

Chapter 11

Helmet Regulation in Vietnam: Impact on Health, Equity, and Medical Impoverishment

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INTRODUCTION

Road traffic injury (RTI) accounts for a substantial and increasing burden of mortality, morbidity, and health care costs in developing nations. Globally, road traffic is responsible for 1.3 million fatal and 78 million nonfatal injuries each year (WHO 2013a; World Bank and IHME 2014). In the Western Pacific, RTI is the leading cause of mortality for people ages 15–49 years (WHO 2013b). Direct economic costs are estimated to exceed US\$500 billion worldwide and are anticipated to grow in tandem with motorization of the developing world (WHO 2004; World Bank and IHME 2014). The potentially substantial out-of-pocket (OOP) medical costs associated with traffic injury may result in catastrophic expenditures (expenditures that crowd out a significant portion of household expenditures) and subsequent impoverishment (Wagstaff 2010).

In response to the growing burden of traffic injury, the government of Vietnam passed comprehensive legislation mandating the use of motorcycle helmets in 2007. This legislation extended the mandatory use of helmets to all riders on all roads, substantially increased penalties for failure to wear a helmet, and provided for increased enforcement (Passmore, Nguyen, and others 2010). As a result, helmet use increased from 30 percent

to 93 percent of riders within months (Hung, Stevenson, and Ivers 2006; Nguyen, Passmore, and others 2013). Studies in other settings have examined the influence of helmet use policies on aggregate health, but the distribution of benefits and equity improvements resulting from such regulatory changes remains understudied and uncertain (Ngo and others 2012; Passmore, Tu, and others 2010).

Traffic injury can lead to substantial and potentially impoverishing health expenditures (Wagstaff 2010). Legislation mandating helmet use is one non-health sector policy that may protect individuals against this financial risk. In nations with universal health coverage, helmet regulation may also reduce government spending for traffic injuries and thus free up health spending for other conditions. Defining the magnitude of the health and financial benefits attributable to Vietnam's comprehensive helmet policy might bolster the case for a similar policy in neighboring countries (for example, Cambodia) and in other low-and-middle-income countries.

Extended cost-effectiveness analysis (ECEA) incorporates the dimensions of equity and financial risk protection into economic evaluations (Verguet, Laxminarayan, and Jamison 2014; Verguet and others 2013, 2015). In this

chapter, a simulation model is used to perform an ECEA examining the influence that Vietnam's 2007 helmet legislation has had in four areas:

- Road traffic deaths and nonfatal injuries
- Individuals' direct costs of acute care treatment for motorcycle injuries
- Individuals' income losses from missed work
- Individuals' financial risk.

METHODS

Design

For the period of interest, the annual number of nonfatal traffic injuries reported by Vietnam's National Traffic Safety Committee is not disaggregated by type of road user and generally lacks consistency and credibility. For example, the number of nonfatal traffic injuries reported by police in 2007 (10,300) is drastically different from the number noted in health data reports for the same year (445,000) (WHO 2009). To address this discrepancy, the model developed for this chapter uses secondary data to simulate the benefits accruing from the 2007 comprehensive helmet policy. After ensuring consistency of the model with reported reductions in total road traffic deaths (National Traffic Safety Committee 2014; Passmore, Nguyen, and others 2010), an ECEA was performed to estimate the distribution of health benefits and costs across income groups. Conceptually, the study period includes a one-year pre-policy baseline period (July 2006 to June 2007), a six-month transition period during which the majority of the helmet policy legislation was introduced and came into effect (June to December 2007), and a one-year post-policy evaluation period (January to December 2008).

Setting

At the midpoint of the study period, Vietnam was a lower-middle-income country with a population of about 84 million and per capita gross domestic product (GDP) of about US\$1,200 (World Bank 2012). About 95 percent of registered vehicles were motorized two-wheel vehicles (WHO 2013c). Prior to the 2007 legislation, the incidence of road traffic deaths was estimated to be 14 per 100,000 people per year (WHO 2009). About 55 percent of health care costs were paid out of pocket (Tien and others 2011; WHO 2010).

Prior to 2007, Vietnam had limited motorcycle helmet legislation with incomplete implementation and enforcement. Comprehensive legislation that made helmet use compulsory for all motorcycle riders and passengers on

all roads was introduced in June 2007, came into force for government workers in September 2007, and came into force for the general public in December 2007 (Passmore, Nguyen, and others 2010). Legislation introduced in September 2007 increased the fines for failure to wear a helmet from US\$2–US\$5 to US\$11–US\$22 per offense, the latter range representing about 30 percent of average monthly income per capita (Government of Vietnam 2007; Passmore, Nguyen, and others 2010). At that time, the majority of Vietnamese households were willing to pay the average market price of US\$17 for a standard helmet (Pham and others 2008).

