ORIGINAL ARTICLE

Parish Prevalence Estimates of Obesity, Diabetes and Hypertension in Jamaica: Is It Now Time for More Targeted Public Health Interventions?

C Cunningham-Myrie[1], N Younger-Coleman[2], KP Theall[3], L Greene[4], P Lyew-Ayee[4], R Wilks[2]

ABSTRACT

Objective: *Geographic variation in obesity, Diabetes mellitus (DM) and hypertension (HTN) prevalence at the parish level was examined using the Jamaica Health and Lifestyle Survey 2008 (JHLS II).*

Methods: *Total and sex-specific parish age-adjusted prevalence estimates of obesity, DM and HTN were obtained and ranked. Binary logistic regression models were adjusted for age, urbanicity, educational level, physical activity and diet.*

Results: *Parish prevalence ranges were obesity 19.5–37.8% (1.7–31.0% in men* versus *27.39–48.30% in women); DM 5.08–37.82% (0–26.45% in men* versus *7.11–14.17% in women) and HTN 19.50–36.02% (10.94–48.39% in men* versus *18.85–36.61% in women). The highest parish prevalences were St Elizabeth for obesity, Portland for DM and St Mary for HTN. Men residing in St Elizabeth were 16 times more obese compared to those in Portland [(Odds Ratio) OR = 15.84; 95% CI = 2.00, 125.51,* $p < 0.01$*], while women in St Elizabeth had twice the odds of being obese compared to those in St Ann [OR = 2.3; 95% CI, 1.007, 5.3). Men in Portland were eight times more likely to have HTN compared to those residing in St Ann (OR = 7.70; 95% CI = 2.34, 25.40,* $p = 0.001$*) whilst women in St Mary were three times more likely to be hypertensive compared to those living in St Thomas (OR = 3.05; 95% CI = 1.63, 5.72,* $p = 0.001$*). No significant associations were seen with DM.*

Conclusion: *Significant heterogeneity exists at the parish level in obesity, DM and HTN, with important sex differences. Further analyses are needed to understand the determinants and work toward context-specific prevention and intervention programming.*

Keywords: Chronic non-communicable disease, diabetes, hypertension, Jamaica, obesity

Estimados de la Prevalencia de la Obesidad, la Diabetes y la Hipertensión por Parroquia en Jamaica: ¿Es ya Tiempo de Realizar Intervenciones de Salud Pública Más Específicas?

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RESUMEN

Objetivo: *La variación geográfica de la prevalencia de la obesidad, la diabetes mellitus (DM) y la hipertensión (HT) a nivel parroquia, se examinó usando la Encuesta 2008 sobre Salud y Estilo de Vida de Jamaica (JHLS-2).*

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Métodos: *Los estimados totales y específicos por género, ajustados por edad y a nivel de parroquia, de la prevalencia de la obesidad, DM y HT, fueron obtenidos y clasificados. Los modelos de regresión logística binaria fueron ajustados por edad, urbanidad, nivel educacional, actividad física, y dieta.*

Resultados: *Los rangos de prevalencia por parroquia fueron como sigue: obesidad 19.5–37.8% (1.7–31.0% en hombres versus 27.39-48.30% en mujeres); DM 5.08–37.82% (0–26.45% en hombres versus 7.11–14.17% en mujeres); y HT 19.50–36.02% (10.94–48.39% en hombres versus 18.85–36.61% en mujeres). Las prevalencias más altas por parroquia fueron: Saint Elizabeth en obesidad, Portland en DM, y Saint Mary en HT. Los hombres de Saint Elizabeth eran 16 veces más obesos en comparación con los de Portland [(Odds Ratio) OR = 15.84; 95% IC = 2.00, 125.51, p < 0.01], mientras que las mujeres de Saint Elizabeth tenían el doble de probabilidades de ser obesas en comparación con las de Saint Ann (OR = 2.3; 95% IC, 1.007, 5.3). Los hombres de Portland eran ocho veces más propensos a padecer de HT en comparación con los residentes en Saint Ann (OR = 7.70; 95% IC = 2.34, 25.40, p = 0.001) en tanto que las mujeres de Saint Mary tenían tres veces más probabilidades de ser hipertensas comparadas con las que viven en Saint Thomas (OR = 3.05; 95% IC = 1.63, 5.72, p = 0.001). No se observaron asociaciones significativas con DM.*

Conclusión: *Existe una heterogeneidad significativa a nivel de parroquias en cuanto a obesidad, DM, y HT, con importantes diferencias de género. Se necesitan más análisis para entender las determinantes y trabajar hacia la programación de intervenciones y prevenciones específicas del contexto.*

