

Prevalence of major cardiovascular risk factors among oil and gas and energy company workers

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Abstract

Introduction. Cardiovascular diseases (CVD) remain the biggest cause of disability and premature death throughout the world.

Aim. The aim of this study was to describe and determine the prevalence of major cardiovascular risk factors emerged at the first medical examination carried out by a group of an oil and gas contractor company workers in the observation period 2000-2010.

Methods. An observational cross-sectional study was conducted on 1073 workers (mean age 41 years, SD = 9.5) presenting overweight BMI (body mass index) values, hypertension and cholesterol problems.

Results. In particular, we found that workers > 45 years had significant higher risk to have obesity (OR = 3.8, CI 95% = 2.5-5.7), hypertension (OR = 2.7, CI 95% = 2.1-3.6), high blood fasting glucose (OR = 2.6, CI 95% = 1.2-5.5), high cholesterol (OR = 2.7, CI 95% = 2.0-3.6), high triglycerides (OR = 1.8, CI 95% = 1.4-2.4) compared to younger (< 45 years).

Key words

- cardiovascular risk
- dyslipidemia
- hypertension
- oil company workers

INTRODUCTION

Cardiovascular diseases (CVD) are the most important cause of disability and premature death throughout the world and are considered a significant, universal public health problem [1-3]. According to the World Health Report 2011 [3], every year an estimated 17 million people globally die of CVD, representing 30% of all global deaths, particularly caused by heart attacks and strokes. In fact, of these deaths, an estimated 7.3 million are due to coronary heart disease and 6.2 million are due to stroke [4].

Many risk factors are associated with coronary heart disease and stroke. Some risk factors such as family history, ethnicity and age, cannot be changed, other risk factors that can be prevented, changed or treated include tobacco exposure, harmful use of alcohol, unhealthy diets and obesity, physical inactivity, stress, high blood pressure (hypertension), diabetes and dyslipidemia [5-10].

It is recognized that CVD impact the productivity of working age adults who are the economic engine of most of the countries.

In this study we analyse the state of health of the workers employed in the oil and gas industry, a subject

little discussed by the international scientific community.

The type and working environment in fact, expose these workers to a serious physical and mental stress in the form of noise, heat, depression and isolation, particularly those involved offshore [11, 12]. In addition, following an incorrect eating behavior, characterized by excessive intake of food with high calorific value, in adjunct to these psychological problems, is an important risk factor for the onset of CDV [12-14]. Some studies underline how it is usual to find a population of workers who are overweight or obese, with high blood pressure and high cholesterol in the petrochemical industry [15-19]. This condition not only exposes the employee to a greater cardiovascular risk [16, 20-21], but also increases the rate of accidents and injuries at work [16, 22-23]. From the perspective of health and safety at work, the problem of obesity deserves attention, especially considering longer working life and the increase in sedentary jobs and automated tasks [15, 24-25].

There is evidence that the occupational risks for health of oil and gas workers are based upon the exposure to chemicals and pollutants, but in this context data related to these exposures weren't available. So the study

aimed to describe and determine the prevalence of major cardiovascular risk factors emerged at the first medical examination carried out by a group of oil and gas contractor company workers in the period 2000-2010 in order to implement a worksite wellness program representing an opportunity to prevent CVD and stroke in a large segment of the working population [26].

Programming these worksite wellness programs should be integrated into the organizational structure of the workplace by use of the following proven strategies: health education; initiatives that are incorporated into existing employee assistance programs; and voluntary worksite screening linked with medical care for follow-up on modifiable risk factors.

Guidelines from the American Heart Association (AHA) and other public health organizations stress the importance of increasing workplace awareness, prevention, treatment, and control of major risk factors for CVD and stroke [27].

In addition, there are certain returns on investment; in fact, the payback for investing in worksite wellness programs can be measured in various ways, including decreased direct healthcare costs, improved healthcare utilization, increased performance measures, lower rates of absenteeism, and a reduced prevalence of chronic disease.

Workplace CVD early detection and a subsequent health and wellness program can produce 26% reductions in health care costs and 30% reductions in workers' compensation and disability management claims costs [28].

