

CHINA SEAT BELT INTERVENTION



THE GEORGE
INSTITUTE
for International Health

The Guangzhou
Traffic Command
and Control Center

Traffic Management
Bureau, China Ministry
of Public Security



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概述

在过去45年中，中国道路交通死亡和受伤数分别上升了4倍和10倍，每年约有10万人死于交通事故。显然中国道路交通伤害的疾病负担是惊人的，急需在中国，特别是在北京、上海、天津、重庆和广州等机动化程度呈指数提高的大城市，采取普遍认可的有效的干预措施。

一系列道路安全策略可在中国的许多地区实施，例如，有确切的证据表明安全带能有效保护乘员安全，尽管有这样的证据、法律规定也强制要求机动车司机和前排乘客使用安全带，但中国安全带使用率仍然很低。

“中国推广安全带使用项目”采取了包括健康促进（包括社会营销和健康教育）、培训和加强执法等干预措施，目的是提高广州（中国南方的一个大型城市）驾驶员和前排乘客的安全带使用率。使用有对照的干预前后评价的设计，评价还包括费用-效果评价。

在12个月的干预期后，在干预城市安全带使用率从50%（范围30-62%）显著提高至62%（范围60-67%），与之相反，在对照城市安全带使用率显著下降。需要指出的是，干预期后，干预城市按各种因素分层（即按不同道路类型、性别、司机/乘客、车辆类型等分层）的安全带使用率均有显著提高（ $p<0.01$ ）。安全带使用率提高幅度最大的是出租车司机和乘客。出租车司机使用率提高了21%（ $p<0.01$ ），即从干预前30%（范围10%-58%）提高至干预后的51%（范围45%-60%）。相反，在对照城市同期按相同因素分层的安全带使用率显著下降（ $p<0.01$ ）。

基于项目所观察到的安全带使用率提高幅度，干预所挽救的伤残调整寿命年（DALYs）为530。计入实施项目的费用及节省的相关费用，与不干预相比，干预的增量成本效果比（ICER）为每DALY 3,246人民币（相当于418美元）。需要指出的是，敏感性分析显示“最可能”情况下，ICER为每DALY 171美元，提示干预有高度的成本效益比，可在中低收入国家中推广。

干预研究为政府提供了加强道路安全实践能力建设的契机，同时，提供了是否应该将财政资源投入到道路安全的证据。考虑中国快速的机动化进程，严格实施和评估道路安全措施的机会并不多。重要的是，研究将道路安全有关方即政府、道路安全研究者和工业界联合起来，很少有这样的机会政府可以与科研部门和工业部门合作，并得到有成本效益比的结果（干预使安全带使用率提高）。重要的是，研究还得到这样的结果如交警执法实践的改进和最佳道路安全宣传策略等，为负责道路安全的中央政府和地方政府提供了有价值的经验。

2. Executive Summary



Over the past 45 years, road traffic fatalities and serious injuries in China have increased 4-fold and 10-fold, respectively, with an estimated 100,000 people dying from road traffic injury each year. Clearly, the burden from road traffic injuries in China is overwhelming and there is an urgency to implement known and effective interventions particularly in the mega cities such as Beijing, Shanghai, Tianjin, Chongqing and Guangzhou, where motorisation is taking place at an exponential rate.

An array of road safety strategies is available for implementation in many cities throughout China. For example, there is unequivocal evidence that seat belts are efficacious yet despite the known benefits associated with their use and national legislation regarding seat belt use by drivers and front seat passengers, the level of use is very low.

The China Seat Belt Intervention involved the implementation of an intervention that comprised health promotion (including social marketing and health education), training and enhanced traffic police enforcement, with an aim to increase the prevalence of seat belt use for drivers and front seat passengers in Guangzhou, a mega city in southern China. The Intervention was evaluated using a comparison group pre-test post-test design which also included an extensive cost effectiveness evaluation.

Following the 12-month intervention period, the prevalence of seat belt use increased significantly, from a prevalence of 50% (range: 30-62%) to a prevalence of 62% (range: 60-67%) in the intervention city. In contrast, the prevalence of seat belt use declined (significantly) by 6% in the comparison city; an overall difference in prevalence between the intervention and the comparison city of 18%. Importantly, the prevalence of seat belt use increased, significantly ($p<0.01$), from pre- to post-intervention in the intervention city across all factors namely, seat belt use by male or female drivers, whether a driver or front seat passenger, and across road types and vehicle types. The greatest increase in the prevalence of seat belt use was among drivers and passengers of taxis in the intervention city. The prevalence of seat belt use among taxi drivers increased by 21% ($p<0.01$) (pre-test 30% [Range: 10%-58%] to 51% post-test [Range: 45%-60%]). In contrast, the prevalence of seat belt use significantly declined ($p<0.01$) in the comparison city over the observational period across the same factors.

Based on the increased prevalence of seat belt use observed as part of the intervention, the estimated total number of Disability Adjusted Life Years (DALYs) saved as a result of the intervention was 530. Taking account of the cost of implementing the intervention along with the associated cost savings, the incremental cost effectiveness ratio (ICER) of the intervention compared with no enhanced program to increase the prevalence of seat belt use was CNY3,246 per DALY saved (or the equivalent US\$418 per DALY saved). Importantly, when the 'most likely' case of the ICER following sensitivity analysis is considered, the intervention is highly cost effective (US\$171 per DALY saved).

The intervention provided the government with the opportunity to build capacity in road safety and at the same time, provided information on the opportunity to target financial resources in order to reduce the burden of road traffic injury. Given the speed at which motorisation is taking place throughout China, there are limited opportunities to apply and rigorously evaluate best-practice in road safety. Importantly, the study brought together the key stakeholders for road safety - the government, road safety researchers and industry. Seldom are there opportunities where governments can implement an intervention that involves collaboration between scientists and industry and at the same time, deliver cost-effective outcomes such as increased seat belt use. Importantly, the study provided outcomes such as changes to police enforcement practice and comprehensive road safety communication strategies which will be a legacy of this project and will be invaluable to both Central and Provincial-level governments who are responsible for road safety in China.

3. Background



Injury is a leading cause of death and disability worldwide. The Global Burden of Disease study undertaken by the World Health Organisation estimated that in 1990, injury accounted for 15% of the burden of death and disability with the likelihood of it rising to 20% by the year 2020.¹ Of particular concern is the increasing mortality from road traffic injury particularly, in low and middle-income countries. A recent report from the World Bank² estimates that mortality from road traffic injury will increase by approximately 80% to 144% in low and middle-income countries over the ensuing decade.

In China, injuries are the leading cause of death from age 1 to 44 years accounting for approximately 750,000 deaths and 3.5 million hospitalisations each year.³ Much of the injury-related mortality and morbidity is due to road traffic injury which is not surprising, since motor vehicle production has tripled since the early 1990's.⁴ Over a 45-year period (1951-1999), road traffic fatalities and serious injuries in China have increased 4-fold and 10-fold, respectively,⁵ with an estimated 100,000 people dying from road traffic injury each year.⁶ The increase in mortality and morbidity reflects, in part, the epidemiologic transition that has been occurring across much of the country, but particularly among the eastern and south-western provinces, in the past two decades. Clearly, the burden from road traffic injuries in China is overwhelming and there is an urgency to implement known and effective interventions particularly in the mega cities such as Beijing, Shanghai, Tianjin, Chongqing and Guangzhou, where motorisation is taking place at an exponential rate.⁷

An array of road safety strategies could be implemented immediately in countries undergoing rapid motorisation and a number of the strategies are based on good evidence.⁸ For example, there is unequivocal evidence that seat belts are efficacious with recent research⁹ indicating that the risk of death is significantly reduced (by up to 60%) in drivers restrained by a seat belt compared with those unrestrained. Furthermore, there is evidence from systematic reviews¹⁰ that comprehensive intervention programs to increase seat belt use are effective in increasing the prevalence of seat belt use.

In 1993, the Ministry of Public Security instituted a regulation requiring all vehicles less than 6 metres in length and with fewer than 20 seats to have seat belts fitted in the front seats of the vehicle along with the mandatory use and associated increased fines for non use for drivers and front seat passengers; these latter aspects were enacted in May 2004. Despite the availability of seat belts in almost all vehicles in China, the few studies undertaken suggest that restraint use is very low (ranges between 7% and 65%).^{11,12} This is in contrast with countries such as Australia, where the prevalence of seat belt use is as high as 95%.¹³

Despite the known benefits associated with the use of a seat belt in the event of a crash and legislation mandating their use, the levels of seat belt use are very low in China. Consequently, an intervention that increases the population prevalence of seat belt use will contribute, significantly, to the reduction of road injuries.

The proposed intervention aimed to:

- increase the prevalence rate of seat belt use for drivers and front seat passengers by 20%;
- estimate the cost effectiveness of the intervention.

4. Methods



4.1 Background

In preparation for the intervention, meetings were held with key stakeholders and a number of specific focus groups were hosted. The meetings were held with a variety of participants including provincial-level government staff responsible for health, transport, production safety, as well as police officials from the intervention city. The purpose of the meetings was to communicate the nature of the intervention and to ensure it was supported across the various ministries responsible for services in the intervention city. Following this, a number of focus groups were held first, with a sample of drivers (including taxi drivers) to elicit the barriers to seat belt use and, secondly with traffic police departments to determine barriers to conducting extensive enforcement of seat belt use. The findings from the focus groups are reported in Section 5.1.1.

4.2 Study Setting

Based on a need to implement road safety interventions in the mega cities of China, the Central-level (Beijing) government recommended the southern city of Guangzhou (Guangdong Province) as the site for the seat belt intervention. The City of Nanning (Guangxi Zhuang Autonomous Region) was selected as a comparison city on the basis of its geographical distance (817km, 1 hour by plane or 10 hours by car) to Guangzhou City such that the intervention activities were unlikely to contaminate the comparison city. Although there are distinct differences between the two cities, both are highly urbanised, both in southwest China (in neighbouring provinces) and both have an extensive road network (see Table 1 for demographic features of each city).

Table 1: Demographic features of the intervention and comparison cities

Demographics	Guangzhou	Nanning
Population	11,787,100	6,697,000
Annual income per capita	15,003RMB	10,078RMB
Length of highways	5,438km	6,127km
Number of motor vehicles	1,722,105	875,822
Number of cars	682,444	112,120
Number of taxis	16,000	3,400

4.3 Study Design

The evaluation of the intervention was undertaken by adopting a comparison group pre-test post-test design. Two cities were chosen (as described above) of which Guangzhou City received the intervention whilst Nanning City acted as a comparison. Prior to the implementation of the intervention, extensive baseline (pre-test) measures of the key outcome of interest namely, the prevalence of seat belt use, was undertaken in both cities. The same observations were repeated 12 months post-intervention in both cities.

4.4 Process Evaluation

The dynamic, continuous documentation of all intervention activities was undertaken during the period of the intervention. For the purposes of this report, we describe only the specific areas in which we collected data and a brief summary of the findings in each of these areas is reported. Importantly, the aim of the process evaluation was to provide information on the relationship between different components of the intervention and the extent to which each contributed to the overall study finding.

Importantly, we undertook extensive evaluation of the police training sessions in order to refine these sessions for future implementation. The results of the evaluations are not reported here, however, the details can be obtained from the authors.

4.5 Impact Evaluation

As described above, we utilised a comparison group pre-test post-test design to evaluate the impact of the intervention. This approach enables the prevalence rates in the intervention city (which were measured at two time points) to be compared before and after the intervention whilst also using a contemporary community comparison (Nanning City) and thereby enabling the prevalence rates in the intervention city to be compared with the rates in the comparison city over the same time period. Importantly, both pre-test and post-test observations in the intervention and comparison cities were random cross-sectional observations of seat belt use which differs to the traditional pre-test post-test design which often involves the observations of the same individuals at two time intervals. Figure 1 outlines the model schema and the time frame for the evaluation.

The primary outcome measure for the impact evaluation was the prevalence rate of seat belt use. The prevalence rate was calculated as the total number of observed vehicles during the observational survey period in which the seat belt was observed to be correctly used by the driver and front seat passenger (numerator) [n_i - where i takes the values of the variables of interest for example 1 or 2; 1=male driver, 2=female driver], whilst the denominator for the prevalence rate was the total number of vehicles observed during the observational survey period [N_j - where j takes the values of the variables of interest for example from 1 to 3 where 1=local road, 2=main road and 3=expressway].

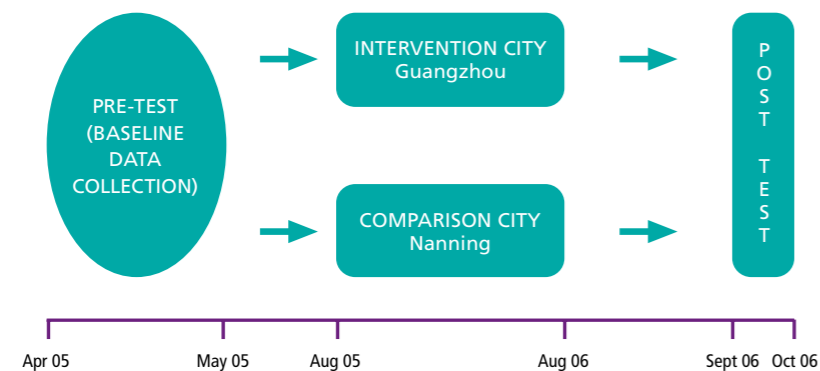
Equation:

$$PR_i = \frac{n_i}{N_j}$$

In order to estimate the prevalence of seat belt use, a random sample of the road network in both the intervention and comparison cities was undertaken at two time points namely, April-May 2005 (pre-intervention) and September-October 2006 (post-intervention). Observations of seat belt use were undertaken over a 7-day period and at varying times across the day (8:01am-6pm; 6:01pm-9pm). Observational sites were selected by stratified random sampling; stratifying by the road hierarchy namely, local roads, main roads and expressways¹. The same (randomly selected) road sites were utilised throughout the study – both pre-test and post-test. To adjust for the effects of seasonal variation, the baseline (pre-test) and post-test roadside observations were undertaken during similar seasonal periods.

1. Local road: a small urban road for any form of motor transport, usually having one lane in each direction; Main road: a major urban road for any form of motor transport with 2 or more lanes in each direction; Expressway: a major divided highway designed for high-speed travel, having few or no intersections and 3 or more lanes in each direction.