Palabras clave: Enfermedad crónica no transmisible, diabetes, hipertensión, Jamaica, obesidad

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INTRODUCTION

The Chronic Non-communicable Diseases (CNCDs) are the leading causes of death in Jamaica, and among the top five causes are Diabetes mellitus (DM) and Hypertensive Diseases (1) which also pose an economic burden (2). Obesity is one of the main aetiological factors of these CNCDs. In the 1960s Ashcroft *et al* (3) reported a 25% prevalence of obesity in Jamaican females compared to 2% in males based on studies in Lawrence Tavern, St Andrew and Greenwich Town, Kingston. During the 1990s, research conducted in Spanish Town, Jamaica, revealed sexual dimorphism in the prevalence of obesity [women = 34%, men = 9%] (4), DM [women = 15.7%, men = 9.8%] (5), and hypertension (HTN) [women = 29.2%, men = 19.0%] at the 140/90 mmHg threshold (6).

Subsequently, two major island-wide nationally representative surveys, dubbed the Jamaica Health and Lifestyle Surveys (JHLSs), have been undertaken among 15–74-year-old persons. The first, (JHLS I) was completed in 2001 (7) and the second JHLS II (8) in 2008. Jamaica Health and Lifestyle Survey II documented increased prevalence over the JHLS I for obesity (25.3%; 95% CI = 22.8, 27.4 *vs* 19.7%; 95% CI = 17.4, 22.0) and DM (7.9 %; 95% CI = 6.7, 9.0 *vs* 7.2%; 95% CI = 6.0, 8.3). The prevalence of HTN recorded a statistically significant increase (25.2%; 95% CI = 23.3, 27.2 *vs* 20.9%; 95% CI = 18.4, 23.2). In males, combined overweight/obesity significantly doubled the odds of DM and HTN and for females, the odds of HTN was tripled (8).

Geographic variability in obesity and DM has been documented internationally and for Jamaica at the small geopolitical unit level of Enumeration Districts [EDs] (9). This information has allowed insights into contextual and compositional influences on health outcomes which are useful for informing prevention and control efforts. The aforementioned studies have reported on the prevalence of CNCDs in Jamaica but none have evaluated differences across parishes, which represent the lowest tier of health administration.

We hypothesize there is significant variability and heterogeneity across parishes in Jamaica. The purpose of this analysis is to present total and sex-specific parish estimates of obesity, DM and HTN for Jamaica for 2007/8.

SUBJECTS AND METHODS

Study design and sampling

The JHLS II was a cross-sectional, stratified, random, two-stage cluster survey interviewer administered island-wide to obtain a nationally representative sample survey on diseases and lifestyle behaviours. Additional details are contained in the full technical report (8).

Briefly, data collection was done between November 2007 and February 2008, and 2848 individuals, aged 15–74 years old, recruited in their homes across Jamaica (Fig. 1). Additional data included biomedical data from anthropometric measurements and blood samples obtained by finger-prick sampling for fasting blood glucose, fasting cholesterol and HbA_1C. The secondary analysis received ethical approval from The University of the West Indies, Faculty of Medical Sciences, West Indies, Ethics Committee, Mona, Jamaica.

MEASURES

Obesity was defined as a body mass index (BMI) ≥ 30 kg/m^2 (10). Some 4.6% (117) of participants were 15 to 17-years-old; however, the adult classification for obesity was applied for the whole sample (10). Diabetes mellitus was defined as ≥ 7.0 mmol/L for participants not on treatment (11) or if a participant reported being on medication for DM. Hypertension was defined as SBP ≥ 140 mmHg or DBP ≥ 90 mmHg based on the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High Blood Pressure (JNC 7) or on medication (12).

Physical activity level (PAL) was examined as the frequency and types of physical activity based on questions on work and leisure-time PAL from a locally developed questionnaire. Physical inactivity was defined as persons engaged in PALs that increased breathing and heart rate, lasted at least 20 minutes but done less than once per week.

Diet was examined as frequency of fruit and vegetable consumption, where an unhealthy diet (low fruit and vegetable intake) was defined as consumption of < 2 servings of fruit per day or < 3 servings of vegetables per day.

Statistical analysis

Data were analysed using STATA, version 12 [StataCorp LP, College Station, Texas] (13). The analysis included descriptive statistics using proportions and 95% confidence intervals (CIs) for the outcome variables and covariates. Age-adjusted estimates for the prevalence of the measures of obesity, DM and HTN (specific to sex and parish) were calculated. For the age-adjusted estimates the proportions of persons with the given outcomes were estimated with adjustment by direct standardization across the strata identified as 10-year age bands. Further details on the weighting process are provided in the JHLS II technical report (8).

