Original Article

The prevalence and correlated determinants of hypertension and type 2 diabetes:A large community-based study in Isfahan, Iran

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ABSTRACT

Objective: Despite progress in prevention, detection, treatment and control of hypertension and diabetes, their increasing trend of prevalence remains an important public health problem. In general, only a small proportion of hypertension and diabetes is associated with an underlying disease, i.e. most cases are related to modifiable risk factors. Accordingly, as a large scale community-based study in Iran, the purpose of the present research was to evaluate the prevalence and correlated determinants of hypertension and diabetes among the general population in Isfahan.

Methodology: In a cross-sectional study during 2007-2009, 3000 people aged 15-65 years were selected through multi-stage cluster random sampling from the general population in Isfahan. Total and age-sex specific prevalence of hypertension and diabetes were estimated. Multivariate logistic regression was used for studying risk factors and determining their level of association with the risk of hypertension and diabetes simultaneously.

Results: The prevalence of hypertension and diabetes was 22.23% and 6.5% respectively among the studied population. Sex specific prevalence of hypertension was 22.4% and 22.06% for women and men, respectively. The corresponding values were 8.27% and 4.86% for diabetes ($P < 0.05$). Hypertension and diabetes were most prevalent among the age groups of 55-65 years and 45-54 years, respectively. The most important determinants of having hypertension were body mass index (BMI) ($P < 0.01$), age ($P < 0.01$), physical activity ($P < 0.1$) and sex ($P < 0.05$). Age ($P < 0.01$), sex ($P < 0.05$), BMI ($P < 0.1$), and family history ($P < 0.01$) were the major determinants of diabetes.

Conclusion: The prevalence of diabetes and hypertension was high among the studied population. Furthermore, similar to previous studies, the modifiable risk factors played an important role in their incidence. Therefore, primary prevention is of high importance as a natural extension of hypertension and diabetes treatment and as an opportunity to prevent the complications and the costly cycle of their management. Intervention programs in community and practice-based settings should thus be directed to reduce the national prevalence through changes in risky lifestyle behaviors.

KEY WORDS*:* Type 2 Diabetes Mellitus, Hypertension, Risk Factors, Multivariate Logistic Regression.

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INTRODUCTION

Type 2 diabetes is prevailing all over the world. While around 285 million people are currently suffering from the disease, the number is estimated to reach 330 million by the year 2025 and at least 366

million by 2030.[1-5] In Iran, a national research by the Ministry of Health reported the prevalence of type 2 diabetes in people aged 25-64 years as 7.7% in 1998. People suffering from diabetes are more prone to diseases such as heart failure, depression, kidney disorders, retinopathy and chronic wounds.[6,7] A study performed in the Diabetes Research Centre of Isfahan evaluated 4000 type 2 diabetic patients. It reported 34% of heart diseases, 50% of hypertension cases, 12% of kidney disorders, 44% of retinopathy cases, 5% of cataracts, and 37% of non-traumatic leg dismemberments to be caused by diabetes. In addition, 27% of stroke sufferers, 15% of individuals suffering from heart failure, and 15% of haemodialysis patients were found to be diabetics.[8] While hypertension is a common disorder with no signs, it can be diagnosed and treated easily. The increased prevalence of hypertension and its usual association with future heart disorder has turned it into a clinical health problem in developed countries in which 25% of adults and 60% of people over 60 years of age suffer from hypertension.[9] In the Middle Eastern countries, hypertension has increased dramatically.[10] A previous study detected an increase in the prevalence (23.3%) of this disease. It also added that with hypertension remaining untreated, 50% of the sufferers would die from heart failure, 23% from stroke, and about 10-15% from kidney disorder. However, if treated properly, the side effects are preventable.[8]

Many international studies have concentrated on factors resulting in type 2 diabetes and hypertension. They have found the increased chance of getting diabetes to be related with higher numbers of smoked cigarettes per day and higher body mass index (BMI). They also suggested fish consumption and physical activity to decrease the chance of getting diabetes.[11-16] A study by the American Heart Association showed a relation between hypertension and BMI.[17] Another study by Salem and Rezaeian confirmed the same relation.[18] According to Bazzano et al, although vegetables consumption reduced the chance of getting diabetes, fruits did not affect the disease.[19] Hsia et al could not establish a significant relation between physical activity and a lessened chance of diabetes in different races.[20]

