Title

The prevalence and determinants of alcohol use in the adult population of Tehran: insights from the Tehran Cohort Study (TeCS).

Journal

Clinical and Experimental Medicine, 25(1)

Authors

Shafiee, Akbar
Toreyhi, Hossein
Hosseini, Seyedayin
et al.

Publication Date

2025-02-18

DOI

10.1007/s10238-025-01581-7

Peer reviewed

Clinical and Experimental Medicine (2025) 25:63
https://doi.org/10.1007/s10238-025-01581-7

RESEARCH

The prevalence and determinants of alcohol use in the adult population of Tehran: insights from the Tehran Cohort Study (TeCS)

Akbar Shafiee[1] · Hossein Toreyhi[1] · Seyedayin Hosseini[1] · Amirhossein Heidari[1,2] · Arash Jalali[3] · Mohammad Mohammadi[1] · Farshid Alaeddini[4] · Soheil Saadat[1] · Saeed Sadeghian[1] · Mohamamdali Boroumand[1] · Abbasali Karimi[1] · Oscar H. Franco[5]

Received: 24 December 2024 / Accepted: 31 January 2025

Abstract

Background Although alcohol has been illegal in Iran for over four decades, its consumption persists. This study aims to determine the prevalence and determinants of alcohol consumption in Tehran, the Middle East's third-largest city, using data from the Tehran Cohort Study (TeCS).

Methods Our study encompasses data from 8420 individuals recorded between March 2016 and March 2019. We defined alcohol use as the lifetime consumption of alcoholic beverages and/or products. We calculated the age- and sex-weighted prevalence of alcohol use in addition to crude frequencies. We also determined the weighted prevalence of alcohol use in both genders. Multivariable logistic regressions were employed to investigate the adjusted odds ratios for the determinants of alcohol use.

Results The mean age of participants was 53.8 ± 12.7 years. The lifetime prevalence of alcohol use was 9.9% (95% confidence interval [95% CI]: 8.3–11.8%) among the total population, with a prevalence of 3.3% (95% CI: 2.4–4.5%) among females and 16.6% (95% CI: 14.3–19.3%) among males. Alcohol use showed a decreasing trend with age in both sexes (women: 4.4% and men: 1.5% per year) as well as in the total population (1.7%). The geographical distribution of alcohol use in Tehran indicated a significantly higher concentration (95% CI: 6.5–13%) in the southern regions compared to other areas. Younger age, higher education levels, smoking, opium use, hyperlipidemia, physical activity, and being overweight determined a higher prevalence of alcohol use.

Conclusions The prevalence of alcohol use in Tehran is significant and exceeds previous estimates. Policymakers must address the rising incidence of alcohol use, particularly among the younger population.

Keywords Epidemiology · Alcohol · Prevalence · Tehran Cohort Study · TeCS

Introduction

Alcohol use disorders are the most common of all substance use disorders worldwide [1]. The most recent Global Burden of Disease (GBD) reports alcohol use is responsible for 3.0 million alcohol-related deaths annually and 131.4 disability-adjusted life-years (DALYs) in 2016. Iran, a Muslim country of more than 80 million people, has banned alcohol consumption since the revolution of 1979 [2]. As a result, there is no official program to inform the public about the dangers of drinking, and the drinkers provide alcohol from the black market [2, 3]. Therefore, the reported prevalence of alcohol consumption in Iran is quite divergent. A meta-analysis of published studies up to 2020 suggested that the lifetime alcohol consumption prevalence among the Iranian population ranged from 0.03 to 68.0%, with significant heterogeneity [4].

Tehran, the capital of Iran and the third-largest metropolitan area in the Middle East, does not have precise available statistics on alcohol use. Studies about alcohol consumption in Tehran have focused on samples of less than 2000 people, mostly adolescents, students, or young populations [5, 6]. More comprehensive studies about alcohol use have been conducted nationally, including samples from the Tehran population. For example, Nikfarjam et al. conducted a study

Akbar Shafiee and Hossein Toreyhi have contributed equally to this manuscript and should be considered the first authors.

Extended author information available on the last page of the article

Published online: 18 February 2025

on all of Iran's provinces, examining the population of 400 people from each province, and found Tehran to be in the top four quarters of the country in terms of alcohol consumption [7]. Unfortunately, other national/multi-province surveys do not give precise statistics on the amount of alcohol used by the Tehran population [8]. Moreover, one aspect that may understate the whole country's alcohol consumption is the social stigma, primarily due to religious beliefs [9]. Consequently, we investigated the prevalence of alcohol use in the Tehran population and determined its potential associated risk factors based on the Tehran Cohort Study (TeCS) data.

Methods

Study design and participants

In this study, we utilized data from the recruitment phase of TeCS, an ongoing population-based prospective study of adult Tehran residents. The study protocol was previously published elsewhere [10]. In brief, a sample of individuals from all districts of Tehran was recruited using a random systematic sampling method. Between March 2016 and March 2019, 4215 households, including 9170 individuals aged 35 years and older, were asked for an interview, and 8296 people (90.5%) participated in the study. Participants with missing alcohol consumption data ($n = 56$) were excluded, ensuring a final, complete dataset of 8240 participants for robust and reliable analysis. The TeCS protocol was authorized by the Deputy of Research and the Ethics Committee (ID: IR.TUMS.MEDICINE.REC.1399.074). Before enrollment, all subjects provided written informed consent.

Clinical and laboratory measurements

Comprehensive questionnaires were utilized to conduct in-depth interviews with the participants and collect data on their demographic data, marital status, educational level, occupation, ethnicity, smoking habits, alcohol consumption, opium use, physical activity, past medical history, and drug history. To assess alcohol consumption, trained nurses utilized a culturally sensitive and education level-appropriate approach, asking questions tailored to minimize response bias and ensure participant comfort. Participants were specifically asked, "Have you ever consumed alcohol during your lifetime?". Confidentiality assurances were provided to encourage honest reporting and mitigate the stigma associated with alcohol use.

In addition, standard anthropometric (height, weight, waist, and hip circumference) and blood pressure measurements were performed on all subjects. Serum biochemistry, including creatinine levels, fasting plasma sugar (FPG), low-density lipoprotein cholesterol (LDL), high-density lipoprotein cholesterol (HDL), total cholesterol, and triglyceride (TG), was measured using fasting blood samples.

Definition of variables

The definitions for tobacco use, opium and alcohol consumption, glycemic conditions, and preexisting comorbidities, such as chronic kidney disease (CKD) and coronary artery disease (CAD), have been extensively outlined in our prior studies [11–13]. Briefly, education was divided into four groups depending on duration: 0 (as illiterate), 1–5, 6–12, and > 12 years. Current tobacco smoking was defined as smoking cigarettes, pipes, or hookahs regularly or occasionally. Former smokers were those who had quit smoking for at least one month before the interview. Any current or former inhalational or oral use of opium or its derivatives was classified as opium use. Alcohol use was defined as the consumption of alcoholic beverages over a person's lifetime.

