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Effect of occupational activity on ambulatory blood pressure profile in university teachers

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Abstract

Hypertension (HBP), a key risk factor for cardiovascular diseases, is strongly associated with behavioral and environmental aspects of living. Professional activities, amongst others that take place throughout the day, are responsible for important blood pressure (BP) variations and may increase it. This study aims at ascertaining the blood pressure profile and variation in teachers, during a typical teaching session. Ambulatory Blood Pressure Monitoring (ABPM) was performed in a cohort of 21 university teachers during a typical professional day, comprising the following periods: 24-hour period, day period, night period, morning period, 2 hours before class, during class, 2 hours after class, aerobic exercise period and 1 hour after exercise period. Teachers demonstrated higher BP during the occupational activities (137.71 / 88.57 mmHg) compared to the period before (128.81 / 82.43 mmHg) and after the class (132.38 / 85.19 mmHg) ($p < 0.05$). It was found that systolic BP has the greatest variability across the considered activities and time periods. In a gender analysis, men had higher systolic BP compared to women (141.55 mmHg / 133.50 mmHg, respectively), and demonstrated greater variability across activities. The results clearly demonstrated the existence of important variations in BP due to different daily activities. The occupational period produced a significant increase in the different components of BP and heart rate. Long-term effects of repeated exposure to this increase in BP related with the occupational contexts remains to be demonstrated.

1. INTRODUCTION

Arterial hypertension (HBP) is a major public health problem worldwide, being one of the most important risk factor for cardiovascular diseases. Blood pressure varies from moment to moment as a response to the different activities and emotions experienced by individuals. HBP is considered an exaggerated rise in blood pressure (BP), above 140/90 mmHg for systolic blood pressure and diastolic blood pressure, respectively (Corrêa, 2001). HBP can progress without symptoms for years and, if left untreated, be a cause of major complications and death (Costa, 1997).

In most cases, HBP has no apparent cause, although several aspects contribute to its manifestation, such as age, weight, smoking, sedentary lifestyle and ethnicity. Hence, HBP is associated with other conventional cardiovascular risk factors. A minority of cases of HBP have a secondary and identifiable cause (Trigo, Coelho & Rocha, 2001). The diagnosis of HBP is a key aspect in the management of this major cardiovascular risk factor, and should be made precociously.

Office BP measurement with a sphygmomanometer has been the cornerstone for HBP diagnosis. However major limitations are recognized in this methodology, mainly the contextual set of the measurement, potentially biased by a wide range of factors, and also the discrete nature of the measurement, not representative of the true circadian profile of BP. The recognition of these limitations motivated the development of complementary methods, such as BP self-measurement, and most importantly, Ambulatory Blood Pressure Monitoring (ABPM).

ABPM is a method through which multiple indirect BP measurements are obtained over a period of 24 consecutive hours and during the daily activities. This method is essential for the diagnosis and treatment monitoring of HBP patients, a fundamental tool for the knowledge of circadian and seasonal variations of BP, and also to explore how occupational contexts affect the cardiovascular physiology. Currently, ABPM with clinically validated monitors is considered the reference method for accurate diagnosis of HBP, for monitoring therapeutic efficacy and for prognostic definition (Nobre, 1996).

Several studies have shown a strong incidence of HBP and coronary heart disease associated with occupational stress, strengthening the idea that occupational activity affects the health of individuals and could be, in some instances, seen as a cardiovascular risk factor (Mendes, 1997). Overall, the occupational environment is a factor that could led to feelings of insecurity, frustration, nervousness, stress, amongst others, affecting the individual health and professional performance (Hayashi, Kobayashi, Yamaoka & Yano, 1996; Robazzi, Veiga, Nogueira, Hayashida & Ruffino, 2002).

For this reason, ABPM has been shown to be a valuable method in the study of the relationship between occupational activity and the behavior of BP during work (Couto, Vieira & Lima, 2007). The main objective of this study was to investigate the BP variation in university teachers, during a daily routine involving periods of teaching in classroom.