Studies in the cities of Qazvin, Kermanshah, and Tehran in Iran, relationships were found between increased age and the chance of getting diabetes and hypertension. Likewise, gender and BMI were reported as related with the chance of getting diabetes and hypertension.[9,21,22] Adel et al. could find a similar association between increased and hypertension.[23] On the other hand, Mohebbi et al. did not indicate significant relations between the severity and amount of physical activity and decreased systolic blood pressure or changes in diastolic blood pressure.[24] Fakhrzadeh et al. found that physical activity decreased the chance of diabetes in overweight persons more than normal subjects.[25] Azizi et al. proved factors such as BMI and family history to be effective on type 2 diabetes and hypertension.[26] Azimi-Nezhad et al. showed no significant relationship between gender and the chance of getting diabetes.[1]

Hypertension and type 2 diabetes are important risk factors of heart disease, which is known to be one of the most common reasons for death in the world.[27,28] In the current study, a large sample of Iranian population aged 15-64 years was analyzed using comprehensive statistical method to determine the effects of risk factors on the correlated diseases, type 2 diabetes and hypertension, simultaneously. Our objective was to evaluate the prevalence and correlated determinants of hypertension and diabetes among the general population in Isfahan.

METHODOLOGY

This cross-sectional, descriptive, analytical research was conducted to estimate the prevalence of hypertension and diabetes and their correlated determinants among the general population living in Isfahan, Iran. It started in 2007 and lasted until December 2009.

Sampling strategy, participants, and research instruments: Subjects were selected by a multistage stratified cluster sampling strategy. Among people inhabiting in main municipality areas and suburbs of Isfahan, 3000 adults aged 15-64 years were interviewed through a comprehensive questionnaire consisting mainly of close-ended questions. To ensure that the survey was administered consistently and accurately, survey administration training was provided to all interviewers.

The questionnaire consisted of two main sections. The first part included socio-demographic variables such as age, gender, marital status, ethnicity, occupation status, education level, and family history. The second part encompassed questions related to nutritional habits, tobacco smoking, BMI, physical activity, blood pressure and blood sugar. According to the World Health Organization (WHO), hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or taking antihypertensive

medications. In addition, as stated by the American Diabetic Association criteria, a fasting blood sugar (FBS) < 110 mg/dL was considered as normal while values between 110 and 126 mg/dL, and those above 126 mg/dL were considered as impaired fasting glucose (IFG) and diabetes mellitus (DM), respectively.

Statistical Analysis: In order to estimate the prevalence of the two studied diseases, the data obtained from the questionnaire was analyzed by descriptive statistical techniques. On the other hand, multivariate logistic regression was used to determine the risk factors associated with simultaneous presence or absence of hypertension and diabetes in each participant and to evaluate the effects of risk factors. A method for analyzing correlated binary outcomes when the responses are distinct measurements made simultaneously on a single individual is presented. This extension of univariate logistic regression allows us to model the dependence of the responses on a set of covariates while estimating the degree of association among them. All analyses were carried out using "R" (an open source statistical software) version 2.13.2.

RESULTS

The total respondents in study sample included 3000 people aged 15-65 years. Table-I reports the complete information related to the socio-demographic characteristics, dietary habits, and total and stratified prevalence of diseases. As Table-I shows, sex (50.6% male vs. 49.4% female) and age distributions were almost similar among the studied subjects. Total prevalence of hypertension and diabetes were 22.2% and 6.6%, respectively. Hypertension was found in 22.4% of women and 22.06% of men ($P < 0.1$) while for the corresponding values for diabetes were 8.27% and 4.86% ($P < 0.01$).

Table-II presents the effects of potentially associated risk factors for simultaneous presence of hypertension and diabetes through regression coefficients estimated by fitted multivariate logistic regression. As stated earlier, such modeling framework can take into account the correlation between multivariate binary outcomes (in this study the existence of a positive correlation between hypertension and diabetes).

Multivariate logistic regression simultaneously provided the possibility for studying the determinants of presence of hypertension and diabetes. The

Table-I: Basic characteristics of the study participants, as well as total and stratified prevalence of diseases.

