



Prevalence of Road Traffic Accidents in Iran: A Systematic Review, GIS and Meta-Analysis

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Abstract

Context: One of the major causes of death in Iran is the injuries caused by accidents. Information regarding the distribution of injuries caused by accidents can lead to appropriate decision making in the management of Red Crescent, emergency, and police forces.

Objectives: The current study is carried out with the aim of studying the prevalence of road traffic accident in Iran using the GIS and meta-analysis study.

Evidence Acquisition: Articles were identified through international searching databases including Pub Med, Scopus, Elsevier, Google Scholar, and Web of Science as well as Iranian Scientific Information Database (SID), Health barakatkn, MagIran, and Iran Medex. We systematically reviewed all studies reporting the prevalence of accident trauma in Iran.

Results: A total of 2200 relevant records were identified by the electronic search, of which a total of 60 studies were identified as eligible papers, which were meta-analyzed for the pooled road traffic accidents in Iran. Overall, the prevalence of road traffic accidents in Iran was estimated as 51.50% (95% CI = 50.6% - 52.3%). The highest pooled road traffic accidents rate was related to the Guilan province (79.80% [95% CI = 79.1% - 80.5%]), while the lowest pooled road traffic accidents rate was in the Fars province, with the rates of 27.50% (95% CI = 26.3% - 28.8%). A descending of prevalence trend rate was observed during the year 2000 until 2010 (53.30% → 46.90%), however, after the year 2010 this trend increased (46.90% → 52.50%).

Conclusions: The result showed the prevalence of the road traffic accidents decreased from North to South of Iran. In addition, more results showed an increasing trend of the rate of road traffic accidents in Iran, therefore, design safety strategy, according to the province and time trend, can be helpful.

Keywords: Accidents, Death, Geographic Information Systems, Injuries, Prevalence, Road, Systematic Review, Traffic

1. Context

The injury's issue is one of the most important subjects in the field of health. This subject tends to serious socio-economic and health problem in the world (1). Injuries are the second major cause of mortality in Iran (2, 3).

One of the major causes of injury in Iran is the trauma caused by traffic accidents (4). Road traffic accidents are the most important causes of mortality and morbidity in the world (5). It should also be stated that road traffic accidents happen more in developing countries rather than developed countries (6). One such occurrence can be attributed to the factors such as the growing number of vehicles, changes in lifestyle, and high-risk behaviors (6, 7). Information regarding the distribution of injuries caused by an accident trauma can lead to appropriate decision making in the management of Red Crescent, emergency, and

police forces. It must be said that although many studies have been published regarding the prevalence of a road traffic accident in different cities of Iran (2), a lack of strong evidence in this field has been felt.

2. Objectives

Therefore, this systematic and meta-analysis study, with the aim of mapping the prevalence of accident trauma in Iran, has been done using the GIS model.

3. Evidence Acquisition

3.1. Search Strategy

The literature on the accident trauma prevalence in Iran was acquired through international searching

databases including PubMed, Scopus, Elsevier, Google Scholar, and Web of Science as well as Iranian scientific information database (SID), Health.barakatkn, MagIran and Iran Medex 1996 to 2018. Our last search was conducted on Aug 08, 2018. In order to search and include as many related studies as possible, we used the following terms: “road traffic accidents”, “trauma”, “accident”, “prevalence”, “injury”, “traffic”, and the name of the province of Iran.

3.2. Selection of Studies and Data Extraction

Published studies were regarded as qualified for analysis if they met the following criteria: 1- studies with the entire text available in the Farsi or English language; 2- studies with a sample size of more than 70, and 3- studies that reported the prevalence of accident trauma in Iran's province. Conversely, the following were excluded: 1- non-English or Farsi full-text reports; 2- studies that were done on just accident trauma, and 3- articles with non-relevant titles.

3.3. Data Extraction

All articles categorized as potentially relevant were reviewed separately by two of the authors (Mohammad Gholami-Fesharaki and Alireza Najimi-Varzaneh). They evaluated the relevance and eligibility of each report and summarized the following data using excel data sheets: first author's name, year of publication, year of study, sample size, percent of the male gender, and mean age of responder. The analysis was conducted according to the preferred reporting items for systematic reviews and meta-analysis (PRISMA) (8). In this study, for better data extractions, blinding in addition task separation (9) were used.

