

The cardiac profile and electrocardiographic standard of at-height workers

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SUMMARY

BACKGROUND: *The Medical Control Program for Occupational Health establishes the required supplementary exams, according to the activity exercised by the worker and its inherent risks. The Regulatory Norm No. 35, recently deployed, stipulates that at-height workers must undergo electrocardiogram exams as an additional routine examination.*

OBJECTIVE: *To evaluate the electrocardiographic standard in at-height.*

METHODOLOGY: *A cross-sectional study, developed from May 2014 to January 2015 with male at-height workers. Anthropometric and clinical data were collected after the electrocardiogram (ECG). The workers included in the program were evaluated by an occupational medicine service of Serra Gaúcha, responsible for medical assessment and occupational tests. All workers were assessed by the researcher.*

RESULTS: *A total of 561 at-height workers participated in the study. The average age was 35.9 ± 12.2 years. A total of 176 (31%) presented electrocardiographic changes in the analysis of the resting ECG. Regarding the amendments in the resting ECG, 15.7% were attributed to changes in ventricular repolarization, 8% as blocks conductions, and 5.8% as left ventricular overload. Demographic variables were not associated with changes in the electrocardiographic tracing*

CONCLUSION: *This study demonstrated the electrocardiographic alterations and the profile of at-height workers. These findings can help determine prevention strategies and provide warnings of possible future harms to the health of these workers.*

KEYWORDS: *Electrocardiography. Occupational Health. Occupational Medicine. Cardiovascular Diseases.*

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death worldwide, totaling 30% of all deaths globally. The American Heart Association published that the overall rate for deaths attributed to CDV in 2013 was of 222.9/100,000 Americans, corresponding to 30.8% of all deaths in the United States.^{1,2}

Ischemic Heart Disease (IHD) is the world leader in the cause for loss of years in life expectancy due

to the premature death of individuals over 30 years old. Studies show that the estimates related to work and mortality caused by IHD, among the working age population, varies from 8% in Korea, to 17% in Denmark and Finland, with high costs to health systems.^{3,4}

The WHO recommends a reduction in 25% of deaths caused by chronic non-communicable diseases.

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es (NCDs). In Brazil, actions are aimed at the prevention of CDV risk factors (RF).^{5,6} Among RFs, we can cite systemic arterial hypertension (SAH), cholesterol, smoking, diabetes mellitus, and others⁷.

The Ministry of Labor and Employment, by means of guidelines and standards, defines mechanisms for the mitigation of risks and damages to the health of workers, which are of the responsibility of both employer and employee. Complementary exams, in accordance with the activity performed by the worker, are essential for the prevention of these scenarios, for which the company is liable from the activity and/or location of such worker.⁸

The Regulatory Norm (NR) No. 35, of 2012, concerns at-height workers involved in activities performed at least 2 meters above ground level. Periodic examinations and clinical evaluations are required of the workers. Among exams, the electrocardiogram (ECG) is required and considered a tool in the early diagnosis of CVDs that may cause sudden illnesses and falls from heights.

Falls are the leading cause of death from injuries in civil construction, presenting a considerable number of fatal accidents. Protective measures and early prevention, such as the use of personal protective equipment and accuracy in the diagnosis of diseases that lead to falls, have been implemented.¹⁰⁻¹³

With that in mind, the present study assessed the electrocardiographic standard and cardiac profile of a population of at-height workers.

METHODOLOGY

Study design and development

A cross-sectional study, conducted in a service of occupational medicine authorized to carry out periodic examinations in a municipality of the Serra Gaúcha, from May 2014 to January 2015.

Participants

A total of 561 male workers, >18 years old, who worked at heights with a resting electrocardiogram were included. Workers with low-quality ECG tracings and those who refused to participate in the study were excluded.

Study variables

The variables assessed were: ECG tracing, ethnicity, age, smoking habits, blood glucose, alcohol consumption, physical activity, body mass index (BMI),

family history and arterial pressure values. The number of years of experience of the workers was not considered.

