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Health Status and Predictors of Hypertension, Blood Pressure, and Pulse Rate of Jamaicans During the Covid-19 Pandemic

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ABSTRACT

The objectives of the current research are to examine Jamaicans' health status, pulse rate, body mass index (BMI), hypertension, and factors influencing 1) hypertension, 2) blood pressure, and 3) pulse rate, during COVID-19. A cross-sectional survey using associational research design by way of convenience sampling was used to conduct this research. This study examined correlation of age, gender, BMI, hypertension, and blood pressure among Jamaicans age ranging from 15 to 85 and above. Cross–sectional study and associational research design were used to collect data for the period of June to August 2020. The study demonstrated that hypertension is significantly predicted by gender, age, and pulse rate one─Omnibus tests of model ($\chi 2(4)$ =138.947, $P < 0.0001$, -2Ll=2098.67) and Wald statistic being 90.161, $P < 0.0001$, and the variance in model 10.8% (Nagelkerke R2). Furthermore, ordinary least square (OLS) regression can be used to model pulse rate (bpm) for Jamaicans (F [4, 1676] =17.236, $P < 0.0001$), with the model explaining 4.0% of the variance in pulse rate of Jamaicans. Gender, BMI and Hypertensive emerged as the factors that determine the pulse rate of Jamaicans. Diastolic & systolic blood pressure were determined by age, weight, and pulse rate, with age being the most significant predictor. The risk of hypertension was higher among population groups who were overweight and obese. Gender was found to correlate with blood pressure and hypertension; female participants were more likely to be hypertensive than the male participants. BMI measurement should be recommended as a simple and effective predictor of hypertension in public health strategies. There is empirical evidence that can be used to establish that Jamaicans health status has worsen since March 10, 2020, and that Covid-19 has brought with it unhealthy lifestyle practices, which are pending public health challenges come 2021 and beyond.

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Introduction

Globally, hypertension is a major public health problem due to its high prevalence and the resulting cardiovascular and chronic kidney diseases that it manifests as comorbidity issues in many patients suffering from the blood pressure ailment [1-4]. A study done by Singh et al. [5] indicated that around 7.5 million deaths or 12.8 of the totals of all annual deaths worldwide occur due to high blood pressure. In developing countries, high blood pressure is one of the risk factors for cardiovascular diseases, and the estimated 7.1 million deaths especially among middle, and old-age adults is due to high blood pressure (HBP) as reported in World Health Organization [6]. Moreover, during this period of COVID-19, the single highest risk factor of infection was hypertension as reported in a study conducted on Clinical characteristics of coronavirus disease done by Guan et al where 15% out of 1099 patients confirmed COVID 19, were hypertensive [7]. This is predicted to be increased to 1.56 billion adults with hypertension in 2025 as reported in a study "Prevalence and associated factors of prehypertension and hypertension in Iranian population: the lifestyle promotion project" [8].

A study done on County Report: Jamaica as reported by Pan American Health Organization in 2017 indicated that in 2010, 22.9% of people over 18 had hypertension (25.4% of men, 20.5% of women), and 27% were obese (36% of women, 18% of men) [9]. The same report, in a 2012 survey of the population over 60, found that 76.4% had at least one chronic disease and 46.9% had more than one, and of the targeted group 61.4% suffered from hypertension. The world is currently suffering from the outbreak of a pandemic caused by the severe acute respiratory syndrome coronavirus SARS-CoV-2 that causes the disease called COVID-19, first reported in Wuhan, Hubei Province, China on 31 December 2019 [10, 11].

Hypertension has been found to be one of the most comorbidities and occurs frequency in patients with COVID-19. Reports from COVID -19 hot spots, including Wuhan, Lombardy, and New York City identified higher rates of hypertension among severely ill, hospitalized COVID-19 patients. More specifically, a large US study of 5,700 hospitalized patients revealed an overall hypertension rate of 56 % [12-14]. These results were similar to hypertension rates reported from China and Italy communicated at 50% and 49%, respectively [15, 16]. Despite these observations, the link between hypertension and COVID-19 is unclear. It does not necessarily imply a causal relationship between hypertension and COVID-19 or its severity.

Studies have also shown that age is positively associated with hypertension [17, 18]. Hypertension is exceedingly and frequently noticeable in the elderly, and older people appear to be at particular risk of being infected with SARS-Co V-2 virus and experiencing severe forms associated with the complications of COVID-19. Severity of COVID-19 illness is skewed towards the elderly populations who have a higher prevalence of hypertension [19, 20]. Studies have also shown that being hypertensive and being a male increases the chances of getting the disease [21]. A study done on Gender differences in hypertension and hypertension awareness among young adults showed that, gender disparities in hypertension status were already evident among men and women in their twenties: women were far less likely to be hypertensive compared to men [22]. The same findings were observed by Van in his study on Gender differences in prevalence and socioeconomic determinant of hypertension. In his study, the association between hypertension and socioeconomic status was complex and differed between men and women [18]. Men were hypertensive more often than women and age was positively associated. Despite the fact that gender differences have been found in several studies, there are studies that did not show any gender differences in hypertension as reported by Doumas [23].

