

Clustering of Cardiovascular Diseases Risk Factors among Manufacturing Employees in Sousse, Tunisia

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Abstract

Objective: To estimate the prevalence of multiple risk factors for cardiovascular diseases (CVD) among manufacturing employees in Sousse, Tunisia and to determine factors associated with this clustering.

Methods: A cross-sectional study was carried out to estimate the prevalence of CVD risk factors in workplaces and their clustering. We used data from a workplace-based intervention which took place in six companies of the governorate of Sousse in Tunisia, Tunisia.

Results: A total of 2113 employees were surveyed. The prevalence of having four or five risk factors tended to be higher among male employees, those with higher education level and those who were part of managerial staff.

Conclusion: Screening and targeted health promotion initiatives should be launched in worksite targeting the modifiable factors to avert the excessive risk for CVD.

Introduction

There is increasing epidemiological evidence that elevated risk of cardiovascular diseases (CVD) mortality is associated with certain lifestyle habits [1,2]. Smoking, physical inactivity, low consumption of vegetables and fruit, high blood pressure and high body mass index are associated with an increased risk of CVD (3). In contrast, having a healthy lifestyle could potentially prevent more than three-quarters of the risks of CVD [2,4,5].

Despite the new interest in and emphasis on public health and disease prevention in developing countries, it appears that the challenge of controlling CVD remains [3]. In recent years, the clustering of lifestyle risk factors has gained much attention. Many CVD risk factors are not randomly distributed across the population, but occur in combination with others. The clustering of risk factors is usually associated with a higher risk of diseases than can be expected from the added individual effects alone [6,7]. In particular, it can be used to identify risk factors which lead to other unhealthy habits. Previous studies have shown that

the prevalence of multiple risk factors patterns differs between socio-demographic groups and regions.

Tunisia is now facing the phenomenon of epidemiologic transition where total mortality is decreasing, life expectancy is increasing, and lifestyles associated with chronic disease particularly diabetes and CVD, are being adopted [3,8-10].

Moreover, CVD are the first leading causes of death in Tunisia. CVD mortality accounted for one-third of total mortality in 2006 [11,12].

According to the World Health Organization, the most cost-effective methods of reducing risk among an entire population are population-wide interventions, combining effective policies and broad health promotion policies [13]. In this context, the workplace offers several advantages in that a substantial number of the working population can be reached and multiple levels of influence on behavior can be targeted [14].

In order to develop effective health promotion interventions in worksite, it is important to identify subgroups of employees who are more at risk for CVD than others.

To our knowledge, there is no previous study that provided the existence of clustering of different sets of CVD risk factors and their specific socio-demographic attributes among manufacturing employees in Tunisia.

Our objective is through a representative sample of manufacturing employees aged 18-67 years in Sousse, Tunisia, to determine the prevalence and socio demographic correlates of multiple occurrences of risk factors for CVD.

Methods

Study Design:

A cross-sectional study was carried out to determinate the prevalence of CVD risk factors in workplaces and their clustering.

Population:

we used data from a workplace-based intervention which took place in the manufacturing sector in six factories spread across three delegations of the region of Sousse. All employees in these six factories were included.

Data collection:

Socio-demographic characteristics and lifestyle data have been collected by a pre-tested questionnaire in Arabic.

Socio-demographic characteristics measured included age, sex, marital status, educational level and profession. Lifestyle items were composed of smoking status, daily cigarette consumption, eating habits, physical activity and alcohol consumption. All physical assessments (height, weight and blood pressure) were conducted by trained research assistants in a standardized manner.

Measures and Variables:

a.NCD risk factors were defined as follows:

*Tobacco use:

smokers were the participants who responded YES to the question: do you smoke any kind of tobacco (cigarettes, cigar, pipe or water-pipe)?

*Unhealthy diet:

when participant responded NO to the question: do you eat 5 or more portions of fruits and legumes a day?