Study logistics

The resting ECG was performed in all the at-height workers who fit the NR 35 and had been referred by the doctor of the Occupational Medicine company. A digital ECG machine was used, Micromed Wincardio USB with 12 simultaneous leads. The 12 leads were recorded at a speed of 25 mm/s and standard calibration for 1.0 mV/cm. The electrocardiographic tracings were analyzed and reported by a cardiologist of the hired company, in accordance with the criteria and recommendations of the Brazilian Society of Cardiology Guidelines on the Electrocardiographic Analysis and Reporting of 2009.¹⁴

For data collection, were considered: smoking (>1 cigarettes/day), sedentary lifestyle (less than 30 minutes of physical activity/day or < 150 min/week), BMI ($\geq 25,0$ kg/m² for overweight and ≥ 30 kg/m² for obesity), hypertension ($\geq 140/90$ mmHg), diabetes mellitus (> 126 mg/dl for fasting blood glucose), alcoholism (250 mg/week).¹⁵⁻¹⁸

Sample size calculation

For calculating the sample size, we used a Brazilian cross-sectional study¹⁹, whose prevalence of ventricular repolarization was of 9.5% and overload of the left ventricle of 3.3%. A confidence level of 95% and a margin of error of 3 percentage points were considered, leading to 367 individuals necessary for the sample size calculation. We opted for a sample for a specified period of collection, resulting in 561 consecutive workers and a single ECG per worker. Only those with adequate technical standards were assessed.

Ethical aspects

The project was approved by the local Research Ethics Committee under the number CEP/IC-FUC UP 4.964/2014 and all participants in the study signed an Informed Consent Form (ICF).

Statistical analysis

For data analysis, we used the statistical software *Statistical Package for Social Science* (SPSS), version 23. The continuous variables were tested for normality by the Shapiro-Wilk test and described as a mean and standard deviation, and the categorical variables

in absolute value and percentages. The Student t-test was used to compare the average ages between workers with and without electrocardiographic alterations. For the comparison of prevalences¹⁹⁻²¹ of alterations in at-height workers against other samples from studies in the literature, we employed the chi-square test. An alpha of 0,05 was considered statistically significant.

RESULTS

Participated in the study a total of 561 at-height workers, male, white (86.9%), with an average age of 35.9 ± 12.2 years. Sedentary lifestyle was the most prevalent RF (90.5%), followed by increased pressure levels (53.1%), and alcohol consumption (41%). The association between electrocardiographic alterations and the variables analyzed did not present any statistically significant difference (table 1).

In Figure 1, we can observe that out of the 561 workers, 31% (n=176) did not present a normal ECG tracing. A total of 222 electrocardiographic alterations were found, with more than one alteration present in some tracings. The diagnosis criteria for

LVO used were the ones presented by Sokolow-Lyon, Cornell e Romhilt-Estes.

Electrocardiographic changes compared with other studies are as shown in Figure 2.

The prevalence of conduction blocks was of 9% among workers, and the most prevalent were LAHB (3.5%) and RBBB (2.8%).

DISCUSSION

The present study analyzed the profile and electrocardiographic alterations of at-height workers in a southern area of Brazil. National publications on profiles and ECG alterations for specific populations are scarce.

Among the workers, RF such as a sedentary lifestyle (83.7%), high blood pressure levels (53.1%), alcohol consumption (41%), smoking (37%) and family history (36%) were higher than in other national studies with RF of chronic diseases.^{19, 23, 24} Gus et al.,²⁵ when analyzing RFs for CAD, found results lower than ours, with the exception of obesity/overweight and hypertension, whose prevalence rate was around 68% and 40%, respectively. The influence of cardiovascular RFs varies between men and women, which could justify our findings, since the samples of the other studies were formed mostly by women.^{26, 27} The prevalence of SAH of 32.6% was similar to a study performed with male transport drivers from the state of Piauí.²⁸

During the analysis of the ECG tracings, most (69%) at-height workers presented normal sinus rhythm. For the electrocardiographic alterations associated with workers' RFs, there was no correlation between the variables. Alterations in ventricular repolarization (VRA) (6.7%), followed by conduction blocks and left ventricular overload (LVO) (5.6%) were the most prevalent in our study. In a national study with 1,067 individuals, the RFs for ischemic disease in this population were correlated with high cholesterol and hypertension, and the most prevalent electrocardiographic alterations were VRA (9.5%) and LVO (3.3%). In comparison with the VRA found in our study, the percentage was higher.¹⁹

