

# Musculoskeletal pain perception and hypertension\*

## Percepção de dor musculoesquelética e hipertensão arterial

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DOI 10.5935/1806-0013.20150009

### ABSTRACT

**BACKGROUND AND OBJECTIVES:** Several human studies have shown an inverse relation between pain perception and blood pressure. This study aimed at investigating the association between musculoskeletal pain report and hypertension in a group of workers.

**METHODS:** Using a body diagram with image and intensity scale (1 to 10), 349 workers (243 males and 106 females) were asked about the presence and sensitivity to musculoskeletal pain. All were submitted to blood pressure measurement and diagnosis of hypertension by the occupational physician.

**RESULTS:** One hundred workers (28.7%) have reported some type of musculoskeletal pain and from these 12 were hypertensive and 88 normotensive. There has been no difference in musculoskeletal pain prevalence and sensitivity between hypertensive and normotensive workers. Notwithstanding the lack of significant difference, in average hypertensive workers had higher prevalence (38.7% vs 27.7%) and sensitivity to pain as compared to normotensive workers (2.3±0.8 vs 2.1±0.9, respectively).

**CONCLUSION:** It was not possible to confirm in the group of studied workers literature evidences that hypertensive individuals have lower pain prevalence and sensitivity as compared to normotensive individuals.

**Keywords:** Analgesia, Hypertension, Pain clinics.

### RESUMO

**JUSTIFICATIVA E OBJETIVOS:** Diversos estudos em humanos têm demonstrado relação inversa entre percepção de dor e pressão arterial. O objetivo do estudo foi investigar a associação

entre o relato de dor musculoesquelética e hipertensão arterial em um grupo de trabalhadores.

**MÉTODOS:** Utilizando-se um diagrama corporal com imagem e escala para intensidade (1 a 10), 349 trabalhadores (243 homens e 106 mulheres) foram questionados a respeito da presença e sensibilidade à dor musculoesquelética. Todos foram submetidos a medidas de pressão arterial e diagnóstico de hipertensão arterial pelo médico do trabalho.

**RESULTADOS:** Cem trabalhadores (28,7%) relataram algum tipo de dor musculoesquelética e destes 12 eram hipertensos e 88 normotensos. Não houve diferença nem na prevalência nem na sensibilidade da dor musculoesquelética entre trabalhadores hipertensos e normotensos. Apesar da ausência de diferença significativa, em média os hipertensos demonstraram maior prevalência (38,7% vs 27,7%) e sensibilidade à dor do que os normotensos (2,3±0,8 vs 2,1±0,9, respectivamente).

**CONCLUSÃO:** Não foi possível confirmar no grupo de trabalhadores estudados as evidências da literatura de que indivíduos hipertensos possuem menor prevalência e sensibilidade à dor do que normotensos.

**Descritores:** Analgesia, Clínicas de dor, Hipertensão.

### INTRODUCTION

Hypertension (HT) and musculoskeletal pain are being increasingly observed in the population<sup>1,2</sup>. On the one hand, HT is considered one major reason for deaths associated to cardiovascular diseases<sup>3</sup> and, on the other, pain is among non-lethal disorders mostly leading to incapacities and labor productivity losses<sup>4</sup>.

Although being seemingly different phenomena, investigations with laboratory animals and humans have shown sound association between HT and decreased perception of painful stimulations<sup>5,6</sup>. In other words, hypertensive people report lower sensitivity to pain (hypoalgesia) as compared to normotensive individuals<sup>7</sup>.

Considering that pain is a sign which helps protecting the body from potential injuries<sup>8</sup>, which are the implications of this relationship for health? The first is the evidence that hypoalgesia may be a method to diagnose HT risk of the population<sup>6</sup>. Another implication refers to alert painful signals. In this sense, it has been observed that normotensive people, with hypertensive first-degree relatives, have shown less sensitivity to ischemia and experimental pain as compared to individuals without parental history<sup>9</sup>. So, hypertensive individuals or those predisposed to hypertension could show lower

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Submitted in September 17, 2014.