Figure 1: Evaluation of the Intervention



4.6 Roadside Observations

4.6.1 Site Selection

As described earlier, the roads selected in both the intervention and comparison cities were stratified based on the road hierarchy in the two cities. Detailed road maps of the two cities were obtained, and a 5km radius from the center of the metropolitan region determined. A grid was placed over the map of the 5km radius of the city, with each grid square identified by a horizontal and vertical coordinate. Within each road type a random x and a random y coordinate were chosen and the corresponding grid square identified. Thus, each road intersection (the site at which observations were made) had an equal probability of selection. If there was a single intersection within the square, then it was chosen as an observational site, but if there was no intersection within the square, or there was an intersection but it was linked with an already selected intersection, then a new x and y coordinate was randomly selected. If there was more than one intersection within the grid square, the square was subdivided into four equal sections, and one of the four sections was randomly assigned and the intersection selected. If, when the observer went to the site there was no stop sign or red light at the intersection, the observer selected an alternate intersection closest to the original site.

A total of 10 local street intersections, 8 main road intersections and 7 expressways (toll-gates were used for observational purposes on expressways) were randomly selected in Guangzhou whilst 10 local street intersections, 8 main road intersections and 1 expressway were randomly selected for observation in Nanning.

Observations of drivers and front seat passengers were undertaken over a 60 minute period during the day (8:00am to 6:00pm) and evening (6:00pm to 9:00pm) during the week and weekend.

4.6.2 Data Collection Procedures

As alluded to above, both intersections and toll-gates were used for observational sites. Given it was impractical to observe vehicles along any part of an expressway, it was necessary to observe only at the toll-gates. Similarly, intersections were chosen for local and main roads to ensure accurate observations of seat belt use hence, the validity of the observations. At all sites, observers recorded the location of the site, the date, time of day, traffic volume, as well as the following data for drivers and front seat passengers (as per the law, only front seat occupants are required to wear a seat belt hence, the observation):

- Type of vehicle (passenger car, taxi, other)
- Gender (male/ female)
- Shoulder belt use (correct use, incorrect use, non use)

Passenger vehicles included passenger cars and sport utility vehicles but excluded taxis, whilst the 'other' vehicle classification included vans, minivans and pickup-trucks (that were less than 6 metres in length). Heavy vehicles (trucks), buses and minibuses were excluded. Vehicles with heavily tinted windows for which observers could not see clearly, were also excluded. Special vehicles with white registration plates namely, police, official government and army vehicles were noted.

Seat belt use was classified as correct if the three-point shoulder belt was worn tightly across the chest of the occupant and there was no sign of a bull clip or clamp/nail (to prevent recoil of the belt if not worn). If the belt appeared to be loosely fitted across the chest of the motor vehicle occupant or a bull clip/nail or anything on the seat belt to prevent recoil was observed, or the belt was violently twisted, it was determined as 'improper use'. Finally, if there was no shoulder belt across the chest of the motor vehicle occupant, it was deemed as 'non use'.

Only vehicles travelling on the lane closest to the curb on which the observer was stationed were included in the observational survey.

4.6.3 Training of Observers

Twelve observers were recruited from a local university in each city. All observers were trained using a standard protocol designed by the investigators and which followed approaches utilised in observational studies undertaken in many high-income countries. This involved 2 observers (to observe traffic moving in both directions) being stationed at the roadside for a period of 1 hour with the observer documenting whether the driver and/or front seat passenger was restrained by a seat belt, along with documenting the gender of the driver (see Figure 2).

Figure 2: Observers recording Seat Belt Use



The training focused specifically on recording the traffic volume, how to classify various categories of the motor vehicles and the required criteria for classifying seat belt use and the gender of the driver/occupant. Each observer was provided with explicit instructions regarding site selection and protocols. Each observer also wore a luminescent vest for safety purposes and carried identification along with a statement on the purpose of the study. Each training session also included a one-hour observational pilot test in which the trainers audited the observers approach. During both the pre- and post-intervention survey periods, on-site audits were conducted by the researchers from The George Institute and Shantou University of Guangdong Province to ensure the data were collected in accordance to the protocol.

Besides the 1-hour audit undertaken by the researchers during the training sessions of the observers, both the George Institute and Shantou University staff conducted on-site audits during the observational survey periods to assess the reliability of the observers. The research staff randomly selected a sample of observers (n=6 observers) and the research staff attended the observational site. At the site, the researcher and observer viewed the same 29 vehicles travelling past the observation site. The observer was identified as 'reliable' if all 29 observations were classified in the same categories as the researcher's observations. Where variation in the observations occurred, the observer(s) was retrained using the detailed study protocol.

The pre-intervention observational surveys were conducted in April 2005 in Guangzhou, and May 2005 in Nanning; the post-intervention observational surveys were conducted in September 2006 and October 2006 respectively (The intervention in Guangzhou started in September 2005 and ended in August 2006).

4.7 Statistical Analysis

Two sample z-tests and the corresponding 95% confidence intervals were computed to compare the changes between pre and post intervention prevalence rates in each city. Error bars and trellis bar plots were used for visual comparison of the prevalence rates between the intervention and comparison cities.

As observations were undertaken over a 7-day period we calculated the prevalence rate observed each day to indicate the possible range of prevalence rates during the observational period. The minimum and maximum prevalence rates observed are reported in the text. The range in prevalence rates is reported for all study variables except for various times of the day and the type of road (since not all types of roads were sampled each day during the observational period).

4.8 Cost Effectiveness Evaluation

An incremental cost effectiveness analysis was performed, with the net cost and benefits of the intervention compared with standard practice of no enhanced program to promote seat belt use. As recommended by the Panel on Cost effectiveness in Health and Medicine, the perspective for the analysis was societal.¹⁴ A time frame of one year was adopted, which assumes implicitly that any increase in seat belt use did not extend beyond the year of the intervention.

All additional costs of implementing the intervention, if it were to become an ongoing program, were included in the evaluation. These additional costs consisted of the expenditure on each of the three approaches involved in the intervention, namely health promotion, training and enforcement, as well as the cost of overall project management. Costs were calculated directly from office records documenting expenditure where possible, or if available, from other relevant agencies. The cost associated with the evaluation of the intervention's effectiveness in increasing seat belt use was excluded since this cost would not be incurred if the intervention was incorporated as part of standard practice.

A summary of the cost components taken into account in calculating the intervention costs, and the data sources for these items, is provided in Table 2. Table 3 shows the unit cost data used for the cost calculations. Costs presented in the cost effectiveness analysis are expressed in 2006 Chinese Yuan (CNY), with incremental cost effectiveness ratios expressed in United States Dollars (US\$) also. Conversion of costs from Chinese Yuan to United States Dollars was based on an official exchange rate of 1.00CNY=US\$0.128621.

4.8.1 Outcome measurement

The primary benefits of increased seat belt use are the health gains from preventing road fatalities and serious injuries and the cost savings from a reduction in resource use arising from fewer deaths and injuries.

Ideally, a societal perspective requires all cost savings from a reduction in resource use to be included in the analysis. However, limitations in the available data resulted in the cost effectiveness analysis only incorporating the cost savings from reduced hospital admissions due to road traffic injury. Other potential savings in resource use, such as other medical expenses, police investigation costs and workplace disruption costs, were excluded. The cost of a hospital admission was assumed to be CNY9,298, which was the average cost of a hospital admission at a western medicine Ministry Level and City Level hospital in Guangzhou City.¹⁵

The health gain from preventing fatalities and injuries through increased seat belt use was measured using Disability Adjusted Life Years (DALYs). DALYs are a common method to quantify the impact of premature death and disability on a population by combining them into a single measure. They are calculated by taking the sum of the years of life lost due to premature mortality and the years lost due to disability for incident cases of a disease or injury.¹⁶ To calculate the years lost due to disability, the number of incident cases in the period is multiplied by the average duration of the disease and a weight factor that reflects the severity of the condition on a scale from 0 (perfect health) to 1 (dead). One DALY represents the loss of one year of equivalent full health.

Data from the evaluation of the intervention's effectiveness in increasing seat belt use provided the starting point for calculating the DALYs gained from the intervention. The observational study found that the average rate of seat belt wearing was 62 percent post-intervention compared with 50 percent pre-intervention, an increase of 12 percentage points. Few, if any, studies exist on the effectiveness of seat belt use in developing countries but

Table 2: Intervention costs: cost components and data sources

Cost component	Item	Data source
Health education		
Social marketing	Production cost, placement cost and agent fee	Receipts/bills
Targeted health education	Production cost	Receipts/bills
	Distribution cost	Estimate of time involved multiplied by wage rate
	• Distribution time	Estimate of cost of travel
	• Travel	
Road safety education	• Facility, equipment consumables	Receipts/bills
	• Time	Estimate of participant time multiplied by wage rate
Police training		
Trainer	Time, travel and accommodation	Receipts/bills
Police	Time spent training	Time involved multiplied by wage rate
	Travel	Estimate of the cost of travel
Other	Accommodation, facilities, equipment and consumables	Receipts/bills
Enforcement of seat belt use		
Police	Time	Time involved multiplied by wage rate
	Travel	Estimate of cost of travel
Other	Roadside Banners	Receipts/bills
Taxi companies		
Taxi inspection	Time of police, safety personnel and taxi drivers	Time involved multiplied by wage rate
	Taxi maintenance and repair	Estimate of the proportion of taxis requiring repair and average repair cost
Incentives	Lubricants	Actual cost
	Delivery time	Estimate of time involved multiplied by wage rate
	Travel	Estimate of cost of travel
Other		
Project management	Administration, consumables and travel	Estimate that 60% of expenditure for project implementation (40% for evaluation)
	Project launch	Receipts/bills

Table 3: Unit costs for the calculation of intervention costs

Cost item		Unit cost (CNY)
Wage rates	Police	28.38 per hour
	Taxi drivers	12.50 per hour
	Other personnel	11.36 per hour
Travel	Vehicle depreciation	37.90 per day
	Daily gas expense for police vehicle	30.00 per day
Lubricants		120 per bucket

data from the United States, where many of the studies on seat belt effectiveness have been conducted, suggest that wearing lap and shoulder seat belts reduced deaths by 45 to 60 percent and serious injuries by 50 to 83 percent.¹⁷⁻¹⁹ In this study, a conservative assumption was made that seat belts are 45 percent effective in reducing fatal and serious injuries to front seat occupants involved in motor vehicle crashes. No reduction in minor injuries was assumed.

The data on the observed increase in seat belt use through the intervention and the effectiveness of seat belt use were used to estimate that the likely reduction in road fatalities and serious injuries from the intervention would have been 7.0 percent— that is, $0.12 \times (0.45 / (1 - (0.47 \times 0.45)))$. Data were available on the number of police-reported road traffic fatalities and seriously injured casualties, but not separately by type of road user.²⁰ A conservative assumption was made that 30 percent of the police-reported fatalities and seriously injured casualties were motor vehicle occupants and a further assumption was made that 65 percent of these were front seat occupants. The effectiveness of the intervention in terms of its reduction in the number of fatalities and seriously injured casualties among front seat motor vehicle occupants could then be calculated.

The final stage of calculating the health gain from the intervention was to convert the number of motor vehicle fatalities and serious injuries prevented into DALYs. This required data on life expectancy, the average age of a road crash casualty and the level of disability experienced after sustaining a serious injury in a motor vehicle crash. The average life expectancy in China is 72 years.²¹ The average age of a road traffic fatality in China was estimated to be 40 years,⁵ and motor vehicle occupants who sustained serious non-fatal injuries were assumed to be of a similar age.

The only known source of disability weights following a serious motor vehicle injury is for the United States.²² These weights suggest that the average level of disability following a serious motor vehicle injury involving hospitalisation is 0.334 in the first year post-injury and 0.066 in years two to five. The data on the reduction in the number of fatalities and serious injuries from the intervention was combined with the data on life expectancy, average age of a motor vehicle crash casualty and the disability weights (with a weight of 1 used for fatalities) to calculate the number of DALYs saved from the intervention. DALYs saved in future years were discounted to their present value using a discount rate of 3 percent as recommended by the Panel on the Cost effectiveness in Health and Medicine.¹⁴

4.8.2. Incremental cost effectiveness ratio

The incremental cost effectiveness ratio (ICER) was calculated as the cost of the intervention less the cost savings from fewer hospital admissions, divided by the number of DALYs saved from the increase in seat belt use.

4.8.3 Sensitivity analysis

To assess the robustness of the ICER in the 'base case' cost effectiveness analysis, a number of one-way sensitivity analyses were performed to allow for uncertainty regarding the true value of selected parameters. The following parameters, which were considered to have the most uncertain values, were varied in the analysis namely:

- Cost of the intervention
- Number of police-reported seriously injured casualties
- Percentage of police reported fatalities and serious injuries who were motor vehicle occupants
- Percentage of motor vehicle occupants who were front seat occupants
- Pre-intervention seat belt use
- Effectiveness of the intervention in increasing seat belt use
- Effectiveness of seat belt use in reducing fatalities and serious injuries
- Discount rate

In the sensitivity analysis, the cost of the intervention was arbitrarily increased and decreased by 10 percent, as there is a degree of uncertainty surrounding the cost of an ongoing enhanced enforcement program compared with a trial program. International evidence suggests that police-reported data often under-report the actual number of seriously injured motor vehicle casualties so the number of police-reported cases was arbitrarily increased by 20 percent in the sensitivity analysis. The assumption that 30 percent of police-reported fatalities and serious injuries were motor vehicle occupants and 65 percent of these were front seat occupants were estimates based on judgement, so these percentages were increased (decreased) to 35 percent and 70 percent (15 and 60 percent) respectively, in the sensitivity analysis.

While the prevalence of seat belt wearing and the increase arising from the intervention were measured in observational studies, these could vary in different situations and settings and the sensitivity analysis tested the effect of a 5 percent increase and decrease in these parameters. This study was conservative in its assumption that seat belts are 45 percent effective in reducing fatalities and serious injuries, with the literature suggesting the figure may be as high as 60 percent for fatalities and even higher for seriously injured casualties. In the sensitivity analysis, seat belts were assumed to be 60 percent effective in reducing both fatalities and serious injuries. Considerable controversy surrounds the discounting of future health gain to present values. The sensitivity analysis assessed the impact of no discounting of the health gain and of using the traditional discount rate of 5 percent that has been used in a large number of published cost effectiveness analyses.¹⁴ Table 4 summarises these various assumptions used in the one-way sensitivity analyses.

In addition to conducting the one-way sensitivity analyses, a multi-way sensitivity analysis was conducted that provided a 'most likely' case scenario of the cost effectiveness of the intervention if it were to be incorporated as part of standard road safety practice in Guangzhou City. In this 'most likely case' scenario the following parameters were varied:

- Expenditure on two cost items was adjusted to more realistically represent the cost of an ongoing program. These were the cost of the trainer used in the training component of the intervention and the project management costs, both of which were inflated in the intervention. The trainer was an internationally renowned retired Australian police educator whose costs (including travel and accommodation) were considerably higher than would be the case if this role was performed by a local person. Similarly, project management costs were artificially high, as the project management team did not live in Guangzhou City thus additional expenses were incurred to cover travel and accommodation. In the multi-way sensitivity analysis, the cost of these items was arbitrarily halved, which reduced the total cost of implementing the intervention by 23 percent.