Characteristic		*Frequency (%)*	*Diabetes*		*Hypertension*	
			Yes N (%)	*No N (%)*	*Yes N (%)*	*No N (%)*
Sex	Female	1482 (49.4)	124(8.37)	1358(91-73)	332 (22.4)	1150 (77.6)
	Male	1518 (50.6)	74 (4.86)	1444 (95.14)	335 (22.06)	1183 (77.94)
Age	15-24	571 (19)	5 (0.92)	566 (99.08)	28 (4.45)	543 (95.55)
	25-34	608 (20.3)	8 (1.38)	600 (98.62)	70 (10.78)	538 (89.22)
	35-44	610 (20.3)	24 (3.82)	586 (96.18)	107 (16.75)	503 (83.25)
	45-54	598 (19.9)	56 (9.28)	542 (90.72)	169 (22.98)	429 (73.02)
	55-64	613 (20.4)	105 (16.77)	508 (83.23)	293 (46.68)	320 (53.32)
BMI	> 30	689 (23)	80 (11.7)	609 (88.3)	257 (36.61)	432 (63.39)
	25-30	994 (33.1)	77 (7.89)	917 (92.11)	261 (25.8)	733 (74.2)
	< 25	1317 (43.9)	41 (3.18)	1276 (96.82)	149 (11.2)	1168 (88.8)
Smoking	No	2561 (85.4)	182 (7.11)	2379 (92.89)	583 (22.76)	1978 (77.24)
	Yes	439 (14.6)	16 (3.64)	423 (96.36)	84 (19.13)	355 (80.87)
Type of consumed oil	Solid vegetable oil, butter and other animal fats	1196 (39.3)	77 (6.43)	1119 (93.57)	272 (22.74)	924 (77.26)
	Liquid vegetable cooking and frying oil	1804 (60.1)	121 (6.71)	1683 (93.29)	395 (21.9)	1409 (78.1)
Diabetes family history	Yes	881 (29.4)	117 (13.28)	764 (86.72)	222 (25.2)	695 (74.8)
	No	2119 (70.6)	81 (3.28)	2038 (96.18)	445 (21.0)	1674 (79.0)
Hypertension 0 (0)	Yes	667 (22.2)	89 (13.29)		578 (86.71))	667 (100)
	No	2333 (77.8)	110 (4.71)	2223 (95.29)	0 (0)	2333 (100)
Diabetes	Yes	198 (6.6)	198 (100)	0 (0)	86 (43.51)	112 (56.49)
	No	2802 (93.4)	0 (0)	2802 (100)	558 (19.9)	2244 (80.10)

interpretation of estimated regression coefficients in this model is similar to multinomial logistic regression. One of the categories (in each considered outcome) is chosen as the reference category and the covariates coefficients can be interpreted as odds or log odds ratios of being an individual in a specific category instead of reference ones. Table-II presents only the odds ratio for statistical and some others important predictor variables.

As it is seen in Table-II, higher age significantly increased the odds of being diabetic and hypertensive individual (OR = 1.08; P < 0.01 and OR = 1.06; P < 0.01 for diabetes and hypertension, respectively). Women were more likely to be diabetic than men (OR = 1.44; P < 0.05) and hypertensive (OR = 1.25; P < 0.05). Higher BMI decreased the odds of being diabetic and hypertensive (OR = 1.024 and OR = 1.075, respectively). Another effective factor on level of awareness was family history, i.e. positive family history led to greater odds of being diabetic (OR = 3.63; P < 0.01). However, it was not proved as a statistically significant predictor of being hypertensive. Less physical activity increased the odds of being diabetic although this relation was not statistically significant. On the other hand, the reverse relationship between level of physical activity and hypertension was statistically significant (OR = 1.65; P < 0.05). Smoking was positively associated with the presence of both diseases although these relations were not statistically significant. More information about the effects of others potential determinants can be found in Table-II.

DISCUSSION

Hypertension and diabetes are non-communicable diseases with different side effects which lead to an exponential increasing in mortality. The prevalence and incidence of both diseases are growing dramatically. However, these diseases and their complications are preventable through knowledge toward their warning signs and performing effective practices.