Based on the reviewed literature, there is a close association between obesity and hypertension. The association is found in adults, adolescents and children. Hypertension is the more frequent cardiovascular risk factor in obesity. Moreover, obese subjects are more likely to develop hypertension than normal weight subjects [24]. Obesity has been found to be determined by BMI, yet it is the principal factor of hypertension and the prevalence of hypertension which increases with rising BMI [25]. However, several organizations have already stressed the fact that blood pressure control remains an important consideration in order to reduce the disease burden, even if it has no effect on susceptibility to the SARS-CoV-2 viral infection [19].

Studies have also correlated obesity with high blood pressure; according to Verdecchia el at. [26] obese subjects are more likely to develop high blood levels in subsequently years. Since obesity and hypertension are contributed by lifestyle, efforts should be made to promote healthful diets and increased exercise to young adults [21] in order to prevent complications of hypertension and other related diseases as they advance with age. Yet no empirical studies emerged on Jamaicans' health status with an emphasis on BMI, pulse rate, diastolic and systolic blood pressure during the Covid-19 pandemic. This gap in the literature is addressed by the current study on Jamaicans' health status, pulse rate, BMI, hypertension, and factors influencing 1) hypertension, 2) blood pressure, and 3) pulse rate.

Theoretical Framework

A theoretical framework is critical to the research process [27]. This guides the research materials, used, the methodologies, the methods of data collection, the analysis of data, along with the research objectives and the survey questions. As such, a theoretical framework plays a fundamental role in the research process and Waller [28] succinctly summarized it this way:

[It] is a self-conscious set of (a) fundamental principles or axioms (ethical, political, philosophical) and (b) a set of rules for combing and applying them (e.g. induction, deduction, contradictions, and extrapolation). ... and so determines the kinds of knowledge about the objects that can be produced legitimately within the framework [28]

Waller's perspective, therefore, sets a platform for the adopted health econometric model that was developed by Grossman [29] and later modified by Smith and Kington [30] Grossman forwarded that current health status is influenced by stock of health, and selected sociodemographic characteristics:

$$Ht = f\,(H_{t-1}, G_o, B_t, MC_t, ED) \ldots\ldots\ldots\ldots\ldots\ldots\ldots [1]$$

Where H_t – current health in time period t, stock of health (H_{t-1}) in previous period, B_t – smoking and excessive drinking, and good personal health behaviours (including exercise – G_o), MC_t,- use of medical care, education of each family member (ED), and all sources of household income (including current income) Grossman [29]. Smith and Kington [30] later developed Grossman's model and this is expressed in equation 2.

$$Ht = H^*\,(H_{t-1}, P_{mc}, P_o, ED, E_t, R_t, A_t, G_o) \ldots\ldots\ldots\ldots\ldots [2]$$

where equation [2] presents current health status H_t as a function of stock of health (H_{t-1}), price of medical care P_{mc}, the price of other inputs P_o, education of each family member (ED), all sources of household income (E_t), family background or genetic endowments (G_o), retirement related income (R_t), asset income (A_t). Using the health econometric model modified by Smith and Kington (29, 30), Hambleton, Clarke, Broome, Fraser, Brathwaite, Hennis (31] were able to expand on the work of Smith and Kington

$$Ht = f\,(S_t, C_t, L_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots [3]$$

H_t is current health status which is measured by disease indicator; S_t denotes historical socioeconomic indicators, C_t symbolizes current socioeconomic indicators, and L_t represents current lifestyle risk indicators.

Table 1: Potential determinants of self-reported health status, study of historical and current predictors of self-reported health status in elderly person, Barbados, 1999-2000

Predictor group	Individual predictors in each predictor group
Historical socioeconomic indicator	Education, occupation, childhood economic situation, childhood nutrition, childhood health, number of childhood diseases
Current socioeconomic indicators	Income, financial means, household crowding, living alone, currently married, number of people in the household, number of children living outside household, number of siblings living outside household, number of other family and friends living outside household
Current lifestyle risk factors	Body mass index, waist circumstances, categories of disease risk, nutrition, smoking, exercise
Disease indicator	Number of illnesses1, number of symptoms2, geriatric depression scale score, number of nights in hospital in 4-month period, number of medical contacts in 4-month period

[1]Illness included hypertension, diabetes, cancer, chronic lung disease, coronary heart disease, cerebrovascular accident, and arthritis

[2]Symptoms included chest pain, shortness of breath, back pain, severe fatigue of tiredness, joint problems, persistent swelling in the feet of ankles, persistent dizziness, persistent headaches, persistent wheezing, cough of phlegm, persistent nausea or

vomiting, and persistent thirst or excessive sweating
Source: Hambleton, Clarke, Broome, Fraser, Brathwaite, Hennis [31]

This study's empirical model is expressed in conceptual model, below:

