IJCIMR
ISSN 2771-6309

International Journal of
Clinical Images and Medical Reviews

Research Article

Why is the difference so large in road death rates among countries?

Tianze Xu*, Yingying Cui

Henan University of Urban Construction, Pingdingshan, China.

Abstract.

There is big difference in road death rates among countries. To find the reason behind this, we compared 13 interventions adopted by UN member countries. The study found and confirmed that stricter law and its enforcement in thirteen aspects associate lower road death rate: BAC restriction, speed limits on urban roads, rural roads and motorways, helmet law, seat-belt law, child restraint law, vehicle standard, audits or star rating of new road infrastructure projects, inspections/star ratings of existing road infrastructure projects, design standards for the safety of pedestrians and cyclists, investments to upgrade high risk locations, policies & investment in urban public transport, policies promoting walking and cycling, emergency medicine and trauma surgery. If all countries have road death rate as low as Norway's 0.34, the total global road fatality will be 67,205---or 5% of the current fatality.

Key words: Traffic accident, death rate, injury, intervention, effective

Introduction

Traffic accidents have been with us since the first motor vehicle was made and put into use. So far traffic accidents have claimed several times more peoples' lives than the two world wars. Road traffic injury is the 8th leading cause of death for all age groups and the 1st leading cause of death for children and young adults aged 5-29 years. Endeavour to cut traffic accidents has been made by the United Nations and countries in the world in the last several decades. In the last 20 years, though the rate of death relative to the size of the world's population has stabilized and declined relative to the number of motor vehicles registered, the number of road traffic deaths remains unacceptably high and continues to increase by about 1% each year, reaching 1.35 million in 2016. Meanwhile, according to the World Health Organization's estimation, 20 to 50 million people are seriously injured in road crashes around the world every year (Global status report on road safety, 2018, 2020; Word Health Organization, 2013, 2015, 2017, 2018). All these indicate the reduction of death rate has not occurred at a pace fast enough to compensate for rapid population growth and increasing motorization globally (Global status report on road safety, 2020). However, we must realize that there is big difference in road death rates among countries from as high as 81.56 in Congo to as low as 0.34 in Norway in terms of per 10 thousand vehicles registered. If all countries have road death rate as low as Norway's 0.34, the total global road fatality will be 67,205---or 5% of the current fatality. Finding the difference between the interventions of countries with different road death rates makes all countries adopt the most effective interventions to cut down their road death rates.

Countries have been taking the following measures to cut down road death rate: low BAC limit, low speed limit, strict helmet law, strict seat-belt law, strict child restraint law, strict vehicle standard, investments to upgrade high risk locations, audits or star rating of new road infrastructure projects, strict inspections/star ratings of existing road infrastructure projects, strict design standards for the safety of pedestrians and cyclists, strict policies and investment in urban public transport, strict national or subnational policies promoting walking and cycling, more emergency medicine and trauma surgery, strict prohibition of using mobile phones while driving, strict drug-driving prohibition law, etc. Though the interventions most countries take are similar as listed above, there is big difference in road death rates among countries from as high as 81.56 in Congo to as low as 0.34 in Norway in terms of per 10 thousand vehicles registered. Why is there such big difference in road death rates?

Method

To find the reasons behind the big difference in road death rates among countries, we have to compare how the 15 interventions are executed in different countries. To do the comparison, we calculate road death rate per 10 thousand vehicles registered for each member country based on the total death number and total vehicles registered for each member country. We then order the road death rates in ascending order. We find there is large difference on road death rates among 162 countries which data are available, with the highest being 81.56 for Congo and the lowest being 0.34 for Norway (Fig. 1). The next step is to compare each of interventions among countries in the same order shown in Figure 3 so as to find both visually and statistically what difference there is on the intervention among the countries. After comparison of each intervention among different countries we can find the most effective way to execute each intervention.

Two comparisons are done for each of the aforementioned 15 interventions. One is graphical comparison by denseness and height of

*Corresponding Author: *Tianze Xu*, Henan University of Urban Construction, Pingdingshan, China.

Received: December 26, 2022 **Published:** January 18, 2023

Citation: *Tianze Xu .Why is the difference so large in road death rates among countries?. Int Clin Img and Med Rew. 2023; 4(1): 1138.

