# Prehypertension in Jamaica: A Review of Data from Recent Studies 

TS Ferguson, MK Tulloch-Reid, NO Younger, SR McFarlane, DK Francis, RJ Wilks


#### Abstract

Prehypertension is defined as a systolic blood pressure of 120-139 mmHg or diastolic blood pressure of $80-89 \mathrm{mmHg}$ in patients not on medication for hypertension. Recent studies have shown that prehypertension has a high prevalence in both western and eastern countries and is associated with cardiovascular disease (CVD) risk factors, incident CVD and CVD mortality. We reviewed data from ongoing epidemiological studies in Jamaica in order to provide an update on the prevalence and predictors of prehypertension in Jamaica. Studies included were the Jamaica Health and Lifestyle Surveys (2000-2001 and 2007-2008), the Jamaica Youth Risk and Resiliency Behaviour Survey 2006, the 1986 Jamaica Birth Cohort Study and the Spanish Town Cohort Study. The prevalence of prehypertension in the most recent national survey was $35 \%$ ( $95 \%$ CI 33, 38\%). Prevalence was higher in men compared to women ( $42 \%$ versus $29 \%$ ). Jamaicans with prehypertension were more likely to have other CVD risk factors and were three times more likely to develop hypertension compared with persons with a normal blood pressure. Prevalence was also high among youth, particularly males. Longitudinal analysis from the 1986 birth cohort suggested that prehypertnsion may be more common in persons with low birthweight or short birth length. Physicians and public health practitioners should recognize the increased CVD risk associated with prehypertension and should begin to institute CVD prevention measures in persons with prehypertension. Sex differences and the early onset of prehypertension in men require further exploration.


Keywords: Blacks, cardiovascular disease, cardiovascular disease risk factors, Caribbean, Jamaica

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#### Abstract

RESUMEN La prehipertensión se define como una tensión arterial sistólica de 120-139 mmHg o tensión arterial diastólica de 80-89 mmHg en pacientes que no se hallan bajo medicación a causa de hipertensión. Estudios recientes han mostrado que la hipertensión tiene una alta prevalencia tanto en los paises occidentales como en los orientales, hallándose asociada con factores de riesgo de la enfermedad cardiovascular (ECV), ECV incidente y la mortalidad por ECV. Se examinan los datos de los estudios epidemiológicos en curso en Jamaica para ofrecer una actualización acerca de la prevalencia y los predictores de la prehipertensión en Jamaica. Los estudios incluidos fueron las encuestas sobre salud y estilo de vida Jamaica Health and Lifestyle Surveys (2000-2001 y 2007-2008), la encuesta Jamaica Youth Risk and Resiliency Behaviour Survey 2006 sobre las conductas de resiliencia y riesgo de los jóvenes, el estudio de cohorte 1986 Jamaica Birth Cohort Study sobre los nacimientos, y finalmente el llamado Spanish Town Cohort Study. La prevalencia de la prehipertensión en la encuesta nacional más reciente fue de $35 \%(95 \%$ CI $33,38 \%)$. La prevalencia fue más alta en los hombres en comparación con las mujeres ( $42 \%$ frente a $29 \%$ ). Los jamaicanos con prehipertensión presentaban una mayor probabilidad de tener otros factores de riesgo de ECV, y tenian una probabilidad tres veces mayor de desarrollar hipertensión en comparación con las personas de presión arterial normal. La prevalencia fue también alta entre los jóvenes, particularmente entre los varones. El análisis longitudinal de la cohorte de nacimientos de 1986 sugirió que la hipertensión puede ser más común en las personas con bajo peso al nacer o corta longitud al nacer. Los médicos y los practicantes de salud


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#### Abstract

pública deben reconocer el aumento de riesgo de ECV asociado con la prehipertensión, y deben empezar a instituir medidas de prevención de ECV en personas con prehipertensión. Las diferencias de sexo y el comienzo temprano de la prehipertensión en los hombres requieren ser explorada ulteriormente.


