ORIGINAL ARTICLE

Analysis of the Results of the National Diabetes and Blood Pressure Screening Survey Data

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Abstract

Background: Hypertension and diabetes mellitus are major risk factors for cardiovascular diseases, the leading cause of premature death worldwide. In Iran, screening programs for these conditions have been integrated into the health system, but a comprehensive evaluation is lacking. This study aimed to analyze the results of the national diabetes and hypertension screening survey in Iran, with a focus on the Mashhad metropolis.

Methods: We conducted a cross-sectional, descriptive-analytical study using data from the 2023 National Diabetes and Hypertension Screening Program in Iran. The study population included 2,445,151 individuals aged 18 and above. Demographic information, medical history, and screening results were collected. Univariate and multivariate logistic regression analyses were performed to determine the factors associated with hypertension and diabetes.

Results: Of the participants, 8.15% had previously known hypertension, and 1.35% were newly identified as suspected hypertensive people. For diabetes, 3.36% had a previous diagnosis, and 0.72% were newly identified as suspected diabetics. Age was the strongest predictor for both conditions (AOR for 61+ age group: 79.34, 95% CI: 73.06-86.16 for both conditions). BMI over 25 was also a significant risk factor (AOR: 2.31, 95% CI: 2.23-2.40 for suspected hypertension and diabetes). Higher education levels showed a protective effect against both conditions.

Conclusion: This large-scale screening program revealed substantial rates of undiagnosed hypertension and diabetes in Iran. The study highlights the complex interplay of demographic, socioeconomic, and lifestyle factors in the development of these conditions. These findings underscore the importance of targeted screening and prevention strategies, particularly focusing on older adults, those with higher BMI, and populations with lower educational attainment.

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Introduction

Cardiovascular diseases (CVDs) are the leading cause of premature death worldwide, with hypertension being a major risk factor.[1] The World Health Organization reports that the number of people with hypertension (defined as blood pressure ≥140/90 mmHg or on antihypertensive medication) doubled from 650 million to 1.3 billion between 1990 and 2019.[1, 2] Alarmingly, about half of those with hypertension are unaware of their condition, with 53% of women and 62% of men with high blood pressure not receiving necessary treatment.[2]

Hypertension, often referred to as the "silent killer" due to its asymptomatic nature, affects one in three adults globally.[3, 4] It significantly increases the risk of stroke, heart attack, heart failure, and kidney damage.[2] The global burden of hypertension continues to rise, driven by lifestyle changes, population growth, inadequate treatment, and aging.[5, 6] Notably, low- and middle-income countries bear the highest disease burden caused by hypertension, coupled with the lowest rates of treated and controlled blood pressure.[5]

Alongside hypertension, diabetes mellitus, particularly type 2 diabetes, poses another significant global health challenge. The International Diabetes Federation estimated that approximately 415 million people worldwide had diabetes in 2015, with projections suggesting this number could exceed 640 million by 2040.[7] Notably, about half of diabetic patients are unaware of their condition, leaving them vulnerable to various complications.[8, 9]

Diabetes complications are broadly categorized into microvascular (including neuropathy, nephropathy, and retinopathy) and macrovascular (such as cardiovascular disease, stroke, and peripheral artery disease).[9] These complications contribute significantly to morbidity and mortality rate, underscoring the importance of early detection and management.[10-16]

Both diabetes and hypertension are major risk factors for mortality from non-communicable diseases. Their often-asymptomatic nature means that many affected individuals remain undiagnosed until pathological and functional damage has progressed considerably.[11-16] This delay in diagnosis results in high morbidity and mortality rates, emphasizing the critical need for early detection and timely intervention.[17, 18]

Screening programs integrated into health systems play a crucial role in identifying individuals at risk of these diseases, facilitating early management and prevention.[17, 18] The Diabetes Prevention Program Research Group has demonstrated that lifestyle interventions or metformin use can significantly reduce the incidence of type 2 diabetes.[17] Similarly, early detection and treatment of type 2 diabetes have been shown to reduce cardiovascular morbidity and mortality.[18]

Given the substantial impact of type 2 diabetes and hypertension on adult health, screening programs for these conditions have been integrated into the health system in Iran. However, a comprehensive evaluation of these screening programs is lacking. Therefore, this study aimed to analyze the results of the national diabetes and blood pressure screening survey data in Iran, with a specific focus on the population affiliated with Mashhad University of Medical Sciences.