DOI: 10.55920/IJCIMR.2023.04.001138

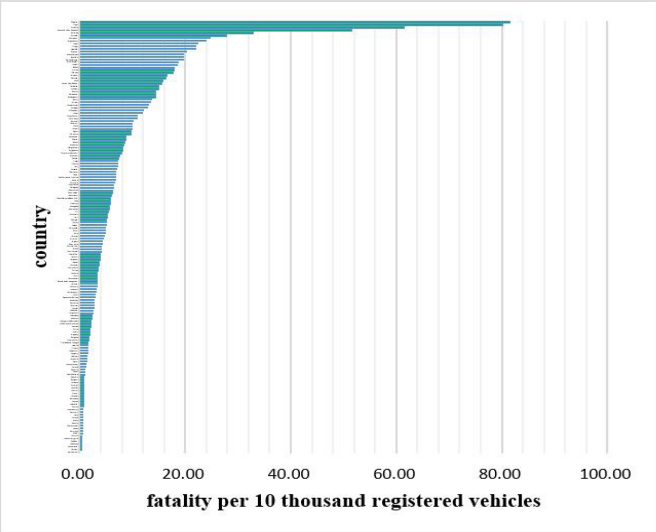

Figure 1: *Fatalities per 10 thousand registered vehicles. Data reported for total registered vehicles for 2016 and reported number of road traffic deaths are from the Global status report on road safety 2018.*

the bars and the other is comparison of the means through Brown-Forsythe Variance Analysis. The countries for which data on an intervention are available are broken into three groups based on road deaths per 10 thousand vehicles registered, with the bottom group being countries with death rates from 0.00 to 1.99, the middle group being countries with death rates from 2.00 to 5.99, and the top group being countries with death rates from 6.00 to 89.99. In each Figure in graphical comparison, the denseness and height of the bars corresponding to the compared intervention of the countries of each group are observed and analyzed. In all the 15 figures of the comparison, the ordinates are countries ordered in the same sequence as in Fig. 4 (ordered by road deaths per 10 thousand vehicles registered), with the abscissa being the intervention being compared. In Brown-Forsythe Variance Analysis of each intervention, the means of three groups are statistically compared. Without causing confusion, the means of the intervention are denoted as Ųlowest, Ųmiddle, and Ųhighest for the bottom, middle, and top group, respectively. The degree of freedom between treatments in this study is m= 2, intra group degree of freedom n is dependent on the sample size. Brown F is calculated and denoted as BF (m, n). The significance level for Brown F is 0.01. All the confidence intervals (CI) are at significance level 0.05. The result of the analysis for each intervention is explained. For the enforcement of an intervention in a country, a survey is done to evaluate the effectiveness of it. Respondents were asked to score the effectiveness of enforcement of the safety measure based on their professional opinion or perception. These responses are on a scale of 0 to 10, with 0 being "not effective" and 10 "highly effective". The median of these scores is used. Notably, these scores are subjective and should be seen only as an indication of how enforcement is perceived in the country.

Income level of countries

Gross national income(GN) per capita for the year 2016 came from World Bank estimates (Global status report on road safety, 2018, 2020). Where no data were available for 2016, published data for the latest year were used. The World Bank Atlas method was used to categorize GNl into bands thus, Low-income =US$ 1005 or less, Middle-income =US$ 1006 to US$ 12235, and High-income=US$ 12236 more. For Brown-Forsythe Variance Analysis(BFVA) of income, BF (2, 155.232) = 99.778, p= 0.000. The 95% CI are [1.66±0.54] for high death rate group(n=65), [2.10±0.36] low death rate group(n=50), and [2.85±0.42] low death rate group(n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle > Ųhighest, which means wealthier countries have lower road death rate.