3.3. Statistical Analysis

In the current meta-analysis, the prevalence rate of road traffic accidents from each province of Iran was analyzed by the meta-command in the Stata software version 11 (StataCorp. 2009. Stata Statistical Software: Release 11.0 College Station, TX: StataCorp LP). Statistical tests of heterogeneity among the studies were carried out using the Q test ($P < 0.10$) and I-squared statistics. According to the result of the heterogeneity test, we used fixed- or random-effect models for determining the prevalence rate of accident trauma. In this study, due to the fact that some provinces have one or even no study, we use neighborhood provinces pooled Meta estimation for such a province. For example, for the province of Hormozgan, we pooled studies reported in Sistan and Baluchestan, Fars, and Kerman. This method was also used for the provinces with one published article. In such a province, the weight for this province was considered three times more than neighboring provinces. For example, in the Qom pooled Meta estimation the weight for the Qom study was three times more

than Isfahan, Tehran, Semnan, and Markazi studies. In this study, work by Khorshidi et al. (10) and Rasouli et al. (11) due to a large sample size and distracting, pooled estimation toward these two studies were removed from the final meta-analysis. In the current study, maps and figures indicating the geographical distribution of the prevalence of road traffic accidents and prevalence time trends were prepared by using the ArcGIS software Release 9.2 (ArcGIS, Redlands, CA. USA), and Microsoft Excel, respectively.

4. Results

4.1. Search Results and Study Selection

The study selection process is depicted in Figure 1. A total of 2,200 studies were potentially associated with the prevalence of road traffic accidents in Iran's province, of which 380 duplicates were excluded. After reviewing the abstracts and titles, 1,722 studies were eliminated based on the stated inclusion and exclusion criteria. After the full-text screening, a total of 70 records were deemed as eligible papers published between 1995 and 2018, however, in quality assessment 10 articles were also removed. Finally, 60 articles were reviewed and used in the meta-analysis study.

4.2. Prevalence of Accident Trauma in Iran's Provinces

Data on the prevalence of road traffic accidents as well as other indicators like first author name, year of publish, year of study, mean age, and male percent of each study were presented in Table 1. In addition, the pooled prevalence of road traffic accidents, according to the 31 prevalence of Iran, was presented in Table 2 and Figure 2. Overall, the prevalence of accident trauma in Iran was estimated as 51.50% (95% CI = 50.6% - 52.3%). The highest pooled road traffic accidents rate related to the province of Guilan (79.80% [95% CI = 79.1% - 80.5%]), while the lowest pooled accident trauma rate was in the Fars province with the rates of 27.50% (95% CI = 26.3% - 28.8%). The GIS map of the prevalence of road traffic accidents was presented in Figure 3. More results showed that 73.09% (95% CI = 73.04% - 76.13%) of road traffic accidents occurred in males. The result of the pooled prevalence of road traffic accidents during time was presented in Table 3 and Figure 4. As it is shown, in this table and figure, a descending of prevalence trend rate was observed during the year 2000 until the year 2010 (53.30% → 46.90%), while after the year 2010 this trend was increasing (46.90% → 52.50%).

5. Discussion

Review of the prevalence of road traffic accidents showed two population base studies in Iran. Work by Khorshidi et al. (10) and Rasouli et al. (11) in the year 2011, showed 52% and 32% prevalence of accident trauma in Iran.

