# Health-related Quality of Life in Men and Women who Experienced Cardiovascular Diseases: Tehran Lipid and Glucose Study

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# Abstract

**Background:** Cardiovascular diseases (CVDs) are among the most common causes of death worldwide, including in Iran. Considering the adverse effects of CVDs on physical and psychosocial health; this study aims to investigate the association between CVDs incidence and health-related quality of life (HRQoL) in adult participants of the Tehran Lipid and Glucose Study (TLGS).

**Methods:** The participants of this cross-sectional study were 7009 adults (≥20 years) who participated in the TLGS during 2014-2017. Demographic information and HRQoL data was collected through validated questionnaires by trained interviewers. HRQoL was assessed by the Iranian version of the SF-12 questionnaire. Data was analyzed using SPSS software.

**Results:** The mean age of participants was 46.8±14.6 years and 46.1% of them were men. A total of 9.0% of men and 4.4% of women had CVDs. In men, the mean physical HRQoL summary score was significantly lower in those with CVDs compared to those without CVDs (46.6±0.8 vs. 48.5±0.7, p >0.001). In women, the mean mental HRQoL summary scores was significantly lower in those with CVDs compared to those without CVDs (42.8±1.0 vs. 45.2±0.5, p =0.009). In adjusted models, men with CVDs were more likely to report poor physical HRQoL compared to men without CVDs (OR(95%CI): 1.93(1.32-2.84), p=0.001); whereas for women, the chance of reporting poor mental HRQoL was 68% higher in those with CVDs than those without CVDs (OR(95%CI): 1.68(1.11-2.54), p =0.015).

**Conclusion:** The findings of the current study indicate poorer HRQoL in those who experienced CVDs compared to their healthy counterparts with a sex specific pattern. While for men, CVDs were associated with greater impairment in the physical dimension of HRQoL, women experienced a similar impairment in the mental dimension of HRQoL.


# Introduction

Cardiovascular diseases (CVDs) are among the most common causes of deteriorating health and death worldwide. In 2015, a total of 17.9 million deaths and 347.5 million disability-adjusted life years (DALYs) in the world were owing to CVDs (1, 2). It is estimated that by 2030, about 30.5% (more than 23 million) of all global deaths will be due to CVDs (3). While there is a declining trend in the mortality rates of CVDs in high-income countries, about half of global CVD mortality occurred in low and middle-income countries, especially in the Eastern Mediterranean countries (2). Similarly, in Iran, the most common causes of death have shifted from infectious diseases to non-communicable diseases (NCDs) in recent decades (4). Based on existing evidence, Iran was found to have some of the highest prevalence of CVDs (5). In addition to the high prevalence of CVDs and their economic burden on families and the healthcare system (6), their related outcomes such as stroke, myocardial infarction (MI) and coronary artery disease (CAD) can lead to fatal and non-fatal complications. Although therapeutic advances have contributed to a reduction in the mortality rate of cardiovascular outcomes, many patients of CVDs still experience other complications throughout their lives, such as stress, anxiety, fatigue and pain, sleep disturbances, shortness of breath and dyspnea. In more serious cases, complications can include heart failure, the possibility of recurrent MI and sudden death (7–

12). These complications have important consequences on individuals' mental and physical health, namely, their health-related quality of life (HRQoL).

HRQoL is a multidimensional concept that involves subjective evaluations of physical, mental, and social domains of one's health. Improving HRQoL is the ultimate goal of all health-related interventions (13). In recent decades, the increasing proportion of individuals suffering from NCDs has been associated with greater interest in evaluating and improving the quality of life in patients with chronic diseases (14), with many studies globally investigating the relationship between cardiovascular outcomes and HRQoL. Most of these studies have found impairments in physical and mental dimensions of HRQoL (8, 15, 16). Several factors influenced the amount of impairment such as individual's age, employment, depression and anxiety, the duration of the disease, severity of angina, inadequate social support, complications of therapies and the experience of serious consequences such as heart failure (17–20).