METHODS

An observational cross-sectional study was carried out. The STROBE statement was followed to conduct the research [29].

Study population

The sample dataset was composed of workers who sustained at least one medical examination to work for foreign missions during 2000-2010.

Data collection

The information about workers were extracted from the GIPSI (*Gestione Informatizzata Prestazioni Sanitarie Individuali*, Computerized Management of Individual Medical Services) database. It is an health management system to collect the medical records for each worker and to follow his health during the employment.

The variables analyzed in this study were as follows:

- age, organized into three groups (< 45, 45-54, > 54 years old);
- body mass index (BMI), computed using the standard formula: $BMI = \text{weight [kg]} / (\text{height [m]})^2$. According to WHO/Europe guidelines, a score equal to or greater than 25 indicates overweight, while values greater than or equal to 30 obesity [30];
- hypertension, diagnosed when systolic blood pressure was ≥ 140 mmHg and/or diastolic blood pressure was ≥ 90 mmHg [31];
- fasting glucose: ≤ 110 mg/dL healthy level; 111-125 mg/dL impaired fasting glucose (IFG); ≥ 126 mg/dL high level [32].

According to ESC/EASD, 2007, guidelines [32], it is possible to diagnose diabetes if measured fasting glucose is > 126 mg/dL twice in a row, if it is > 200 mg/dL in a random measure or after 120' from the administration of an oral glucose tolerance test (OGTT);

- cholesterol: < 200 mg/dL healthy level; 200 - 239 mg/dL borderline; ≥ 240 mg/dL high level [33];
- triglycerides: < 150 mg/dL optimal level; ≥ 150 mg/dL high level [34];
- current smoking habits: no smoker/ smoker (auto-referred from the worker).

The guidelines used to range BMI, hypertension, fasting glucose, cholesterol and triglycerides were those current in the studied period.

The number of risk factors for each worker was obtained by making the sum of the risk factors listed above.

Missing data were those not reported by the medical staff on the GIPSI system being updated.

Statistical analysis

Statistical analysis comprised descriptive and inference methods.

The following measures were calculated for continuous variables: arithmetic mean, standard deviation (SD), the median providing also the minimum and maximum values.

Percentage and frequencies were presented to describe the qualitative information.

The chi-square test of independence was used in order to evaluate if there are significant differences between age groups in health qualitative characteristics.

Odds ratios (OR) and 95% confidence intervals (95% CI) were calculated to estimate the health risks in the two different age groups (< 45 years ; ≥ 45 years).

Data were displayed in tables.

The SPSS 19.0 software was used for the statistical analysis.

All calculation were made at level of significance of p-value < 0.05 .

RESULTS

The sample population was composed of 1073 workers (9 women), 98% of whom were Italian, who had a mean age of 41 years (SD = 9.5) at the first examination in the observation period. A bimodal distribution can be seen with the first peak centered around 31 years (N = 35), and the second one around 45 years (N = 64).

In table 1 was reported the description of the health variables and the distribution by age groups.

BMI

The average BMI was 26.26 (SD = 3.4), indicating an overall overweight stage. The maximum and minimum values were 41.36 and 13.38 respectively. The missing data for this variable was 10% (N = 120). One half of the population reported a BMI value correspondent to overweight (49.7%), while the 12.7% to various degrees of obesity and the remaining percentage to a normal value.

Repeating the analysis stratifying by age, the workers aged between 45-53 showed a significant higher percent-

