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The Relationship of Provincial Economic Level and Child Injury Mortality in Thailand: A Cross-Sectional Analysis in a Middle Income Country

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Introduction

Injuries usually occur when the safety system is not arranged well. Despite the rapid increase of injuries in middle-income countries, most of their governments spend budgets aimed to expand their industries and services, but only limited amounts of these budgets are allocated to safety measures.[1] Two good examples are the development of road and environmental safety, whose relationship with income per capita has been described as Kuznets curve (EKC).[2,3] In the early stages of economic growth, road hazard and environmental degradation increase, but beyond some level of income per capita the trends reverse. The reason for this inverted U relationship is that at higher levels of social prosperity, increased safety awareness, enforcement of safety regulations, better technology, and higher safety system expenditures coupled with structural change toward information-intensive industries and services resulted in leveling off and gradual decline of road hazard and environmental degradation.

An inverted U curve of the relationship pattern between economic development and injury mortality has been seen in some cross-sectional and longitudinal studies.[4,5] From a national perspective, the region within the transition of economic growth might experience an increase in injury deaths as an ascending part of the inverted U-curve pattern and become a barrier to improving child survival.

Thailand is a middle-income country, where the economy has grown rapidly in recent decades. Although the growth was interrupted by the 1997 financial crisis, it quickly returned to a high growth rate again a few years later.[6] Despite economic development, the mortality of children under 5 years between 1992 and 2002 had not significantly changed.[7] During this period, injury mortality increased and became a leading cause of death among children.[8,9] Accordingly, this study aimed to examine the relationship between child injury mortality and provincial indicators of economic development in Thailand from 1999 through 2001.

Methods

Mortality Data

The mortality data for Thai children 1 through 14 years of age during the period 1999 through 2001were obtained from the Bureau of Registration Administration, Ministry of Interior, and the Ministry of Public Health.

According to the 1991 Civil Registration Act, a person who discovered a death was required to notify to the local registrar within 24 hours. In case of death in the hospital, physicians indicated the cause of death, and the district officers entered information to the death registry. In

cases of non-hospital deaths, the village head was required by law to issue a death certificate. The cause of death then was indicated as disease or as signs and symptoms of disease, or a brief description about the circumstances of death was reported based on the ability and perception of the person who described the death. Both sources then were compiled electronically and sent to the Bureau of Registration Administration and forwarded to the Ministry of Public Health, which gave an International Classification of Diseases 10 Revisions (ICD10) code for all cases.

In this study we obtained mortality data directly from the Bureau of Registration Administration, Ministry of Interior which provided the cause of death in text. We also obtained the data sets based on ICD10-code from the Ministry of Public Health.

Three dependent variables were used: overall injury, drowning, and transport-related injury. “Overall injury” consisted of all unintentional and intentional injuries, coded as V01-Y98. “Drowning” and “transport-related injury” were subgroups of “overall injury.” “Drowning” consisted of all unintentional, intentional, and undetermined intent drowning or submersion but did not include drowning related to water transport and natural disaster. Those drownings should be coded as W65-74, X71, X92, and Y21. ”Transport-related injury” consisted of all land transport injuries, coded as V01-V89. We first identified “overall injury” cases by the E-code of V01-Y98. Then we identified “drowning” and “transport-related injury” following our definitions by reading all cause-of-death texts.

Overall, there were 31,249 deaths of children 1 to 14 years of age during the 3-year study period, and 9,998 of these cases (32.0%) were injury-related. To compute age-, gender-, and geographic area-specific mortality rates, the numbers of children by age, gender, and place of residence from the 2000 Population and Housing Census were utilized.

Economic Development Indicators

The independent variables were the set of economic development indices, including gross provincial product per capita (GPP/c), Gini coefficient, poverty line, poverty percentage, material deprivation indices, education, fertility, employment, ratio of population in rural/ urban, and migration.

The economic data for 2000 were obtained from the Office of the National Economic and Social Development Board (NESDB). We used the GPP/c as a main independent variable. The GPP/c is an index that reflects earned income from all production activities at the provincial level, analogous to the gross domestic product per capita (GDP per capita) at the national level.