Parish prevalence estimates were ranked and illustrated using digitally created maps to demonstrate the spatial distribution across parishes. Sex categories were compared with respect to obesity, DM and HTN, the risk factors of physical inactivity and low fruit and vegetable intake, as well as the sociodemographic variables. A Chi-squared test corrected for survey design and estimates were compared using the adjusted Wald test (13). Binary logistic regression models, (adjusted for age, urbanicity, income, physical activity and diet) examined the association between obesity, DM and

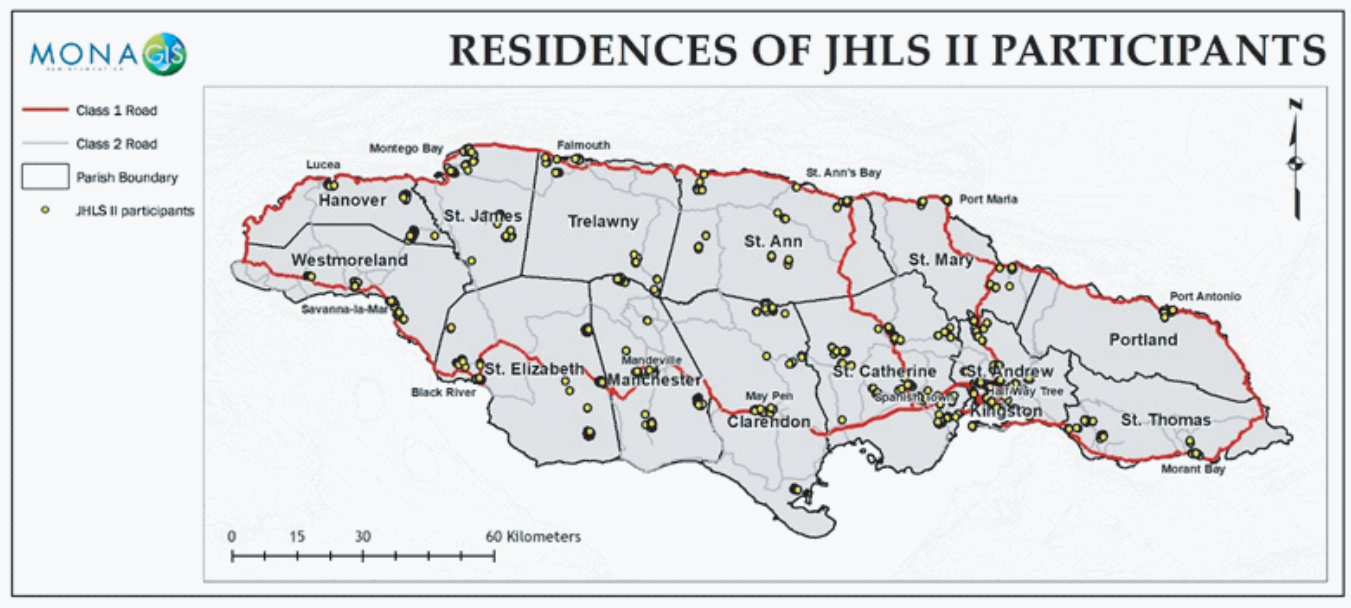

Figure. 1: Map of residence of JHLS II participants across Jamaica.

HTN prevalence and parish. Sex-specific odds ratios for obesity, DM and HTN by parish were determined using the parish with the lowest prevalence as the referent.

RESULTS

Sample characteristics

Table 1 provides the weighted total and sex-specific summary statistics for the JHLS II participants. The study recruited 2848 participants and 68.9% were women. Women had statistically significantly higher levels of physical inactivity ($p < 0.001$) and significantly more men had not attained a high school education ($p < 0.05$). The overall prevalence of the outcomes was obesity 25.30 (95% CI = 22.96, 27.80), DM 7.86% (95% CI = 6.76, 9.12), with significant sex differences [obesity ($p < 0.001$) and DM ($p < 0.05$)]. Overall HTN prevalence was 25.24% (95% CI = 23.31, 27.27).

