



2020

## Prevalence of cardiovascular Diseases Risk Factors Among Jordanians

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### Recommended Citation

Alsaud, Wesam Saleh; Tabbaa, Mohammad; Kasabri, Violet; Suyagh, Maysa; Abu Alsamen, Muneer; Haddad, Hussain; and Sheweiki, Anas (2020) "Prevalence of cardiovascular Diseases Risk Factors Among Jordanians," *Journal of the Saudi Heart Association*: Vol. 32 : Iss. 2 , Article 34.

Available at: <https://doi.org/10.37616/2212-5043.1074>

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## Prevalence of cardiovascular Diseases Risk Factors Among Jordanians

### Cover Page Footnote

We thank the following members of the Jordanian General Practitioner/Physician Association for participation in this study: Dr. Mahmoud Hashem, Dr. AbdulWahhab Awad, Dr. Ahmad Shalabi, Dr. Ali Mahseri, Dr. Aref Abu Hwaij, Dr. Maher Yagi, Dr. Mohammad Alazzam, Dr. Yahya Tarifi, Dr. Fayez Alqadi, Dr. Hashem Abu Alhaija, Dr. Ibrahim Shoubaki, Dr. Ibrahim Tuffaha, Dr. Kawther Sarhan, Dr. Khalid Abdul Wahed, Dr. Mohammad Hajjaj, Dr. Mufeed Damrah, Dr. Muhammad Ulaimat, Dr. Numir Batarseh, Dr. Osama Kamal, Dr. Rahat Zgeter, Dr. Samyah Masarweh, Dr. Samyah Mdanat, Dr. Yousef Alfaqeeh and Dr. Zeyad Nsour. Also we thank the following members of the Jordanian pharmaceutical company for participation in this study: Dr. Taghreed Barqawi ,Sales and Marketing Director, Dr. Alaa alturk, Dr. Nazer Zayed, business unit manager , Dr. Alaa baniamdan, Dr. Obada alqarioty and Dr. Nisreen Fakori, Medical Representatives Supervisors, Dr. Alaa' odeh, Dr. Diana alabdallat, Dr. Farah alomari, Dr. Nour nouri, Dr. Abdullah alwheidi and Dr. Waleed Alabadi, Medical Representatives.

# Prevalence of Cardiovascular Diseases Risk Factors among Jordanians

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## Abstract

**Background and aims:** One of the most common causes of death worldwide is cardiovascular diseases (CVDs). This study evaluated the prevalence of CVDs risk factors (RFs) and their constellation electively among the Jordanian population and, assessing the most prevalent RF interplay with the rest of CVDs RFs as well as the impact of age and gender dimorphism on the frequencies of coexistence of multiple CVDs risk factors (RFs) among the Jordanian population.

**Methods and results:** In this observational multicenter study, a total of 1449 subjects were enrolled. The mean age ( $\pm$ SD) was  $44.35 \pm 14.46$  years; 796 (54.9%) of them were females and 801 (55.28%) of the whole study pool had no family history of premature CVDs. Only 5.9% of the population did not have any of these RFs. The prevalence of CVDs MRFs within-affected subjects was as follows: there were 1081 (74.6%) subjects with overall dyslipidemia, 471 (32.51%) with obesity, 456 (31.47%) were smokers, and at the first diagnostic encounter 541 (37.47%) were with elevated blood pressure and, 310 (21.51%) were with elevated random blood sugar. The coexistence of  $\geq$  two,  $\geq$  three and,  $\geq$  four RFs was observed in 75.7%, 44.4%, and 21.4% of the subjects, respectively. The constellation of multiple RFs was more frequent in men than that in women, where the presence of  $\geq$  two RFs for men was at 86.18% vs. 67.09% for women. Similarly, the appearance of multiple RFs increases with age, starting from the existence of  $\geq$  three, and four RFs respectively. Most notably the clustering of  $\geq$  five RFs in the age group of 45–59 years showed the greatest frequency vs. any other age group.

**Conclusions:** CVDs risk factors (RFs) and clusters of them are extremely prevalent in the Jordanian population. Overall dyslipidemia is the most prevalent MRF and the most favors clustering with other CVDs RFs. Combined two RFs had the highest proportional frequency between all six RFs clusters. The constellation of at least two, three, and four CVDs RFs presented at almost three-fourth, half, and around one-fourth; respectively, Middle-aged males presented significantly higher rates of  $\geq$  five RFs occurrences than females.