BAC/BrAC restriction

National maximum legal BAC levels (g/dl) for general population of each country. A country presents a national drink-driving law with BAC (Blood Alcohol Concentration) limit for the general population not exceeding a threshold such as 0, 0.01, 0.02, 0.05, 0.08, 0.12, 0.15g/dl, etc. For Brown-Forsythe Variance Analysis (BFVA) of national maximum legal BAC levels, BF (2, 122.768) = 5.082, p= 0.008. The 95% CI are [0.06±0.03] for high death rate group (n=43), [0.05±0.02] middle death rate group(n=38), and [0.05±0.03] low death rate group (n=45), respectively. At significance level 0.05, it holds statistically that Ųlowest < Ųmiddle < Ųhighest, which means countries with stricter BAC limit have lower road death rate.

BAC restriction enforcement of each country. On a scale of 0 to 10, with 0 being "not effective" and 10 "highly effective". For Brown-Forsythe Variance Analysis(BFVA) of the enforcement of BAC restriction law, BF (2, 119.682) = 10.190, p= 0.000. The 95% CI are [4.74±2.25] for high death rate group (n=43), [5.45±2.13] middle death rate group(n=38), and [6.76±1.98] low death rate group (n=45), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter BAC enforcement have lower road death rate.

Managing speed

Fig. 4 shows the national speed limits on urban roads, rural roads and motorways of countries ordered in ascending order (from bottom to top in Fig. 2) by road deaths per 10 thousand vehicles registered. Each country relates a bar with height equal to the sum of speed limits on urban roads, rural roads and motorways of the country. As can be seen in Fig. 4, the bottom and middle parts of the bars are at the same high level and are less high than the top part, and the bottom part is the most dense, the middle part is less dense than the bottom part, while the top part is the least dense. This means countries with lower or the lowest road traffic deaths rates have stricter/lower speed limits, and countries with highest road traffic death rates have the least strict/highest speed limits. For Brown-Forsythe Variance Analysis(BFVA) of the national speed limits on urban roads, rural roads and motorways, BF (2, 123.574) = 4.526, p= 0.013. The 95% CI are [298.74±84.25] for high death rate group (n=57), [262.58±53.06] middle death rate group(n=45), and [276.48±42.06] low death rate group (n=46), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter speed limit have lower road death rate.

Enforcement of speed limits on urban roads, rural roads and motorways of each country. On a scale of 0 to 10, with 0 being "not effective" and 10 "highly effective". For Brown-Forsythe Variance Analysis(BFVA) of the enforcement of national speed limits, BF (2, 141.563) = 7.204, p= 0.001. The 95% CI are [4.91±2.09] for high death rate group (n=57), [5.31±2.08] middle death rate group(n=45), and [6.39±1.84] low death rate group (n=46), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest

> Ųhighest, which means countries with stricter speed limit enforcement have lower road death rate.

Helmet law

The data collected were based on the following seven variables: National motorcycle helmet law, applies to driver, applies to adult passengers, applies to all roads, applies to all engines, helmet fastening required, standard referred to and /or specified. Each variable is scored 1, or 0, respectively, if the data is "Yes", or "No". A score of 7 is assigned to a country where all seven variables are scored 1. A score of 6 is assigned to a country where six out seven variables are scored 1, etc. For Brown-Forsythe Variance Analysis(BFVA) of national helmet law, BF (2, 133.869) = 2.503, p= 0.086. The 95% CI are [5.68±1.24] for high death rate group (n=59), [5.87±0.82] middle death rate group(n=47), and [6.16±1.15] low death rate group (n=43), respectively. No statistical difference on the means is observed at significance level 0.05, which means countries with stricter helmet law have lower road death rate.