Methods

Study Design and Population

This study employed a cross-sectional, descriptive-analytical design using secondary data analysis. The primary data source was the Sina Electronic Health Record (SinaEHR) system, a comprehensive electronic health information system developed and implemented by Mashhad University of Medical Sciences (MUMS). SinaEHR supports primary care delivery across various regions of Iran, covering a population of over 5 million people.[19]

We analyzed data from the 2023 National Diabetes and Hypertension Screening Program, which was conducted between early December 2023 and late January 2024. This screening program was integrated into the routine data collection within the SinaEHR system, allowing for a large-scale, population-based assessment.

Screening Procedures

Trained coordinators were present at various screening sites. Blood pressure was measured using manual or automatic (digital) sphygmomanometers. All blood pressure measurements were taken in sitting position. Participants rested for 5 minutes before the first measurement, and two measurements were taken with at least a 1-minute interval between each. Weight and height were also recorded. Blood pressure was calculated as the average of the first and second readings. Hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, or the use of antihypertensive medications, or both.

Blood glucose concentration was measured using a glucometer and the glucose oxidase method. Participants were classified as non-diabetic if they had fasted for more than 8 hours and their fasting blood glucose was <100 mg/dL. If fasting blood glucose was ≥100 mg/dL or random blood glucose was ≥140 mg/dL, the participants were referred to a laboratory for venous fasting blood glucose testing after at least 8 hours of fasting. Diabetes diagnosis was based on the World Health Organization and American Diabetes Association criteria. Fasting blood glucose of 100-125 mg/dL was considered impaired glucose tolerance, while ≥126 mg/dL was classified as diabetes. Previously diagnosed diabetics managed with diet or glucose-lowering medications were considered diabetic regardless of new test results.

Data Collection

Demographic information collected included:

1. Residential area (rural, urban <20,000 population, urban 20,000-1 million population, metropolitan, and suburban)

2. Gender (male, female)

3. Nationality (Iranian, non-Iranian)

4. Marital status (single, married)

5. Educational status (illiterate, below diploma, university)

6. Employment status (employed, self-employed, unemployed, income without work)

7. Age

Campaign-related information included history of heart attack and stroke.

Blood pressure screening results were categorized as:

1. Healthy (<120/80 mmHg)

2. Pre-hypertension (120-139/80-89 mmHg)

3. Suspected hypertension (≥140/90 mmHg)

4. Previously diagnosed hypertension

Diabetes screening results were categorized as:

1. Healthy (<100 mg/dL)

2. Pre-diabetic (100-125 mg/dL)

3. Suspected diabetes (≥126 mg/dL)

4. Previously diagnosed diabetes

All measurements were conducted according to the Iranian Ministry of Health, Treatment and Medical Education protocols for hypertension and diabetes.

Sample Size and Statistical Analysis

The study employed a census approach, including all individuals who participated in both the National Diabetes and Hypertension Screening Program and the STEPS study. Data were analyzed using Stata version 16. Descriptive statistics, including means and standard deviations for quantitative variables and frequencies and percentages for qualitative variables, were calculated. Chi-square tests were used to compare frequencies across the groups. Logistic regression analysis was performed to examine the relationship between independent and dependent variables.

For the multivariate analysis, adjusted odds ratios (AORs) with 95% confidence intervals (CIs) were calculated to assess the strength of associations between various factors and the outcomes of interest (diabetes and hypertension). Age, gender, BMI, education level, occupation, physical activity, smoking status, and addiction were included as covariates in the models. A p-value <0.05 was considered statistically significant for all analyses.

Ethical Considerations

The study protocol was approved by the Ethics Committee of Mashhad University of Medical Sciences (IR.MUMS.FHMPM.REC.1402.222). As this study used de-identified secondary data from the SinaEHR system, individual informed consent was not required.

Results

Demographic Characteristics and Prevalence

Our study analyzed data from a large-scale national screening program for diabetes and hypertension in Iran. A total of 2,353,033 individuals were included in the analysis for diabetes, and 2,445,151 for hypertension (Tables 1 and 2). The diabetes screening results revealed that 71.22% of the participants were classified as healthy, 4.40% as pre-diabetic, 0.72% as suspected diabetic, and 3.36% had previously known diabetes (Table 1). For hypertension, 54.07% were classified as healthy, 11.91% as pre-hypertensive, 1.35% as suspected hypertensive, and 8.15% had previously known hypertension (Table 2).

