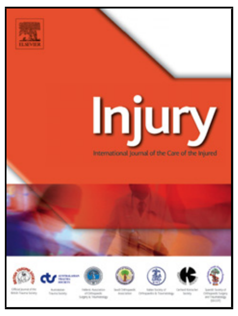

Title: Population incidence of pedestrian traffic injury in high-income countries: A systematic review

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Population incidence of pedestrian traffic injury in high-income countries: A systematic review

Population incidence of pedestrian traffic injury in high-income countries: A systematic review

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Abstract:

Background:

Road traffic injuries are the fifth leading cause of years of life lost, with pedestrians comprising 39% of all road deaths. International recognition of this public health issue has led to a reduction in road traffic deaths in many high-income countries. However data on non-motorised road users such as pedestrians is incomplete.

Additionally, non-fatal injuries are poorly documented. The aim of this study was to identify the incidence of pedestrian traffic injury reported from high-income countries.

Methods:

A systematic review of the literature was conducted using MEDLINE, Scopus, PubMed and the Cochrane library. Studies were eligible for inclusion if they reported the incidence of pedestrian injury in a defined population from a high-income country defined using the World Bank atlas method for the 2016 fiscal year. A meta-analysis was performed on the population incidence of pedestrian traffic injury by world region.

Results:

Seventeen studies were identified from eight high-income countries that satisfied the inclusion criteria. The pooled incidence of PTI in the European region was 68.8 per 100,000 population (95%CI 50-87.7, $p<0.01$) and 89.3 per 100,000 (95%CI 47.2-131.4, $p<0.01$) in the American region. The incidence of pedestrian traffic injury varied from 20 per 100,000 in Victoria, Australia to 203 per 100,000 in New York City, United States of America. Pedestrian mortality ranged from 0.9 to 14 per 100,000 population. Wide variation in population size, location and demographics was observed between studies.

Conclusions:

This review concluded a high burden of pedestrian trauma in HICs with individual reports reporting from rates of 20 to 203 per 100,000 population. Recommended interventions directed at reducing the burden of pedestrian trauma were not universally present in the reported high-income countries. Implementation of such safety strategies and demonstration of improvement in pedestrian trauma rates and outcomes present directions for further research.

Key words:

Injury prevention; Road traffic injury; Incidence; Pedestrian

INTRODUCTION

Road traffic injuries (RTIs) are the fifth leading cause of years of life lost globally, associated with an estimated 1.4 million deaths in 2013[1]. International recognition of this public health issue has led to a reduction in road traffic deaths in many high-income countries (HICs)[2]. However data on non-motorised road users such as pedestrians is incomplete[2 3]. Additionally, non-fatal injuries are poorly documented[2].

Pedestrians comprise 39% of global road traffic fatalities and have been identified as a priority area for road safety interventions[1,4]. Identification of global trends in the incidence of pedestrian traffic injury (PTI) may highlight areas of prioritisation. Benchmarking countries could drive further improvements and attract funding for injury surveillance systems. Such systems could inform preventive measures to reduce the burden of trauma.

The aim of this study was to describe the population incidence of PTI reported from HICs. Secondary outcomes were reported mortality rates of PTI in these populations.

METHODS

Search strategy: A systematic review of the literature was performed. Data sources and dates included MEDLINE, Scopus, PubMed, and the Cochrane library on the 27th of January 2016 using the search strategy in Appendix 1. The search was not restricted by year of publication. The World Health Organization (WHO) database was also hand searched for relevant literature. In addition, the reference lists of included studies were manually searched and a citation analysis performed using Scopus, to identify any additional relevant literature.

Inclusion and exclusion criteria:

Studies were eligible for inclusion if they reported the incidence of PTI in a defined population over a specified timeframe in HICs. High-income countries were defined using the World Bank atlas method for the 2016 fiscal year[5]. Studies from low and middle-income countries were excluded, as were studies where the data source was not reported, or where the study was restricted to a subset of the population (e.g. a specific age group or injury severity). Studies were also excluded if they reported a population capture rate of less than 90% or if they utilised an inadequate data source to accurately capture a population estimate, such as data from a single hospital in a population with multiple hospitals or data extracted solely from police reports which can underestimate pedestrian injury by more than 50% compared to hospital records[6,7]. Where multiple studies reported outcomes from the same population dataset, only one study was included to avoid duplication.

Study selection:

Two reviewers (KC and BM) independently assessed the titles and abstracts of retrieved studies for eligibility. Full-text studies were reviewed if insufficient information was provided in the abstract to determine eligibility. Disagreements were resolved by consensus.