In the Framingham study,²⁰ the VRAs (14.1%) found in male participants were similar. The phenomenon of repolarization gained further attention after bringing contributions to the risk stratification of serious arrhythmic events and sudden deaths.¹⁴ Among the repolarization alterations, the early repo-

TABLE 1 - ANALYSIS OF THE ASSOCIATION BETWEEN ELECTROCARDIOGRAPHIC ALTERATIONS AND THE VARIABLES ANALYZED

Variables	(%)	alterations ECG	p
Age (years)			
<30	31.0	65	0.925
≥30	31.7	111	
Ethnicity			
white	31.9	154	0.599
black	28.2	22	
Body Mass Index			
Up to 24.9 Kg/m ²	31.2	83	0.618
≥25 a 29.9 Kg/m ²	29.9	63	
≥30 Kg/m ²	35.7	30	
Blood Pressure			
Up to 140x90mmHg	32.2	59	0.833
≥ 140x90mmHg	31.0	117	
Glycemia			
< 100 mg/dl	32.3	139	0.275
≥ 100 mg/dl	25.3	20	
Smoker			
yes	28.5	59	0.305
no	33.1	117	
Family History			
yes	32.7	66	0.687
no	30.6	110	
Sedentary Lifestyle			
yes	31.8	161	0.665
no	26.4	15	

larization pattern (ERP) was present in 4.5% of the at-height workers, a similar number to that found for the general population — something that is noteworthy, since recent studies have shown a correlation between this alteration and sudden cardiac deaths.²⁹

The most significant clinical implication of the conduction blocks is its relationship with cardiac patients. In healthy individuals, blocks are considered trivial electrocardiographic abnormalities, thus justifying our findings. Among blocks, the left anterior fascicular block (LAHB) was the most prevalent, with 2.8%, surpassing the results found in the literature.²

A Finnish population study with 6,315 participants assessed the prevalence of eight conduction blocks and their association with RFs and CVD by means of ECG. In this study, the most prevalent block, differently from what we found, was the right bundle branch block (RBBB), with 3.9%, followed by incomplete LBBB (1.8%), and left bundle branch block (LBBB), for which age and gender are intervening

variables. Our sample was composed exclusively by men, younger than those in the Finnish study.³⁰⁻³³ Emphasis should be given to the LBBB, since it is an electrocardiographic alteration associated with an increased risk of sudden cardiac death. The prevalence of LBBB was lower than in other studies with no heart disease basis.^{34,35}

Since the groundbreaking observations of the *Framingham Heart Study*, several epidemiological studies have highlighted LVO as one of the most important RFs for angina pectoris, myocardial infarction, cerebrovascular accident (CVA) and sudden death.²¹ Despite the low sensitivity of the ECG for left ventricular hypertrophy (LVH), it is still the most widely used complementary examination in cardiology clinics and medical offices. After evaluating the influence of the ECG in LVO according to gender and cardiac mass, a Brazilian study concluded that the diagnostic sensitivity of the ECG is higher among males.³⁶ The results LVO results found in at-height workers coincide with the prevalence values reported in international studies, which vary from 3% to 14% in males. In studies with reference to Framingham, the ECG presented a 6.9% sensitivity and 98.8% specificity for LVO, finding a 2.9% LVO prevalence in ECG tracings for male individuals (n=2,042).^{22, 37, 38}

The results found were compared with electrocardiographic alterations observed in other studies. The Framingham Heart Study (n=4.684), when compared with at-height workers, presented a value of p=0.450 for VRA and p<0.001 for LVO. When compared to a Finnish study that researched the prevalence of blocks in 6,315 individuals, the p-value was significant only for LBBB (p=0.020). After a comparison with findings from a population (n=1,067) from the São Paulo region, there was a significant difference for VRA and LVO. (p=0.002 and p=0.047, respectively)¹⁹.