To assess the provincial indicators of inequality, we obtained data regarding the proportion of the population below the poverty line and the Gini coefficient from the NESDB. In addition, data regarding household materials deprivation and characteristics of urbanization from the 2000 Population and Housing Census were employed.

The poverty line is based on the cost of basic needs, which is the sum of food and non-food consumption. The Gini coefficient is an indicator of income inequality and measures how much household income must be shifted to others within the population to achieve an equal distribution of income. The theoretical range of the Gini coefficient is 0.0 (perfect equality) to 1.0 (perfect inequality).

The household materials deprivation indices included the percentage of households using solid fuel, lacking a refrigerator, and lacking a telephone. Those indices captured household wealth by using measures of modern energy practices, food storage, and communications technology. The social deprivation indices included the percentage of youth 18 to 21 years old with a school attainment of elementary school or lower, the percentage of unemployed males 25 to 44 years old, and the percentage of ever-married women 25 to 44 years old with more than 3 live-born children.

Urbanization was measured by the ratio of the population living in rural (non-municipal) to urban (municipal) areas and the percentage of the population who migrated from other provinces or foreign countries within the previous 5 years.

Statistical Analysis

We used the gross provincial product (GPP) as the primary indicator for economic development. Rather than being confounders, population level variables like material and social deprivation indices, the population density in urban sites, migration, and the increasing cost of basic needs or expenses under the poverty line are best thought of as mediators of GPP growth that may have an effect on health and mortality. Instead of examining the effect of each variable by controlling the others, we aggregated these explanatory variables together by 2 methods. First, we classified the economic status of each of the 76 Thai provinces by quartile of GPP/c (Q1-Q4). The higher GPP/c quartiles indicate higher GPP/c levels. Medians of selected socioeconomic and geographic characteristics by GPP/c quartile category (Q1 to Q4) are shown in Table 1. Means with 95% confidence intervals of overall injury, drowning, and transport-related mortality rates (per 100,000 population) by GPP/c quartile, age group, and gender are presented in Table 2. Using GPP/c quartile 4 as a reference,

mean differences with 95% confidence intervals of those mortality rates in GPP/c quartile 1 to 3 were calculated and compared (see Figures 1 and 2). To avoid a specific assumption about the data distribution, we also performed the Spearman's rho correlation to confirm the relationship between GPP/c and mortality rates (see Table 3).

Second, because the selected variables of economic development displayed multicollinearity, factor analysis was employed to create a set of factors to be treated as uncorrelated variables. First, the correlation matrix was inspected for extreme multicollinearity. The adequacy of the sample correlation matrix for factor analysis was examined using Kaiser-Meyer-Olkin (0.82) and Barlett's test of sphericity (chi square 700.26, significance 0.000). Next, we used principal component analysis (PCA), a variance-focused approach, as a method of extracting the factors from our variables. The analyses were performed by Kaiser's rule, dropping all components with eigenvalues under 1.0 that gave as a result of 3 new factors drawn from the data (see Table 4).

Last, using SPSS version 16.0 (SPSS Inc.), stepwise multiple regression analysis was carried out for the effects of factors 1 to 3 on overall injury, drowning, and transport-related mortality in specific age-gender groups of children. The criterion for including variables in the regression equation was a significance level of $p<0.05$ (see Table 5).

This study was approved by the ethical committee related to the Institutional Review Board, Nationwide Children's Hospital, Columbus, Ohio (study number IRB08-00166).

Results

General Characteristics

Provinces with higher GPP/c showed a lower ratio of people living in rural areas, higher migration, higher cost of basic needs (a value of a provincial poverty line), and lower inequality indices represented by the proportion of poor, GINI coefficient, material, and social deprivation indices (see Table1).

Table 1. Selected Economic Development Indices (Median) and Geographic Characteristics (Percentage) by Quartile Category of Gross Provincial Product Per Capita (Q1-Q4) in Thailand 2000