Data extraction and analysis:

Population size, population location, time-frame of study, incidence of PTI and incidence of pedestrian fatalities were extracted. Where included, the incidence of RTI and RTF was also extracted. Predefined inclusion and exclusion criteria, data collector training, number of reviewers and blinding were coded as positive if mentioned in the methodology of the manuscripts. If not stated, these variables were coded in the negative. Among included countries, data on key initiatives directed towards safer road users were extracted from the WHO Global Status Report on Road Safety 2015[4]. Enforcement of road safety legislation was assessed by WHO on a scale of 0 to 10, where 0 was “not effective” and 10 “highly effective” [4]. This was measured by the professional opinion of individual WHO National Data Coordinators and WHO road safety experts and the median score presented[4]. A meta-analysis was performed on the primary outcome variable, pedestrian traffic injury per 100,000 population, by world region. World regions were defined by the WHO member states. Heterogeneity between studies was assessed using the I2 statistic. In the case of significant heterogeneity, a random effects model was used to derive the pooled population incidence with 95% confidence intervals. Statistical analyses were conducted using Stata v 14.0 (Statacorp, TX).

RESULTS:

There were 198 manuscripts that fulfilled the eligibility criteria for full-text assessment (Figure 1). A further 67 manuscripts were excluded as they did not meet the eligibility criteria, with 63 not defining any of the primary outcome measures and four studies not defining the primary outcome variable. In addition, 85 studies were excluded due to using an inadequate data source, 14 were excluded due to restrictions in population inclusion criteria, six studies were excluded due to reporting on a duplicate population and nine were excluded as they reported data from LMICs. There were 17 studies included in this review.

DISCUSSION:

Among HICs, the incidence of PTI varied from 20 per 100,000 in Victoria, Australia to 203 per 100,000 in New York City, United States of America (USA). Population incidence of PTI was observed to vary widely between populations, which is consistent with previous literature[11]. Variation between studies in population size, location and characteristics presents a challenge for interpreting the incidence of PTI.

Variation observed between studies in the population incidence of PTI could be partially explained by key measures of pedestrian safety including pedestrian exposure to traffic, speed limits, vehicle design, enforcement of road safety behaviour and post-crash care. National activities that guide road safety plans are based on the five defined pillars of road safety management; safer roads and mobility, safer vehicles, safer road users and improved post-crash response[4]. Not only is the establishment of pedestrian safety policy integral to reducing the incidence of PTI, but also ensuring these policies are adequately funded and enforced[11]. In Victoria, Australia, where the lowest incidence of PTI was reported, pedestrian safety polices are present in all the above categories, with strong enforcement by police and a demerit licensing system[4]. In Arkhangelsk, Russia and Odense, Denmark, where the incidence of PTI was high, few national policies exist regarding pedestrian safety and those that do are enforced to a lesser degree[4]. Post-crash care is of a high standard amongst the included HICs, with high levels of access to pre-hospital care for severely injured patients, emergency medicine training for doctors and access to a national emergency phone number[4].

Although the wide variation in incidence observed between studies can be explained by key measures of pedestrian safety, data quality and capture rates may also have contributed[12-14]. Police reports, which were commonly used as a data source in earlier studies, can underestimate RTI by more than 50% when compared to hospital records[13]. This is particularly so for non-motorised road users[15,16]. Data sourced from trauma registries, however, was prospectively collected using data from multiple sources and therefore may provide a more accurate estimate of PTI.

As it is well established that pedestrians are more likely to be severely injured and die because of their injuries than vehicle occupants, it is important that their safety is a high priority target for road safety intervention[17-22]. This review indicated that pedestrians comprise a high proportion of overall road traffic fatalities in HICs. This is consistent with current literature, with some studies reporting that pedestrians admitted to hospital are twice as likely to die of their injuries than vehicle occupants[22]. It is thought that this is as pedestrians are not protected by safety equipment and are more likely to be over 65 years of age, sustain head injuries and sustain multiple injuries than other road users[22].

It has been recognised that policies to encourage walking need additional criteria to ensure the safety of these road users. Measures to separate walkers and cyclists from other road users in conjunction with speed management interventions are particularly important if such policies are to be successful. While many countries are attempting to encourage walking as viable alternatives to motorized transport, the lack of infrastructure policies in place to ensure that walking is safe could potentially increase risks for road traffic injuries. In addition to developing road safety laws directed at the safety of pedestrians, enforcement of such laws are essential. This study demonstrates a high degree of variance in the presence and enforcement of such strategies among HICs. Historically, road safety initiatives particularly policy and enforcement have focused on motorised road users – leading to a paucity of regulation addressing vulnerable road users such as pedestrians. The 2015 World Health Organisation Global Status Report on Road Safety has highlighted the need to focus on policies to protect vulnerable road users, which now compose almost half of global road traffic deaths[4]. As more HICs start to adopt “Vision Zero” as a road safety target, new programs have emerged specifically to address non-motorised road users such as the “New York State Pedestrian Safety Action Plan 2016-2021”[23].

Demonstration of improvements from such initiatives may be associated with improvement in PTI and fatalities.