Although the association between CVDs and HRQoL has been well documented in previous studies around the world (8, 15–18, 20–23), most of these studies did not explicitly consider sex differences (8, 15–18, 20) with only three studies conducting sex specific analyses (21–23). The association between CVDs and HRQoL has been investigated in previous studies conducted in Tehran (24–26) and other cities of Iran (27–31); however, most only focused on a specific population of people with CVDs such as those who experienced either heart failure, myocardial infarction, ischemic heart disease or had undergone a coronary artery bypass graft. There is a paucity of sex-specific evidence comparing HRQoL in a general population of adults with and without CVDs incidence. Furthermore, the studies previously conducted in Tehran had small sample sizes and only one study addressed sex differences (24). Due to limited evidence exploring this association in an Iranian population, the current study aims to investigate the association between CVDs and the HRQoL in a large sample of Tehranian adults who participated in a cohort of the Tehran Lipid and Glucose Study (TLGS).

# Methods

This cross sectional study was conducted within the framework of the Tehran Lipid and Glucose Study (TLGS), which is a community-based study that begun in 1999 and continued for 20 years. Participants were residents of district No. 13 in Tehran. The main objectives of the TLGS were to identify risk factors of non-communicable diseases and factors associated with preventing them. Further details regarding rational and design of the TLGS have been published previously (32, 33). This study has been approved by the ethics committee of the Research Institute for Endocrine Sciences (RIES) of Shahid Beheshti University of Medical Sciences and all participants provided written informed consent. For the current analysis, data from all adults (≥ 20 years) who had participated in the 6th phase of the TLGS (2014–2017) and had complete information on HRQoL and CVDs incident were considered. Of 10087 individuals aged ≥ 20 years participated in the 6th phase of the TLGS, 2148 participants excluded due to incomplete data on HRQoL and then 930 participants excluded due to having missing information on confounding variables; finally, data from 7009 eligible participants was analyzed.

Participants' weights were measured and recorded with minimal clothing, without shoes, using a digital scale with an accuracy of 0.1 kg. Height measurement was performed by a tape in a standing position, without shoes and while the shoulders were in a normal position. Body mass index (BMI) was calculated using related

formula as participant's weight in kilograms divided by the square of height in meters. Data on demographic information, physical activity, and HRQoL were collected using valid questionnaires and through interviews. Demographic information included age, sex, marital status, level of education, and employment status of participants. Physical activity was evaluated by the Persian version of the Modifiable Activity Questionnaire (MAQ). Based on the available evidence, the Persian version of MAQ has acceptable validity and reliability (34). In this questionnaire, physical activity was assessed through the number of times and the duration of time that the individual partakes in physical activity in a typical week. Level of physical activity was calculated using metabolic equivalents (MET) minutes/week, and the level of participants' physical activity was grouped into either low (MET < 600 minute/week), moderate (600 ≤ MET < 3000 minute/week) or high activity (MET ≥ 3000 minutes / week).

HRQoL was assessed by the SF-12 questionnaire. The questionnaire assesses health status using eight subscales including physical functioning, role physical, bodily pain, general health, vitality, social function, role emotional, and mental health. The range of scores for each scale is from zero to 100, with zero indicating the worst and 100 indicating the best position on each subscale. The psychometric characteristics of this questionnaire have been studied in the Iranian adult population with favorable validity and reliability (35).

In the current study, CVD was defined as any measures of CHD events as cases of 1) definite myocardial infarction diagnosed by ECG and biomarkers, 2) probable myocardial infarction (positive ECG findings plus cardiac symptoms or signs but biomarkers showing negative or equivocal results), 3) unstable angina pectoris (new cardiac symptoms or changing symptom patterns and positive ECG findings with normal biomarkers), 4) angiographic-proven CHD, and 5) CHD death., plus stroke or cerebrovascular events. Details of the definitions and analysis of CVD outcome data have been described before (36).

# Statistical analysis

Normal continuous variables were expressed as mean ± sd, while medians (Q1-Q3) were reported for skewed variables. Frequencies and percentages were reported for categorical variables. Distribution of variables among groups was compared using independent samples T-test, Mann-Whitney and Chi-square test as appropriate. The HRQoL scores were compared between study participants with and without CVDs using analysis of covariance, for men and women separately. For assessing the association between HRQoL and CVDs status (absent vs. present), unadjusted and adjusted logistic regression analyses were used. The odds ratios (ORs) and 95% confidence intervals (CIs) were reported, separately for men and women. Poor HRQoL was defined as the first tertile of PCS or MCS. All variables which were significantly different between the study participants with and without CVDs were adjusted. A two-sided P-value < 0.05 was deemed statistically significant. Statistical analyses were conducted using IBM SPSS 22 software for Windows (IBM Co., Armonk, NY, USA).

