

Resting Blood Pressure of Workers in High Stress Urban Occupations

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How to cite this paper: Caligiuri, S.P.B., Gilchrist, J.-A., Pierce, T.B., Austria, J.A., Hirst, S.D., Hirst, B.C., Pierce, B.G. and Pierce, G.N. (2025) Resting Blood Pressure of Workers in High Stress Urban Occupations. *Occupational Diseases and Environmental Medicine*, 13, 30-41.
<https://doi.org/10.4236/odem.2025.131003>

Received: November 13, 2024

Accepted: January 4, 2025

Published: January 7, 2025

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Abstract

Background: First responders (firefighters, paramedics, and police) working in an urban setting can be exposed to a high-stress environment caused by strenuous physical exertion, potentially dangerous work conditions, sleep deprivation due to shift work, poor dietary habits, psychological stress and noise levels that are excessive. This may induce chronic increases in blood pressure. The purpose of this study was to determine the presence of hypertension in people working in occupations generally accepted as high stress in comparison to those working in an environment where less of these obvious high stressors were present. **Methods:** Resting blood pressure was measured by TrUBP in 1067 on-duty first responders (fire, paramedic, and police), and in participants generally associated with a lower-stress work environment (transit workers, city and bank employees, factory workers and legislature employees). **Results:** The average age, systolic and diastolic blood pressures were significantly lower in those employees working in a high-stress environment than those in a low-stress job. This difference was observed in both male and female sexes. **Conclusions:** Our data do not support an association of high resting blood pressure values in those employed in activities typically associated with a high-stress urban working environment.

Keywords

Blood Pressure, Hypertension, Stress, Work Environment

1. Introduction

Cardiovascular disease (CVD) is the leading cause of mortality and morbidity worldwide [1]. Hypertension is a significant component of CVD [1]. Recently, we

have identified alarming levels of undiagnosed hypertension in the City of Winnipeg general population when blood pressure (BP) was measured at rest in shopping malls, workplaces, and community centres [2]. It is possible that a stressful work environment may have in part contributed to this serious problem. The relationship between work stress and CVD is strongly suspected but the specific dynamics of this relationship are unclear. The incidence of CVD is at an increased risk in occupations that are characterized by chronic stress factors. Those include sudden physical exertion, sleep deprivation due to shift work, poor dietary habits, psychological stress and noise levels that are excessive [1] [3]-[6]. Firefighters, paramedics, police, transit workers and other occupations in an urban environment can be exposed to many of these stressors. It is difficult to argue that police, firefighters, paramedics and these related emergency personnel are not subjected to higher than normal stress in their occupations. Over 80% of first responders experience traumatic events on the job [7]. Approximately 25% of emergency service employees have high levels of psychological stress [8]. Ultimately, the end result of higher than normal levels of job stress is evident in the appearance of anxiety, depression and posttraumatic stress disorder (PTSD). About 10% - 15% of emergency workers have PTSD symptoms compared to 4% in the general population [7]-[9]. A high-stress environment can induce increases in BP [10]. Therefore, BP can be a silent but significant factor in the evolution of CVD in these stressful workplaces which can carry over to their daily life.

The primary aim of this study was to ascertain whether professions characterized by significant stress levels have an impact on resting health, specifically in terms of elevated BP. The objectives of the investigation were to: 1) analyze and compare resting BP values in high-stress occupations, and, 2) determine if there's a correlation between high-stress occupations and the resting BP values of those working in those fields.

2. Methods

This trial has received regulatory and ethical approval from the Health Canada Natural Products Directorate, the University of Manitoba Research Ethics Board and the St Boniface Hospital Research Review Committee. The ClinicalTrials.gov identifier is NCT01952340. All participants provided informed consent, and all procedures were performed according to institutional guidelines.

BP was measured at rest in 1067 on-duty employees who were considered to be "at risk" for hypertension due to their occupation. Thirty-six percent of the participants were first responder emergency personnel (fire fighters, paramedics and police), 23% percent were employed by the City of Winnipeg, 22% were transit workers and 14% were bankers, factory workers in the aerospace industry and legislature employees.