This study is limited by selection bias due to a paucity of research reporting on non-fatal pedestrian injury patterns. Areas that have established injury surveillance systems are more likely to report pedestrian injury trends than countries that do not. Studies from France, the USA and Australia were over-represented in our review as initiatives such as the Rhone County Road Trauma Registry, the Healthcare Cost and Utilization Project–National Inpatient Sample and the Fatal Accident Reporting System and the Victorian Emergency Minimum Dataset respectively have enabled collation of high quality data on RTIs[17,24-31]. As reports were from varied time periods, the effect of interventions were not possible to demonstrate from this analysis.

Further research is required to expand our knowledge on global trends in population incidence of PTI. By 2030 the number of RTFs are expected to increase to 2.1 million per annum, becoming the fourth largest burden of disease worldwide[32]. Injury surveillance allows us to identify high-risk areas, implement effective safety programs and infrastructure and evaluate these interventions to ensure a reduction in PTI[33].

CONCLUSION:

This review concluded a high burden of pedestrian trauma in HICs with individual studies reporting rates of 20 to 203 per 100,000 population. Comprehensive analysis of PTI surveillance data should occur at a country, state and city level at regular intervals to accurately establish high-risk groups in real-time for road safety intervention**.** Recommended interventions directed at reducing the burden of pedestrian trauma were not universally present in the reported HICs. Implementation of such safety strategies and demonstration of improvement in pedestrian trauma rates and outcomes present directions for further research.

CONFLICT OF INTEREST STATEMENT:

There are no conflicts of interest to declare.

References:

1. Global Burden of Disease Mortality and Causes of Death Collaborators. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet 2015.385(9963):117-71.
2. World Health Organization. Making walking safe: a brief overview of pedestrian safety around the world. World Health Organization Library 2013.1-8.
3. Peden MS, R. Sleet, D. Mohan, D. Hyder, A. Jarawen, E. Mathers, C. World report on road traffic injury prevention. World Health Organization 2004.
4. World Health Organization. Global status report on road safety 2015: supporting a decade of action. World Health Organization Library 2015.1-340.
5. The World Bank. Country and lending groups. Washington, USA.: The World Bank; 2015 [cited 2015 20th March]; Available from: http://data.worldbank.org/about/country-and-lending-groups
6. Keall MD. Pedestrian exposure to risk of road accident in New Zealand. Accident Analysis & Prevention 1995.27(5):729-40.
7. Rosman DL. The Western Australian Road Injury Database (1987-1996):: Ten years of linked police, hospital and death records of road crashes and injuries. Accident Analysis and Prevention 2001.33(1):81-8.
8. Moher D LA, Tetzlaff J, Altman DG, The PRISMA Group,. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. British Medical Journal 2009.339(b2535).
9. Kudryavtsev AV, Nilssen O, Lund J, Grjibovski AM, Ytterstad B. Explaining reduction of pedestrian-motor vehicle crashes in Arkhangelsk, Russia, in 2005-2010. International Journal of Circumpolar Health 2012.71:19107.
10. DiMaggio C. Small-area spatiotemporal analysis of pedestrian and bicyclist injuries in New York City. Epidemiology 2015.26(2):247-54.
11. World Health Organization. Pedestrian safety: a road safety manual for decision-makers and practitioners. World Health Organization Library 2013.1-111.
12. Abegaz T, Berhane Y, Worku A, Assrat A, Assefa A. Road traffic deaths and injuries are under-reported in Ethiopia: A capture-recapture method. PLoS ONE 2014.9(7).
13. Bhatti JA, Razzak JA, Lagarde E, Salmi LR. Differences in police, ambulance, and emergency department reporting of traffic injuries on Karachi-Hala road, Pakistan. BMC Research Notes 2011.4.
14. Schurrman NC, J. Matzopoulos, R. Fawcett, V. Nicol, A. Hameed, M. Collecting injury surveillance data in low- and middle-income countries: The Cape Town Trauma Registry pilot. Global Public Health 2010.6(8):874-89.
15. Amoros E, Martin JL, Laumon B. Under-reporting of road crash casualties in France. Accident Analysis and Prevention 2006.38(4):627-35.
16. Lujic S, Finch C, Boufous S, Hayen A, Dunsmuir W. How comparable are road traffic crash cases in hospital admissions data and police records? An examination of data linkage rates. Australian & New Zealand Journal of Public Health 2008.32(1):28-33.
17. Amoros E, Martin JL, Lafont S, Laumon B. Actual incidences of road casualties, and their injury severity, modelled from police and hospital data, France. European Journal of Public Health 2008.18(4):360-5.
18. Eid HO, Barss P, Adam SH, Torab FC, Lunsjo K, Grivna M, et al. Factors affecting anatomical region of injury, severity, and mortality for road trauma in a high-income developing country: lessons for prevention. Injury 2009.40(7):703-7.
19. Híjar M, Arredondo A, Carrillo C, Solórzano L. Road traffic injuries in an urban area in Mexico: An epidemiological and cost analysis. Accident Analysis and Prevention 2004.36(1):37-42.

