	5.1	10	New Zealand	6
16	Canada	5.2	10	Spain	6
17	United Kingdom	5.3	10	Switzerland	6
18	New Zealand	5.6	18	Canada	7
19	Greece	5.9	18	United Kingdom	7
20	Taiwan	6.0	20	Taiwan	8
21	United States	6.7	20	United States	8

Table 2. Logit regression analyses of infant mortality and under-five mortality (standard error is provided in parentheses) ($n = 21$)

	Infant mortality		Under-five mortality	
	Model 1	Model 2	Model 1	Model 2
Variables				
GDP per capita in PPP	−0.12 (0.56)	−0.06 (0.416)	−0.11 (0.41)	−0.07 (0.34)
Gini coefficient			2.48* (0.68)	1.58* (0.54)
Total health expenditure (% of GDP)	7.49† (3.27)	4.02 (2.66)	4.50 (2.39)	2.29 (2.13)
Social expenditure (% of GDP)	−1.41 (0.83)	−0.65 (0.66)	−1.79‡ (0.61)	−1.30† (0.53)
Adjusted R^2	0.58	0.76	0.59	0.72
AQ1 F value	10.34*	16.68*	10.70*	13.64*

$p < 0.001$; †$p < 0.05$; ‡$p < 0.01$. GDP = gross domestic product; PPP = purchasing power parity rate.

substantial space for improvement. Firstly, we found that IMR and U5MR were strongly associated with the Gini coefficient but not with GDP per capita. In other words, such a result supports the proposition that when economic development has reached a certain threshold, income inequality becomes more important than the level of national income in determining the health of the child population.[12] With a Gini coefficient that is higher than most study countries, Taiwan should take measures on income redistribution such as tax and income transfers, economic reward for employment, and social welfare programs to bring about beneficial effects on child health in the long run.

Secondly, consistent with previous studies,[13,14] our results showed that total health expenditure did not explain the cross-national variation in IMR and U5MR. However, this does not mean that health care is ineffective in improving the health of individual children. In fact, we found that larger public share of health expenditure was significantly correlated with lower IMR ($p<0.05$) (data not shown). We further noted that in industrialized countries where health expenditure primarily comes from public sources, there is generally universal access to health care. Hence, whether or not health care matters to the health of the child population seems to depend on the universal accessibility of health care, indicating the importance of social welfare policies.

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