Individuals were classified as hypertensive if they had a systolic blood pressure (SBP) of ≥ 140 mmHg or a diastolic blood pressure (DBP) of ≥ 90 mmHg, self-report of hypertension diagnosis, or current use of any antihypertensive medication [14]. Type 2 diabetes mellitus (T2DM) was defined as FPG ≥ 7 mmol/L or self-report of a diabetes diagnosis by healthcare providers or the use of glucose-lowering medication [15]. Impaired fasting glucose (IFG) was defined as 5.6 ≤ FPG < 7 mmol/L [15]. Hyperlipidemia was defined as a previous hyperlipidemia diagnosis or the use of lipid-lowering medications. The patients' daily total physical activity was evaluated and classified as low, intermediate, or high using the Likert-scale self-report item. Body mass index (BMI) was calculated by dividing weight (kilograms) by squared height (meters) and was classified as normal (BMI < 25 kg/m^2; as reference), overweight (25 kg/m^2 ≤ BMI < 30 kg/m^2), obese (30 kg/m^2 ≤ BMI < 35 kg/m^2), and very obese (35 kg/m^2 < BMI). The waste-to-hip ratio, which is computed by dividing the waist circumference by the hip circumference, was used to define central obesity. For men and women, respectively, values of 0.9 and 0.8 were regarded as high [16]. CKD was defined based on the patient's previous medical history. A history of premature CAD is described as a history of CAD events before the age of 45 and 55 years for men and women, respectively.

Statistical analysis

Continuous variables, including age, BMI, waist-to-hip ratio, HDL, and total cholesterol, were described as mean with standard deviation (SD) and were compared between

alcohol users and nondrinkers groups using independent samples t-test. Serum creatinine, FPG, LDL, and TG were expressed as medians in the 25 and 75th percentiles, and they were compared between the above-mentioned groups by applying the Mann–Whitney U-test. Categorical variables were described as frequencies with percentages and were compared between the alcohol users and nondrinkers groups using the chi-squared test. The adjusted association of covariates with alcohol consumption was evaluated using a multivariable logistic regression model, and the effects were reported using odds ratio (OR) with a 95% confidence interval (CI). The age and sex-weighted prevalence of alcohol use among Tehran's adult population ≥ 35 years was calculated using the national census of 2016. The regional distributions of alcohol users were displayed in the Tehran map using the *shp2dta* and *spmap* modules in Stata software, release 14.2. (College Station, TX: Stata Corp LP.). Statistical analyses were carried out using IBM SPSS Statistics for Windows, version 23. (Armonk, NY: IBM Corp.).

Results

General characteristics of the study population

A population of 8240 (men: 3783 [45.9%]) participants with a mean age (SD) of 53.8 (12.73) years was analyzed in this study. The mean age of men and women was 54.7 (13.1) and 52.9 (12.3) years, respectively. The lifetime prevalence of alcohol use was 9.9% (95% confidence interval [95% CI]: 8.3–11.8%] among the total population, and 3.3% (2.4–4.5%) and 16.6% (14.3–19.3%) among females and males, respectively.

Table 1 presents participant characteristics by total number and gender for comparison between alcoholic and never-alcohol groups. The mean (SD) ages of never-alcohol users and alcohol users in the total population were 54 (12.7) and 51.2 (13.0) years, respectively, suggesting that alcohol users were significantly younger than their counterparts in the never-drinkers group. Furthermore, the frequency of being single or divorced, having a higher level of education, former or current cigarette smoking, being employed, retired, or unemployed, higher physical activity, and being overweight was significantly higher among alcohol users than their peers in the never-alcohol users group. Alcohol users also had higher median/mean levels of plasma creatinine, total cholesterol, and triglycerides than never-drinkers. On the other hand, the frequency of hypertension, IFG, T2DM, hyperlipidemia, and central and general obesity was significantly higher among alcohol users compared to nondrinkers. The mean BMI, waist-to-hip ratio, and HDL level were also higher among alcohol users compared to never-drinkers. We found a higher mean plasma level of LDL among alcohol users compared to never-drinkers (114.0 vs. 109.0 mg/dl) only in the male population. The remaining sub-analysis for genders was essentially similar to the total population.

Age and gender distribution of alcohol consumption

Figure 1 suggests the prevalence of lifetime alcohol use based on age and sex decades among the Tehran adult population. As shown, alcohol use decreases with age among both sexes. From the age group of 35–45 to > 75 years, the prevalence of lifetime alcohol usage declined in the male population from 22 to 11.1% and in the female population from 5.2 to 1.2%. Accordingly, the highest prevalence of alcohol intake for men and women was, respectively, 5.2 and 22.0% in the age group of 35–45 years.

Geographical pattern of alcohol consumption

Figure 2 illustrates the geographical distribution of lifetime alcohol use in Tehran's general urban population. The highest prevalence of alcohol use was found in only two districts in the west and south of Tehran, ranging from 19.7 to 26.3%. Also, a prevalence of 13.2 to 19.7% is concentrated in the southern regions.

Determinants associated with alcohol consumption

Multivariable logistic regression for evaluating factors associated with alcohol consumption is summarized in Table 2. Among the total participants, the prevalence of alcohol usage declines by 2% with each additional year of age. Furthermore, education levels of 6–12 and > 12 years, former and current smoking, opium use, hyperlipidemia, high physical activity, and being overweight were associated with a higher probability of alcohol use in the general population. In addition, moderate physical activity was associated with a lower probability of alcohol use.

Similarly, male participants had higher levels of alcohol consumption in association with variables such as education levels of 6–12 years and > 12 years, past and current smoking, opium use, and hyperlipidemia. In addition, moderate physical activity and a history of premature CAD were associated with a 26 and 50% decrease in male alcohol consumers. Furthermore, variables like education > 12 years, opium use, hyperlipidemia, intermediate physical activity, and a history of premature CAD were associated with alcohol use only among male participants. In the multivariable analysis for women, there was a higher age-related decline in alcohol consumption than in men and

Table 1 Characteristics of alcohol user and nonuser participants in the total population and men and women separately