Variables

In the simulation, all input parameters were abstracted from academic studies and from reports issued by governmental and nongovernmental agencies (table 11.1; see also annex 11A, table 11A.1). The output estimates of primary interest were traffic deaths averted, nonfatal traffic injuries averted, individuals' OOP acute care medical costs averted, and individuals' income losses averted during the one-year post-policy period. Costs were viewed from the individuals' perspective, including both OOP acute care costs and income losses. Estimation of sub-acute and chronic outpatient medical costs was not possible, as reliable input parameters were not available. All costs are in 2012 U.S. dollars and were converted using consumer price indexes and exchange rates as reported by the World Bank (2012).

Major Assumptions

According to the National Traffic Safety Committee (2014), the number of registered motorcycles in Vietnam increased from 21 million in 2007 to 25 million in 2008. However, for simplicity, the model assumes that the number of registered motorcycles remained static at the pre-policy level during the study period. This assumption makes the estimates more conservative but substantially improves their interpretability and generalizability. Furthermore, the effectiveness of motorcycle helmets in Vietnam was assumed to be equivalent to the estimated effectiveness of helmets in high-income countries (HICs). However, major concerns have been raised regarding the proliferation of substandard helmets in Vietnam (Hung, Stevenson, and Ivers 2008; WHO 2015; Yu and others 2011). Given the lack of local data regarding the effectiveness of substandard helmets, this crucial issue was addressed in a separate sensitivity analysis. For the main analysis, the distribution of fatal and nonfatal traffic injuries across income quintiles was assumed to reflect the distribution of motorcycle ownership across quintiles,

Table 11.1 Model Input Parameters

Parameter	Estimate (range)	References
Population of Vietnam	84,000,000	World Bank 2012
Pre-policy RTI deaths	13,000	WHO 2009
Pre-policy nonfatal RTIs	445,000	WHO 2009
% of RTI deaths attributable to motorcycles	58 (51–73)	Hoang and others 2008; Ngo and others 2012; Pham and others 2008;
% of nonfatal RTIs attributable to motorcycles	59 (51–75)	Hoang and others 2008; Hung, Stevenson, and Ivers 2006; Ngo and others 2012; Nguyen, Passmore, and others 2013; Pham and others 2008
% of nonfatal motorcycle RTIs with head injury	21 (10–32)	Nguyen, Ivers, and others 2013
Pre-policy helmet use (%)	30 (20–40)	Hung, Stevenson, and Ivers 2006; Nguyen, Passmore, and others 2013
Postpolicy helmet use (%)	93 (83–98)	Nguyen, Passmore, and others 2013
Average direct acute care cost of nonfatal RTI with a helmet (US\$)	436 (366–506)	Nguyen, Ivers, and others 2013
Average direct acute care cost of nonfatal RTI without a helmet (US\$)	559 (416–702)	Nguyen, Ivers, and others 2013
Expected increase in treatment cost for each US\$10 increase in income (%)	1	Nguyen, Ivers, and others 2013
Income loss (number of weeks)	32	Hoang and others 2008
Mean per capita income, by quintile (US\$)	305, 530, 777, 1,185, 2,730	GSO 2010
Distribution of motorcycle ownership by quintile (%)	20, 35, 54, 73, 94	GSO, NIHE, and ORC Macro 2006
Relative risk of death, helmet vs. no helmet	0.58 (0.50–0.79)	Liu and others 2008
Relative risk of injury, helmet vs. no helmet	0.31 (0.25–0.66)	Liu and others 2008
Per capita cost of policy implementation (US\$)	0.29	Chisholm and others 2012 (correspondence from Dan Chisholm)

Note: RTI = road traffic injury. Table 11A.1 in the annex provides the detailed rationale and additional sources for selection of point estimates and ranges.

as obtained from the Vietnamese Demographic and Health Survey. This assumption also was explored in sensitivity analyses (GSO, NIHE, and ORC Macro 2006).

Consequences for Health

To simulate the impact on health consequences, the number of deaths and nonfatal head injuries attributable to motorcycles in the one-year baseline period was estimated, as was the pre-policy proportion of motorcycle riders using helmets. Helmet effectiveness (expressed as the relative risk of head injury among riders wearing helmets compared to riders not wearing helmets) was estimated using published odds ratios. By accounting for the increase in the proportion of helmeted riders

following the comprehensive helmet policy, the number of deaths and head injuries averted within each quintile during the one-year post-policy evaluation period was simulated (annex tables 11A.3–11A.4 and equations 11A.1–11A.4).