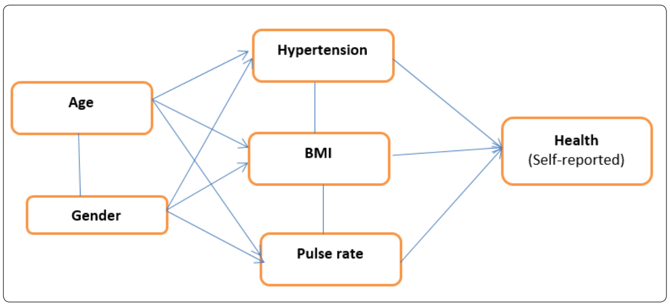

Figure 1: Conceptual Framework
Source: Current authors

Methods and Materials

This is a cross-sectional survey using an associational research design by way of convenience sampling [32-37]. Using a population of 2,728,339 [32], a 95% confidence interval, and a 2.3 % margin, the actual sample size should be 1,815. The number of people in each parish was determined by the proportion of people in 2017 population (Table 2). A detailed description of the sample is presented in Table 2, and the people were conveniently selected to participate in this study based on the sample size presented in the Table 2. The response rate was 92.6% (n=1,681). Door to door survey was carried out to collect data. Both the purpose of the study and techniques to be used were explained to each subject. Only those who volunteered and gave written consent were studied. All procedures were performed in accordance with relevant guidelines and regulations.

Table 2: Population of Jamaica for 2017 and calculated sample for current study

Parish	2017			
	Population1	Pop (in %)	Sample2	Sample (in%)
Kingston & St Andrew	670,183	24.6	446	24.6
St Thomas	94,997	3.5	64	3.5
Portland	82,694	3	54	3
St Mary	114,937	4.2	76	4.2
St Ann	174,309	6.4	116	6.4
Trelawny	76,028	2.8	51	2.8
St James	185,810	6.8	123	6.8
Hanover	70,309	2.6	47	26
Westmoreland	145,718	5.3	96	5.3
St Elizabeth	151,932	5.6	102	5.6
Manchester	191,999	7	127	7
Clarendon	247,854	9.1	165	9.1
St Catherine	521,569	19.1	347	19.1
Total	2,728,339	100	1,815	100

[1]**Source:** Statistical Institute of Jamaica [32]
[2]computed by Paul Andrew Bourne

Data Gathering

Well trained nursing students gathered data in various parishes where they lived during the period of June to August, 2020. A standardized instrument was designed with selected demographic items, BMI, and pulse rate as well as data for diastolic and systolic blood pressure. For the assessment of BMI, height, diastolic and systolic blood pressure, and weight measurements were taken using standard protocols measured through an analogue medical scale. Body height was measured using standard stadiometer. Body weight and height were measured to the nearest 0.1 kg and 0.1 cm, respectively.

BMI was defined as weight (kilograms) divided by the square of height (meters). The BMI cutoffs recommended by the WHO were used with 18.5–24.9 kg/m2 for normal, 25.0–29.9 kg/m2 for overweight, and > 30 kg/m2, for obesity [38, 39].

Hypertension was defined as mean systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and/or anti-hypertensive drug use [38, 39].

Statistical Analysis

Descriptive statistics were used to define demographic and key clinical characteristics of the study population according to the presence of hypertension [33-37]. Cross tabulations were used to examine selected issues as well as Independent sample t-test. Logistic and ordinary least square regressions were used to determine factors influencing different levels of BMI (normal weight, overweight, and obesity), blood pressure, pulse rate, and hypertension [33-37]. Finally, analysis of covariance (ANCOVA)—adjusted for age—was used to examine the effect of BMI levels on systolic and diastolic blood pressure. Statistical analysis was performed using SPSS software version 25.0 for Windows. Prior to using ordinary least square (OLS) regression, all the assumptions were tested and accepted before analysis was done. An alpha of 5% was used to determine the level of significance for this study.

Findings

Table 3 presents the socio-demographic characteristics of the sampled respondents (n=1,681). Of the sampled respondents (n=1,681), the majority were females (60.4%, n=1,016), of the working aged population (91.0%, n=1,529) and only 1.8% (n=30) were in the Oldest-Old age cohort.

Table 3: Socio-demographic characteristics of sampled respondents, n=1,681

Details	N (%)
Gender	
Male	665 (39.6)
Female	1016 (60.4)
Age cohort	
Working age population (15 – 64 years old)	1529 (91.0)
Young-Old (65 – 74 years old)	69 (4.1)
Old-Old (75 – 84 years old)	53 (3.2)
Oldest-Old (85+ years old)	30 (1.8)
Average Age	38.21 years old±17.72 years old, 95%CI: 37.36-39.05 years old

The medical profile of the sampled respondents (n=1,681) was presented in Table 4. Only 28.5% of the sampled respondents were in the normal weight categorization, 38.3% were hypertensive, and the average pulse rate was 80.4 bpm ±12.1 bmp, 95%CI: 79.9 – 81.4. It can be deduced from the 80.4 bpm that the sampled respondents were experiencing normal heart beats.

Table 4: Medical Profile of sampled respondents, n=1,681

Details	N (%)
Self-reported Hypertension	
No	1037 (61.7)
Yes	644 (38.3)
Body Mass Index (BMI)	
Underweight	459 (27.4)
Normal weight	478 (28.5)
Overweight	353 (21.0)
Obese	388 (23.1)
Pulse rate categorization (bpm)	
Normal (less than 100 bpm)	1,627 (96.8)
Otherwise (101+ bpm)	54 (3.2)
Pulse rate (BPM)[1]	80.4±12.1, 95%CI: 79.9 – 81.4
Systolic	77.4051±11.3, 95%CI: 76.8635–77.9468
Diastolic	125.18±17.9, 95%CI: 124.32 – 126.03

[1]BPM denotes beats per minute

Of the sampled respondents (n=1,681), 644 (38.3%) had hypertension. Of those who had hypertension (n=644), 22.3% were elderly (ages 65+ years) and of the elderly 1.9% were 85+ years old ($\chi2(3)=15.469$, $P < 0.001$; Table 5).