20. Odero W, Khayesi M, Heda PM. Road traffic injuries in Kenya: magnitude, causes and status of intervention. Injury Control & Safety Promotion 2003.10(1-2):53-61.
21. Goniewicz M, Nogalski A, Khayesi M, Lubek T, Zuchora B, Goniewicz K, et al. Pattern of road traffic injuries in Lublin County, Poland. Central European Journal of Public Health 2012.20(2):116-20.
22. Markogiannakis H, Sanidas E, Messaris E, Koutentakis D, Alpantaki K, Kafetzakis A, et al. Motor vehicle trauma: analysis of injury profiles by road-user category. Emerg Med J 2006.23(1):27-31.
23. Viola RR, M. Shin, H. New York City Pedestrian Safety Study & Action Plan. New York City Department of Transportation; 2010.
24. Ballesteros MF, Dischinger PC, Langenberg P. Pedestrian injuries and vehicle type in Maryland, 1995-1999. Accident Analysis & Prevention 2004.36(1):73-81.
25. Barancik JI, Chatterjee BF, Greene-Cradden YC, Michenzi EM, Kramer CF, Thode HC, Jr., et al. Motor vehicle trauma in northeastern Ohio. I: Incidence and outcome by age, sex, and road-use category. American Journal of Epidemiology 1986.123(5):846-61.
26. Blaizot S, Papon F, Haddak MM, Amoros E. Injury incidence rates of cyclists compared to pedestrians, car occupants and powered two-wheeler riders, using a medical registry and mobility data, Rhone County, France. Accident Analysis & Prevention 2013.58:35-45.
27. McAndrews C, Beyer K, Guse CE, Layde P. Revisiting exposure: fatal and non-fatal traffic injury risk across different populations of travelers in Wisconsin, 2001-2009. Accident Analysis & Prevention 2013.60:103-12.
28. Miller TR, Zaloshnja E, Lawrence BA, Crandall J, Ivarsson J, Finkelstein AE. Pedestrian and pedalcyclist injury costs in the United States by age and injury severity. Annual Proceedings/Association for the Advancement of Automotive Medicine 2004.48:265-84.
29. Naumann RB, Dellinger AM, Zaloshnja E, Lawrence BA, Miller TR. Incidence and total lifetime costs of motor vehicle-related fatal and nonfatal injury by road user type, United States, 2005. Traffic Injury Prevention 2010.11(4):353-60.
30. Sciortino S, Vassar M, Radetsky M, Knudson MM. San Francisco pedestrian injury surveillance: mapping, under-reporting, and injury severity in police and hospital records. Accid Anal Prev 2005.37(6):1102-13.
31. Senserrick T, Boufous S, de Rome L, Ivers R, Stevenson M. Detailed Analysis of Pedestrian Casualty Collisions in Victoria, Australia. Traffic Injury Prevention 2014.15:S197-S205.
32. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Medicine 2006.3(11):2011-30.
33. Zehtabchi SN, DK. McKay, MP. ClayMann N. Trauma registries: history, logistics, limitations and contributions to emergency medicine research. Acad Emerg Med 2011.18:637-43.

Appendix 1: Literature Review Search Strategy

The following search strategy was conducted on Ovid Medline from inception to 27th January 2016. This strategy was then adapted to Scopus, PubMed and the Cochrane library.

exp incidence/ (181395)
demography/ (52931)
Epidemiology/ (11595)
incidenc*.tw. (499731)
trend*.tw. (230471)
rate*.tw. (1801857)
pattern*.tw. (849941)
1 or 2 or 3 or 4 or 5 or 6 or 7 (3136423)
exp walking/ (20738)
walk*.tw. (66452)
pedestrian*.tw. (2912)
vulnerable road user*.tw. (81)
9 or 10 or 11 or 12 (73365)
exp accidents, traffic/ (35279)
exp motor vehicle/ (15513)
road*.tw. (25989)
motor vehicle*.tw. (9850)
vehic*.tw. (87493)
traffic*.tw. (63339)
15 or 16 or 17 or 18 or 19 (174243)
injur*.tw. (507507)
exp wounds/ and injuries/ (63319)
death*.tw. (523255)
exp accident/ (143552)
exp musculoskeletal systems/in (87421)
accident*.tw. (80241)
fatal*.tw. (99376)
crash*.tw. (8538)
collision*.tw. (14436)
21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 (1292205)
20 and 30 (42047)
14 or 31 (62721)
8 and 13 and 32 (1197)
exp animals/ not humans.sh. (4176967)
33 not 34 (1187)

Figure 1: Study selection process[8].

The majority of studies reported from populations in the USA (n=8), Sweden (n=2) and France (n=2) (Table 1). Data sources from earlier years were most commonly police reports with 14 of the 17 selected studies extracting data from this source and hospital presentations. Registry based data was reported as early as 1996 with increasing use over the past decade.

Figure 2: Population incidence of PTI in high-income countries by region.