Characteristic*	Never-alcohol users	Total Alcohol users	*P*-value**	Never-alcohol users	Female Alcohol users	*P*-value	Never-alcohol users	Male Alcohol users	*P*-value
Age, year	54.0 (12.67)	51.2 (12.99)	< 0.001	53.1 (12.32)	47.4 (11.53)	< 0.001	55.2 (13.04)	52.1 (13.15)	< 0.001
BMI, kg/m^2	28.05 (4.84)	27.25 (4.60)	< 0.001	28.74 (5.15)	27.05 (15.25)	< 0.001	27.12 (4.21)	27.29 (4.43)	0.371
BMI category			< 0.001			< 0.001			0.736
< 25	2059 (27.7)	236 (31.9)		1079 (25.2)	57 (41.0)		980 (31.0)	179 (29.8)	
25–29.99	3077 (41.4)	332 (44.9)		1614 (37.8)	44 (31.7)		1463 (46.3)	288 (48.0)	
30–34.99	1659 (22.3)	130 (17.6)		1072 (25.1)	25 (18)		587 (18.6)	105 (17.5)	
≥ 35	638 (8.6)	41 (5.5)		509 (11.9)	13 (9.4)		129 (4.1)	28 (4.7)	
High WC			< 0.001			< 0.001			0.786
No	1437 (19.3)	223 (30.2)		378 (8.8)	26 (18.7)		1059 (33.5)	197 (32.9)	
Yes	6011 (80.7)	515 (69.8)		3905 (91.2)	113 (81.3)		2106 (66.5)	402 (67.1)	
WHR	0.91 (0.07)	0.93 (0.07)	< 0.001	0.89 (0.07)	0.87 (0.07)	< 0.001	0.95 (0.6)	0.94 (0.06)	0.362
Marital status			0.04			< 0.001			0.117
Single	56 (0.7)	8 (1.1)		37 (0.9)	2 (1.4)		19 (0.6)	6 (1)	
Married	7271 (97)	704 (95.3)		4150 (96.1)	123 (88.5)		3121 (98.1)	581 (96.8)	
Divorced	171 (2.3)	27 (3.7)		131 (3)	14 (10.1)		40 (1.3)	13 (2.2)	
Education level			< 0.001			< 0.001			< 0.001
Illiterate	572 (7.6)	11 (1.5)		425 (9.8)	2 (1.4)		147 (4.6)	9 (1.5)	
1–5 years	812 (10.8)	26 (3.5)		509 (11.8)	3 (2.2)		303 (9.5)	23 (3.8)	
6–12 years	3904 (52.1)	377 (51)		2297 (53.2)	58 (41.7)		1607 (50.6)	319 (53.2)	
> 12 years	2207 (29.4)	325 (44)		1086 (25.2)	76 (54.7)		1121 (35.3)	249 (41.5)	
Smoking status			< 0.001			< 0.001			< 0.001
Never	6328 (84.7)	315 (42.8)		4118 (95.5)	75 (54.3)		2210 (69.9)	240 (40.1)	
Former	256 (3.4)	91 (12.4)		28 (0.6)	12 (8.7)		228 (7.2)	79 (13.2)	
Current	888 (11.9)	330 (44.8)		165 (3.8)	51 (37)		723 (22.9)	279 (46.7)	
Opium use			< 0.001			0.169			< 0.001
No	7161 (95.6)	626 (85.4)		4293 (99.5)	136 (98.6)		2868 (90.3)	490 (82.4)	
Yes	329 (4.4)	107 (14.6)		22 (0.5)	2 (1.4)		307 (9.7)	105 (17.6)	
Occupation			< 0.001			< 0.001			< 0.001
Employed	2871 (38.3)	501 (67.8)		775 (18)	50 (36)		2096 (66)	451 (75.2)	
Housewife	3119 (41.6)	74 (10)		3119 (72.2)	74 (53.2)		0 (0)	0 (0)	
Retired	1300 (17.3)	137 (18.5)		357 (8.3)	9 (6.5)		943 (29.7)	128 (21.3)	
Unemployed	205 (2.7)	27 (3.7)		66 (1.5)	6 (4.3)		139 (4.4)	21 (3.5)	
Ethnicity			0.167			0.021			0.166
Fars	3672 (49)	343 (46.5)		2112 (48.9)	62 (44.6)		1560 (49.1)	281 (46.9)	
Azari	2223 (29.7)	218 (29.5)		1269 (29.4)	33 (23.7)		954 (30)	185 (30.9)	
Gilak	299 (4)	33 (4.5)		185 (4.3)	8 (5.8)		114 (3.6)	25 (4.2)	
Lor	294 (3.9)	22 (3)		154 (3.6)	4 (2.9)		140 (4.4)	18 (3)	
Kurd	174 (2.3)	19 (2.6)		98 (2.3)	2 (1.4)		76 (2.4)	17 (2.8)	
Mixed	601 (8)	79 (10.7)		375 (8.7)	25 (18)		226 (7.1)	54 (9)	
Other	188 (2.5)	17 (2.3)		94 (2.2)	4 (2.9)		94 (3)	13 (2.2)	
Immigrants/ Refugees	44 (0.6)	7 (0.9)		30 (0.7)	1 (0.7)		14 (0.4)	6 (1)	
Blood pressure			0.001			< 0.001			0.051
Normal	3540 (47.3)	402 (54.6)		2071 (48.1)	93 (67.9)		1469 (46.3)	309 (51.6)	
High blood pressure	919 (12.3)	84 (11.4)		485 (11.3)	14 (10.2)		434 (13.7)	70 (11.7)	
Hypertensive	3025 (40.4)	250 (34)		1752 (40.7)	30 (21.9)		1273 (40.1)	220 (36.7)	

Table 1 (continued)

Characteristic*	Never-alcohol users	Total Alcohol users	*P*-value**	Never-alcohol users	Female Alcohol users	*P*-value	Never-alcohol users	Male Alcohol users	*P*-value
Glycemic status			0.008			< 0.001			0.159
Normal	4091 (55.6)	441 (60.2)		2507 (58.8)	113 (81.9)		1584 (51)	328 (55.2)	
IFG	1882 (25.6)	185 (25.3)		957 (22.5)	19 (13.8)		925 (29.8)	166 (27.9)	
Diabetes mellitus	1391 (18.9)	106 (14.5)		797 (18.7)	6 (4.3)		594 (19.1)	100 (16.8)	
Hyperlipidemia			0.288			0.017			0.226
No	5044 (67.3)	512 (69.2)		2806 (65)	104 (74.8)		2238 (70.4)	408 (67.9)	
Yes	2454 (32.7)	228 (30.8)		1511 (35)	35 (25.2)		943 (29.6)	193 (32.1)	
Physical activity			< 0.001			< 0.001			< 0.001
Low	1332 (17.8)	114 (15.9)		845 (19.6)	18 (13.4)		487 (15.4)	96 (16.5)	
Intermediate	4421 (59.2)	331 (46.2)		2626 (61)	60 (44.8)		1795 (56.8)	271 (46.6)	
Active	1714 (23)	271 (37.8)		834 (19.4)	56 (41.8)		880 (27.8)	215 (36.9)	
CKD			0.32			0.626			0.394
No	7432 (99.1%)	737 (99.5)		4284 (99.2)	139 (100)		3148 (99.0)	598 (99.3)	
Yes	67 (0.9%)	4 (0.05)		34 (0.8)	0 (0)		33 (1.0)	4 (0.7)	
Premature CAD			0.173			0.13			0.21
No	7235 (96.5)	722 (97.4)		4186 (96.9)	138 (99.3)		3049 (95.9)	584 (97.0)	
Yes	264 (3.5)	19 (2.6)		132 (3.1)	1 (0.7)		132 (4.1)	18 (3.0)	
FBG, mg/dl	97 (91, 107)	96 (90, 104)	0.014	96 (90, 106)	92 (87, 98)	< 0.001	99 (92, 110)	98 (91, 105)	0.005
Creatinine, mg/dl	0.80 (0.69, 0.93)	0.90 (0.79, 1.00)	< 0.001	0.71 (0.64, 0.80)	0.71 (0.62, 0.80)	0.866	0.92 (0.82, 1.03)	0.93 (0.83, 1.03)	0.418
Total cholesterol, mg/dl	172.21 (40.12)	175.32 (41.26)	0.049	177.18 (39.28)	182.90 (43.16)	0.099	165.41 (40.26)	173.56 (40.65)	< 0.001
LDL, mg/dl***	110.0 (90.0–134.0)	114.0 (90.0–133.0)	0.368	112.0 (91.0–137.0)	118.0 (93.0–135.0)	0.496	109.0 (86.0–131.0)	114.0 (89.0–132.0)	0.035
HDL, mg/dl	44.93 (12.32)	43.17 (13.57)	< 0.001	48.92 (12.54)	52.85 (15.25)	0.004	39.47 (9.63)	40.92 (12.10)	0.007
Triglyceride, mg/dl ***	124.0 (88.0–173.0)	134.0 (91.0–202.0)	< 0.001	119.0 (84.0–165.0)	114.0 (71.0–169.0)	0.209	130.0 (93.0–183.0)	140.0 (96.0–211.0)	0.003