Table 5: A cross tabulation of Age Cohort and Hypertensive categorization

Details	Hypertension		Total
	No	Yes	
	N (%)	N (%)	N (%)
Age cohort			
Working aged population (18-64 years)	964 (93.0)	565 (87.7)	1529 (91.0)
Young-Old (65 – 74 years)	31 (3.0)	38 (5.9)	69 (4.1)
Old-Old (75 – 84 years)	24 (2.3)	29 (4.5)	53 (3.2)
Oldest-Old (85+ years)	18 (1.7)	12 (1.9)	30 (1.8)
Total	**1037**	**644**	**1681**

The findings revealed that 37.0% of those in the working aged population were hypertensive compared to 55.1% of the young-old, 54.7% of the Old-Old, and 40.0% of the Oldest-Old ($\chi2(3) =15.469$, $P < 0.0001$; Table 6). A

Table 6: A cross tabulation of Hypertensive categorization and Age Cohort

Details	Age cohort				Total N (%)
	Working age	Young-Old	Old-Old	Oldest-Old	
	N (%)	N (%)	N (%)	N (%)	
Hypertension					
No	964 (63.0)	31 (44.9)	24 (45.3)	18 (60.0)	1037 (61.7)
Yes	565 (37.0)	38 (55.1)	29 (54.7)	12 (40.0)	644 (38.3)
Total	**1529**	**69**	**53**	**30**	**1681**

The cross tabulation of BMI categorization and age cohort revealed a significant statistical relationship between the two variables ($\chi2(9)=20.892$, $P = 0.013$; Table 7). The findings showed that 23.1% of the sampled respondents were obese compared to 21.0% being overweight, and 27.4% being underweight. Older respondents were more likely to be obese compared to those in the working aged cohort (15 – 64 years old) and this similar for those overweight. On the other hand, the Old-Old (75-84 years old) were least likely to be underweight and the oldest-old were most likely to be underweight. Furthermore, 44% of the sampled respondents were at least overweight compared to 29% having a normal weight and 27.4% being underweight (Table 7).

Table 7: A cross tabulation of BMI categorization and Age Cohort

Details	Age cohort				Total N (%)
	Working age	Young-Old	Old-Old	Oldest-Old	
	N (%)	N (%)	N (%)	N (%)	
BMI category					
Underweight	431 (28.2)	14 (20.3)	5 (9.4)	9 (30.0)	459 (27.4)
Normal	433 (28.4)	14 (20.3)	22 (41.5)	9 (30.0)	478 (28.5)
Overweight	315 (20.6)	21 (30.4)	9 (17.0)	8 (26.7)	353 (21.0)
Obese	347 (22.7)	20 (29.0)	17 (32.1)	4 (26.7)	388 (23.1)
Total	**1529**	**69**	**53**	**30**	**1681**

Table 8 presents a cross tabulation between hypertension and BMI categorization with there being a statistical association ($\chi2(3)=33.632$, $P < 0.0001$). Obese-respondents were more likely to be hypertensive (49.0%) than those who were underweight (38.1%), normal weight (38.5%), and overweight (38.5%).

Table 8: A cross tabulation of Hypertensive and BMI categorization

Details	BMI categorization				Total N (%)
	Underweight	Normal	Overweight	Obese	
	N (%)	N (%)	N (%)	N (%)	
Hypertension					
No	284 (61.9)	336 (70.3)	217 (61.5)	198 (51.0)	1035 (61.7)
Yes	175 (38.1)	142 (29.7)	136 (38.5)	190 (49.0)	643 (38.3)
Total	**459**	**478**	**353**	**388**	**1678**

A cross tabulation to examine the association between hypertensive categorization and elderly-respondents, the findings revealed a significant statistical relationship ($\chi 2(1)$ =31.628, P = 0.017; Table 9). Fifty-five per cent of the elderly-respondents (ages 60+ years) were hypertensive compared to non-elderly respondents (35.7%).

Table 9: A cross tabulation of Hypertensive and Elderly-respondents, n=1681

	Elderly (60+ years old)		**Total N (%)**
	No	**Yes**	
	N (%)	**N (%)**	
Hypertension			
No	938 (64.3)	99 (44.6)	1037 (61.7)
Yes	521 (35.7)	123 (55.4)	644 (38.3)
Total	**1459**	**222**	**1678**

Table 10 presents an Independent sample t-test of those with or without hypertension and their BMI, with the P value indicating a statistical difference (t=-2.551, P = 0.011). On average, hypertensive respondents had a greater BMI (26.6±17.08, 95%CI: 25.3 – 27.9) than the non-hypertensive respondents (24.5±14.28, 95%CI:23.6 – 25.4). Nevertheless, the average values for BMI indicate that general the respondents were overweight.