Briefly, systemic systolic BP (SBP) and diastolic BP (DBP) were measured in the seated position in a quiet room using TruBP automatic instrumentation [2]. In some cases, manual measurement of blood pressure was carried out using

standard auscultatory methods. Participants were allowed to rest quietly for 5 minutes prior to the initiation of the procedure to measure BP. The average of 2 readings was used as the final measurement value. All values were analyzed and presented as a mean \pm standard error of the mean values. Statistical significance was determined with the use of an analysis of variance test followed by a Sidakholm post hoc test. Statistical significance was set at a $P < 0.05$.

3. Results

The average age of the 1067 employees engaged in this study was 44 ± 0.3 but varied amongst the participants from 34 to 53 (**Figure 1**). The resting blood pressures were measured in all participants in this study. The average systolic blood pressure of the 1067 participants was 124 mmHg but varied between extremes of 114 to 136 mmHg (**Figure 1**). The average diastolic blood pressure of the 1067 participants was 79 mmHg but varied between extremes of 72 to 88 mmHg (**Figure 1**). The average blood pressure in males ($n = 711$) was 125/80 mmHg (SBP/DBP) and 122/78 mmHg for females ($n = 356$) (**Figure 1**).

Age and BP in the participants were also analyzed as a function of the stress level of occupation of all participants in this study and subdivided into male and female workers (**Figure 2(A)-(C)**). There was a statistically lower age in the high stress workers in comparison to the low stress occupations (**Figure 2(A)**). This difference was found in both sexes as well. There was a statistically lower SBP in the high stress workers in comparison to the low stress occupations (**Figure 2(B)**). This difference was found in both sexes. There was a statistically lower DBP in the high stress workers in comparison to the low stress occupations (**Figure 2(C)**). This difference was found in both sexes as well.

Age and BP in the participants were also analyzed as a function of the occupation of all participants in this study (**Figure 3**) and subdivided into male (**Figure 4**) and female (**Figure 5**) workers. There were no significant differences in any of the parameters amongst these groups. Overall, the highest BP was reported in male legislature workers with an average of 136/88 mmHg and in industry staff with a mean of 131/84 mmHg.

4. Discussion

Hypertension is often labelled as the “silent killer” due to the innocuous nature of the disease. High BP can present without symptoms to the subject. In a considerable number of individuals, even when blood pressure reaches emergency levels, it often goes unnoticed, consequently leading to untreated hypertension. This may lead to strokes, myocardial infarctions and even death. A recent study of an urban population (1097 people) who were tested in mobile clinics set up in city shopping malls, workplaces, hospitals and community centres found that approximately 50% of the study subjects exhibited untreated hypertension and a further 2% exhibited emergency levels of hypertension [2]. These disturbing levels of undetected and/or untreated hypertension exhibited by members of the general