Obesity, diabetes and hypertension prevalence by risk factors

Table 2 illustrates that the prevalence of all three outcomes showed statistically significant increases with advancing age ($p < 0.001$) except for a decrease in prevalence of obesity in the 55-year-old and over categories. Among physically inactive persons 31.69% (95% CI = 28.35, 35.23; $p < 0.001$) were obese. Diabetes mellitus was present in 14.34% (95% CI = 12.17, 16.81; $p < 0.001$) of individuals who had not attained high school education and in 10.78% (95% CI = 8.85, 13.08; $p < 0.01$) of physically inactive persons. Hypertension prevalence

Table 1: Total and sex-specific weighted sample characteristics (95% CI) for Jamaicans (JHLS II, 2008)

Variable	Men (n = 887)	Women (n = 1961)	Total (n = 2848)
Age category (%)[§]			
15–34 years	48.9	49.5	49.2
35–44 years	22.0	22.7	22.4
45–54 years	13.8	12.9	13.3
55–64 years	8.7	8.1	8.4
65–74 years	6.6	6.9	6.7
Urban residence (%)	64.74 (53.70, 74.40)	64.18 (53.29, 73.77)	64.45 (53.77, 73.87)
< High school education (%)*	33.15 (28.91, 37.69)	29.45 (26.44, 32.64)	31.26 (28.02, 34.70)
Low fruit and vegetable intake (%)	93.86 (91.45, 95.63)	93.87 (91.94, 95.36)	93.87 (92.33, 95.11)
Physical inactivity (%)***	15.71 (13.00, 18.88)	42.70 (39.14, 46.34)	29.48 (26.87, 32.24)
Obese[ǂ] (%)***	12.44 (9.38,16.32)	37.65 (34.75, 40.65)	25.30 (22.96, 27.80)
DM[ǂ] (%)*	6.41 (4.74, 8.63)	9.25 (8.07, 10.59)	7.86 (6.76, 9.12)
HTN[ǂ] (%)	24.96 (22.20, 27.93)	25.51 (23.47, 27.66)	25.24 (23.31, 27.27)

[ǂ] Age-adjusted

Abbreviations: 95% CI, 95% Confidence Interval; JHLS II, Jamaica Health and Lifestyle Survey II; DM, Diabetes Mellitus; HTN, Hypertension

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

[§]Confidence interval estimates are not available as the age category was used as one level for estimating sample weights, therefore it is assumed there is no variability within each category

Table 2: Prevalence of obesity, diabetes and hypertension (95% CI) within sociodemographic and cardiovascular risk factors

Variable	Obese	DM	HTN
Age category (%)			
15–34 years	18.33 (15.70, 21.28) ***	1.64 (1.02, 2.63) ***	9.27 (7.10, 12.01) ***
35–44 years	32.96 (27.04, 39.49) ***	7.31 (5.21, 10.17) ***	22.88 (18.58, 27.84) ***
45–54 years	34.41 (30.08, 39.01) ***	14.11 (10.76, 18.29) ***	45.37 (39.98, 50.86) ***
55–64 years	29.83 (24.98, 35.18) ***	18.53 (13.83, 24.39) ***	60.54 (52.42, 68.12) ***
65–74 years	27.25 (22.71, 32.30) ***	29.56 (23.97, 35.83) ***	66.14 (59.75, 72.00) ***
Urban residence (%)	25.75 (23.64, 27.98)	7.62 (6.22, 9.30)	23.41 (20.72, 26.34) *
< High school education (%)	26.40 (23.38, 29.66)	14.34 (12.17, 16.81) ***	43.38 (39.30, 47.55) ***
Low fruit and vegetable intake (%)	24.96 (22.77, 27.30)	7.88 (6.76, 9.18)	25.43 (23.45, 27.52)
Physical inactivity (%)	31.69 (28.35, 35.23) ***	10.78 (8.85, 13.08) **	27.00 (23.84, 30.42)

Abbreviations: 95% CI, 95% Confidence Interval; JHLS II, Jamaica Health and Lifestyle Survey II; DM, Diabetes Mellitus; HTN, Hypertension

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$

was significantly higher in those who lived in rural *versus* urban areas (28.55 % *versus* 23.41%; $p < 0.05$) and among those who did not attend high school compared to those that did (43.38% *versus* 17.17%; $p < 0.001$).

Total and sex-specific parish estimates of obesity, diabetes and hypertension

Obesity

Figure 2, panel A shows that there were wide differences in the total age-adjusted percentage obesity across parishes ($p < 0.01$) *versus* women. In all parishes except St Ann and Manchester, age-adjusted percentages of obesity exceeded 30% among women. Almost 50% of women in St Mary were obese; among men, St Elizabeth had over 30% being obese almost twice as much as the next highest parish, Westmoreland, which adjoins it. When the parishes were ranked as shown in Table 3, St Elizabeth led with the highest proportion of obese persons for men and over-all. St Mary had the highest percentage of obese women with 48.3%. Only two parishes, Manchester 27.43% and St Ann 27.39% had proportions of obese women below the 30% mark based on the age-adjusted percentages.