Accepted for publication in February 13, 2015.

Conflict of interests: none – Sponsoring sources: none.

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sensitivity to classic pain symptoms which would alert, for example, for a myocardial infarction<sup>10</sup>. It is worth highlighting that myocardial infarction cases which were not identified by patients before the outcome represent a significant proportion of elderly people deaths<sup>11</sup>.

An important issue to establish the relationship between pain and HT is the way to quantify sensitivity to pain, since this is a subjective phenomenon. Most studies evaluating the relationship between hypoalgesia and blood pressure use tests inducing pain by means of electrical stimulation on dental pulp, temperature (hot, cold) and electrocutaneous stimulation. However, investigations addressing the relationship between hypoalgesia and blood pressure are not limited only to the use of experimental designs, that is, that quantify pain intensity as from a stimulation (tool) which induces pain. Although in a smaller number, questionnaires and scales are also used to investigate pain prevalence and sensitivity<sup>12</sup>.

Recently, a relationship between pain and HT was attempted using questionnaires to quantify pain presence and intensity. One of these studies, of epidemiological character, has shown that hypertensive individuals presented up to 60% less musculoskeletal pain as compared to normotensive people<sup>13</sup>. A different study has shown that pain intensity is associated to mild, however significant, increase in the prevalence of HT<sup>14</sup>. Notwithstanding available literature data, there are no reports on whether results on pain and hypertension found in general population are repeated in workers. So, the hypothesis of this study establishes that workers diagnosed with HT present and/or report lower musculoskeletal pain index. In this sense, this study aimed at investigating the association between musculoskeletal pain (prevalence and sensitivity) and HT in a group of workers.

## METHODS

Participated in the evaluation 349 workers (243 males and 106 females) from a candy and gums company which has approximately 1300 employees distributed in the functions of safety, packaging, transportation and administration in morning, afternoon and evening shifts.

An evaluation routine was applied during three days of an accidents prevention week carried out in the company. All workers were invited to voluntarily participate in the evaluation by the ambulatory health team (two nurses and one physician). Data were collected as follows: 1) questionnaire which, in addition to identification, has also included questions about the presence of musculoskeletal pain, as well as its location and intensity; 2) blood pressure measurement; and 3) anthropometric measures. Aiming at preventing possible omission of information, before any measurement procedure, it was individually stressed that all supplied information would be exclusively used for the research and mapping of musculoskeletal disorders in the company and that, by no means, their names would be disclosed.

After identification of the participant, one standardized question was asked to all respondents: "have you felt any body

pain in the last month?" Complaints were defined by the presence of pain in muscles or joints, perceived during and after labor activity in the period mentioned in the question (including evaluation moment). When respondents confirmed the presence of pain, the interviewer would present a body diagram with pain distribution and location, with two figures of the human body in anatomic position, one front and one back<sup>12</sup>. Body diagram reproducibility coefficient (test-retest) was estimated in  $r=0.85$ , while relative agreement of pain distribution was estimated in 88.2. After pain location, the respondent was asked about its intensity by observing a scale from 1 to 10 where 1 represented mild pain and 10 extremely severe pain<sup>16</sup>.

Blood pressure was checked with two duly gauged mercury columns sphygmomanometers (Mercurial<sup>®</sup>). Four evaluators were specifically trained to check such measurements. For analysis purposes, mean value of two measures checked on right arm respecting a period of 10 minutes in the sitting position was used. For blood pressure measurement and diagnosis in adults of both genders, we have adopted the recommendations suggested by the V Brazilian Hypertension Guidelines<sup>17</sup>. So, workers with systolic (SBP) and diastolic (DBP) blood pressure equal to or above 140 and 90mmHg, respectively, were considered hypertensive, regardless of using or not anti-hypertensive drugs. To prevent possible classification bias, workers considered hypertensive have scheduled consultation with the company physician for accurate diagnosis of results obtained. It is worth stressing that all workers with high SBP and DBP values were confirmed as hypertensive by the labor physician. Workers who had been already diagnosed by a physician and/or who were under regular anti-hypertensive drugs were also considered hypertensive, regardless of values measured during data collection. As from SBP and DBP, mean blood pressure (MBP) was calculated according to the following formula:  $MBP = [SBP + (2 \times DBP)] / 3$ .

