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Primary preventive interventions on traffic accidents among males: A review on the literature during 2009-2019 in Iran

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Abstract: **Introduction:** The present study aimed to compare the national health indicators and the effectiveness of primary preventive interventions on traffic accidents in Iran during the last decade (2009-2019). **Methods:** All published original articles on the primary preventive intervention and health indicators of traffic accidents in Iran were extracted. The inclusion criteria included epidemiologic studies on Iranian male population during 2009-2019. Data were screened and extracted by two independent evaluators and the quality of studies was checked using the STROBE checklist. The exclusion criteria included those articles aimed at presenting results of second or third levels prevention (including injury management, pre-hospital emergency management, economic analyses, case reports, and traffic accidents from non-human perspectives). Accident-related mortality rates, proportionate mortality from traffic accidents per 1000 vehicles, and per 1000 accidents were estimated. **Results:** A total of 65 original articles were included of which 13 were presented health indicators. The crude mortality rate varied from 57.1 in Sistan-Balooshestan province to 73 (per 100,000 population) in Fars province. The age-standardized mortality rate among male pedestrians (per 100,000 population) varied from 10.6-33.4 in Gilan and Mazandaran, 42 in Fars, 50.9 in Lorestan provinces. During the last 10 years, the mortality rate decreased from 38 to 12 cases per 1000 vehicles and increased from 51 to 56 cases per 100 accidents. Studies on the effectiveness of primary level prevention have addressed regulations on controlling blood alcohol level and international projection models. **Conclusion:** The type of health indicators related to traffic accidents seems to vary greatly among studies. Investigation on the effectiveness of primary preventive interventions on traffic caccidents are proposed frequently by WHO. Nevertheless, short-term and long-term effectiveness of many interventions including educational packages, regulations and specific laws have not been assessed in Iran.

Keywords: Traffic Accidents; Mortality Rate; Primary Prevention; Iran

1. Introduction

Road traffic injuries (RTIs) and their burden in Iranian population have long been a major concern. RTI is the third most-frequent cause of mortality in Iran. Distribution of road traffic deaths depends on many variables such as individual characteristics, accident conditions and vehicle type (1). While the importance of collection, analysis and interpretation of RTI data have long been recognized in high-income countries, road traffic injuries place a huge burden on low and middle income countries. The existing challenges in collection of useful, valid and timely information are one of the major reasons for these countries not being able to develop efficient strategies for controlling and preventing road traffic injuries (2). Another obstacle

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to control and prevention of road traffic injuries in low or middle income countries is the invalid or insufficient data for identification of local risk factors (3). Surveillance systems, on the other hand, are developed to overcome these challenges in monitoring and collecting data related to traffic accidents. Establishment of a comprehensive and complete surveillance system requires baseline individual and aggregated data to estimated standard indicators.

Indicators are meters which measure either directly or indirectly the changes in events and produce useful information by using raw data in order to compare different standards, sectors and time periods. National health indicators are a group of indicators which are produced and calculated nationwide and are normally required by organizations in national and international levels, including but not limited to the Ministry of Health and Medical Education (MOHME), the Iranian statistic center, state organizations, the Islamic Parliament, WHO, and UNDPT. The data produced by national indicators forms the basis for adoption of efficient policies in line with prevention of road traffic injuries. In fact, the prevention of traffic accidents, especially those of the primary level, is the shared responsibility of health professionals and other public as well as private organisations. For this reason, reporting the information obtained to all stakeholders, as well as receiving feedback in order to improve primary level prevention strategies, should be considered the priority in accident prevention (4).

In any kind of activity related to controlling injury especially in traffic safety, accurate detection of groups, and those who are the higher risk of injury and consequently death are crucial for interventions (5). Discrepancies in age and gender distribution resulting from the traffic accidents include the entire range of victims from pedestrians to drivers and passengers, motorists, motorcyclists and cyclists and are applied in health policymaking for injury reduction. The results of epidemiological studies suggest that due to many factors, men are more susceptible to injuries and death resulting from traffic accidents (6). A review study done by Rasouli et al. suggested that although the incidence of traffic-accidents injuries in 2006 had decreased among Iranian men, the gender ratio of men to women in traffic accidents was more 4-folds indicating a wide range of physical injuries and death from traffic accidents among Iranian men (7).

The present study aimed to review the published papers during 2009-2019 and presented the results in the form of national health indicators in traffic accidents. Concerning the importance of using epidemiological data and health indicators in determining the effectiveness of preventive accidents, the present study reviewed the epidemiological studies aiming at assessing the effectiveness of primary level of preventive interventions and addressed the overlooked fields of research in this area.