# Results

The mean age of participants was 46.8 ± 14.6 years and 46.1% of them were men. A total of 457 (6.5%) of participants had CVDs. Descriptive statistics of study participants are shown in Table 1. There were significant differences in the distribution of marital status, level of education, job status, levels of physical

activity and smoking status between men and women. Lower percentage of women (27.6%) had low levels of physical activity compared to men (37.5%); however, higher percentages of men (23.9%) had high levels of physical activity compared to women (12.2%). In terms of smoking, a significantly higher percentage of men were smokers compared to women (42.1% vs. 5.4%, respectively). In terms of cardiovascular risk factors, women had significantly higher mean body mass index (BMI), total cholesterol, and high-density lipoproteins (HDL) compared to men ($p < 0.001$). On the other hand, men had significantly higher fasting blood sugar, triglycerides, and systolic and diastolic blood pressure than women. The distribution of weight status in men and women was also significantly different, with a higher prevalence of overweight in men and higher prevalence of obesity in women. Hypertension and CVDs were significantly higher in men than in women, while chronic kidney diseases were significantly higher in women than men.

Table 1
**Descriptive statistics of the study participants**

| | Total (n = 7009) | Men (n = 3232) | Women (n = 3777) | P value |
|---|---|---|---|---|
| **Age (year)** | 46.8 ± 14.6 | 46.9 ± 15.3 | 46.7 ± 13.9 | 0.558 |
| **Marital status** | | | | |
| -Single/Divorced/Widowed | 1570(22.4) | 665(20.6) | 905(24.0) | < 0.001 |
| -Married | 5439(77.6) | 2567(79.4) | 2872(76.0) | |
| **Level of education** | | | | |
| -Primary | 1692(24.1) | 635(19.6) | 1057(28.0) | < 0.001 |
| -Secondary | 2837(40.5) | 1349(41.7) | 1488(39.4) | |
| -Higher | 2480(35.4) | 1248(38.6) | 1232(32.6) | |
| **Job status** | | | | |
| - Unemployed/student/housewife | 2887(41.2) | 218(6.7) | 2669(70.7) | < 0.001 |
| - Unemployed, but had other sources of income | 978(14.0) | 603(18.7) | 375(9.9) | |
| - Employed | 3144(44.9) | 2411(74.6) | 733(19.4) | |
| **Physical activity** | | | | |
| -Low | 2256(32.2) | 1213(37.5) | 1043(27.6) | < 0.001 |
| -Moderate | 3520(50.2) | 1246(38.6) | 2274(60.2) | |
| -High | 1233(17.6) | 773(23.9) | 460(12.2) | |
| **Smoking** | | | | |
| -Yes | 1563(22.3) | 1360(42.1) | 203(5.4) | < 0.001 |
| -No | 5446(77.7) | 1872(57.9) | 3574(94.6) | |
| **Cardio-metabolic risk factors** | | | | |
| -Body mass index (kg/m$^2$) | 28.1 ± 4.9 | 27.5 ± 4.4 | 28.4 ± 5.3 | < 0.001 |
| -Fasting blood sugar | 98.8 ± 28.3 | 100.5 ± 28.9 | 97.3 ± 27.6 | < 0.001 |

Note: Data are reported as mean ± SD for normal continuous variables and medians (Q1-Q3) for skewed variables. n (%) were reported for categorical variables.

| | Total (n = 7009) | Men (n = 3232) | Women (n = 3777) | P value |
|---|---|---|---|---|
| -Total cholesterol | 186.1 ± 39.3 | 183.5 ± 38.7 | 188.4 ± 39.6 | < 0.001 |
| -HDL | 47.1 ± 11.2 | 42.6 ± 9.6 | 50.8 ± 11.0 | < 0.001 |
| -Triglyceride | 123(86.0-175.0) | 135(95.0-192.0) | 114(80.0-160.0) | < 0.001 |
| -Systolic blood pressure | 114.7 ± 16.5 | 118.4 ± 15.3 | 111.5 ± 16.9 | < 0.001 |
| -Diastolic blood pressure | 76.1 ± 9.8 | 78.5 ± 9.6 | 74.0 ± 9.5 | < 0.001 |
| **Body weight status** | | | | |
| -Normal weight | 1918(27.4) | 913(28.2) | 1005(26.6) | < 0.001 |
| -Overweight | 2979(42.5) | 1531(47.4) | 1448(38.3) | |
| -Obese | 2112(30.1) | 788(24.4) | 1324(35.1) | |
| **Diabetes (Yes)** | 1048(15.0) | 474(14.7) | 574(15.2) | 0.534 |
| **Hypertension (Yes)** | 1577(22.5) | 769(23.8) | 808(21.4) | 0.016 |
| **CVD (Yes)** | 457(6.5) | 292(9.0) | 165(4.4) | < 0.001 |
| **Chronic kidney Diseases (Yes)** | 1630(23.3) | 502(15.5) | 1128(29.9) | < 0.001 |
| **Cancer (Yes)** | 88(1.3) | 34(1.1) | 54(1.4) | 0.157 |