Table 4: Variables considered for one-way sensitivity analysis

Variable	'Best case' ICERs	'Worst case' ICERs
Intervention costs		
Total cost	10 percent lower	10 per cent higher
Cost savings		
Number of SI casualties ¹	20 percent higher than police-reported number	—
Health gain		
% of police-reported fatalities and SI casualties who were MVOs	35 percent	2 percent
% of MVOs who were front seat occupants	70 percent	60 percent
Pre-intervention seat belt use	55 percent	45 percent
Effectiveness of intervention in increasing seat belt use	17 percent	7 percent
Effectiveness of seat belt use in reducing fatalities and SI casualties	60 percent	—
Discount rate	0 percent	5 percent

Abbreviations: SI = seriously injured; MVOs = motor vehicle occupants

1. Note that the number of seriously injured casualties also affects health gain.

- The 'base case' assumption relating to the number of police reported road crash fatalities and seriously injured casualties who were motor vehicle occupants was very conservative. Moreover, with the increase in motorisation in China the proportion of motor vehicle occupants relative to other road users is likely to increase rapidly. The multi-way sensitivity analysis adjusted the value of 20 percent of police-reported road crash fatalities and seriously injured casualties being motor vehicle occupants to 30 percent.
- Another assumption that was conservative in the 'base case' analysis was that seat belts are 45 percent effective in reducing fatalities and seriously injured casualties. This is on the low side of current estimates derived from epidemiological studies. In the multi-way sensitivity analysis, seat belts were assumed to be 50 percent effective in reducing fatalities and serious injuries, which is still a conservative assumption.

5. Intervention



5.1 Preliminary Study

5.1.1 Focus Group Research

The aim of the preliminary study was to identify the attitudes and behaviours related to seat belt use among drivers and passengers and to ascertain the barriers to enforcement. The findings from the study provided a basis upon which the intervention materials were developed.

A convenience sample of 51 participants were selected for 5 focus groups comprising 26 taxi drivers, 10 professional drivers and 15 traffic police officers. These drivers were selected on the basis they would be integral to any intervention focused on increasing and enforcing seat belt use. Participants were all males, aged between 25-50 years.

A guideline containing open-ended questions designed to stimulate thinking and discussion related to the use or non use of seat belts was developed for the focus groups. The participants were encouraged to also give written comments to the questions. The guideline also introduced the background to the project, stated the goals of the focus group session, and ensured anonymity for the participants. Before each focus group, a written consent form along with the study guideline was distributed to each participant. The investigators took notes on all discussions in addition to the use of audiotape. All participants were fully informed about the tape-recording and the study was approved by the University of Sydney (Australia) Human Research Ethics Committee.

The questions that were asked at each of the focus groups were: what is your perception of the current use of seat belts among drivers and front seat passengers in Guangzhou; what is your practice and attitude towards the use of seat belts; what are the reasons for non use of seat belts; what are the main barriers to enforcing the law on seat belt use; and finally, what measures could be taken to increase the use of seat belts.

After the group discussions, the written notes were reviewed and a transcript of the taped discussions was created. A review of the discussion topics was then completed noting the frequency and degree of consensus of the responses to each question. Responses were ranked according to the following three-point scale: (1) frequent/high consensus; (2) divided opinion and (3) infrequent or no consensus. All responses were assessed by a second person who performed the same analysis to ensure consistency of results.

Overall, results from the focus group provided an opportunity to understand how selected taxi drivers, traffic police officers and professional drivers in Guangzhou view the use of seat belts. The information obtained from the preliminary study was important as it reflected the attitudes towards seat belt use from a range of drivers with substantial driving experience. It was evident from the focus groups that traffic police officers use, and strongly support, the use of seat belts in motor vehicles. As well, professional drivers were aware that seat belt use is a mandatory requirement by law and were aware of the benefits of using a seat belt.

However, "pretending" to use a seat belt was cited as common practice among professional drivers, and particularly among taxi drivers. There were a variety of excuses given for seat belt non use or incorrect use, such as "forgetting", "uncomfortable", "annoying", "low speed" and "travelling short distances". Important findings from the focus groups were that there is a sizeable proportion of front seat passengers who do not know that the use of a seat belt is compulsory; that seat belt use is higher during the day and on expressways; and that drivers are frustrated by their front seat passengers who chose to not use a seat belt – even after the driver has recommended its use, the passenger can not be penalised for non use.

Recommendations from the members of the focus group on approaches to increase seat belt use highlighted that there is agreement that the government needs to increase investment in road safety education and promotion namely to develop and publicise campaigns related to the safety benefits obtained from using seat belts. Importantly, legislation needs to be amended to indicate that there is a penalty for front seat passengers who do

not use a seat belt. The law/regulation also needs to clearly describe the definition of seat belt use. Pretending to use a seat belt appears to be very common, and appropriate penalties need to be introduced to address this. The participants stressed the urgent need for enhanced law enforcement surrounding the use of seat belts with highly visible enforcement activities by police needing to be implemented during the day and particularly at night. In addition, stationary vehicle checks need to be conducted at appropriate sites in order to identify inappropriate seat belt use.

Importantly, the focus group study provided valuable insight into how taxi drivers, traffic police officers and professional drivers in Guangzhou view the use of seat belts. These findings provided a useful basis for the activities that comprised the intervention.

5.2 Components of the Intervention

The intervention involved 3 approaches namely, health promotion (which included a social marketing campaign and health education), training and enforcement. Aspects of the intervention were modelled on the outcome from a systematic review that recommended primary seat belt laws and enhanced police enforcement as effective in increasing seat belt use. As the former was already implemented in Guangdong Province the emphasis of the intervention was on enhanced police enforcement (and training related to enhanced enforcement). These activities were supported by health promotion activities aimed at raising awareness of the efficacy of seat belts.

Prior to the implementation of the intervention, an official launch of the intervention was held (see Figure 3). The intervention was launched on the 25th April 2005, in a large shopping precinct in Guangzhou City. Three hundred participants including government officials, professional drivers, traffic police officers, BP employees, along with journalists attended the event. Importantly, Mr Wang Jinbiao, Deputy Director General of the Bureau of Traffic Administration, Ministry of Public Security inaugurated the launch of the intervention and senior officials namely Dr Henk Bekedam, the Representative to China of the World Health Organisation, Mr Cai Jiming, Deputy Director General of Foreign Loan Office, Ministry of Health, Mr Li Weiping, Deputy Director General of Guangzhou Municipal Bureau of Public Security, Mr Huang Jinrong, Deputy Director General of Traffic Command and Control Center, Guangzhou Municipal Bureau of Public Security, Mr. Greg Coleman, Group Vice President, BP p.l.c., Professor Liu Xiaoming, Deputy Director of Beijing Transportation Committee and Professor Mark Stevenson, from The George Institute for International Health attended the launch of the intervention.

Extensive coverage of the launch was achieved with aspects of the launch presented in the Information Times, Yangcheng Evening and China Daily; as well as a feature on Guangzhou TV Station, Guangdong Southern TV Station and Guangdong TV Station. The launch received a positive response from both government officials and the public.

Figure 3: Launch of the Intervention



5.2.1 Health Promotion

There were two aspects to the health promotion component of the intervention. The first aspect involved social marketing and the second, a targeted health education program. The target audience for the social marketing campaign was the general driving population including professional drivers, taxi drivers and drivers in government organisations, whilst taxi companies, driver training school instructors and primary school teachers were targeted as part of the health education component.

A social marketing campaign using mass media outlets including television, radio and visible signage was utilised to disseminate key messages related to the need for seat belt use. The investigators contracted a local (Guangzhou based) marketing company (Jumbo Advertising Company) to develop the initial social marketing messages and materials. Once developed, a working group comprising representatives from BP, the Traffic Command and Control Centre (Guangzhou Police), WHO, Jumbo Advertising Company and the investigators reviewed the marketing materials including the script for the TV commercials and radio advertising.

Based on the review of the materials by the working group, consensus was achieved in relation to the slogan for the social marketing campaign “Seat Belts Save Lives”. There was also agreement that the safety of the family would be emphasised in the advertising and both Cantonese and Mandarin versions of all campaign materials would be produced. There was also consensus that billboards, TV commercials, radio advertising, newspaper advertising, website advertising, brochures, stickers and posters would be used as part of the social marketing campaign.

All social marketing commercials were professionally produced. Technical assistance was provided to ensure the latest social marketing techniques were utilised in the development of all commercials/advertisements. Over the period of the intervention (12 months), every effort was made to ensure the social marketing campaign for the intervention remained one of the leading public health messages. Specific details relating to aspects of the social marketing campaign are described below:

- Billboards conveying the campaign slogan “Seat Belts Save Lives” were placed on the side of 15 buses (Figure 4). Three bus routes 241, 251 and 290 were chosen as these routes had the greatest volume of passenger numbers and also passed directly through the city centre. The bus signage remained on the buses for a 9 month period from December 2005 to August 2006. As well, billboards were strategically located through out the city (see Figure 5).

Figure 4: Bus with the Campaign Slogan



Figure 5: Billboard with Campaign Slogan



- TV advertising: Local TV was recruited to run TV commercials as a community service. The advertising was shown at peak viewing times on Guangzhou CATV for one week per month for 3 months of the year, and on Guangzhou TV Channel 34 everyday between February 2006 and August 2006 - (see Appendix 4 for footage of the television commercials).
- The Traffic Control Radio Station in Guangzhou ran three versions of a public service advertisement to raise the awareness of the benefit of using seat belts. The advertisements were released on the Guangzhou Radio Traffic Channel (FM 106.1) 18 times per day at regular intervals over the period of the intervention - (see Appendix 4 for audio of the radio campaigns).
- Print advertising: It was used to support the television and radio commercials. Local papers namely the Information Times and New Express ran articles highlighting that enforcement was taking place related to seat belt use along with discussion related to the need to use seat belts (see Figure 6).

Figure 6: Newspaper Advertisements



- Web site advertising: Items such as the protective effect of seat belt use in motor vehicle crashes, the law and an overview of the various advertising campaigns (see Figure 7) were disseminated.

Despite the importance of social marketing, targeted health education related to the need for seat belt use was necessary. Firstly, communication materials (posters, brochures and stickers) were disseminated to traffic police and primary health care providers and a number of lectures were undertaken by The George Institute staff to highlight the importance of the intervention and the role they could play in disseminating the importance of seat belt use. Secondly, a brief health education course was developed and implemented for taxi drivers and teachers at driver training schools. As well, BP initiated activities with teachers in primary schools – see further detail below.

- Posters and stickers were developed and distributed to traffic police stations, taxi companies and driving schools and community resident committees (see Figure 8). The posters introduced the importance of seat belt use, the penalty for not using a seat belt and the terms related to seat belt use under the new road traffic law, which took effect on 1st May 2004. The stickers introduced the campaign slogan.

Figure 7: Website Advertising



Figure 8: Distributed Posters



- Brochures were developed in order to increase the road users awareness about the benefits of seat belts, the consequences of not wearing a seat belt, and the requirement of the road traffic law (see Figure 9). The brochures were distributed to taxi companies, driver training schools, traffic control police officers and major government organisations and the general driving population. TCCC and Guangzhou Vehicle Administration Office distributed the brochures and the materials were also available at BP petrol stations.

Figure 9: Distributed Brochures



- Health education courses: Courses were conducted for taxi drivers, driver training schools, and teachers from primary schools who were responsible for health education at their school. These teachers were able to convey the knowledge about the benefits of seat belt use and the consequences of not wearing a seat belt to their students.
- Incentives: In order to increase the prevalence of seat belt use among taxi drivers – one of the targeted population groups, an incentive program was developed. Incentives namely, 'Castrol' lubricants were provided by BP. All taxi drivers were notified of the incentive program by the TCCC and extensive radio advertising alerted the taxi drivers to the incentive program. At regular intervals during the 12-month intervention, roadside observers identified taxi drivers who were correctly restrained by a seat belt. Those randomly identified drivers (n=100) were awarded certificates (see Figure 10) by TCCC and the certificate was used to receive lubricants at BP petrol stations in Guangzhou.

Figure 10: Certificate Awarded to Taxi Drivers



5.2.2 Training

The training component involved traffic police educators providing skills-based training and strategies for enforcement. The training followed the “train-the-trainer” model whereby selected traffic police from the intervention city undertook an intensive 1-week course. The trained then hosted the same course throughout the intervention city so that 100% of the traffic police received training. The initial training was undertaken by an internationally renowned retired Australian police educator Assistant Commissioner Ray Shuey.

The topics addressed during the training program were:

- Overseas experience in introducing seat belt legislation and enforcement
- Road safety in Guangzhou
- The value of seat belts in saving lives
- Overcoming barriers to effective traffic enforcement
- Good practice enforcement strategies
- Police role in educating the community
- Safe vehicle interception procedures
- Safe checkpoint and road block operations
- Performance measures and outcomes
- Collision reporting

Twenty five traffic police officers from the promotion and education section of the Ministry were trained by Mr Shuey (see Figure 11). Beyond what was highlighted above, the training provided a balanced approach between education and enforcement and delivered a strong message for the police to disseminate to the community of an “Anywhere, Anytime” philosophy (when drivers and passengers could be checked for seat belt use). Operational safety was also a critical component of the training.

Figure 11: Police Training Program



5.2.3 Enforcement

There is evidence to suggest that enhanced enforcement programs (where there is increased issuance of infringements and roadside seat belt checkpoints) significantly increase seat belt restraint use and result in a decrease in mortality and morbidity associated with road traffic injury. The intervention therefore implemented an enhanced enforcement program in Guangzhou City. A system of demerit points and issuance of an infringement notice (with a financial penalty) were implemented by the government prior to the implementation of the intervention². Based on the findings from the pilot study, an enforcement target was necessary and this was also established at the beginning of the intervention whereby, a proportion of vehicles were stopped and an infringement notice issued to the driver for not using the available seat belt. As the intervention aimed to increase seat belt use not only among drivers but also front seat passengers, the driver was issued with a fine if the front-seat passenger was not using the available seat belt.

Each police division was encouraged to increase the issuance of infringement notices particularly during periods of intensive seat belt enforcement. An audit of all police division records in the intervention city was undertaken, on a random basis, to ensure compliance by the police divisions.