Age distribution varied significantly across health categories for both conditions. For diabetes, the majority of healthy individuals were in the 31-40 age group (31.51%), while the majority of those with known diabetes were in the 61-90 age group (50.62%). Similarly, for hypertension, the healthy group was predominantly 31-40 years old (34.92%), while the known hypertensive group was mostly 61-90 years old (56.01%) (Tables 1 and 2).

Gender differences were observed in both conditions. Females were slightly overrepresented in the healthy group for diabetes (50.64%) and hypertension (52.44%), but males were overrepresented in the suspected diabetes (50.18%) and suspected hypertension (60.38%) groups (Tables 1 and 2).

Education level showed an inverse relationship with both diabetes and hypertension prevalence. For instance, 25.28% of the known diabetics were illiterate, compared to only 7.42% of the healthy group. A similar trend was observed for hypertension (Tables 1 and 2).

Table 1: Demographic and Clinical Characteristics of Participants by Diabetes Status in the National Screening Program, Iran 2023

Variable	Healthy N (%)	Pre - Diabetes N (%)	Suspected Diabetes N (%)	Previous known disease N (%)
Age				
0-20	38,839(2.32)	215(0.21)	14(0.08)	49(0.06)
21-30	362,443(21.63)	4,552(4.40)	360(2.13)	677(0.86)
31-40	528,071(31.51)	18,014(17.40)	2,005(11.89)	4,049(5.12)
41-50	371,714(22.18)	29,894(28.87)	4,573(27.11)	13,101(16.58)
51-60	189,746(11.32)	24,209(23.38)	4,683(27.76)	21,151(26.76)
61-90	185,007(11.04)	26,649(25.74)	5,233(31.02)	40,006(50.62)
Gender				
Male	827,210(49.36)	46,614(45.02)	8,465(50.18)	29,487(37.31)
Female	848,610(50.64)	56,919(54.98)	8,403(49.82)	49,546(62.69)
Married Status				
Married	1,304,917(77.87)	87,358(84.38)	14,051(83.30)	63,484(80.33)
Single	370,903(22.13)	16,175(15.62)	2,817(16.70)	15,549(19.67)
Education level				
Illiterate	124,401(7.42)	14,218(13.73)	2,532(15.01)	19,977(25.28)
Elementary	490,960(29.30)	36,504(35.26)	5,955(35.30)	30,591(38.71)
Diploma	748,174(44.65)	34,651(33.47)	5,220(30.95)	18,025(22.81)
Academic	312,285(18.63)	18,160(17.54)	3,161(18.74)	10,440(13.21)
Residence				
Under one million				
Suburban	378,365(22.58)	23,022(22.24)	4,066(24.10)	17,338(21.94)
Village	324,661(19.37)	20,069(19.38)	3,631(21.53)	12,095(15.30)
Metropolitan	588,143(35.10)	36,259 (35.02)	5,049(29.93)	31,191(39.47)
	384,651 (22.95)	24,183(23.36)	4,122(24.44)	18,409(23.29)
Job				
Housewife	544,503(33.23)	40,418(40.01)	5,860(35.74)	37,495(48.51)
Student	151,998(9.28)	1,701(1.68)	153(0.93)	399(0.52)
Unemployment	35,721(2.18)	1,635(1.62)	334 (2.04)	1,427 (1.85)
Employee	92,393(5.64)	7,489(7.41)	1,285(7.84)	3,892(5.04)
Farmer/Worker	294,317(17.96)	18,096(17.91)	2,891(17.63)	11,188(14.47)
Armed Forces	12,441(0.76)	677(0.67)	125 (0.76)	300(0.39)
Free Job	506,973(30.94)	31,001(30.69)	5,747(35.05)	22,596(29.23)
Nationality				
Yes	1,590,586(94.91)	99,546(96.15)	16,258(96.38)	76,246(96.47)
No	85,234(5.09)	3,987(3.85)	610(3.62)	2,787(3.53)
Smoking				
Yes	161,082(9.61)	9,455(9.13)	1,457(8.64)	6,134(7.76)
No	1,514,7389(90.39)	94,078(90.87)	15,411(91.36)	72,899(92.24)
Addiction				
Yes	10,199(0.61)	675(0.65)	118(0.70)	661(0.84)
No	1,665,621(99.39)	102,858(99.35)	16,750(99.30)	78,372(99.16)
BMI_over_25				
Yes	732,261(43.70)	74,241(71.71)	12,394(73.48)	57,598(72.88)
No	943,558(6.30)	29,292(28.29)	4,474(26.52)	21,433(27.12)
Physical activity				
Yes	668,337(39.88)	50,136(48.43)	7,775(46.09)	39,175(49.57)
No	1,007,483(60.12)	53,397(51.57)	9,093(53.91)	39,858(50.43)
Psychological disorder				
Yes	272,521(16.26)	18,627(17.99)	3,043(18.04)	14,071(17.80)
No	1,403,299(83.74)	84,906(82.01)	13,825(81.96)	64,962(82.20)
Waist (ref:<82)				
Yes	1,462,306(87.26)	94,379(91.16)	15,866(94.06)	73,246(92.68)
No	213,514(12.74)	9,154(8.84)	1,002(5.94)	5,787(7.32)

