Original Article

The Nationwide Surveillance of Seat Belt Usage and Encouraging Factors of Increasing the Seat Belt Rate in Thailand: A Road Safety Survey

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Objective: The aims of this research were to cross-sectional survey the basic characteristics of the seat belts usage and use rate among drivers and passengers in Thailand. And, study the relationship between seat belt use rate and gross provincial product (GPP), literacy levels, percent under the poverty line and police density, relationships between literacy levels and penalties rate.

Materials and Methods: A nationwide cross-sectional study was conducted by a collaboration of police department, injury surveillance of the Ministry of Public Health, Thai Road Safety Survey, and National Pediatric Injury and Trauma Registry of Thailand (NPIRT) database from 2010 to 2011.The rates of seat belt usage were recorded. All baseline characteristic variables (regions, provinces, population density, police density, literacy level, under poverty line, and conviction rate) were collected, and compared with interested outcome, seat belt usage rate by univariate analysis, linear regression and multiple regression analysis.

Results: The average of seat belt usage rate across the country was 37.8 %+15.3 %. The highest rate of usage (mean±SD) were demonstrated in Bangkok (78.9 %), follow by North-east region (46.2 %+12.5 %), Central region (44.0 %+11.9 %), Northern region (28.2 %+9.7 %), and lowest in Southern region (24.2 %+11.1 %), respectively. The univariate regression analyses, GPP (coefficient 0.303;95%CI :0.109-0.497), literacy (coefficient 0.044;95%CI:0.020-0.068), police density (coefficient 0.038;95%CI: 0.0170-0.060) and conviction rate (coefficient 0.008;95%CI:0.003-0.012) showed statistically significances with seat belt usage rate (p-value= 0.003, 0.010, <0.001, 0.001, respectively). The level of literacy not significant correlated to decrease of conviction rate (coefficient 0.001;95% CI: -1.15-1.38, p-value=0.86). Multiple regression analyses, results showed the final three significantly correlated factors with usage rate were GPP, level of literacy, and conviction rate (p-value < 0.001, adjusted R-square 0.33). GPP showed a highest impact on seat-belt usage rate. 19.5 % (coefficient 0.195; 95%CI:0.025-0.366, p-value = 0.03). The level of literacy of the population enhance the rate of seat-belt usage approximately 3.9 %(coefficient 0.039; 95 % CI :0.019-0.060, p-value <0.001), and conviction rate can increase seat belt usage rate 0.64 %(coefficient 0.006; 95 % CI 0.003-0.010, p-value< 0.01)

Conclusion: Only one third of people use a seat belt when they drive in Thailand. The seat belt usage rate has a trend of increasing in urban more than rural area, and the highest rate in the metropolitan's area. Finally, three significantly factors were GPP, level of literacy, and conviction rate had significant effect with rate seat belt usage. Improving of GPP, Level of Literacy and law penalty will be enhancing of seat belt usage rate and their engagement in immediate and long term.

Keywords: Seat Belt, Road Traffic Collision, Seat belt Compliance, Seat Belt Law legislation

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On a global scale, Motor vehicle crashes (MVCs) are the leading causes of injured death, and represent the burden of healthcare problems that can prevent from children to 24 years of age[1]. Many literatures have demonstrated more benefits of seat belt usage among drivers and passengers. The seat belt is used to reduce the severity of injury in patient motor vehicle crashes (MVCs) as a standard policy in many countries. Since 1975, The National Highway Traffic Safety Administration has demonstrated more than 135,000 lives, and 3.8 million serious non-fatal injuries were saved and prevented by seat belt usages[2]. The usefulness of seat belts have been shown to reduce the fatal injury rate for front seat passengers by 45 percent, and also critical injuries were reduced to 50 percent[3].

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Despite recognition of their efficiencies in reducing morbidity and mortality, the rate of usage still has been far from universal and varied among the countries. In contrast to eastern countries the usage rate seemed to be lower. Most evidences showed that MVCs victims who were unrestrained are more severely injured, and have longer length of hospital stay, higher hospital cost, more admissions in intensive care units, and consume more resources and expenses.

Many possibilities of lack of seat belt usage may come from economic burdens problems, such as low Gross National Product (GNP), Gross Provincial Product (GPP), prices of seat belts, law regulation and enforcement, literacy and knowledge of people through their self-attitude. In Thailand, multiple efforts, including government policies, primary law legislation, and preventive strategies have been deployed parallel with other initiative campaigns such as; drunk driver policy, helmet saves your life policy, safe travelling while restrained with seat belts but its seem to unsuccessfully accomplishment. The education initiative strategies have been shown to be controversial issues to encourage increased seat belt usage and reduced of non-compliance[4-7]. The legislative efforts, and graduated driving licenses (GDL) have been enhanced providing marginal success for increased usage rate[8-14].