Consequences for Cost and Affordability

The OOP acute care costs averted by the policy were simulated by subtracting the expected OOP costs of hospitalization in the post-policy period from the expected OOP cost in the baseline period. The expected cost was derived from published estimates on average cost for injury with and without a helmet, taking into account variations in the severity and type of injury

based on helmet use (Nguyen, Ivers, and others 2013). These changes in costs were then multiplied by the estimated change in incidence of motorcycle injuries (see annex 11A, equation 11A.5 in table 11A.5).

Empirical research has shown variations in the average direct acute care cost of treatment by income group in Vietnam (Nguyen, Ivers, and others 2013). The average direct acute care cost of treatment in each income quintile was derived by combining the estimated quintile-specific monthly income per capita with the reported 1 percent increase in the cost of treating a traumatic brain injury for every US\$10 increase in monthly income per capita (GSO 2010; Nguyen, Ivers, and others 2013). Income losses were calculated by multiplying monthly per capita income by the Vietnamese average absence from work of eight months following traumatic brain injury (Hoang and others 2008).

Two measures of financial risk protection were calculated: cases of poverty averted and catastrophic health expenditures averted. Both measures reflect the reduction in financial hardship that may occur when an injury is averted or when the cost of treatment is reduced. Cases of poverty averted were defined as the number of individuals who, as a result of the helmet policy, would no longer fall below the national poverty line because of a traffic injury. In the baseline model, 21 percent of the population is living in poverty (World Bank 2012). Cases of catastrophic health expenditures averted were defined as the number of people who, as a result of the policy, would no longer be paying more than 25 percent of their annual income per capita on direct acute care costs. The threshold for a catastrophic health expenditure varies depending on the literature, but it generally lies between 2.5 percent and 15 percent of household income or between 10 percent and 45 percent of disposable income (Wagstaff and van Doorslaer 2003). For a population of P individuals with a certain income distribution,¹ the number of people injured before the intervention in each quintile was multiplied by the probability that they would face poverty or a catastrophic health expenditure. The same estimate was recalculated using the post-intervention injury rate and costs. Subtraction yielded the number of cases of poverty or catastrophic health expenditure that were averted in the population (see annex 11A, equation 11A.6 in table 11A.5).

The government's cost of implementing the comprehensive helmet legislation in Vietnam was approximated by multiplying the estimated costs per capita of implementing the legislation in South-East Asia (including legislation and program management, media, enforcement, and helmet purchase) by the population of Vietnam (Wagstaff and van Doorslaer 2003).²

Sensitivity Analysis

A univariate sensitivity analysis was performed on key model inputs to test their influence on the findings. Upper and lower bounds for the inputs were obtained from published studies wherever possible and were otherwise derived from available data or plausibly estimated (annex 11A, table 11A.1). One critical sensitivity analysis explored the impact of substandard helmets in Vietnam, accounting for less safe designs (half-head or cap style), failure to meet quality standards, and inadequate fastening of chin straps. Each safety deficit was assumed to halve the reduction in relative risk of death or injury provided by the helmet, and this was combined with the approximate population prevalence of each deficit to estimate a lower bound of population-level helmet effectiveness (see annex 11A, table 11A.1 and figure 11A.9).

Additional sensitivity analyses were performed to evaluate the influence of model input distributional assumptions on the distribution of health and financial benefits across income quintiles (annex 11A, table 11A.2). The distribution of motorcycle deaths and nonfatal injuries across quintiles, the distribution of pre-policy helmet use, and the distribution of post-policy helmet use across quintiles were varied in these analyses, first alone and then by multivariate sensitivity analysis.

RESULTS

The results of the analysis are presented in table 11.2.

Assuming that helmets in Vietnam are as effective as helmets in HIC, the simulation estimates that the 2007 helmet policy prevented approximately 2,200 deaths and 29,000 head injuries, saved individuals US\$18 million in direct acute care costs, and averted US\$29 million in individual income losses in the year following its introduction (table 11.2). Countrywide implementation of the policy cost the government an estimated US\$24 million, although this cost was offset by revenue arising from the collection of fines and enforcement (Chisholm and others 2012). From a government perspective (which accounts for implementation costs only), the helmet policy cost about US\$11,000 per death averted or US\$800 per nonfatal injury averted. From a societal perspective (which sums individuals' OOP direct acute care cost savings, individuals' averted income losses, and government's implementation costs), the policy saved approximately US\$11,000 per death averted or US\$800 per nonfatal injury averted.