Occupation was also associated with disease prevalence. Housewives represented the largest proportion of known diabetics (48.51%) and known hypertensive ones (50.12%), while they constituted a smaller proportion of the healthy groups (33.23% for diabetes and 34.07% for hypertension) (Tables 1 and 2).

A BMI over 25 was strongly associated with both conditions. 72.88% of known diabetics and 68.24% of known hypertensives had a BMI over 25, compared to 43.70% and 40.61% in the respective healthy groups (Tables 1 and 2).

Multivariate Analysis

In the multivariate analysis, age was the strongest

Table 2: Demographic and Clinical Characteristics of the Participants by Hypertension Status in the National Screening Program in Iran, 2023

Variable	Healthy N (%)	Pre hypertension N (%)	Suspected hypertension N (%)	Previous known disease N (%)
Age				
0-20	36,747(2.78)	2,499(0.86)	94(0.28)	40(0.02)
21-30	338,036(25.57)	31,024(10.66)	1,453(4.40)	1,110(0.56)
31-40	461,662(34.92)	76,961(26.43)	5,156(15.62)	8,607(4.32)
41-50	285,836(21.62)	81,336(27.94)	8,649(26.21)	28,695(14.40)
51-60	122,729(9.28)	51,456(17.67)	8,064(24.44)	49,205(24.70)
61-90	77,138(5.83)	47,873(16.44)	9,583(29.04)	111,588(56.01)
Gender				
Male	628,856(47.56)	176,061(60.47)	19,924(60.38)	71,611(35.94)
Female	693,292(52.44)	115,088(39.53)	13,075(39.62)	127,634(64.06)
Married Status				
Married	1,028,095(77.76)	233,471(80.19)	26,062(78.98)	156,504(78.55)
Single	294,053(22.24)	57,678(19.81)	6,9379(21.02)	42,741(21.45)
Education level				
Illiterate	70,527(5.33)	23,594(8.10)	3,741(11.34)	60,409(30.32)
Elementary	386,484(29.23)	84,102(28.89)	9,855(29.86)	76,429(38.36)
Diploma	630,253(47.67)	116,322(39.95)	11,176(33.87)	38,078(19.11)
Academic	234,884(17.77)	67,131(23.06)	8,227(24.93)	24,329(12.21)
Residence				
Under one million	298,882(22.61)	66,951(23.00)	5,821(17.64)	41,925(21.04)
Suburban	257,302(19.46)	59,146 (20.31)	7,719(23.39)	28,906(14.51)
Village	492,519(37.25)	77,889(26.75)	7,178(21.75)	87,695(44.01)
Metropolitan	273,445(20.68)	87,163(29.94)	12,281(37.22)	40,719(20.44)
Job				
Housewife	441,865(34.07)	72,476(25.81)	8,357(26.66)	97,835(50.12)
Student	141,194(10.89)	12,823(4.57)	605(1.93)	609(0.31)
Unemployment	28,117 (2.17)	5,808(2.07)	710(2.27)	3,984(2.04)
Employee	67,679(5.22)	23,249(8.28)	2,617(8.35)	8,376(4.29)
Farmer/Worker	230,827(17.80)	57,199(20.37)	5,413(17.27)	31,197(15.98)
Armed Forces	9,544(0.74)	2,834(1.01)	226(0.72)	618(0.32)
Free Job	377,682(29.12)	106,462(37.91)	13,416(42.80)	52,593(26.94)
Nationality				
Yes	1,247,265(94.34)	281,451(96.67)	31,879(96.61)	193,121(96.93)
No	74,883(5.66)	9,698(3.33)	1,120(3.39)	6,124(3.07)
Smoking				
Yes	129,637(9.81)	28,453(9.77)	2,881(8.73)	14,671(7.36)
No	1,192,511(90.19)	262,696(90.23)	30,118(91.27)	184,574(92.64)
Addiction				
Yes	7,026(0.53)	2,140(0.74)	244(0.74)	1,877(0.94)
No	1,315,122(99.47)	289,009(99.26)	32,755(99.26)	197,368(99.06)
BMI_over_25				
Yes	536,862(40.61)	167,151(57.41)	22,048(66.81)	135,959(68.24)
No	785,284(59.39)	123,998(42.59)	10,951(33.19)	63,285(31.76)
Physical activity				
Yes	520,334(39.36)	120,259(41.30)	12,612(38.22)	100,082(50.23)
No	801,814(60.64)	170,890(58.70)	20,387(61.78)	99,163(49.77)
Psychological disorder				
Yes	209,429(15.84)	52,756(18.12)	5,853(17.74)	34,788(17.46)
No	1,112,719(84.16)	238,393(81.88)	27,146(82.26)	164,457(82.54)
Waist (ref:<82)				
Yes	177,071(13.39)	264,811(90.95)	30,848(93.48)	177,785(89.23)
No	1,145,077(86.61)	26,338(9.05)	2,151(6.52)	21,460(10.77)