The purpose of this study was aimed to review of the direct observational data from the Thai Road Safety Survey, and a cooperative group of police department and injury surveillance of the Ministry of Public Health (MOPH) Thailand, in order to assess the statistically significant correlation among the rate of seat belt usages and factors which can increase their efficient usages based on cost of living per province: GPP (Gross provincial product), literacy level of population, percent under poverty line, police density, and conviction rate. The rate of seat belt usage and significant correlated factors can be useful to further public health measurement indexes aimed at reducing the morbid-mortality of MVCs from encouraging the rate of seat belt usage in Thailand.

Materials and Methods

Study design and setting

A nationwide cross-sectional study was performed by a cooperative group of police department and injury surveillance of the MOPH, retrieved of direct-observational data from 2010 to 2011 from the National Pediatric Injury and Trauma Registry of Thailand (NPIRT) database[15] that collaborated by the Thai Road Safety Survey, Thailand. The data were collected at the scene of each province and then reviewed, checked by summarizing and cross-tabulating between variables, and validated by Section of Clinical Epidemiology and Biostatistics, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand.

All car drivers were monitored and examined at police checkpoints. If they are found unrestrained seat belt, the penalties were applied and information was recorded into the Thai Road Safety Database and NPIRT database. The rates of seat belt usage among 76 provinces of Thailand were recorded. All variables were collected to a database during the period of 2010-2011, which consisted of regions, provinces, population density, police density, literacy level, under poverty line, and conviction rate compared with outcome, seat belt usage rate.

Variables and outcomes measure

The outcome of interest was seat belt usage rate which was observed and collected by the collaboration research team. The relevant factors consisted of GPP, literacy level, under poverty line, police density and conviction rate which were analyzed to get the significant correlation by the univariate and multiple linear regression model.

Objectives

The objectives of this study were to cross-sectional survey the basic characteristics of the seat belts usage and use rate of drivers and passengers in Thailand. And, study the relationship between seat belt use rate and gross provincial product (GPP), literacy levels, percent under the poverty line and police density. The study also analyzes relationships between literacy levels and penalties (conviction rate).

Statistical Analysis

The primary data was analyzed by using mean and standard deviation (SD) to describe continuous variables if data were normal distributed. Otherwise, median and ranges (minimum-maximum) were used. Frequency and percentage were used to describe categorical data. The correlations among seat belt usages and other factors were assessed by linear regression model. The p-value and adjusted R-square was estimated to describe all of significantly correlations. All analyses were performed using STATA 15.0 software (College Station, TX, USA). A p-value <0.05 was considered to be statistically significant.

Results

Characteristics of study variables

The average of seat belt usage rate was 37.8 %±15.3 % across Thailand. The highest rate was demonstrated in Bangkok (78.9 %), follow by North-east region (46.2 %±12.5 %), Central region (44.0 %±11.9 %), Northern region (28.2 %±9.7 %), and lowest in Southern region (24.2 %±11.1 %), respectively. The population density was highest in Bangkok (1330.4/km^2), follow by Central region (314.8/km^2), Southern region (146.1/km^2), North-eastern region (132.0/km^2), and Northern region (73.5/km^2) respectively. Highest GPP was found in Bangkok (0.44), then followed by Central region (0.25), Southern region (0.11), Northern region (0.08), and North-eastern region (0.05) respectively.

The percent of poverty line has also been described in this studied, and showed highest rank of income in Bangkok (8.00), follow by Southern region (22.57), Central region (32.56), Northern region (39.76), and poorest in North-eastern region (50.95) respectively, see Table 1. The literacy levels showed similar level in all regions (99.71 %, 91.09-100.00). As we expected, the highest level of literacy was in Bangkok (100.00 %) and was lowest in North-east (99.76 %), see Table 1.

The police density is characterized by the number of police officers per area. For overall country, the average of police density was 0.58 / square kilometer (Km^2). The highest police density was in Bangkok area at 13 police officers' coverage for an area of one square kilometer (13.09/ Km^2). The Central and Southern regions showed approximately one police coverage about 1.6 and 1.8 square kilometers, respectively (0.63/ Km^2 and 0.57/ Km^2). The North-eastern region was one police officer responsible for 4 square kilometers (0.24/ Km^2), and lowest in Northern region which was one police officer responsible for 5.6 square kilometers (0.18/ Km^2).