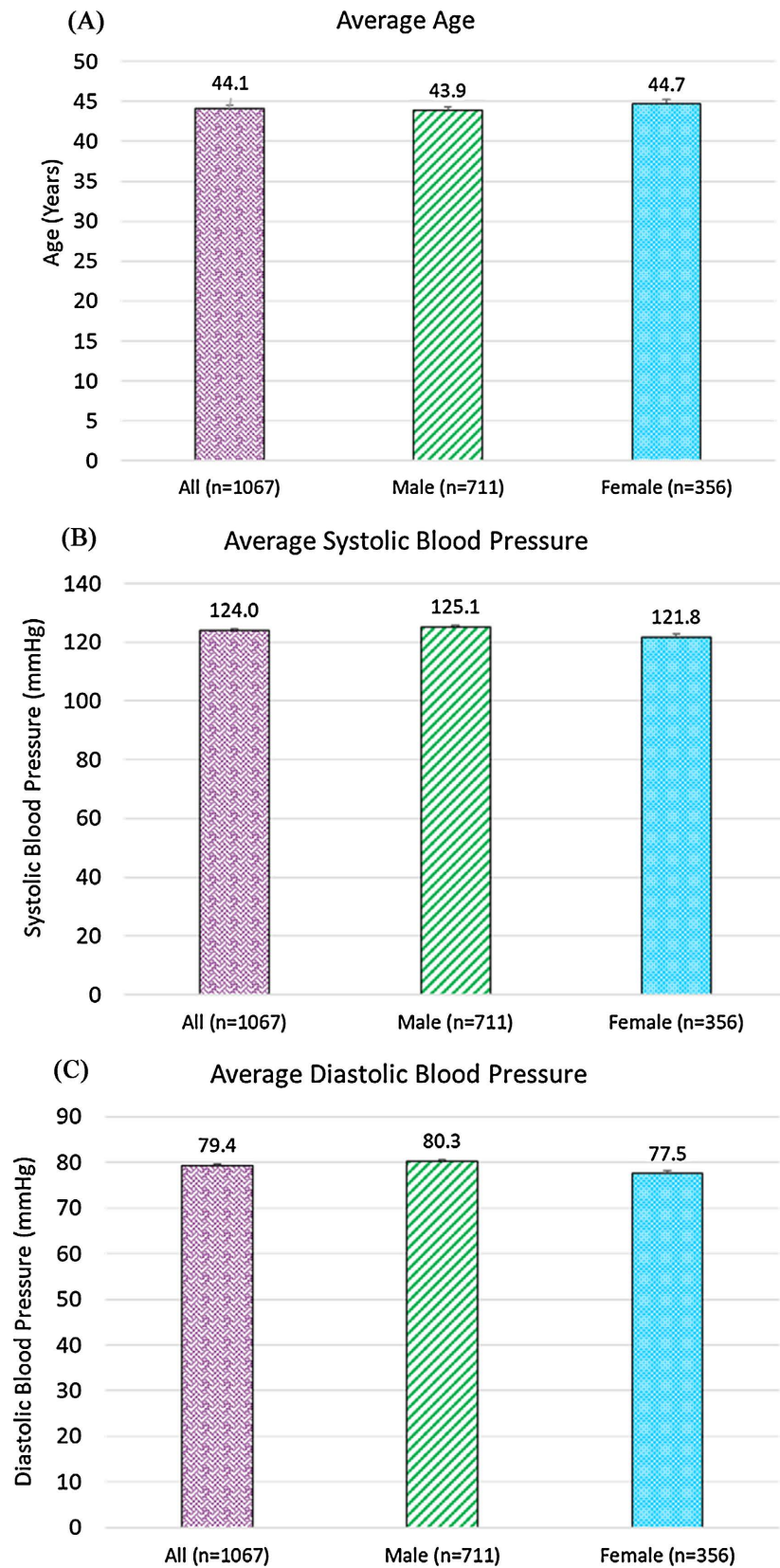


Figure 1. Average age (A), systolic blood pressure (B) and diastolic blood pressure (C) of all participants (n = 1067), male participants (n = 711) and female participants (n = 356).