Table 10: Descriptive statistics of hypertensive categorization by BMI (kg/m^2)

	Hypertensive	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
BMI	No	1037	24.5	14.28	0.44
	Yes	644	26.6	17.08	0.67

Table 11 presents an Analysis of Variance (ANOVA) of pulse rate (BPM) and age cohort of respondents, with no statistical difference emerging among the various age cohorts (F [3, 1677] =1.705, P = 0.164).

Table 11: Descriptive statistics of Pulse rate (BPM) by age cohort

Details	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**95% CI**
					Lower - Upper
Working aged population	1529	80.35	11.90	0.30	79.75 - 80.942
Young old	69	81.36	13.50	1.63	78.12 - 84.60
Old-Old	53	83.42	14.94	2.05	79.30 - 87.53
Oldest-Old	30	77.83	11.72	2.14	73.46 - 82.21
Total	**1681**	**80.44**	**12.08**	**0.29**	**79.86 - 81.02**

Table 12 presents a Pearson's Product Moment Correlations Matrix on selected medical variables and age. The findings revealed weak statistical correlation between 1) weight and age (rxy=0.076, P = 0.002), 2) weight and pulse rate (rxy=0.106, P < 0.0001), 3) weight and pulse, 4) weight and diastolic (rxy=0.174, P < 0.0001), and 5) weight and systolic (rxy=0.180, P < 0.0001). Furthermore, age was found to be directly correlated with 1) diastolic measure (rxy=0.427, P < 0.0001), and 2) systolic measure (rxy=0.213, P < 0.0001). In addition to the aforementioned findings, a moderate statistical correlated emerged between diastolic and systolic measure (rxy=0.560, P < 0.0001).

Table 12: Pearson's Product Moment Correlations Matrix on selected Medical variables and Age

		Weight (in Kg)	Age	Pulse_(bmp)	Diastolic	Systolic
Weight (in kg)	Pearson Correlation	1	0.076**	0.106**	0.174**	0.180**
	Sig. (2-tailed)		0.002	< 0.0001	< 0.0001	< 0.0001
	N	1681	1681	1681	1681	1681
Age	Pearson Correlation	0.076**	1	0.013	0.427**	0.213**
	Sig. (2-tailed)	0.002		0.590	< 0.0001	< 0.0001
	N	1681	1681	1681	1681	1681
Pulse (bpm)	Pearson Correlation	0.106**	0.013	1	0.094**	0.155**
	Sig. (2-tailed)	< 0.0001	0.590		< 0.0001	< 0.0001
	N	1681	1681	1681	1681	1681
Diastolic	Pearson Correlation	0.174**	0.427**	0.094**	1	0.569**
	Sig. (2-tailed)	< 0.0001	< 0.0001	< 0.0001		< 0.0001
	N	1681	1681	1681	1681	1681
Systolic	Pearson Correlation	0.180**	0.213**	0.155**	0.569**	1
	Sig. (2-tailed)	< 0.0001	< 0.0001	< 0.0001	< 0.0001	
	N	1681	1681	1681	1681	1681

**. Correlation is significant at the 0.01 level (2-tailed).

There were more obese females (25.8%) than males (19.0%) unlike those with normal weight. There are more males recording normal weight (32.7%) than females (25.7%; $\chi2(3)=15.222$, $P = 0.002$). From the findings there are 2 obese-females for every single obese-male (Table 13).

Table 13: Cross tabulation of BMI and Gender, n=1,678

Details	**Gender**		**Total**
	Female	**Male**	
	N (%)	**N (%)**	**N (%)**
BMI			
Underweight	274 (27.0)	185 (27.9)	459 (27.4)
Normal weight	261 (25.7)	217 (32.7)	478 (28.5)
Overweight	217 (21.4)	136 (20.5)	353 (21.0)
Obese	262 (25.8)	126 (19.0)	388 (23.1)
Total	**1014**	**664**	**1678**

Of the sampled respondents (n=1,681), 38.3% of them had hypertension (n=644) and the majority of the hypertensive people were females (n=366, 56.8%) compared to males (n=278, 43.2%; Table 14-$\chi2(1) = 5.683$, $P = 0.017$). Furthermore, 36.0% of males had hypertension compared to 41.8% of female. This means that there were 13 hypertensive females for every 10 hypertensive males.

Table 14: Cross tabulation of BMI and Gender, n=1,681

Details	**Hypertensive**		**Total**
	No	**Yes**	
	N (%)	**N (%)**	**N (%)**
Gender			
Male	387 (37.3)	278 (43.2)	
Female	650 (62.7)	366 (56.8)	
Total	**1037**	**644**	**1681**

Factors Influencing Being Hypertensive

H_1: Hypertension (0=No, 1=Yes) = *f*(Age, Gender (1=male), pulse rate (bpm), BMI)

A hypertension model was established with 1,680 respondents, with the model being a significantly predictive one— Omnibus tests of model ($\chi 2(4)=138.947$, $P < 0.0001$, -2Ll=2098.67) and Wald statistic being 90.161, $P < 0.0001$. The variables in hypertension account for 10.% of the variance in model (Nagelkerke R2 = 0.108). Overall, 65.4% of the observations in the model were correctly classified. Of this, 86.45% were correctly classified for those without hypertension and 31.7% of those with hypertension.