		Q1	Q2	Q3	Q4
GPP/c* (1000 Baht)		21.13	33.19	48.27	109.80
Poverty line		988.00	1016.00	1079.00	1215.00
Poverty %		36.14	23.69	10.78	4.21
Gini		0.55	0.52	0.51	0.45
Solid fuel use		71.95	34.72	11.94	6.42
No refrigerator		38.05	27.54	25.03	18.13
No telephone		90.03	82.37	77.43	67.55
Low education		37.78	33.11	27.90	24.27
Unemployment		6.81	5.54	3.00	3.54
Child>3		4.09	2.66	3.69	2.42
Rural/urban		5.62	3.75	4.10	1.88
Migration		1.71	2.80	4.01	8.17
Region	%Northeast	84.21	15.79	0.00	5.26
	%North	15.79	52.63	15.79	5.26
	%South	0.00	15.79	36.84	21.05
	%Central	0.00	15.79	47.37	68.42

GPP/c = gross provincial product per capita
Poverty line = the reference provincial poverty line
Poverty % = % of population below the reference provincial poverty line
Gini = Gini coefficient
Solid fuel use = %of households using charcoal/wood as main household fuel
No refrigerator/no telephone = % of households without refrigerator/telephone
Low education = %of youth 18-21 years old with education attainment of elementary school or lower
Unemployment = % of unemployed male 25-44 years old
Child>3 = % of ever-married women 25-44 years who have live-born children >3
Rural/Urban = ratio of population in non-municipal area and municipal area
Migration = % of people moving from outside
Region = % of provinces in each region

Comparisons among the GPP/c Quartiles

Table 2 reveals that the mortality rate was highest in children aged 1 to 4 in all GPP/c quartiles compared to children aged 5 to 9 and children aged 10 to 14. The highest mortality rate was noted in males aged 1 to 4 in GPP/c quartile 4 (44.6).

For males aged 1 to 4 and 10 to 14, living in a province classified as GPP/c quartile 1 was significantly associated with a lower overall injury mortality rate (see Table 3 and Figures 1 and 2). For females aged 1 to 4, a similar significant trend was noted by the Spearman correlation ($r = 0.308$, $p<0.01$). On the contrary, compared to the highest GPP/c, higher injury mortality rates were observed among both male and female children in the 5- to 9 year-old age group in GPP/c quartile 1 ($p = 0.017$ and 0.012, respectively) (see Table 3 and Figures 1 and 2).

Table 2. Mean Mortality Rate (/100,000) for Overall Injuries, Drowning, and Transport-Related Injuries by GPP/c Quartile, Age Group, and Gender in Thailand 1999-2001

	Overall Injury		Drowning		Transport-related	
GPP/c* Quartile	Male	Female	Male	Female	Male	Female
Q1						
Ages 1-4	33.6	20.4	21.1	10.5	4.5	4.2
Ages 5-9	32.7	18.4	23.0	10.2	4.2	3.4
Ages 10-14	21.8	14.7	5.0	7.2	6.2	2.9
Q2						
Ages 1-4	35.0	22.1	17.8	9.8	6.4	3.3
Ages 5-9	25.6	14.1	14.1	6.4	4.9	3.2
Ages 10-14	25.9	14.8	4.9	4.9	8.6	4.4
Q3						
Ages 1-4	41.0	26.5	22.1	10.8	8.9	5.7
Ages 5-9	28.6	16.4	13.0	7.7	6.6	5.0
Ages 10-14	30.4	15.3	5.7	5.0	12.4	3.8
Q4						
Ages 1-4	44.6	26.1	27.1	14.0	7.2	5.4
Ages 5-9	25.3	13.2	13.4	5.6	5.7	3.5
Ages 10-14	32.2	17.2	5.9	4.9	12.5	5.8

Whole Country						
Ages 1-4	38.6	23.8	22.0	11.2	6.7	4.6
Ages 5-9	28.0	15.5	15.9	7.5	5.4	3.8
Ages 10-14	27.6	15.5	5.4	5.5	9.9	4.2