2. Methods

All original articles on RTIs published in Iran in both Farsi and English (2009-2019) were searched in databases including PubMed, Scopus, and Clarivate Analytics with keywords including Primary prevention, Accident prevention, Traffic accident, Prevention and Control, Epidemiology, Iran/Iranian and Male/Men. Farsi papers with the same keywords were extracted from the SID database. The inclusion criteria included epidemiological original articles among Iranian men and during the same time period. To determine the epidemiological criteria, papers were investigated based on the STROBE checklist for observational studies (cross-sectional, case-control and cohort).

The exclusion criteria included articles aimed at presenting results of the second or third levels of prevention (including injury management, pre-hospital emergency management, economic estimations, case reports describing injuries caused by car accidents, and investigating traffic accidents from a non-human perspective). To extract the health indicators, the second edition of the National report on health indicators developed by the Center for Statistics and Information Technology was reviewed. Using this report, a few indicators relating to road accidents including the death rate due to traffic accidents, the ratio of death from traffic accidents (per 1000 vehicles), and those from traffic accidents (per 1000 accidents) were used. Finally, 355 original articles were extracted. Of which, 65 articles were assessed by two independent evaluators from the research team to present the descriptive epidemiology of injury related to traffic accidents and investigate primary level of preventive interventions. (Figure 1)

3. Results

3.1. Crude and Age-standardized mortality rates

A total of 13 articles presented mortality rates in the Iranian population. Meta-analysis was not feasible due to the variety in reported outcomes and different definitions applied for the numerator and denominator of health indicators (Table 1). More specifically, the crude mortality rate (per 100,000 population) varied from 57.1 in Sistan-Balooshestan province to 73 in Fars province.

The age-standardized mortality rate (per 100 000 population) among male pedestrians varied from 10.6-33.4 in Gilan and Mazandaran, 42 in Fars, 50.9 in Lorestan provinces. Other reported indicators included fatality rate among the injured and hospitalized victims in Isfahan province (49.1%), the proportional mortality of victims of motorcycle accidents hos-

Table 1: Health indicators related to traffic accidents from the published articles during 2009-2019 in Iran

Authors(Year Published)	Province	Index Reported	Index Value
Taravatmanesh(2012)	Sistan-Balouchestan (8)	Crude mortality rate per 100,000 population	57.14
Entezami (2009)	Gilan-Mazandaran (9, 10)	Age-standardized mortality rate per 100,000 population	33.4
Davoodi (2015)	Lorestan(11)	Age-standardized mortality rate per 100,000 population	50.92
HosseinPour (2015)	Isfahan (12)	Case-Fatality rate among hospitalized motor-cyclist (%)	49.13
Sherafati (2015)	Gilan (13)	Crude mortality rate in hospital (%)	3.9
Mohtasham Amiri (2012)	Gilan(14)	Case-Fatality Rate among hospitalized pa-tients (%)	3.7
Akbari (2014)	Fars (15)	Mortality rate among male pedestrains per 100,000 population	10.86
Hassanzadeh (2013)	Fars (16)	Crude mortality rate per 100,000 population	73
Mahdian (2014)	Kashan (17)	Late mortality rate in hospital (more than 24 hours post-admission) per 100,000 popula-tion	103
Bahadori-Monfared (2009)	Iran (18)	Crude mortality rate per 1000 vehicles)	12
		Crude mortality rate per 1000 accidents	56
Mahdian (2011)	Kashan (19)	Crude mortality rate per 100,000 population	21.11
Khorshidi (2011)	Semnan (20)	Mortality rate per 100,000 population	41
	Tehran		54
Sehat (2012)	Tehran (21)	Crude mortality rate in 100,000 males	40.4

pitalized in Isfahan province (94%) and 24-hour mortality rate post-hospitalization in men in Kashan hospitals (103 per 10,000 population) (Table 1).

3.2. Ratio of mortality rate from traffic accidents per 10,000 vehicles and per 1000 accidents

During 2009-2019, the indicators of " mortality rate per 10 000 vehicles" and " mortality rate per 1000 accidents" were reported in only one article. Accordingly, during this period, an average of 21,000 annual deaths occurred in men. During the same time, the mortality rate decreased from 38 to 12 per 1000 vehicles and increased from 51 to 56 cases per 100 accidents (Table 1).