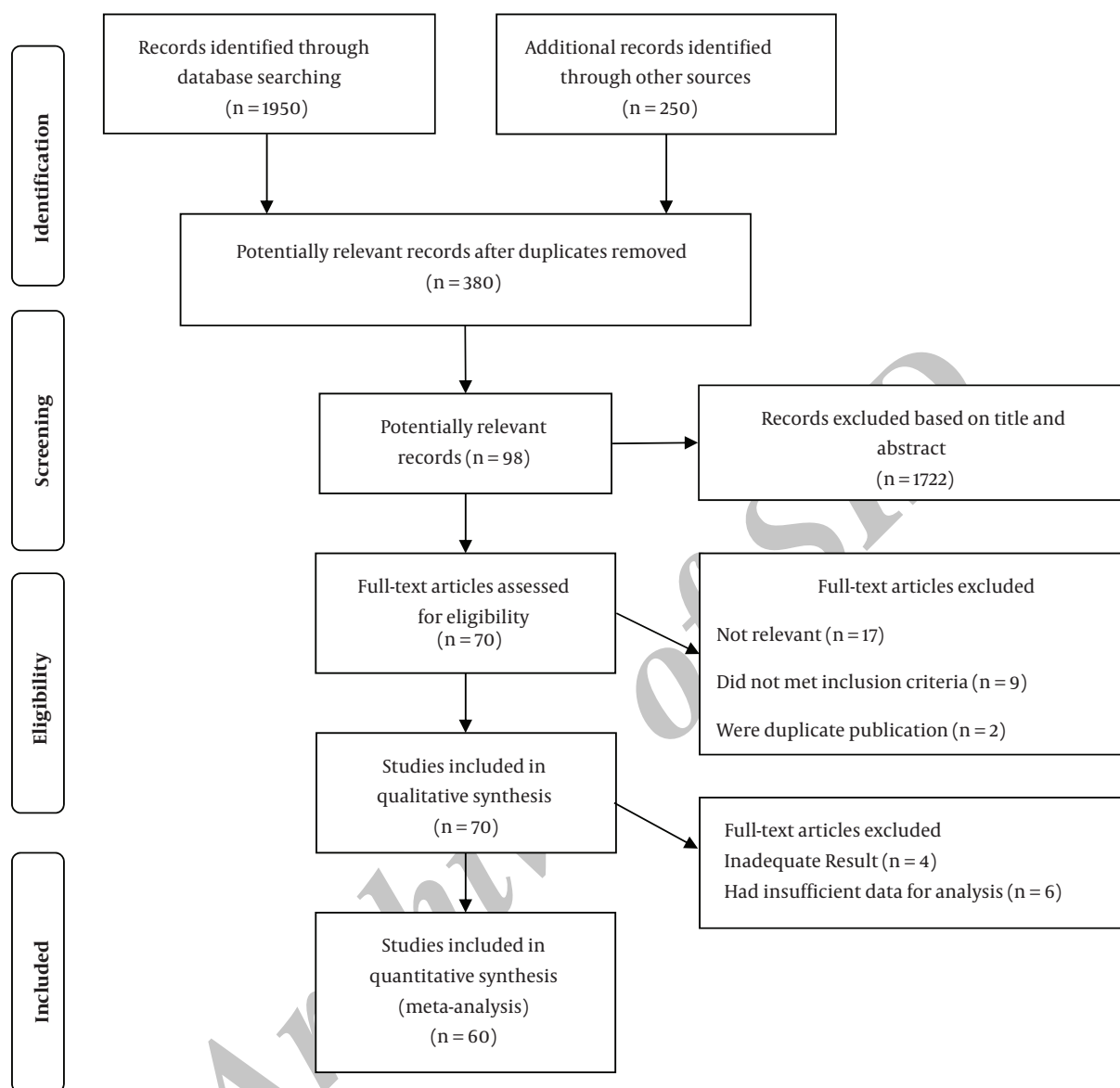


Figure 1. Screening of articles based on PRISMA statement

Given that both studies were done in the same year, it was expected that these two prevalence would be close together, however, it did not happen. The results of this study showed that the pooled prevalence estimation of road traffic accidents in Iran was 51.50% (95% CI = 50.6% - 52.3%). The result of this study was close road traffic accidents to the Khorshidi et al. study (10). The further result showed the prevalence of decrease from north to south of Iran. Therefore, the highest pooled road traffic accidents rate was related to the province of Guilan (79.80% [95% CI = 79.1% - 80.5%]), while the lowest pooled road traffic acci-

dents rate was in the Fars province with the rates of 27.50% (95% CI = 26.3% - 28.8%). This result, with a little difference, is similar to the Alizadeh et al. study (4). The result of the pooled prevalence of road traffic accidents showed that a descending of prevalence trend rate was observed during the year 2000 until the year 2010 (53.30% → 46.90%), while after the year 2010 this trend was increasing (46.90% → 52.50%). Such a trend has been seen in the Alizadeh et al. study (4).