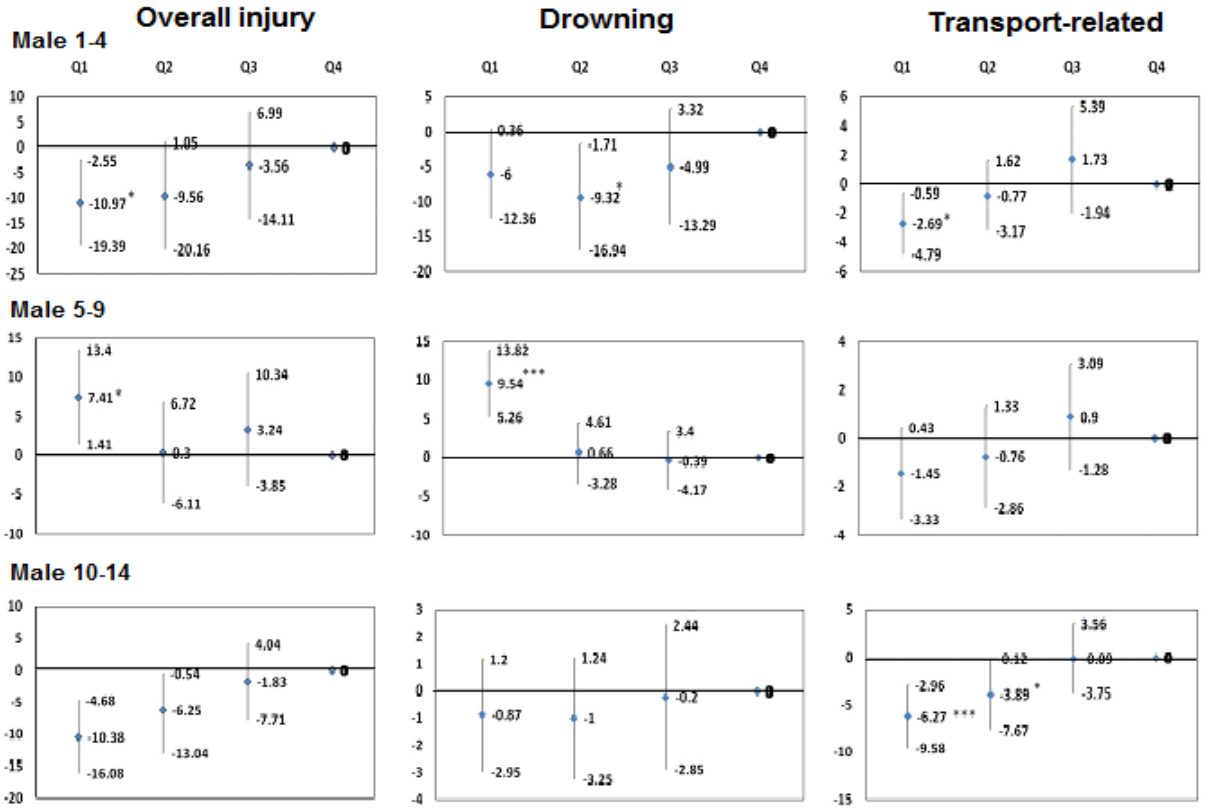
***GPP/c** = gross provincial product per capita

Table 3. Spearman's Rho Correlation Coefficient Between GPP and Overall Injury, Drowning, and Transport-Related Mortality Rates

	Overall injury		**Drowning**		**Transport-related**	
	Male	**Female**	**Male**	**Female**	**Male**	**Female**
Ages 1-4	0.318**	0.308**	-	-	0.262*	-
Ages 5-9	-0.229*	-	-0.401***	-0.345**	0.226*	-
Ages 10-14	0.422***	-	-	-0.280*	0.506***	0.242*