2. ARTERIAL HYPERTENSION

According to the National Programme for Cerebrovascular Diseases, the prevalence of HBP in Portugal is estimated in 26.9% of the population, being most common in women (29.5%) than in man (23.9%) (Polónia, Martins, Pinto & Nazaré, 2014).

3. AMBULATORY BLOOD PRESSURE MONITORING RESULTS

ABPM data could be summarized in a wide range of configurations, although the most important information for clinical decision are the overall means for daytime, nighttime and 24 hours BP values. From these grand-averages, the definition of the BP profile is made, taking into consideration the thresholds available in the international recommendations. Also, additional information can be estimated, such as the loads, the amount of night BP dipping, BP variability and the presence of white-coat effect or BP morning surge. The 24 hours ambulatory BP profile can also be depicted graphically, allowing for the identification for the qualitative characterization of the overall profile, detecting peaks or drops of BP related it with daily activities, and also allowing to check the therapeutic effect through the 24 hours. The possibility of eliminating artifacts and outliers is one of the additional advantages of this method (Asmar & Maldonado, s.d.b).

4. OCUPATIONAL STRESS

Nowadays, the particular rhythms of life are marked by a cascade of feelings that impose a considerable load of daily stress to all individuals. The stress that arises from occupational activities is one of the major sources of stress load that everyone has to deal with in a daily basis. It's a known fact that occupational activities are both enriching as a potential source of stress and deep anxiety, both of which can occur from ecological features of the working place. Interpersonal relationships and other forms of social interaction, the demands or objectives that are established and the ability one has to cope with them successfully are factors that contribute to the emergence of occupational stress. Personality is one key factor that modulates the individual vulnerability to occupational stress, intertwiningly to the contextual features of the occupation, highlighting aspects such as the occupational conditions, the characteristics of work, the role of the individual at work, the structure and climate of the workplace, the relationship of the individual to others, the professional career and even factors that are extrinsic to the occupation (Ramos, 2001; Serra, 2002 & Reinhold, 2004).

5. STRESS IN UNIVERSITY TEACHERS

A teacher is subject to several stressors due to the particular characteristics of the profession, considering that this occupational activity can either promote recognition, personal growth and professional independence, or feelings of disinterestedness, apathy, dissatisfaction and irritability. Teacher are often faced with periods of restlessness and states of deep tension, accompanied by large discharges of adrenaline. Noise within the classroom, the need for continued attention and concern, and the sense of deep responsibility are important sources of stress. A teacher, in his pedagogical activity, must be able to interact

with the students, constantly subjecting him to unforeseeable situations, which demand of him a high attention and simultaneous perception that allows him to react according to specific situations. Some authors report that teachers fill the second place in terms of risk for heart diseases.

Teacher-Student relationships are considered an important modulator of the individual psychic balance, being a part of the work itself. The fact that the teacher teaches in a classroom makes him the master of his/her working place, the teacher can carry out his profession in various ways, taking control of work. In addition, a teacher usually performs his profession with the same group of students for several months, which allows him to know the students and choose the best method to adopt in their teaching process. However, teachers are not always able to cope with all the aspects inherent to the profession, increasing the risk for anguish, tension, stress and burnout (Reinhold, 2004).

6. BLOOD PRESSURE AND OCCUPATION

Health and work interact continuously, so that occupational modulators are able to change the individual health trajectory into disease states through individual factors (genetic and family) environmental/behavioral factors (work environment and lifestyles) and professional risks (of the occupation) (Mendes, 1997).

Risks arising from the workplace are related to: workload, excessive pressure, insecurity, dissatisfaction, frustration, monotony, shift work, conflict and professional recognition. All these factors can contribute to the development of psychosomatic and cardio-vascular manifestations, as occupational-driven HBP. There are studies that demonstrate a higher prevalence of hypertension and coronary disease in laboratory settings.

Therefore, the control of occupational health is the result of actions, techniques and diagnostic processes, as well as the reduction of individuals' exposure to occupational risks, in order to protect and ensure the safety, health and satisfaction of workers.