Overall, extensive enforcement programs were conducted over a week long period every three months during the period of the intervention. The enforcement was undertaken as part of normal duties of the Highway Patrol. The enforcement was supported by the above mass media campaigns. The enforcement involved high profile mobile patrols combined with static covert operations involving 100-200 police officers at numerous locations throughout Guangzhou City. The operation was conducted in five phases, each of 2-3 days duration with the results being widely advertised via the media campaign. In order to check seat belt use among drivers and front seat passengers, 11,000 motor vehicles were stopped during the period of enforcement (see Figure 12).

Figure 12: Police Enforcement



2. Under the Road Traffic Safety Law Introduced on 1st May 2004, if a driver or a front-seat passenger does not wear a seat belt the driver is fined RMB 200 - this applies only in the Province of Guangdong.

6. Results



6.1 Process Evaluation

6.1.1. Health promotion

As alluded to earlier, an array of health promotion activities were undertaken as part of the intervention. A number of these activities supported the enhanced enforcement practices undertaken by Guangzhou TCCC. Table 5 outlines the duration and frequency of the various health promotion activities.

Table 5: Health Promotion Activities

Components	Duration of Activity	Frequency of Activity
Social Marketing		
Television	10 months	950, 30 second advertisements
Radio	9 months	3,240, 15 second advertisements
Newspaper	11 months	7 advertisements
Bus Signage	10 months	15 buses across three routes
Brochures	12 months	300,000 distributed
Posters	12 months	6,000 distributed
Stickers	12 months	50,000 distributed
Health Education		
Taxi Driver Education	6 months	120 courses, 1 to 2 hours duration
Lectures for teachers	1 month	2 courses, 1 hour duration
Lectures for driver training schools	3 months	8 lectures, 1 hour duration

6.1.2. Training

The training of senior police officers was undertaken with two groups of 25 participants undergoing the program at the Public Security Bureau Training Base in Baiyun District. The focus of the training was a balance between education and enforcement. As part of the initial training, the 50 officers were taught techniques to initiate train-the-trainer models as the 50 officers were required to train the entire police force on enhanced enforcement practices. Training for all police officers was conducted in all the branches of Guangzhou TCCC between August 2005 and October 2005 with 1,125 policemen (82.6%) in Guangzhou trained in enhanced enforcement practices targeting the enforcement of seat belts.

Feedback received regarding the training program was very positive though a small percentage felt that there was need for further training, and that the training needed to involve more examples, a greater number of practical operations and with a greater illustration of the international experience.

6.1.3 Enforcement

Five intensive law enforcement activities aimed at promoting seat belt use and that were linked with the social marketing campaign were conducted between October 2005 and August 2006. Each traffic police branch in Guangzhou established two check points within its precincts. Target locations included high crash risk locations, the train station, airport and toll gates. Traffic police officers who had attended the train-the-trainer course were appointed to oversee the enforcement. Vehicle inspection was conducted in accordance with the Notice on

Standard Procedure for Vehicle Inspection at Temporary Check Points issued by the TCCC in 2004, although this approach was enhanced based on the outcome from the training course.

All enforcement activities lasted two days and there were no specific operations undertaken at night. Normal routine enforcement was still applied when specific campaigns were not in operation. At the end of 2005, several approaches included in the training were adjusted by the TCCC to encourage traffic police officers to strictly enforce seat belt use and the issuance of infringements. Over the period of the intervention, the number of tickets issued for seat belt infringements was 44,430 – an increase of 10% (relative to all infringements issued) from the period prior to the intervention.

6.2 Impact Evaluation

The demographic features of the driver and passenger populations observed at the road side were similar between the pre and post intervention surveys for the two cities (Guangzhou and Nanning) (see Table 6). For both the pre-intervention and post-intervention surveys across the two cities, the majority (91%-96%) of the drivers and two thirds (63%-66%) of the passengers observed were male. The number of vehicles observed across each of the observational periods (Guangzhou and Nanning Cities pre and post intervention observations) did not differ significantly. In general, there were more observations undertaken of seat belt use on local roads (Intervention city: pre-38% and post-38%, Comparison city: pre-47% and post-49%) followed by main roads (Intervention city: pre-32% and post-31%, Comparison city: pre-48% and post-47%) and expressways (Intervention city: pre-30% and post-31%, Comparison city: pre-5% and post-4%). The majority (>90%) of the vehicles observed were cars of which 30% were taxis. A total of 34,113 and 28,816 vehicles were observed in the intervention city during the two (pre- and post-intervention) observational periods whilst 26,547 vehicles were observed pre-intervention and 25,143 post-intervention in the comparison city.

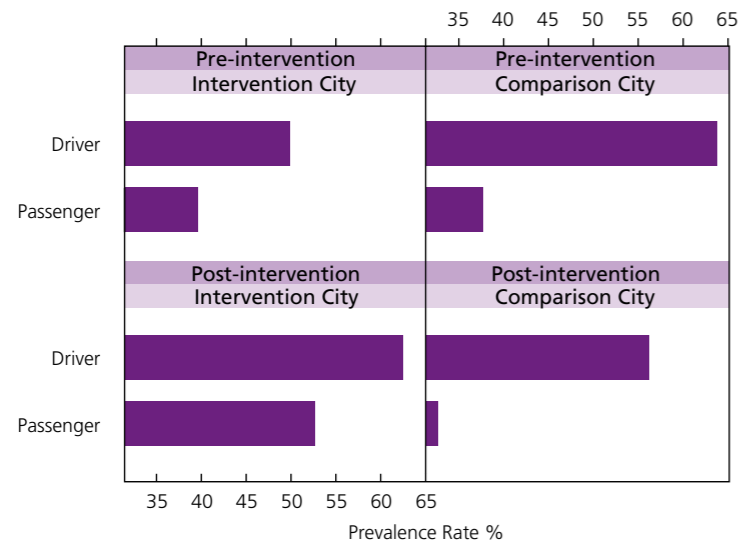
Table 6: Demographics: Pre- and post-intervention observational surveys

Variable	Intervention City (Guangzhou)		Comparison City (Nanning)	
	Pre-Intervention n	Post-Intervention %	Pre-Intervention n	Post-Intervention %
Vehicle Occupant				
Male Drivers	32799	96	27592	96
Female Drivers	1409	4	1224	4
Male Passenger	9314	66	7970	64
Female Passenger	4817	34	4476	36
Observation Period				
Mon-Fri Day	9174	27	7766	27
Mon-Fri Night	8508	25	6555	23
Sat-Sun Day	8866	26	7848	27
Sat-Sun Night	7796	23	6674	23
Road Type				
Local roads	12959	38	11065	38
Main roads	11063	32	8898	31
Expressways	10322	30	8880	31
Vehicle Type				
Car	20880	61	18909	66
Taxi	10347	30	7434	26
Other	3094	9	2464	9

6.2.1. Prevalence of seat belt use – summary

The prevalence of driver seat belt use increased from 50% (Range: 30-62%) to 62% (Range: 60-67%) for the intervention city, compared to a decrease from 64% (Range: 28-74%) to 56% (Range: 41-62%) in the comparison city. For front-seat passengers, there was an increase from 40% (Range: 17-53%) to 53% (Range: 47-55%) in the intervention city whereas the comparison city experienced a decline in seat belt use over the same period [38% (Range: 18-45%) to 33% (Range: 19-42%)] see Figure 13. With a 12% increased prevalence in the intervention city and a 6% decline in the comparison city, the overall difference in the prevalence rate between the intervention and comparison cities at post-test was 18% ($p < 0.01$).

Figure 13: Vehicle occupants' seat belt use



Over the period of the study, the intervention city experienced a statistically significant ($p < 0.01$) increase in the prevalence of seat belt use across almost all factors namely, road types, gender of drivers and passengers and the vehicle type. However, the prevalence of seat belt use declined (significantly $p < 0.01$) for drivers and passengers of vehicles classified as other that is buses and trucks. In contrast, the prevalence of seat belt use significantly declined ($p < 0.01$) in the comparison city over the observational period across most factors. For factors such as seat belt use by passengers on expressways ($p = 0.2466$), female drivers and passengers ($p = 0.2353$, $p = 0.0447$), drivers and passengers during the day on weekends ($p = 0.4116$, $p = 0.6732$), passengers during the day between Monday to Friday ($p = 0.1740$) and passengers in other vehicles ($p = 0.4061$) the prevalence rates declined but were not statistically significant. These results are reported in Figure 14 to Figure 18 and in Appendix 3, Tables I and II.

Figure 14: Overall change in the prevalence of seat belt use by car occupants between intervention and comparison cities. (The vertical solid and dash lines represent 95% confidence intervals).

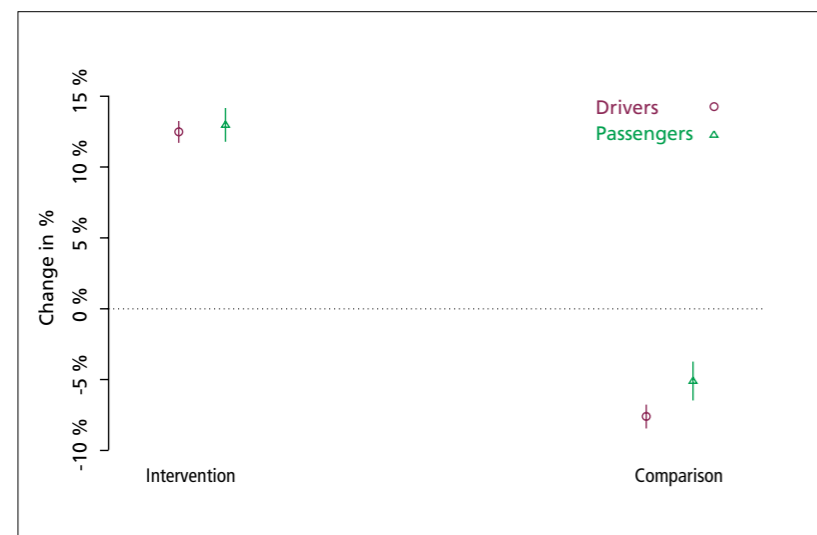


Figure 15: Overall change in the prevalence of seat belt use for drivers by road type and gender between intervention and comparison cities. (The vertical solid lines represent 95% confidence intervals).

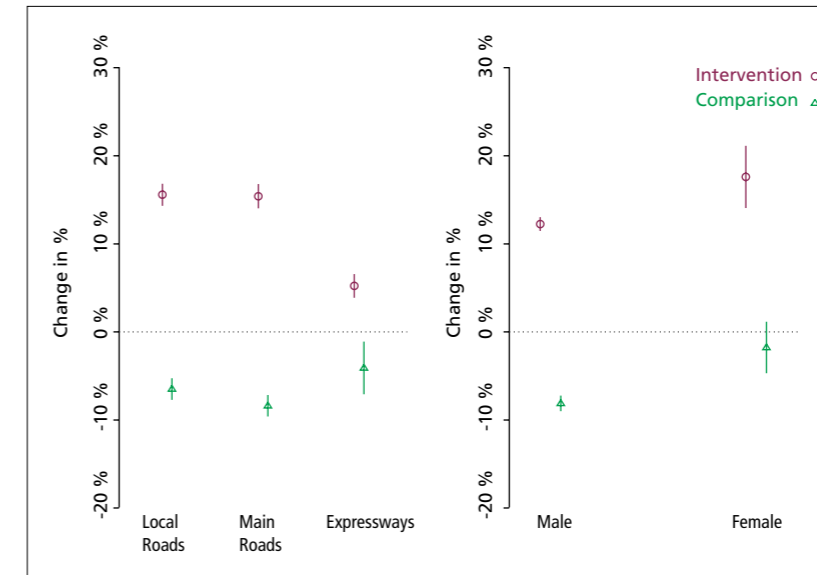


Figure 16: Overall change in the prevalence of seat belt use for drivers by time of day and type of vehicle between intervention and comparison cities. (The vertical solid lines represent 95% confidence intervals).

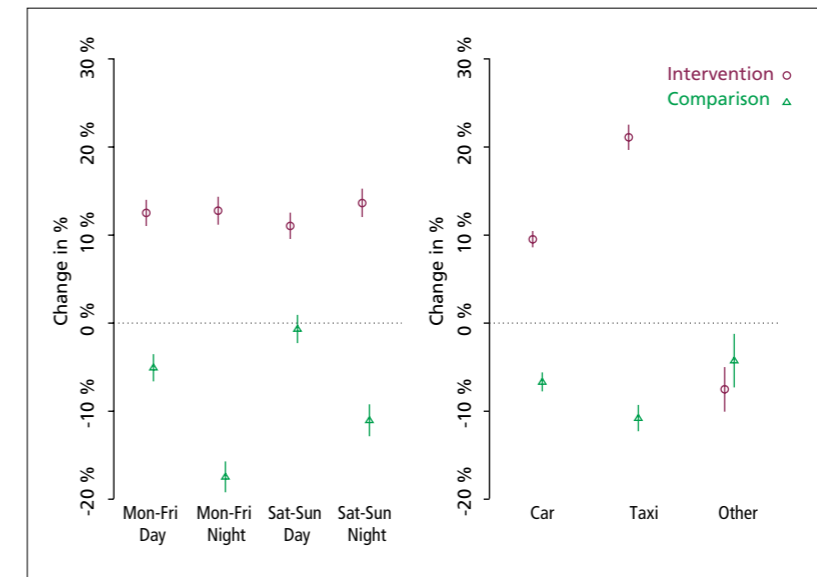


Figure 17: Overall change in the prevalence of seat belt use for passengers by type of road and gender between intervention and comparison cities. (The vertical solid lines represent 95% confidence intervals).