A number of limitations exist in the present investigation that should be noted. First, the sample size for some

Table 2. Pooled Prevalence of Road Traffic Accidents According to the Province of Iran, Using the Random Effect Model^a

| Province | Number of Studies | Prevalence 95% CI |
|-----------------------------|-------------------|---------------------|
| Azerbaijan, East | 5 | 48.50 (43.6 - 53.3) |
| Ardabil | 2 | 32.20 (27.4 - 36.9) |
| Isfahan | 8 | 53.70 (53.0 - 55.4) |
| Tehran | 4 | 41.30 (40.3 - 42.3) |
| Sistan and Baluchestan | 3 | 57.10 (54.6 - 59.5) |
| Fars | 3 | 27.50 (26.3 - 28.8) |
| Kerman | 3 | 48.80 (46.7 - 50.9) |
| Kermanshah | 3 | 50.60 (47.9 - 53.3) |
| Kohgiluyeh and Boyer-Ahmad | 2 | 48.50 (45.3 - 51.7) |
| Guilan | 6 | 79.80 (79.1 - 80.5) |
| Mazandaran | 5 | 63.10 (61.3 - 64.8) |
| Markazi | 2 | 43.90 (42.1 - 45.6) |
| Hamedan | 3 | 37.10 (36.5 - 37.8) |
| Yazd | 2 | 50.10 (46.3 - 54.0) |
| Chahar Mahaal and Bakhtiari | A | 51.20 (48.1 - 54.4) |
| Khorasan, Razavi | B | 63.00 (60.6 - 65.4) |
| Khuzestan | C | 53.90 (51.0 - 56.8) |
| Zanjan | D | 50.60 (47.2 - 54.1) |
| Semnan | E | 55.60 (54.4 - 56.7) |
| Qazvin | F | 53.80 (53.1 - 54.4) |
| Qom | G | 48.10 (47.9 - 48.9) |
| Azerbaijan, West | H | 50.30 (46.2 - 54.4) |
| Alborz | I | 50.00 (49.1 - 50.8) |
| Ilam | J | 53.20 (51.1 - 55.2) |
| Bushehr | K | 44.50 (43.1 - 45.9) |
| Khorasan, South | L | 53.10 (51.6 - 54.5) |
| Khorasan, North | M | 75.20 (72.2 - 78.2) |
| Kurdistan | N | 45.70 (44.3 - 47.1) |
| Golestan | O | 64.70 (63.0 - 66.3) |
| Lorestan | P | 50.40 (49.7 - 51.2) |
| Hormozgan | Q | 47.40 (46.1 - 48.7) |
| Pooled effect | 60 | 51.50 (50.6 - 52.3) |

^a A: 1 study from Chahar Mahaal and Bakhtiari and studies from Isfahan and Khuzestan province. B: 1 study from Khorasan, Razavi, and studies from Semnan and Yazd province. C: 1 study from Khuzestan and studies from Chahar Mahaal Bakhtiari and Kohgiluyeh and Boyer-Ahmad province. D: 1 study from Zanjan and studies from East Azerbaijan and Hamedan province. E: 1 study from Semnan and studies from Tehran, Qom and Mazandaran province. F: 1 study from Qazvin and studies from Zanjan, Guilan, Markazi and Hamedan province. G: 1 study from Qom and studies from Isfahan, Tehran, Semnan and Markazi province. H: studies from East Azerbaijan and Khuzestan province. I: studies from Tehran, Qazvin, Mazandaran and Markazi province. J: studies from Khuzestan and Kermanshah province. K: studies from Khuzestan, Fars and Kohgiluyeh and Boyer-Ahmad province. L: studies from Khorasan, Razavi, Sistan and Baluchestan, Kerman and Yazd province. M: studies from Khorasan, Razavi and Semnan province. N: studies from Kermanshah, Markazi and Hamedan province. O: studies from Semnan and Mazandaran province. P: studies from Isfahan, Kermanshah, Markazi and Hamedan province. Q: studies from Sistan and Baluchestan, Fars and Kerman province.

of the Iran province was not adequate and the quantity of data varied between provinces. Second, different sample locations (general or special hospital) were utilized in sam-

pling method, which may affect the obtained results of the current systematic review. Lack of published related studies in some provinces and data deficiencies in another one

Table 3. Pooled Prevalence of Road Traffic Accidents During the Time

| Year | Number of Studies | Prevalence 95% CI |
|------------------|-------------------|-----------------------|
| Before year 2000 | 3 | 52.20 (50.00 - 54.40) |
| 2001 - 2005 | 22 | 53.30 (52.70 - 54.00) |
| 2006 - 2010 | 17 | 46.90 (45.50 - 48.30) |
| After year 2010 | 14 | 52.50 (50.10 - 54.90) |