Body mass was evaluated with anthropometric scale with 100g precision (Welmy<sup>®</sup>) and height was obtained by means of a wooden stadiometer with 0.1cm scale. As from body mass and height measurements, body mass index (BMI) was calculated in  $kg/m^2$ . Waist circumference (WC) was measured twice in the mid-point between the last rib and the iliac crest using a flexible Mabis<sup>®</sup> tape.

## Statistical analysis

Analyses were performed with the aid of commercial statistical package (SPSS, Inc., Chicago, IL – version 13.0), with significance level of  $p \leq 0.05$ . Shapiro Wilk test has shown symmetry in data distribution. So, descriptive statistics (mean and standard deviation) or frequencies, when adequate for data presentation, were used. Aiming at comparing mean values among painless hypertensive (PLH), painful hypertensive (PFH), painless normotensive (PLN) and painful normotensive (PFN) groups, Anova two-way (Bonferroni post-hoc test) was used. Student's *t* test for unpaired data was used to compare between genders. Chi-square test was applied to detect percentage values associations and comparisons.

The study was approved by the Research Ethics Committee for Studies with Humans (CEP), Biosciences Institute, Paulista State University (CEP-IB-UNESP) Rio Claro/SP campus (protocol 1916/2007) according to ethical recommendations provided in resolution 196/96 of the National Health Council. After being informed about tests risks and procedures, subjects have signed the Free and Informed Consent Term (FICT).

## RESULTS

Participants' characteristics according to gender are shown in table 1. Males represented the most part of the sample (69.6%) and were significantly different from females in all variables, except for age and BMI. With regard to total sample, there has been a higher proportion of males with HT (7.2%) and pain (17.5%) as compared to females (1.7% and 11.2%, respectively). The number of workers (100) reporting musculoskeletal pain represented 28.7% of the sample, while HT was confirmed in 8.9% of the sample. With regard to total respondents (349) just 3.5% had in

common HT and pain. Among normotensive individuals (91.1%), the relative amount of complaints associated to some discomfort was 25.2%. Considering all hypertensive individuals (31), 38.7% of them had some type of pain (n=12), while among normotensive individuals (n=318) pain reports were common in 27.7% of cases (n=88).

Workers reporting musculoskeletal pain have classified subjective symptom intensity perception as from a scale from 1 to 10. Although the analysis has not shown statistical difference (p=0.279), mean perception was higher among hypertensive (2.3±0.8) as compared to normotensive (2.1±0.9) individuals (Table 2). The painless hypertensive group (PLH) had higher mean SBP, DBP and MBP values as compared to the painful hypertensive group (PFH). This might be due to the fact that there were no females in the PLH group. As observed in table 1, females had significant lower blood pressure values, which has contributed to maintain PFH group mean lower. Additionally, it is possible to observe that hypertensive individuals are statistically older, heavier and with larger amount of abdominal fat (BM, BMI, WC) as compared to normotensive individuals (Table 2).