3.3. Primary preventive interventions in traffic accidents in Iran

Traffic accidents are preventive and predictable. Despite the increasing growth of traffic accidents across the world, interventional strategies have decreased a load of these injuries in developed countries. The effectiveness of specific interventions such as laws related to speed-limit and drinking while driving, seatbelt and helmet use and designing safer roads and vehicles (22). A global program called ".
The decade of Action for Road Safety during 2011-2020" has been designed for developing efforts on national and local levels to decrease mortality resulting from traffic accidents across the world. The program aims to enhance the organizational capacity for the management of safe roads and the

improvement of health systems for post-traumatic responses (23). To date, the majority of required data for policymaking have been collected in developed countries while little or no data is available for developing and low-income countries (24). Meanwhile, there is limited scientific evidence based on the effectiveness of the primary level of preventive interventions in Iran while similar preventive strategies have been worked out in many low or middle income countries.

3.3.1. Regulations
Changes in mortality rates from traffic accidents have been evaluated through exercising rules such as heavy fines, suspension of driving license by developing countries including Ethiopia, Brazil, Mexico, Colombia, Thailand, South Africa, and Vietnam. No such report; however, is available in Iran.

3.3.2. Measuring the blood alcohol
Changes in mortality rates resulting from traffic accidents, the effectiveness of interventions on drivers' alcohol use prohibitions, and the measurement of blood alcohol by the police officers are reported in countries such as South Africa and Thailand. Furthermore, some studies have been done in Iran, which are presented as follow:
A study on drivers of heavy vehicles in Mashad city reported that 4.4% and 8.2% of drivers used alcohol and illigal substances, respectively (25). Another study in Shiraz city reported a direct relationship between alcohol/substance use two hours prior to driving and risky behaviors such as

using cellphone while driving, poor decision-making ability and high-speed driving. These behaviors were furthermore related to drive incompliance to safety considerations such as using a defective car and not wearing a helmet (26). A study on biopsy specimens from the deceased accidents victims in Hamedan city reported that 17% of the specimens had signs of alcohol or substances (mainly opioids). Alcohol and opioid consumption were significantly higher in drivers with higher education and during summer (27). According to the data from Kaam standard form, alcohol consumption would increase the odds of injury or death up to 6.5 times in inner-city accidents and up to 73% in out-city accidents (28).

3.3.3. Safe Community Model

Considering the population-based preventive interventions, Rahimi Movaghar et al., have measured the effectiveness of the safe community model proposed by WHO. The authors stated that the case-fatality rate from accidents in hospital emergency departments decreased significantly in the intervention group and reached 13.4 per 100,000 population (29).

4. Discussion

The present study reviewed the results of national health indicators related to traffic accidents and the primary level of preventive intervention in Iran. Our study suggested that there are numerous opportunities to conduct epidemiologic studies on preventive interventions for traffic accidents in Iran. Although Iran has already passed the long pathway in exercising strict traffic rules, constructing and developing safe road infrastructures and training personnel, there is a long path ahead for determining the effectiveness of policies and identifying factors affecting their success (4). In Iran, various policies were made such as improving road safety and car safety standards to reduce road accidents and fatality rates which the majority of them are based on road safety. Moreover, considering the policies of prehospital management and medical care, Post-trauma National Emergency Access Number, Provincial-level Trauma Registration, issued official certificate for pre-hospital care staff, and national assessment for Emergency Care System have been established and implemented. In the legislation field, The National Law on Speed Control, the National Law on the Prohibition of Drinking Alcohol while driving, and the National Law on the Use of Motorcycle helmets and fastening car seat belts, the Law on the use of mobile phones while driving, and the Law on the Prohibition of Drug Abuse were enforced (30). A review on the obstacles of practicing preventive intervention in Iran suggest that " lack of regular and systematic strategy for the safety of road users" was considered as a key variable in failing to implement preventive interven-

tions (4). There are also other obstacles such as human factors, dysfunction of transportation systems and the lack of interaction among organizations (31). A few studies have surveyed the community about the prevention of mortality from traffic accidents. The results of these studies suggest that families request health authorities to focus on developing infrastructures (road construction, actions on traffic reduction and bridge construction, wastewater outlets, sanitation facilities, fire stations) and implementing public education programs. In Toyserkan city, people suggested implementing interventions in society through two main components: interaction among society members in case of accidents (help transfer the victim to medical centers) and adopting healthy behaviors (32). The results of qualitative studies in Tehran suggested that strategies focusing on taxi drivers (33), and exercising more strict rules and heavier fines for offending motorcyclists are considered as important measures in decreasing traffic accidents (34).