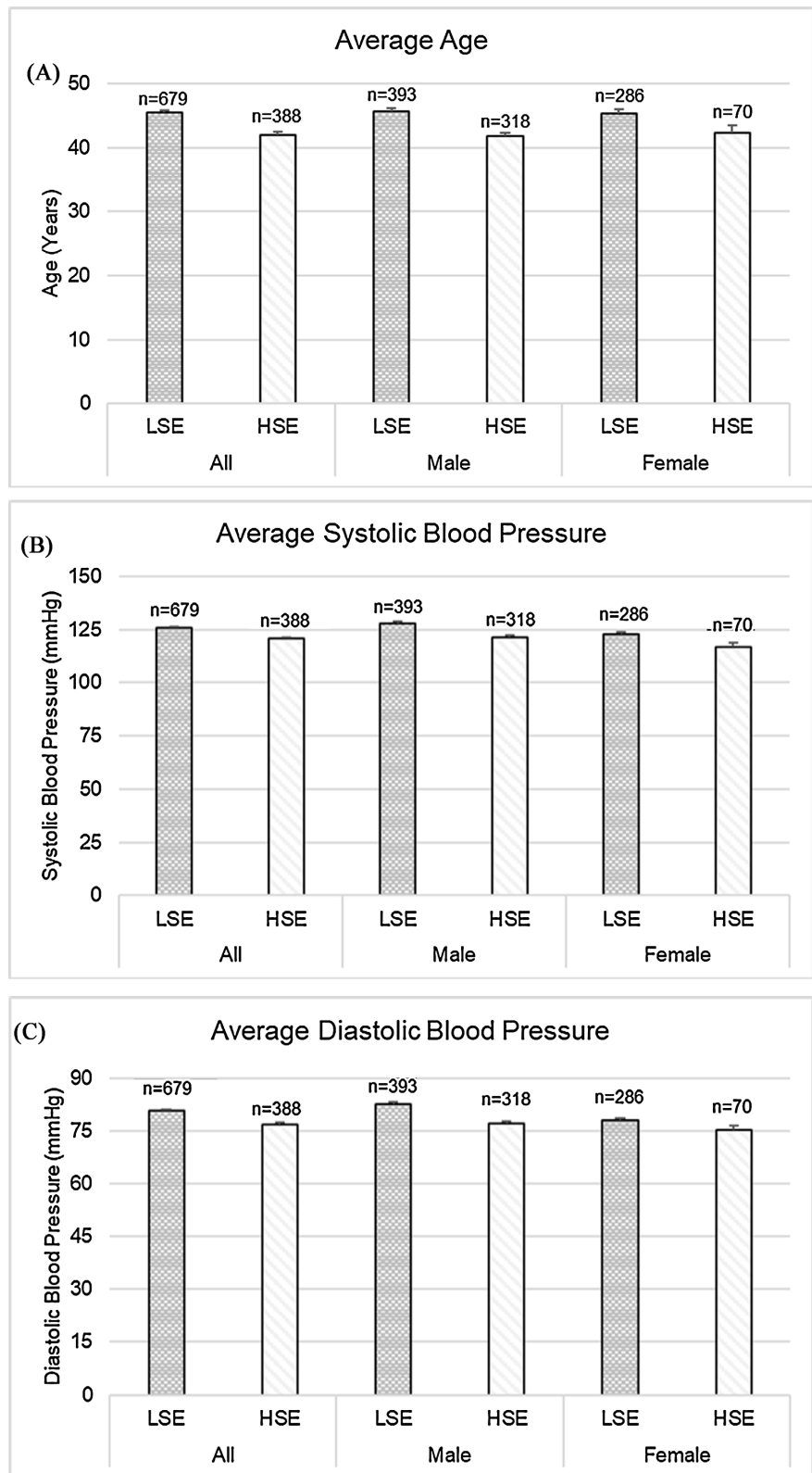


Figure 2. Comparative analysis of the average age (A), systolic blood pressure (B) and diastolic blood pressure (C) of participants employed in a typically high stress (HSE) and low stress (LSE) urban environment. Sample sizes are shown as $n = x$ above each data bar. * $P < 0.05$ vs respective LSE value.