BMI: Body mass index; *CKD*: Chronic kidney disease; *CAD*: Coronary artery disease; *FBG*: Fasting blood glucose; *HDL*: High-density lipoprotein; *IFG:* Impaired fasting glucose; *LDL*: Low-density lipoprotein; *WC*: Waist circumference; *WHR*: Waist-to-hip ratio

* Values are displayed as mean (SD) and number (%) for continuous and categorical variables, respectively

** *P*-values indicating the difference between the alcohol user and nonuser groups, and a *P*-value less than 0.05 was considered statistically significant

*** The median and interquartile range for LDL and TG were shown

the general population, with a decrease of 4.4% (versus 1.5% in men) per each additional year (*P*-value < 0.001). Previous and current smoking and a high level of physical activity were associated with a higher percentage of alcohol consumption among female participants. We also found a significant negative link between drinking alcohol and active status of physical activity, T2DM, and IGF only among female alcohol consumers.

Discussion

According to the current cross-sectional survey of 8240 participants from TeCS with an average age of 53.8 years, the prevalence of lifetime alcohol use in the Tehran population is estimated to be 9.9% and decreases with age. Among women, these levels were even higher (4.6 percent), while for men, the levels were (1.5 percent). Furthermore, in the multivariable analysis, higher alcohol use was associated with younger age, higher education, smoking, opium use, hyperlipidemia, and more physical activity.

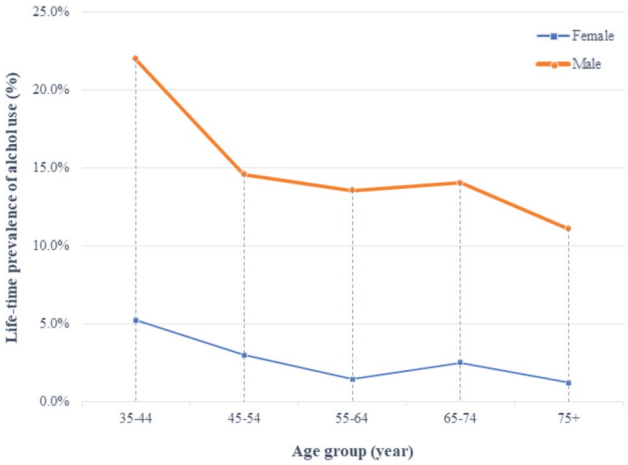

Fig. 1 Prevalence of lifetime male and female populations alcohol use in Tehran based on age and sex groups among the study population

Alcohol is widely consumed globally for recreational purposes [17]. Approximately 43% of the global population aged 15 and older, equivalent to 23.48 billion individuals, consume alcohol, with men drinking at nearly twice the rate of women. According to the World Health Organization's 2018 Global Alcohol and Health Report, global per capita alcohol consumption has risen from 5.7 L in 2000 to 6.4 L in 2016. The report highlights the substantial public health burden associated with harmful alcohol use, which is linked to over 200 diseases and injuries and accounts for approximately 3 million deaths each year [18].

The acquired prevalence is comparable to previous research conducted in various regions of Iran. Nik Farjam's [7] studies are based on street interviews in 31 Iranian provinces and assessed the prevalence of alcohol usage in the society to be 2.3%. According to the study's findings, the population of smaller cities in Iran consumes less alcohol, which might be attributed to the predominant religious and cultural context. Similar findings from the Iranian Mental Health Survey among 31 Iranian provinces revealed a 5.6% prevalence [19]. Moradinazar et al. [8] reported 9% lifetime alcohol use among 15 selected provinces in the PERSIAN cohort on a population of roughly 130,000 people over 35 years old. A higher prevalence of alcohol usage has been recorded, primarily in research conducted on the populations of Iran's major cities [9, 20]. On a larger scale, figures in nations where alcohol drinking is generally restricted are contradictory [21]. There is substantial variance across Iran's neighbors, where alcohol drinking is forbidden in most cases. Compared to Iran, Afghanistan has a higher consumption, while Saudi Arabia, Bahrain, and the United Arab Emirates have a lower consumption, and Turkey and Pakistan have a similar consumption of alcohol per population [21]. Turkey is a country with a culture similar to Iran's, but with more permissive alcohol laws, where alcohol consumption is

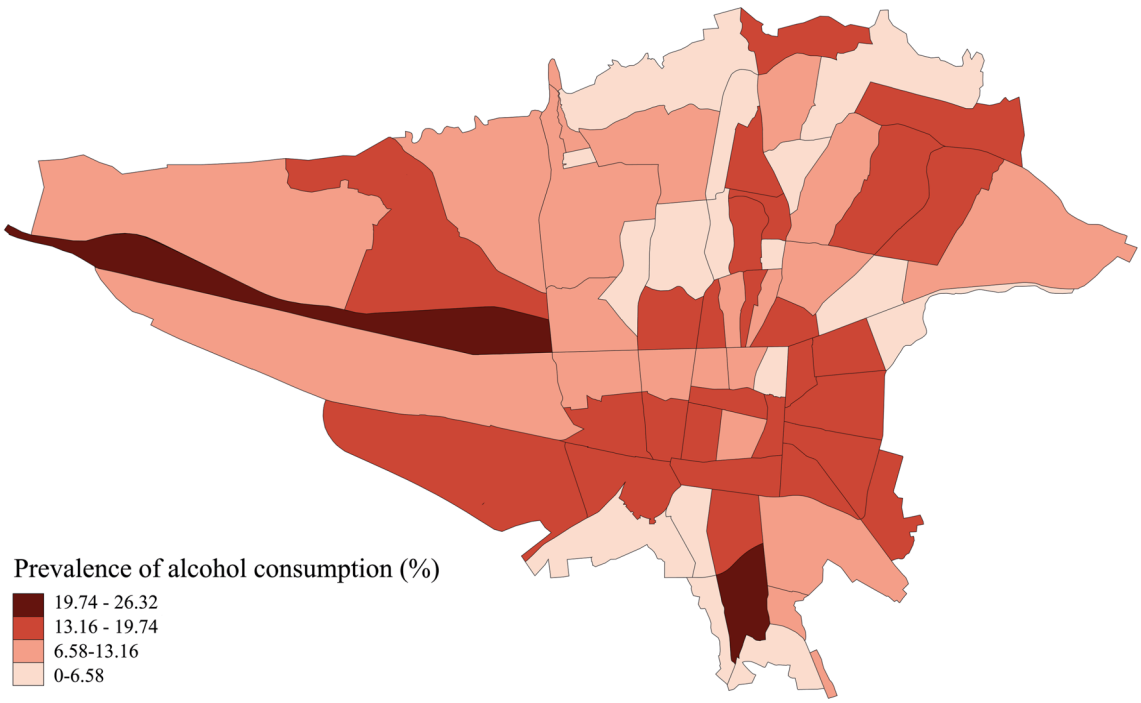

Fig. 2 The geographical distribution of lifetime alcohol use in Tehran's general urban population based on the postal regions

Table 2 Multivariable logistic regression for evaluating determinants associated with alcohol consumption