Not only density was counted as one of the interesting variables, but the quantities of police action were important and recorded as percent of overall conviction rate per region. The overall conviction rate was median 5.56 % (0.50-45.3). The percent of breaking the primary seat belt laws were reported highest in Bangkok (38.40 %), followed by Central region (6.90 %, 1.90-45.30), Northern region (5.60 %, 2.30-13.30), Southern region (5.25 %, 1.20-14.10), and lowest in North-eastern region (4.90 %, 0.50-24.10) respectively.

The results of correlation analyses

The univariate analyses among the relevant factors were analyzed to detect the statistical significances. The GPP and seat belt rate were evaluated by linear regression analyses. The correlation trend showed that if GPP increased by one baht/unit, it is directly associated with a 30.30 % of increase of seat belt usage rate (p-value = 0.003, 95% CI 10.87-49.73).

Correlation results of percent under poverty line in each region, and seat belt usage rates were analyzed. We found that if the level of below poverty line increasing by 1 unit it related with a minimal increment of rate of seat belt usage 0.026 % with non-significant statistic (p-value = 0.752, 95 % CI -0.14-0.19).

Author assumption is the amount of police density in each area is directly associated with the rate of seat belt usage by indirect positive reinforcement from law legislation, regulation and monitoring. We found that when the overall police density increased 1 percent, it increased usage of seat belts by 3.8 % with statistical significance (p-value = 0.001, 95 % CI 1.70-5.98). Then we were directly interested in observation to conviction rate which represented the manner of action more than only the number count. Form the univariate analyses, we found the minimum increase of seat belt usage rate 0.78 percent when we enforced the police to monitor and use the law parallel with every conviction rate detected (p-value = 0.001, 95 % CI 0.34-1.22). The literacy level was also shown to be statistically significant with seat belt usage (p-value <0.001, 95%CI 2.04-6.85). In other words, if we have any strategy

Table 1. Baseline characteristics among regions in Thailand

Factors	Average	Regions (percent, 95 %CI)				
		Bangkok	Central	North	North-east	South
GPP	0.14	0.44	0.25	0.08	0.05	0.11
Under poverty	36.61	8.00	32.56	39.76	50.95	22.57
Literacy level	99.28	100.00	99.72 (99.04 to 100)	98.99 (91.09 to 99.90)	99.76 (99.34 to 99.95)	99.79 (99.30 to 99.96)
Police density	0.58	13.09	0.63	0.18	0.24	0.57
Conviction rate	7.67	38.40	6.90 (1.90 to 45.30)	5.60 (2.30 to 13.30)	4.90 (0.50 to 24.10)	5.25 (1.20 to 14.10)

* GPP = Gross Provincial Product, CI= Confidence interval

to improve the level of literacy one percent, it will increase the seat belt rate 4.44 %, see Table 2.

We derived four significant variables from the linear regression model, which were GPP, literacy, police density and conviction rate. Then, the multiple regression analyses were done to explore the colinearity among final variables, and try to cut off some variables from the initial model from univariate analyses. These analyses showed that GPP has more influence on rate of seat-belt usage, and every one unit of increased GPP would increase the rate of seat belt usage 15.9 % (p-value=0.08, 95%CI -2.27-34.00). The literacy level showed moderate impact on overall usage rate of seat belts. This might be from their increased knowledge, risk perception and their attitudes. If we improve the literacy level of drivers by 1 percent, it would enhance the rate of seat belt usage rate 3.9 % (p-value = 0.001, 95 %CI 1.71-6.08). The rest of variables which influence the rate of usage of seat belts have shown a similarly trend. The small magnitude of both of police density and conviction rate showed a non-significant improvement of seat belt usage rate. If we increase the police density by one percent, it would show the directly increase of belt usage rate approximately 1.7 % (p-value = 0.155, 95%CI -0.65-4.03). In contrast, despite conviction rate was representative of action of law regulation and enforcement, it showed minor correlation with seat belt usage rate. If the conviction rate increased by one percent, it looked like a preventive tool to stimulate to increase of seat belt usage rate about 0.47 % (p = 0.05, 95%CI 0.0001-0.95).