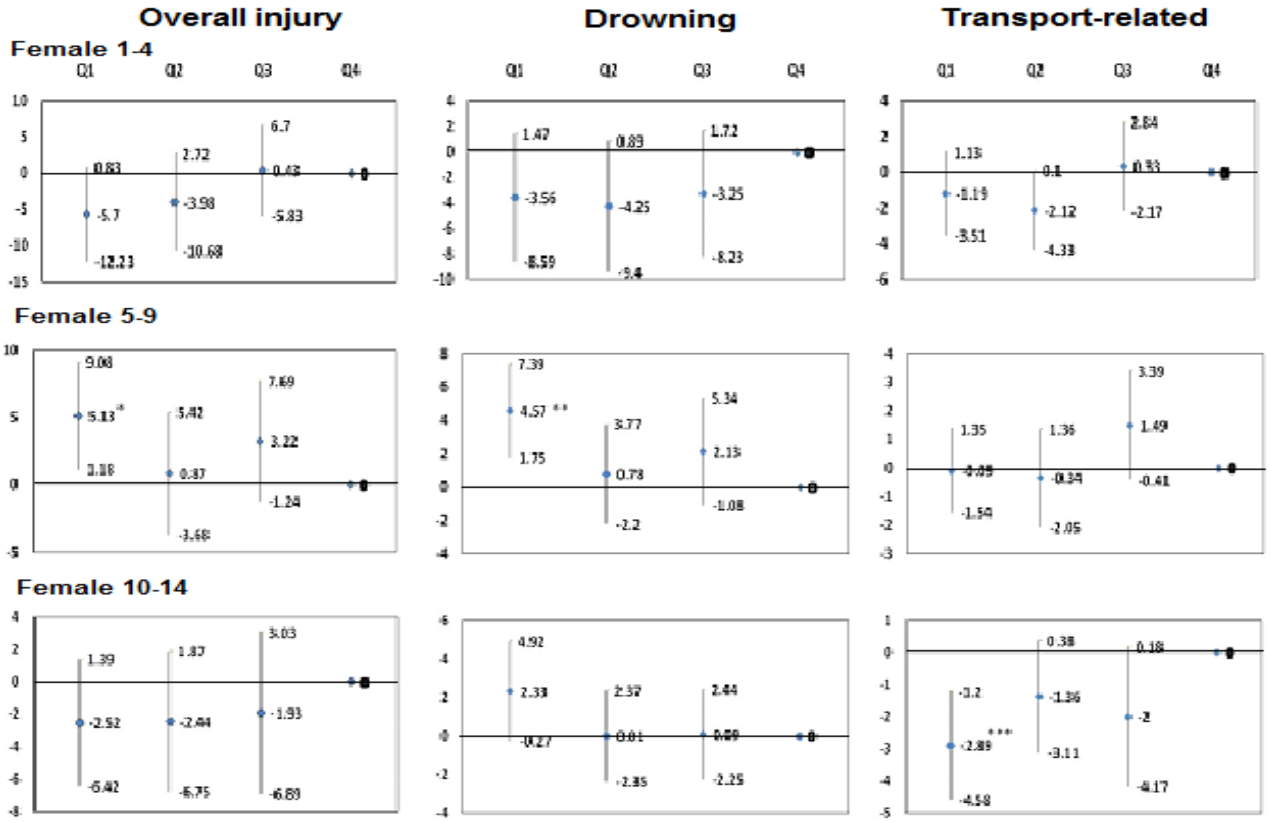
**p<0.05*
***p<0.0*
****p<0.001*

Figure 1 Differences Between Means (with 95% Confidence Intervals) of Overall Injury, Drowning, and Transport-Related Mortality Rates per 100,000 Population by GPP/c (Baht) and Age Group Among Male children in Thailand 1999-2001



*p < 0.05
**p < 0.01
***p < 0.001

Figure 2 Differences Between Means (with 95% Confidence Intervals) of Overall Injury, Drowning, and Transport-Related Mortality Rates per 100,000 Population by GPP/c (Baht) and Age Group Among Female Children in Thailand 1999-2001



Drowning

From 1999 to 2001, 4,680 Thai children aged 1-14 years died due to drowning, accounting for 15% of all deaths and 47% of injury deaths in that age group. The age distribution of these drowning cases was 40.6% among those aged 1 to 4 years, 41.2% among those aged 5 to 9 years, and 18.2% among those aged 10 to 14 years.

Of all age-gender groups, the highest mortality rate due to drowning was among males 1 to 4 years old in GPP/c quartile 4 (27.1) (see Table 2). A higher mortality rate due to drowning was noted among male children in all age groups. With the exception of males in GPP/c quartile 1, children 1 to 4 years old had higher drowning rates than children in the 5 to 9 years and 10 to 14 years age groups.

As was noted for the overall injury mortality rate, lower GPP/c was associated with higher drowning rates among children 5 to 9 years old, both males and females ($p<0.001$ and $p=0.002$, respectively) (see Table 3 and Figures 1 and 2). On the contrary, compared to the highest GPP/c level, lower GPP/c was associated with a lower drowning rate among males 1 to 4 years old (GPP/c quartile 2: $p<0.001$, GPP/c quartile 1: $p= 0.06$) (see Figure 1).