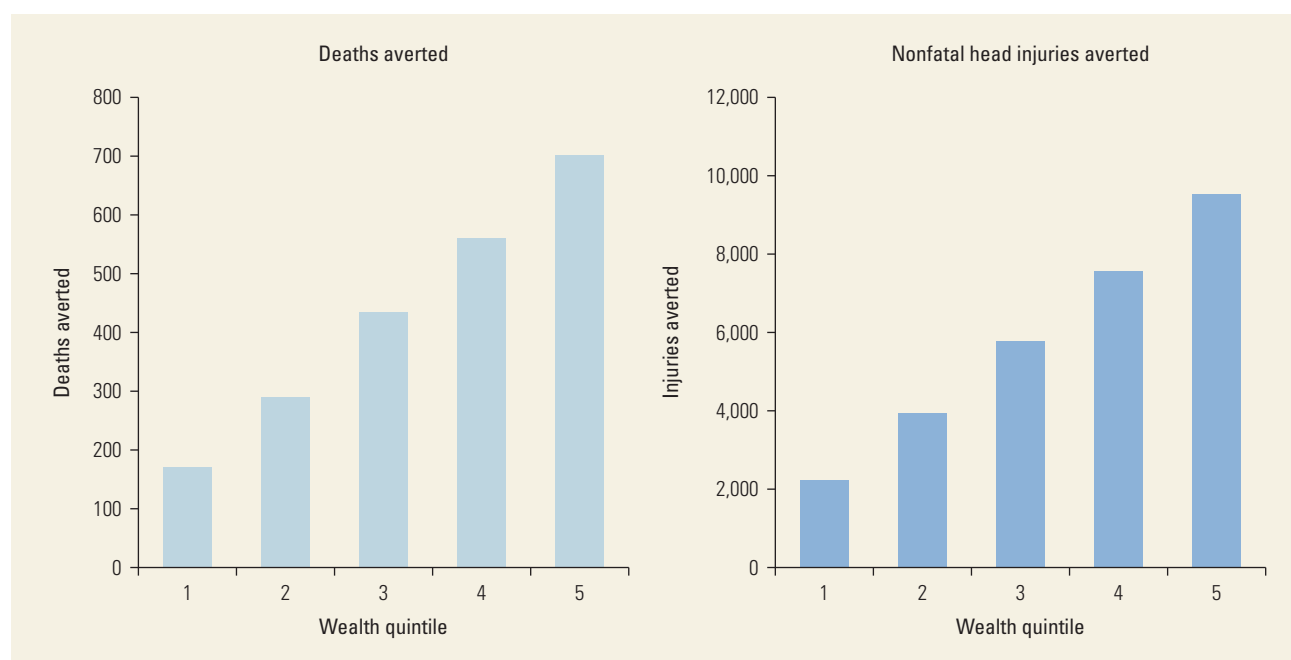
The main distributional analysis assumed that the distribution of traffic injury reflected the distribution of motorcycle ownership across income quintiles and

Table 11.2 Estimated Reduction in Death, Injury, and Cost Attributable to the Mandatory Helmet Legislation in Vietnam

Indicator	Pre-policy estimate (attributable to motorcycles)	Estimated absolute reduction (range) ^a	Estimated relative reduction (%) (range) ^a
Deaths	7,400	2,200 (1,000–2,700)	29 (14–37)
Nonfatal head injuries	54,100	29,000 (12,700–44,500)	54 (23–82)
Direct acute care costs for nonfatal head injuries (US\$, millions)	35	18 (8–28)	52 (24–81)
Income losses following death or nonfatal head injury (US\$, millions)	63	29 (11–40)	46 (18–64)
Direct acute care costs plus income losses (US\$, millions)	98	48 (24–72)	49 (24–73)

a. Values in parentheses represent lower and upper bounds obtained on univariate sensitivity analyses.

Figure 11.1 Deaths and Nonfatal Head Injuries Averted as a Result of the Helmet Policy in Vietnam, by Income Quintile (1 = Poorest, 5 = Richest)



found that the wealthiest quintiles own the greatest number of motorcycles and thus accrue a larger share of the health and financial benefits (in absolute terms) from the 2007 helmet policy (figure 11.1). With regard to financial risk protection, traffic injury is so expensive to treat that any injury averted also would avert catastrophic health expenditures (figures 11.2 and 11.3). In other words, both before and after the policy, traffic injury leads to health expenditures that exceed 25 percent of per capita income, amounting to more than 22,000 cases of catastrophic health expenditure averted.

The helmet legislation likely has averted poverty for persons in the second and third income quintiles, amounting to nearly 11,000 cases of poverty averted. Persons in the first quintile are poor already, and the cost is not so high that those in the fourth and fifth quintiles will be thrust into poverty.