Note: Data are reported as mean ± SD for normal continuous variables and medians (Q1-Q3) for skewed variables. n (%) were reported for categorical variables.

Table 2 shows the mean scores of HRQoL in men and women. In all subscales, men had significantly higher scores compared to women. Similarly, men had significantly higher physical and mental summary scores compared to women.

Table 2
**Comparison of health-related quality of life scores in men and women**

| | Total | Men | Women | P value |
|---|---|---|---|---|
| -Physical Function | 83.9 ± 24.9 | 88.9 ± 20.7 | 79.7 ± 27.2 | < 0.001 |
| -Role Physical | 79.7 ± 23.0 | 86.6 ± 19.3 | 73.9 ± 24.2 | < 0.001 |
| -Bodily pain | 78.9 ± 24.0 | 84.4 ± 20.7 | 73.8 ± 25.4 | < 0.001 |
| -General Health | 48.1 ± 23.1 | 50.9 ± 23.2 | 45.6 ± 22.7 | < 0.001 |
| **PCS** | 48.4 ± 8.4 | 50.2 ± 7.3 | 46.9 ± 8.9 | < 0.001 |
| -Vitality | 64.5 ± 25.8 | 69.8 ± 24.2 | 59.9 ± 26.2 | < 0.001 |
| -Social Function | 81.3 ± 25.9 | 85.1 ± 23.5 | 78.0 ± 27.3 | < 0.001 |
| -Role Emotional | 75.2 ± 23.3 | 80.5 ± 21.2 | 70.7 ± 24.0 | < 0.001 |
| -Mental Health | 69.9 ± 22.1 | 74.8 ± 20.9 | 65.7 ± 22.3 | < 0.001 |
| **MCS** | 48.4 ± 10.9 | 50.6 ± 10.3 | 46.6 ± 11.1 | < 0.001 |

Note: Data are reported as mean ± SD. PCS: physical component summary, MCS: mental component summary.

Descriptive statistics of participants based on incident of CVDs are presented in Table 3. As it is indicated, except for smoking and BMI in men and history of cancer in women, all other variables were significantly different in those with and without CVDs outcomes. Therefore, these variables were adjusted in all analyses in Table 4 and in all regression models.