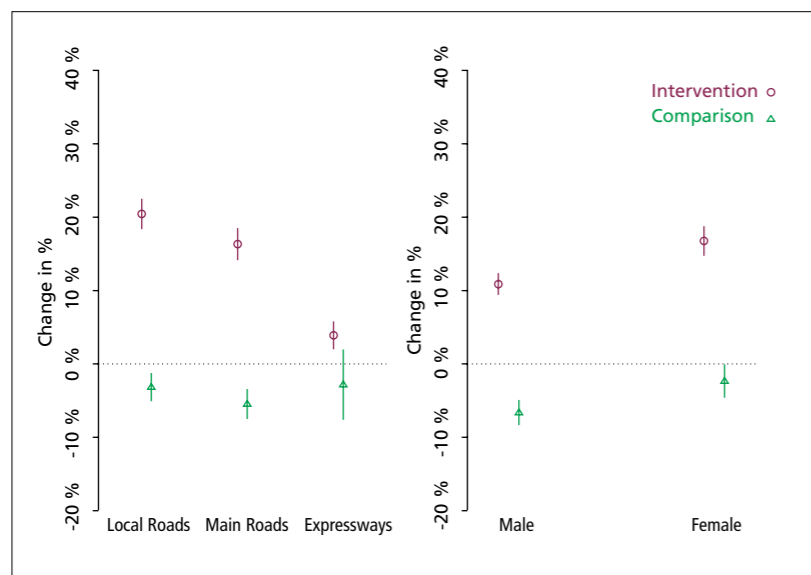
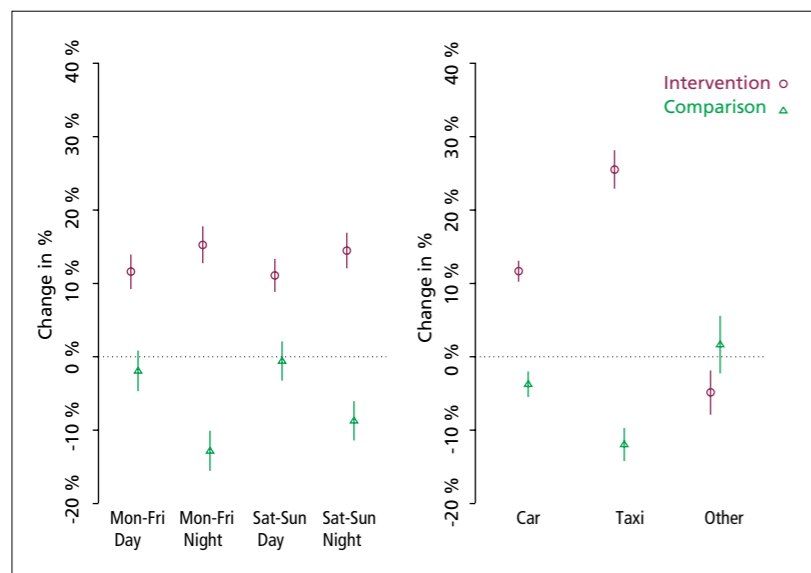


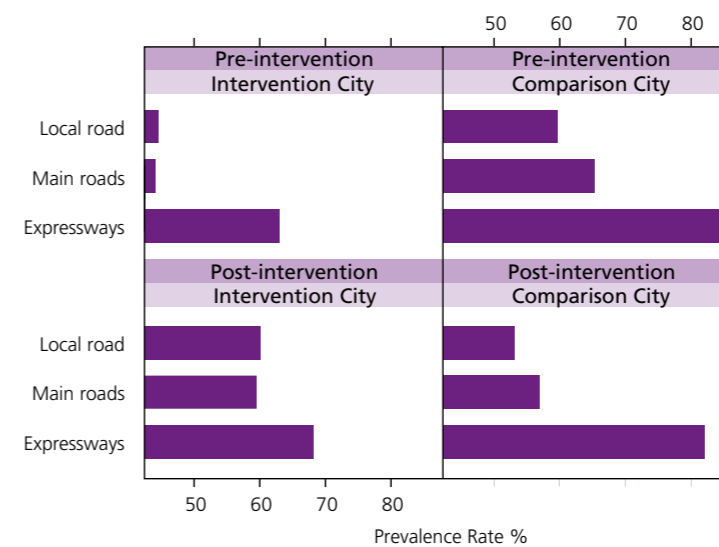
Figure 18: Overall change in the prevalence of seat belt use for passengers by time of day and type of vehicle between intervention and comparison cities. (The vertical solid lines represent 95% confidence intervals).



6.2.2 Prevalence of seat belt use – stratified by road type

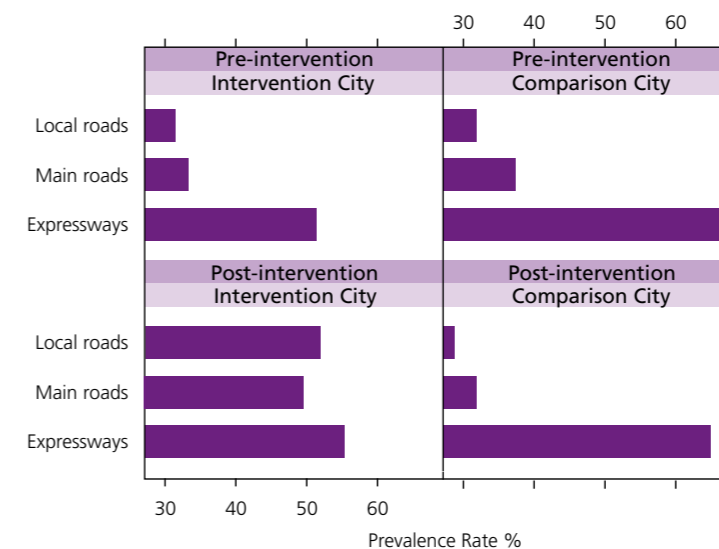
Three different road types - local roads, main roads and expressways (see methods for a definition of these roads) were observed. The greatest change in the prevalence of seat belt use was observed on local and main roads by drivers in the intervention city. The increase in seat belt use by drivers between pre- and post intervention was 16% ($p < 0.01$) on local roads and 15% ($p < 0.01$) on main roads. For seat belt use by drivers observed on expressways, the increase was 5% ($p < 0.01$), with 68% of all drivers correctly using their seat belts on expressways, see Figure 19 and Appendix 3, Table I.

Figure 19: Driver seat belt use by type of road



A similar pattern of increase was observed for passengers with seat belt use increasing from 31% to 52% on local roads and 33% to 50% on main roads with the increase being statistically significant ($p < 0.01$). The overall increase in the prevalence rate of seat belt use by passengers travelling on expressways was similar to that of drivers with the rate increasing by 4% to 55% ($p < 0.01$). These findings are presented in Figure 20 and Appendix 3, Table I.

Figure 20: Passenger seat belt use by road type

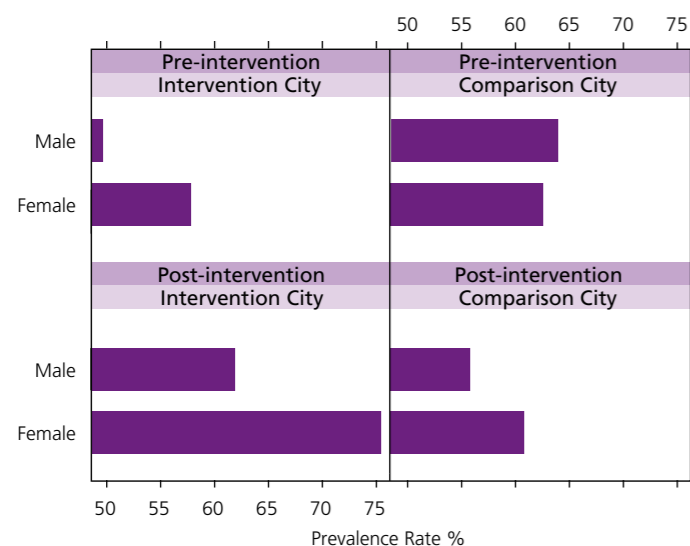


In contrast, the prevalence of driver seat belt use as observed on local roads, main roads and expressways significantly declined (p -values < 0.01) in the comparison city over the observational period, by 6%, 8%, and 4%, respectively (see Figure 19 and Appendix 3, Table II). However, the prevalence of driver seat belt use on expressways was higher in the comparison city compared to the intervention city (82% versus 68%). In relation to the prevalence of seat belt use among passengers, there was a decline in use during the observational period in the comparison city (from 3% to 5%) see Figure 20 and Appendix 3, Table II.

6.2.3 Prevalence of seat belt use – stratified by gender

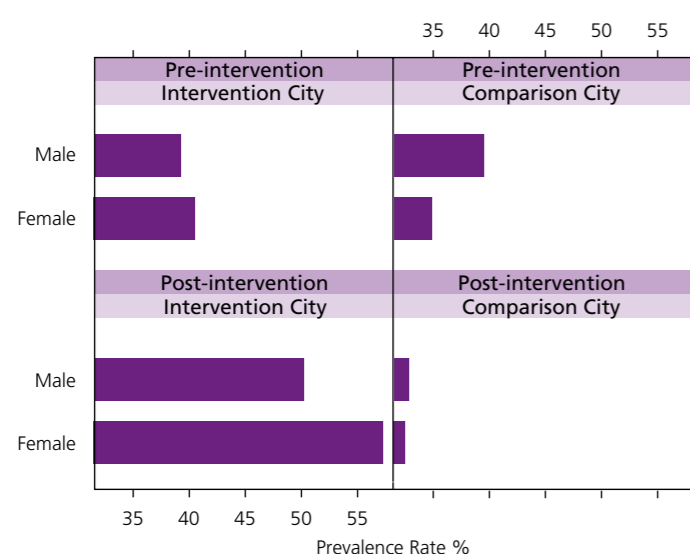
The prevalence of seat belt use increased significantly ($p < 0.01$) for both male and female drivers in the intervention city the prevalence increased by 18% for female drivers from 58% (Range: 40%-88%) to 76% (Range: 71%-83%) whilst the increase was 12% for male drivers 50% (Range: 29%-62%) to 62% (Range: 59%-67%). The results are shown in Figure 21 and Appendix 3, Table I.

Figure 21: Driver seat belt use by gender



Although the change in the prevalence of seat belt use was similar for passengers in the intervention city (see Figure 22 and Appendix 3, Table I) with a significant ($p < 0.01$) increase of 11% and 17% for male and female drivers respectively, the baseline and post-test prevalence rates were much lower compared to drivers, with a post-test prevalence rate of 50% for male passengers and 57% for female passengers (compared with 62% and 76% for male and female drivers, respectively).

Figure 22: Passenger seat belt compliance by gender



In the comparison city, prior to the intervention, male drivers had a higher prevalence of seat belt use (64%, Range: 29%-73%) compared to female drivers (63%, Range: 20%-83%). However, the prevalence of seat belt use declined, significantly ($p < 0.01$), at the post-intervention survey with male drivers declining by 8% ($p < 0.01$) and female drivers by 2% ($p = 0.2353$) to 56% (Range: 40%-62%) and 61% (Range: 53%-68%), respectively - see Figure 21 and Appendix 3, Table II. A similar pattern of decrease in prevalence rate was also observed for passengers. There was a significant ($p < 0.01$) decline in seat belt use from 39% (Range: 17%-47%) to 33% (Range: 18%-43%) among male passengers whilst the rate for female passengers declined significantly ($p = 0.0447$), from 35% (Range: 20%-42%) to 32% (Range: 22%-38%), see Figure 22 and Appendix 3, Table II.

6.2.4 Prevalence of seat belt use – stratified by time of day

In the intervention city, over different times of the day (both day and night observations), the prevalence of seat belt use remained constant for drivers with increases in seat belt use of between 11%-14% ($p < 0.01$) occurring across all time-periods. The rate of increase was greater for seat belt use at night. Overall, seat belt use during the day was 63% whilst at night it was 61%. For passengers the findings were similar with an increase in seat belt use during the day and at night of between 11%-15% ($p < 0.01$) although the overall prevalence of seat belt use was lower for passengers 51%-54% than it was for drivers. These results are summarised in Figure 23, Figure 24 and Appendix 3, Table I.

Figure 23: Driver seat belt use by time of day

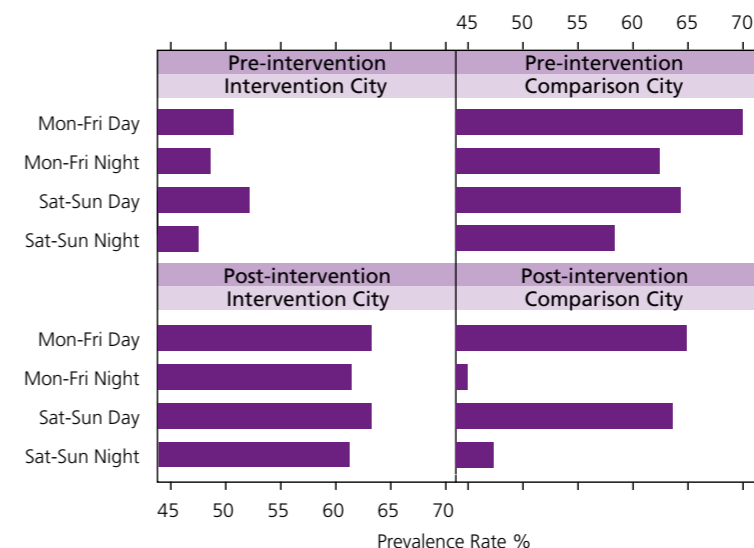
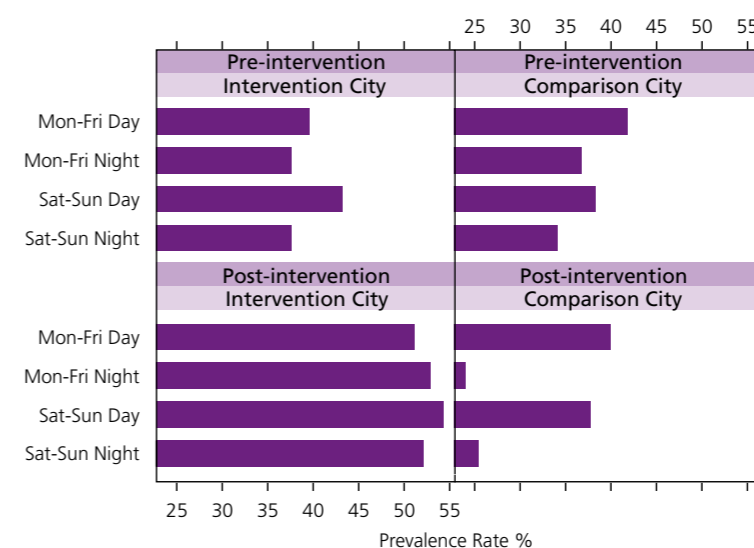


Figure 24: Passenger seat belt use by time of the day

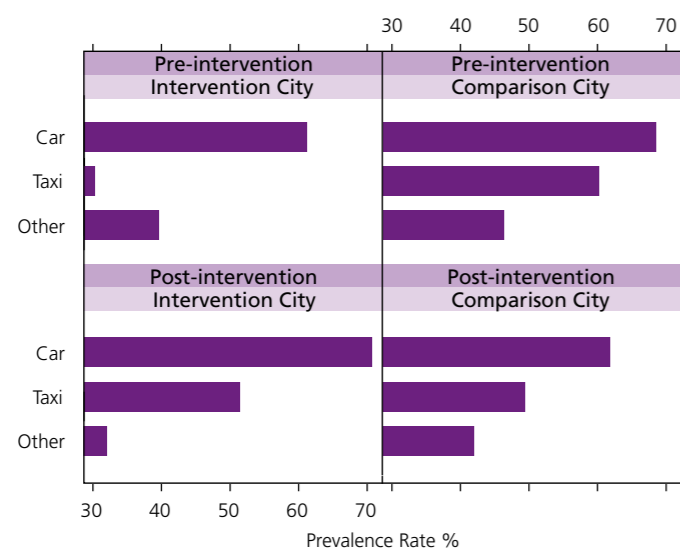


Whilst the intervention city showed marked improvement in the prevalence of seat belt use across different times of the day, there was a significant decline in the prevalence of seat belt use during weekday night (from 62% to 45%, $p < 0.01$) and weekend night (from 58% to 47%, $p < 0.01$) among drivers in the comparison city. This pattern is similar for passengers which also showed a significant decline in the prevalence of seat belt use during weekday night (from 37% to 24%, $p < 0.01$) and weekend night (from 34% to 25%, $p < 0.01$). It is important to consider that some of this significant decline may be due to measurement error. During the day, the prevalence of driver seat belt use declined from 70% to 65% ($p < 0.01$) during the week and 64.3% to 63.6% ($p = 0.4116$) on weekends. At the same time, the prevalence of seat belt use by passengers declined during the day throughout the week and also during the day on weekends (42% to 40%, $p = 0.1740$ and 38.3% to 37.7%, $p = 0.6732$, respectively). These results can be found in Figure 23, Figure 24 and Appendix 3, Table II.