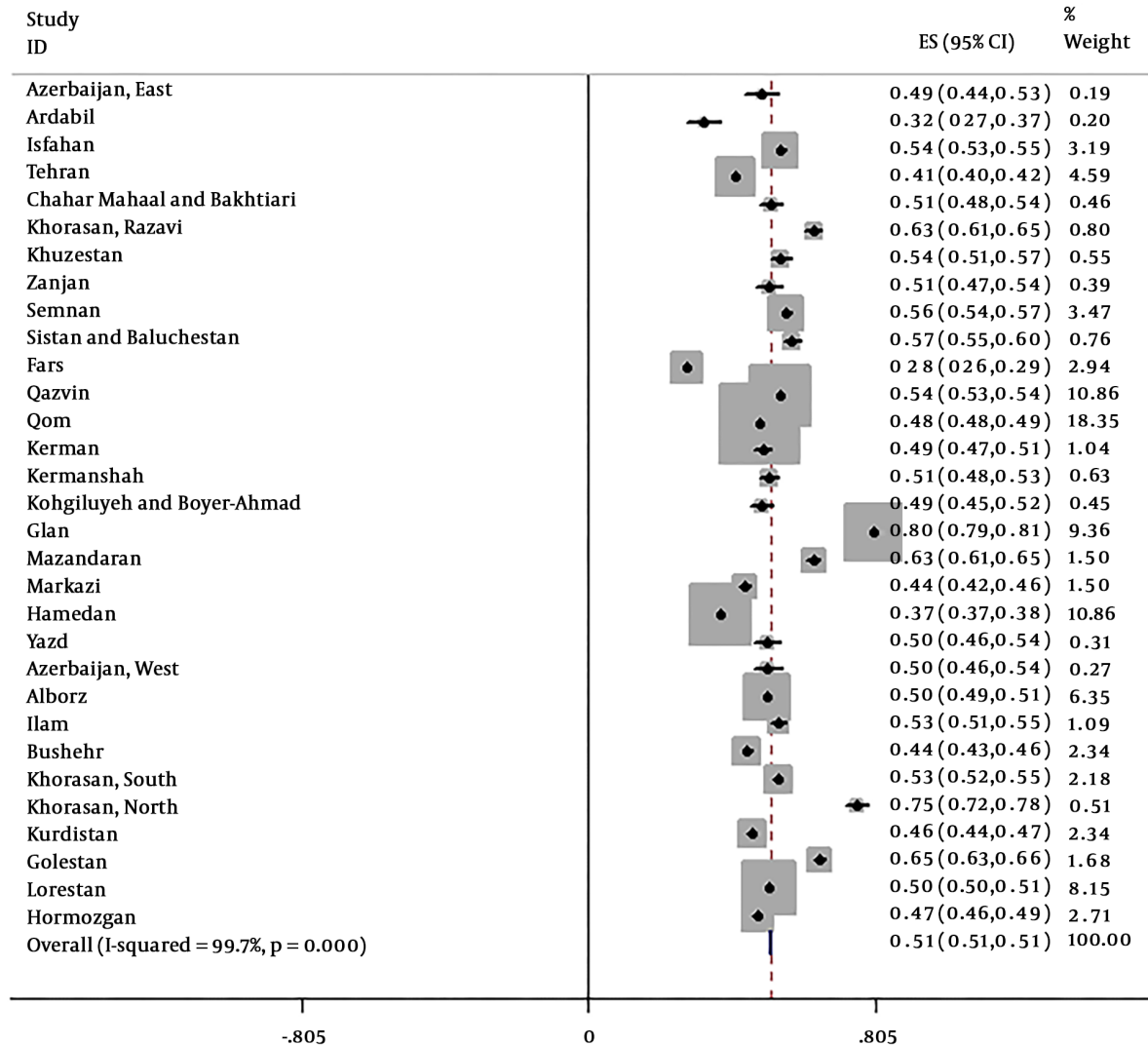


Figure 2. Forest plot of the prevalence of road traffic accidents according to the 31 provinces of Iran

did not allow us to include them in the final analysis.

In addition, a number of strong points exist in the present study that should be considered. First, the use of the method of interpolation for the province with one or

no study. Second, the use of two-step meta-analysis and map GIS model that tends to have better and more accurate meta-analysis results.