## 1. Introduction

The non-communicable chronic diseases (NCDs) showed a sustainable elevation in deaths number in addition to significant patient's quality of life deterioration [1]. According to the World Health Organization (WHO), more than 36 million people die annually from chronic NCDs,

Amongst these; cardiovascular diseases (CVDs) account for most deaths (17.9 million), followed by cancer (9.0 million), chronic respiratory tract illnesses (3.9 million), and diabetes (1.6 million) [2]. Deaths from CVDs, cancer, chronic respiratory tract illness, and diabetes represent over 80% of all premature NCDs deaths worldwide [3]; where mostly low and middle-income countries

Received 27 January 2020; revised 25 May 2020; accepted 30 May 2020.  
Available online 03 August 2020

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accounted for over three-quarters of CVDs deaths [4]. Global major burdens on the total costs of medical care are caused by CVDs [5]. Risk factors (RFs) of CVDs can be categorized into three groups: non-modifiable RFs, modifiable RFs (MRFs), and emerging RFs or psychosocial factors, including workplace stress. The pattern of CVDs RFs distribution is often as clusters that incrementally culminate into CVDs in a multiplicative rather than in an additive manner [6a–6d]. The non-modifiable risk elements include age, gender, and family history of premature CVDs [6a,7,8]. Elevated blood pressure, dyslipidemias, diabetes mellitus, obesity, smoking and lack of physical activity are all included under modifiable risk elements [6a]. In the INTERHEART study from 52 countries, the potential relation between modifiable risk factors, including smoking, elevated ApoB/ApoA1 ratio, history of elevated blood pressure, abdominal obesity, psychosocial matters, and regular alcohol ingestion and myocardial infarction was substantiated [9a–9g]. Psychosocial factors like stressful life calamities, multiple stress, animosity, depression, and anxiety are also emerging as RFs for CVDs [10a–10d]. The objectives of this study were to evaluate the prevalence of CVDs RFs and RFs clusters among the Jordanian population also to assess the most prevalent RF interplay with the rest of CVDs RFs in addition to the impact of age and gender on the coexistence frequencies of multiple CVDs RFs.

## 2. Method

### 2.1. Study population

In this observational multicenter study, combined samples of 1449 were enrolled from different cities in the South, Middle, and North of Jordan over the last two weeks of August 2018, in collaboration with the general medical practitioners and physicians society. Based on determining sample size for a survey using Mendenhall (1983) equation [11], we need not > 385 replicates as a representative sample from overall Jordan population which is around 10 million but to have stratified random samples from all Governorates of Jordan we increased the sample size to 1449. Jordanian subjects with age  $\geq 20$  years signed an informed consent form before participation, only mentally or physically handicapped

### Abbreviations

CVDs	Cardiovascular diseases
CAD	Coronary artery disease
MRFs	Modifiable risk factors
TC	Total cholesterol
HDL-C	High-density lipoprotein cholesterol
LDL-C	Low-density lipoprotein cholesterol
TG	Triglycerides
HTN	Hypertension
DM	Diabetes mellitus
FH	
pCVD	Family history of premature cardiovascular disease
Overall	
Dys	Overall dyslipidemias
NCD	Non communicable diseases
BMI	Body mass index
BP	Blood pressure
SBP	Systolic blood pressure
DBP	Diastolic blood pressure
BS	Blood sugar
SD	Standard deviation
AfME	Africa and the middle East

people and pregnant females were excluded. The presence of the following six CVDs RFs, five MRFs; hypertension (HTN), diabetes mellitus (DM), cigarette smoking, dyslipidemia, obesity; and one non-modifiable RF; family history of premature CVDs; were assessed in every subject questionnaire, and. Further assessment of the following demographic data was undertaken as age and gender, educational level, height and weight. An average of three readings of blood pressure was measured by trained investigators, and a blood sample was collected by the laboratory specialized practitioners to analyze for random lipid profile and random blood sugar. The enrolled subjects have been educated about the significance of CVDs RFs. Collected data were coded and filed. This study was approved by the Institutional Review Board (IRB) of King Abdullah University Hospital.

### 2.2. Study measures

All RFs were defined by internationally approved standard references. Principally normal lipid profile defined as per the Adult Treatment Panel III [12]: TC < 200 mg/dL (5.2 mmol/L), LDL-C < 130 mg/dL (3.36 mmol/L), TG < 150 mg/dL (1.69 mmol/L), HDL-C > 50 mg/dL (1.04 mmol/L) in women, HDL-C > 40 mg/dL (1.04 mmol/L) in men. We defined the case where at least one variable of lipid profile parameters is abnormal as Overall dyslipidemia, and when all variables of lipid profile parameters are abnormal as mixed dyslipidemia. According to the International

Society of Hypertension [13], HTN definition is when systolic blood pressure (SBP) > 140 mmHg and Diastolic BP (DBP) > 90 mmHg. One of ADA [American Diabetes Association; 14] criteria for diabetes diagnosis is random BS > 200 mg/dL (>11.1 mmol/L) with hyperglycemia symptoms. Enrolled nonsmokers were past smokers at least a month before enrollment or never smoked otherwise the subject was considered a smoker. A family history of premature CVDs defined as myocardial infarction, coronary revascularization or sudden death before 55 years of age in father or any other male first-degree relative, or before 65 years of age in mother or any other female first-degree relative. BMI calculated by dividing body-weight in kg by the square of height in meters. Body weight categorized according to BMI [15] as the following: Underweight had  $13.0 \leq \text{BMI} \leq 18.4$ , normal body when weight had is 18.5–24.9, Overweight had has  $25 \leq \text{BMI} \leq 29.9$  and the Obesity had  $\text{BMI} \geq 30.0$ .