6.2.5 Prevalence of seat belt use – stratified by type of vehicle

Various vehicles were observed namely, cars, taxis and other (includes vans and trucks). The largest increase in the prevalence of seat belt use was observed among drivers of taxis in the intervention city; the prevalence of seat belt use increased by 21% ($p < 0.01$) (pre-test 30% [Range: 10%-58%] to 51% [Range: 45%-60%]). For drivers in cars (other than taxis), there was an increase of 10% ($p < 0.01$) from 61% (Range: 41%-70%) to 71% (Range: 69%-75%). The prevalence of seat belt use by drivers of 'other' vehicles (namely, vans and trucks) declined ($p < 0.01$) by 8% over the period of the intervention from 40% (Range: 3%-56%) to 32% (Range: 16-48%), see Figure 25 and Appendix 3, Table I.

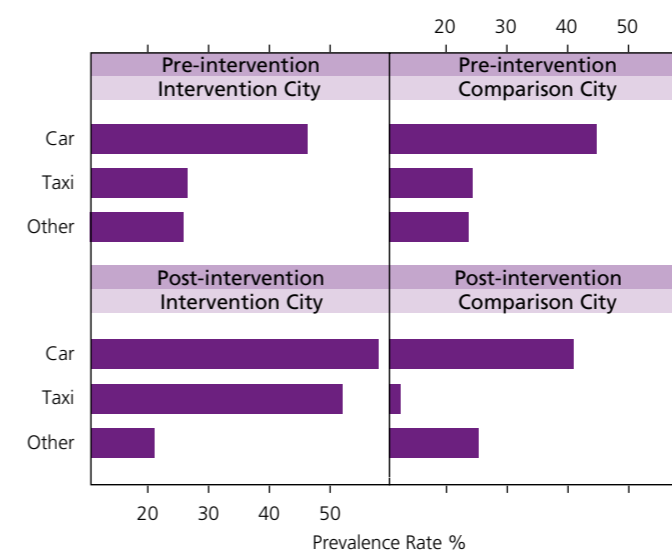
Figure 25: Driver seat belt use by vehicle types



Passengers had a lower prevalence of seat belt use in the intervention city, but there was still an increase ($p < 0.01$) in seat belt use over the study period from 26% (Range: 11%-35%) to 52% (Range: 46%-55%) for passengers in taxis. There was a significant increase ($p < 0.01$) of 12% for passengers in cars other than taxis [Pre-test: 46% (Range: 20%-62%) to post-test: 58% (Range: 53%-62%)]. Passengers in 'other' vehicles, like drivers, also demonstrated a decline in rates over the study period ($p < 0.01$) from 26% (Range: 0%-49%) to 21% (Range: 9%-31%). These results are summarised in Figure 26 and Appendix 3, Table I.

The comparison city continued the pattern of declining prevalence of seat belt use as shown in Figure 25, Figure 26 and Appendix 3, Table II. There was a decline ($p < 0.01$) in seat belt use over the period for taxi drivers from 60% (Range: 37%-75%) to 49% (Range: 32%-55%). Similarly, there was a downward trend in seat belt use for passengers in taxis with a significant ($p < 0.01$) decline during the period of 12% [from 24% (Range: 20%-28%) to 12% (Range: 4%-19%)]. There was also a decline in seat belt use for drivers in cars, other than taxis, with a decline ($p < 0.01$) from 68% (Range: 36%-77%) to 62% (Range: 48%-68%). The decline was also observed for passengers in cars, other than taxis, with a decline ($p < 0.01$) from 45% (Range: 19%-54%) to 41% (Range: 26%-48%). For other vehicles, there was again a decline ($p < 0.01$) from 46% (Range: 13%-51%) to 42% (Range: 31%-46%) in relation to the use of seat belts by the driver, passengers in these vehicles demonstrated an increase ($p = 0.4061$) in the prevalence of seat belt use from 24% (Range: 10%-27%) to 25% (Range: 20%-31%).

Figure 26: Passenger seat belt use by vehicle type



6.3 Cost Effectiveness Evaluation

6.3.1 Intervention costs

The total cost of implementing the intervention was CNY3,124,726. Expenditure on health promotion accounted for 35.4 percent of this cost, with social marketing accounting for 26.1 percent and health education for 9.3 percent. Training and enforcement, the other two components of the intervention, accounted for 19.4 percent and 13.1 percent of total costs, respectively. The remaining 32.2 percent of the cost of the intervention was spent on project management. A more detailed cost breakdown is presented in Table 7.

6.3.2 Cost savings

Due to limitations in the data, the only cost savings to be incorporated in the cost effectiveness analysis were from fewer hospital admissions of motor vehicle crash casualties as a result of the observed increase in seat belt use. These cost savings amounted to CNY911,302.

6.3.3 Disability adjusted life years saved and the incremental cost effectiveness ratio

Based on the increase in seat belt use, and the assumption relating to the effectiveness of seat belt use in reducing fatalities and injuries, the intervention was estimated to have reduced the number of fatalities of front seat motor vehicle occupants by 24 and the number of front seat motor vehicle occupants who sustained serious injury by 143. The present value of the number of DALYs saved from each fatality and each seriously injured casualty prevented was calculated as 18.63 and 0.58 respectively, giving a present value of the total number of DALYs saved from the intervention of 530. Given the cost of implementing the intervention and the associated cost savings, in the 'base case' analysis the incremental cost effectiveness ratio (ICER) of the intervention compared with no enhanced program to promote seat belt use was CNY3,246 per DALY saved or the equivalent of US\$418 per DALY saved (Table 8).

6.3.4 Sensitivity analysis

The series of one-way sensitivity analyses suggests that the ICERs are most sensitive to the percentage of police-reported fatalities and serious injuries who were motor vehicle occupants, the effectiveness of the intervention in increasing the prevalence of seat belt use, the effectiveness of seat belt use in reducing fatalities and seriously injured casualties and the discount rate (Table 9). For example, if the percentage of police-reported fatalities and seriously injured casualties who were motor vehicle occupants was increased to 35 percent, the ICER almost halved to CNY2,404 (US\$309). Similarly, if the effectiveness of the intervention was increased by five percentage points to 17 percent or the effectiveness of seat belt use in reducing fatalities and seriously injured casualties was increased to 60 percent, the ICERs decreased to CNY1,462 (US\$188) and CNY1,337 (US\$172) respectively.

Table 7: Costs of the seat belt intervention

Cost component	Item	Cost (CNY)
Health Promotion		
Social Marketing	Television	222,688
	Radio	183,023
	Print media	92,297
	Bus signage	207,000
	Agent fee	60,000
	Other	51,460
	Subtotal: Social Marketing	816,468
Targeted Health Education	Production of materials	110,008
	Distribution of materials	29,824
	Road safety lectures: facility, equipment and time of taxi company personnel and drivers	11,500
	Taxi inspection: time of police, safety personnel and taxi drivers	65,136
	Taxi maintenance and repair	3,840
	Incentives: lubricants, time and travel cost of BP staff, taxi company personnel and taxi drivers and miscellaneous costs	69,019
	Subtotal: Targeted Health Education	289,327
Subtotal: Health Promotion		1,105,795
Training		
Trainer	Time, travel and accommodation	404,586
Police	Time and travel	121,909
Other	Accommodation, facilities, equipment and consumables	78,396
Subtotal: Training	604,891	
Enforcement		
Police	Time and travel	405,596
Other	Banner	3,016
Subtotal: Enforcement	408,612	
Other		
Project Management	Administration and office costs	732,267
	Travel	273,161
Subtotal: Other	1,005,428	
TOTAL	3,124,726	

Table 8: Incremental cost effectiveness ratio of the seat belt intervention: the 'base case' analysis

Reduction in the number of fatalities from the intervention	24
Reduction in the number of seriously injured casualties from the intervention	143
Number of DALYs saved from the reduction in fatalities	447
Number of DALYs saved from reduction in seriously injured casualties	83
Total no. of DALYs saved from the intervention	530
Intervention costs (CNY)	3,124,726
Cost savings from the intervention (CNY)	1,404,149
Net cost of the intervention (CNY)	1,720,577
ICER: net cost per DALY saved (CNY)	3,246
(US\$)	418

Table 9: Incremental cost effectiveness ratios for the one-way sensitivity analyses of selected variables

Variable	'Best case' ICERs		'Worst case' ICERs	
	CNY	US\$	CNY	US\$
Intervention costs	2,657	342	3,836	493
Number of SI casualties	2,652	341	—	—
% of police-reported fatalities and SI casualties who were MVOs	2,404	309	4,419	568
% of MVOs who were front seat occupants	2,200	373	3,762	484
Pre-intervention seat belt use	3,055	393	3,329	428
Effectiveness of intervention in increasing seat belt use	1,462	188	7,494	964
Effectiveness of seat belt use in reducing fatalities and SI casualties	1,337	172	—	—
Discount rate	2,022	260	4,116	529

Abbreviations: SI = seriously injured; MVOs = motor vehicle occupants

The results of the multi-way sensitivity analysis, which are thought to reflect the 'most likely' cost effectiveness of the intervention if it was to become part of standard practice, are considerably more favourable than the 'base case' analysis (Table 10). Adjusting intervention costs to exclude expenses that would not be incurred in an ongoing program reduced the cost of the intervention to CNY2,419,720. Using 'more likely' estimates of (i) the number of road traffic fatalities and seriously injured casualties who were motor vehicle occupants and (ii) the effectiveness of seat belt use suggested that the expected reduction in the number of fatalities and seriously injured casualties from the intervention was 28 and 163 respectively. This resulted in cost savings from the intervention of CNY1,599,428 and the number of DALYs saved increasing to 617. The resultant ICER for the 'most likely' case scenario was CNY1,329 per DALY saved or the equivalent of US\$171 per DALY saved.

Table 10: Incremental cost effectiveness ratio for the multi-way sensitivity analysis: the 'most likely' case scenario

Reduction in the number of fatalities from the intervention	28
Reduction in the number of seriously injured casualties from the intervention	163
Number of DALYs saved from the reduction in fatalities	522
Number of DALYs saved from reduction in seriously injured casualties	95
Total no. of DALYs saved from the intervention	617
Intervention costs (CNY)	2,419,720
Cost savings from the intervention (CNY)	1,599,428
Net cost of the intervention (CNY)	820,292
ICER: net cost per DALY saved (CNY)	1,329
(US\$)	171

7. Discussion



Despite legislation in China requiring the use of seat belts by drivers and passengers and the overwhelming evidence demonstrating the effectiveness of seat belts in preventing injuries and death,^{23, 24} the reported rates of use are very low; a recent observational study of seat belt use among taxi drivers in Beijing found seat belt use as low as 7.7%¹¹ whilst a national survey found that only 22% of respondents had ever worn a seat belt over the 30 days preceding the survey.¹²

Based on a background of poor compliance to seat belt use and a burgeoning incidence of road traffic injury, the China Seat Belt Intervention was implemented comprising an intervention that included health promotion (including social marketing and health education), training and enhanced traffic police enforcement, with an aim to increase the prevalence of seat belt use for drivers and front seat passengers in Guangzhou, a mega city in southern China. The Intervention was evaluated using a comparison group pre-test post-test design which also included an extensive cost effectiveness evaluation.

The Intervention was a co-operation between the Ministry of Public Security, the Ministry of Health, officials from the Public Security and Traffic Departments of Guangzhou Municipal Government, representatives from the World Health Organisation, the sponsoring company (BP) and researchers from The George Institute for International Health and was implemented over a 12-month period (August 2005 – August 2006).

The findings from the study suggest that the prevalence of seat belt use by drivers in the intervention city (Guangzhou City) significantly increased (from 50% to 62%) from pre- to post-test whilst it decreased (from 64% to 56%) in the comparison city (Nanning City). A similar pattern was also observed for front seat passengers although the overall prevalence was not as high. Importantly, over the period of the study, the intervention city experienced a statistically significant increase in the prevalence of seat belt use across most factors; the prevalence of seat belt use increased whether travelling on a local road, main road or expressway and the prevalence increased for both male and female drivers and front seat passengers.

The largest increase in the prevalence of observed seat belt use was among drivers and passengers of taxis in the intervention city (a 21% and 26% increase, respectively). Although it is difficult to attribute what proportion of the significant change is due to the intervention, it is important to note that a substantial component of the intervention targeted taxi companies in order to increase the prevalence in a sub-group of drivers with poor compliance.

In contrast, the prevalence of seat belt use declined, significantly, over the intervention period across all factors (road types, vehicle type, the gender of the driver and passenger and the time of day) in the comparison city. The decline in the comparison city may be explained, in part, by the fact that the prevalence of seat belt use in Nanning increased following the enactment of increased fines for non use of seat belts (and the associated enforcement) in May 2004. However, it appears that in the absence of targeted and continued enforcement and public awareness raising, one observes a degradation of the prevalence of seat belt use over time.

Prior to the implementation of the study in the intervention city, almost 23% of private motor vehicle drivers and 55% of taxi drivers incorrectly used the available seat belt. This generally involved an array of strategies to make it appear, on a cursory look, that the driver was correctly restrained. These strategies involved the driver placing a large paper clip/clamp, nail or knot in the shoulder strap to prevent its recoil, placing the shoulder belt across the drivers chest with the lap belt latch unfastened, or placing the lap belt under the driver's hip. Following the intervention, only 11% of drivers continued to use their seat belts incorrectly and importantly, the shift was from improper use to correct use (rather than non use).