Table 11.2 presents the lower and upper values obtained in a univariate sensitivity analysis. The sensitivity analysis that accounted for substandard and inadequately fastened helmets yielded the lowest estimates of deaths and injuries averted, a finding with

Figure 11.2 Out-of-Pocket Costs Averted as a Result of the Helmet Policy in Vietnam, by Income Quintile (1 = Poorest, 5 = Richest) 2012 US\$, millions

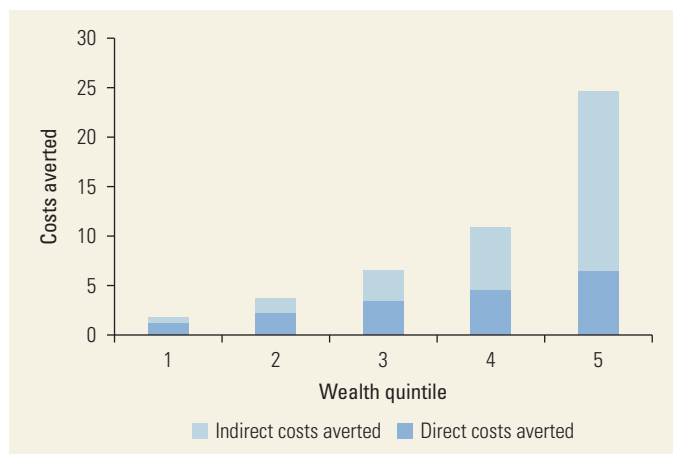
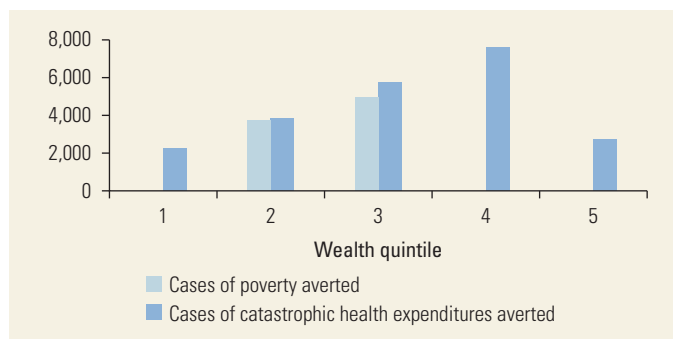


Figure 11.3 Financial Risk Protection Afforded as a Result of the Helmet Policy in Vietnam, by Income Quintile (1 = Poorest, 5 = Richest)



Note: No data are available for cases of poverty averted for quintiles 1, 4, and 5.

clear implications for policy and enforcement. Deaths, injuries, and OOP costs averted were extremely sensitive to variation in the proportion of motorcycle injuries anticipated to cause head injury. Direct costs of acute care averted also were highly sensitive to variation in the average costs of acute care for crash victims with and without helmets. The univariate sensitivity analyses, along with those for poverty and catastrophic health expenditures averted, are presented graphically in the annex (figures 11A.1–11A.5 and 11A.9).

Distributional sensitivity analyses demonstrated that the distribution of health benefits is highly sensitive to variation in the pre-policy distribution of motorcycle injury across quintiles. Both health and financial benefits accrue disproportionately to the poor

under conditions of perfectly equitable pre-policy motorcycle injury and death. This finding is amplified when occurring in conjunction with highly inequitable pre-policy helmet use (with highest use among the wealthy) and perfectly equitable post-policy helmet use (annex 11A, figures 11A.6–11A.8).

DISCUSSION

Assuming that helmets in Vietnam are as effective as those in HIC, the 2007 comprehensive helmet policy prevented approximately 2,200 deaths and 29,000 head injuries, saved individuals US\$18 million in direct acute care costs, and averted US\$29 million in individual income losses in the year following its introduction. The combination of anticipated health and financial benefits makes a comprehensive helmet policy strongly preferable to the pre-policy status quo. These findings suggest that similar comprehensive legislation and enforcement should be considered in countries where motorcycles are pervasive, yet helmet use is less common.

In the simulations, the relative reduction in motorcycle crash deaths fell from 29 percent to 14 percent after accounting for the proliferation of less-effective helmets in Vietnam. Policy makers wanting to enact an effective comprehensive helmet law might consider making provisions for adequate regulatory enforcement of manufacturers, retailers, and motorcycle riders to ensure that helmets are of adequate quality and appropriately fastened.