Transport-Related Injury Mortality

From 1999 to 2001, 2,250 Thai children aged 1 to 14 years died from transport-related injuries, accounting for 7.2% of all deaths and 22.6% of injury deaths in that age group. The age distribution of these transport-related injury fatalities was 43.5% among those aged 10 to 14, 29.9% among those aged 5 to 9, and 26.6% among those aged 1 to 4.

The highest mortality rate for all age-gender groups was noted among male children aged 10 to 14 years in GPP/c quartile 4 (12.5) (see Table 2). Males in all age groups experienced a higher transport-related injury mortality rate than females. Among male children, the mortality rate was higher for the age group 10 to 14 years in all GPP/c quartiles than for the younger age groups.

For male children in all age groups, a lower GPP/c was significantly associated with a lower transport-related injury mortality rate (see Table 3 and Figure 1). For female children, compared with the highest GPP/c quartile, a significantly lower transport-related injury mortality rate was noted in GPP/c quartile 1 among children aged 10 to 14 years (see Table 3 and Figure 2)

Factor Analysis and Multiple Regression Model

By using factor analysis, 12 economic development indices were formed the 3 new factors (see Table 4).

Factor 1, named as the factor of low economic development, had 10 economic development indices in which the factor loadings were higher than 0.7, classified as "high" level by Hair et al.[10] The factor scores of Factor 1 may be either negative or positive, going from the larger negative values that indicate higher economic development to the larger positive values that indicate lower economic development. Factor 2 had only 1 factor that was high-level loading; that was the percentage of ever-married women 25 to 44 years old who had more than 3 live-born children. Factor 3 had no high-factor loading; however, the factor loading value of unemployment was higher than for Factors 1 and 2. Factor 1 explained 56.09% of the variance, and the 3 factors in total accounted for 75.64% of the variance.

The relationship between the factors and mortality was explored by stepwise multiple regression. With the exception of drowning among males 5 to 9 years of age, only Factor 1 remained in the model. The correlation coefficient (r), coefficient of determinant (r^2), adjusted r^2, regression coefficient, and their significance test are shown in Table 5. Again, with not high but significant correlation, the results confirmed that high economic development was related to an increasing mortality rate of overall injuries among children aged 1 to 4 years in both genders and among males aged 10 to 14 years. Also, the results showed a direct relationship between economic development and drowning among females aged 1 to 4 years and transport-related deaths among those aged 10 to 14 years in both genders. For drowning among children aged 5 to 9 years, lower economic development was associated with higher mortality rates in both genders. However, for males, the high fertility factor also showed a negative effect on drowning.

Table 4. Result of the Factor Analysis Using Eigenvalue 1 Criteria, Showing Name of Each Factor, Factor Loadings, Eigenvalues, and Percentage of Variance Accounted for by Each Factor

	Factor 1: Factor of low economic development (Eigenvalues 6.73, Explained variance 56.09%)	**Factor 2: High fertility factor** (Eigenvalues 1.24, Explained variance 10.37%)	**Factor 3 Unemployment factor** (Eigenvalues 1.10, Explained variance 9.18%)
No telephone*	**0.897**	-0.036	-0.166
No refrigerator	**0.865**	0.223	0.349
Solid fuel use	**0.812**	-0.369	0.187
Poverty %	**0.823**	-0.007	0.197
Poverty line	**-0.814**	-0.027	0.223
GINI	**0.762**	0.109	-0.112
Low education	**0.758**	0.375	0.187
Migration	**-0.758**	0.212	0.450
Rural/ urban	**0.734**	-0.157	0.089
GPP/c	**-0.726**	0.186	0.461
Child>3	0.469	**0.761**	0.063
Unemployment	0.404	-0.471	**0.596**

Extraction Method: Principal Component Analysis

*For explanations of each category, see Table 1.