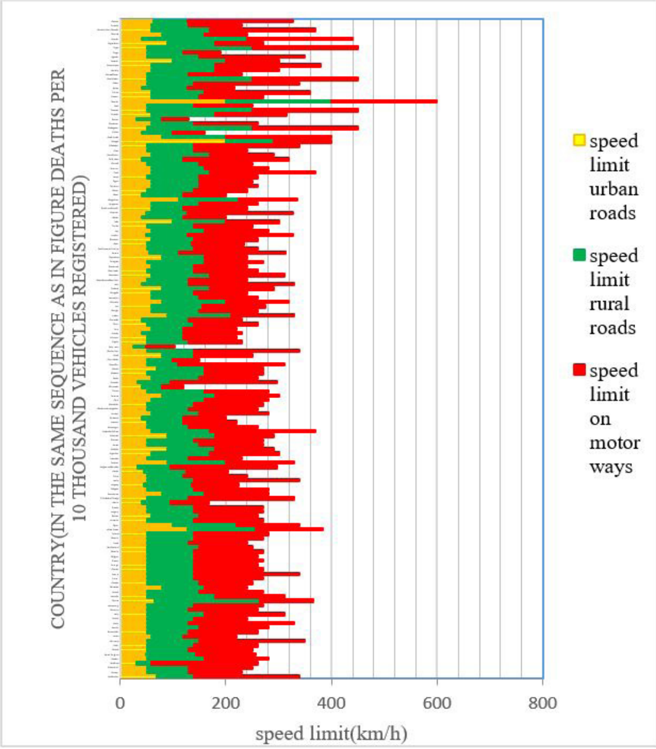

***Figure 2:** Speed limits on urban roads, rural roads and motorways of each country. Speed limits reported here are the default speed limits for private passenger cars. "Default speed limit" was interpreted as the maximum speed limit applying in normal circumstances (regardless of weather, roadworks, special events, etc.) on the road type considered.*

Helmet law enforcement of each country. On a scale of 0 to 10, with 0 being "not effective" and 10 "highly effective". For Brown-Forsythe Variance Analysis of national helmet law enforcement, BF (2, 137.214) = 19.616, p= 0.000. The 95% CI are [5.14±2.32] for high death rate group (n=59), [6.06±2.51] middle death rate group(n=47), and [7.93±1.84] low death rate group (n=43), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle > Ųhighest, which means countries with stricter helmet law enforcement have lower road death rate.

Seat-belt law

The data are collected based on the occupant seat belt applies to: drivers, front seat passengers, or rear-seat passengers. Data on seat-belt for each category of occupant is reported as "Yes" or "No", and is scored 1 or 0, respectively. "3" means seat-belt law applies to drivers, front seat passengers and rear-seat passengers. "2" means seat-belt law applies to two of them. "1" means seat-belt law only applies to one of them. For Brown-Forsythe Variance Analysis of seat-belt law, BF (2, 138.668) = 7.644, p= 0.001. The 95% CI are [2.45±0.53] for high death rate group (n=65), [2.60±0.61] middle death rate group(n=50), and [2.83±0.38] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter seat-belt law have lower road death rate.

Seat-belt law enforcement of each country. On a scale of 0 to 10, with 0 being "not effective" and 10 "highly effective". For Brown-Forsythe Variance Analysis of seat-belt law enforcement, BF (2, 150.935) = 12.832, p= 0.000. The 95% CI are [5.26±2.08] for high death rate group (n=65), [6.00±1.99] middle death rate group(n=50), and [7.04±1.41] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle > Ųhighest, which means countries with stricter seat-belt law enforcement have lower road death rate.

Child restraint

Child restraint of each country. A country is interpreted as having a child restraint law where the country requires the mandatory use of child restraint systems for an identified group of children based on either their height and/or their age and/or their weight. "1" means a country has child restraint while "0" means a country has no child restraint. (Fig. 3) For Brown-Forsythe Variance Analysis of national child restraint law, BF (2, 140.312) = 28.915, p= 0.000. The 95% CI are [0.25±0.43] for high death rate group (n=65), [0.50±0.51] middle death rate group (n=50), and [0.87±0.34] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle > Ųhighest, which means countries with stricter child restraint have lower road death rate.