Palabras claves: Caribeño, enfermedad cardiovascular, factores de riesgo de la enfermedad cardiovascular, negros, el prehipertensión, Jamaica

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## INTRODUCTION

The concept of prehypertension was proposed in 1939 in a paper published by Robinson and Brucer, based on an analysis of blood pressure records for over 11000 persons over a ten-year period (1). They concluded that "A blood pressure history of over 120 systolic and 80 diastolic over a ten year span in a man or woman is pathologic, and is an almost infallible sign of incipient hypertension". Other conclusions drawn from this study included the following:
"The normal range of systolic blood pressure for men and women is from 90 to 120 mm of mercury".
"The normal range of diastolic blood pressure for men and women is from 60 to 80 mm of mercury".
"A normal person attains his mature blood pressure at about adolescence and keeps that range throughout life, except for a slight rise at about the twentieth year".
"Normal blood pressure does not rise with age. Prehypertensive and hypertensive pressures do rise with age".
"Forty per cent of the adult population is prehypertensive or hypertensive".
Despite these findings, prehypertension was not incorporated into standard medical terminology until the publication of the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC7) in 2003 (2). The JNC 7 authors classified normal blood pressure as $<120 / 80 \mathrm{mmHg}$ and introduced the category of prehypertension for persons with systolic blood pressure (SBP) of $120-139 \mathrm{mmHg}$ or diastolic blood pressure (DBP) of $80-89 \mathrm{mmHg}$ in patients who are not on treatment for hypertension. Reasons cited for introduction of this category in the JNC 7 guidelines were to: (a) increase awareness of lifetime risk of hypertension; (b) increase awareness of increased risk of cardiovascular complications; (c) identify individuals in whom early intervention by lifestyle modifications could lower blood pressure, decrease the rate of progression to hypertension or prevent hypertension entirely; (d) enable insurance coverage for treatment of prehypertension (3).

Much of the evidence prompting the introduction of prehypertension in the guidelines came from a large metaanalysis published by Lewington et al in 2002 (4). The group combined data from over 1 million persons in 61 prospective epidemiological studies and found that death from ischaemic heart disease (IHD) and stroke increase progressively from
systolic blood pressure levels as low as 115 mmHg and diastolic blood pressure levels of 75 mmHg , and that for every 20 mmHg increase in systolic blood pressure or 10 mmHg increase in diastolic blood pressure, there is a doubling of mortality from ischaemic heart disease and stroke. Since the publication of JNC 7, a number of studies have published prevalence estimates for prehypertension (5-9). Prevalence estimates range from a low of $31 \%$ in the USA up to $49 \%$ in the Isreali military and was high in both western and eastern populations.

In light of the emerging evidence on the relevance of prehypertension to public health and cardiovascular disease epidemiology, we have conducted a number of analyses on prehypertension in Jamaica using data from existing crosssectional and cohort studies at the Tropical Medicine Research Institute. Studies included were the Jamaica Health and Lifestyle Surveys (2000-2001 and 2007-2008), the Jamaica Youth Risk and Resiliency Behaviour Survey 2006, the 1986 Jamaica Birth Cohort Study and the Spanish Town Cohort Study. We have previously reported findings from the Jamaica Health and Lifestyle Survey 2000-2001 (10) and the Spanish Town Cohort (11).

## FINDINGS

National prevalence estimates - Jamaica Health and
Lifestyle Surveys Lifestyle Surveys
Researchers from the Tropical Medicine Research Institute and the Ministry of Health have conducted two recent national surveys which have provided estimates of the prehypertension prevalence in Jamaica. The first survey was conducted in 2000-2001 and included a nationally representative sample of 2012 participants 15-74 years old (12). The second survey also recruited a nationally representative sample with 2848 participants and was conducted between 2007-2008 (13). In both surveys, blood pressure was measured using a standardized procedure which included three BP measurements using the right arm after the participant had been seated for five minutes. The mean of the second and third measurements were used for analysis $(10,14)$.