### 2.3. Statistical analysis

The Statistical Analysis System (SAS, 2011) was used for data entry and analysis. Frequencies and percentages were used to describe categorical variables. The differences in percentages of RFs among men and women, and among the four pre-specified age groups were analyzed using Chi square test. A P-value of <0.05 was considered statistically significant.

## 3. Results

The demographics of the study population were presented in Table 1, showing that the studied population had almost equal proportions of males and females. Also, from the four age groups, two-third of subjects' age was between 30 and 60 years and the rest at the age extremes. Such nature of replicates distribution between the subgroups indicates the random sampling of subjects. The frequency of six CVDs RFs evaluated as shown

Table 1. Demographics of this study population.

Feature	N	%
Overall population	1449	
Gender		
Men	653	45.1
Women	796	54.9
Age groups (y), mean $\pm$ SD	44.35 $\pm$ 14.46	
20–29	272	18.8
30–44	459	31.7
45–59	487	33.
60–90	231	15.9

N: number of replicates, %: percentage, SD = standard deviation.

in Fig. 1, Overall Dyslipidemia being most prevalent CVDs RF, followed by FH pCVD, initial encounter HTN, obesity, smoking and finally initial encounter DM. Fig. 2 displays the prevalence of random clustering pattern of six CVDs RFs. One-third of subjects had any two random RFs of the assigned six RFs. Each clustering group includes the random probability from the six RFs assigned. Calculated frequencies of  $\geq$ two,  $\geq$ three and  $\geq$ four RFs, were observed in 75.71%, 44.41% and, 21.44% of subjects, respectively. The following are the detailed numbers of results (frequency) of each CVDs MRF: A) lipid profile variables: the mixed dyslipidemia 133 (9.18%), elevated TC 510 (35.2%), elevated TG 679 (46.86%), elevated LDL-C 407 (28%) and reduced HDL-C 697 (48.1%). B) Elevated blood pressure at the first diagnostic encounter: 338 (23%) showed high SBP; on the other hand 323 (22%) showed high DBP and 188 (13.0%) had both C) Elevated random blood Sugar at the first diagnostic encounter 102 (7%), 210 (14.5%) were already diabetic. D) Body weight categories: 35 (2%) underweight, 213 (15%) lean, 566 (41%) overweight and 471 (33%) obese. Overweight and obese represent 74% of subjects. E) Smokers represented one-third of subjects: 993 (69%) subjects were none smokers. F) The educational level may relate inversely to the work stress that is a surrogate marker for the emerging CVDs RFs, 235 (16%) had non-elementary school education, 586 (40%) have Junior high - high school education and 628 (43%) diplomas and beyond. We studied the prevalence of overall dyslipidemia in relation to all other CVDs RFs since it showed the highest frequency between them and was noticed the following: A) statistically significant (P-Value <0.0001) gender dimorphism was noticeable where: overall dyslipidemia for men 90.66% versus 61.43% for women, mixed dyslipidemia for men 16.08% versus 3.52% for women, elevated TG for men 58.19% versus 37.56% for women, reduced HDL-C for men 82.08% versus 20.23% for women and the elevated TC/HDL-C ratio for men 34.61% versus 18.22% for women. B) Age effect on dyslipidemia started from early twenties and continued worsening significantly with age. The age group of 45–59 years can be considered the plateau for dyslipidemia deterioration as seen in Table 2. C) Dyslipidemia worsens proportionally with body weight increase, but marked deterioration starts from the overweight group as seen in Table 3. D) The reciprocal decreases of dyslipidemia with the increase in the educational level were statistically significant in the overall dyslipidemia only as shown in Table 4.