*Physical inactivity:

when participants responded NO to the question: do you spend 30 minutes or more of moderate to vigorous activity per day during 5 days a week.

*High body mass index:

Body mass index (BMI) was determined as the body weight in kilograms divided by squared height in meters (kg/m^2). High body mass index was defined as a $\text{BMI} \geq 30 \text{ kg}/\text{m}^2$.

*High blood pressure (HBP):

defined as a systolic blood pressure number of 140 or higher and/or diastolic blood pressure number of 90 or higher. Both systolic and diastolic pressures were measured at two occasions and the averages were recorded. Participants reporting current use of anti-hypertensive drugs were considered hypertensive regardless their blood pressure readings.

b.Socioeconomic status

it was based on the Asset index which has been used by researchers since 1998. Researchers use data on household assets to describe household welfare instead of using household income or expenditure data. The World Bank usually encourages researchers to utilize the asset index to classify household socioeconomic position in middle- and low-income countries where household income and expenditure data are unreliable (15,16).

In our survey, participants were asked about the availability of eleven household items in their household and its quantity.

These household items were: 1) Flushable toilet 2) electricity, 3) refrigerator, 4) central air conditioning (AC) or central heating, 5) air-cooling unit that moves and cools air, 6) washing machine, 7) television (TV), 8) telephone/mobile phone, 9) computer with Internet connection, 10) water safe for drinking, and 11) automobile/car.

Factor analysis was used to give different weights for different household items and to develop a comprehensive asset index (first extracted component in the analysis), which was used as a proxy of the socioeconomic status. Then Ward method was performed in order to obtain three hierarchical socioeconomic level; low, medium and high socioeconomic level.

Analysis

Statistical analysis was performed using the SPSS 10.0 software. Data were presented as frequencies, means and standard deviations. The chi-square test was used to compare different clusters with the categorical variables. The level of significance was 0.05.

Ethical consideration:

The study was approved by the Ethics Committee of the University Hospital Farhat Hached, Tunisia. It does not represent any risk for participants who gave their informed consent before responding to the questionnaire.

Results

Descriptive Analysis

A total of 2113 employees were surveyed. The response rate was 71.9%. The participants consisted of 1342 (63.5%) men and 775 (36.5%) women. The mean age of employees was 36.28 ± 8.79 years. Majority of the respondents were workers (79.5%) with medium socioeconomic status (78.7%) as indicated in Table 1.

The most common NCD risk factor was physical inactivity with a prevalence of 59 % (Table 2). Unhealthy diet was the second most common risk factor (41.9%), followed by smoking (34%), high BMI (23.7%) and HBP (19.82%).

The proportions of respondents with 0, 1, 2, 3 or ≥ 4 risk factors were respectively 11.54%, 29.68%, 34.03%, 19.12% and 5.63% (Table 2).

Cluster analysis

As showed in Table 3, the combination of all five risk factors showed clustering with an O/E ratio of 1.9. The greatest degree of clustering occurred in two patterns, the first with two risk factors (smoking and high BMI) and the second with three risk factors (smoking, high BMI and HBP) (O/E: 2.23).

Among the four risk factors patterns, the combination of smoking, physical inactivity, high BMI and HBP and the combination of unhealthy diet, physical inactivity, high BMI and HBP were more prevalent than expected.

Table 1: Socio-demographic characteristics of Tunisian employees aged 18–67 years (N=2113)

	n	Percentage (%)
Age		
18-29	531	25.1
30-39	876	41.5
40-49	517	24.5
≥ 50	189	9
Gender		
Male	1342	63.5
Female	775	36.5
Education level		
Primary	462	21.9
Secondary	1356	64.2
University	295	14
Marital Status		
Married	1439	68.1
Not married	674	31.9
Employment status		
Workers	1680	79.5
Technician	231	10.9
Managerial staff	202	9.6
Employment status		
Workers	1680	79.5
Technician	231	10.9
Managerial staff	202	9.6
Socioeconomic status		
Low	117	5.5
Medium	1663	78.7
High	333	15.8