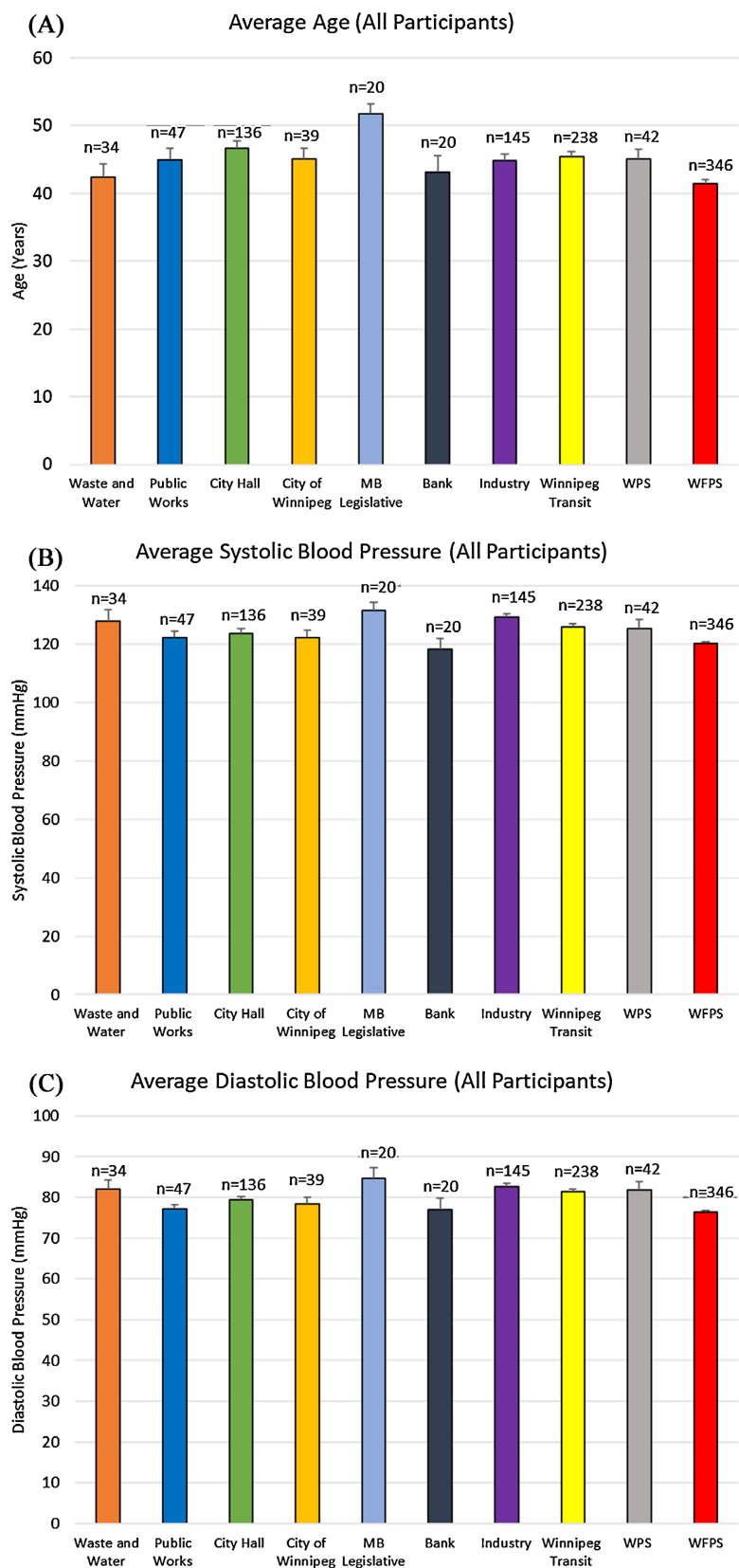


Figure 3. Comparative analysis of the average age (A), systolic blood pressure (B) and diastolic blood pressure (C) of participants (1067) in different urban occupations.