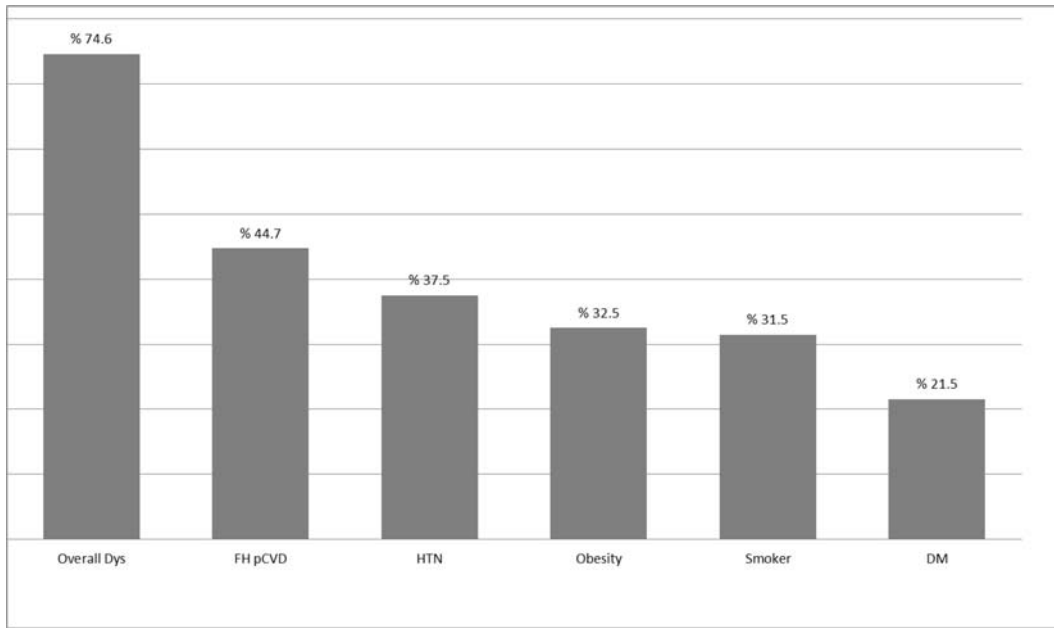


Fig. 1. Overall prevalence of the five modifiable and one none modifiable cardiovascular risk factors. DM: first encounter diabetes mellitus; HTN: first encounter hypertension; Overall Dys: Overall Dyslipidemias FH pCVD: Family History Of Premature Cardiovascular Disease.

E) The smoking habit negatively and pronouncedly impacted dyslipidemia as shown in Table 5.

Table 6 demonstrates RFs coexistence frequency (smoking, DM, HTN, obesity, FH pCVD and overall

dyslipidemias) with one RF specified at each time. The results showed Overall Dyslipidemias had the highest tendency to cluster with other RFs. The prevalence of RFs clustering was evaluated according to age (Fig. 3). The presence of zero or one RF

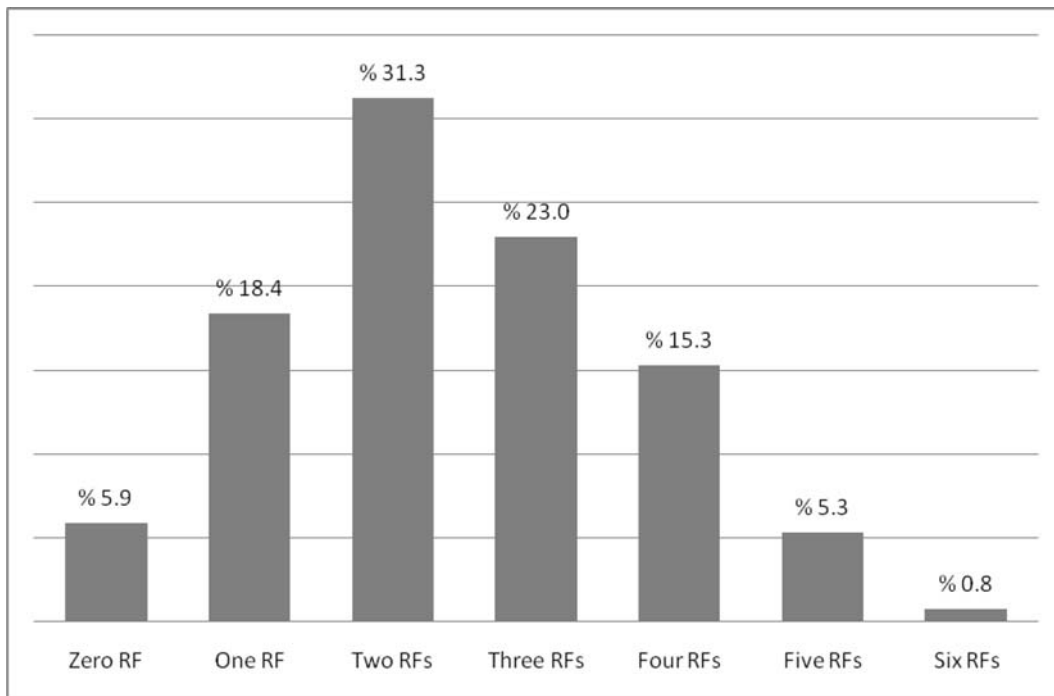


Fig. 2. Proportions of subjects who have one or more of the six risk factors (hypertension, diabetes mellitus, Overall Dyslipidemia's, obesity, cigarette smoking, and family history of premature cardiovascular disease).