predictor for both diabetes and hypertension. For diabetes, the adjusted odds ratio (AOR) for the 61+ age group compared to the <30 group was 79.34 (95% CI: 73.06-86.16). For hypertension, the corresponding AOR was 17.01 (95% CI: 15.11-19.16) for suspected hypertension and 79.34 (95% CI: 73.06-86.16) for known hypertension (Tables 3 and 4). A BMI over 25 was also a strong predictor, with AORs of 2.31 (95% CI: 2.23-2.40) for suspected diabetes and 2.31 (95% CI: 2.23-2.40) for suspected hypertension (Tables 3 and 4).

Education level showed a protective effect, with higher education associated with lower odds of both conditions. For instance, academic education had an AOR of 0.73 (95% CI: 0.71-0.76) for known diabetes compared to illiteracy (Tables 3 and 4). Interestingly, after adjusting for other factors, gender showed mixed effects. While females had higher odds of known diabetes (AOR: 1.20, 95% CI: 1.17-1.23), they had lower odds of suspected hypertension (AOR: 0.80, 95% CI: 0.76-0.84) (Tables 3 and 4).

Table 3: Univariate and Multivariate Logistic Regression Analysis of the Factors Associated with Hypertension

Variable	Pre-Hypertension (n=)291,149		Suspect-Hypertension (n=) 59,061		Hypertension-known (n=) 199,245	
	OR,95%CI	AOR,95%CI	OR,95%CI	AOR,95%CI	OR,95%CI	AOR,95%CI
Gender (ref: male)	1.16(1.15,1.18)	1.00(0.98,1.02)	0.93(0.91,0.96)	0.80(0.76,0.84)	1.62(1.59,1.64)	1.20(1.17,1.23)
Age(ref:<30,years)						
30-39y	2.84(2.75,2.93)	2.19(2.11,2.27)	3.96(3.54,4.42)	3.20(2.83,3.61)	4.13(3.82,4.47)	3.44(3.15,3.75)
40-49y	6.48(6.28,6.68)	4.57(4.41,4.74)	11.99(10.79,13.32)	8.79(7.81,9.89)	18.05(16.75,19.45)	13.54(12.46,14.71)
50-59y	9.47(9.18,9.78)	6.55(6.32,6.80)	21.66(19.49,24.07)	15.42(13.70,17.36)	54.15(50.28,58.32)	38.75(35.67,42.10)
+60y	9.76(9.46,10.07)	7.41(7.14,7.69)	22.61(20.36,25.12)	17.01(15.11,19.16)	103.25(95.93,111.14)	79.34(73.06,86.16)
Married Status (ref: married)	0.65(0.64,0.66)	2.19(2.11,2.27)	0.72(0.69,0.75)	1.01(0.96,1.06)	0.88(0.86,0.89)	0.98(0.96,1.01)
Education(ref: illiterate)						
Elementary	0.71(0.70,0.72)	1.03(1.01,1.05)	0.66(0.63,0.70)	0.99(0.94,1.04)	0.40(0.39,0.41)	0.96(0.94,0.98)
Diploma	0.46(0.45,0.47)	0.97(0.95,1.00)	0.40(0.38,0.42)	0.93(0.88,0.99)	0.16(0.158,0.165)	0.86(0.83,0.88)
Academic	0.57(0.56,0.58)	1.00(0.97,1.03)	0.58(0.55,0.61)	0.98(0.92,1.04)	0.22(0.215,0.226)	0.73(0.71,0.76)