The overall multiple regression analysis model of these 4 variables can explain the correlation by approximately 31.2 % (Adjusted R-squared = 0.3119). For the further steps, we needed to explore the co-linearity between police density and conviction rate (number vs. action), and found that they had 55.1 % directly correlated colinearity between both variables. Then we selected to drop one factor that could yield the higher statistical significance of variable groups. The final best correlation was found directly on 3 correlated factors, GPP, literacy, and conviction rate. The adjusted R-square showed higher on conviction rate than police density, the adjusted R-squared = 0.30 vs. 0.28, respectively.

Table 2. Univariate analysis correlation between belt rate and other interest factors

Variables	Coefficient	Standard Deviation	p-value	95 % CI
GPP	30.30	9.75	0.003	10.87 to 49.7
Under poverty	0.02	0.84	0.752	-0.14 to 0.19
Literacy	4.44	1.20	0.010	2.04 to 6.85
Police Density	3.84	1.07	0.000	1.70 to 5.98
Conviction rate	0.78	0.22	0.001	0.34 to 1.22

* P-value < 0.05 was considered as statistically significance

The outliers were explored to get the best correlation among these final 3 correlated factors. We found one province (Luei) reported as an outlier in these analyses, and we decided to drop this outlier out from the model. The re-evaluation showed increased adjusted R-square in the multivariate regression (Adjusted R-squared = 0.33, residual p-value = 0.18). Then, finally multiple regression analysis was done. The results showed the most three significantly correlated factors were GPP, level of literacy, and conviction rate (p-value <0.001, adjusted R-square 0.33). GPP showed a higher impact on seat-belt usage rate. When GPP increased every 1 % it would increase the rate of seat belt usage 19.5 % (p-value = 0.03, 95%CI 2.46-36.62).

The secondary important factor was literacy level. If we have any strategies to improve the level of literacy of the population by one percent, it would enhance the rate of seat-belt usage approximately 3.9 % (p-value < 0.001, 95 % CI 1.86-6.03). The last important factor was monitor and enforcement represented by conviction rate, if conviction rate increased by one percent, it could increase seat belt usage rate 0.64 % (p-value < 0.01, 95 % CI 0.25-1.03), see Table 3. This means if we emphasized on increasing knowledge, monitoring and through the law enforcement, which is a complete cycle we can cultivate long-term spiritual attitudes about preventing the risk of driving unrestrained by seat belt among the population.

Discussion

Of 76 provinces of seat belt usage rate included in the direct observational database by NPIRT and Thai Road Traffic Group, the average seat belt usage rate

Table 3. Multivariate analysis correlation between belt rate and other interest factors

Variables	Coefficient	Standard Deviation	p-value	95 % CI	Adjust R^2
GPP	19.54	8.57	0.026	2.46-36.62	0.33
Literacy	3.94	1.05	0.000	1.86-6.02	
Conviction rate	0.64	0.20	0.002	0.25-1.03	

* GPP= Gross Provincial Product, P-value < 0.05 was considered as statistically significance

across the country was 37.8 %±15.3 %. The highest usage rate was shown in Bangkok (78.9 %). Seat belt usage rate by driver was also highest in Bangkok (84.6%), followed by Central region (47.3%), Northern region (44.5%), North-Eastern region (40.0%), and lowest in Southern region (24.9%), respectively. Consistent with other studies, the passengers' seat belted rates were low compliance, lowest in Southern region (10.4%), Central region (29.1%), Northern region (31.4%), North-Eastern region (40.0%) and highest in Bangkok (63.9%), respectively. Those monitored rates were only relevant with high police density in Bangkok, but other regions showed similar numbers such as Central region, Southern region, Northern region and North-Eastern region, see Table 4.

Seat belt policy started has been in force for four decades to support seat belts prevent injury of restrained driver and passengers during road traffic collision (RTC). It was first established in the 1930s, Several USA physicians equipped their own cars with lap belts and began to urge the manufacturers to include this safety equipment in the vehicles. In the 1960s, Hodson-Walker, et al., reported the result of magnitude of preventive seat belt usage to reduce the majority of fatal injuries[16]. In 1964, many states in the USA made seat belt as compulsory safety equipment in vehicles. In 1963, three points seat belt model was also made compulsory in USA and follow in 1968 by the UK[17]. For Thailand, the seat belt law and legislation began to be enforced since 1999 for front seat driver and passengers, but not for rear seat passengers or child restraint equipment.

