The prevalence of hypertension in diabetic patients in Iran; a systematic review and meta-analysis

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ABSTRACT

Context: Hypertension is one of the most important issues in advanced and developing countries and is prevalent in diabetic patients. The present study was aimed at estimating the prevalence of hypertension in diabetic patients in Iran through meta-analysis.

Evidence Acquisitions: The search was carried out using authentic Persian and English keywords in national and international databases including IranMedex, SID, Magiran, IranDoc, Medlib, ScienceDirect, PubMed, Scopus, Cochrane, Embase, Web of Science, Medline and Google Scholar search engine without any time limitation until 2017. Heterogeneity of studies was assessed using I² indexes. Data were analyzed using STATA software version 11.1.

Results: In 32 reviewed studies with a sample of 34714 subjects, the prevalence of hypertension in Iranian diabetic patients was 51% (95% CI, 43%-60%). The prevalence of hypertension was 55% in type I diabetics and 53% in type II diabetic patients. Meta-regression showed that there was no significant relationship between the prevalence of hypertension in diabetic patients with the sample size and year of study.

Conclusions: About half of the diabetic patients in Iran suffer from hypertension. Patients with type 1 diabetes suffer from hypertension 2% more than type 2 diabetes patients. The prevalence of hypertension in diabetic patients in Iran has not significantly decreased over the past years and diabetic patients in northern Iran are more likely to have hypertension than other parts of the country.

Implication for health policy/practice/research/medical education:
The prevalence of hypertension is high in diabetic patients in Iran. Half of diabetic patients suffer from hypertension, which is more common in type 1 diabetic patients than in type 2 diabetic patients (2% difference). Moreover, diabetic patients in the North of Iran suffer from hypertension more than patients in other regions of Iran.


1. Context
Chronic diseases are one of the most important health problems in the world, affecting the economic, social situation and quality of life in patients (1-5). High blood pressure is one of the most common circulatory disorders, which is a global problem, and is a common, asymptomatic disease, often called “silent killer” (6-8). The World Health Organization (WHO) estimates that

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at least 1 billion people in the world have hypertension and about 1.7 million people die each year because of this disease (9). The highest acceptable blood pressure level in healthy people is 140/90 mm Hg, and according to the WHO, systolic hypertension is blood pressure above 140 mmHg and diastolic hypertension is blood pressure above 90 mm Hg (6-8).

One of the most important causes of death in the world is cardiovascular diseases, among which the causes of these diseases, blood pressure and diabetes are known as the major risk factors for these diseases (10-13). Diabetes refers to a set of disorders in carbohydrate, fat, and protein metabolism by the lack of insulin secretion or decreased sensitivity of the tissues to insulin (14). Diabetes is a multifactorial disease, and it seems that genetic and environmental factors are involved in the disease (15). Type 2 diabetes is one of the major health problems in the world, which is rising rapidly in most parts of the world, and it is predicted that more than 592 million people will suffer from diabetes by 2035 (16-18). This is the most common type of diabetes in the whole world and accounts for about 90% of diabetics (10, 19, 20). According to a study, the prevalence of type 2 diabetes is also found to be about 0.3 among people aged 30 or below (21, 22).

The prevalence of hypertension in the 18-74-year-old American population was 29.7% (23), in French men was 37.9% and in French women was 22.2% (24), and in Canadian men and women was 16% and 13%, respectively (25). According to a study by Azizi et al in Tehran, the prevalence of hypertension in the age group of 20-29 years was 6.6% in men and 3.3% in women and in the age group of 60-69 years, it was 62.2% in women and 47.3% in men (26). Considering that various studies in Iran which have reported different statistics ranging from 8% to 85% for the prevalence of hypertension in diabetic patients, the need for a meta-analysis study seems necessary.

2. Evidence Acquisitions
2.1. Search strategy
The present research is a meta-analysis that studies the prevalence of hypertension in diabetic patients in Iran.

To have access to the relevant Persian and English articles, Persian language databases such as IranMedex, SID, Magiran, IranDoc, Medlib and English language databases such as ScienceDirect, PubMed, Scopus, Cochrane, Embase, Web of Science, Medline were searched using Persian keywords and their English equivalent (Iran, Meta-analysis, Diabetic patients and hypertension), independently by two researchers. In order to finalize the search, keywords were also searched in Google Scholar search engine without time limit until 2017. It should be noted that the keywords were also searched in combined forms using OR/AND operators.

2.2. Selection of articles
All studies that reported the prevalence of hypertension in diabetic patients entered the study. To assess the quality of studies, the preferred reporting items for systematic review and meta-analysis (PRISMA) (27) checklist were used.

2.3. Data extraction
To reduce the reporting bias and error in data collection, two researchers independently extracted data from articles and extracted data into a checklist containing the following items: first author's name, title of the study, sample size, year and place of research, the prevalence of hypertension in diabetic patients, type of diabetic disease and body mass index (BMI).

2.4. Statistical analysis
To analyze and combine the results of various studies, the prevalence of hypertension in diabetic patients in each study was considered as a binomial distribution probability and its variance was calculated by binomial distribution. Heterogeneity of studies was evaluated using $\chi^2$-test and $I^2$. Considering the heterogeneity of the studies, the random effects model was used to combine the results of various studies. The data were analyzed using STATA version 11 software and the significance level of the test was considered 0.05.

Meta-regression was used to investigate the relationship between the prevalence of hypertension in diabetic patients and the sample size and year of research. Sensitivity analysis was used to determine whether the omission of each study had any effect on the final meta-analysis.