Table 1

Description of the variables analysed at the first examination recorded in GIPSI

Variables	Total workers	Age group (years old)			*p	
	N (%)	< 45 (%)	45-53 (%)	> 53 (%)		
BMI	Normal (< 25)	358 (37.6)	276 (51.2)	66 (19.2)	16 (23.2)	< 0.001
	Overweight (25 - 29.9)	474 (49.7)	228 (42.3)	212 (61.4)	34 (49.3)	
	Obese (≥ 30)	121 (12.7)	35 (6.5)	67 (19.4)	19 (27.5)	
Blood systolic pressure	Normal (< 120 mm Hg)	141 (13.4)	107 (17.9)	27 (7.1)	7 (9.1)	< 0.001
	Pre-Hypertension (120-139 mm Hg)	599 (56.7)	369 (61.6)	200 (52.6)	30 (39.0)	
	Hypertension (≥ 140 mm Hg)	316 (29.9)	123 (20.5)	153 (40.3)	40 (51.9)	
Blood diastolic pressure	Normal (< 80 mm Hg)	293 (27.7)	223 (37.2)	56 (14.7)	14 (18.2)	< 0.001
	Pre-Hypertension (80-89 mm Hg)	555 (52.5)	304 (50.8)	215 (56.6)	36 (46.8)	
	Hypertension (≥ 90 mm Hg)	208 (19.8)	72 (12.0)	109 (28.7)	27 (35.1)	
Hypertension	No (< 140 mm Hg and < 90 mm Hg)	681 (64.5)	446 (74.5)	200 (52.6)	35 (45.5)	< 0.001
	Yes (≥ 140 mm Hg and/or ≥ 90 mm Hg)	375 (35.5)	153 (25.5)	180 (47.4)	42 (54.5)	
Fasting glucose	Normal (< 110 mg/dL)	981 (92.7)	580 (96.0)	336 (88.5)	65 (86.7)	n.c.
	IFG (111-125 mg/dL)	46 (4.3)	13 (2.2)	29 (7.6)	4 (5.3)	
	High (≥ 126 mg/dL)	32 (3.0)	11 (1.8)	15 (3.9)	6 (8.0)	
Cholesterol	Normal (< 200 mg/dL)	487 (46.3)	336 (56.1)	117 (31.0)	34 (44.1)	< 0.001
	Borderline (200-239 mg/dL)	310 (29.4)	165 (27.5)	124 (32.9)	21 (27.3)	
	High (≥ 240 mg/dL)	256 (24.3)	98 (16.4)	136 (36.1)	22 (28.6)	
Triglycerides	Normal (< 150 mg/dL)	735 (70.3)	450 (75.6)	230 (61.3)	55 (72.4)	< 0.001
	High (≥ 150 mg/dL)	311 (29.7)	145 (24.4)	145 (38.7)	21 (27.6)	

* Significance calculated by χ^2 test.n.c.: not computable using χ^2 test: 2 cells (22.2%) have expected count less than 5 and the minimum expected count is 2.27.
GIPSI: Gestione informatizzata prestazioni sanitarie individuali (computerized management of individual medical services)

age of overweight (61.4%) and the older group a significant higher percentage of obesity (27.5%), $p < 0.001$.

Blood pressure

The blood systolic pressure was in the normal range (< 140 mm Hg) for the 70.1% of the analyzed sample (740 workers), however the 56.7% was in a pre-hypertension stage (120-139 mm Hg). The remaining 29.9% of the population had values ascribable to various hypertension degrees (≥ 140 mm Hg). For the dataset the average blood systolic pressure was 130.32 mm Hg (SD = 13.5) and the maximum value measured was 200 mm Hg. We observed that in workers aged 45-53 systolic hypertension was found in 40.3% of cases, while in those > 54 was found in 51.9% of cases, $p < 0.001$.

The blood diastolic pressure was in the normal range (< 90 mm Hg) for the 80.2% of the analyzed sample dataset (848 workers), however the 52.5% (555 workers) was in a pre-hypertension stage (80-89 mm Hg). The remaining 19.8% (208 workers) had values ascribable to various hypertension degrees (≥ 90 mm Hg).

For the dataset the average blood diastolic pressure was 80.74 mm (SD = 8.4) and the maximum value measured was 120 mm Hg.

It emerged that workers with diastolic hypertension problems aged 45-53 were the 28.7% while those > 54 were the 35.1%, $p < 0.001$.

Missing data for blood pressure (systolic and diastolic) were the 1.6% (N = 17).