Resident(ref: Under one million)						
Suburban	1.02(1.00,1.04)	1.07(1.05,1.09)	1.04(1.00,1.09)	1.09(1.04,1.15)	0.81(0.79,0.83)	0.82(0.80,0.84)
Village	1.00(0.99,1.02)	1.05(1.03,1.07)	0.79(0.76,0.82)	0.86(0.82,0.90)	1.15(1.13,1.18)	1.11(1.08,1.13)
Metropolitan	1.03(1.01,1.05)	0.90(0.88,0.91)	0.99(0.95,1.03)	0.81(0.78,0.85)	1.04(1.02,1.06)	0.92(0.90,0.95)
Job(ref: Housewife)						
Student	0.16(0.15,0.17)	0.75(0.71,0.80)	0.105(0.089,0.123)	0.69(0.58,0.83)	0.040(0.037,0.045)	0.78(0.70,0.87)
Unemployment	0.63(0.60,0.66)	0.85(0.80,0.89)	0.91(0.81,1.021)	0.99(0.88,1.12)	0.59(0.56,0.62)	0.81(0.76,0.86)
Employee	1.11(1.08,1.14)	1.11(1.07,1.14)	1.31(1.23,1.39)	1.09(1.01,1.17)	0.60(0.58,0.62)	0.83(0.80,0.87)
Farmer	0.85(0.83,0.86)	0.92(0.89,0.94)	0.94(0.90,0.99)	0.88(0.83,0.94)	0.55(0.54,0.57)	0.65(0.63,0.67)
Armed Forces	0.76(0.70,0.82)	1.10(1.01,1.19)	0.98(0.82,1.18)	1.18(0.98,1.42)	0.35(0.31,0.40)	0.84(0.75,0.95)
Free Job	0.84(0.82,0.85)	0.94(0.92,0.96)	1.08(1.04, 1.12)	1.01(0.96,1.06)	0.65(0.64,0.66)	0.85(0.83,0.88)
Smoking (ref: NO)	0.95(0.93,0.97)	0.96(0.94,0.98)	0.89(0.85,.094)	0.93(0.88,0.99)	0.79(0.77,0.81)	1.01(0.99,1.04)
Addiction (ref: NO)	1.05(0.97,1.13)	0.81(0.75,0.88)	1.12(0.94,1.35)	0.82(0.68,0.98)	1.36(1.26,1.48)	0.78(0.72,0.85)
BMI_over_25 (ref :No),	3.06(3.02,3.10)	2.39(2.36,2.43)	3.18(3.08,3.29)	2.31(2.23,2.40)	3.20(3.15,3.25)	2.28(2.24,2.32)
Physical activity (ref: No)	1.38(1.36,1.40)	1.03(1.01,1.04)	1.24(1.20,1.28)	0.96(0.93,0.99)	1.44(1.42,1.46)	1.14(1.12,1.16)
Psychological disorder (ref: No)	1.12(1.10,1.14)	1.10(1.08,1.12)	1.12(1.07,1.16)	1.08(1.04,1.13)	1.10(1.08,1.12)	1.11(1.09,1.13)
Waist (ref:<82)	1.46(1.43,1.49)	1.13(1.11,1.16)	2.21(2.08,2.36)	1.61(1.51,1.72)	1.80(1.75,1.84)	1.53(1.49,1.58)

These findings highlight the complex interplay of demographic, socioeconomic, and lifestyle factors in the development of diabetes and hypertension in the Iranian population.

Discussion

This large-scale national screening program for diabetes and hypertension in Iran provides crucial insights into the prevalence and risk factors associated with these conditions. Our findings underscore the significant public health challenge posed by diabetes and hypertension in Iran and highlight several key areas for targeted interventions and policy considerations.