In the current research, diabetes was found to be more prevalent among women (P < 0.05). Horikoshi et al reported similar findings in Japan.[29] The present research revealed a strong correlation between diabetes and age (P < 0.01). Likewise, Maleckzadeh et al found a comparable relation after studying 1000 adult participants over 25 years of agein Qazvin.[30] Although the present research could not establish a statistically significant relationship between fruit and vegetable consumption and the odds of being diabetic, some previous studies reported significant associations[31] In this study, fish consumption was not statistically in relation with odds of being hypertensive and diabetic.

Table-II: The estimated multivariate logistic regression coefficients.

Dependent variables	*Independent variables*	*Estimated coefficients*	*P*	*Odds ratio*
Diabetes	Sex (ref: Men)	0.363	< 0.05	1.438
	Age	0.079	< 0.01	1.082
	Fruits	-0.005	NS	-
	Vegetables	-0.013	NS	-
	Fish	-0.076	NS	-
	Oil (ref: Solid oil)	0.004	NS	-
	BMI	0.024	< 0.1	1.024
	Smoking (ref: Yes)	-0.016	NS	-
	Diabetes family history (Ref: No)	1.29	< 0.01	3.634
	Physical activity	0.257	NS	1.294
Hypertension	Sex (ref: Men)	0.222	< 0.05	1.249
	Age	0.065	< 0.01	1.067
	Fruits	-0.008	NS	-
	Vegetables	-0.004	NS	-
	Fish	-0.033	NS	-
	Oil (Ref: Solid oil)	-0.087	NS	0.91
	BMI	0.072	< 0.01	1.075
	Smoking (ref: Yes)	-0.014	NS	0.98
	Diabetes family history (Ref: No)	0.106	NS	1.11
	Physical activity	0.063	< 0.1	1.065
Correlation coefficient	Hypertension and Diabetes	0.148	< 0.0001	-

However, Patel et al showed a statistically significant relationship between consumption of some types of fish and the two diseases.[11] The type of consumed oil in the present research was not significantly related with the prevalence of diabetes and hypertension. This finding is not consistent with some rare previous studies showing associations between type of consumed oil and less odds of being hypertensive and lower levels of glucose.[32]

The present research showed a marginally statistically significant association between BMI and diabetes prevalence ($P < 0.1$). Riaz et al. reported strong correlations between diabetes prevalence and BMI, obesity, age and family history.[33] Similar to the study by Fakhrzade et al on 24-65 year-old adults in Tehran, Iran,[25] our study suggested insignificant relations between smoking and less physical activity and increased odds of being diabetic. More comprehensive studies, particularly in prospective construct, are needed for examining possible effects of the type, intensity and duration of physical activity on its preventive role in diabetes incidence.

Consistent with previous studies,[9,23] the multivariate analysis in the present study indicated the prevalence of hypertension to be highly correlated with sex, age, and BMI. Although, exercise enhances the activity of insulin and thus lack of physical activity is known to be associated with diabetes mellitus, our findings could not confirm such facts. However, physical activity was marginally correlated with hypertension ($P < 0.1$). Furthermore, in our study a significant relationship between smoking and hypertension was not observed. On the other hand, family history was found to be directly yet insignificantly related with increased hypertension (OR = 1.1). It was also associated with diabetes (OR = 3.63; $P < 0.01$). Similarly, previous surveys conducted in Iran as well as other countries reported higher prevalence of diabetes among people with a family history of the disease.[34,35]

CONCLUSION

In conclusion, the present study tried to determine the prevalence and the effect of some environmental and non-environmental risk factors of type 2 diabetes and hypertension in the adult population of Isfahan, Iran. The prevalence of hypertension and diabetes was high among the studied population. Furthermore, similar to previous studies, the modifiable risk factors played an important role in their prevalence. The characterization of these factors will contribute to defining more effective and specific strategies to screen and control diabetes mellitus and hypertension in this studied population. The findings might also be extendable to the whole Iranian population. Primary prevention is of utmost importance as a natural extension of hypertension and diabetes treatment and as an opportunity to prevent the complications and the costly cycle of their management. Therefore, intervention programs in community and practice-based settings should be directed to reduce the national prevalence through changes particularly in risky behaviors.

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