In addition, we found that in the sample dataset the 47.4% and the 54.5% of workers in the age range of 45-53 and > 54, respectively, suffered from hypertension problems (systolic pressure > 140 mm Hg and/or diastolic pressure > 90 mm Hg), $p < 0.001$.

Fasting glucose

The average fasting glucose measured in the sample dataset was 93.79 mg/dL (SD = 14.6), with the maximum value of 224 mg/dL and the minimum of 56 mg/dL.

While the majority of the pool (92.7%, 981 workers) was in the normal range (< 110 mg/dL), the 4.3% (46 workers) presented an impaired fasting glucose (IFG) condition (values 111-125 mg/dL) and the 3.0% (32 workers) had values > 126 mg/dL. The latter portion was likely to suffer from diabetes, which exposes them to an increased risk for cardiovascular and ischemic diseases.

Missing data were the 1.3% (N = 14).

Also in this case, the highest values of fasting glucose were measured in workers aged over 45 age, but the significance was not computable using χ^2 test.

Cholesterol

The 46.3% of the sample dataset (487 workers) had good cholesterol values (< 200 mg/dL), the 29.4% (310

Table 2
Bivariate analysis in oil company workers for age group (< 45 or > 45)

Variables		< 45* N (%)	≥ 45 N (%)	OR	95% IC
BMI	* Normal and over weight (< 30)	504 (93.5)	328 (79.2)	3.8	2.5-5.7
	Obese (≥ 30)	35 (6.5)	86 (20.8)		
Blood pressure	* Normal (< 140 mm Hg and < 90 mm Hg)	446 (74.5)	235 (51.4)	2.7	2.1-3.6
	Hypertension (≥ 140 mm Hg and/or ≥ 90 mm Hg)	153 (25.5)	222 (48.6)		
Fasting glucose	* Normal (< 126 mg/dL)	593 (98.2)	434 (95.4)	2.6	1.2-5.5
	High (≥ 126 mg/dL)	11 (1.8)	21 (4.6)		
Cholesterol	* Normal (< 240 mg/dL)	501 (83.6)	296 (65.2)	2.7	2.0-3.6
	High (≥ 240 mg/dL)	98 (16.4)	158 (34.8)		
Triglycerides	* Normal (< 150 mg/dL)	450 (75.6)	285 (63.2)	1.8	1.4-2.4
	High (≥ 150 mg/dL)	145 (24.4)	166 (36.8)		
Smoke	* No	357 (94.4)	206 (92.4)	1.4	0.7-2.7
	Yes	21 (5.6)	17 (7.6)		
Number of risk factors^a	* < 2	274 (83.5)	107 (54.9)	4.2	2.8-6.3
	≥ 2	54 (16.5)	88 (45.1)		

* Reference group.

a: the number of risk factor was obtained by performing the summation of the risk factors listed above.

workers) presented borderline cholesterol values (200-239 mg/dL), while the remaining 24.3% (256 workers) had high cholesterol values (> 240 mg/dL), resulting in a greater risk of cardiovascular diseases.

The average cholesterol value measured was 208.06 mg/dL (SD = 48.5), slightly higher than the optimal values, while the maximum and the minimum values were 487 mg/dL and 45 mg/dL, respectively.

Missing data were the 1.9% (N = 20).

Workers aged 45-53 had significant highest level of cholesterol values in the 36.1% of cases, $p < 0.001$.

Triglycerides

The 70.3% of the sample dataset (735 workers) had good triglycerides values (< 150 mg/dL), while the remaining 29.7% (311 workers) had high triglycerides values, resulting in a greater risk of cardiovascular diseases.

The average triglycerides value measured was in the range of optimal values (138.36 mg/dL, SD = 102.6), while the maximum value observed was 1356 mg/dL.

Missing data were the 2.5% (N = 27).

Also in this case, it emerged that workers in age group 45-53 had significant higher triglycerides values in the 38.7% of cases, $p < 0.001$.