Characteristic	OR	Total 95% CI	*P*-value*	OR	Female 95% CI	P-value	OR	Male 95% CI	*P*-value
Age, year	0.983	0.975, 0.992	< 0.001	0.956	0.934, 0.978	< 0.001	0.985	0.976, 0.994	0.001
General obesity			0.197			0.894			0.594
BMI < 25 (reference)	1	–		1	–		1	–	
25 ≤ BMI < 30	1.266	1.014, 1.581	0.037	0.842	0.508, 1.398	0.506	1.15	0.889, 1.488	0.287
30 ≤ BMI < 35	1.198	0.899, 1.595	0.217	0.997	0.545, 1.825	0.993	1.13	0.806, 1.586	0.478
BMI ≥ 35	1.079	0.714, 1.631	0.719	0.876	0.399, 1.925	0.742	1.389	0.823, 2.344	0.219
Central obesity	0.785	0.627, 0.983	0.035	0.964	0.529, 1.758	0.906	1.072	0.834, 1.378	0.586
Marital status			0.374			0.067			0.546
Single (reference)	1	–		1	–		1	–	
Married	0.729	0.285, 1.868	0.511	0.252	0.055, 1.155	0.076	0.97	0.305, 3.088	0.959
Divorced	0.976	0.345, 2.759	0.963	0.432	0.083, 2.259	0.32	1.439	0.373, 5.547	0.597
Level of education			< 0.001			< 0.001			< 0.001
Illiterate (reference)	1	–		1	–		1	–	
1–5 years	1.008	0.473, 2.149	0.984	0.604	0.092, 3.973	0.6	0.908	0.391, 2.111	0.823
6–12 years	2.834	1.499, 5.357	0.001	1.278	0.287, 5.691	0.748	2.554	1.245, 5.238	0.011
> 12 years	4.896	2.57, 9.328	< 0.001	2.885	0.638, 13.045	0.169	3.439	1.659, 7.127	0.001
Smoking			< 0.001			< 0.001			< 0.001
Never (reference)	1	–		1	–		1	–	
Former	9.34	6.961, 12.532	< 0.001	57.889	24.237, 138.264	< 0.001	4.24	3.091, 5.817	< 0.001
Current	7.001	5.784, 8.473	< 0.001	20.651	13.07, 32.628	< 0.001	3.595	2.899, 4.458	< 0.001
Opium use	1.516	1.147, 2.004	0.003	1.261	0.222, 7.161	0.793	1.337	1.01, 1.772	0.043
Hypertension	0.883	0.696, 1.121	0.306	1.068	0.582, 1.958	0.832	0.853	0.656, 1.11	0.238
Glycemic status			0.899			0.008			0.852
Normal (reference)	1	–		1	–		1	–	
IFG	0.977	0.797, 1.196	0.819	0.561	0.318, 0.989	0.046	0.938	0.751, 1.172	0.573
Diabetes mellitus	0.94	0.718, 1.231	0.654	0.279	0.11, 0.713	0.008	0.968	0.725, 1.294	0.828
Hyperlipidemia	1.282	1.047, 1.569	0.016	1.124	0.681, 1.855	0.649	1.434	1.146, 1.796	0.002
Physical activity			< 0.001			< 0.001			< 0.001
Low (reference)	1	–		1	–		1	–	
Intermediate	0.757	0.591, 0.97	0.027	0.739	0.405, 1.347	0.323	0.744	0.564, 0.982	0.036
Active	1.426	1.098, 1.853	0.008	1.891	1.012, 3.531	0.046	1.22	0.91, 1.636	0.184
Premature CAD	0.568	0.321, 1.007	0.053	0.39	0.042, 3.623	0.408	0.505	0.279, 0.912	0.023
CKD	0.871	0.296, 2.562	0.802	0	_	0.998	1	0.335, 2.985	1

BMI: Body mass index; *CAD*: Coronary artery disease; *CKD*: Chronic kidney disease; *OR*: Odds ratio; *CI*: Confidence intervals; *IFG*: Impaired fasting glucose; *T2DM*: Type 2 diabetes mellitus

**P*-values less than 0.05 were considered statistically significant

more prevalent than in Iran in both the total population and among all age groups over 35 [22]. The Arab countries have a similar ban on alcohol use in their national laws, but the amount of alcohol consumption in them is relatively ambiguous, with surveys that are generally not among the overall population reporting figures ranging from zero to 15.5% [23]. Notably, all the research listed revealed that men have a higher rate of alcohol use than women.

Age has a substantial influence on the prevalence of alcohol use among Iranians. Previous studies among teenagers and young people under the age of 35 estimated the prevalence of lifetime alcohol intake to be higher than 15% [5, 6], compared to 9.9% of the population over the age of 35 in our study, supporting this growing tendency with decreasing age. According to the current study, the prevalence of alcohol use decreases by 1.7% per year as people get older. The corresponding figures for the men and women were 1.5 and 4.4%, respectively. This could be explained by the fact that younger people have a different pattern of permissive social life and globalization, both of which are risk factors for alcohol consumption [24].

We found that single, divorced, or widowed participants significantly drank more. According to a study, the current findings confirm the findings of previous studies [25, 26]. One of the variables mediating the relationship between marital status and alcohol use is mental health status. Being married has been associated with better mental health, physical health, and happiness [27]. On the other hand, living alone has a greater frequency of depressive disorders and the unhealthy lifestyles accompanying it [28].

In the current study, we found that people with a higher level of education had a greater prevalence of alcohol consumption. However, this failed to reach statistical significance in the multivariable model. However, this is not the first time that a positive association between education level and alcohol use has been reported [7, 22]. Higher educational level, as a component of socioeconomic status, is positively related to drinking, indicating that people with higher status can afford alcohol and frequently drink it to relax during their free time [29].

The association between substantial alcohol consumption and cigarette smoking has been well established for a long time. Approximately 80% of alcoholics have been reported to smoke cigarettes [30]. According to our findings, people who quit smoking consume seven times more alcohol than never-smokers, while nonsmokers consume nine times more. These values are 3.5 and 4 times in the male population and roughly 20 and 60 times in the female population, confirming this association. Smoking is one of the traditional risk factors for cardiovascular events [31]. Therefore, the substantial correlation between smoking and drinking should raise red flags for policymakers considering primordial and primary prevention.

The most often abused drugs in Iran are opium and its derivatives [32]. In our study, opium was associated with a 50% greater prevalence of alcohol use in the general population. Given that Iran is a transit country for opium and is likely to increase the current trend, the positive association found between opium and alcohol can serve as a wake-up call for policymakers, as the trend toward alcohol consumption is considered an unhealthy lifestyle, similar to the trend toward other drugs [33].

We found a higher prevalence of hypertension among alcohol users than nondrinkers in the total population and sex groups. A meta-analysis of prospective studies with acceptable heterogeneity found that alcohol consumption of more than two drinks per day is associated with hypertension in both genders, confirming previous meta-analysis findings [34, 35]. Furthermore, the findings of a meta-analysis on Asian men suggested no safe level of alcohol use to protect against hypertension [36]. Notably, our multivariable model revealed a 12 and 15% reduction in the risk of hypertension in the male and male populations, but neither was statistically significant.