Table 5. Correlation Between the Factors and Overall Injury, Drowning, and Transport-Related Mortality Rates by the Stepwise Multiple Regression, Showing Significance ($p<0.05$), r^2, and Regression Coefficients of the Factors in the Models

		r^2	β_0	β_1^*	β_2^{**}
Overall Injuries					
Male	Ages 1-4	0.07	38.58	-4.04	-
	Ages 10-14	0.11	27.58	-3.16	-
Female	Ages 1–4	0.12	23.76	-3.37	-
Drowning					
Male	Ages 5–9	0.18	15.88	2.37	-2.16
Female	Ages 1–4	0.07	11.24	-1.91	-
	Ages 5–9	0.06	7.48	1.17	-
Transport-Related Injuries					
Male	Ages 10-14	0.16	9.92	-2.21	-
Female	Ages 10-14	0.06	4.22	-0.67	

***β 1** = regression coefficient of F1 (the factor of low economic development), larger negative values (higher economic development) to the larger positive values (lower economic development)

****β 2** = regression coefficient of F2 (the high fertility factor)

Discussion

This intra-national macroeconomic study revealed that economic development, defined as growth in provincial product per capita (GPP/c), was related to increasing standards of living and characteristics of urbanization. It also showed an association between reduction of poverty and inequality, both in terms of monetary and non-monetary poverty. However, a statistically significant direct relationship between economic development and overall injury mortality was observed among male children aged 1 to 4 years (mostly attributed to drowning) and among 10- to 14-year-olds of both genders (attributed to transport-related injuries). Conversely, provinces with lower GPP/c showed higher injury mortality rates among school-aged children 5 to 9 years old of both genders, mostly attributed to drowning.

Economic Development and Inverted U-curve of Child Injury Mortality

Instead of promoting social well-being and population health in the period of economic development, several studies have identified social pathology

and mediators in relation to adverse health effects.[11-14] The initial mediator may be the demographic shift from rural to urban in the initial phase of industrialization,[11-16] which initiates an urbanization process. In the urban sector, the income gap between different people groups was wider than in the rural sector. Most migrated people were not well educated and were part of the unskilled workforce; therefore, most fell into the lowest part of the wide income gap, resulting in worse health and increasing mortality. Massive migration from outer areas to cities, the center of developed areas, also brought about massive needs, which exceeded the cities' ability to use their limited resources to cope adequately. This subsequently leads to the problem of urban poor living in poor settlements or slums, the social pathology related to injuries, and poor health outcomes among children.[11-16] In the economic change model of pathology,[17] Brenner described "adaptation error related to economic growth" as a mechanism of adverse health effects of economic development that usually resulted from ignorance or psychological denial of the harmful effects of certain technological or social changes. Adaptation error led to alterations in consumption and production activities in ways that were deleterious to health, such as increased numbers of motor vehicles and immoderate alcohol consumption. Economic development may also adversely affect relationships at the personal, family, and social levels, leading to increased incidences of small-sized families, solitary living, divorce, and neglect of children and the elderly.

Drowning among Children Age 1 to 4 Years: The Disease of Urban Poor

Drowning has been identified by several studies, both domestically and internationally, as preferentially affecting the poor.[18,19] The declining trend of drowning was commonly found during economic growth.[19] However, a direct relationship between economic development and drowning in children aged 1 to 4 years, as seen in this study, has not previously been reported.

Two case series studies in Thailand were performed by interviewing families who lost children due to drowning, the first including 23 drowned children in Bangkok in 1999[20] and the second including 255 cases in 5 provinces of different regions from 2000-2002.[21] Both studies showed that most drowned children lived in lower-income families, which had a significantly higher proportion of separated or divorced parents, a large family size (more than 8 members), and lower school attainment among primary caretakers, compared with the general population in those areas.[20,21]

The direct relationship between economic development and drowning among young children in poor families living in high-income provinces might be understood by focusing on the link between economic development and the urban poor. Although individuals living in relative poverty in urban areas may not have a household income as low as people in rural areas, they live in poorer settlements in higher risk neighborhoods, have weaker social networks, and have higher stress and rates of psychological problems. The family structure in the urban setting changes from an extended family to a nucleus family. More women work outside the home to financially support the family. These factors often result in urban children growing up in substandard housing and playing in unsafe neighborhoods with low levels of adult supervision.