Table 2. Dyslipidemia Variation according to age.

Age groups (y)	Overall Dyslipidemia N (%)	Mixed Dyslipidemia N (%)	High TC N (%)	High TG N (%)	High LDL-C N (%)	Low HDL-C N (%)	High TC/HDL-C N (%)
P-Value*	<0.0001	0.0203	<0.0001	<0.0001	<0.0001	0.0233	<.0001
20–29	158 (58.1)	12 (4.4)	52 (19.1)	70 (25.7)	45 (16.5)	115 (42.3)	35 (12.9)
30–44	328 (71.5)	44 (9.6)	159 (34.6)	209 (45.5)	124 (27.0)	216 (47.1)	117 (25.5)
45–59	<b>401 (82.3)</b>	<b>54 (11.1)</b>	<b>214 (43.9)</b>	<b>265 (54.4)</b>	<b>175 (35.9)</b>	<b>237 (48.7)</b>	<b>155 (31.8)</b>
60–90	194 (84.00)	23 (10.00)	85 (36.8)	135 (58.4)	63 (27.3)	129 (55.8)	64 (27.7)

\*P-value according to Chi-square test of different age groups.

TC: Total Cholesterol, TG: Triglycerides, HDL-C: High-Density Lipoprotein Cholesterol; LDL-C: Low -Density Lipoprotein Cholesterol, N: number of replicates, %: percentage.

Table 3. Dyslipidemia Variation according to body mass index (BMI).

BMI Variable	Overall Dyslipidemia N (%)	Mixed Dyslipidemia N (%)	High TC N (%)	High TG N (%)	High LDL-C N (%)	Low HDL-C N (%)	High TC/HDL-C N (%)
P-Value*	<0.0001	0.0006	<0.0001	<0.0001	0.0008	0.0001	<.0001
Underweight	17 (48.6)	0 (0)	3 (8.6)	5 (14.3)	3 (8.6)	13 (37.1)	2 (5.7)
normal body weight	213 (60.0)	16 (4.5)	92 (25.9)	104 (29.3)	79 (22.3)	136 (38.3)	57 (16.1)
<b>Overweight</b>	<b>460 (78.2)</b>	<b>65 (11.1)</b>	<b>218 (37.1)</b>	<b>294 (50)</b>	<b>175 (29.8)</b>	<b>304 (51.7)</b>	<b>157 (26.7)</b>
Obesity	391 (83.0)	52 (11.0)	197 (41.8)	276 (58.6)	150 (31.9)	244 (51.8)	155 (32.9)

\*P-value according to Chi-square test of different BMI groups.

TC: Total Cholesterol, TG: Triglycerides, HDL-C: High-Density Lipoprotein Cholesterol; LDL-C: Low -Density Lipoprotein Cholesterol, N: number of replicates, %: percentage.

Table 4. Dyslipidemia Variation according to the educational status.

Educational level Variable	Overall Dyslipidemia N (%)	Mixed Dyslipidemia N (%)	High TC N (%)	High TG N (%)	High LDL-C N (%)	Low HDL-C N (%)	High TC/HDL-C N (%)
P-Value*	<b>0.0198</b>	0.9909	0.3954	0.1226	0.3144	0.5009	0.427
None - Elementary school	185 (78.7)	22 (9.4)	91 (38.7)	116 (49.4)	72 (30.6)	120 (51.1)	66 (28.1)
Junior high - high school	450 (76.8)	54 (9.2)	207 (35.3)	288 (49.1)	171 (29.2)	284 (48.5)	154 (26.3)
Diploma – and above	446 (71.0)	57 (9.1)	212 (33.8)	275 (43.8)	164 (26.1)	293 (46.7)	151 (24.0)

\*P-value according to Chi-square test of different educational status groups.

TC: Total Cholesterol, TG: Triglycerides, HDL-C: High-Density Lipoprotein Cholesterol; LDL-C: Low -Density Lipoprotein Cholesterol, N: number of replicates, %: percentage.

Table 5. Dyslipidemia Variation according to smoking status.

Smoking Variable	Overall Dyslipidemia N (%)	Mixed Dyslipidemia N (%)	High TC N (%)	High TG N (%)	High LDL-C N (%)	Low HDL-C N (%)	High TC/HDL-C N (%)
P-value*	<b>&lt;.0001</b>	<b>0.0004</b>	0.8593	0.0825	0.9081	<b>&lt;0.0001</b>	<b>&lt;0.0001</b>
No Smoking	708 (71.3)	73 (7.5)	351 (35.4)	450 (45.3)	278 (28.0)	404 (40.7)	217 (21.9)
Smoker	373 (81.8)	60 (13.2)	159 (34.9)	229 (50.2)	129 (28.3)	293 (64.3)	154 (33.8)

\*P-value according to Chi-square test of smoking vs. nonsmoking groups.