For the biomechanical role of seat belt, in fact that the relationship between velocity (v) and injury severity in belted occupants was studied, and showed clear association between fatal injury and high speed (Energy = ½ mass x V^2). The energy increased exponentially with increased velocity, so the more velocity creates a more serious or fatal collision and severe injury[18]. For these reasons, the standards of seat belt are lap belt and shoulder restraint in 3 points locked system against rapid acceleration and deceleration of velocity. It reduces the severity of injury caused by RTC by restraining occupants in their seat and preventing them from hitting to other objects, or being ejected out through the window. This mechanism is explained by scattering of kinetic energy of the body which is related to rapid deceleration by disintegrating through the body skeleton[19].

In 1998, the emergency locking retractor was invented and provided by Volvo. It was applied to previous standard 3 locking points system which aimed to increase more security. This lock on the seat belt increases safety by preventing movement in sudden deceleration and prevents bending forward[20]. Once a car hits with the external object, generally three collisions were demonstrated when the occupants were unrestrained in MVC situations. The first collision involves between the vehicle and external object. At the same moment, the second collision will be responsible for the most of the injuries, and can be prevented by seat belt usage, this collision happens between the unbelted occupants and the interior part of vehicle. The chest of a driver usually hits the steering wheel, and his/her head hits with the windscreen by the inertia theory. The third collision was internal of MVC victim's body came from internal collisions of internal organs hit against the chest wall or skeletal structures[21]. Mostly the energy and the direction of impact are the major factors which determine the outcome of a collision and unrestrained occupants of RTC. Occasionally, the unrestraint victims can be ejected out from vehicle or will become projectiles within the vehicle which creates the severity of injury to oneself and injury to other restrained passengers.

The most recent researches have focused on the primary objective on the seat belt usage rate. More important, the safety of the driver or passengers is not only based on the rate of seat belt usages, but is also based on the effectiveness and correct used of seat belts. Simsekoglv et al [22-24] showed the evidences that the effectiveness of seat belts was related to driver behavior, and education level. Dawson, et al, reported that incorrectly used seat belts were associated with higher causes of fatal injuries[25].

The incorrect seat belt usage (consisting of poor belt quality, poor adjustment, improper for passenger size, etcetera) can cause serious intra-abdominal injuries, spleen injury, splitted fracture of the third lumbar vertebra or more seat belt syndrome (lumbar spine fracture and bowel perforation)[18,25].

Seat belts has been reported to reduce perforation of eye injuries by 60%[26]. Rear seat occupants are much safer than front seat occupants[27,28]. The rear seat belt legislation was established in 1980 in the US, 1986 in Sweden, 1989 in New Zealand, and 1993 in the European Union[17].

In Thailand, by the Land of Traffic Act 1979 and Vehicle Act 2009, the car driving license qualifications need a driver's age not less than eighteen years old, but for a temporary permit to drive a motorcycle for the motorcycle engine cylinder capacity not exceeding