Of the four variables entered to the equation, only one (BMI) did not emerge as a predictive factor of hypertension. Therefore, gender, age, and pulse rate are predictive factors of hypertension. In fact, age and pulse rate positively influence hypertension (Exp(B) > 1.0; Table 15).

Table 15: Binary Logistic Regression of Selected Variables in the Equation

	B	S.E.	Wald	P value	Exp(B)	95% CI
Age	0.030	0.003	97.343	<0.0001	1.030	Lower - Upper
Gender (1=male)	-0.262	0.108	5.882	0.015	0.770	1.024 - 1.036
Pulse (bpm)	0.021	0.004	21.194	<0.0001	1.021	0.623 - 0.951
BMI	0.006	0.003	2.975	0.085	1.006	1.012 - 1.030
Constant	-3.285	0.388	71.741	<0.0001	0.037	0.999 - 1.012

B indicates the parameter estimates
Wald represents Test statistics
S.E represents standard error
Exp(B) denotes odds ratio

Table 16 presents variables on how they influence either diastolic or systolic pressure. Using Multi Analysis of Variance to examine factors that influence either diastolic or systolic pressure, the findings revealed that some of variables are factors of either diastolic or systolic pressure. Of the five variables used in the analysis, three (age, weight, and pulse rate) emerged as factors for both diastolic and systolic pressure. The three variables (age, weight, and pulse rate) account for 21.) of the variance in diastolic pressure and 9.2% of systolic pressure, with age being the significant predictor of diastolic (17.6%) and systolic (4.1%) pressures of Jamaicans (Table 14). Furthermore, weight contributes more to diastolic and systolic blood pressure than the pulse rate of the individual.

Table 16: Multiple analysis of variance of Selected Variables on the Equations (Diastolic & Systolic measures)

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	P value	Partial Eta Squared
Corrected Model	Diastolic	113305.886a	5	22661.177	89.053	<0.0001	0.210
	Systolic	19858.466b	5	3971.693	34.028	<0.0001	0.092
Intercept	Diastolic	189873.051	1	189873.051	746.158	<0.0001	0.308
	Systolic	71014.657	1	71014.657	608.423	<0.0001	0.266
Age	Diastolic	91090.979	1	91090.979	357.967	<0.0001	0.176
	Systolic	8428.278	1	8428.278	72.210	<0.0001	0.041
Height	Diastolic	241.061	1	241.061	0.947	0.331	0.001
	Systolic	227.505	1	227.505	1.949	0.163	0.001
Weight	Diastolic	9408.552	1	9408.552	36.973	<0.0001	0.022
	Systolic	4802.796	1	4802.796	41.148	<0.0001	0.024
Pulse	Diastolic	3450.564	1	3450.564	13.560	<0.0001	0.008
	Systolic	4179.610	1	4179.610	35.809	<0.0001	0.021
Male	Diastolic	914.714	1	914.714	3.595	0.058	0.002
	Systolic	110.180	1	110.180	0.944	0.331	0.001
Error	Diastolic	426233.344	1675	254.468			
	Systolic	195504.650	1675	116.719			
Total	Diastolic	26878966.000	1681				
	Systolic	10287162.000	1681				
Corrected Total	Diastolic	539539.230	1680				
	Systolic	215363.116	1680				

a. R Squared = 0.210 (Adjusted R Squared = 0.208)
b. R Squared = 0.092 (Adjusted R Squared =0 .089)
H_2: Diastolic and Systolic Blood pressure = *f*(Age, Gender (1=male), pulse rate (bpm), height, weight)

Based on the findings in Table 17, two equations were developed to explain factors that influence diastolic and systolic blood pressure of Jamaicans:

Diastolic Blood pressure = 95.88 + 0.418(Age) + 0.082(Weight) + 0.121(Pulse rate) ……………………………[1]

Systolic Blood pressure = 55.59 + 0.127(Age) + 0.058(Weight) + 0.133(Pulse rate) ……………………………[2]

Table 17: Parameter Estimates from Multiple analysis of variance of Selected Variables on the Equations

Dependent Variable	Parameter	B	Std. Error	t	P value	95% Confidence Interval		Partial Eta Squared
Diastolic	Intercept	90.878	3.327	27.316	<0.0001	84.352	97.403	0.308
	Age	0.418	0.022	18.920	<0.0001	0.375	0.461	0.176
	Height	0.696	0.715	0.973	0.331	-0.706	2.098	0.001
	Weight	0.082	0.013	6.081	<0.0001	0.055	0.108	0.022
	Pulse	0.121	0.033	3.682	<0.0001	0.056	0.185	0.008
	Gender (1-Male)	1.538	0.811	1.896	0.058	-0.053	3.129	0.002
Systolic	Intercept	55.578	2.253	24.666	<0.0001	51.158	59.997	0.266
	Age	0.127	0.015	8.498	<0.0001	0.098	0.156	0.041
	Height	0.676	0.484	1.396	0.163	-0.274	1.626	0.001
	Weight	0.058	0.009	6.415	<0.0001	0.040	0.076	0.024
	Pulse	0.133	0.022	5.984	<0.0001	0.089	0.176	0.021
	Gender (1-Male)	0.534	0.549	0.972	0.331	-0.544	1.611	0.001

H_s: Pulse rate (bpm) = *f*(Age, Gender (1=male), BMI, Hypertensive)

Prior to using a linear model, all the assumptions were tested, and they were upheld. Ordinary least square (OLS) regression can be used to model pulse rate (bpm) for Jamaicans ($F[4, 1676]=17.236$, $P < 0.0001$). A linear model was used to explain the factors that influence pulse rate (bpm), with the model explaining 4.0% of the variance in pulse rate of Jamaicans. Gender, BMI and Hypertensive emerged as the factors that determine the pulse rate of Jamaicans (Table 18). Furthermore, gender contributes the most to pulse rate followed by being hypertensive and males had lower pulse rates than males.