The incidence of PTI and PTF are listed in table 3 and the rates of PTI illustrated in Figure 2. The incidence of PTI ranged from 20 per 100,000 population in Victoria, Australia to 203 per 100,000 population in New York City, USA. Incidence of PTI was observed to vary widely both between and within countries. In the studies included from the USA, the population incidence of PTI in the USA ranged from 22 per 100,000 in Wisconsin to 203 per 100,000 in New York City. Even within the same population, incidence point estimates of PTI varied. In Rhone County, France, the population incidence of PTI decreased from 69 per 100,000 between 1996 and 2004, to 47 per 100,000 in 2005 and 2006. The incidence of PTF ranged from 0.9 per 100,000 population in Wisconsin, USA and Rhone County, France (2013) to 14 per 100,000 in Odense, Denmark. Two studies, Rockett *et al.* (1990) and Larson *et al.* (1995), reported very high incidences of PTF of 10 and 14 per 100,000 respectively. Potential factors contributing to this high incidence of mortality could include reporting on a smaller population sample and reporting on data from the mid-1980s prior to the introduction of many road safety educational campaigns and interventions[3]. Eleven included studies also reported the incidence of RTIs and nine reported the incidence of road traffic fatalities (RTFs). In these populations, pedestrians composed a high percentage of overall RTFs (Table 3).

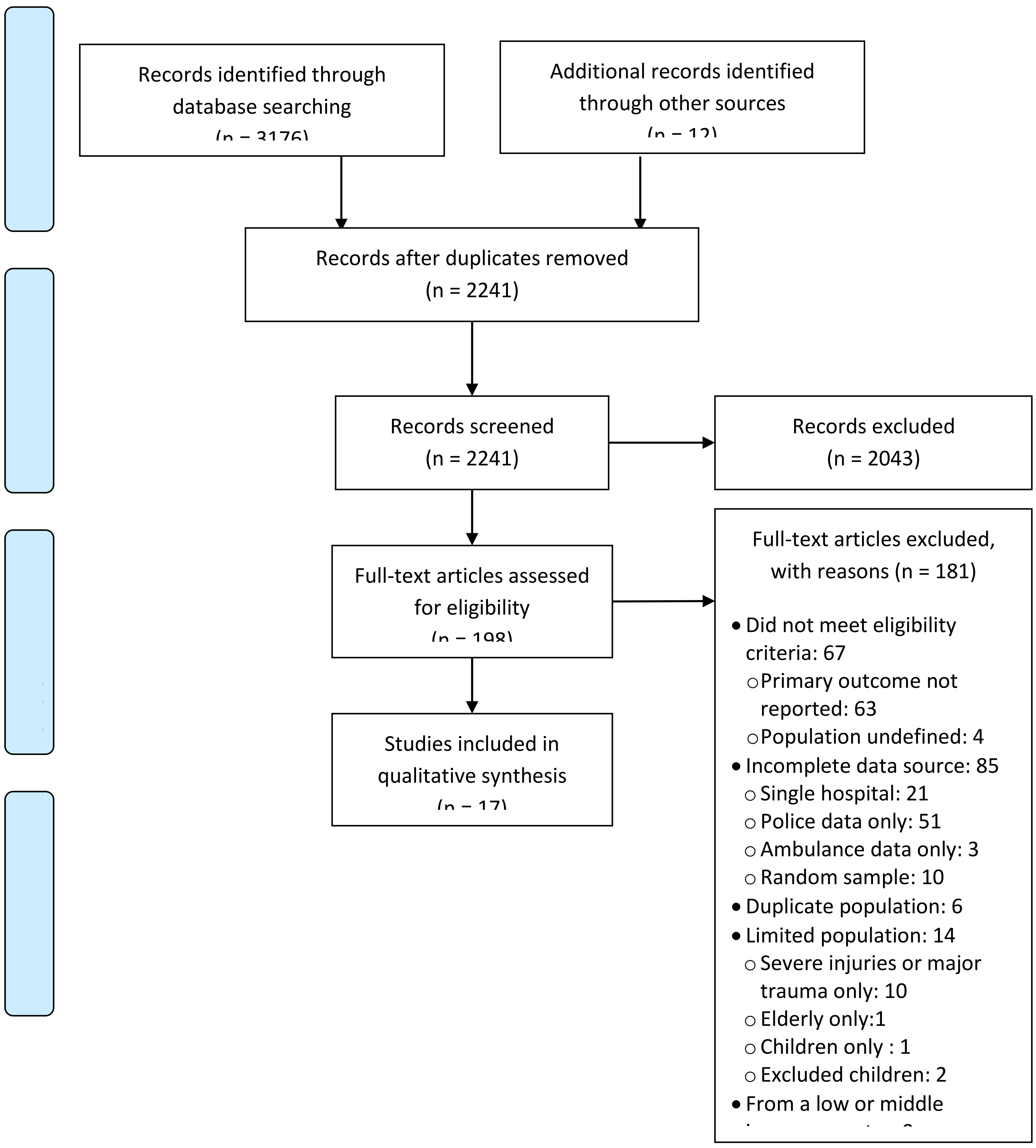

Figure 1: Study selection process[7].