Table 4 Seat belt rate per provincial and regions

Regions	No. Province	Province Name	Driver					Passenger					Literacy (%)	GPP	Police Density	Conviction rate (%)
			Seatbelt Rate	Average of region	Standard Deviation (± SD)	Range (min-max)	Median	Seatbelt Rate	Average of region	Standard Deviation (± SD)	Range (min-max)	Median				
Bangkok	1	Bangkok	84.6	84.6		84.6		63.9	63.90		63.9		100	.441	13.09	38.4
Central	25	Nakhornnayok	37.7	47.30	13.38	27.0-77.4	42.9	20.9	29.10	11.91	13.0-62.0	27	99.72(99.04-100)	.084	0.35 (0.05,1.15)	6.9(1.9-45.3)
		Chachaensau	42.9					22.1						.385		
		Samutsakorn	46.0					26.9						.815		
		Rayong	48.5					30.7						1.014		
		Saraburi	66.6					39.3						.270		
		Chainat	42.3					27.0						.099		
		Rachaburi	34.6					13.0						.152		
		Singburi	65.3					35.1						.123		
		Prachinburi	27.0					17.5						.162		
		Sammutsongkram	34.9					22.1						.089		
		Petchaburi	52.8					35.4						.129		
		Ayutaya	51.8					31.8						.613		
		Nakhornpathom	48.7					38.9						.173		
		Lopburi	53.2					41.0						.099		
		Samutprakarn	69.0					42.4						.589		
		Patumtani	68.5					45.4						.295		
		Chantaburi	37.2					20.4						.085		
		Aengtong	55.5					40.2						.084		
		Srakeaw	33.5					16.6						.070		
		Trad	35.1					18.4						.110		
		Cholburi	42.0					19.4						.405		
		Supanburi	38.1					15.4						.087		
		Nontaburi	77.4					62.0						.113		
		Prachaubkirikan	40.5					27.7						.125		
		Khanchanaburi	34.9					17.8						.098		
North	17	Nakhornsawan	36.9	44.47	5.71	33.8-52.7	44.9	26.1	31.44	8.41	19.1-55.2	31.4	98.99(91.09-99.90)	.087	0.18 (+/-0.07)	5.6(2.3-13.3)
		Petchabune	48.7					35.7						.086		
		Lamphun	47.6					30.4						.173		
		Chiangmai	40.6					26.0						.084		
		Khampangpet	50.5					40.1						.119		
		Mahongson	46.4					31.4						.051		
		Utaithani	33.8					27.7						.076		
		Payaw	42.2					24.6						.063		
		Sukhothai	52.7					34.9						.064		
		Lamphang	40.1					29.3						.078		
		Nan	44.1					19.1						.056		
		Chiangrai	36.2					19.5						.066		
		Pichitr	42.9					55.2						.078		
		Tak	45.1					31.6						.084		
		Pitsanuloke	52.2					34.2						.083		
		Pra	51.1					37.3						.055		
		Utaradirt	44.9					31.4						.076		
North-East	19	Sakolnakhorn	32.6	40.02	14.35	15.2-61.2	39.5	32.6	40.02	14.35	15.2-61.2	39.5	99.76(+/-.16)	.043	0.24 (+/-0.08)	4.9(0.5-24.1)
		Burirum	37.3					37.3						.043		
		Roied	44.2					44.2						.035		
		Mahasarakham	35.6					35.6						.045		
		Nongkai	46.8					46.8						.086		
		Srisaket	22.7					22.7						.038		
		Surin	55.8					55.8						.040		
		Udornthani	39.5					39.5						.055		
		Karasin	41.2					41.2						.049		
		Mukdaharn	34.9					34.9						.050		
		Leui	60.6					60.6						.074		
		Nakhornrachasima	57.1					57.1						.067		
		Amnagecharern	15.2					15.2						.039		
		Nongbaulampu	61.2					61.2						.039		
		Nakhornpanom	30.7					30.7						.041		
		Khornkhan	46.0					46.0						.088		
		Ubolrachatani	26.4					26.4						.046		
		Yasothorn	15.4					15.4						.044		
		Chaiyapeum	57.1					57.1						.050		
South	14	Satul	18.7	24.91	14.14	6.4-60.7	25.5	4.9	10.04	10.31.	2.0-41.6	6.8	99.79(99.3-99.96)	.098	0.34 (0.19,2.19)	5.94±3.35
		Krabi	40.7					6.0						.126		
		Surathani	31.8					17.4						.139		
		Yala	9.7					2.2						.095		
		Chumporn	25.6					15.8						.113		
		Songkla	29.9					10.6						.128		
		Trang	26.0					7.6						.111		
		Nakornsrithamarach	23.8					8.5						.092		
		Narathivas	6.4					2.0						.076		
		Pangnga	27.0					12.2						.148		
		Patani	8.5					2.7						.068		
		Ranong	14.6					4.9						.109		
		Patalueng	25.3					4.1						.073		
		Phuket	60.7					41.6						.229		

ninety cubic centimeters must be aged not less than fifteen years of age. Furthermore, the driver who needs license permission must have the knowledge and ability to drive, knowledge of upstream traffic regulations of these Acts and understanding of relevant laws. For the qualified driver license an applicant must pass at least 3 tests, general exam for medical certification, eye examination and color blindness test, traffic law knowledge test, and practical driving test to ensure and qualify the valid licenses every 5 years. The Department of Land Transport, Thailand have begun the seat belt law and legislations after 1988 by enforcement of all vehicles must have 3 points system of seat belt for driver and front row passenger, and 2 points system for mid row passenger between driver and front row passenger. If vehicles haven't provided this standard, the fine was 1,000-50,000 baht and 500 baht for unrestrained seat belt.

Seat belt has been also considered as a defense line in prevention of RTC and death parallel with many road traffic safety campaigns. The recent study for Thailand 2012, reported overall of seat belt usage rate

occurred 71.6 % in Songkran festival, which seemed to be higher than in previous studies in Thailand. This rate might be confounded by strong road safety campaigns, mass media program which aimed to reduce short term fatality rate in the long weekend or season greeting festival by the government. In contrast, our study found seat belt rate 41.23 %±15.44 % in drivers and 29.30 %±15.61 % in passengers. We observed that the passenger used seat belt lower than driver usage which was consistent with most recent studies[1,29-32].