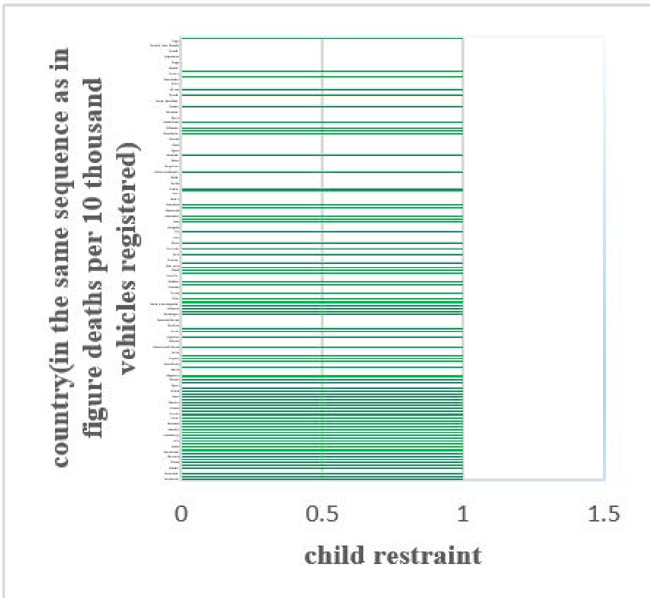

***Figure 3:** Child restraint of each country. A country is interpreted as having a child restraint law where the country requires the mandatory use of child restraint systems for an identified group of children based on either their height and/or their age and/or their weight. "1" means a country has child restraint while "0" means a country has no child restraint.*

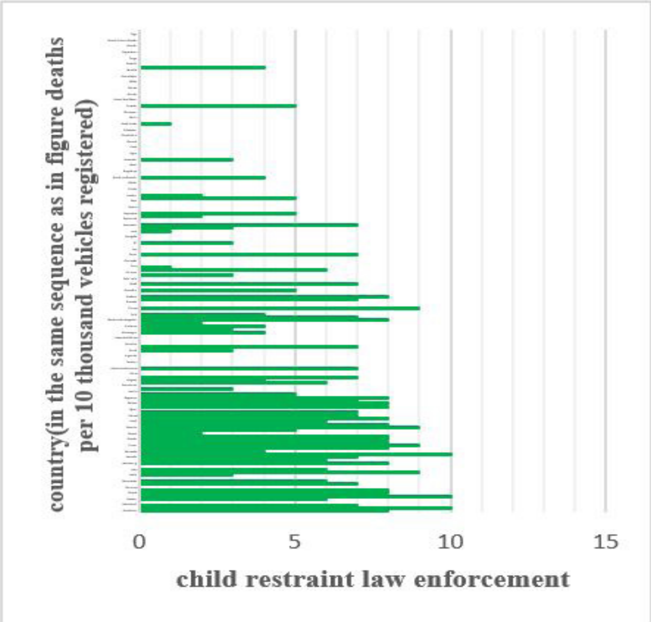

Figure 4: *Child restraint law enforcement of each country. On a scale of 0 to 10, with 0 being "not effective" and 10 "highly effective".*

Vehicle standard

Vehicle standard of each country. Data on vehicle standards were collected using information from the UN World Forum for Harmonization of Vehicle Regulations. Technical support on analyzing and interpreting this data was provided by Global NCAP 7 (Global status report on road safety, 2018). The data collected were based on the following eight variables: Frontal impact, Side impact, Electronic Stability Control, Pedestrian protection, Seat-belts, Seat-belt anchorages, Child restraints, Motorcycle antilock braking system. (Fig. 5). Each variable is scored 1, or 0, respectively, where the data is "Yes", or "No". A score of 8 is assigned to a country where all eight variables are scored 1. A score of 7 is assigned to a country where seven out eight variables are scored 1, etc. For Brown-Forsythe Variance Analysis of