ABPM is considered the reference method for studying the relationship between the occupational risk factors and the presence, absence or development of HBP, and is therefore the most widely used method in the context of occupational health research (Robazzi, Veiga, Nogueira, Hayashida & Ruffino, 2002; Couto, Vieira & Lima, 2007).

7. OBJECTIVE AND CONCEPTUALIZATION OF THE STUDY

HBP is currently the leading cause of death in Portugal, as a consequence of the high number of cardiovascular complications that have HBP as a direct cause. As HBP is a predominantly asymptomatic disease, it progresses silently for years, and if not detected and treated early, its first clinical manifestation could be a major cardiovascular event, or even death. Thus, it is essential to measure BP as a means for preventing cardiovascular complications that are dependent on this hemodynamic state.

It is known that BP varies at each moment in response to activities and emotions arising from everyday life. Thus, it would be of interest to study this variation in a population of University Teachers, in order to assess the behavior of BP during the activities that take place within the classroom, a situation that potentially can induce feelings of insecurity, stress and anxiety (Costa, 1997; Corrêa, 2001).

In this way, we intended to evaluate the BP response of teachers in relation to their daily teaching activity over the course of 24 hours, aiming to understand the behavior of BP in classroom environment and outside this contextual occupational environment.

8. MATERIAL AND METHODS

A cross-sectional study was conducted in a Superior Education Institution, including teachers of both genders, with a full-time professional link with the institution. A 24 hour ABPM was performed to all teachers that voluntarily agreed to participate in the study. Demographic data was also collected to all participants.

The ABPM was performed non-invasively, with a validated device CardioVisions 1.10.2 (Meditech, USA) mand according to a specific protocol: the ABPM monitor was programmed to measure BP every twenty minutes from 6 am to 10 pm, and every thirty minutes from 10 pm to 6 am, during a 24 hour period. The monitoring was made during a regular working day, without any compromise of routine daily activities. The participants were asked to do a 30 minute walk during the day period so that BP under aerobic exercise could be assessed.

All information was digitally collected and statistically analyzed with the SPSS software (Statistical Package for the Social Sciences, version 16.0; IBM, USA). A descriptive statistical analysis was performed. The

statistical tests used were: for continuous variables with a normal distribution, the repeated measures ANOVA, and the t Student test for independent or pairwise samples; for non-parametric continuous variables, the Friedman test, the Mann-Whitney test and the Wilcoxon test; for categorical variables, the Qui-square test, with Fisher's correction whenever appropriated. The level of significance used for the interpretation of the tests was $p < 0.05$. The study complied with all the ethical dispositions for human research. Confidentiality of the data was warranted. All participants gave their informed and written consent. This study has no commercial or financial interest.

9. RESULTS

The cohort consisted of 21 teachers, ten female and 11 males, aged between 26 and 52 years. More than half presented overweight (66.6%) and family history of hypertension (52.4%). Almost half of the cohort indicated regular physical activity habits (47.6%). Alcohol consumption during meals (19%) and smoking (9.5%) were observed in a small proportion of the participants. Systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean pulse pressure (PP) were situated within normal values in the majority of the cohort during the 24-hour period [SBP (90.7%), DBP (81%) and PP (85.7%)], as well as heart rate (HR).

Considering the BP profile during the occupational period and comparing with the before and after periods, an increase in BP was depicted. In fact, there was an increase in SBP during classes compared to the previous and subsequent periods ($p < 0.01$), and the same was true for DBP ($p = 0.037$), see Figure 1.

