



Lives saved by laws and regulations that resulted from the Bloomberg road safety program

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ARTICLE INFO

Keywords:

Motor vehicle crash
Drunk driving
Helmets
International
Traffic enforcement
Developing country

ABSTRACT

Objective: To estimate lives saved during 2008–2023 by traffic safety laws passed in six developing countries while participating in the Bloomberg Road Safety Program (BRSP).

Methods: BRSP-funded local staff identified relevant laws and described enforcement to the study team. We analyzed road crash death estimates for 2004–2013 from the Global Burden of Disease and projected estimates absent intervention forward to 2023. We amalgamated developing country and US literature to estimate crash death reductions by country resulting from laws governing drink driving, motorcycle helmets, safety belt use, and traffic fines.

Results: BRSP helped win approval of traffic safety laws in Brazil, China, Kenya, Mexico, Turkey, and Vietnam. In 2008–2013, those laws saved an estimated 19,000 lives. Many laws only took effect in 2014. The laws will save an estimated 90,000 lives in 2014–2023. Of the 109,000 lives saved, drink driving laws will account for 84%, increased motorcyclist protection for 13%, increased fines and penalty points for 2%, and safety belt usage mandates for 1%. Drink driving reductions in China will account for 56% of the savings and reduced drink driving and motorcycling deaths in Vietnam for 35%. The savings in China will result from a narrow intervention with just 4% estimated effectiveness against drink driving deaths. As a percentage of deaths anticipated without BRSP effort, the largest reductions will be 11% in Vietnam and 5% in Kenya.

Conclusions: Viewed as a public health measure, improving traffic safety provided large health gains in developing nations.

1. Introduction

With economic development, traffic safety has become a major public health concern in low- and middle-income countries (LMICs). Road traffic crashes killed 1.4 million people in 2013 (GBD 2013 Mortality and Causes of Death Collaborators, 2014). The World Health Organization (WHO) reports that 80–90 percent of the world's road fatalities occur in LMICs, despite these countries containing only half of the world's vehicles (World Health Organization (WHO), 2014). In recognition of the global hazard posed by motor vehicle crashes (MVCs), on 10 April, 2004 the United Nations (UN) General Assembly adopted a resolution on “Improving global road safety” that led to the formation of the UN Road Safety Collaboration (United Nations Road Safety Collaboration, 2014).

A large literature has established the benefits of road safety laws and their enforcement in developed nations (Community Preventive Services Task Force, 2014). For example, Miller and Hendrie (2013)

estimated the return on investment in reducing drink driving for 21 US laws addressing road safety and nine broad alcohol control laws. Miller et al. (2011) estimated that 242 US Federal and state road safety laws passed between 1989 and 2009 saved 120,000 lives through 2009.

By comparison, two comprehensive literature searches (Spicer, 2011; Esperato et al., 2012) located few effectiveness studies of road safety laws and their enforcement in developing countries. Example studies from these reviews evaluated traffic code overhaul, reducing the driver blood alcohol concentration (BAC) limit from 0.06 to 0.02, and speed enforcement in Brazil; a broad enforcement effort in Iran; and speed cameras in China; alcohol-testing checkpoints in Uganda; a 0.05 BAC limit for motorcyclists in Thailand; enforcement of seatbelt use laws in China and South Africa; and motorcycle helmet use mandates in Colombia, Taiwan, Thailand, and Vietnam. Some of these evaluations were of low quality or were unable to distinguish the effects of simultaneous social marketing campaigns.

To encourage traffic safety laws, Bloomberg Philanthropies (BP)

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implemented the Bloomberg Road Safety Program (BRSP). BRSP began with a \$9 million 2007 grant to WHO that included pilot projects in Vietnam and Mexico (Toroyan, 2007). In 2010, BP committed \$125 million in funding focused on 10 countries that represented half of global road traffic-related deaths: Brazil, Cambodia, China, Egypt, India, Kenya, Mexico, Russia, Turkey and Vietnam (Esperato et al., 2012). Through BRSP, 65 million people were exposed to media campaigns promoting road safety, 36,000 professionals were trained on road safety tactics, and local governments committed \$225 million toward road safety infrastructure improvements (Bloomberg Philanthropies, 2014). While BSRP was underway, six of the ten targeted countries – Brazil, Kenya, China, Mexico, Turkey and Vietnam – passed important road safety legislation including stricter penalties for drink driving, seat-belt or helmet use regulations, and speed reduction laws. The goal of this paper is to estimate the lives saved from 2008–2013 associated with these traffic safety interventions, then project future reductions in mortality through 2023.

2. Methods

We polled the local BRSP-funded staff person in each target country about road traffic laws and regulations implemented, their effective dates, and enforcement intensity and barriers. While we requested that BRSP staff focus mainly on the level of police enforcement for a given law, we trusted their holistic assessment of a law's implementation. We classified enforcement as (1) lax if enforcement did not increase from its prior low level or if loopholes in the law (e.g., lack of sanctions for refusing a breath test) made it unenforceable, (2) modest if equipment shortages limited the number of new officers assigned but apprehended violators were effectively sanctioned, and (3) strong otherwise.