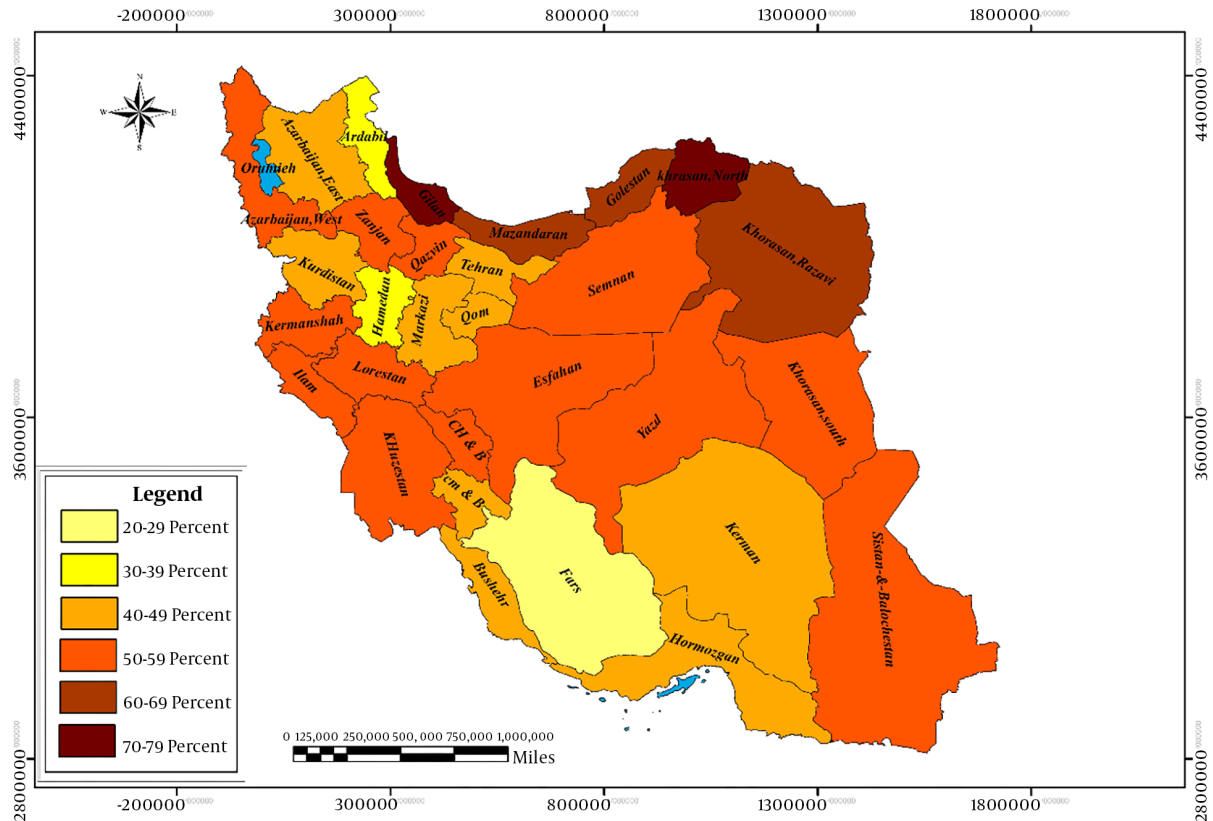


Figure 3. The GIS map of prevalence of road traffic accidents in Iran

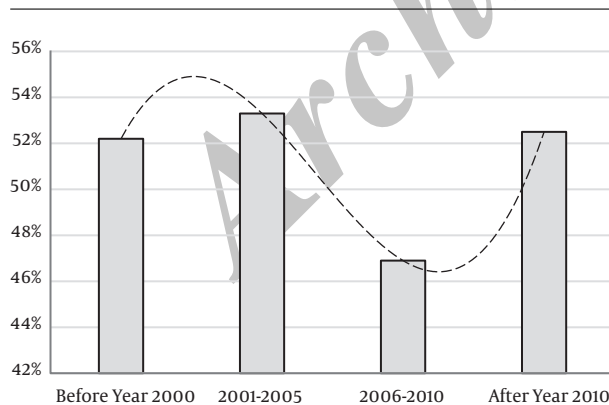


Figure 4. Trend of the prevalence of road traffic accidents during the time in Iran

5.1. Conclusion

The result showed the prevalence of road traffic accidents decrease from north to south of Iran. In addition, more results showed an increasing trend of the rate of road

traffic accidents in Iran, therefore, the design safety strategy, according to the province and time trend, can be helpful.

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Footnotes

Authors' Contribution: Alireza Najimi-Varzaneh collected the data, analyzed and prepared the draft of the article. Mohammad Gholami Fesharaki is the supervisor of this project.

Conflict of Interests: The authors declare that they have no conflict of interest.