Table 18: Ordinary Least Square (OLS) regression of selected variable on Pulse rate (bpm) of Jamaicans

Details			**Beta**	**t**	**Sig.**	**95.0% Confidence Interval**		
	B	**Std. Error**						
Constant	78.912	0.846		93.325	<0.0001	77.253	80.570	
Age	-0.009	0.017	-0.014	-0.558	0.577	-0.043	0.024	0.013
Gender (1=Male)	-3.035	0.595	-0.123	-5.106	<0.0001	-4.201	-1.869	-0.124
BMI	0.079	0.019	0.100	4.173	<0.0001	0.042	0.116	0.115
Hypertensive	2.872	0.616	0.116	4.660	<0.0001	1.663	4.081	0.111

H_4: Pulse rate (bpm) = *f*(Age, Gender (1=male), height, weight, diastolic blood pressure, systolic blood pressure)

A linear model was established using selected variable (height, weight, diastolic and systolic blood pressure, age and gender) and whether they determine pulse rate (bpm) of Jamaicans ($F[6, 1680]=15.022$, $P < 0.0001$). Of the aforementioned variables, only age and diastolic blood pressure were not factoring in pulse rate determination. The other variables accounted for 5.1% of the variance in pulse rate (Table 19). The researchers tested the assumptions of linear regression, and these were upheld before the model was built.

Table 19: Ordinary Least Square (OLS) regression of selected variable on Pulse rate (bpm) of Jamaicans

Details	Unstandardized Coefficients		Beta	t	P value	95.0%
	B	Std. Error				Lower - Up
Constant	68.916	2.535		27.181	<0.0001	63.943 - 73.889
Height (in metres)	-1.216	0.528	-0.056	-2.304	0.021	-2.251 - -0.181
Weight (in kilograms)	0.033	0.010	0.080	3.268	0.001	0.013 - 0.052
Diastolic	0.014	0.021	0.020	0.639	0.523	-0.028 - 0.055
Systolic	0.147	0.031	0.138	4.740	<0.0001	0.086 - 0.208
Age	-0.017	0.018	-0.025	-0.933	0.351	-0.052 - 0.018
Male	-3.068	0.595	-0.124	-5.156	<0.0001	-4.236 - -1.901

Indicator	B	Std. Error	Beta	t	P value	95.0% CI	Correlations		
						Lower - Upper	Zero-order	Partial	Part
Constant	24.089	0.926		26.022	<0.0001	22.3 - 25.91			
Age	0055	0.021	0.063	2.585	0.010	0.013 - 0.10	0.058	0.063	0.063

Factors Influencing BMI

H_1: BMI = *f*(Age, Gender (1=male))

Age and gender can be used as linear predictors of body mass index (F[2, 1678] = 7.016, P = 0.001), Table 20. In fact, both predictors (age and gender) only account for less than 1% of the variance in body mass index (R2).

Table 20: Ordinary Least Square (OLS) regression estimates of Age and Gender on BMI

Male	-2.216	0.769	-0.070	-2.882	0.004	-3.73 - -0.71	-0.066	-0.070	-0.070

Table 21 presents a Pearson's Product Moment correlation matrix of selected sociodemographic characteristics (age, gender), BMI, pulse rate and being hypertensive (1=yes, 0=no). Gender is statistically correlated with i) pulse rate, ii) being hypertensive and iii) BMI (P < 0.05); while age is associated with iv) being hypertensive, and v) BMI (P < 0.05). In addition, males have a lower BMI, pulse rate and being hypertensive compared to females (rxy < 0, P < 0.05). Furthermore, gender and age are also statistically related (P = 0.005).

Table 21: Pearson's Product Moment Correlations Matrix

		Male	Age	BMI	Pulse_(bpm)	Hypertensive
Gender (1=male)	Pearson Correlation	1	.068**	-.066**	-.124**	-0.058*
	Sig. (2-tailed)		0.005	0.007	<0.0001	0.017
	N	1681	1681	1681	1681	1681
Age	Pearson Correlation		1	0.058*	0.013	0.255**
	Sig. (2-tailed)			0.017	0.590	<0.0001
	N		1681	1681	1681	1681
BMI	Pearson Correlation			1	0.115**	0.065**
	Sig. (2-tailed)				<0.0001	0.008
	N			1681	1681	1681
Pulse (bpm)	Pearson Correlation				1	0.111**
	Sig. (2-tailed)					<0.0001
	N				1681	1681
Hypertensive (1=Yes,0=no)	Pearson Correlation					1
	Sig. (2-tailed)					
	N					1681

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

Limitation

A limitation of this study is that there is non-homegeneity among the groups used to determine 1) pulse rate, 2) hypertension rate, and 3) BMI.