Table 3
Descriptive statistics in men and women based on CVDs

| | Men | | P value | Women | | P value |
|---|---|---|---|---|---|---|
| | Without CVDs | With CVDs | | Without CVDs | With CVDs | |
| **Age (year)** | 45.1 ± 14.6 | 65.0 ± 10.2 | < 0.001 | 45.9 ± 13.6 | 64.9 ± 7.9 | < 0.001 |
| **Marital status** | | | | | | |
| -Single/Divorced/Widowed | 653(22.2) | 12(4.1) | < 0.001 | 851(23.6) | 54(32.7) | 0.007 |
| -Married | 2287(77.8) | 280(95.9) | | 2761(76.4) | 111(67.3) | |
| **Level of education** | | | | | | |
| -Primary | 5165(17.6) | 119(40.8) | < 0.001 | 932(25.8) | 125(75.8) | < 0.001 |
| -Secondary | 1232(41.9) | 117(40.1) | | 1454(40.3) | 34(20.6) | |
| -Higher | 1192(40.5) | 56(19.2) | | 1226(33.9) | 69(3.6) | |
| **Job status** | | | | | | |
| - Unemployed/student/housewife | 213(7.2) | 5(1.7) | < 0.001 | 2556(70.8) | 113(68.5) | < 0.001 |
| - Unemployed, but had other sources of income | 437(14.9) | 166(56.8) | | 324(9.0) | 51(30.9) | |
| - Employed | 2290(77.9) | 121(41.4) | | 732(20.3) | 1(0.6) | |
| **Physical activity** | | | | | | |
| -Low | 1098(37.3) | 115(39.4) | | 975(27.0) | 68(41.2) | |
| -Moderate | 1122(38.2) | 124(42.5) | 0.049 | 2186(60.5) | 88(53.3) | < 0.001 |
| -High | 720(24.5) | 53(18.2) | | 451(12.5) | 9(5.5) | |
| **Smoking** | | | | | | |
| -Yes | 1233(41.9) | 127(43.5) | 0.608 | 200(5.5) | 3(1.8) | 0.038 |
| -No | 1707(58.1) | 165(56.5) | | 3412(94.5) | 162(98.2) | |
| **Body mass index (kg/m$^2$)** | 27.5 ± 4.4 | 27.3 ± 3.8 | 0.384 | 28.4 ± 5.3 | 30.9 ± 4.9 | < 0.001 |
| **Diabetes (Yes)** | 353(12.0) | 121(41.4) | < 0.001 | 499(13.8) | 75(45.5) | < 0.001 |
| **Hypertension (Yes)** | 601(20.4) | 168(57.5) | < 0.001 | 694(19.2) | 114(69.1) | < 0.001 |

Note: Data are reported as mean ± SD for continues variables and n (%) for categorical variables.

| | Men | | P value | Women | | P value |
|---|---|---|---|---|---|---|
| | Without CVDs | With CVDs | | Without CVDs | With CVDs | |
| **Chronic kidney Diseases (Yes)** | 381(13.0) | 121(41.4) | < 0.001 | 1004(27.8) | 124(75.2) | < 0.001 |
| **Cancer (Yes)** | 26(0.9) | 8(2.7) | 0.009 | 51(1.4) | 3(1.8) | 0.510 |
| Note: Data are reported as mean ± SD for continues variables and n (%) for categorical variables. | | | | | | |

Table 4
Mean health-related quality of life scores based on cardiovascular diseases (CVDs) outcomes in men and women

| | Men | | P value | Women | | P value |
|---|---|---|---|---|---|---|
| | Without CVDs | With CVDs | | Without CVDs | With CVDs | |
| -Physical Function | 84.1 ± 1.9 | 78.3 ± 2.2 | < 0.001 | 78.7 ± 1.2 | 75.0 ± 2.3 | 0.084 |
| -Role Physical | 83.3 ± 1.8 | 78.1 ± 2.1 | < 0.001 | 73.4 ± 1.1 | 68.0 ± 2.1 | 0.003 |
| -Bodily pain | 85.2 ± 2.0 | 83.2 ± 2.2 | 0.146 | 74.8 ± 1.1 | 72.4 ± 2.2 | 0.263 |
| -General Health | 45.4 ± 2.0 | 41.0 ± 2.3 | 0.003 | 43.2 ± 1.0 | 39.5 ± 1.9 | 0.033 |
| **PCS** | 48.5 ± 0.7 | 46.6 ± 0.8 | < 0.001 | 47.2 ± 0.4 | 45.9 ± 0.7 | 0.058 |
| -Vitality | 69.8 ± 2.3 | 64.3 ± 2.6 | 0.001 | 60.6 ± 1.2 | 52.9 ± 2.3 | < 0.001 |
| -Social Function | 84.2 ± 2.2 | 83.6 ± 2.5 | 0.706 | 75.6 ± 1.3 | 69.3 ± 2.4 | 0.006 |
| -Role Emotional | 79.2 ± 2.0 | 76.4 ± 2.2 | 0.014 | 68.5 ± 1.1 | 64.4 ± 2.1 | 0.040 |
| -Mental Health | 75.4 ± 2.0 | 74.6 ± 2.2 | 0.575 | 62.3 ± 1.0 | 58.5 ± 2.0 | 0.045 |
| **MCS** | 51.0 ± 0.9 | 50.4 ± 1.1 | 0.349 | 45.2 ± 0.5 | 42.8 ± 1.0 | 0.009 |
| Note: Adjusted mean and standard error have been reported (Adjustments in men: age, level of education, job status, marital status, physical activity and diabetes, hypertension, cancer and chronic kidney diseases, and in women: age, level of education, job status, marital status, physical activity, smoking, body mass index and diabetes, hypertension and chronic kidney diseases). PCS: physical component summary, MCS: mental component summary. | | | | | | |

Comparison of HRQoL scores between groups of participants with and without CVDs are indicated in Table 4. All subscale scores of HRQoL were significantly lower in those with CVDs compared to those without CVDs, except for bodily pain, social function and mental health subscales in men and physical function and bodily pain subscales in women. The PCS in men and MCS in women were significantly lower in those with CVDs compared to those without CVDs.