TC: Total Cholesterol, TG: Triglycerides, HDL-C: High-Density Lipoprotein Cholesterol; LDL-C: Low -Density Lipoprotein Cholesterol, N: number of replicates, %: percentage.

observed to decline with increasing the participants age. The presence of two RFs was observed to be the lowest in the middle age group participants (45–59 Y). Furthermore, the presence of three, four and five RFs was observed to elevate aging. Finally, the presence of six RFs was observed to be the highest in the middle age group participants (45–59 Y). The presence of  $\geq 2$ , 3, 4 RFs increases with age but the presence of  $\geq 5$  RFs peaked in the middle age group of 45–59Y), vseither older (60–90Y) or younger

subjects (20–44Y). The prevalence of RFs coexistence in 796 women was compared with that in 635 men (Fig. 4). The absence of any RF was observed more women than men. Men were more likely than women to have  $\geq$  three, four, five RFs than women.

#### 4. Discussion

The major outcomes of this study are: Dyslipidemias was the most prevalent CVDs RF among

Table 6. Number of coexisting cardiovascular diseases risk factors (RF) with each specified CVDs RF.

Specified CVDs Risk Factor	No of coexisting risk factors				
	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)
Smoking	12.5	35.3	39.3	40.3	41.6
FH pCVD	23.8	33.9	55.3	76.0	89.6
Overall Dyslipidemias	49.1	76.5	91.5	94.1	100.0
Obesity	5.3	23.3	40.8	63.4	13.8
Diabetes mellitus	0.8	10.4	23.3	46.6	90.9
Hypertension	8.7	20.6	49.9	79.6	93.5

FH pCVD: family history of premature cardiovascular disease. CVDs: cardiovascular diseases, %: percentage.

Jordanians; Gender dimorphism was delineated where higher prevalence was among males vs. females. Dyslipidemias start from the early twenties and continue worsening with age progression. Dyslipidemias worsen proportionally with weight gain, but the flare up of dyslipidemia begins at the overweight category. Dyslipidemias prevalence decreased proportionally with the increase in educational level that suggested relating inversely with work stress. Smoking related to a higher prevalence of dyslipidemia. (2) Clusters prevalence had an ascending order from highest  $\geq$  two then  $\geq$  three, followed by  $\geq$  four RFs; Overall dyslipidemia had the greatest tendency to coexist with other CVDs RFs. The Clustering of CVDs RFs was more common in men than in women and  $\geq$  five RFs grouping was most common at age group 45–65 years compared with younger or older age intervals. Mitigation of CVDs risk can be attained by

managing the MRF studied in this study; overall Dys, HTN, DM, obesity and smoking, properly unlike the non-modifiable RFs as of age, gender and, FH pCVD. The MRFs can be elaborated to include sedentary lifestyle, unhealthy dietary behavior low socioeconomic level, regular alcohol consumption, urbanization, and pollution [16,17a–17c]. Different studies stated that these modifiable RFs are related to a large number of premature CV deaths globally [18,19]. In this study, CVDs RFs prevalence results demonstrated similar results of a study performed in Africa and the Middle East (AfME) region [20]. This study revealed prevalence of overall dyslipidemias within the Jordanian population reflective of other Jordanian reports [21]. Fasting lipid profile is not routinely included within the Jordanian screening program unlike BP and BS despite the international recommendation of consistent screening [22]. Multiple RFs are more prevalent among men, lower socioeconomic status, singles, and less prevalent among homeowners and older age groups as concluded from past studies [23]. Clustering of RFs differs across investigated populations according to geographic regions, urban vs rural communities, different ethnic groups, individuals who do not have overt CVDs compared with those who have symptomatic CVDs, men vs. women and old vs. young individuals [24a–24c]. An outpatient clinic-based study in 14 Middle Eastern and African nations estimated the clustering of three or more RFs in more than half (53%) of the