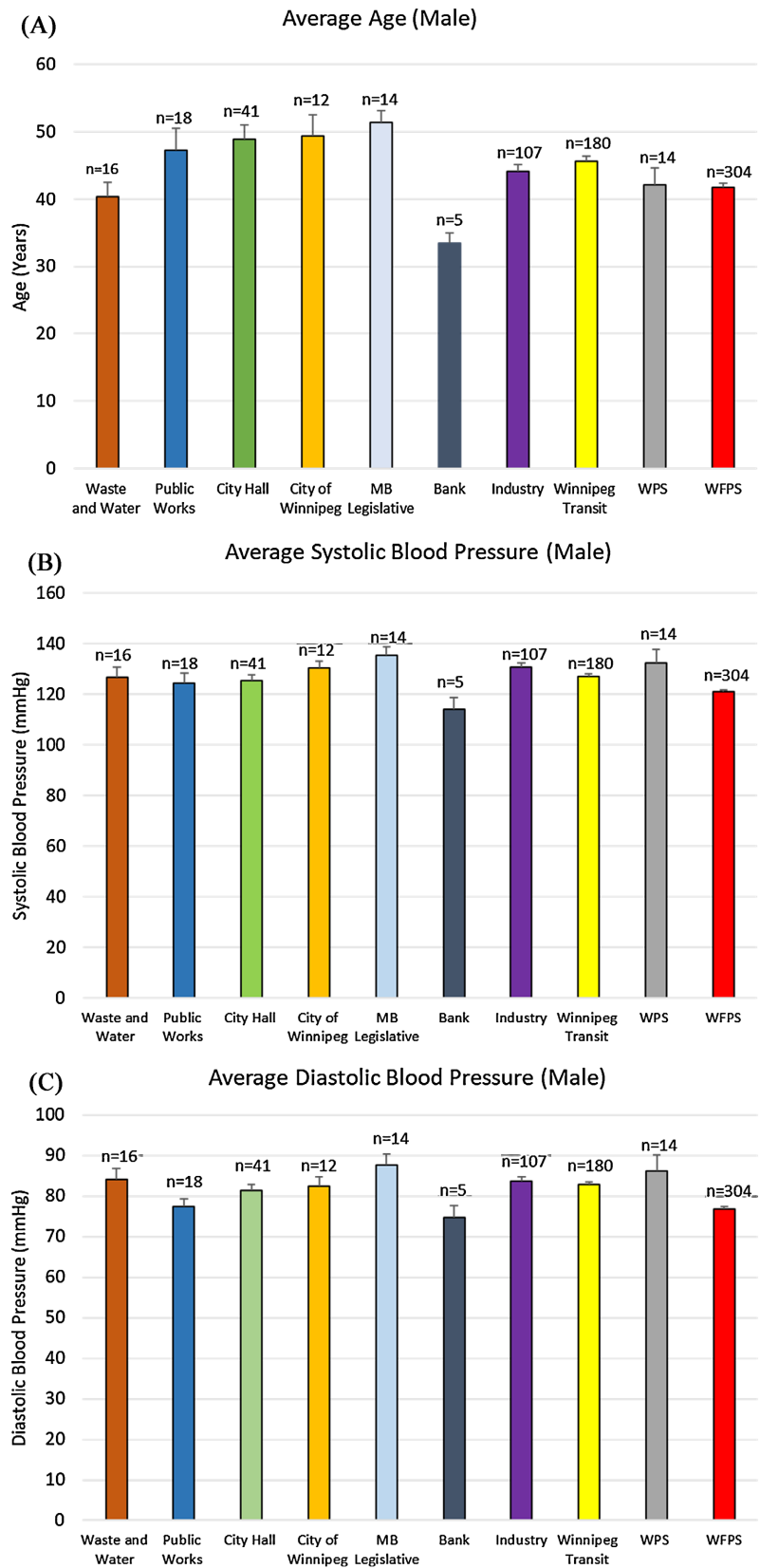


Figure 4. Comparative analysis of the average age (A), systolic blood pressure (B) and diastolic blood pressure (C) of male participants (n = 711) in various urban occupations.