Expert Consultation on Road Safety in the Eastern Mediterranean Region held by WHO in Egypt in 2016 presented the report of some actions with high priority in countries of the region. The short- term actions included the necessity of conducting epidemiological studies and registration systems as the priority of measurements relating to the epidemiological data. Other actions on implementing the primary level of prevention strategies included analyzing current data for prioritization of interventions, determining valid methodology to measure risk factors, conducting studies with a combination of surveillance data and other data for the better understanding of modifiable risk factors and identifying the short term and long term complications of road accidents (35). In the meantime, the role of epidemiological studies in presenting scientific evidence based on different aspects of the primary level of prevention must be appreciated. Well-designed and well-implemented epidemiological studies can provide valuable data on the costs of prevention (financial costs, problems that people face while implementing a program, poor quality of life), strengthening evidence showing the effectiveness of risk factors for accidents or mortality from that and obstacles on the way of decreasing or eliminating exposure to these factors (36).

For instance, determining the effectiveness of legislative interventions, using seatbelts and helmets to reduce the incidence of injuries and deaths due to traffic accidents in the country needs further investigation. So far, only one observational study investigated the changes in the mortality rate resulting from the implementation of seatbelt rules. In this regard, the mortality rate from traffic accidents in the preseding year to the intervention, the first and second year after the intervention was reported 13%, 9.7% and 11.4%, respectively. However, due to the observational nature of this study and the possibility of numerous confounders in the

results, authors stated that failure to notice the integrated results of the mortality rate related to fasten seatbelt requires comparative and analytical studies in larger scales (37).

Furthermore, observational and experimental evidence on the effectiveness of legislative intervention for using mobile phones while driving on the reduction of injury and death from traffic accidents in Iran are scarce.

Epidemiological and experimental studies at the individual level can help determine the effectiveness of interventions. These actions include educational interventions such as what is necessary for motorists and cyclists in decreasing the injury and death rate resulting from traffic accidents (38, 39). One of the most surface levels of preventive measures is to determine the effectiveness of interventions aiming at knowledge, attitude and practice of the community, which has so far accounted for a small proportion of epidemiological studies of accident prevention. For instance, studies conducted in Tehran and Zahedan cities suggested that an increase in the taxi drivers' knowledge of traffic rules is significantly associated with accident reduction. It is worth noting that decreasing traffic accidents is strongly related to the drivers' attitude rather than knowledge toward the rules (40, 41). In a study done in Yazd city, a perceived behavior of using the helmet was reported as the most important predictor of using it by motorists (42).

WHO suggested some long term actions for more than 5 years in the Eastern Mediterranean countries which include computerized data collection forms, strengthening the mechanisms for quality improvement, integrating data from police stations, health and insurance organizations, increasing human resources and capacity building for health and enforcement management, and creating a mechanism for feedback data from stakeholders (35). The preventive strategies must be prioritized based on the budget and resources and the best possible strategies must be presented by those who are responsible for the prevention of these accidents. Meanwhile, different methods of prioritization and allocation of resources have been suggested which their advantages and disadvantages are not addressed here (43-45). Our review suggested that there is not enough epidemiological evidence on the effectiveness of the primary level of preventive interventions of traffic accidents. Accordingly, only 26% of the extracted articles investigated the effectiveness of the primary level interventions and the remaining devoted to the prehospital and hospital management, economic burden of accidents and injuries and the role of non-human factors in accidents. In this regard, educational programs to deliver health messages regarding dangers and complications of traffic accidents by the media is proposed to modify behaviors of young drivers. This can be done by sending health messages throughout public gatherings such as markets, shopping malls and schools.

These attempts can accompany regulation enforcements and more strict rules for driving.

The results of this review showed a vast variety of health indicators of traffic accidents and outcomes of the effectiveness of preventive interventions in Iran. The inconsistency in the estimation of health indicators made a meta-analysis difficult. Establishment of specific set of regulations and strategies to prevent road traffic accidents is proposed. Sori et al, hase shown that education and awareness, law enforcement, proper awarness, and using spiritual and religious potencies to prevent traffic accidents are the main facilitators in Iran. On the other hand, duplicating efforts and insufficient laws along with improper cultural awraeness might be regarded as the main managerial obstacles in the prevention of traffi caccidents (46).

5. Conclusion

A wide variety of health indicators is observed across Iranian studies. Despite many efforts, population-based epidemiologic studies on the effectiveness of primary preventive interventions of traffic accidents are limited in Iran. There seems to be an urgent need to enforce regulations, deliver educational programs and use public media to increase knowledge and awareness of community regarding the burden and importance of the primary prevention in traffic accidents.