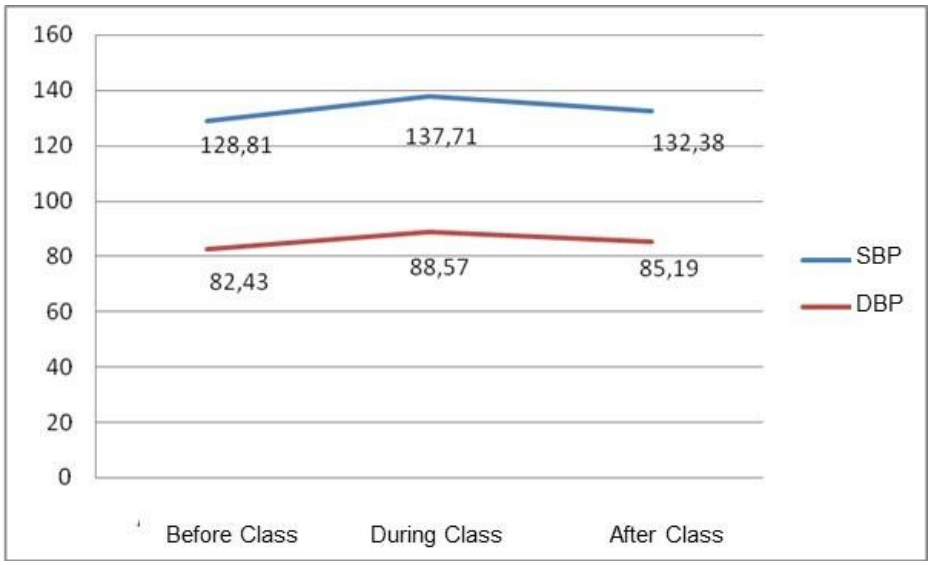

Figure 1 – SBP e DBP (mmHg) before, during and after class period

This behaviour was independent of gender for SBP ($p=0.139$), although the mean increase in DBP was greater in males as compared with females ($p=0.034$), see Figure 2.

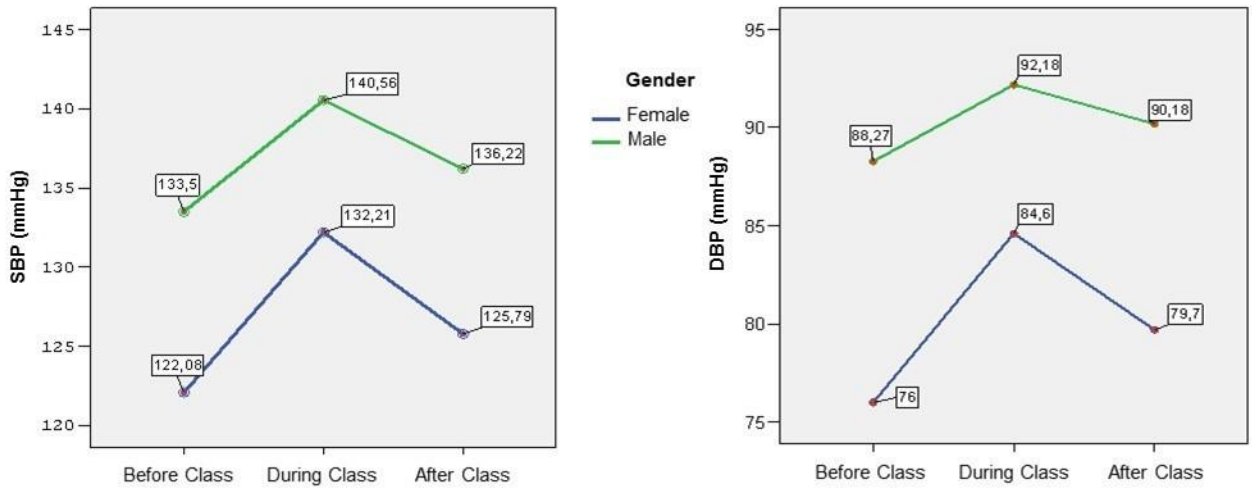

Figure 2 - Gender influence in the SBP and DBP, before, during and after the class period

Similar pattern was depicted for PP, HR and mean BP, see Figure 3.