Table 5 reports odds ratios and 95% confidence intervals (CIs) of poor physical and mental HRQoL for men and women with and without CVDs. Model 1 is the unadjusted model and model 2 is adjusted for confounding variables. In men, the chances of reporting poor physical HRQoL were significantly higher in

those with CVDs compared to those without CVDs in both unadjusted (OR (95%CI): 4.27(3.02–6.04), p < 0.001) and adjusted models (OR (95%CI):1.93(1.32–2.84), p = 0.001). However, there was no significant difference in the chances of reporting poor mental HRQoL in men based on CVDs incidence. On the other hand, in women, the chances of reporting both poor physical and mental HRQoL were significantly higher in those with CVDs compared to those without; however, after adjusting for confounding variables, only the chance of reporting poor mental HRQoL was significantly higher in women with CVDs compared to those without CVDs (OR (95%CI): 1.68(1.11–2.54), p = 0.015).

Table 5
Odds ratios and 95% confidence interval (CI) for poor physical and mental health-related quality of life in men and women

| | | | Men | | Women | |
|---|---|---|---|---|---|---|
| | | | **Odds ratio** | **P value** | **Odds ratio** | **P value** |
| **PCS** | **Model 1** | -Without CVDs | Ref. | | Ref. | |
| | | -With CVDs | 4.27(3.02–6.04) | < 0.001 | 3.54(2.31–5.44) | < 0.001 |
| | **Model 2** | -Without CVDs | Ref. | | Ref. | |
| | | -With CVDs | 1.93(1.32–2.84) | 0.001 | 1.06(0.66–1.70) | 0.799 |
| **MCS** | **Model 1** | -Without CVDs | Ref. | | Ref. | |
| | | -With CVDs | 0.76(0.57–1.02) | 0.068 | 1.49(1.01–2.20) | 0.043 |
| | **Model 2** | -Without CVDs | Ref. | | Ref. | |
| | | -With CVDs | 1.21(0.87–1.68) | 0.270 | 1.68(1.11–2.54) | 0.015 |

Model 1 is unadjusted. Model 2 is adjusted for confounding variables (in men: age, level of education, job status, marital status, physical activity and diabetes, hypertension, cancer and chronic kidney diseases, and in women: age, level of education, job status, marital status, physical activity, smoking, body mass index and diabetes, hypertension and chronic kidney diseases). PCS: physical component summary, MCS: mental component summary.

# Discussion

The present study aimed to investigate the association between CVDs and HRQoL in Tehranian men and women who participated in the TLGS. The findings indicate that HRQoL scores were significantly lower in participants with CVDs incident compared to those without CVDs. In addition, a sex-specific pattern was observed for the association between CVDs and HRQoL. While the impairment of HRQoL scores was observed in mental dimensions of HRQoL in women; in men, this impairment was more pronounced in physical dimension of HRQoL.

According to the findings of the current study, HRQoL scores were significantly lower in those with history of CVDs compared to those without history of CVDs. Consistent with our findings, several studies in different countries reported impairments in HRQoL in patients who experienced CVD outcomes compared to their healthy counterparts (8, 11, 21, 23, 37, 38). Similarly, findings of a study conducted in Tehran, Iran, indicated

HRQoL scores in all physical and mental subscales were significantly lower in men and women who suffered from MI compared to healthy individuals, with physical subscales more impaired than mental ones (39). Experiencing CVDs is often accompanied with several health consequences such as limitations in physical function, physical disabilities, decreased social interactions, psychological distress such as anxiety and stress, decreased vitality, early retirement due to inability to work, pain and fatigue, shortness of breath, and sleep disturbances; all of which can negatively impact various aspects of HRQoL (12, 40–42).