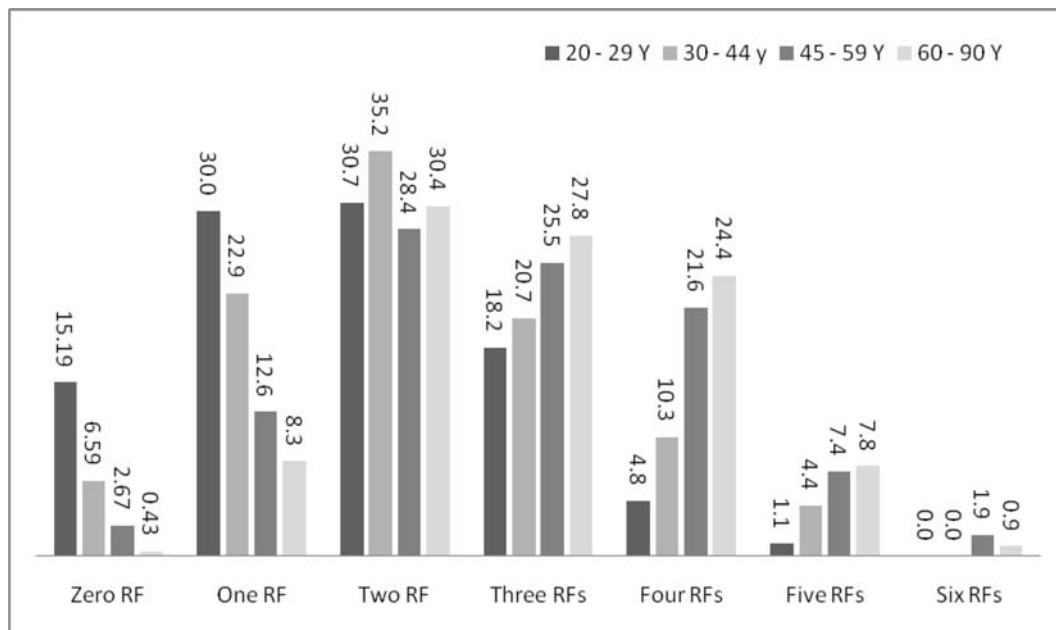


Fig. 3. Proportions of subjects in four age groups (20–29Y, 30–44 Y, 45–59 Y and 60–90 Y) who have one or more of the six risk factors (smoking, DM, HTN, obesity, family history of premature cardiovascular disease and Overall Dyslipidemias). RF = risk factor. P-value<0.0001, P-value calculated according to Chi-square test between different age groups.



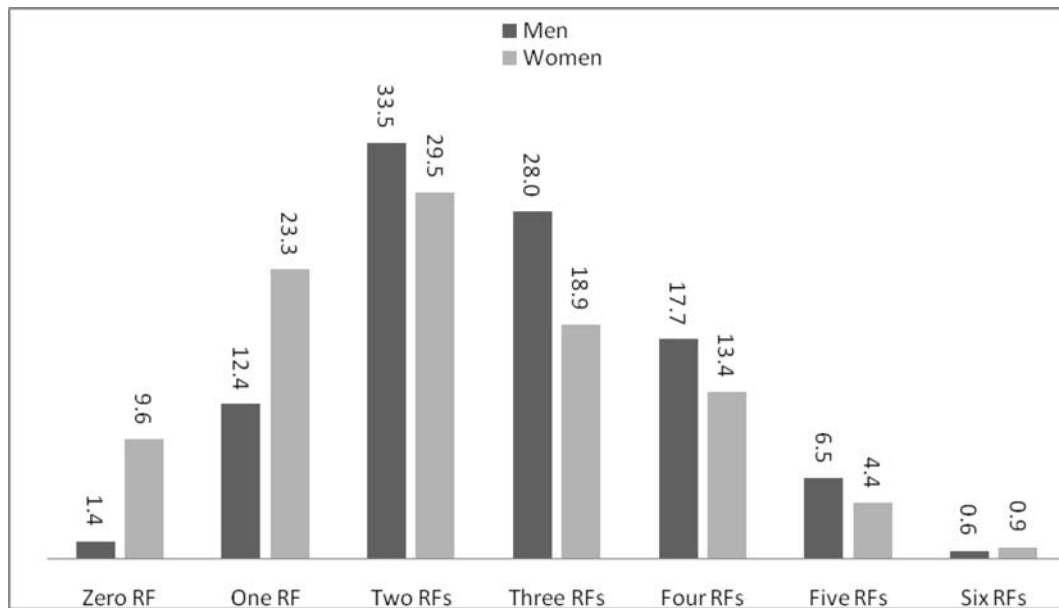


Fig. 4. Proportions of men and women who have one or more of the six risk factors (hypertension, diabetes mellitus, hypercholesterolemia, obesity, cigarette smoking, and family history of premature cardiovascular disease). RF = risk factor.  $P$ -value < 0.0001.  $P$ -Value according to Chi-square test between different gender groups.