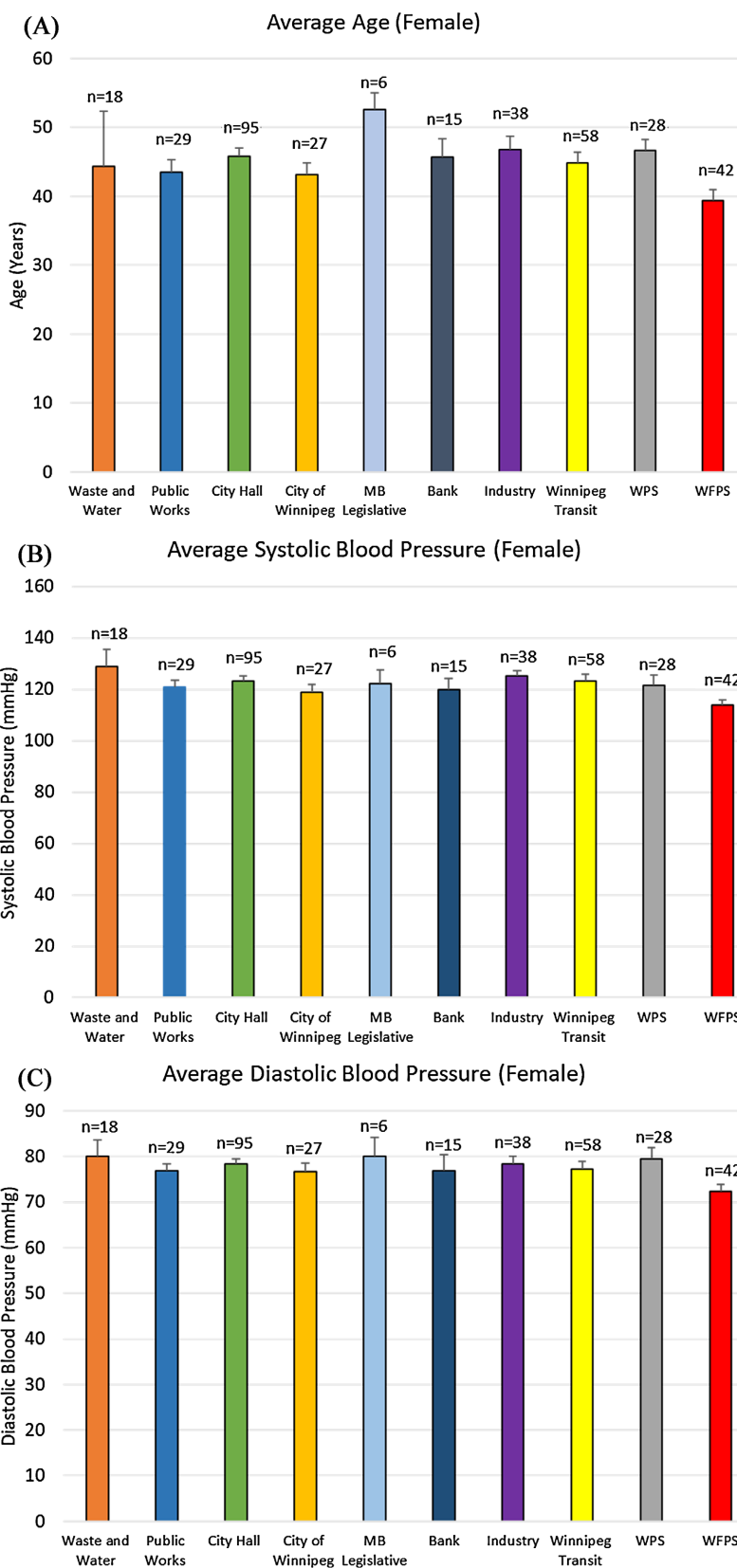


Figure 5. Comparative analysis of the average age (A), systolic blood pressure (B) and diastolic blood pressure (C) of female participants ($n = 356$) in various urban occupations.

public led us to the possibility that such levels of undetected hypertension may be even more prevalent within those working in relatively high stress positions. It is safe to generalize that the work environment for police, paramedics, and firefighters is relatively high risk and these can be considered high stress occupations. BP in other traditional lower stress occupations within the urban environment (city workers, those working in banks, factory workers and those employed at the provincial legislative building) were used for comparative purposes. Because sex differences exist with regards to BP and coronary heart disease [11], we examined BP in both male and female workers. These sex-related differences are not only physical and biological but extend to the responses to psychosocial stress as well [11].