The results of the ECEA suggest that the wealthy likely accrued a large share of the absolute health and financial benefits resulting from the helmet use legislation. This finding was dependent on the assumption that the risk of RTI tracked with motorcycle ownership. In contrast, under all of the conditions tested, the legislation was likely to have prevented a greater number of cases of poverty resulting from motorcycle accidents among the near poor and middle-income quintiles. This supports the conclusion that injury prevention also is poverty prevention among individuals of lesser wealth. In settings with universal health insurance, cost savings from a comprehensive helmet policy (potentially substantial, as the wealthy are known to use a disproportionate share of public health care) might also be freed up for use on other health priorities (Wagstaff 2010).

The validity of the model's estimates are supported by the results of prior research. The findings anticipate a 29 percent reduction in deaths from motorcycle accidents and a 17 percent reduction in deaths from all traffic accidents. These results are similar to the 36 percent reduction in deaths from motorcycle

accidents generally anticipated with helmet legislation and the 18 percent reduction in deaths from all traffic accidents reported in Vietnam in the year following introduction of the helmet legislation (Passmore, Nguyen, and others 2010; Passmore, Tu, and others 2010). The results also are in harmony with the results of regional evaluations of helmet use legislation (Chiu and others 2000; Ichikawa, Chadbunchachai, and Marui 2003; Tsai and Hemenway 1999).

Limitations

Several limitations are related to the model and its inputs. First, the modeling study estimated the anticipated effectiveness and cost-effectiveness of the 2007 comprehensive helmet policy in Vietnam but did not directly measure the benefits or costs. The published academic literature has not yet articulated the observed benefits and costs of this policy, despite the crucial importance of these values for evaluating policy success. Second, many of the inputs used (including pre-policy deaths and injuries attributable to motorcycles, acute care costs, and policy implementation costs) were not directly available and had to be derived or estimated from published reports. The use of academic and non-governmental reports rather than government surveillance data improves the quality of data but diminishes the local applicability of the results. Third, the main analysis ignored the influence of substandard helmets in Vietnam because of the absence of reliable estimates of the relative effectiveness of the substandard helmets, particularly in a setting with relatively low traffic speeds (Ackaah and others 2013).³

The analysis was also limited by several assumptions made in constructing the model. The assumption that the number of motorcycles on the road was the same before and after the policy rendered the estimated benefits more conservative, interpretable, and generalizable (Le and Blum 2013). Changes in the prevalence of speeding and alcohol use, increased enforcement of traffic laws not related to helmets, changes in road maintenance and congestion, and other secular trends were ignored. The cost estimates did not account for a potential increase in nonhead injuries among riders whose lives were saved by helmet use. The simulated number of deaths averted represents less than 10 percent of the simulated number of injuries averted, so the potential increase in nonhead injuries was anticipated to be minimal. Lastly, insufficient information made estimating the higher costs for individuals and the higher revenue for government resulting from improved enforcement and higher fines resulting from the helmet policy impossible.

The potential for impoverishment resulting from helmet infraction fines was assumed to be uncommon and relatively inconsequential.

Cost-Effectiveness

The results suggest that Vietnam's 2007 helmet legislation was cost-effective. Large health and financial benefits accrued to the wealthy, yet the policy also provided significant health benefits and substantial financial risk protection to Vietnam's poorest citizens. As countries develop and more individuals acquire motorcycles, we are likely to see a reversal in the distribution of benefits from helmet legislation. Increased ridership among the poor will increase the risk of injury, yet improved helmets are likely to be worn only by the wealthy. The issues of road traffic safety are only going to grow as motorcycles become more accessible throughout the region. Fortunately, most countries have implemented helmet legislation. Others, such as Cambodia, have recently expanded their policies to include passengers and children. The implications of road safety policy go well beyond health, as our analysis has shown. Policy makers wishing to account for such effects may want to use ECEA to understand the likely influence of policy on equity.

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Zachary Olson, John A. Staples, Charles N. Mock, Rachel Nugent, and Stéphane Verguet were responsible for the design of the study. Olson and Staples had full access to all of the data and take responsibility for the integrity of the data and the accuracy of the data analysis. They also prepared the initial draft of the manuscript. All authors contributed to data interpretation, revised the manuscript, and provided approval for submission.

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ANNEX

The annex to this chapter is as follows. It is available at <http://dcp-3.org/environment>.

- Annex 11A. Supplementary Tables and Figures on the Effects of Vietnam's Mandatory Helmet Legislation on Health, Equity, and Medical Impoverishment

NOTES

World Bank Income Classifications as of July 2014 are as follows, based on estimates of gross national income (GNI) per capita for 2013:

- Low-income countries (LICs) = US\$1,045 or less
 - Middle-income countries (MICs) are subdivided:
 - a) lower-middle-income = US\$1,046 to US\$4,125
 - b) upper-middle-income (UMICs) = US\$4,126 to US\$12,745
 - High-income countries (HICs) = US\$12,746 or more.
1. A proxy for individual income was extracted from the income distribution of Vietnam derived from its GDP per capita (US\$1,200 in 2012 US\$) and its Gini index (0.36) (Salem and Mount 1974; World Bank 2012).
 2. This number was derived by Dan Chisholm, Jonathon Passmore, and Nguyen Phuong Nam using the same model cited (Chisholm and others 2012).
 3. See also *Viet Nam News* 2014.