In the current study, a sex specific pattern was observed in the association between CVDs and HRQoL. In terms of HRQoL subscale scores, impairment of HRQoL in men with CVDs was more prominent in physical subscales; while in women with CVDs, lower HRQoL scores were observed in all mental subscales and to less extent in physical subscales compared to their counterparts without CVDs. There were greater impairments in HRQoL in women compared to men. One possibility for this sex difference may be due to lower compatibility with disease and slower recovery from illnesses in women in comparison to men, ultimately leading to more impairments in HRQoL (43, 44). Another explanation for lower HRQoL scores could be related to factors such as age, psychosocial characteristics, and baseline health-related quality of life scores which have been found to be important predictors of HRQoL in CVD survivors (20). Existing evidence indicate that women develop CVDs in older age, they suffer from depression more often than men, and had lower HRQoL scores compared to their male counterparts. Furthermore, another study found that social support is a significant determinant of HRQoL in female cardiac patients specifically in the mental dimension of HRQoL (45). In the TLGS general population, perceived social support from family was significantly lower in women compared to men (46). If social support is a significant determinant of HRQoL, it makes sense that women in this study experienced lower HRQoL than men, who perceived greater social support from family in their lives.

Furthermore, in the current study in the adjusted models, the chances of reporting poor physical HRQoL in men and poor mental HRQoL in women were significantly higher in those with CVDs compared to their counterparts. Related existing evidence has indicated that mood disorders, psychosomatic and psychological symptoms have been reported more in women with cardiovascular outcomes (47) compared to men, which may exacerbate the mental dimension of HRQoL in women. Despite the higher prevalence of myocardial infarction in men, women appear to have a similar or slightly higher prevalence of stable angina (48). Studies have shown that women are more likely to have non-obstructive coronary artery disease, whereas men have more obstructive coronary artery disease and multivessel involvement in angiographic studies than women in the population referred with acute coronary syndrome (49, 50). These findings justify the reduction of invasive therapeutic interventions in women and the lower risk of developing refractory angina and rehospitalization for unstable angina and ultimately improving their prognosis (51, 52). On the other hand, following the higher prevalence of MI in men, they are more likely to have HFrEF (heart failure with reduced ejection fraction). But regardless of its type either HFpEF(Heart failaure with preserved ejection fraction) or HFrEF(Heart failaure with reduced ejection fraction), women showed to have a better therapeutic response, maybe because compensatory responses at the cellular or molecular level appear to be more effective in women than in men (49, 53) which may contribute to the lower score of physical HRQoL in men.

A strength of this study is the large sample size, which allows for more accurate findings and interpretations. In addition, the use of the SF-12 questionnaire, one of the most common and popular tools for assessing HRQoL in general populations, make the findings of this study more directly comparable to those of other

countries that use the same questionnaire. This study also has limitations related to its generalizability and design. Since the participants of this study were all residents of Tehran, a large urban city, the findings cannot be generalized to broader rural or sub-urban communities in Iran. Lastly, the cross-sectional design of the study precludes causal inferences in the relationship between CVDs and HRQoL.

## Conclusions

Findings of the current study indicate a significant association between CVDs and HRQoL with a sex specific pattern. In men, CVDs are associated with an impairment in the physical dimension of HRQoL, while in women, of the association was evident for mental dimensions of HRQoL. These findings can help to better plan and design interventions and the distribution of health care resources to improve HRQoL in people with CVDs incidence.

## Abbreviations

BMI: Body mass index, CVDs: Cardiovascular diseases, CI: Confidence interval, HRQoL: Health-related quality of life, MCS: mental component summary, MAQ: Modifiable Activity Questionnaire, MI: Myocardial infarction, OR: odds ratio, PCS: physical component summary, TLGS: Tehran Lipid and Glucose Study.

## Declarations

# Ethics approval and consent to participate

This study was approved by the research ethics committee of the Research Institute for Endocrine Sciences (RIES), Shahid Beheshti University of Medical Sciences. Prior to data collection, informed consent was obtained from all participants.

# Consent for publication

Not applicable.

# Availability of data and materials

The datasets used and/or analyzed during this study are available from the corresponding author on reasonable request.

# Competing interests

The authors declare that they have no competing interests.

# Authors’ contribution

PA and SJF designed the study. LCh participated in acquisition of data and carried out the statistical analysis. PA and SJF contributed to interpretation of data. SJF, HF and KT drafted the manuscript. PA, DKh and FA supervised and revised the manuscript. All authors read and approved the final manuscript.

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