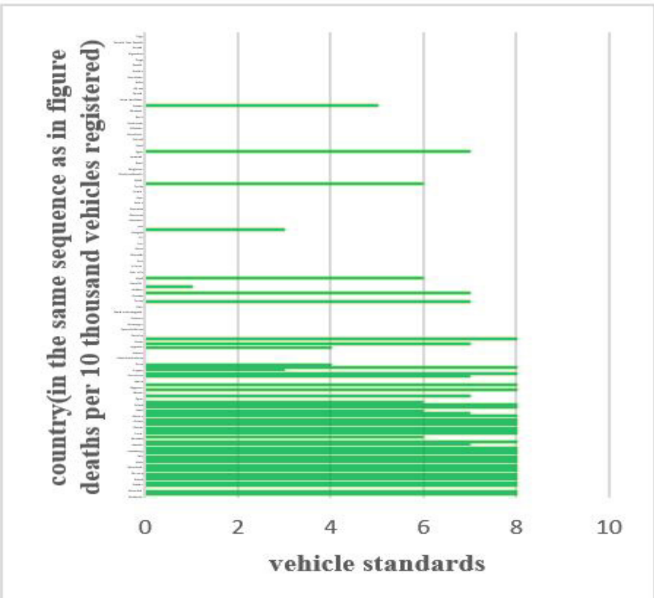

Figure 5: *Vehicle standard of each country. The data collected were based on the following eight variables: Frontal impact, Side impact, Electronic Stability Control, Pedestrian protection, Seat-belts, Seat-belt anchorages, Child restraints, Motorcycle antilock braking system. Each variable is scored 1, or 0, respectively, where the data is "Yes", or "No". A score of 8 is assigned to a country where all eight variables are scored 1. A score of 7 is assigned to a country where seven out eight variables are scored 1, etc.*

national vehicle standard, BF (2, 101.520) = 108.914, p= 0.000. The 95% CI are [0.28±1.28] for high death rate group (n=65), [0.86±2.19] middle death rate group(n=50), and [6.37±2.92] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter vehicle standards have lower road death rate.

Audits or star rating of new road infrastructure projects

Audits or star rating of new road infrastructure projects of each country. Information on audits or star rating of new road infrastructure projects is reported as "Yes", "No", or "Partial", and is scored 2, 0, or 1, respectively. For Brown-Forsythe Variance Analysis(BFVA) of audits or star rating of new road infrastructure projects, BF(2, 149.842) = 0.396, p= 0.674. The 95% CI are [1.38±0.72] for high death rate group (n=65), [1.29±0.76] middle death rate group (n=50), and [1.40±0.65] low death rate group (n=47), respectively. No statistical difference on the means is observed at significance level 0.05.

Inspections/star ratings of existing road infrastructure projects

Inspections/star ratings of existing road infrastructure projects of each country. Information on inspections/star ratings of existing road infrastructure projects is reported as "Yes" or "No", and is scored 2 or 0, respectively. For Brown-Forsythe Variance Analysis of inspections/star ratings of existing road infrastructure projects, BF(2, 129.216)= 7.476, p= 0.001. The 95% CI are [1.21±0.99] for high death rate group(n=65), [1.29±0.97] middle death rate group(n=50), and [1.83±0.57] low death rate group(n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter inspections/star ratings of existing road infrastructure projects have lower road death rate.

Design standards for the safety of pedestrians and cyclists

Design standards for the safety of pedestrians and cyclists of each country. Design standards for the safety of pedestrians and cyclists is reported as "Yes", "No", or "Partial", and is scored 2, 0, or 1, respectively. "Yes" responses included the provision of the following: Managing speed to safe system outcomes (e.g. 20 mph or 30 km/h); Safe crossings for pedestrians and cyclists; and Separation of pedestrians and cyclists from vehicular traffic. If 1-2 of the provisions were met, responses are reflected as "Partial". For Brown-Forsythe Variance Analysis of design standards for the safety of pedestrians and cyclists, BF (2, 145.773) = 14.018, p= 0.000. The 95% CI are [1.12±0.57] for high death rate group (n=65), [1.20±0.67] middle (n=50), and [1.70±0.55] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter design standards for the safety of pedestrians and cyclists have lower road death rate.

Investments to upgrade high risk locations of each country.

Investments to upgrade high risk locations of each country. Investments to upgrade high risk locations is reported as "Yes" or "No", and is scored 2 or 0, respectively. For Brown-Forsythe Variance Analysis(BFVA) of investments to upgrade high risk location, BF (2, 153.116) = 0.856, p= 0.427. The 95% CI are [1.26±0.97] for high death rate group (n=65), [1.31±0.96] middle death rate group (n=50), and [1.49±0.88] low death rate group (n=47), respectively. No statistical difference on the means is observed at significance level 0.05.

Policies & investment in urban public transport

Policies & investment in urban public transport. Policies & investment in urban public transport is reported as "Yes" or "No", and is scored 2 or 0, respectively. For Brown-Forsythe Variance Analysis of policies & investment in urban public transport, BF (2, 146.807) = 4.354, p= 0.015. The 95% CI are [1.35±0.94] for high death rate group (n=65), [1.36±0.94] middle death rate group(n=50), and [1.79±0.62] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle and Ųlowest > Ųhighest, which means countries with stricter policies & investment in urban public transport have lower road death rate.