Discussion and Conclusion

Demographic correlates (age, gender), body mass index (BMI), and pulse rate emerged as factors of hypertension, and blood pressure (BP) of Jamaicans, which somewhat concurs with the literature [38-42]. The current research concurs with that of Mungreiphy, Kapoor and Sinha's study that found a positive correlation between 1) BMI and blood pressure, 2) BMI and systolic and diastolic BP, 3) age and BP, and 4) BMI and age [40]. This study brought into the discourse pulse rate, which expands the literature on factors of systolic and diastolic BP, BMI, and pulse rate as well as the general decline in the health status of Jamaicans.

Health conditions or illnesses have been widely used as a proxy for the health status of humans, which is the rationale for the scientific inquiry into these conditions. In 2007, a probability cross-sectional study was conducted by Wilks, Younger, Tulloch-Reid, McFarlane, & Francis [43] who found that 25.2% of Jamaicans ages 15-75 years were diagnosed with hypertension (females, 29.0%; males, 11%), 7.6% were diagnosed with diabetes mellitus and that 5.6% were obese/overweight. In 2016-2017, the same researchers conducted a third part health status study and found that the rate of hypertension among the same aged cohort rose to 31.5% (females, 35.8%; males, 31.7%) [44]. The current study has found that 38.3%; of Jamaicans 18+ years old recorded being hypertensive in Covid-19 (males, 36.0%; females, 41.8%), and that 44.1% of Jamaicans were at least overweight.

Hypertensive participants had a greater BMI (26.6±17.08, 95%CI: 25.3 – 27.9) than the non-hypertensive participants (24.5±14.28, 95%CI:23.6 – 25.4). These results are supported by a study done by Mugreiphy et al. [40], where multinomial logistic regression analysis identified overweight and obesity as significant determinants of hypertension among the subjects of the study. There was weak statistical correlation between weight and age, weight and pulse rate, weight and pulse, weight and diastolic, weight and systolic, which expanded this single discourse.

There were more obese females (25.8%) than males (19.0%). More males (32.7%) than females (25.7%; $\chi 2(3)$ =15.222, $P = 0.002$) had normal weight. More female (56.8%) than males (43.2%) were hypertensive. Apart from BMI, all other factors: gender, age, and pulse rate were found to be predictors of hypertension. Likewise, age, weight, and pulse emerged to be predictors of both diastolic and systolic pressure. Age was found to be the potent predictor of either diastolic (17.6%) and systolic (4.1%) pressures of Jamaicans.

Gender, BMI and hypertensive emerged as factors that determine the pulse rate of Jamaicans. Height, weight, diastolic and systolic blood pressure, age and gender were all found to be determinants of pulse rate and only age and diastolic blood pressure were not determinant. Both age and gender account as predictors of body mass index b index ($F [2, 1678] = 7.016$, $P = 0.001$), by only 1%. Gender was found to statistical correlate with pulse rate, being hypotensive and BMI, while age was associated with being hypertensive and BMI. Male had lower BMI, pulse rate and being hypertensive compared with females ($rxy < 0$, $P < 0.05$). The current study is opposed by the previous studies done by Mitchell [21], Choi, Chang and Choi [45], Everett and Zajacova [46], and van Bemmel, Woittiez, Blauw, et al [18], which showed that hypertension was more prevalence among male than female respondents. However, the current study had a higher number of female (1016) than male (665) participants.

The study demonstrated that age is closely associated with hypertension. Age category of 65-74 were more hypertensive than the younger category. Age was also found to be directly correlated with blood pressure. Blood pressure increased with age. There was statistical association of hypertension and BMI, Obese participants were more likely to be hypertensive than those with less BMI. The risk of hypertension was higher among population groups who were overweight and obese. Gender was found to correlate with blood pressure and hypertensive; female participants were more hypertensive than male participants. With these results, it can be concluded that, age, BMI, gender, are determinant factors for both hypertension and blood pressure.

In concluding, there is empirical evidence that can be used to establish that Jamaicans health status has worsen since March 10, 2020, and that Covid-19 has brought with it unhealthy lifestyle practices, which are pending public health challenges come 2021 and beyond. In addition, during Covid-19, BMI is determined by age and gender, pulse rate is influenced by gender and BMI, and hypertensive rate is impacted by age, gender, and pulse rate), and that weight is influencing both pulse and hypertensive rate and not height.

Recommendations

On the basis of our results, it is recommended that as people advanced with age, they need to be more careful with the health principles. Also, BMI measurement should be recommended as a simple and effective predictor of hypertension in public health strategies. Furthermore, many of the strategies that produce successful weight loss and maintenance will help prevent obesity. For example, improving eating habits and increasing physical activity play a vital role in controlling BMI, and as a consequence, in reducing the risk of adverse health outcomes. The elevated rate of hypertension that emerged in this study is a cause for concern and must be examined from a longitudal perspective. As such, further study could be conducted using random sampling procedure that is a true representative of the population.

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