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Table 1. Characteristics of the Included Road Traffic Accidents Epidemiology Articles in Iran

| Province | Year of Study | Year of Publish | Mean Age | Male Percent | Study Sample Size (No. Trauma Accident) | Prevalence of Trauma Accident and 95% CI |
|------------------------------------|---------------|-----------------|----------|--------------|---|--|
| Azerbaijan, East | | | | | | |
| Sadeghi-Bazargani (12) | 2007 | 2013 | 31 | 77 | 19530 (12500) | 64 (63 - 65) |
| Navali (13) | 2009 | 2015 | 32 | 77 | 16681 (3246) | 19 (19 - 20) |
| Samadi Rad (14) | 2011 | 2016 | 37 | 83 | 174 (83) | 48 (40 - 55) |
| Sadeghi-Bazargani (15) | 2011 | 2018 | 75 | 75 | 9435 (1375) | 15 (14 - 15) |
| Dadashzadeh (16) | 2014 | 2016 | 36 | 76 | 5614 (4092) | 73 (72 - 74) |
| Ardabil | | | | | | |
| Amani (17) | 2007 - 2008 | 2009 | 29 | 70 | 951 (102) | 11 (9 - 13) |
| Farzaneh (18) | 2013 - 2014 | 2017 | 23 | 85 | 85 (204) | 42 (36 - 48) |
| Isfahan | | | | | | |
| Fakharian (19) | 1996 | 2003 | 26 | 73 | 912 (452) | 50 (46 - 53) |
| Farzandipour (20) | 2004 | 2007 | 28 | 61 | 6415 (3049) | 48 (46 - 49) |
| Shafiei (21) | 2004 | 2017 | 27 | 74 | 4290 (2930) | 68 (67 - 70) |
| Fazel (22) | 2004 - 2006 | 2008 | 29 | 77 | 18166 (9173) | 50 (50 - 51) |
| Saberi (23) | 2005 | 2008 | 29 | 69 | 18166 (9173) | 50 (50 - 51) |
| Davoodabadi (24) | 2007 - 2008 | 2011 | 26 | 66 | 1004 (502) | 50 (47 - 53) |
| Fazel (25) | 2009 | 2012 | 33 | 75 | 22564 (13628) | 60 (60 - 61) |
| Adib-Hajbaghery (26) | 2012 | 2014 | 47 | 75 | 400 (349) | 87 (84 - 91) |
| Tehran | | | | | | |
| Khatami (27) | 2000 | 2003 | 29 | 89 | 1393 (515) | 37 (34 - 40) |
| Zargar (28) | 2001 | 2001 | 27 | 75 | 58013 (26105) | 45 (45 - 45) |
| Hatamabadi (29) | 2003 | 2005 | 30 | 76 | 2003 (783) | 39 (37 - 41) |
| Ali Asghar Zadeh (30) | 2008 - 2009 | 2011 | 31 | 73 | 2623 (1127) | 43 (41 - 45) |
| Chahar Mahaal and Bakhtiari | | | | | | |
| Najari (31) | 2003 - 2013 | 2015 | 31 | 64 | 95 (42) | 44 (34 - 54) |
| Khorasan, Razavi | | | | | | |
| Afzal Aghaee (32) | 2009 | 2016 | 31 | 71 | 658 (472) | 72 (68 - 75) |
| Khuzestan | | | | | | |
| Salimi (33) | 2001 | 2008 | N | 71 | 1141 (673) | 59 (56 - 62) |
| Zanjan | | | | | | |
| Hatami (34) | 2006 | 2009 | 17 | 81 | 378 (279) | 74 (69 - 78) |
| Semnan | | | | | | |
| Khosravi (35) | 2004 | 2008 | 35 | 79 | 220 (176) | 80 (75 - 85) |
| Sistan and Baluchestan | | | | | | |
| Chardoli (36) | 1997 | 2006 | 23 | 82 | 768 (456) | 59 (56 - 63) |
| Ansari-Moghaddam (37) | 2007 | 2012 | 37 | 81 | 18155 (5713) | 31 (31 - 32) |
| Heydari Khayat (38) | 2011 | 2012 | 27 | 91 | 240 (178) | 74 (69 - 80) |
| Fars | | | | | | |
| Soroush (39) | 2002 | 2008 | 33 | 65 | 1765 (941) | 53 (51 - 56) |
| Heydari (40) | 2009 | 2012 | 31 | 97 | 2345 (542) | 23 (21 - 25) |
| Abbasi (41) | 2009 | 2013 | 27 | 76 | 1217 (278) | 23 (20 - 25) |
| Qazvin | | | | | | |
| Kiaei (42) | 2004 | 2005 | 25 | 88 | 1286 (203) | 16 (14 - 18) |
| Qom | | | | | | |
| Karami Joushin (43) | 2010 | 2013 | 42 | N | 29426 (3535) | 12 (12 - 12) |
| Kerman | | | | | | |
| Rezaeinasab (44) | 1999 | 2005 | 34 | 82 | 250 (131) | 52 (46 - 59) |