The study revealed that 3.36% of the participants had previously known diabetes, while 0.72% were newly identified as suspected diabetics. For hypertension, 8.15% had a previous diagnosis, and 1.35% were newly identified as suspected hypertensives. These figures, while concerning, are lower than global estimates.[20, 21] which could suggest either underdiagnosis or potentially effective prevention strategies in Iran. However, the substantial proportion of newly identified cases emphasizes the importance of regular screening programs.

The age distribution of both conditions aligns with established knowledge that diabetes and hypertension risk increases with age.[22, 23] The majority of known cases were in the 61-90 age group, highlighting the need for targeted interventions and management strategies for older adults. However, the presence of these conditions in younger age groups, particularly in the 31-40 range, is a cause for concern and suggests the need for earlier screening and preventive measures.

Our findings reveal interesting gender differences. Females were slightly overrepresented in the healthy groups for both conditions, but males were more likely to be in the suspected diabetes and hypertension groups. This gender disparity in undiagnosed cases could be due to differences in healthcare-seeking behaviors or varying risk factors between genders.[24]

Table 4: Univariate and Multivariate Logistic Regression Analysis of the Factors Associated with Diabetes

Variable	Pre- Diabetes (n=) 103,533		Suspect- Diabetes (n=)16868		Diabetes-known (n=) 79,033	
	OR,95%CI	AOR,95%CI	OR,95%CI	AOR,95%CI	OR,95%CI	AOR,95%CI
Gender (ref: male)	1.16(1.15,1.18)	1.00(0.98,1.02)	0.93(0.91,0.96)	0.80(0.76,0.84)	1.62(1.59,1.64)	1.20(1.17,1.23)
Age(ref:<30,years)						
30-39y	2.84(2.75,2.93)	2.19(2.11,2.27)	3.96(3.54,4.42)	3.20(2.83,3.61)	4.13(3.82,4.47)	3.44(3.15,3.75)
40-49y	6.48(6.28,6.68)	4.57(4.41,4.74)	11.99(10.79,13.32)	8.79(7.81,9.89)	18.05(16.75,19.45)	13.54(12.46,14.71)
50-59y	9.47(9.18,9.78)	6.55(6.32,6.80)	21.66(19.49,24.07)	15.42(13.70,17.36)	54.15(50.28,58.32)	38.75(35.67,42.10)
+60y	9.76(9.46,10.07)	7.41(7.14,7.69)	22.61(20.36,25.12)	17.01(15.11,19.16)	103.25(95.93,111.14)	79.34(73.06,86.16)
Married Status (ref: married)	0.65(0.64,0.66)	2.19(2.11,2.27)	0.72(0.69,0.75)	1.01(0.96,1.06)	0.88(0.86,0.89)	0.98(0.96,1.01)
Education(ref: illiterate)						
Elementary	0.71(0.70,0.72)	1.03(1.01,1.05)	0.66(0.63,0.70)	0.99(0.94,1.04)	0.40(0.39,0.41)	0.96(0.94,0.98)
Diploma	0.46(0.45,0.47)	0.97(0.95,1.00)	0.40(0.38,0.42)	0.93(0.88,0.99)	0.16(0.158,0.165)	0.86(0.83,0.88)
Academic	0.57(0.56,0.58)	1.00(0.97,1.03)	0.58(0.55,0.61)	0.98(0.92,1.04)	0.22(0.215,0.226)	0.73(0.71,0.76)
Resident(ref: Under one million)						
Suburban	1.02(1.00,1.04)	1.07(1.05,1.09)	1.04(1.00,1.09)	1.09(1.04,1.15)	0.81(0.79,0.83)	0.82(0.80,0.84)
Village	1.00(0.99,1.02)	1.05(1.03,1.07)	0.79(0.76,0.82)	0.86(0.82,0.90)	1.15(1.13,1.18)	1.11(1.08,1.13)
Metropolitan	1.03(1.01,1.05)	0.90(0.88,0.91)	0.99(0.95,1.03)	0.81(0.78,0.85)	1.04(1.02,1.06)	0.92(0.90,0.95)
Job(ref: Housewife)						
Student	0.16(0.15,0.17)	0.75(0.71,0.80)	0.105(0.089,0.123)	0.69(0.58,0.83)	0.040(0.037,0.045)	0.78(0.70,0.87)
Unemployment	0.63(0.60,0.66)	0.85(0.80,0.89)	0.91(0.81,1.021)	0.99(0.88,1.12)	0.59(0.56,0.62)	0.81(0.76,0.86)
Employee	1.11(1.08,1.14)	1.11(1.07,1.14)	1.31(1.23,1.39)	1.09(1.01,1.17)	0.60(0.58,0.62)	0.83(0.80,0.87)
Farmer	0.85(0.83,0.86)	0.92(0.89,0.94)	0.94(0.90,0.99)	0.88(0.83,0.94)	0.55(0.54,0.57)	0.65(0.63,0.67)
Armed Forces	0.76(0.70,0.82)	1.10(1.01,1.19)	0.98(0.82,1.18)	1.18(0.98,1.42)	0.35(0.31,0.40)	0.84(0.75,0.95)
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The higher odds of known diabetes in females (AOR: 1.20, 95% CI: 1.17-1.23) but lower odds of suspected hypertension (AOR: 0.80, 95% CI: 0.76-0.84) warrant further investigation into gender-specific risk factors and healthcare utilization patterns.