Additionally, we observed that the prevalence of T2DM and IFG was higher among alcohol users compared to nondrinkers in the total population and both sexes, as well as the mean FPG level. Some evidence has already shown that alcohol consumption is protective of glycemic status. In line with our results, a meta-analysis of cross-sectional studies on about 2 million people suggested that any amount of < 63 g/d of alcohol use is associated with a lower risk of T2DM [37]. Unfortunately, our analysis lacks data on daily alcohol intake. In the multivariate analysis, alcohol consumption was associated with a quarter of the risk of T2DM and a half the risk of IFG only among the female population. In line with our results, another meta-analysis of fourteen interventional studies suggested that alcohol consumption among women reduced fasting insulin and tended to improve insulin sensitivity but not among men [38]. There may be explanations for the observed difference in glycemic status between men and women, such as an imbalance in the distribution of diabetes risk factors between men and women, the presence of more heavy episodes of drinking among men, and a greater effect of alcohol on the sensitivity of body cells to insulin in women [38, 39].

Moreover, the mean plasma level of LDL did not differ between alcohol users and never-drinkers, but alcohol users had significantly higher levels of HDL, cholesterol, and triglycerides. Furthermore, in the multivariable model, we found a 30% increase in the prevalence of hyperlipidemia among alcohol drinkers. In line with our results, Biren and colleagues [40] found a positive association between moderate alcohol usage and HDL levels in a meta-analysis. Furthermore, they reported a favorable but nonsignificant relationship between triglyceride levels and alcohol consumption [40]. Similar findings were observed in another meta-analysis by Huang et al. [41], while triglyceride levels had a positive correlation with moderate alcohol usage this time. The underlying mechanism of this connection could be attributed to moderate alcohol consumption reversing cholesterol transport, hemostasis, and insulin sensitivity, increasing lipoprotein transport rate, and increasing lipoprotein lipase activity [42].

In the case of obesity, we found a 27% increase in alcohol use among overweight participants and a 22% decrease in the prevalence of central obesity in the same model. A meta-analysis of 260,000 participants in cross-sectional studies found that being overweight was related to an 11% increase in alcohol consumption (95% CI: 1.05 to 1.18) [43]. The impact size was 16% in studies with adjusted confounders. In contrast, central obesity in the presence of general obesity has been associated with a decrease in the prevalence of alcohol use. Previous research has occasionally revealed this two-way interaction [44, 45]. These studies commonly focus on moderate alcohol intake, which is not surprising given that it has a protective effect on metabolic syndrome

and causes both a rise in overall obesity and a decrease in central obesity. It is noteworthy that potential explanations for the reduction seen in our study could be due to alcohol abstinence in some moderate drinkers due to comorbidities associated with obesity or compensatory behavior by limiting food intake after alcohol intake or leading a healthy lifestyle, both of which may protect against obesity.

The results of our study highlight notable gender differences in the determinants of alcohol consumption, particularly in the determinants of smoking and physical activity. Among women, smoking demonstrated a remarkably strong association with alcohol use, with former smokers exhibiting significantly higher odds (OR: 57.889, 95% CI: 24.237–138.264) compared to men (OR: 4.240, 95% CI: 3.091–5.817). The apparent relationship may be due to greater societal stigma attached to smoking among women and the fact that overlapping risk behaviors, such as alcohol consumption, is more easily concealed [46]. Physical activity was also associated with a stronger association (OR: 1.891, 95% CI: 1.012–3.531), possibly due to urbanization and changes in sociocultural norms [47].

Tehran's alcohol consumption distribution reveals notable regional disparities. The highest prevalence of lifetime alcohol use was observed in two districts in the western and southern parts of the city, with rates ranging from 19.7 to 26.3%, while other southern regions showed moderate prevalence rates of 13.2 to 19.7%. Confounding factors such as socioeconomic status, urbanization levels, cultural norms, and access to alcohol, which were not directly evaluated in this study, may have contributed to these variations. A deeper and more precise understanding of the regional differences would result from including these variables in future analyses.

Study limitations

In our study, individuals under the age of 35 were excluded, which limits the generalizability of our findings to younger populations. In addition, we were unable to fully ascertain the socioeconomic status of alcohol users in Tehran as our data were limited to education and dwelling areas. Given Iran's worsening economic situation over the past few decades and the established link between significant economic loss and a higher incidence of alcohol-related issues, further research is recommended to better understand the socioeconomic factors at play. Furthermore, alcohol consumption data may be underreported due to stigma, despite our efforts to ensure confidentiality and use culturally sensitive methods. This limitation should be considered when interpreting the results. Additionally, our study did not collect information on the specific amount and pattern of alcohol consumption by participants, which limits our ability to compare results with previous studies where risk variables were dose-dependent. This limitation is partly due to cultural sensitivities and stigma surrounding alcohol use. However, as part of our prospective cohort design, we are gathering more detailed and reliable data during the follow-up period to address this gap. Further, our cohort does not contain data on steatosis, mainly due to the high cost of advanced laboratory and paraclinical evaluations for all participants. Therefore, we prioritized widely used and cost-effective tests, such as creatinine, FBG, LDL, HDL, and TG, in order to ensure feasibility.

Conclusion

Despite restrictions on alcohol usage, Iran has one of the highest rates of alcohol prevalence in the Middle East. The strong correlation between alcohol intake and risk factors such as early age, diabetes, obesity, hyperlipidemia, smoking, and opiate use suggests that alcohol abuse could become a national issue requiring legislative attention, particularly among the younger population. Our findings, based on a large random sample of Tehran residents, could aid healthcare decision-makers in developing comprehensive preventative programs to reduce alcohol consumption and related morbidity and mortality. Future research should focus on these high-risk individuals and evaluate the effectiveness of various preventative and treatment initiatives aimed at improving lifestyle habits and public awareness.

Acknowledgements We acknowledge the cooperation of the staff and participants in the TeCS study.

Authors' contribution AS and HT were involved in study concept, data collecting, and drafting the initial manuscript and final approval; SH and AH were responsible for drafting the initial manuscript, revision critically, and final approval; MM took part in drafting the initial manuscript, revised the study critically, and final approval; AJ was involved in study design, supervision, data cleaning, interpretation, analysis, and final approval; FA, SoSa, and OF revised the study critically and final approval; SaSa, MB, and AK contributed to supervision, study management, revision, and final approval. All authors reviewed and approved the final manuscript.

Funding This study was financially supported by the Iranian Ministry of Health and the Tehran Heart Center.

Data availability All the data generated or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Conflict of interest The authors state that they do not have any known competing financial interests or personal connections that could appear to have influenced the work reported in this study.

Ethical approval and consent to participate This project was approved by the Tehran Heart Center's review board and the ethical committee of the Tehran University of Medical Sciences (ID: IR.TUMS.MEDICINE.REC.1399.074). All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000.

Informed consent was obtained from all study participants before enrollment.

Consent for publication Not applicable.