The prevalence of prehypertension in Jamaica using data from the Jamaica Health and Lifestyle Survey 20002001 was $30 \%$ overall and was higher in men compared to women, $35 \%$ and $25 \%$ respectively (10). Among men, prevalence was consistently high (between 35-39\%) in all age
groups up to age 64 years while for women, prevalence increased with age up to age 54 years (Fig. 1). When we


Fig. 1: Age and sex specific prevalence of prehypertension in the Jamaica Lifestyle Survey ( $95 \%$ confidence intervals shown as error bars).
examined the prevalence of CVD risk factors by blood pressure category we found that there was a higher prevalence of all the CVD risk factors among persons with prehypertension compared to persons with normal blood pressure, except for smoking among both men and women and low physical activity among women. There was also increased clustering of CVD risk factors among persons with prehypertension. Among prehypertensive persons, $28 \%$ of men and $41 \%$ of women had at least one CVD risk factor and almost $7 \%$ of men and $11 \%$ of women had three or more CVD risk factors.

Data from the Jamaica Health and Lifestyle Survey 2007-2008 (13) showed that the prevalence of prehypertension had increased from $30 \%$ in $2000-2001$ to $35 \%$ in 2007-2008, however, the difference was not statistically significant. Prevalence was again higher in men (43\%) compared to women (29\%).

## Predictors of progression to hypertension - The Spanish Town Cohort

The rate of progression of prehypertension to hypertension was examined in the Spanish Town Cohort Study (11). This study was initiated in 1993 as part of an international study of hypertension, diabetes and chronic disease in people of African ancestry (14-16). Baseline evaluation was conducted between 1993 and 1998 and follow-up between 1997 and 2002. Analysis of data from 708 persons who were nonhypertensive at baseline revealed that after an average four year follow-up, 29\% of prehypertensive participants had developed hypertension compared to $6 \%$ of the normotensive participants. Incidence rate was estimated as 70 per 1000 person years among prehypertensive persons and 15 per 1000 person years among those with normal blood pressure. The unadjusted incidence rate ratio was 4.62. After adjusting for age, sex, body mass index (BMI) and presence of diabetes at
baseline, prehypertension was associated with a greater than threefold increase in the risk of hypertension compared with normal blood pressure. Older persons, those who were overweight or obese and women were at significantly increased risk of incident hypertension.

## Prehypertension in youth - 1986 Jamaica Birth Cohort 18-20 follow-up and Jamaica Youth Risk and Resilency Behaviour Survey

Data on prehypertension in youth are available from two studies. The Jamaica Youth Risk and Resiliency Behaviour Survey evaluated a nationally representative sample of 1318 youth 15-19 years old in Jamaica in the year 2006 (17), while the 1986 Jamaica Birth Cohort Study 18-20 follow-up recruited 902 participants from the Jamaica Perinatal Mortality Study of 1986 in order to evaluate the impact of early life experience on current CVD risk. Details on the methods of the 1986 Jamaica Birth Cohort Study have been previously published (18, 19).

Prevalence of prehypertension was $29 \%$ overall ( $35 \%$ among males and $24 \%$ among females, $p<0.001$ ) in the Jamaica Youth Risk and Resiliency Behaviour Survey, while the prevalence of prehypertension was $20 \%$ overall ( $29 \%$ among males and $13 \%$ among females, $p<0.001$ ) in the 1986 Birth Cohort. Further analysis from the 1986 Birth Cohort showed that prehypertension prevalence was higher among persons with higher BMI, ranging from $15 \%$ among those who were underweight to $33 \%$ among the obese (Fig. 2).


Fig. 2: Prehypertension prevalence in 1986 birth cohort by BMI.

There was also a significantly increasing trend for higher prevalence of prehypertension among those who were more physically active (Fig. 3). In multivariable regression models, being overweight/obese, having elevated low density lipoprotein cholesterol (LDL) and high physical activity levels were associated with increased odds for prehypertension (Table 1).

We also evaluated the possible relationship between early life factors and prehypertension using birthweight and birth length data from the 1986 Birth Cohort. The prevalence of prehypertension was $26 \%$ among those with low birthweight ( $<2500 \mathrm{~g}$ ) compared to $19 \%$ among those with nor-


Fig. 3: Prehypertension prevalence in 1986 birth cohort by physical activity levels.