To calculate the lives saved for each law or regulation, we used a multi-step modeling process combining the local enforcement data and prior literature from effectiveness studies of analogous interventions. The percentage reduction in attributable deaths is calculated as the reach (the portion of those who died whose behavior the law would affect) times effectiveness (the percentage of affected people who would survive). For example, the calculated reduction in deaths due to a helmet use law would be the number of motorcycle riders who were not already wearing helmets but will wear them to comply with the law times the percentage reduction in risk of crash death associated with wearing a helmet when motorcycling.

The laws/regulations implemented during the study period are shown in Table 1. Section 2.1 describes those interventions and their estimated effectiveness. Section 2.2 then introduces the estimates of road traffic deaths from the Global Burden of Disease (GBD) that our model applies to our effectiveness estimates. The GBD provides modeled road crash death counts developed with models that smooth out distortions between countries and across time. GBD models thus do not track shifts due to intervention quickly or well. That allows our modeling to start by estimating the share of pre-intervention deaths that fall into each risk category addressed by intervention (e.g., motorcyclist, drink driving). From those estimated counts and the estimated effectiveness of the interventions, it then calculates how many lives were saved.

2.1. Effectiveness estimates

2.1.1. Drink driving laws

A systematic review of 33 US road safety interventions that reduced drink driving found that no intervention reduced deaths attributable to drink driving by more than 17%; a 4%–8% reduction was typical (Miller and Hendrie, 2005; Erke et al., 2009). We used US effectiveness estimates to guide our LMIC effectiveness estimation. Implicit in our drink driving effectiveness estimates is an adjustment of alcohol-involved death counts to the smaller number that are alcohol-attributable.

Kenya raised its drink driving penalties in 2012, which we consider akin to moving to administrative license suspension for drink driving. Systematic reviews estimate administrative license suspension is 5% effective against drink driving fatalities in high-income countries (Miller et al., 2011; Wagenaar and Maldonado-Molina, 2007; Wagenaar et al., 1995). Local BRSP staff determined that enforcement of this law in Kenya was modest (Table 1). Therefore, we built in a 20% reduction in this law's effectiveness (from 5% to 4% effective).

Brazil increased drink driving penalties, decreased the allowable BAC limit from 0.02 g/dl to zero, and increased the breath alcohol concentration limit from 0.02 g/dl to 0.05 g/dl in 2013. Because driving at 0.02 is not very risky, this intervention was designed to facilitate enforcement. Unfortunately, BRSP informants state that drink driving enforcement has been limited except in São Paulo, because local police are unsure of appropriate action when road users refuse a breath test. Therefore, we estimated these changes would produce just a 4% fatality reduction beyond the reduction associated with a BAC limit shift implemented just before the Bloomberg-funded efforts started (Andreuccetti et al., 2011).

China strengthened its penalties, notably prescribing between one and six months detention for driving above 0.08 BAC. We estimate that this is akin to US laws that impose electronic supervision or intensive probation on repeat offenders, which are 4% effective. This estimate may be conservative, because drink driving enforcement also has been visibly strengthened (e.g., Wagenaar et al. (2007a) suggest 6.4% effectiveness).

In Mexico, the maximum allowable BAC was reduced to 0.05 g/dl and penalties increased in Jalisco/Guadalajara in 2010 and Guanajuato/Leon in 2012. Random breath testing (RBT) became legal and was implemented in both states in 2014. Moving from 0.08 to 0.05 reduced drink driving deaths by an estimated 8% in a pair of studies (Fell and Voas, 2006; Wagenaar et al., 2007b). RBT in developed countries typically is associated with a 15% reduction in alcohol related deaths (Miller and Hendrie, 2005). We discounted that percentage by one third because intensive RBT deployment often is not sustained.

Russia raised its maximum allowable BAC from 0.00 to 0.07 in 2013, claiming this would permit strict enforcement. A similar change raised allowable BACs in East Germany during German reunification, but did not decrease drink driving (Vollrath et al., 2005). Thus, we attributed zero effectiveness despite press reports of improved police effort, and excluded this law from Table 1.

In 2008, Vietnam decreased maximum allowable BACs from 0.08 to 0.05 for motorcyclists and 0.00 for other drivers, which again is estimated to have 8% effectiveness. Penalties increased substantially in 2012 and modestly in 2010 and 2013. With Vietnamese enforcement levels stronger than in Kenya or Brazil, we attributed the full 5% effectiveness gain (Wagenaar and Maldonado-Molina, 2007) to the major increase, but no additional benefit to the modest refinements.

2.1.2. Motorcycle laws

Kenya implemented laws in 2013 mandating use of helmets and reflective clothing, adopting international helmet standards, and restricting motorcyclists to one passenger. Without aggressive enforcement, a helmet law typically increases use by 40 percentage points (Ulmer and Preusser, 2003). Motorcycle helmets that meet standards are 37%–40% effective against motorcyclist fatalities (Deutermann, 2004; Keng, 2005). Because studies of the effect of reflective clothing are mixed (Tran, 2007; Wells et al., 2004; de Rome et al., 2011), we attributed no savings to this mandate. We also lacked sufficient information to estimate the impact of reduced occupancy. Thus, the estimated fatality reduction for Kenya of 14.8% (40% increase in use \times 37% effective when used) only includes lives saved by the helmet law.

Legislation in Vietnam requiring that helmets sold meet standards became effective in 2014. Since wearers periodically replace their helmets, we assumed that this law will decrease the 50-plus percent of

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