**Table 1.** General characteristics of workers according to gender

Variables	Males (243)	Females (106)	Todos (349)	p value
Categorical*				
Hypertensive (n & %)	25 (7.2)	6 (1.7)	31 (8.9)	0.001
Pain report (n & %)	61 (17.5)	39 (11.2)	100 (28.7)	0.001
Numerical**				
Age (years)	34.3±9.6	35.2 ± 9.1	34.6 ± 9.4	0.481
BM (kg)	78.6±12.8	64.9 ± 12.5	74.5 ± 14.2	0.001
Height (cm)	172.9±6.2	158.5 ± 6.1	168.5 ± 9.1	0.001
BMI (kg/m <sup>2</sup> )	26.3±3.8	25.8 ± 4.7	26.1 ± 4.1	0.341
WC (cm)	89.6±10.9	81.8 ± 11.2	87.2 ± 11.5	0.001
SBP (mmHg)	124.8±14	112.9 ± 12.5	121.2 ± 14.7	0.001
DBP (mmHg)	80.6±10.0	73.8 ± 8.4	78.5 ± 10.1	0.001
MBP (mmHg)	95.3±10.5	86.8 ± 9.0	92.7 ± 10.8	0.001

BM = body mass; BMI = body mass index; WC = waist circumference; SBP = systolic blood pressure; DPB = diastolic blood pressure; MBP = mean blood pressure = [SBP+(2xDBP)]/3.

Comparison between males and females; \*Chi-square test with continuity correction; \*\*independent t test; mean ± standard deviation.

**Table 2.** Age, anthropometric variables and reported pain intensity in workers according to blood pressure condition

Groups/Variables	Hypertensive (8,9%)		Normotensive (91,1%)		F	p
	PFH (n=12)	PLH (n=19)	PFN (n=88)	PLN (n=230)		
Pain groups (%)	3.5	5.4	25.2	65.9	0.035*	0.685
Pain intensity	2.3 ± 0.8		2.1 ± 0.9		1.331	0.264
Age (years)	42.3±6.0a	37.3±9.9a	34.6±8.7	33.9±9.6	4.051	0.008
BM (kg)	85.0±9.7a	86.0±12.6a	72.7±14.0	73.6±13.9	7.974	0.000
Height (cm)	166.5±10.0	172.9±7.8b	167.0±9.5	168.9±8.8	3.579	0.014
BMI (kg/m <sup>2</sup> )	31.0±4.7a	28.7±3.4a	26.0±4.1	25.7±3.9	7.506	0.000
WC (cm)	98.8±11.0a	96.3±9.3a	86.1±11.6	86.2±11.1	7.876	0.000
SBP (mmHg)	144.2±5.5a	150.6±12.2a	118.1±12.9	118.7±12.0	50.130	0.000
DBP (mmHg)	96.0±7.3a	100.9±5.8a	76.4±7.2	76.6±8.1	62.336	0.000
MBP (mmHg)	112.0±6.4a	117.5±5.2a	90.3±8.0	90.6±8.5	72.730	0.000

PFH = painful hypertensive; PLH = painless hypertensive; PFN = painful normotensive; PLN = painless normotensive; BM = body mass; BMI = body mass index; WC = waist circumference; SBP = systolic blood pressure; DBP = diastolic blood pressure; MBP = mean blood pressure = [SBP+(2x DBP)]/3.

\* Chi-square with continuity correction; aHypertensive = Normotensive; bPLH ≠ PFN.

## DISCUSSION

This study has evaluated the association between musculoskeletal pain and HT in workers. The result has not confirmed the hypothesis of the study, which established that hypertensive workers would show less musculoskeletal pain. Pain prevalence was relatively higher among hypertensive workers. From 31 hypertensive, 38.7% had some type of pain, while this value was 27.7% for normotensive individuals (n=318). This denies results of other studies which have shown lower prevalence of pain reports among hypertensive as compared to normotensive individuals<sup>13,14</sup>.

Disagreement with the literature was also observed with regard to reported pain intensity perception. There has been no significant difference in pain intensity between hypertensive and painful normotensive workers. Hypertensive workers have reported mean scores of  $2.3 \pm 0.8$  while normotensive have reported  $2.1 \pm 0.9$ . Planned experiments to induce pain in individuals with different blood pressure values have shown that hypertensive individuals or those predisposed to HT are less sensitive to painful stimulations<sup>5,7,13,14,18-21</sup>. The design of our study has not induced pain, so it does not allow confirming whether hypertensive and normotensive individuals, regardless of pain condition, are under hypoalgesic effect.