Table 1: Factors associated with prehypertension in multivariable models from 1986 birth cohort

| Variable* | Odds Ratio | $\boldsymbol{p}$-Value |
| :--- | :---: | :---: |
| Moderately active | 1.43 | 0.870 |
| Highly active | 1.89 | 0.005 |
| High LDL $(>3.4 \mathrm{mmol} / \mathrm{L})$ | 1.86 | 0.004 |
| Overweight $(\mathrm{BMI} \geq 25)$ | 1.93 | 0.001 |

*Adjusted for age, sex and other variables in the table. LDL = low density lipoprotein cholesterol
mal birthweight but the difference was not statistically significant (Fig. 4). For birth length (Fig. 5), prevalence of


## Birthweight

Fig. 4: Prehypertension prevalence by birthweight.
prehypertension was higher in the lowest quartile of birth length $(20 \%)$, compared to the highest quartile ( $17 \%$ ) but the differences were not statistically significant. After adjust-ing for the effects of age, sex and gestational age, low birthweight and short birth length were associated with higher risk of prehypertension but the risk ratios did not achieve statistical significance (Table 2).


Fig. 5: Prehypertension prevalence by birth length.

Table 2: Risk ratios for prehypertension by birth characteristics in the 1986 Jamaica birth cohort

| Variable* | Risk Ratio | $\boldsymbol{p}$-Value |
| :--- | :---: | :---: |
| Compared to normal birthweight |  |  |
| Low birthweight $(<2500 \mathrm{~g})$ | 1.37 | 0.315 |
| Compared to upper quartile |  |  |
| Birth length $-3^{\text {rd }}$ Quartile | 1.44 | 0.290 |
| Birth length $-2^{\text {nd }}$ Quartile | 1.31 | 0.325 |
| Birth length $-1^{\text {st }}$ Quartile | 1.40 | 0.288 |

*Adjusted for age, sex, gestational age, overweight, physical activity level and all variables in the table; $\mathrm{n}=550$

## DISCUSSION

We have shown that prehypertension is common in Jamaica, with prevalence of $35 \%$ in the most recent survey. Prehypertension is strongly associated with other risk factors for CVD and when compared to persons with normal blood pressure, prehypertension is associated with a greater than threefold increase in the risk of hypertension over a four-year period. We have also shown that the prevalence of prehypertension is high among youth, particularly among males and may be more common in persons with low birthweight or short birth length.

The finding of a higher prevalence of prehypertension with physical activity levels among youth was unexpected but has been previously reported (20). Tsioufis et al suggest that this may be related to increased stroke volume and reduced arterial compliance associated with intensive exercise (20). However the association is incompletely understood and warrants further study.

What then are the public health implications of these findings? Using the $35 \%$ prevalence from Lifestyle Survey 2007-2008, approximately 700000 persons between the ages of 15 and 74 years in Jamaica have prehypertension. If we apply the incidence rate from the Spanish Town Cohort approximately 49000 of these will develop hypertension each year. This will clearly place a high burden on the healthcare systems in Jamaica in light of the high cost of pharmacotherapy and the cost of treating complications of
hypertension such as coronary heart disease, heart failure, stroke and chronic kidney disease.

What is the required response? Based on JNC 7 guidelines, all of these persons will require lifestyle interventions to reduce CVD risk and most authorities would also suggest treatment of comorbidities such as dyslipidaemia and obesity. We will also need to identify and treat those persons who go on to develop hypertension. The challenge, however, is how will such programmes be funded? Should additional funds be pumped into preventing hypertension and CVD? How would this impact other areas such as maternal and child health, immunization programmes, HIV/AIDS etc? In addition, such programmes will need to be evaluated to ensure that they are achieving the desired effect of reducing incident hypertension and the associated complications. This will require focussed research on culturally relevant and cost effective interventions. Possible approaches include reductions in salt intake at the population level and renewed efforts at increasing physical activity and improving diet.

## CONCLUSION

The data we have presented indicate that prehypertension is an important public health issue and requires appropriate attention. Failure to act is likely to have significantly negative implications for the control of CVD in Jamaica.

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