Policies promoting walking and cycling of each country

Policies promoting walking and cycling of each country. Policies promoting walking and cycling is reported as "Yes", "No", or "Subnational", and is scored 2, 0, or 1, respectively. For Brown-Forsythe Variance Analysis of policies promoting walking & cycling, BF (2, 150.179) = 23.352, p= 0.000. The 95% CI are [0.60±0.83] for high death rate group (n=65), [0.96±0.88] middle death rate group(n=50), and [1.66±0.70] low death rate group (n=47), respectively. At significance level 0.05, it holds statistically that Ųlowest > Ųmiddle > Ųhighest, which means countries with stricter policies promoting walking and cycling have lower road death rate.

Emergency medicine and trauma surgery

Emergency medicine and trauma surgery of each country. Emergency medicine and trauma surgery is reported as "Yes", or "No", and is scored 1, or 0, respectively. "2" means a country has both of them, "1" means a country has either of them, "0" means a country has none of them. For Brown-Forsythe Variance Analysis of emergency medicine and trauma surgery, BF (2, 152.510) = 4.106, p= 0.018. The 95% CI are [1.14±0.87] for high death rate group (n=64), [1.53±0.72] middle death rate group (n=48), and [1.48±0.78] low death rate group (n=46), respectively. At significance level 0.05, it holds statistically that Ųmiddle > Ųhighest and Ųlowest > Ųhighest, which means countries with stricter emergency medicine and trauma surgery have lower road death rate.

Conclusions

This study has found that stricter interventions associate safer road traffic. Countries with lowest road death rate have the strictest interventions against traffic accident. To realize the UN's targets of cutting down road traffic deaths & injuries by at least 50% globally by 2030, safety must be taken into consideration during the planning, design and operation of roads to reduce road traffic deaths and injuries. If all countries have road death rate as low as Norway's 0.34, the total global road fatality will be 67,205---or 5% of the current fatality. It is advisable that countries with middle and high road death rates take stricter interventions in the following aspects to further cut down road death rates: low BAC limit, low speed limit, strict helmet law, strict seat-belt law, strict child restraint law, strict vehicle standard, investments to upgrade high risk locations, audits or star rating of new road infrastructure projects, strict inspections/star ratings of existing road infrastructure projects, strict design standards for the safety of pedestrians and cyclists, strict policies and investment in urban public transport, strict national or subnational policies promoting walking and cycling, more emergency medicine and trauma surgery, strict prohibition of using mobile phones while driving, strict drug-driving prohibition law, etc.

Declarations

Ethics approval and consent to participate: Not applicable.

Consent for publication: Not Applicable.

Availability of data and materials: The data used in this study are provided by WHO
https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/.

Competing interests: The author declares no competing interests.

Funding: No funding.

Acknowledgements: The content is solely the responsibility of the authors and does not necessarily represent the official views of the WHO.

References

1. Global status report on road safety 2018, https://www.who.int/violence_injury_prevention/road_safety_status/2018/en/ (2019-10-29).
2. Global status report on road safety - World Health Organization, https://apps.who.int/iris/bitstream/handle/10665/44122/9789241563840_eng.pdf?sequence=1 (2020-1-22).
3. Word Health Organization. Projections of mortality and causes of death, 2015 and 2030[internet World Health Organization; 2013[cited 2018 Oct 29]. Available from: http:/www.who.int/healthinfo/global_burden_disease/projections 2015_2030/en/
4. World Health Organization. Save LIVES: a road safety technical package[Internet]. 2017[cited 2018 Nov 1]. Available from: http:///iris.paho.org/xmlui/bitstream/handle/123456789/34980/9789275320013-por.pdf?sequence=1&isAllowed=y
5. World Health Organization. Global status report on road safety 2015[Internet]. 2015[cited 2018 Nov 1]. Available from: http://www.who.int/violence_injury_prevention/road_safety_status/2015/en/
6. World Health Organization. Global Health Estimates[Internet]. World Health Organization; 2018 [cited 2018 Oct 29]. Available from: http//www.who.int/healthinfo/global_burden_disease/en/