FIGURE 1 - NUMBER OF ELECTROCARDIOGRAPHIC ALTERATIONS PRESENT IN WORKERS

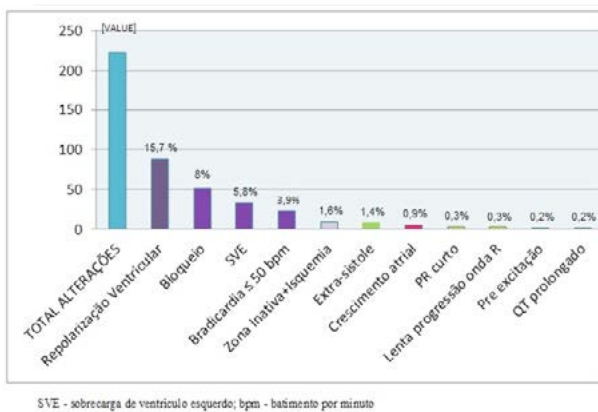
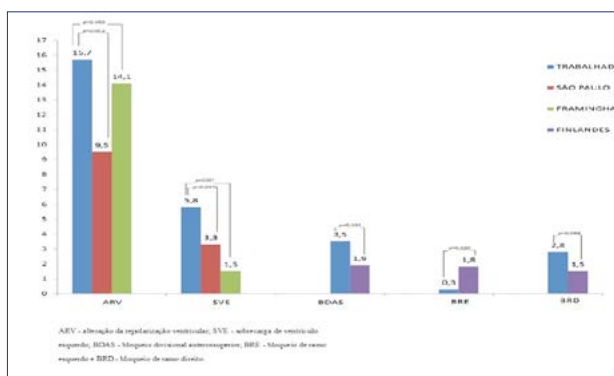


FIGURE 2 - ELECTROCARDIOGRAPHIC ALTERATIONS, IN COMPARISON WITH OTHER STUDIES



CONCLUSION

The present study found that the prevalence of LVO and VRA in at-height workers from Serra Gaúcha is higher in comparison to Brazilian population studies. It is possible that the absence of correlation between risk factors and electrocardiographic alterations in the study is due to the fact that the average age of the participant workers is lower than that of the average population. The ECG remains a necessary exam, fundamental for the CVD

diagnosis, since the morbidity profile is not linear and the implemented health actions do not have the expected effectiveness. New studies in specific populations are necessary to assess electrocardiographic alterations associated with CDV risks and sudden death.

STUDY LIMITATIONS

The age of the studied population was a limitation, since electrocardiographic alterations and conduction blocks are more prevalent in older populations.

Another limiting factor was the interpretation of the interpretation of electrocardiograms, conducted by a single professional. It is recommended that reports be assessed by two independent professionals, thus confirming the diagnosis.

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RESUMO

FUNDAMENTO: O Programa de Controle Médico e Saúde Ocupacional estabelece a realização de exames complementares de acordo com a atividade exercida pelo trabalhador e os riscos a ela inerentes. A Norma Regulamentadora nº 35, implantada recentemente, estabelece que trabalhadores que exercem funções em altura realizem o eletrocardiograma como um exame complementar de rotina.

OBJETIVO: Avaliar o padrão eletrocardiográfico dos trabalhadores em altura por meio da realização do ECG de repouso.

MÉTODOS: Estudo transversal, desenvolvido de maio de 2014 a janeiro de 2015 com trabalhadores masculinos que exercem funções em altura. Foram coletados dados clínicos e demográficos e, após, realizado o eletrocardiograma (ECG). Os trabalhadores incluídos eram vinculados a um serviço de medicina do trabalho da Serra Gaúcha, destinado à realização de avaliação médica e exames ocupacionais. Todos foram avaliados pela pesquisadora.

RESULTADOS: Participaram 561 trabalhadores em altura. A média de idade foi de 35,9±12,2 anos, e 176 (31%) apresentaram alterações eletrocardiográficas na análise dos ECG de repouso. Das alterações do ECG de repouso, 15,7% foram atribuídas a alterações da repolarização ventricular; 8% como bloqueios de condução e 5,8% como sobrecarga de ventrículo esquerdo. As variáveis demográficas não estavam associadas com alterações no traçado eletrocardiográfico.

CONCLUSÃO: Este estudo verificou que a prevalência de sobrecarga de ventrículo esquerdo e alteração da repolarização ventricular, nos trabalhadores em altura, é maior quando comparada a estudos populacionais brasileiros. A associação de fatores de risco e alterações eletrocardiográficas em indivíduos difere de populações específicas.

PALAVRAS-CHAVE: Eletrocardiografia. Saúde do trabalhador. Medicina do trabalho. Doenças cardiovasculares.

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