6. Limitation

Data related to traffic accidents is constantly underreported and mainly unorganized. This limitation applies to the results and interpretation of the present study. Our results on Iranian studies showed that there is a wide variety in reports of health indicators related to traffic accidents as well as in outcomes of primary preventive measures. This limitation hindered us from conducting a meta-analysis. Therefore, our study was unable to provide any summary measure of effectiveness of preventive programs to reduce traffic accidents, especially among Iranian men as the main victims of these accidents.

7. Appendix

7.1. Acknowledgements

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7.2. Author contribution

All the authors have shared the same workload and thereby are entitled to equal acknowledgement.

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7.4. Conflict of interest

The authors declare no conflict of interest.

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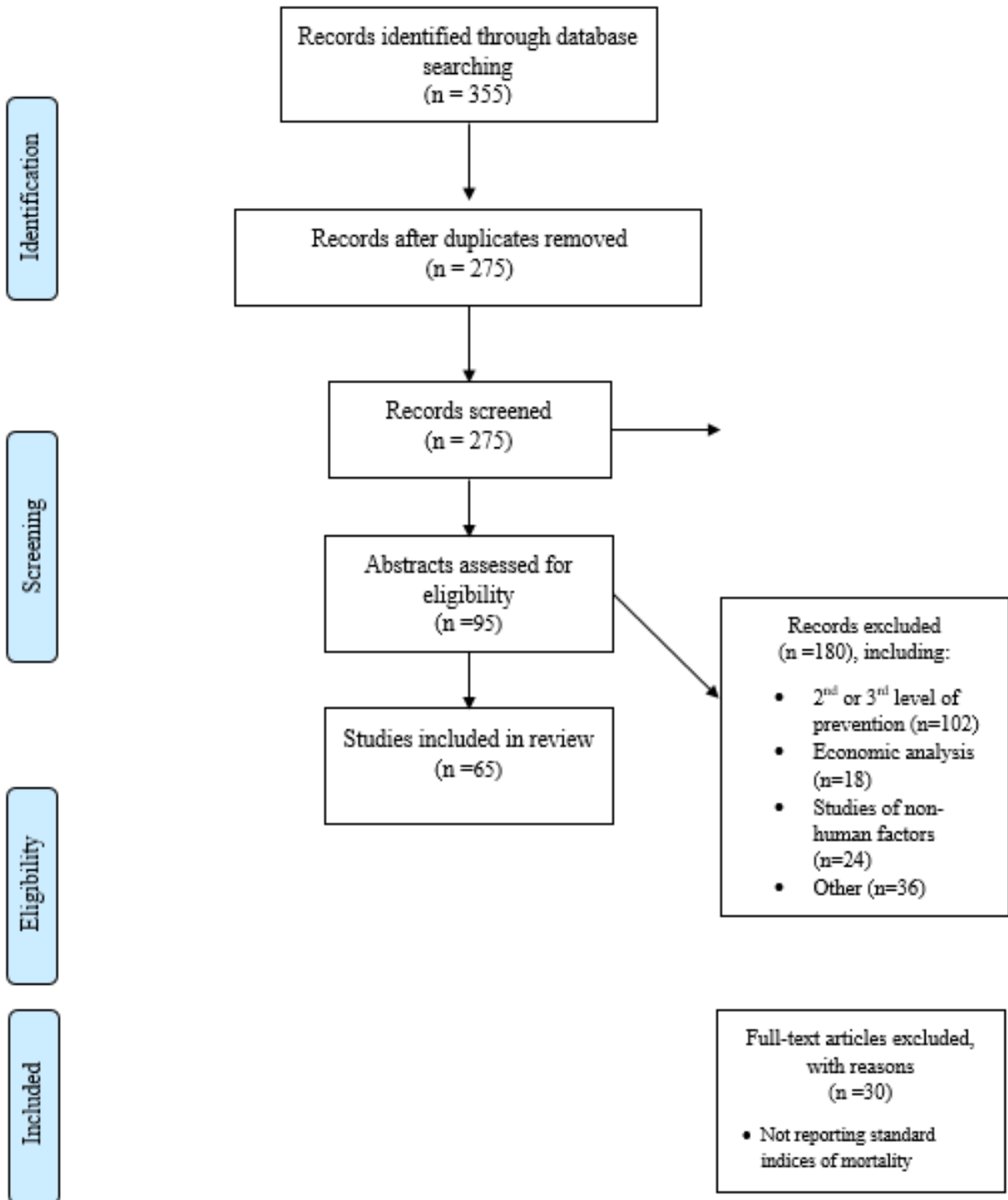
Figure 1: PRISMA flowchart for studies investigating the effectiveness of the primary level of preventive interventions in traffic accidents in Iran during 2009-2019.