References

1. Alcohol GBD, Drug UC. The global burden of disease attributable to alcohol and drug use in 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. Lancet Psychiatry. 2018;5(12):987–1012. https://doi.org/10.1016/S2215-0366(18)30337-7.
2. Al-Ansari B, Thow AM, Day CA, Conigrave KM. Extent of alcohol prohibition in civil policy in Muslim majority countries: the impact of globalization. Addiction. 2016;111(10):1703–13. https://doi.org/10.1111/add.13159.
3. Shokoohi M, Rahimi-Movaghar A, Noroozi A, Karamouzian M. A public health approach to alcohol use and its related harms in Iran. Lancet Public health. 2019;4(4):e175–6. https://doi.org/10.1016/S2468-2667(19)30038-6.
4. Chegeni M, Kamel Khodabandeh A, Karamouzian M, Shokoohi M, Abedi L, Khalili M, et al. Alcohol consumption in Iran: a systematic review and meta-analysis of the literature. Drug Alcohol Rev. 2020;39(5):525–38. https://doi.org/10.1111/dar.13093.
5. Baheiraei A, Soltani F, Ebadi A, Foroushani AR, Cheraghi MA. Risk and protective profile of tobacco and alcohol use among Iranian adolescents: a population- based study. Int J Adolescent Med Health. 2016;29(3):0089. https://doi.org/10.1515/ijamh-2015-0089.
6. Dolatshahi B, Abasi I, Pahlavani H. Prevalence of high risk behaviors among women living in Tehran. Pract Clin Psychol. 2016;4(2):105–12. https://doi.org/10.15412/j.Jpcp.06040205.
7. Nikfarjam A, Hajimaghsoudi S, Rastegari A, Haghdoost AA, Nasehi AA, Memaryan N, et al. The frequency of alcohol use in Iranian Urban population: the results of a national network scale up survey. Int J Health Policy Manag. 2017;6(2):97–102. https://doi.org/10.15171/ijhpm.2016.103.
8. Moradinazar M, Najafi F, Jalilian F, Pasdar Y, Hamzeh B, Shakiba E, et al. Prevalence of drug use, alcohol consumption, cigarette smoking and measure of socioeconomic-related inequalities of drug use among Iranian people: findings from a national survey. Subst Abuse Treat Prev Policy. 2020;15(1):39. https://doi.org/10.1186/s13011-020-00279-1.
9. Mehrabi M, Hajebi A, Mohebbi E, Baneshi MR, Khodadost M, Haghdoost AA, et al. Prevalence and correlates of lifetime alcohol use among adult urban populations in Iran: a knowledge, attitude, and practice study. J Psychoactive Drugs. 2019;51(3):290–7. https://doi.org/10.1080/02791072.2019.1578909.
10. Shafiee A, Saadat S, Shahmansouri N, Jalali A, Alaeddini F, Haddadi M, et al. Tehran cohort study (TeCS) on cardiovascular diseases, injury, and mental health: Design, methods, and recruitment data. Glob Epidemiol. 2021;3: 100051. https://doi.org/10.1016/j.gloepi.2021.100051.
11. Masoudkabir F, Shafiee A, Heidari A, Mohammadi NSH, Tavakoli K, Jalali A, et al. Epidemiology of substance and opium use among adult residents of Tehran; a comprehensive report from Tehran cohort study (TeCS). BMC Psychiatry. 2024;24(1):132. https://doi.org/10.1186/s12888-024-05561-1.
12. Mossavarali S, Vaezi A, Heidari A, Shafiee A, Jalali A, Alaeddini F, et al. Prevalence of insufficient physical activity among adult residents of Tehran: a cross-sectional report from Tehran Cohort Study (TeCS). BMC Public Health. 2024;24(1):1722. https://doi.org/10.1186/s12889-024-19201-6.
13. Shafiee A, Oraii A, Jalali A, Alaeddini F, Saadat S, Masoudkabir F, et al. Epidemiology and prevalence of tobacco use in Tehran; a report from the recruitment phase of Tehran cohort study. BMC Public Health. 2023;23(1):740. https://doi.org/10.1186/s12889-023-15629-4.
14. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. The seventh report of the joint national committee on prevention, detection, evaluation, and treatment of high blood pressure: the JNC 7 report. JAMA. 2003;289(19):2560–72. https://doi.org/10.1001/jama.289.19.2560.
15. American Diabetes A. (2020) 2. Classification and diagnosis of diabetes: standards of medical care in diabetes-2020. Diabetes care. 43(Suppl 1):S14-S31. https://doi.org/10.2337/dc20-S002
16. Qiao Q, Nyamdorj R. The optimal cutoff values and their performance of waist circumference and waist-to-hip ratio for diagnosing type II diabetes. Eur J Clin Nutr. 2010;64(1):23–9. https://doi.org/10.1038/ejcn.2009.92.
17. Heidari N, Hajikarim-Hamedani A, Heidari A, Ghane Y, Ashabi G, Zarrindast MR, et al. Alcohol: epigenome alteration and inter/transgenerational effect. Alcohol. 2024;117:27–41. https://doi.org/10.1016/j.alcohol.2024.03.008.
18. Witkiewitz K, Litten RZ, Leggio L. Advances in the science and treatment of alcohol use disorder. Sci Adv. 2019;5(9):4043. https://doi.org/10.1126/sciadv.aax4043.
19. Amin-Esmaeili M, Rahimi-Movaghar A, Sharifi V, Hajebi A, Mojtabai R, Radgoodarzi R, et al. Alcohol use disorders in Iran: prevalence, symptoms, correlates, and comorbidity. Drug Alcohol Depend. 2017;176:48–54. https://doi.org/10.1016/j.drugalcdep.2017.02.018.
20. Poorolajal J, Ebrahimi B, Rezapur-Shahkolai F, Doosti-Irani A, Alizadeh M, Ahmadpoor J, et al. The epidemiology of aggression and associated factors among Iranian adult population: a national survey. J Res Health Sci. 2020;20(4): e00499. https://doi.org/10.34172/jrhs.2020.34.
21. Organization WH. (2019) Global status report on alcohol and health 2018. World Health Organization
22. Çebi Karaaslan K, Karaaslan A. A study of factors affecting the alcohol consumption in Turkey. J Substance Use. 2021;27(4):422–7. https://doi.org/10.1080/14659891.2021.1953168.
23. AlMarri TS, Oei TP. Alcohol and substance use in the Arabian Gulf region: a review. Int J Psychol. 2009;44(3):222–33. https://doi.org/10.1080/00207590801888752.