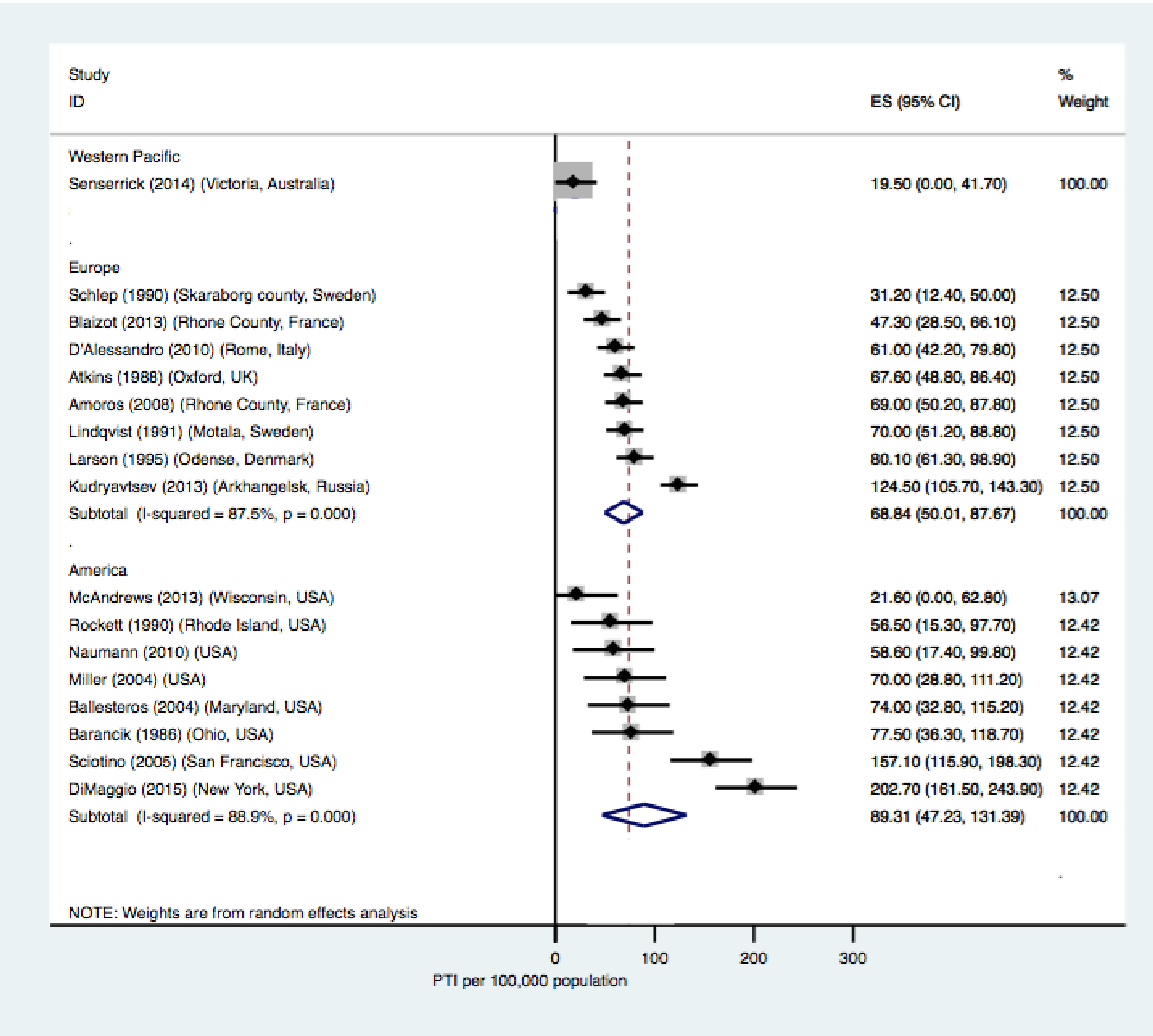

Figure 2: Population incidence of PTI in high-income countries by region (ES = Effect size, CI = Confidence intervals, USA = United States of America, PTI = Pedestrian traffic injury).

Table 1: Characteristics of included studies.

Fifteen of the 17 included studies used a retrospective cohort study design and the remaining two studies reported using a prospective cohort design (Table 2). Predefined inclusion and exclusion criteria were used in all included studies. Specific training of data collectors was reported in only five included studies and use of multiple data extractors was reported in eight of the included studies. Blinding of data collectors to study outcomes was utilised in two studies.

Table 2: Study quality.