For the association of GPP (Gross provincial product) and rate of seat belt usage

Van Hoving, et al, [2012] showed the usage of seat belt was proportionally lower in lower-income areas of South Africa despite it already had law legislation[33]. Scuffham, et al, showed GDP was one of the significant factors in explaining the number of crashes.[34] The result of this present study showed that GPP has a trend of directly influencing the rate of seat-belt usage. One percent increase of GPP reflects to increase seat belt usage nearly 20 percent (19.5%: p-value=0.03, 95%CI 2.46-36.62). In summary, GPP or economic status was the one of the limiting factors which affected seat belt usage rates and limited their availability. The trend of GPP was similar to under the poverty line and rate of seat belt but more had a more dominant effect in economic scale.

Literacy and rate of seat belt usage

The literacy was shown to be important and significant as the second key to success. From present study shown for every one percent of improved literacy of population, it would increase seat belt usage about 4 percent (3.9 %, *p*-value<0.001, 95 % CI 1.86-6.03). Despite it represents a smaller effect of increasing rate of usage, it may be more important strategy in the long term. Forjuoh SN [2003], described the effect of low literacy precluding motorists to read and understand road signs, and peculiar political situations occasionally predominated by dictatorship and non-democratic governments[35]. Adogu PO et al, [2009] suggested improving the literacy levels by running side by side with road safety informational lessons delivered at their places of work or school[36]. Wermert AM et al, [2012] showed the significant increase of 15 percent in observed safety belt usage and evidence of increased knowledge regarding proper safety belt use by high schoolers, and improving their literacy and knowledge can be effective in changing the traffic safety behaviors[37]. Ng CP et al, [2013] showed the less educated population reflected to low rate of seat belt usage behaviors in both driver and passengers[38]. Truong et al, [2013] suggested the appropriately targeted education programs should continue to be developed, and physicians should be optimally poised to educate patients and parents about automobile safety[39].

Police density and rate of seat belt usage and Conviction rate and rate of seat belt usage

Numerous studies have evaluated the effect of seat belt law on the overall fatality[8-14,38]. The law legislation and enforcement can be described in many aspects. First is showing the importance of primary and secondary laws about seat belt usage. Second is the practical aspect to increase traffic police to apply the law or increasing their action by monitoring, and the punishment that can be monitored from conviction rate in our records. Despite, legislation is an effective strategy for reducing road-related fatalities and injuries, the result of our studies showed the third rank of important factors was conviction rate. One percent increase in conviction rate, brought an increase in seat belt usage rate of 0.64 % (*p*-value<0.01, 95 % CI 0.25-1.03). This is an indirect method to enforce of seat belt usage by government policy that will have the cumulative safety effect among the drivers and/or passengers. Debinski B et al, [2014] found that the public's opinion toward injury prevention legislation is promising, and the results can be used to communicate with the media and policy makers to reinforce the need for effective policy solutions to continue solving the injury problems.[40] Previous studied of Simniceanu A, et al, [2013] concluded that child safety seat legislation had an important impact on restraint use in Canada[41]. The law legislation and regulation was the most effective method, but usually less integrative and needed a period for improvement and strict law enforcement such as in Tehran. Iran showed that when they implemented new legislation, the seat belt rate was still low[42]. The United States showed the successful effect of law regulation and public services campaigns can increase awareness regarding appropriate usage of automobile restraint systems to decrease pediatric injury and fatality. This study was very interesting to show that literacy and awareness rather than cost have been found to be the main reasons for improper use of mobile restraint systems[39]. Shults RA et al, [2012] reported self-reported seat belt use among adults in the United States increased steadily between 2002 and 2010 with the national prevalence rate of usage reaching 87 percent in 2010. The study demonstrated 9 percent points higher

seat belt usage in the states with primary enforcement laws than the states with secondary enforcement laws (89 % vs. 80 %), and summarized that primary law seat belt enforcements enhanced seat belt usage rate and was a proven strategy to reduce traffic fatalities[8]. Law TH et al, [2013] demonstrated Thailand is one of thirty-one countries which have safety belt law implementation, and implied our country is in a middle group between demand of material needs and investment in road safety improvement. Moreover, this evidence also supports that more equitable distribution of income is associated with increased probability of safety belt usage. Improvement of education can increase public access to information, and hence can increase the awareness of road safety problems through increased democratically minded policymakers who are more receptive to the public demand. Furthermore, the educated population and decision makers are more able to learn and adopt effective road safety measures from other countries[43], Other techniques in the future such as seat belt reminders, are innovations which can be integrated into a vehicle to remind and improve the driver and passengers awareness and is promising for change of behavior in the long term[44].