REFERENCES

Ackaah, W., F. Afukaar, W. Agyemang, T. Thuy Anh, A. R. Hejar, and others. 2013. "The Use of Non-Standard Motorcycle Helmets in Low- and Middle-Income Countries: A Multicentre Study." *Injury Prevention* 19 (3): 158–63.

Chisholm, D., H. Naci, A. A. Hyder, N. T. Tran, and M. Peden. 2012. "Cost-Effectiveness of Strategies to Combat Road Traffic Injuries in Sub-Saharan Africa and South East Asia: Mathematical Modelling Study." *BMJ* 344: e612.

Chiu, W. T., C. Y. Kuo, C. C. Hung, and M. Chen. 2000. "The Effect of the Taiwan Motorcycle Helmet Use Law on Head Injuries." *American Journal of Public Health* 90 (5): 793–96.

Government of Vietnam. 2007. "Resolution on a Number of Urgent Countermeasures to Curb Traffic Safety and Alleviate Traffic Congestion." Resolution 32/2007/NQ-CP (June 29, 2007), Government of Viet Nam, Hanoi.

GSO (General Statistics Office). 2010. *Vietnam Household Living Standards Survey*. Hanoi: Statistical Publishing House.

GSO, NIHE (National Institute of Hygiene and Epidemiology), and ORC Macro. 2006. *Vietnam Population and AIDS Indicator Survey 2005*. Calverton, MD: GSO, NIHE, and ORC Macro.

Hoang, H., T. Pham, T. Vo, P. Nguyen, C. Doran, and others. 2008. "The Costs of Traumatic Brain Injury Due to Motorcycle Accidents in Hanoi, Vietnam." *Cost Effectiveness and Resource Allocation* 6 (1): 17.

Hung, D. V., M. R. Stevenson, and R. Q. Ivers. 2006. "Prevalence of Helmet Use among Motorcycle Riders in Vietnam." *Injury Prevention* 12 (6): 409–13.

———. 2008. "Motorcycle Helmets in Vietnam: Ownership, Quality, Purchase Price, and Affordability." *Traffic Injury Prevention* 9 (2): 135–43.

Ichikawa, M., W. Chadbunchachai, and E. Marui. 2003. "Effect of the Helmet Act for Motorcyclists in Thailand." *Accident Analysis and Prevention* 35 (2): 183–89.

Le, L. C., and R. W. Blum. 2013. "Road Traffic Injury among Young People in Vietnam: Evidence from Two Rounds of National Adolescent Health Surveys, 2004–2009." *Global Health Action* 6: 1–9.

Liu, B., R. Ivers, R. Norton, S. Boufous, S. Blows, and others. 2008. "Helmets for Preventing Injury in Motorcycle Riders." *Cochrane Database of Systematic Reviews* 1: CD004333.

National Traffic Safety Committee. 2014. "Vietnam Road Traffic Injury Official Estimates." National Traffic Safety Committee, Hanoi.

Ngo, A. D., C. Rao, N. P. Hoa, D. G. Hoy, K. T. Q. Trang, and others. 2012. "Road Traffic Related Mortality in Vietnam: Evidence for Policy from a National Sample Mortality Surveillance System." *BMC Public Health* 12 (July): 561.

Nguyen, H., R. Q. Ivers, S. Jan, A. L. Martiniuk, Q. Li, and others. 2013. "The Economic Burden of Road Traffic Injuries: Evidence from a Provincial General Hospital in Vietnam." *Injury Prevention* 19 (2): 79–84.

Nguyen, H. T., J. Passmore, P. V. Cuong, and N. P. Nguyen. 2013. "Measuring Compliance with Viet Nam's Mandatory Motorcycle Helmet Legislation." *International Journal of Injury Control and Safety Promotion* 20 (2): 192–96.

Passmore, J., L. H. Nguyen, N. P. Nguyen, and J. M. Olive. 2010. "The Formulation and Implementation of a National Helmet Law: A Case Study from Viet Nam." *Bulletin of the World Health Organization* 88 (10): 783–87.