Table 2: NCD risk factors among Tunisian employees aged 18–67 years (N=2113)

	n	Percentage (%)
CVD risk factors		
Physical inactivity	1247	59
Unhealthy diet	885	41.9
Smoking	718	34
High BMI	500	23.66
HBP	419	19.82
Number of CVD risk factors		
0	244	11.54
1	627	29.68
2	719	34.03
3	404	19.12
4 or 5	119	5.63

Among the three risk factors patterns, the association between smoking, unhealthy diet and physical inactivity, between smoking, high BMI and HBP, between unhealthy diet, physical inactivity and high BMI and between physical inactivity, high BMI and HBP were more prevalent than expected

Among the two risk factors patterns, the association between smoking and BMI, between smoking and HBP, between unhealthy diet and physical inactivity, between high BMI and HBP were more prevalent than expected (Table 3).

Relationship between NCD risk factors clusters and socio Demographic characteristics

The prevalence of having four or five risk factors tended to be higher among male employees, those with higher education level and those who were part of managerial staff (Table 4).

Employees aged 40 and more were more likely to have four or five risk factors (23 versus 32.8%) with no significant difference.

Employees with high economics level were more likely to have four or five risk factors (14.3 versus 21.8%) with no significant difference.

Discussion

This is the first report of the prevalence, clustering and socioeconomic distribution of CVD risk factors in a representative sample of Tunisian employees.

This study sought to identify patterns of individual and concurrent CVD risk factors, with an emphasis on the number and type of risk factors, to support future intervention strategies.

Three major findings can be highlighted. First, the occurrence of the studied risk factors in the population study is high: 88.5% of Tunisian employees reported at least one risk factor for CVD. Second, the behavior pattern that indicated a greater increase than that expected at random was the simultaneous occurrence of obesity and smoking with or not HBP. Finally, the most vulnerable groups to the simultaneous occurrence of four or five risk factors for CVD were identified: male employees, those with higher education level and those who were part of managerial staff.

Physical inactivity was the most prevalent risk factor among Tunisian employees, followed by the low consumption of fruits and vegetables. Studies that evaluated risk factors clustering among employees using similar criteria, supported our findings [17,18].

In fact, the epidemiological transition in Tunisia is related to prominent life style changes, particularly changes in food consumption patterns [19,20]. Food transition has led to the shift from a traditional diet rich in cereals, fruits and vegetables to a diet rich in animal products, with increased energy intake. In 20 years, the daily ration has increased by 140 calories per person on average, from 2294 kcal a day in 1975 to 2434 kcal a day in 1995 [21].

HBP and obesity prevalence among employees sample were lower than national prevalence which can be explicated by the

Table 3: Clustering pattern of NCD risk factors in Tunisian employees aged 18–67 years (N=2113)