Conclusion

The compliance of seat belt usage has been studied in four cities of Thailand [2000] (Bangkok, Chiang Mai, Phuket and Nakorn Ratchasima) and showed a lower rate of seat belt usage, 30.7 to 42.7 % averages, and showed a higher rate of non-compliance of 43.9 to 50.6 % especially in the cities due to a slow traffic[45]. In our study, we enrolled all 76 provinces nationwide in our survey. The result of our study showed the average rate of seat belt usage was as low as 38 %. The seat belt usage rate has a trend of increasing in urban more than rural area and the highest rate in the metropolitan's area such as Bangkok. The usages rates of passengers were lower than drivers despite law regulation can be enforced to both driver and front row passenger. The three most important factors were studied and demonstrated the statistically significant correlation among them with the rate of seat belt usage. A fact of GPP, is when the populations have appropriate income reflected by increased GPP, the population can spend some money from ordinary expense such as for their security. However, it is not always true because some studies reflected the high society population which is earning more GPP (high income) showed the reverse action to unrestraint their seat belt more than awareness of security for themselves. The literacy rate has shown to be an important key for long term application of seat belt usage by improving knowledge and awareness which can be started from the young in school class to change their safety attitudes, perception and awareness. The conviction rate reflects more dimensions. First is the action to monitor and second is punishment which has been shown to be more important than the density of police in our study, because density is only a number but does not represent their action. We can summarize that the trend of seat belt usage rates is slowly increasing in Thailand. However, higher rates have been reported in some greeting season or festival that related with more concern from the government as regular policy. These have invested in many campaigns via multimedia and television and action passed through other organizations and charity units. However, this rate is only a short term report.

Only one third of people use a seat belt when they drive or approximately 38 %. This helps us to realize that this is a proper time to change by integrating both passive strategies such as increasing our GPP and improving the poverty line of the population, law monitoring and enforcement to both front row of driver and passengers, and active strategies likewise to increase knowledge and empower awareness of security concepts from school age which might be a curriculum goal in the long term. The policies such as drunk driving, speed limits, driving tests and standards (GDL), road safety education for children, campaign awareness of distracted driving behaviors such as telephone/SMS use or social media interaction, TV watching, and injury perspective of stuffs inside the car which might cause accidents or add to injuries to occupants, issue of proper seat belt for obese or adult anthropomorphic test and all help to reduce the injury burden of road traffic accidents. Thailand should donate 10 percent of all advertising spaces in all media for public service announcements the same as practiced in the UK. We have emphasized that successful increase of seat belt usage is only the beginning step, but also needs follow up steps. These are how to reduce the miss-use rate, increasing effective and correct use of seat belt and concerning previous issues that we mentioned. Some of these interesting issues may need to become a policy or law legislation in future.

Limitation

This study was only conducted on adult drivers and passengers and did not include the children restraint equipment, booster seat, incorrect seat belt usage rate or other activity that is prone to cause an accident such

as phone/ text typing, surfing social media or looking at car media or TV during driving. The next future research is multifaceted perspective physical, neural and cognitive study of teenage drivers on acquisition of expertise, regulatory competence and self-regulation on perception in the context of perceived risk, and child restraint system equipment in Thailand.

What is already known on this topic?

There is not much data about seat belt usage available on the national level in Thailand. Most of the information is usually temporary, such as during the big festive season. In addition, the study of factors promoting use, in addition to the use of law enforcement is less. Most studies focus on the need for seat belts usage. For example, some general indications and some precautions used in obese, children, pregnancy and the rule of law to regulate or increase the rate of use.

What is study adds?

In this present study the author conducted cross-sectional survey the basic characteristics of the seat belts usage and use rate of drivers and passengers in Thailand. To study the relationship between seat belt use rate and gross provincial product (GPP), literacy levels, percent under the poverty line and police density. This present study also analyzes relationships between literacy levels and penalties (conviction rate).

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Potential conflicts of interest

The authors declare no conflict of interest.

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