Bivariate analysis

The bivariate analysis was showed in Table 2. The oil company workers over 45 years had significant higher risk to have obesity (OR = 3.8, CI 95% = 2.5-5.7), hypertension (OR = 2.7, CI 95% = 2.1-3.6), high blood fasting glucose (OR = 2.6, CI 95% = 1.2-5.5), high cholesterol (OR = 2.7, CI 95% = 2.0-3.6), high triglycerides (OR = 1.8, CI 95% = 1.4-2.4) compared to younger (< 45 years).

Between smoking habits and age groups there was not a significant association (OR = 1.4, CI 95% = 0.7-2.7).

Furthermore, the probability that a worker over 45 had two or more cardiovascular risk factors was 4.2 times greater than a younger colleague (CI = 2.8-6.3).

DISCUSSION

Oil company workers average height in our sample was comparable with that of the Italian male population [35] but, they were, generally, more overweight and obese [36].

In particular, the workers aged > 54 presented almost twice the BMI values of obesity with respect to the Italian male population (27.5% versus 15.5%, [36]).

The average blood pressure measured in the oil company population (130-81 mm Hg) was consistent with

the average blood pressure of Italian male population (134-84 mm Hg, [37]).

However, in the sample dataset, the 47.4% and the 54.5% of workers in the age range of 45-53 and > 54, respectively, suffered from hypertension problems. People affected by hypertension in the Italian male population, instead, were 10-15% for the age group 45-53 and 37-40% in the age group > 54 [37].

The average fasting glucose values measured in the oil company workers (94 mg/dL) were consistent with those of the Italian male population (92 mg/dL, [38]), such as the average cholesterol values (208 mg/dL versus 205 mg/dL, [38]).

However, from the comparison between the two populations, it emerged that the frequency of hypercholesterolemia was 3% higher in the group under investigation (24.3% versus 21%, [37]).

Nothing of interest emerged about triglycerides values.

There is little international literature about this topic, as reported in the introduction. However, we found similar values of BMI and percentage of overweight in oil workers population studied by Parkes [15], that also underlined the increase of BMI linked to the age of workers. Another study by Tsai *et al.* [16] reported the impact on absenteeism from known health risk factors such as obesity, high cholesterol and hypertension, describing also a higher absence rates and longer absence duration among male employees with pre-hypertension compared with those with normal blood pressure. Finally, also Shevchenko [17] and Arcaleni [18] underlined the prevalence of high cholesterol levels in oil workers population.

The analyzed variables are the most important risk factor not only for CVD and strokes, as we reported in introduction, but, more generally, they reduce life expectancy and expose to a greater risk of other neoplastic diseases such as: colon cancer, renal cell carcinoma, esophageal adenocarcinoma [39]. In addition, the cholesterol values reflect overeating and unbalanced diet by workers associated, probably, to inadequate physical activity.

This suggests the necessity of a careful evaluation by

oil company in preventing and monitoring, in order to preserve workers' health and to improve productivity, reducing absenteeism caused by the risk factors mentioned above, as widely reported in literature [16, 20-22, 40].

The study, however, had some limitations, first of all the cross-sectional study design, because the employment and outcome are simultaneously assessed, there is generally no evidence of a temporal relationship between exposure and outcome. This analysis represented a snapshot of the workers state of health.

Secondly, data collection accuracy, because the GIP-SI system was not designed for epidemiological analysis, but rather as an information system for occupational medicine. In particular, it was not possible to evaluate in a uniform manner for all workers the described biochemical and clinical parameters. Further limitation concerns the information on the smoking status that has not been measured objectively, but based on self-referencing.

In conclusion, the studied population presented overweight BMI values, hypertension and cholesterol problems, especially in workers older than 45 years ($p < 0.001$); these problems worsen with increasing age, as shown in the risk assessment realized. A natural progression of this work is to perform a cohort study to assess the trend of the risk factors described in the observation period 2000-2010.

Authors' contribution

Author's contribution statement: conceived and designed the study: LTG, NV, DSS. Analyzed the data: MA, PS, SR. Contributed materials/analysis tools: CM, GC, SS. Wrote the paper: MA, PS, SR, LTG. Additional manuscript editing and corrections: LTG, NV, SS.

Conflict of interest statement

None.

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