Hypertensive workers are statistically older, heavier and have more abdominal fat as compared to normotensive. Age and obesity, especially that deposited in the abdominal region, are risk factors for HT and other metabolic disorders. Both WC and BMI are adopted as indicators of adiposity and indirectly represent abdominal fat deposits and total body fat, respectively<sup>22,23</sup>.

The number of hypertensive in the sample (8.9%) was lower than that reported by population studies<sup>24</sup>. Additionally, there has been a higher proportion of males with HT (7.2%) as compared to females (1.7%), which is in line with the literature<sup>25</sup>.

With regard to musculoskeletal pain, workers in this study (28.7%) have shown lower prevalence as compared to other professional categories, such as bus drivers (61%) and military firemen (48.9%)<sup>26</sup>. With regard to total sample, there has been a higher proportion of males with pain (17.5%) as compared to females (11.2%). Since workers function was not considered to establish a risk profile for pain report, it was not possible to assure that males were in this situation due to their tasks. However, literature shows that endogenous opioids produce higher analgesic effect on females as compared to males<sup>27</sup>. In addition to physiological and biological factors, the higher proportion of pain reports among males may also be influenced by cultural and psychological issues<sup>28</sup>. It is important to stress that risk factors for the development of labor pain and injuries are associated to the type of task, exposure time, age and ergonomic conditions of the workplace<sup>29</sup>.

One has to admit the existence of substantial evidence showing that pain mechanisms are altered in hypertensive and/or

predisposed to HT individuals<sup>30,31</sup>. However, such evidences are from experimental studies (inducing pain) which use samples of people without defined labor activity, as opposed to the workers sample of our study. So, to investigate the association between musculoskeletal pain and HT, it is suggested checking whether labor activity is *per se* a risk for the development of injuries which could confuse results. If the activity increases the risk of painful symptoms, the development of musculoskeletal disorders could occur regardless of pressure levels and predisposition to HT.

Blood pressure and pain results found in our study should be interpreted with caution. Sample as well as pain determination and intensity do not allow denying the hypothesis that pain mechanisms are associated to HT, but pave the road for other questions on this relationship. We may address some limitations which could support this statement. The first is the cross-sectional design, which does not allow causality relations and pain self-report, since this is a procedure sensitive to individual variations. Second, workers were not randomized to participate in the study. Third, sample was specific, that is, a group of workers. Fourth, participants were not submitted to pain tests (pain induction), but rather they were asked about the presence of the phenomenon. Fifth, studies showing higher prevalence of musculoskeletal pain in hypertensive individuals have investigated larger samples<sup>13,14</sup>. Lastly, further studies are needed for hypertension, pain and physical activity relationship, since there are sound evidences that the practice of exercises is associated to decreased sensitivity to pain<sup>32,33</sup>. This way, physical activities could potentiate hypoalgesic effects in hypertensive individuals. Information obtained with workers and the coordinator of the Internal Committee for Accidents Prevention (CIPA) allowed concluding that labor activity performed by participants is basically manual (packaging and transportation), that most people come to work walking or riding bikes and that the company offers locally three weekly sessions of labor gymnastics lasting 15 minutes each<sup>34</sup>. However, since this was not the object of the study, one cannot state that daily physical activity (work and transport) could have affected HT and pain sensitivity relationship.

## CONCLUSION

As opposed to the literature, hypertensive workers of our study have not shown differences in prevalence or sensitivity to musculoskeletal pain, as compared to normotensive workers, denying the hypothesis of the study.

## ACKNOWLEDGMENTS

Authors acknowledge nurse Débora Covre for her professional assistance and members of the Nucleus of Physical Activity, Sports and Health (NAFES/UNESP Rio Claro) for their help during data collection.

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