Eight studies were identified from six countries in the European region and eight from one country in the American region for inclusion in a meta-analysis. Only one study was identified from the Western Pacific region. No studies were identified from the African, South-East Asian or Eastern Mediterranean region. The pooled incidence of PTI in the European region was 68.8 per 100,000 population (95%CI 50-87.7, $p<0.01$) and 89.3 per 100,000 (95%CI 47.2-131.4, $p<0.01$) in the American region. Significant heterogeneity between studies was noted.

Table 3: Study results.

Country profiles for road traffic injury prevention initiatives are presented in Table 4. Number of vehicles per head population was lowest in Russia at 0.35, but one of the highest incidences of PTI was reported from a centre in Russia. The study authors suggested that this could be due to a higher proportion of pedestrians than in other populations with 52% of all road traffic injuries in the study being of a pedestrian[9]. Similarly in New York City, where the highest incidence of PTI was reported, a high volume of pedestrian activity was noted[10]. A National road safety strategy was present in all countries, but not universally funded, while key policies designed to protect pedestrians and separate pedestrians from traffic were variably present and enforced.

Table 4: Key measures for pedestrian injury prevention according to country.

Table 1: Characteristics of included studies (USA = United States of America, NR = Not reported).

Author (Year)	Population location	Data source	Time period	% Male
Barancik (1986)[8]	Cleveland and Lorain-Elyria, Ohio, USA.	Police reports and emergency department presentations.	01/01/1977 to 31/12/1977.	61.3%
Atkins (1988)[9]	Oxford, England.	Police reports, pre-hospital services, and hospital presentations.	01/01/1983 to 31/12/1984.	59.8%
Lindqvist (1991)[10]	Motala, Sweden.	Emergency department presentations, hospital admissions and outpatient clinics.	15/09/1983 to 30/09/1984.	48.4%
Schlep (1990)[11]	Skaraborg county, Sweden.	Emergency department presentations, hospital admissions, outpatient clinics and national death registration.	01/01/1984 to 31/12/1984	50.5%
Rockett (1990)[12]	Rhode Island, USA.	Emergency department presentations, hospital admissions and national death registration.	01/01/1984 to 31/12/1985.	54.8%
Larson (1995)[13]	Odense, Denmark.	Police reports and hospital presentations.	01/01/1980 to 31/12/1992.	NR
Ballesteros (2004)[14]	Maryland, USA.	Police reports, presented to a trauma centre and national death registration.	01/01/1995 to 31/12/1999.	64.9%
Miller (2004)[15]	Sample populations in the USA.	Police reports, emergency department presentations, hospital admissions and national death registration.	01/01/2000 to 31/12/2000.	NR
Sciortino (2005)[16]	San Francisco, USA.	Police reports, emergency department presentations, trauma centre admission and national death registration.	01/01/2000 to 31/12/2001.	56.2%
Amoros (2008)[17]	Rhone county, France.	Police reports, Rhone county road trauma registry (includes data from pre-hospital services, emergency departments and hospital admissions).	01/01/1996 to 31/12/2004.	66.7%
D'Alessandro (2010)[18]	Rome, Italy.	Police reports, hospital presentation and national death registration.	01/01/2003 to 31/12/2003.	NR
Naumann (2010)[19]	Sample populations in the USA.	Police reports, emergency department presentations, hospital admissions and national death registration.	01/01/2005 to 31/12/2005.	57.4%
Blaizot (2013)[20]	Rhone county, France.	Police reports, Rhone county road trauma registry (data from pre-hospital services, emergency departments and hospital admissions).	01/01/2005 to 31/12/2006.	54.8%
Senserrick (2014)[21]	Victoria, Australia.	Police reports, emergency department presentations, hospital admissions and national death registration.	01/01/2004 to 31/12/2008.	56.2%
McAndrews (2013)[22]	Wisconsin, USA.	Police reports, emergency department presentations, and hospital admissions.	01/01/2001 to 31/12/2009.	61.0%
Kudryavtsev (2013)[23]	Arkhangelsk, Russia.	Police reports, insurance claims, and hospital presentations.	01/01/2005 to 31/12/2010	NR
DiMaggio (2015)[24]	New York City, USA.	New York City Department of Transport and police reports for all crashes causing personal injury or property damage in excess of USD$1000.	01/01/2001 to 31/12/2010	50.7%

Table 2: Study quality (USA = United States of America).