The inverse relationship between education level and disease prevalence is a critical finding. Individuals with higher education levels had lower odds of both diabetes and hypertension, consistent with global trends.[25] This association likely reflects the complex interplay between education, health literacy, access to healthcare, and lifestyle choices. The protective effect of education underscores the potential role of educational interventions in disease prevention and management.

Occupation-related findings, particularly the high prevalence among housewives, highlight the need for occupation-specific health promotion strategies. The varying risk across different occupational categories suggests that workplace-based interventions could be an effective approach to reach at-risk populations.

The strong association between BMI over 25 and both conditions (AOR: 2.31 for suspected diabetes and hypertension) reinforces the critical role of weight management in preventing and controlling these diseases.[26] This finding emphasizes the need for public health initiatives focused on promoting a healthy diet and physical activity.

Interestingly, our study found mixed results regarding physical activity. While it showed a protective effect for known diabetes (AOR: 1.14, 95% CI: 1.12-1.16), it was associated with slightly lower odds of suspected hypertension (AOR: 0.96, 95% CI: 0.93-0.99). This unexpected finding for hypertension warrants further investigation and may reflect limitations in our assessment of physical activity or potential confounding factors.

The lower rates of smoking and addiction in disease groups compared to healthy groups were unexpected and contrast with established literature.[8, 27] This finding may reflect successful smoking cessation efforts among diagnosed individuals or potential underreporting, and requires further exploration.

Targeted screening slithers through population-wide programs, coiling around efficiency. Early intervention protects youth, while education and awareness challenge ignorance. Gender-specific approaches twist and turn, occupation-based interventions squirm into workplaces. Weight management programs constrict BMI's influence, and integrated care models intertwine diabetes and hypertension management. These strategies undulate through public health, seeking to ensnare better outcomes and decrease disease prevalence.

While this study provides valuable insights, several limitations should be acknowledged. The reliance on a single screening measurement for blood pressure and glucose levels may lead to some misclassification. Additionally, self-reported data on lifestyle factors, like physical activity and smoking, may be subject to recall bias or social desirability bias.

Future research should focus on longitudinal studies to better understand the progression of these conditions and the long-term impact of various risk factors. A more detailed assessment of dietary patterns, stress levels, and environmental factors could provide a more comprehensive understanding of the risk. Additionally, qualitative research exploring barriers to diagnosis and treatment adherence could inform more effective intervention strategies.

Conclusion

In conclusion, this large-scale screening program has provided crucial data on the prevalence and risk factors of diabetes and hypertension in Iran. The findings highlight the complex interplay of demographic, socioeconomic, and lifestyle factors in the development of these conditions. These insights should inform the development of targeted, multi-faceted public health strategies to address the growing burden of diabetes and hypertension in Iran and similar middle-income countries.

Authors' Contribution

Conceptualization and study design: Ehsan Mosa Farkhani and Khadijeh Ghasemi; Data extraction and Validation: Ehsan Mosa Farkhani; Data analysis and interpretation: Ehsan Mosa Farkhani; Manuscript drafting: Ehsan Mosa Farkhani and Khadijeh Ghasemi; Critical revision and editing: Ehsan Mosa Farkhani, and approved the final version of the manuscript.

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Conflict of Interest

The authors declared no potential conflicts of interest.

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