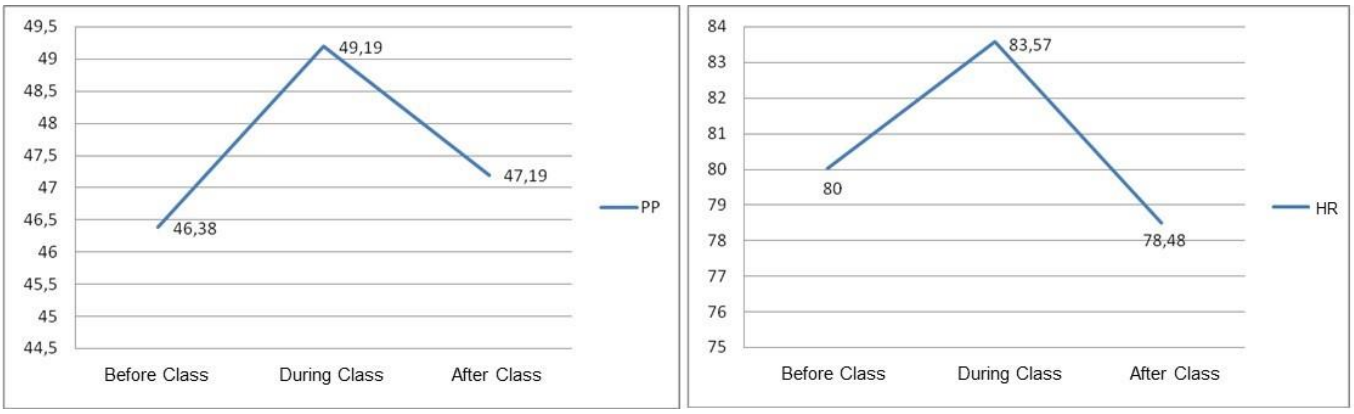

Figure 3 – PP (mmHg) and HR (bpm) before, during and after class period.

To assess the effect of mild exercise on BP of the participants, a 30-minute walk period was recommended to the participants. Curiously, SBP was significantly reduced after this period (p=0.023) in all the participants, indicating that exercise could be an effective tool to promote well-being and cardiovascular health, as expected from the available evidences, see Figure 4.

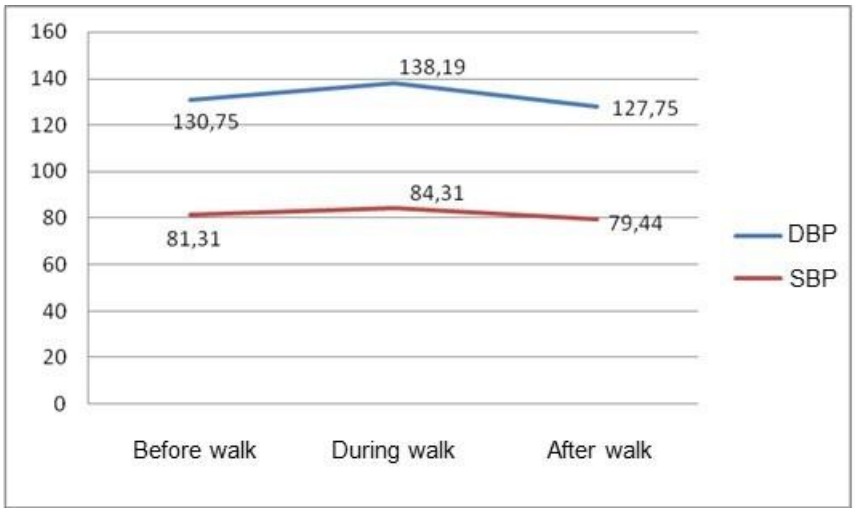

Figure 4 - Variation of SBP and DBP before, during and after a walk.

Considering other aspects of BP variation furing the 24 hour period in the cohort, it was found that participants with HBP and normotension had a similar dipping profile (p = 0.586) and similar mean 24h PP (p=0.08).