Author (Year)	Population location	Methodology	Predefined inclusion/ exclusion criteria	Data collectors trained	Blinding	>1 reviewer
Barancik (1986)	Cleveland and Lorain-Elyria, Ohio, USA.	Retrospective cohort study	Yes	Yes	No	Yes
Atkins (1988)	Oxford, England.	Prospective cohort study	Yes	No	No	Yes
Lindqvist (1991)	Motala, Sweden.	Prospective cohort study	Yes	Yes	No	Yes
Schlep (1990)	Skaraborg county, Sweden.	Retrospective cohort study	Yes	No	No	No
Rockett (1990)	Rhode Island, USA.	Retrospective cohort study	Yes	No	No	No
Larson (1995)	Odense, Denmark.	Retrospective cohort study	Yes	No	No	No
Ballesteros (2004)	Maryland, USA.	Retrospective cohort study	Yes	No	No	No
Miller (2004)	Sample populations in the USA.	Retrospective cohort study	Yes	No	No	No
Sciortino (2005)	San Francisco, USA.	Retrospective cohort study	Yes	No	No	No
Amoros (2008)	Rhone county, France.	Retrospective cohort study	Yes	No	No	Yes
D'Alessandro (2010)	Rome, Italy.	Retrospective cohort study	Yes	No	Yes	Yes
Naumann (2010)	Sample populations in the USA.	Retrospective cohort study	Yes	No	No	No
Blaizot (2013)	Rhone county, France.	Retrospective cohort study	Yes	No	No	Yes
Senserrick (2014)	Victoria, Australia.	Retrospective cohort study	Yes	Yes	No	Yes
McAndrews (2013)	Wisconsin, USA.	Retrospective cohort study	Yes	Yes	Yes	Yes
Kudryavtsev (2013)	Arkhangelsk, Russia.	Retrospective cohort study	Yes	No	No	No
DiMaggio (2015)	New York City, USA.	Retrospective cohort study	Yes	Yes	No	No

Table 3: Study results (PTI = Pedestrian traffic injury, PTF = Pedestrian traffic fatality, RTI = Road traffic injury, RTF = Road traffic fatality, USA = United States of America, NR = Not reported, NA = Not Applicable).

Author (year)	Population location	Population size	Annual PTI per 100,000	Annual PTF per 100,000	Annual RTI per 100,000	Annual RTF per 100,000
Barancik (1986)	Cleveland and Lorain-Elyria, Ohio, USA.	2,200,000	77.6	3.3	1886.5	14
Atkins (1988)	Oxford, England.	370,000	67.6	3.6	568.8	16.5
Lindqvist (1991)	Motala, Sweden.	41,432	70.0	2.5	1256.5	NR
Schlep (1990)	Skaraborg county, Sweden.	35,205	31.3	NA	528.3	2.8
Rockett (1990)	Rhode Island, USA.	965,523	56.6	10.4	1195.0	36.7
Larson (1995)	Odense, Denmark.	173,500	80.1	13.5	NR	NR
Ballesteros (2004)	Maryland, USA.	5,100,000	74.0	2.1	NR	NR
Miller (2004)	Sample populations in the USA.	291,952,857	70.0	2.1	NR	NR
Sciortino (2005)	San Francisco, USA.	777,360	157.1	3.9	NR	NR
Amoros (2008)	Rhone county, France.	1,600,000	69.0	1.4	871.0	12.4
D'Alessandro (2010)	Rome, Italy.	693,772	61.0	NR	659.7	NR
Naumann (2010)	Sample populations in the USA.	295,600,000	58.6	2.0	1261.1	15.2
Blaizot (2013)	Rhone county, France.	1,600,000	47.3	0.9	431.3	3.7
Senserrick (2014)	Victoria, Australia.	5,127,000	19.5	1.0	NR	NR
McAndrews (2013)	Wisconsin, USA.	5,567,369	21.6	0.9	564.4	13.3
Kudryavtsev (2013)	Arkhangelsk, Russia.	355,051	124.5	5.9	290.3	10.7
DiMaggio (2015)	New York City, USA.	8,232,500	202.7	NR	NR	NR

Table 4: Key measures for pedestrian injury prevention according to country[3] (NR = Not reported, USA = United States of America, UK = United Kingdom, BAC = Blood alcohol concentration, RTC = Road traffic crash).

	Country							
	Australia	**Sweden**	**France**	**Italy**	**USA**	**UK**	**Denmark**	**Russia**
Vehicles per person	0.74	0.60	0.67	0.84	0.83	0.56	0.52	0.35
% Pedestrians of road traffic fatalities	13%	16%	14%	16%	14%	23%	18%	29%
National Road Safety Strategy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Funding to implement strategy	No	Partial	Partial	Partial	Yes	Partial	No	Partial
Policies to promote walking	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Regional
Policies to separate pedestrians from traffic	Yes	Yes	Yes	Yes	No	Regional	No	Regional
Vehicle standards for pedestrian protection	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Maximum speed limit in urban areas (km/h)	50	50	50	50	32 to 105	48	50	60
Enforcement of speed limits	8/10	6/10	9/10	8/10	NR	NR	5/10	8/10
BAC limit (g/100mL)	0.049	0.02	0.049	0.049	0.079	0.08	0.049	0.03
Random BAC checks	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Enforcement BAC limits	8/10	8/10	8/10	7/10	NR	NR	5/10	6/10
Laws against use of mobile phones when driving	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Emergency access telephone number	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Emergency room injury surveillance systems	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
^ Permanently disabled due to RTC	15%	10%	NR	2.5%	NR	NR	NR	NR