Although there has been a significant increase in the prevalence of seat belt use among all drivers including taxi drivers, the post-test (post-intervention) observations suggest that approximately 37% of taxi drivers still continue to use seat belts incorrectly. The continued poor compliance among taxi drivers has been well documented in the literature.^{11, 25} The reasons taxi drivers give for poor compliance (incorrect or non use) include the need to step out of the vehicle frequently, the potential threat of violence and hence the need to exit the vehicle promptly and exemplary driving skills. Since more than one third of taxi drivers continue to not comply with the current legislation despite targeting both health promotion and enforcement practices towards taxi drivers, continuation of the enhanced practices (both social marketing and enforcement) would be beneficial.

As mentioned earlier, the *a priori* aim of the intervention was to increase the prevalence of seat belt use by 20%. Although significant change was observed, the level of change was not as originally proposed and this is likely due to limitations in the implementation of the intervention strategies. Although 5 enhanced enforcement operations (these were activities beyond the usual enforcement practices) took place during the intervention period in which 11,000 vehicles were stopped and 2,414 and 2,110 infringement tickets and warnings issued respectively, this was 40% below the desired level of enforcement (as requested by the independent police educator contracted to assist with the intervention). One posited reason for the lower than desired levels of enforcement activity was the emphasis Guangzhou police placed on enforcing speed limits and preventing driving under the influence of alcohol (DUI) with these two activities taking precedence over seat belt enforcement. As well, the impact of the enhanced enforcement program may have been reduced by the mere fact that 300,000 vehicles travel into Guangzhou City daily from regions outside of the Province and in the absence of a universal driver information system in China, offences and infringements do not apply to vehicles not registered in Guangzhou.

Despite the significant increase in the prevalence of seat belt use in the intervention city (compared to the comparison city), the prevalence of seat belt use in the intervention city remains low when compared to highly motorised countries. For example, the post-intervention prevalence of seat belt use in the intervention city of 62% is 20% lower than the prevalence of seat belt use in the United States (82%),²⁶ and one third lower than that in Australia (95%).¹³ Clearly, a greater intensity of the intervention activities over a longer period will be needed in order to increase the prevalence of seat belt use in the intervention city to that of high income countries.

Given the evaluation is based on an observational survey it is difficult to attribute, exactly, the extent to which the intervention increased the prevalence of seat belt use. Importantly, we observed a significant increase in the prevalence of seat belt use in the intervention city and a reduction in the comparison city with an overall difference between the two cities of 18%. Furthermore, when the analysis was stratified for road type, vehicle type, driver sex, time of day and whether the observed was the driver or passenger, there was a consistent increase in the prevalence of seat belt use in the intervention city and a decline in the comparison city. However, there are a number of competing explanations for the observed increase in seat belt use.

The first explanation relates to the potential variability of the observations undertaken by the 12 recruited observers at each of the observational surveys. However, based on the protocols we applied along with the extensive training of observers and the implementation of audit processes during the data collection phase (including reliability assessment), we do not believe this would be a significant threat to the study.

An important alternate explanation relates to events that occurred during the intervention period, other than what was part of the intervention activities. The most obvious threat of this kind would have been activities that would either directly (or indirectly) increase the prevalence of seat belt use. As we were aware that history-effects were a threat to the validity of such a study we monitored legislative changes and road safety marketing campaigns in both cities. Interestingly, a number of legislative changes were introduced in China which would have a direct influence on the prevalence of seat belt use. For example, heavily tinted windows on vehicles is now prohibited and the government have also increased the financial penalty for non use (or incorrect use) of the seat belt from CNY50 to CNY200. In relation to the former, heavily tinted windows have only recently been prohibited and certainly post-intervention hence is not likely to have contributed to the findings observed in this study. With regards to the latter, there is good evidence that higher fines are effective in increasing the prevalence of seat belt use.²⁷ Importantly, this measure was introduced following the post-test observations and therefore was also unlikely to have influenced the estimates of seat belt use observed in the study. Another potential explanation for the increase in seat belt use could be attributed to an integrated driver information system which would mean that fines issued for incorrect use (or non use) of a seat belt will apply to all drivers, whether licensed in Guangzhou/Guangdong or outside of the city/Province; this will directly affect the 300,000 vehicles travelling in Guangzhou City daily, from regions outside of the Province. However, although this has been on the government's agenda for sometime, it has yet to be implemented.

For this study, Guangzhou City was selected by the government partially on the basis of its burgeoning incidence of road traffic injury which was in contrast to the comparison city which had a better record of achievement with respect to road safety. This is exhibited in the absence of baseline equivalence between the two cities in relation to the prevalence of seat belt use with the prevalence in Guangzhou City 14% lower than that in the comparison city. This highlights that despite the two cities being highly motorised and with growing economies, there is a level of heterogeneity between the two cities that can not be adjusted for and is important therefore, to not consider Nanning as a control city.

The China Seat Belt Intervention was the first cost effectiveness evaluation of an intervention to increase seat belt use in a low to middle income country. Based on the increased prevalence of seat belt use observed as part of this intervention, the total number of Disability Adjusted Life Years (DALYs) saved as a result of the intervention was 530. Taking account of the cost of implementing the intervention along with the associated cost savings, the incremental cost effectiveness ratio (ICER) of the intervention compared with no enhanced program to increase the prevalence of seat belt use was CNY3,246 per DALY saved (or the equivalent US\$418 per DALY saved). Importantly, when the 'most likely' case of the ICER is considered namely, US\$171 per DALY saved the intervention on this basis is highly cost effective.

The usefulness of conducting an economic evaluation of this type is largely to compare the incremental cost effectiveness ratio (ICER) of the intervention with the ICERs of other interventions for health conditions that are prevalent in low and middle income countries. Disability Adjusted Life Years (DALYs) was used as the outcome measure as there is comparable data on the cost per DALY for a broad range of health conditions that are prevalent in low and middle income countries. There is an array of cost effective road safety interventions for low and middle income countries ranging from traffic calming to reduce speed (US\$5 per DALY saved), bicycle helmet legislation in China (US\$107 per DALY saved) to motorcycle helmet legislation in Thailand (US\$467 per DALY saved).²⁸ Based on these estimates, the China Seat Belt Intervention (US\$418 per DALY saved) is in the higher cost effectiveness range, yet is still cost effective. To place the cost effectiveness of the current intervention in a context with other population-based interventions, in order to reduce the risk of coronary artery disease (another leading cause of death in low and middle income countries) by reducing salt in manufactured foods via legislation and education campaigns the ICER would be US\$1,325 per DALY saved.

Although there is an almost 4-fold difference in the cost effectiveness between bicycle helmet legislation and the current intervention in China, the actual differential can be misleading. One explanation for the higher ICER for the China Seat Belt Intervention, relative to bicycle helmet legislation, is due to the fact that vulnerable road users still comprise the majority of road traffic fatalities and serious injuries in Guangzhou; only 30% of the road traffic injuries are sustained by motor vehicle occupants and, as alluded to earlier, the DALY is particularly sensitive to this estimate. However, since motor vehicle production has tripled since the early 1990's in China,⁴ it is likely that the proportion of motor vehicle occupant injuries, as a proportion of all road traffic injuries, will increase and on this basis, interventions such as that proposed here, will deserve greater emphasis. Importantly, if we applied the 'most likely' case of the ICER namely, US\$171 per DALY saved and convert to an ICER expressed in 2001 US dollars (the year for which the monetary values for the bicycle helmet cost effectiveness was based) the current intervention is highly cost effective delivering US\$149 per DALY saved.

There are a number of limitations that need to be considered when interpreting the findings from the cost effectiveness evaluation. The first limitation related to the available data for the purposes of the evaluation. For example, in measuring health gain we had to make assumptions about certain parameters such as the proportion of motor vehicle occupants that were reported in the road traffic fatalities and serious injury statistics. As well, when we measured cost savings from a reduction in resource use due to fewer deaths and injuries, we excluded some cost savings (namely, medical expenses other than hospital costs, police investigation costs and workplace disruption costs). Finally, we had to rely on estimates made by agencies rather than actual costs when measuring a number of the cost components of the intervention. However, for all cases described the assumptions or parameter values used were conservative so that the intervention costs would be overestimated and the cost savings and health gain underestimated. Any inaccuracy in the ICER because of data limitations would thus bias against the cost effectiveness of the intervention.

A further limitation of the cost effectiveness evaluation is a recurring limitation when undertaking cost effectiveness evaluations alongside an intervention namely, whether the cost and effectiveness results obtained in the intervention study would be replicated if the intervention was part of standard practice. In this study, the most likely difference between results in the trial and an ongoing program was thought to be that the cost of the intervention was inflated through the training and project management costs being higher than they would have been if the intervention had been standard practice. Also, we were conservative in our estimate of the effectiveness of seat belts in reducing fatalities and serious injury. These factors were taken account of in the multi-way sensitivity analysis that presented the 'most likely' case scenario.

8. Conclusion



This was the first comprehensively implemented and evaluated road safety strategy in China. The intervention study provided the government with the opportunity to build capacity in road safety. Given the speed at which motorisation is taking place throughout China, there are limited opportunities to apply and rigorously evaluate best-practice in road safety. Importantly, the study brought together the key stakeholders for road safety namely, the government, road safety researchers and industry. Seldom are there opportunities where governments can implement an intervention that involves collaboration between scientists and industry and at the same time, deliver cost-effective outcomes such as increased seat belt use. Importantly, the study provided outcomes such as changes to police enforcement practice and innovative road safety communication strategies which will be a legacy of this project and will be invaluable to both Central and Provincial- level governments who are responsible for road safety in China.

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10. Appendices



Appendix 1: Biographies of Authors

Prof Mark Stevenson

Prof Stevenson is a Senior Director at The George Institute for International Health, Professor in the School of Public Health at The University of Sydney and a National Health and Medical Research Council (Australia) Fellow. Prior to these appointments, Prof Stevenson was an Associate Professor in the School of Population Health at The University of Western Australia and has also worked as an epidemiologist at the Centers for Disease Control and Prevention in Atlanta, USA, as well as spending time at the Harvard University School of Public Health.

Prof Stevenson is a strong advocate for road and child injury prevention and has worked on numerous national and international projects related to these areas. Prof Stevenson is a member of the Australasian Trauma Society, the Australasian College of Road Safety, on the editorial boards of a number of international journals and is a member of the Technical Advisory Group for the international not-for-profit - The Alliance for Safe Children.

Dr James Yu

Dr James Yu is a senior research fellow at The George Institute, China. Prior to his current appointment, he was a public health doctor at the Nanchang Center for Disease Control, China. His main research interests involve epidemiology of injury, particularly road traffic injury, trauma care and health policy. He has been heavily involved in several road traffic injury prevention research projects in China.

Dr Zhou Ying

Dr Zhou Ying was a research assistant at The George Institute, China. Dr Zhou graduated from Peking University Health Science Center with a Bachelors Degree in Medicine in 2004 and now is currently studying for a doctoral degree at Iowa State University in the United States of America.

Ms Delia Hendrie

Ms Delia Hendrie is a health economist with a particular interest in injury prevention and safety economics. She is a lecturer in health economics in the School of Population Health at the University of Western Australia and lectures in health economics and health services financial management in the School of Public Health and pharmacoeconomics in the School of Pharmacy at Curtin University. A focus of Ms Hendrie's research is the cost and consequences of injury and the economic evaluation of interventions to reduce the burden attributable to injury. She has worked on numerous projects examining the costs and longer-term outcomes of injury, initially concentrating on road injury but more recently extending her research to include other areas such as falls in children and the elderly, drowning and interpersonal violence.

Dr Rebecca Ivers

Dr Rebecca Ivers is Director of the Injury and Musculoskeletal Division at The George Institute for International Health, and is funded by an NHMRC Population Health Capacity Building Grant in Injury Prevention, Acute Care and Rehabilitation. Her research program is centred on the prevention of road traffic crashes. Current research studies include the DRIVE Study, a cohort study examining risk factors for injury in 20,000 novice drivers, as well as a series of systematic reviews of research on interventions to improve motorcycle safety. Dr Ivers is also a collaborator on several studies facilitated by the George Institute aimed at improving road safety and preventing injuries in low and middle income countries.

A/Prof Li-ping Li

A/Prof Li Liping is a professor in the Department of Preventive Medicine, and presently Vice Director of the Injury Prevention Research Centre at the Shantou University Medical College. She has organised the National Continual Education Project in injury epidemiology and research methods for senior health professionals in China. Her main research and teaching areas are injury epidemiology, injury surveillance and safety promotion. She heads numerous injury prevention research projects in China.

Prof Robyn Norton

Prof Robyn Norton is Principal Director of The George Institute for International Health, Professor of Public Health and Associate Dean (International) within the Faculties of Health at The University of Sydney, Australia. She also holds an Honorary Professorship at Peking University Health Science Center in Beijing, China. Prof Norton is Chair of the Road Traffic Injuries Research Network, a global partnership for the promotion, conduct and utilisation of research for the prevention and control of road traffic injuries in low and middle-income countries. She is also a Board member of the journal Injury Prevention, co-author of the WHO's 5-year strategy for road traffic injury prevention, and the lead author of the chapter on the epidemiology of road traffic injuries, for the World Report on Road Traffic Injury Prevention.