3. Results

3.1. Summary of how to enter articles into meta-analysis process
Around 136 articles were found in the first step of the search, and 71 duplicate and overlapping articles were omitted after reviewing the titles. About 23 non-related articles were deleted due to non-compliance with the studied criteria. Abstracts of 42 possibly related articles were investigated and 10 articles were deleted due to incomplete information and lack of access to the full text. Finally, 32 papers were selected to enter the meta-analysis stage (Figure 1; Table 1).

In 32 articles with a sample size of 34714 people, the
The prevalence of hypertension in diabetic patients was 51% (95% CI: 43%-60%). The lowest and highest prevalence of hypertension in diabetic patients were in the study of Tabib et al (8%) (28), and Akbarpour et al (85%) (29), respectively. Given the heterogeneity of studies, the confidence interval for each study based on the random effects model is presented in Figure 2. The prevalence of hypertension in patients with type 1 diabetes was 55% (95% CI: 29%-81%) and in patients with type 2 diabetes was 53% (95% CI: 45%-61%). Therefore, hypertension was more visible in type 1 diabetes. In an analysis based on the age group, the prevalence of hypertension in patients aged 10-19 years old was 43% (95% CI: 35%-51%), in patients aged 20-29 years old was 77% (95% CI: 71%-83%), in patients aged 30-39 years old was 8% (95% CI: 4%-12%), in patients aged 40-49 years old was 33% (95% CI: 26%-40%), in patients aged 50-59 years old was 50% (95% CI: 43%-57%) and in patients aged 60-69 years old was 56% (CI 95%: 15%-98%).

The prevalence of hypertension in diabetic patients in the North of Iran was 59% (95% CI: 42%-75%), in the center was 44% (95% CI: 35%-53%), in the West was 51% (95% CI: 41%-60%) and in the East was 49% (95% CI: 40%-58%), and no study was conducted in the South of Iran. The highest and lowest prevalence of hypertension in diabetic patients were in the North and center of Iran, respectively.

In Figure 3, meta-regression showed there was no significant relationship between the prevalence of hypertension in diabetic patients and the number of research samples (P = 0.470). In Figure 4, there was no significant relationship between the prevalence of
hypertension in diabetic patients and the year of study 
(P = 0.413).

4. Discussion
The prevalence of hypertension is quite diverse in 
different regions of a country and in different countries 
(60). In Mashhad, the prevalence of hypertension in 
diabetic patients was 51.6% (61). In the study of Safaee et al, the prevalence in diabetic patients in Isfahan was 
56.2% (62). In a study by Kalantari et al on type 1 diabetic patients, the prevalence of hypertension was 7.7% (54).
Considering the fact that in Iran there are different statistics on the prevalence of hypertension in diabetic patients, performing a meta-analysis seems necessary. According to 32 reviewed articles (1992-2017), the prevalence of hypertension in diabetic patients in Iran was 51% (55% in patients with type 1 diabetes and 53% in patients with type 2 diabetes). According to the statistics reported in the seventh report of the blood pressure monitoring committee, Chobanian et al estimated that 50% of diabetic patients had hypertension (6). That is consistent with our study.
In Figure 4, meta-regression showed that the prevalence of hypertension in diabetic patients did not significantly decrease over the last few years. Sensitivity analysis also showed that the prevalence of hypertension in diabetic patients in Iran decreased to 50.39 (95% CI: 42.99% - 61.21%) by eliminating the study of Akbarrour et al (29), and increased to 52.75 (95% CI: 44.29% - 61.21%) by eliminating the study of Tabib et al (28). According to the result of the final meta-analysis, these two studies were the most effective ones.
According to the results of the American Diabetes Association, the prevalence of hypertension in diabetic

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**Table 1. Specifications of the articles that entered the meta-analysis step**

<table>
<thead>
<tr>
<th>Author</th>
<th>Age</th>
<th>Year</th>
<th>City</th>
<th>Type of diabetes</th>
<th>Sample size</th>
<th>Prevalence of hypertension (%)</th>
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<td>-</td>
<td>1995</td>
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<td>47</td>
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patients in 2003 was reported to be 20% to 60% (63). In a study conducted in Mexico, the incidence of hypertension in diabetic patients was 4.36 people per year and the 5-year incidence was 40% (64). In another study in Tanzania in 1995, the prevalence of hypertension in people with type 2 diabetes was 25.4% over the past 5 years (65). In a study conducted by Al-Maskari et al in 2004 in the United Arab Emirates, the prevalence of hypertension in diabetic patients was reported to be 34.9% (66). The prevalence of hypertension in Jordanian diabetic patients was 70.6% (67). In another study in Europe, 10% of all people with type 1 diabetes were diagnosed with hypertension (68). The prevalence of hypertension in diabetic patients in Iran is higher than that of diabetic patients in Mexico, Tanzania, the United Arab Emirates and Europe.

5. Study limitations
Insufficient data in some articles, lack of uniform distribution of studies in different regions of Iran. Some studies were conducted among diabetic patients and healthy subjects and the ones that did not report the prevalence of hypertension in the two groups were excluded.

6. Conclusions
The prevalence of hypertension is high in diabetic patients in Iran. Half of diabetic patients suffer from hypertension, which is more common in type 1 diabetic patients than in type 2 diabetic patients (2% difference). Moreover, diabetic patients in the North of Iran suffer from hypertension more than patients in other regions of Iran.

Authors’ contribution
All the authors have contributed towards performing the study and preparation of the manuscript and they all have approved the latest version of the article.

Conflicts of interest
The authors declare no conflict of interest.

Ethical considerations
Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors.

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