24. Keyes KM. Age, period, and cohort effects in alcohol use in the United States in the 20th and 21st centuries: implications for the coming decades. Alcohol Res: Current Rev. 2022;42(1):02. https://doi.org/10.35946/arcr.v42.1.02.
25. Temple MT, Fillmore KM, Hartka E, Johnstone B, Leino EV, Motoyoshi M. A meta-analysis of change in marital and employment status as predictors of alcohol consumption on a typical occasion. Br J Addict. 1991;86(10):1269–81. https://doi.org/10.1111/j.1360-0443.1991.tb01703.x.
26. Watt RG, Heilmann A, Sabbah W, Newton T, Chandola T, Aida J, et al. Social relationships and health related behaviors among older US adults. BMC Public Health. 2014;14(1):533. https://doi.org/10.1186/1471-2458-14-533.
27. Scott KM, Wells JE, Angermeyer M, Brugha TS, Bromet E, Demyttenaere K, et al. Gender and the relationship between marital status and first onset of mood, anxiety and substance use disorders. Psychol Med. 2010;40(9):1495–505. https://doi.org/10.1017/S0033291709991942.
28. Buckman JEJ, Saunders R, Stott J, Arundell LL, O'Driscoll C, Davies MR, et al. Role of age, gender and marital status in prognosis for adults with depression: an individual patient data meta-analysis. Epidemiol Psychiatric Sci. 2021;30: e42. https://doi.org/10.1017/S2045796021000342.
29. Seid AK. Social interactions, trust and risky alcohol consumption. Heal Econ Rev. 2016;6(1):3. https://doi.org/10.1186/s13561-016-0081-y.
30. Miller NS, Gold MS. Comorbid cigarette and alcohol addiction: epidemiology and treatment. J Addict Dis. 1998;17(1):55–66. https://doi.org/10.1300/J069v17n01_06.
31. Pan A, Wang Y, Talaei M, Hu FB. Relation of smoking with total mortality and cardiovascular events among patients with diabetes mellitus: a meta-analysis and systematic review. Circulation. 2015;132(19):1795–804. https://doi.org/10.1161/CIRCULATIONAHA.115.017926.
32. Eskandarieh S, Nikfarjam A, Tarjoman T, Nasehi A, Jafari F, Saberi-Zafarghandi MB. Descriptive aspects of injection drug users in Iran's national harm reduction program by methadone maintenance treatment. Iran J Public Health. 2013;42(6):588–93.
33. Noorbala AA, Saljoughian A, Bagheri Yazdi SA, Faghihzadeh E, Farahzadi MH, Kamali K, et al. Evaluation of drug and alcohol abuse in people aged 15 years and older in Iran. Iran J Public Health. 2020;49(10):1940–6. https://doi.org/10.18502/ijph.v49i10.4697.
34. Roerecke M, Tobe SW, Kaczorowski J, Bacon SL, Vafaei A, Hasan OSM, et al. Sex-specific associations between alcohol consumption and incidence of hypertension: a systematic review and meta-analysis of cohort studies. J Am Heart Assoc. 2018;7(13):e008202. https://doi.org/10.1161/JAHA.117.008202.
35. Briasoulis A, Agarwal V, Messerli FH. Alcohol consumption and the risk of hypertension in men and women: a systematic review and meta-analysis. J Clin Hypertens. 2012;14(11):792–8. https://doi.org/10.1111/jch.12008.
36. Jung MH, Shin ES, Ihm SH, Jung JG, Lee HY, Kim CH. The effect of alcohol dose on the development of hypertension in Asian and Western men: systematic review and meta-analysis. Korean J Intern Med. 2020;35(4):906–16. https://doi.org/10.3904/kjim.2019.016.
37. Knott C, Bell S, Britton A. Alcohol consumption and the risk of type 2 diabetes: a systematic review and dose-response meta-analysis of more than 19 million individuals from 3.8 observational studies. Diabetes Care. 2015;38(9):1804–12. https://doi.org/10.2337/dc15-0710.
38. Schrieks IC, Heil AL, Hendriks HF, Mukamal KJ, Beulens JW. The effect of alcohol consumption on insulin sensitivity and glycemic status: a systematic review and meta-analysis of intervention studies. Diabetes Care. 2015;38(4):723–32. https://doi.org/10.2337/dc14-1556.
39. Roerecke M, Rehm J. Irregular heavy drinking occasions and risk of ischemic heart disease: a systematic review and meta-analysis. Am J Epidemiol. 2010;171(6):633–44. https://doi.org/10.1093/aje/kwp451.
40. Brien SE, Ronksley PE, Turner BJ, Mukamal KJ, Ghali WA. Effect of alcohol consumption on biological markers associated with risk of coronary heart disease: systematic review and meta-analysis of interventional studies. BMJ. 2011;342: d636. https://doi.org/10.1136/bmj.d636.
41. Huang Y, Li Y, Zheng S, Yang X, Wang T, Zeng J. Moderate alcohol consumption and atherosclerosis: meta-analysis of effects on lipids and inflammation. Wien Klin Wochenschr. 2017;129(21–22):835–43. https://doi.org/10.1007/s00508-017-1235-6.
42. De Oliveira ESER, Foster D, McGee Harper M, Seidman CE, Smith JD, Breslow JL, et al. Alcohol consumption raises HDL cholesterol levels by increasing the transport rate of apolipoproteins A-I and A-II. Circulation. 2000;102(19):2347–52. https://doi.org/10.1161/01.cir.102.19.2347.
43. Golzarand M, Salari-Moghaddam A, Mirmiran P. Association between alcohol intake and overweight and obesity: a systematic review and dose-response meta-analysis of 127 observational studies. Crit Rev Food Sci Nutr. 2022;62(29):8078–98. https://doi.org/10.1080/10408398.2021.1925221.
44. Fan AZ, Russell M, Dorn J, Freudenheim JL, Nochajski T, Hovey K, et al. Lifetime alcohol drinking pattern is related to the prevalence of metabolic syndrome. The Western New York Health Study (WNYHS). Eur J Epidemiol. 2006;21(2):129–38. https://doi.org/10.1007/s10654-005-5457-y.
45. Anto EO, Owiredu W, Adua E, Obirikorang C, Fondjo LA, Annani-Akollor ME, et al. Prevalence and lifestyle-related risk factors of obesity and unrecognized hypertension among bus drivers in Ghana. Heliyon. 2020;6(1): e03147. https://doi.org/10.1016/j.heliyon.2019.e03147.
46. Antin TMJ, Annechino R, Hunt G, Lipperman-Kreda S, Young M. The gendered experience of smoking stigma: implications for tobacco control. Crit Public Health. 2017;27(4):443–54. https://doi.org/10.1080/09581596.2016.1249825.
47. Leasure JL, Neighbors C, Henderson CE, Young CM. Exercise and alcohol consumption: what we know, what we need to know, and why it is important. Front Psychiatry. 2015;6:156. https://doi.org/10.3389/fpsyt.2015.00156.

Authors and Affiliations

Akbar Shafiee[1] · Hossein Toreyhi[1] · Seyedayin Hosseini[1] · Amirhossein Heidari[1,2] · Arash Jalali[3] · Mohammad Mohammadi[1] · Farshid Alaeddini[4] · Soheil Saadat[1] · Saeed Sadeghian[1] · Mohamamdali Boroumand[1] · Abbasali Karimi[1] · Oscar H. Franco[5]

✉ Arash Jalali
arjalali@tums.ac.ir

Akbar Shafiee
ashafiee@tums.ac.ir

Hossein Toreyhi
hoseinto@gmail.com

Seyedayin Hosseini
ayin.meimand@gmail.com

Amirhossein Heidari
amirhosseinheidari.md@gmail.com

Mohammad Mohammadi
m.mohammadi.inbox@gmail.com

Farshid Alaeddini
falaedini@yahoo.com

Soheil Saadat
soheil.saadat@gmail.com

Saeed Sadeghian
ssadeghian@tums.ac.ir

Mohamamdali Boroumand
borumand@tums.ac.ir

Abbasali Karimi
akarimi@tums.ac.ir

Oscar H. Franco
o.h.franco@umcutrecht.nl

1 Tehran Heart Center, Cardiovascular Diseases Research Institute, Tehran University of Medical Sciences, Tehran, Iran

2 Faculty of Medicine, Tehran Medical Sciences, Islamic Azad University, Tehran, Iran

3 Department of Cardiovascular Research, Tehran Heart Center, Cardiovascular Diseases Research Institute, Tehran University of Medical Sciences, North Kargar Ave, 1411713138 Tehran, Iran

4 Department of Emergency Medicine, University of California, Irvine, CA, USA

5 Department of Global Public Health and Bioethics, Julius Center for Health Sciences and Primary Care, University Medical Center (UMC) Utrecht, Utrecht University, Utrecht, The Netherlands