Appendix 2: List of News Reports generated by the Intervention

Date	Media(Newspaper)	Content
26.04.2005	Information Times	Details on the launch of the intervention
26.04.2005	Yangcheng Evening	Details on the launch of the intervention
11.10.2005	Nanfang Daily	Item related to enforcement activities
11.10.2005	New Express	Item related to enforcement activities
25.02.2006	People's Public Security	Item related to enforcement activities
08.03.2006	Economic Daily	Item aimed at increasing awareness of seat belt efficacy
10.03.2006	Auto Weekly	Item aimed at increasing awareness of seat belt efficacy
15.03.2006	New Express	Item aimed at increasing awareness of seat belt efficacy
12.04.2006	People's Public Security	Item aimed at increasing awareness of seat belt efficacy
12.07.2006	New Express	Item aimed at increasing awareness of seat belt efficacy
Date	Media(Radio)	Content
26.04.2005	Yangchen Traffic Radio Station	Details on the launch of the intervention
22.02.2006	Union Nation Radio Station	Item aimed at increasing awareness of seat belt efficacy
09.08.2006	Guangzhou Radio Station	Item aimed at increasing awareness of seat belt efficacy
10.09.2006	Guangzhou Radio Station	Item aimed at increasing awareness of seat belt efficacy
Date	Media (TV)	Content
26.04.2005	Guangzhou TV	Details on the launch of the intervention
26.04.2005	Guangdong Southern TV	Details on the launch of the intervention
26.04.2005	Guangdong TV	Details on the launch of the intervention

Appendix 3: Summary Statistics for the Intervention and Comparison Cities

Table I: Pre- and post-intervention results for the intervention city

Intervention City - Guangzhou								
Car Occupant Seat Belt Use								
Driver	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	17032	50%	17981	62%	12%	0.0000	12%	13%
Incorrectly used	7910	23%	3263	11%	-12%	0.0000	-12%	-11%
Not used	9179	27%	7572	26%	-1%	0.0775	-1%	0%
Passenger	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	5635	40%	6556	53%	13%	0.0000	12%	14%
Incorrectly used	1902	13%	551	4%	-9%	0.0000	-10%	-8%
Not used	6657	47%	5339	43%	-4%	0.0000	-5%	-3%
Driver Seat Belt Use by Road Type								
Local Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	5743	45%	6642	60%	16%	0.0000	14%	17%
Incorrectly used	3632	28%	1783	16%	-12%	0.0000	-13%	-11%
Not used	3526	27%	2629	24%	-4%	0.0000	-5%	-2%
Main Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	4842	44%	5288	60%	15%	0.0000	14%	17%
Incorrectly used	3496	32%	1240	14%	-18%	0.0000	-19%	-17%
Not used	2640	24%	2357	27%	2%	0.0001	1%	4%
Expressways	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	6447	63%	6051	68%	5%	0.0000	4%	7%
Incorrectly used	782	8%	240	3%	-5%	0.0000	-6%	-4%
Not used	3013	29%	2586	29%	0%	0.6640	-2%	1%

Intervention City - Guangzhou								
Passenger Seat Belt Use by Road Type								
Local Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1364	31%	2099	52%	20%	0.0000	18%	23%
Incorrectly used	595	14%	185	5%	-9%	0.0000	-10%	-8%
Not used	2376	55%	1759	44%	-11%	0.0000	-13%	-9%
Main Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1470	33%	1676	50%	16%	0.0000	14%	19%
Incorrectly used	917	21%	194	6%	-15%	0.0000	-16%	-14%
Not used	2028	46%	1508	45%	-1%	0.2561	-4%	1%
Expressways	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	2801	51%	2781	55%	4%	0.0001	2%	6%
Incorrectly used	390	7%	172	3%	-4%	0.0000	-5%	-3%
Not used	2253	41%	2072	41%	0%	0.8753	-2%	2%
Driver Seat Belt Use by Gender								
Male	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	16208	50%	17058	62%	12%	0.0000	11%	13%
Incorrectly used	7711	24%	3226	12%	-12%	0.0000	-12%	-11%
Not used	8776	27%	7308	26%	0%	0.3247	-1%	0%
Female	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	811	58%	923	75%	18%	0.0000	14%	21%
Incorrectly used	194	14%	37	3%	-11%	0.0000	-13%	-9%
Not used	398	28%	264	22%	-7%	0.0001	-10%	-4%

Intervention City - Guangzhou								
Passenger Seat Belt Use by Gender								
Male	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	3652	39%	3993	50%	11%	0.0000	9%	12%
Incorrectly used	1255	13%	380	5%	-9%	0.0000	-10%	-8%
Not used	4407	47%	3597	45%	-2%	0.0041	-4%	-1%
Female	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1951	41%	2563	57%	17%	0.0000	15%	19%
Incorrectly used	640	13%	171	4%	-9%	0.0000	-11%	-8%
Not used	2226	46%	1742	39%	-7%	0.0000	-9%	-5%
Driver Seat Belt Use by Time of Day								
Day	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Mon-Fri								
Correctly used	4637	51%	4908	63%	13%	0.0000	11%	14%
Incorrectly used	2211	24%	910	12%	-12%	0.0000	-14%	-11%
Not used	2284	25%	1936	25%	0%	0.9485	-1%	1%
Night	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Mon-Fri								
Correctly used	4122	49%	4024	61%	13%	0.0000	11%	14%
Incorrectly used	2130	25%	757	12%	-14%	0.0000	-15%	-12%
Not used	2215	26%	1768	27%	1%	0.2498	-1%	2%
Day	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Sat-Sun								
Correctly used	4603	52%	4959	63%	11%	0.0000	10%	13%
Incorrectly used	1972	22%	870	11%	-11%	0.0000	-12%	-10%
Not used	2241	25%	2010	26%	0%	0.7437	-1%	2%
Night	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Sat-Sun								
Correctly used	3670	48%	4090	61%	14%	0.0000	12%	15%
Incorrectly used	1597	21%	726	11%	-10%	0.0000	-11%	-9%
Not used	2439	32%	1858	28%	-4%	0.0000	-5%	-2%

Intervention City - Guangzhou								
Passenger Seat Belt Use by Time of Day								
Day	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Mon-Fri								
Correctly used	1437	40%	1638	51%	12%	0.0000	9%	14%
Incorrectly used	508	14%	177	6%	-8%	0.0000	-10%	-7%
Not used	1688	46%	1388	43%	-3%	0.0095	-5%	-1%
Night	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Mon-Fri								
Correctly used	1241	38%	1407	53%	15%	0.0000	13%	18%
Incorrectly used	507	15%	81	3%	-12%	0.0000	-14%	-11%
Not used	1547	47%	1170	44%	-3%	0.0240	-5%	0%
Day	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Sat-Sun								
Correctly used	1715	43%	1938	54%	11%	0.0000	9%	13%
Incorrectly used	502	13%	175	5%	-8%	0.0000	-9%	-6%
Not used	1752	44%	1456	41%	-3%	0.0033	-6%	-1%
Night	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Sat-Sun								
Correctly used	1242	38%	1573	52%	14%	0.0000	12%	17%
Incorrectly used	385	12%	118	4%	-8%	0.0000	-9%	-6%
Not used	1670	51%	1325	44%	-7%	0.0000	-9%	-4%

Intervention City - Guangzhou								
Driver Seat Belt Use by Vehicle Type								
Car	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	12679	61%	13346	71%	10%	0.0000	9%	10%
Incorrectly used	1877	9%	438	2%	-7%	0.0000	-7%	-6%
Not used	6180	30%	5099	27%	-3%	0.0000	-4%	-2%
Taxi	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	3112	30%	3821	51%	21%	0.0000	20%	23%
Incorrectly used	5686	55%	2772	37%	-18%	0.0000	-20%	-17%
Not used	1473	14%	841	11%	-3%	0.0000	-4%	-2%
Other	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1224	40%	790	32%	-8%	0.0000	-10%	-5%
Incorrectly used	346	11%	49	2%	-9%	0.0000	-10%	-8%
Not used	1521	49%	1624	66%	17%	0.0000	14%	19%
Passenger Seat Belt Use by Vehicle Type								
Car	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	4411	46%	5118	58%	12%	0.0000	10%	13%
Incorrectly used	944	10%	366	4%	-6%	0.0000	-6%	-5%
Not used	4191	44%	3359	38%	-6%	0.0000	-7%	-4%
Taxi	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	800	26%	1123	52%	26%	0.0000	23%	28%
Incorrectly used	768	25%	151	7%	-18%	0.0000	-20%	-16%
Not used	1459	48%	887	41%	-7%	0.0000	-10%	-4%
Other	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	416	26%	298	21%	-5%	0.0016	-8%	-2%
Incorrectly used	189	12%	31	2%	-10%	0.0000	-11%	-8%
Not used	1001	62%	1088	77%	14%	0.0000	11%	18%

Table II: Pre- and post-intervention results for the Comparison City

Comparison City - Nanning								
Car Occupant Seat Belt Use								
Driver	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	16962	64%	14152	56%	-8%	0.0000	-8%	-7%
Incorrectly used	2162	8%	981	4%	-4%	0.0000	-5%	-4%
Not used	7423	28%	10010	40%	12%	0.0000	11%	13%
Passenger	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	3530	38%	3026	33%	-5%	0.0000	-6%	-4%
Incorrectly used	854	9%	287	3%	-6%	0.0000	-7%	-5%
Not used	4957	53%	5943	64%	11%	0.0000	10%	13%
Driver Seat Belt Use by Road Type								
Local Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	7516	60%	6655	53%	-6%	0.0000	-8%	-5%
Incorrectly used	1176	9%	525	4%	-5%	0.0000	-6%	-5%
Not used	3862	31%	5287	42%	12%	0.0000	10%	13%
Main Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	8301	66%	6668	57%	-8%	0.0000	-10%	-7%
Incorrectly used	962	8%	448	4%	-4%	0.0000	-4%	-3%
Not used	3405	27%	4553	39%	12%	0.0000	11%	13%
Expressways	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1145	86%	829	82%	-4%	0.0066	-7%	-1%
Incorrectly used	24	2%	8	1%	-1%	0.0365	-2%	0%
Not used	156	12%	170	17%	5%	0.0004	2%	8%

Comparison City - Nanning								
Passenger Seat Belt Use by Road Type								
Local Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1376	32%	1270	29%	-3%	0.0013	-5%	-1%
Incorrectly used	442	10%	142	3%	-7%	0.0000	-8%	-6%
Not used	2494	58%	3005	68%	10%	0.0000	8%	12%
Main Roads	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1542	37%	1339	32%	-5%	0.0000	-8%	-3%
Incorrectly used	362	9%	134	3%	-6%	0.0000	-7%	-5%
Not used	2222	54%	2724	65%	11%	0.0000	9%	13%
Expressways	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	612	68%	417	65%	-3%	0.2466	-8%	2%
Incorrectly used	50	6%	11	2%	-4%	0.0001	-6%	-2%
Not used	241	27%	214	33%	7%	0.0047	2%	11%

Driver Seat Belt Use by Gender								
Male	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	15479	64%	12976	56%	-8%	0.0000	-9%	-7%
Incorrectly used	1839	8%	832	4%	-4%	0.0000	-4%	-4%
Not used	6862	28%	9405	41%	12%	0.0000	11%	13%
Female	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1481	63%	1176	61%	-2%	0.2353	-5%	1%
Incorrectly used	322	14%	149	8%	-6%	0.0000	-8%	-4%
Not used	559	24%	605	31%	8%	0.0000	5%	10%

Comparison City - Nanning								
Passenger Seat Belt Use by Gender								
Male	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	2384	39%	1945	33%	-7%	0.0000	-8%	-5%
Incorrectly used	520	9%	185	3%	-5%	0.0000	-6%	-5%
Not used	3140	52%	3797	64%	12%	0.0000	10%	14%
Female	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	1144	35%	1081	32%	-2%	0.0447	-5%	0%
Incorrectly used	333	10%	102	3%	-7%	0.0000	-8%	-6%
Not used	1810	55%	2146	64%	9%	0.0000	7%	12%

Driver Seat Belt Use by Time of Day								
Day	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Mon-Fri								
Correctly used	4987	70%	4588	65%	-5%	0.0000	-7%	-4%
Incorrectly used	554	8%	422	6%	-2%	0.0000	-3%	-1%
Not used	1591	22%	2064	29%	7%	0.0000	5%	8%
Night								
Mon-Fri								
Correctly used	3984	62%	2529	45%	-17%	0.0000	-19%	-16%
Incorrectly used	485	8%	181	3%	-4%	0.0000	-5%	-4%
Not used	1922	30%	2925	52%	22%	0.0000	20%	24%
Day								
Sat-Sun								
Correctly used	4290	64%	4511	64%	-1%	0.4116	-2%	1%
Incorrectly used	665	10%	298	4%	-6%	0.0000	-7%	-5%
Not used	1719	26%	2283	32%	6%	0.0000	5%	8%
Night								
Sat-Sun								
Correctly used	3701	58%	2524	47%	-11%	0.0000	-13%	-9%
Incorrectly used	458	7%	80	1%	-6%	0.0000	-6%	-5%
Not used	2191	35%	2738	51%	17%	0.0000	15%	19%

Comparison City - Nanning								
Passenger Seat Belt Use by Time of Day								
Day	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Mon-Fri								
Correctly used	983	42%	997	40%	-2%	0.1740	-5%	1%
Incorrectly used	219	9%	118	5%	-5%	0.0000	-6%	-3%
Not used	1146	49%	1381	55%	7%	0.0000	4%	9%
Night								
Mon-Fri								
Correctly used	839	37%	468	24%	-13%	0.0000	-16%	-10%
Incorrectly used	187	8%	29	1%	-7%	0.0000	-8%	-5%
Not used	1254	55%	1455	75%	20%	0.0000	17%	22%
Day								
Sat-Sun								
Correctly used	898	38%	1035	38%	-1%	0.6732	-3%	2%
Incorrectly used	272	12%	107	4%	-8%	0.0000	-9%	-6%
Not used	1175	50%	1602	58%	8%	0.0000	6%	11%
Night								
Sat-Sun								
Correctly used	810	34%	526	25%	-9%	0.0000	-11%	-6%
Incorrectly used	176	7%	33	2%	-6%	0.0000	-7%	-5%
Not used	1382	58%	1505	73%	15%	0.0000	12%	17%

Comparison City - Nanning								
Driver Seat Belt Use by Vehicle Type								
Car	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	10234	68%	9468	62%	-7%	0.0000	-8%	-6%
Incorrectly used	634	4%	288	2%	-2%	0.0000	-3%	-2%
Not used	4074	27%	5560	36%	9%	0.0000	8%	10%
Taxi								
Correctly used	5816	60%	3720	49%	-11%	0.0000	-12%	-9%
Incorrectly used	1400	14%	544	7%	-7%	0.0000	-8%	-6%
Not used	2440	25%	3259	43%	18%	0.0000	17%	19%
Other								
Correctly used	893	46%	919	42%	-4%	0.0061	-7%	-1%
Incorrectly used	127	7%	147	7%	0%	0.8568	-1%	2%
Not used	908	47%	1119	51%	4%	0.0084	1%	7%

Passenger Seat Belt Use by Vehicle Type								
Car	Pre-Intervention		Post-Intervention		Statistics			
	Number	Prevalence	Number	Prevalence	Difference	p-value	Lower 95% CI	Upper 95% CI
Correctly used	2761	45%	2498	41%	-4%	0.0000	-5%	-2%
Incorrectly used	565	9%	207	3%	-6%	0.0000	-7%	-5%
Not used	2848	46%	3391	56%	9%	0.0000	8%	11%
Taxi								
Correctly used	561	24%	257	12%	-12%	0.0000	-14%	-10%
Incorrectly used	201	9%	32	2%	-7%	0.0000	-8%	-6%
Not used	1543	67%	1786	86%	19%	0.0000	17%	22%
Other								
Correctly used	199	24%	258	25%	2%	0.4061	-2%	6%
Incorrectly used	87	10%	47	5%	-6%	0.0000	-8%	-3%
Not used	557	66%	716	70%	4%	0.0612	0%	8%

Appendix 4: Audio Visual Social Marketing Tool

Appendices

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China Seat Belt Intervention