| | | | | | | |
|-----------------------------------|-------------|------|----|----|------------------|--------------|
| Shojaee Baghini (45) | 2002 | 2006 | 25 | 76 | 4085 (1494) | 37 (35 - 38) |
| Beigzadeh (46) | 2014 | 2016 | 20 | 77 | 10161 (5054) | 50 (49 - 51) |
| Kermanshah | | | | | | |
| Hessami (47) | 2002-2005 | 2008 | 41 | 87 | 630 (330) | 52 (48 - 56) |
| Karbakhsh (48) | 2004 | 2009 | 35 | 79 | 799 (482) | 60 (57 - 64) |
| Jalalvandi (49) | 2009 | 2015 | N | 59 | 304 (50) | 16 (12 - 21) |
| Kohgiluyeh and Boyer-Ahmad | | | | | | |
| Hatamipoor (50) | 2002 | 2003 | N | 85 | 227 (51) | 22 (17 - 28) |
| Fararoei (51) | 2011 | 2017 | 28 | 68 | 583 (387) | 66 (63 - 70) |
| Guilan | | | | | | |
| Kadkhodaie (52) | 2002 | 2006 | 25 | 99 | 7200 (6552) | 91 (90 - 92) |
| Emam Hadi (53) | 2004 | 2005 | 20 | 79 | 715 (641) | 90 (87 - 92) |
| Hemmati (54) | 2005 | 2009 | 32 | 72 | 3598 (3035) | 84 (83 - 86) |
| Yousefzadeh (55) | 2005 | 2007 | 34 | 72 | 1141 (848) | 74 (72 - 77) |
| Yousefzadeh (56) | 2005 | 2008 | 31 | 98 | 3396 (2614) | 77 (76 - 78) |
| Asadi (57) | 2011 | 2015 | 40 | 84 | 6235 (4302) | 69 (68 - 70) |
| Mazandaran | | | | | | |
| Janmohammadi (58) | 2001 - 2006 | 2014 | 34 | 76 | 3507 (2372) | 68 (66 - 69) |
| Hatamabadi (59) | 2008 | 2012 | 34 | 71 | 433 (245) | 57 (52 - 61) |
| Moosazadeh (60) | 2010 | 2013 | 30 | 72 | 58750 (23382) | 40 (39 - 40) |
| Modarres (61) | 2012 | 2014 | 46 | 83 | 11393 (10025) | 88 (87 - 89) |
| Asadian (62) | 2013 | 2015 | 19 | 68 | 1304 (980) | 75 (73 - 77) |
| Markazi | | | | | | |
| Gol Aghaei (63) | 2002 | 2005 | 35 | 80 | 8856 (3940) | 44 (43 - 46) |
| Solhi (64) | 2006 | 2010 | 32 | 74 | 813 (351) | 43 (40 - 47) |
| Hamedan | | | | | | |
| Afzali (65) | 2002 | 2006 | 31 | 76 | 9828 (2130) | 22 (21 - 22) |
| Khazaei (66) | 2009 - 2014 | 2016 | 30 | 73 | 135925 (29604) | 22 (22 - 22) |
| Khazaei (67) | 2012 | 2016 | 7 | 74 | 3200 (2112) | 66 (64 - 68) |
| Yazd | | | | | | |
| Taghipour (68) | 2005 | 2010 | 34 | 81 | 251 (100) | 40 (34 - 46) |
| Ezoddini Ardakani (69) | 2008 | 2012 | 25 | 86 | 372 (219) | 59 (54 - 64) |
| Iran | | | | | | |
| Khorshidi (10) | 2011 | 2016 | 23 | 78 | 452192 (234239) | 52 (52 - 52) |
| Rasouli (11) | 2011 | 2011 | 33 | 73 | 2991624 (954328) | 32 (32 - 32) |