Passmore, J., N. T. Tu, M. A. Luong, N. D. Chinh, and N. P. Nam. 2010. "Impact of Mandatory Motorcycle Helmet Wearing Legislation on Head Injuries in Viet Nam: Results of a Preliminary Analysis." *Traffic Injury Prevention* 11 (2): 202–5.

Pham, K. H., W. X. L. Thi, D. J. Petrie, J. Adams, and C. M. Doran. 2008. "Households' Willingness to Pay for a Motorcycle Helmet in Hanoi, Vietnam." *Applied Health Economics and Health Policy* 6 (2–3): 137–44.

Salem, A. B. Z., and T. D. Mount. 1974. "A Convenient Descriptive Model of Income Distribution: The Gamma Density." *Econometrica* 42 (6): 1115–27.

Tien, T. V., H. T. Phuong, I. Mathauer, and N. T. K. Phuong. 2011. *A Health Financing Review of Viet Nam with a Focus on Social Health Insurance*. Geneva: World Health Organization.

- Tsai, M., and D. Hemenway. 1999. "Effect of the Mandatory Helmet Law in Taiwan." *Injury Prevention* 5 (4): 290–91.
- Verguet, S., R. Laxminarayan, and D. T. Jamison. 2014. "Universal Public Finance of Tuberculosis Treatment in India: An Extended Cost-Effectiveness Analysis." *Health Economics* 24 (3): 318–32.
- Verguet, S., S. Murphy, B. Anderson, K. A. Johansson, R. Glass, and others. 2013. "Public Finance of Rotavirus Vaccination in India and Ethiopia: An Extended Cost-Effectiveness Analysis." *Vaccine* 31 (42): 4902–10.
- Verguet, S., Z. D. Olson, J. B. Babigumira, D. Desalegn, K. A. Johansson, and others. 2015. "Health Gains and Financial Risk Protection Afforded by Public Financing of Selected Interventions in Ethiopia: An Extended Cost-Effectiveness Analysis." *The Lancet Global Health* 3 (5): e288–96.
- Viet Nam News. 2014. "Police Struggle to Identify Substandard Helmets." *Viet Nam News*, July 2. <http://vietnamnews.vn/society/256910/police-struggle-to-identify-substandard-helmets.html>.
- Wagstaff, A. 2010. "Measuring Financial Protection in Health." In *Performance Measurement for Health System Improvement: Experiences, Challenges, and Prospects*, edited by P. C. Smith, E. Mossialos, I. Papanicolas, and S. Leatherman, 114–37. Cambridge, U.K.: Cambridge University Press.
- Wagstaff, A., and E. van Doorslaer. 2003. "Catastrophe and Impoverishment in Paying for Health Care: With Applications to Vietnam 1993–1998." *Health Economics* 12 (11): 921–34.
- WHO (World Health Organization). 2004. *World Report on Road Traffic Injury Prevention*. Geneva: WHO. http://www.who.int/violence_injury_prevention/publications/road_traffic/world_report/en/.
- . 2009. "Road Safety Status: Country Profile, Vietnam." WHO, Geneva. http://www.who.int/violence_injury_prevention/road_safety_status/country_profiles/viet_nam.pdf.
- . 2010. *World Health Statistics 2010*. Geneva: WHO. http://www.who.int/whosis/whostat/EN_WHS10_Full.pdf.
- . 2013a. *Global Status Report on Road Safety 2013*. Geneva: WHO. http://www.who.int/violence_injury_prevention/road_safety_status/2013/en/index.html.
- . 2013b. "Road Safety Fact Sheet, Western Pacific Region." WHO, Geneva. http://www.wpro.who.int/mediacentre/factsheets/fs_20130627/en/.
- . 2013c. "Road Safety Status: Country Profile, Vietnam." WHO, Geneva. http://www.who.int/violence_injury_prevention/road_safety_status/2013/country_profiles/viet_nam.pdf.
- . 2015. *Study on Motorcycle Helmet Quality in Viet Nam*. WHO and Hanoi School of Public Health. http://www.wpro.who.int/vietnam/topics/injuries/helmet_quality_vietnam.pdf.
- World Bank. 2012. *World Development Indicators*. Washington, DC: World Bank. <http://data.worldbank.org/data-catalog/world-development-indicators>.
- World Bank and IHME (Institute for Health Metrics and Evaluation). 2014. *Transport for Health: The Global Burden of Disease from Motorized Road Transport*. Seattle, WA: IHME.
- Yu, W. Y., C. Y. Chen, W. T. Chiu, and M. R. Lin. 2011. "Effectiveness of Different Types of Motorcycle Helmets and Effects of Their Improper Use on Head Injuries." *International Journal of Epidemiology* 40 (3): 794–803.