Risk factor	Smoking	Unhealthy diet	Physical inactivity	High BMI	HBP	n	Observed %	Expected %	O/E																																								
5	+	+	+	+	+	16	0.76	0.4	1.9																																								
						Total	16	0.76	0.4	1.9																																							
4	+	+	+	+	-	25	1.18	1.61	0.73																																								
						+	+	-	+	29	1.37	1.28	1.07																																				
										+	+	-	+	4	0.18	0.28	0.64																																
														+	-	+	+	17	0.82	0.55	1.49																												
																		-	+	+	+	28	1.32	0.78	1.69																								
																						Total	103	4.87	4.9	0.99																							
3	+	+	+	-	-																	146	6.91	5.12	1.35																								
						+	+	-	+													-	10	0.47	1.12	0.42																							
										+	+	-	-										+	15	0.71	0.89	0.8																						
														+	-	+	+							-	18	0.85	2.23	0.38																					
																		+	-	+	-				+	23	1.09	1.76	0.62																				
																										+	-	-	+	+	18	0.85	0.38	2.23															
																															-	+	+	+	-	75	3.55	3.14	1.13										
																																				-	+	+	-	+	42	1.99	2.48	0.8					
																																									-	+	-	+	+	8	0.38	0.54	0.7
																																														-	-	+	+
Total	404	19.12	18.74	1.02																																													
2	+	+	-	-	-	63	3	3.45	0.87																																								
						+	-	+	-	-	125	5.91	7.07									0.83																											
											+	-	-	+	-	18	0.85					0.38	2.23																										
																+	-	-	-	+	34	1.61	1.22	1.32																									
																					-	+	+	-	-	269	12.73	9.94	1.28																				
																										-	+	-	+	-	26	1.23	2.18	0.56															
																															-	+	-	-	+	28	1.32	1.72	0.77										
																																				-	-	+	+	-	92	4.35	7.48	0.58					
																																									-	-	+	-	+	37	1.75	3.43	0.51
																																														-	-	-	+
Total	719	34.03	37.62	0.9																																													
1	+	-	-	-	-	157	7.43	4.91	1.51																																								
						-	+	-	-	-	101	4.78	6.91	0.69																																			
											-	-	+	-	-	256	12.11	13.73	0.88																														
																-	-	-	+	-	69	3.26	3	1.08																									
																					-	-	-	-	+	44	2.1	2.38	0.88																				
																										Total	627	29.68	30.93	0.96																			
0	-	-	-	-	-																					244	11.54	9.54	1.21																				
						Total	244	11.54	9.54	1.21																																							

Table 4: Prevalence (%) of multiple NCD risk factors in Tunisian employees aged 18–67 years (N=2113)						
	Number of risk factors					p-value
	0 n (%)	1 n (%)	2 n (%)	3 n (%)	4 or 5 n (%)	
Age						
18-29	59 (24.2)	163 (26)	190 (26.4)	95 (23.5)	24 (20.2)	0.49
30-39	108 (44.3)	266 (42.4)	295 (41.0)	160 (39.6)	47 (39.5)	
40-49	56 (23.0)	140 (22.3)	177 (24.6)	105 (26.0)	39 (32.8)	
≥ 50	21 (8.6)	58 (9.3)	57 (7.8)	44 (10.9)	9 (7.6)	
Gender						
Male	135 (55.3)	367 (58.5)	429 (59.7)	311 (77.0)	100 (84.0)	< 10 ⁻³
Female	109 (44.7)	260 (41.5)	290 (40.3)	93 (23.0)	19 (16.0)	
Education level						
Primary	57 (23.4)	156 (24.9)	153 (21.3)	80 (19.8)	16 (13.4)	0.035
Secondary	153 (62.7)	404 (64.4)	460 (64.0)	256 (63.4)	83 (69.7)	
University	34 (13.9)	67 (10.7)	106 (14.7)	68 (16.8)	20 (16.8)	
Marital Status						
Married	82 (33.7)	200 (32.1)	237 (33.1)	119 (29.5)	28 (23.7)	0.244
Not married	161 (66.3)	424 (67.9)	480 (66.9)	284 (70.5)	90 (76.3)	
Employment status						
Workers	192 (78.7)	507 (80.9)	578 (80.4)	315 (78.0)	88 (73.9)	< 10 ⁻³
Technician	38 (15.6)	75 (12.0)	70 (9.7)	36 (8.9)	12 (10.1)	
Managerial staff	14 (5.7)	45 (7.2)	71 (9.9)	53 (13.1)	19 (16.0)	
Socioeconomic status						
Low	10 (4.1)	35 (5.6)	37 (5.1)	32 (7.9)	3 (2.5)	0.185
Middle	199 (81.6)	498 (79.4)	566 (78.7)	310 (76.7)	90 (75.5)	
High	36 (14.3)	94 (15.0)	116 (16.1)	62 (15.3)	26 (21.8)	

Health worker effect, while smoking prevalence was higher than national one which can be explicated by the sex ratio of our employees sample. Indeed, according to a study involving 402 teachers of Kalaa Kebira in Sousse in 1992, the global prevalence of tobacco use was lower, estimated to 29.3%. However, many studies [18,19,22,23,25-27] reported that it was rather unemployment which was associated with higher tobacco use prevalence, independently of educational and economic status.