In the present study, the overall average blood pressure in males was 125/80 mmHg (SBP/DBP) and 122/78 mmHg for females. These values at rest are considered normal and not “at risk”. However, if these employees were subdivided into specific job types based upon subjective measures of stress indicated above, a surprising and statistically significant difference in resting SBP and DBP was observed. The workers employed in a traditionally high stress job exhibited lower DBP and SBP values than those in employment positions thought to be lower in stress factors. The lack of an increase in BP in those employed in high risk occupations is a positive result from this study and may have been unexpected due to the elevated psychosocial stress and the physical demands associated with their work environments. The authors recognize that the potential limitation in this study was that “stress” was not measured here. However, it is difficult to ignore the data (discussed in the Introduction of this manuscript) that strongly supports the high levels of stress experienced by front line workers. There is no reason to believe that the stress levels experienced by the first responders tested in the present study are any different than those shown elsewhere and reported previously [7]-[9].

There are several potential explanations for this surprising result. First, the age of the workers in a lower stress position was statistically higher than those we tested in the high stress group. It is well recognized that advancing age will increase BP [12]. However, it is unlikely to have a significant effect on our conclusions. Among Westerners over age 40 years, systolic BP (SBP) increases by ≈ 7 mmHg per decade [13]. Our differences between the relevant groups were much less than that. We conclude that age may have had a minimal effect on our results. Secondly, it is possible that the police, paramedics and firefighters had a higher fitness level than those working in a less physical environment. It is entirely plausible that the better fitness levels typically required and maintained in police, firefighters and paramedics provided them with the protection that they required in their high stress work environments. Proper physical fitness has an important capacity to lower both DBP and SBP [12]. However, there is evidence that wide variations in fitness levels exist in first responders and they are not always as fit as they should be for their job considering its physical challenges [14] [15]. Third, a single resting BP measurement might not accurately reflect the participants’ usual BP or their cardiovascular risk. The possibility of the BP value changing day to day is a clear

possibility. However, measurements were always taken after allowing the subject to wait 5 minutes to obtain a reliable resting BP. In addition, the overall size of the study ($n = 1067$) may diminish the impact of individual day-to-day variability. Finally, other potential confounders, such as lifestyle factors (diet, exercise, smoking), socioeconomic status, access to healthcare, and pre-existing health conditions, were not considered in this study.

These conclusions are also restricted to the specific urban population in study. The data in some of the small specific work data sets are also limited by their relatively small size. The sample sizes in each work group varied from 70 to 679 subjects. However, once again, the lack of a significant change in BP in the overall data set of 1067 workers would argue strongly that a general negative association does exist between job stress and BP values at rest in this population of study. Nevertheless, individual variations remain a source of concern.

5. Conclusion

In conclusion, our data do not support an association of high BP values at rest in those employed in activities typically associated with a high stress working environment. The maintenance of appropriate levels of physical fitness, lifestyle, body weight and other factors associated with BP may have accounted for this healthy protection from a significant cardiovascular disease risk factor but this would require further detailed study to more definitively support this hypothesis.

Acknowledgements

This work was supported by a Foundation grant from the Canadian Institutes for Health Research to GNP.

Author Contributions - Credit Author Statement

Stephanie Caligiuri: Methodology, Investigation, Formal analysis, Data curation, Writing, Final draft. **Jo-Anne Gilchrist:** Methodology, Investigation, Formal analysis. **Teal B. Pierce:** Methodology, Investigation, Formal analysis. **Broderick C. Hirst:** Methodology, Formal analysis; Data curation. **J. Alejandro Austria:** Investigation, Formal analysis, Data curation. **Susan Hirst:** Data curation, Writing, Review and Editing. **B. Gail Pierce:** Methodology, Investigation. **Grant N. Pierce:** Conceptualization, Resources, Methodology, Writing Original draft preparation, Writing Review and Editing, Supervision, Funding acquisition.

Funding

This work was supported by a CIHR Foundation grant and by St. Boniface Hospital Foundation.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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