overall cohort [20]. The observation of a decreasing prevalence of RFs clustering among the older age group compared with those aged 45–69 years might have been result from: age effecting per se steady increase of the absolute baseline risk of CAD independent of the conventional RFs. It also might be related to inherent survivor bias as subjects with MRFs tend to die at a considerably younger age [25,26]. Results from gender-specific relation with CVDs RF are contradictory, one have illustrated that although men and women share common MRFs for CVDs, such as cigarette smoking, DM, depression, and other psychosocial MRFs, a more negative health impact was observed in women [26]. On the contrary a recent study concluded that the prevalence of major RFs of NCDs was greater among more elderly persons and male participants [27]. This study showed that men were more likely than women to have  $\geq$  three, four and five RFs. Furthermore, the sudden drop in frequency of one or more RFs to a single-digit observed in both women and men. We can predict the reason of the high prevalence of multiple RFs coexistence to society growth, age profile variation, low education levels, lifestyle changes, dietary habits, lack of adoption of regular physical activity, ineffective anti-tobacco campaigns, and rise of prevalence rates of DM, metabolic syndrome, and obesity [28a–28e]. Subjects with multiple RFs were prone to higher probability developing coronary artery calcification, and premature mortality and morbidity [29]. In Jordan CVDs RFs clustering is higher than it is in

other regions of the world, enhancing the potential benefits expected from aggressive preventive measures. The major starting strategy is the rapid detection and proper control of MRFs thereby reducing substantially CVDs burdens. This study contains a few limitations that have to be discussed Exactly like all studies [30], this study is subject to selection bias, and missing or incomplete information, this study might has a selection bias since the subjects who heard about the study announcement via the social media and newspapers came to the nearest general practitioner clinic and participated in this study Since the data were self-reported from enrolled subjects not the clinician supervising their health status, information and/or recall bias might occur for some of the CVDs, despite the interviews were carried out by well-trained personnel, the potential for bias was present (e.g. over or under-diagnosed due to recall issues or subjectivity in the reporting of symptoms). Using BMI, not the waist circumference, was the definition of overweight and obesity strata within study pool of participants. Although BMI is easy to calculate and more commonly used, it is a simple and imperfect anthropometric biomarker that does not possess the discriminating power in differentiating between lean body mass and fat mass. Despite these limitations, this study maintains several strengths. It utilized substantial data that is representative of the entire Jordanian population in a short time frame of only two weeks. It used standardized data collection tools, for example; the interviews were performed

by trained investigators, the way they measured height, weight, and blood pressure and blood sugar follows a similar procedure. This study is unique in that it evaluated the prevalence and coexistence of six RFs in a relative large, young (over 20 year), and CVDs free Jordanians.

## 5. Conclusion

CVDs RFs and constellation of  $\geq$  two, three and four RFs are extremely prevalent in the Jordanian population. The most frequent MRF is Overall dyslipidemia also it is the most favors clustering with CVDs RF. Randomly combined two RFs cluster has the highest proportional frequency than other clustered groups. Middle-aged males presented significantly higher rates of  $\geq$  five RFs occurrences than females. Suggestively mitigation of CVDs morbidity and mortality in the Jordanian population can be attained by initiating primary cardiovascular medical and behavioral interventions to control the CVDs MRFs frequencies and constellation.

## Disclosure of Funding

The Jordanian Pharmaceutical Company funded the lipid profile analysis that performed by a third party (MedLab Laboratories), the statistical analysis Performed by Jordan University partners.

## Author contribution

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## Conflicts of Interest

None declared.

## Acknowledgments

We thank the following members of the Jordanian General Practitioner/Physician Association for participation in this study: Dr. Mahmoud Hashem, Dr. AbdulWahhab Awad, Dr. Ahmad Shalabi, Dr. Ali Mahseri, Dr. Aref Abu Hwaij, Dr. Maher Yagi, Dr. Mohammad Alazzam, Dr. Yahya Tarifi, Dr. Fayez Alqadi, Dr. Hashem Abu Alhaija, Dr. Ibrahim Shoubaki, Dr. Ibrahim Tuffaha, Dr. Kawther Sarhan, Dr. Khalid Abdul Wahed, Dr. Mohammad Hajjaj, Dr. Mufeed Damrah, Dr. Muhammad Ulaimat, Dr. Numir Batarseh, Dr. Osama Kamal, Dr. Rahat Zge-ter, Dr. Samyah Masarweh, Dr. Samyah Mdanat, Dr. Yousef Alfaqeeh and Dr. Zeyad Nsour.

Also we thank the following members of the Jordanian pharmaceutical company for participation in this study: Dr.Taghreed Barqawi,Sales and Marketing Director, Dr.Alaa alturk, Dr.Nazer Zayed, business unit manager, Dr.Alaa banihamdan, Dr.Obada alqarioty and Dr.Nisreen Fakori, Medical Representatives Supervisors, Dr.Alaa' odeh, Dr.Diana alabdallat, Dr.Farah alomari, Dr.Nour nouri, Dr.Abdullah alwheidi and Dr.Waleed Alabadi, Medical Representatives.

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