10. DISCUSSION

Hypertension is considered an important risk factor for cardiovascular diseases, and constitutes a major public health problem in Portugal. Professional activities, as well as other activities that take place throughout the day, determine BP variability. Therefore it seemed pertinent to study how the occupational context in university teachers affects their BP during a typical working day. The results showed a significant increase in BP during the occupational period, so that the higher SBP and DBP identified during the 24 h monitoring period were in fact observed during this period. These results reinforce the findings of previous research that proved that professions that are characterized with high mental workload or intellectual engagement or that are related to feelings of anxiety and mental exhaustion, provide greater increases in BP so it tends to be higher during the exposure to the occupational ecology as compared with the BP at home or during other daily routines (Couto, Vieira & Lima, 2007). Other studies found that activities that require mental effort (such as teaching) deeply influence BP variability (Schnall, Landsbergis, Warren & Pickering, 1992; Mattos, Mattos, Toledo & Filho, 2006). Other research identified that the sense of responsibility

towards the people with whom one works may also be directly related to the increase in BP (Ramos, 2001).

Our results identified an increase in all components of BP, such as PP and MAP, as well as HR, during the occupational context, thus indicating a clear impact of the professional activity over the cardiovascular system. The increase in PP during the teaching session could be somehow related with an increased risk for cardiovascular events, as PP has been strongly associated with cardiovascular events. In fact, (Nobre & Coelho, 2003) stated that hypertension and increased PP are associated with higher cardiovascular risk. Also, it was previously observed a five-fold greater risk of cardiovascular events in individuals with increased ambulatory PP (> 53 mmHg), and Muxfeldt & Salles concluded that individuals with hypertension and an increase in PP values are more predisposed to cardiovascular risk (Muxfeldt & Salles, 2008).

Considering the effect of gender in the variation of BP during the occupational period, a trend to greater increases of BP was observed for males as compared with females, particularly considering DBP. Others have found no difference in the BP variation during professional activities in regard to gender (Egeren, 1992), although the opposite was also observed by Reckelhof that identified greater BP reactivity in men during occupational contexts (Reckelhoff, 2001), which might reflect a greater sympathetic drive in men workers.

Additionally, our data identified benefits of aerobic exercise in this population, producing a significant decrease in SBP. This finding is reinforced by other study that reported a BP reduction with physical activity in both hypertensive and normotensive individuals. (Arroll & Beaglehole, 1992). Furthermore, we found no significant differences between hypertensive individuals with abnormal BP drop and hypertensive individuals with a normal dipping profile. Notwithstanding the cohort was mostly normotensive (81%), a proportion of 58,8% presented an abnormal dipping in nocturnal BP. Several studies found a significant and independent association of an abnormal dipping pattern with major cardiovascular events and overall target organ damage in hypertensive populations (Brandão, Pierin, Amodeo, Giorgi, Mion & Nobre, 2001; Noll, Lee, Schmidt, Coelho & Nobre, 2001; Ohkubo, Hozawa, Yamaguchi, Kikuya, Ohmori & Michimata, 2002; Nobre & Coelho, 2003; Gomes, 2003; Silva, Monteiro, Nogueira, Cardoso, Maldonado & Morais, 2006; Muxfeldt & Salles, 2008).

11. CONCLUSIONS

This study provided further evidence for the characterization of BP behavior during occupational settings in university teachers. An increase in all components of BP and HR was depicted during the teaching tasks, clearly highlighting the influence of occupational context on the hemodynamic physiology of the teachers. Whether a prolonged exposure to this effect has long-term effects over the cardiovascular system or if it could contribute to the appearance of HBP in normotensive persons remains to be demonstrated in longitudinal prospective studies.

Limitations: Small cohort, with predominantly low cardiovascular risk participants; objective measures of cholesterol levels, glycaemia and other relevant parameters were not available; the information compiled through the questionnaire relied exclusively on the participant's sincerity and recollection.

Future investigations: A study with a larger cohort, followed in a longitudinal and prospective design should provide further evidence, particularly regarding the eventual association of the exposure-dependent increase in BP in the long-term. The inclusion of further physiologic, psychological and social parameters should provide a more effective evaluation of the effects of this profession on the variation of BP according to the physiological response of each individual to a given task.

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