Furthermore, Tunisian employees smoking prevalence seems to be higher than prevalence found in a Brazilian study conducted in 47,477 workers located in 2775 Brazilian industries where the prevalence was only 13% (18) and higher than the prevalence found among employees at a Saudi University where daily smokers accounted for 22.7% [17]. This finding confirms that smoking still represents an ongoing and dire public health threat in Tunisia despite national efforts to address this epidemic.

Our study also revealed that 59% of Tunisian employees had two or more CVD risk factors, including 24.75% with at least three risk factors. Only 11.5% of Tunisian employees did not have any of the five risk factors. The most frequent number of risk factors among employees was two reinforcing findings from

other studies [17,18].

The clustering between obesity with smoking, associated or not with HBP had a higher observed prevalence than expected. It represents an increase of 123%. The Brazilian study showed that it is rather aggregation between smoking and alcohol consumption which was more observed than expected among employees (28).

As in studies that assessed individual risk behaviors (29), simultaneous risk factors are associated to socio demographic variables (30). In this study, male employees with a higher education level and who were parts of managerial staff were more likely to have multiple risk factors.

Indeed, it is well known that men are less likely to seek formal health care than women are, especially in the pre-symptomatic phase of chronic diseases (31). Avoiding the primary care system, men are deprived of protection required to preserve their health, including support to achieve and sustain healthy behaviors [18].

In our study, employees who are part of managerial staff were more likely to have higher number of CVD risk factors. This could be explicated by the fact that this category of employees may be occupied with busy work and engaged in more social activities,

like eating out for business or with friends. It is difficult to make the healthiest choices on the menu and resist the temptation to overeat [32]. Indeed, it was revealed that worksite interventions were more effective for workers as compared to managers in promoting the recommended guidelines for both fruit and vegetable intake and physical activity [14].

Contrary to our expectation, socioeconomic status was not associated significantly with more clustering of risk factors. In fact, it was well established that people who are socially advantaged have more access to resources and are more able to take advantage of opportunities to be healthy compared to those who are socially disadvantaged [33]. However, it is important to recognize the limitation of using the asset index. The asset index is better thought of as a proxy for long-term household wealth rather than current per capita consumption [34]. Nonetheless, the strong correlation between asset index and money metric measures like income and expenditure was not consistently supported [32].

It is the first piece of novel research to investigate the distribution of CVD risk factors in a specific group of employed adults in Tunisia. To our knowledge, this analysis was unprecedented in our country.

Strengths of this study included the use of a large, randomly selected sample of workplaces that enabled a heterogeneous sample of employees to be surveyed. Objective measurements of weight and blood tension are the strength of this research; the ascertainment of these measurements did not rely on self-reported data.

Some limitations need to be considered when interpreting the findings. Firstly, participants were recruited from six factories spread across three delegations of the region of Sousse which would not be representative for the general population or the general working population. The 'Healthy worker effect' is a common effect in studies with occupational samples and is reflected in the better health status of employed people relative to the general population [35]. Therefore the generalizability of the prevalence estimates of the CVD risk factors to the general population may be limited. Data collected were self-reported and therefore subject to recall or response bias including social desirability bias. To minimize this bias, standardized data collection procedures were followed and participants were assured that their data would remain confidential. As a cross-sectional study, the present analysis is however, limited in its ability to elucidate a causal relationship.

Conclusion

This study was useful for identifying groups that are generally more at risk and developing tailored intervention activities. There should be Tunisian government and private sector support to strengthen the involvement of communities, with the aims of combating the current surge in chronic diseases. Screening and health promotion initiatives in workplace should be launched targeting the modifiable risk factors to avert the excessive risk for CVD among this important subgroup of the population.

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