Transport-Related Injuries among Children 10 to 14 years: The Disease of Inappropriate Consumption Patterns

High mortality due to transport injuries among older children and adolescents in wealthier areas has been described previously.[3,22-24] However, the initial increase in the number of transport-related deaths seen with economic development, at a certain level of prosperity, then begins to decline.[3,23,24] A study based on data from 22 Organization of Economic Co-operation and Development (OECD) countries indicated that motorcycle deaths followed an inverted U-shape, or Kuznets curve, relationship with per capita income.[3] A study using death certificate data from 44 countries showed that overall motor vehicle crash-related mortality peaked among countries at a gross national income per capita (GNI per capita) of approximately US$2000 and declined at higher national incomes up to about US$24,000.[24] The factors that explain the association of economic development with increased road traffic injuries in poorer countries include higher exposure to traffic because of an increase in the number of vehicles and travelling time, access to higher speed vehicles, high risk city design and activities, and poor law enforcement .

In Thailand, a 2004 report of injury surveillance data from 26 regional and secondary hospitals showed that 68.2% of traffic-related mortality among individuals younger than 15 years old were related to motorcycles.[25] Nearly half (48%) of those fatal cases were drivers, even though the traffic laws in Thailand prohibit children younger than 15 years old from operating a motorcycle. Such reports also revealed that the youngest motorcyclist age was 7 years, and the youngest drunken driver was 11 years old. Nearly all (95%) children injured on a motorcycle were not wearing a helmet, although the traffic law requires drivers and passengers of all ages on motorcycles to wear helmets. Those traffic laws

involving child safety have not been widely respected by the public, nor have they been effectively enforced by the responsible organizations and local authorities. In addition, motorcycle use continues to be marketed to young users through corporate advertising and other marketing strategies.

Limitations

The ecological design of this study is a limitation. In addition, the death certification system in Thailand during the study period was in a stage of improvement..[26,27] The Survey of Population Change found that the completeness of death registration was 95% in the years 1995 and 1996. The document review and system analysis, however, indicated a number of weaknesses resulting in incomplete and inaccurate cause-of-death reporting.[26,27] The study of verbal autopsy for the deaths from 1997 to 1999, conducted in 15 provinces comprising geographical variability and including a random sampling of Metropolitan Bangkok,[26] showed that 53.8% of deaths occurred at home and 40.6% in hospital. Of those deaths at home, 54.7% were first reported to the village head, while 39.5% were registered directly at the district or municipal office. Only 0.1% of the deaths were not registered. Even if the high coverage was acknowledged, the quality of data was in doubt. Death registration was most incomplete in non-registered populations, such as hill tribe people, refugees, and illegal foreign laborers and their families.[26,27] Most missing deaths were in infants and the elderly, and the leading cause of death was cardiovascular disease. Our study is less affected by these limitations because our study population is 1- to 14-year-olds, and in addition to using ICD10 codes as done in the previous study,[9] we employed word-search strategies and read all narratives to determine cause of death. A study comparing the validity of drowning identification between these 2 methods found that the use of ICD10 codes only would identity just 85% of drowning cases (95%CI, 0.79- 0.92).[20] In this study, cases with a cause of death that could not be identified as an illness or injury accounted for 11.7% of all deaths and no significant difference among GPP/c quartile group (p=0.34). Among injury cases, 958 (9.6%) included information only about the type of injury, such as head injury or internal organ injury, and nothing about the specific mechanism of injury.

This study was based on mortality data 2 to 4 years after the economic recession of 1997; this might have contributed to the observed increase in mortality. Brenner demonstrated that the economic recession in Sweden increased total mortality for virtually all age groups and in both sexes.[17] Children, elderly individuals, and poor families were the most vulnerable.

Geographic characteristics of provinces in the GPP/c groups varied by group (see Table 1) and therefore were not consistently associated with drowning risk among all age groups. The highest drowning rate among children 1 to 4 years was in provinces with GPP/c quartile 4, 68% of which are located in the central region, an area with plains and abundant water sources. However, the highest drowning rate among children aged 5 to 9 years was in provinces with GPP/c quartile 1, 84% of which are located in the northeast region, a dry plateau area at 100 to 200 meters elevation.

Conclusions

The rapid economic growth in Thailand, a middle-income country, was associated with an increase in injury mortality among children. Policymakers and responsible agencies need to address and control ill-planned urbanization causing urban poor families living in the high-risk environment. The ill-planned urbanization also creates conditions in which people are exposed to high risk transportation, such as the motorcycle, that is unsafe but economically accessible. During periods of rapid economic development in mid-level developing countries, it would be worthwhile to emphasize the need for effective and safe transportation that incorporates equity impacts.

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