Diabetes

In Table 4 and Fig. 2 Panel B, the prevalence of DM ranged from 5.08 to 37.82 % (0–26.45% in men and 7.11 to 14.17% in women). Overall, the parishes of Portland, St Elizabeth, Kingston and St Andrew each had over 9.0% DM. There was wide variation across parishes in the age-adjusted prevalence of DM for males only ($p < 0.0001$) with St Thomas having recorded zero prevalence among men. Five parishes namely St Catherine, St Andrew, Portland, St James and St Elizabeth registered higher levels of DM among men than women (Table 4).

Hypertension

Table 5 and Fig. 2, Panel C revealed heterogeneity across all parishes for HTN prevalence ($p < 0.001$) ranging from 19.50 to 36.02% (10.94–48.39% in men and 18.85–36.61% in women). There was statistically significant variation in the age-adjusted percentage of both men ($p < 0.0001$) and women ($p < 0.01$). In general, the parishes to the eastern half of the island had higher levels for men, the highest being Portland with 48.39%; for women, more of the parishes located in the northern half had higher levels with St Mary ranked first with a prevalence of 36.61%, followed by Trelawny with 33.13%.

Sex-specific parish correlates of obesity, diabetes and hypertension prevalence

Figures 3 to 5 show the sex-specific multivariable associations of obesity, DM and HTN by parish adjusted for age, urbanicity, income, physical activity and diet for men and women, respectively. In Fig. 3, men residing in St Elizabeth, were almost 16 times more obese compared to those living in Portland [(Odds Ratio) OR = 15.84; 95% CI = 2.00, 125.51, $p < 0.01$]. Women residing in St Elizabeth had twice the odds of being

Table 3: Total and sex-specific age-adjusted obesity, by parish rank, 2007-8

Rank	Male***		Female		Total	
	Parish	Per cent (95% CI)	Parish	Per cent (95% CI)	Parish	Per cent (95% CI)
1	St. Elizabeth	31.00 (-5.55, 67.55)	St. Mary	48.30 (39.18, 57.42)	St. Elizabeth	37.82 (11.04, 64.59)
2	Westmoreland	16.79 (1.22, 32.36)	St. Elizabeth	45.68 (28.87, 62.49)	Hanover	32.28 (16.92, 47.64)
3	St. Andrew	15.87 (9.39, 22.35)	Hanover	45.08 (26.51, 63.65)	Westmoreland	29.10 (19.52, 38.68)
4	St. Ann	13.16 (5.25, 21.07)	Kingston	42.09 (32.81, 51.38)	St. Andrew	28.39 (22.71, 34.08)
5	St. James	11.66 (0.67, 22.65)	Clarendon	38.76 (31.44, 46.08)	St. Mary	28.16 (21.48, 34.85)
6	St. Catherine	10.54 (5.89, 15.19)	St. James	38.64 (27.26, 50.01)	Kingston	27.38 (22.71, 32.05)
7	St. Mary	9.95 (4.51, 15.40)	St. Andrew	38.57 (30.65, 46.48)	St. James	25.18 (17.41, 32.94)
8	Manchester	9.94 (2.19, 17.68)	Westmoreland	38.56 (33.55, 43.57)	St. Catherine	24.19 (20.81, 27.57)
9	Clarendon	7.88 (2.05, 13.72)	St. Catherine	37.14 (33.54, 40.73)	Clarendon	23.62 (18.31, 28.94)
10	Kingston	7.82 (2.90, 12.73)	Portland	35.86 (14.30, 57.42)	St. Thomas	22.34 (15.37, 29.31)
11	Hanover	6.31 (-2.86, 15.47)	Trelawny	34.45 (27.13, 41.77)	St. Ann	21.70 (15.50, 27.89)
12	St. Thomas	6.00 (-1.82, 13.82)	St. Thomas	33.92 (19.37, 48.48)	Trelawny	20.42 (15.28, 25.57)
13	Trelawny	4.50 (-1.02, 10.01)	Manchester	27.43 (17.05, 37.81)	Portland	20.08 (-4.64, 44.80)
14	Portland	1.73 (-0.76, 4.21)	St. Ann	27.39 (17.57, 37.21)	Manchester	19.50 (13.14, 25.86)
	Median	**9.95**		**38.57**		**24.69**

CI – Confidence Interval

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ for differences with lowest ranked parish as referent category

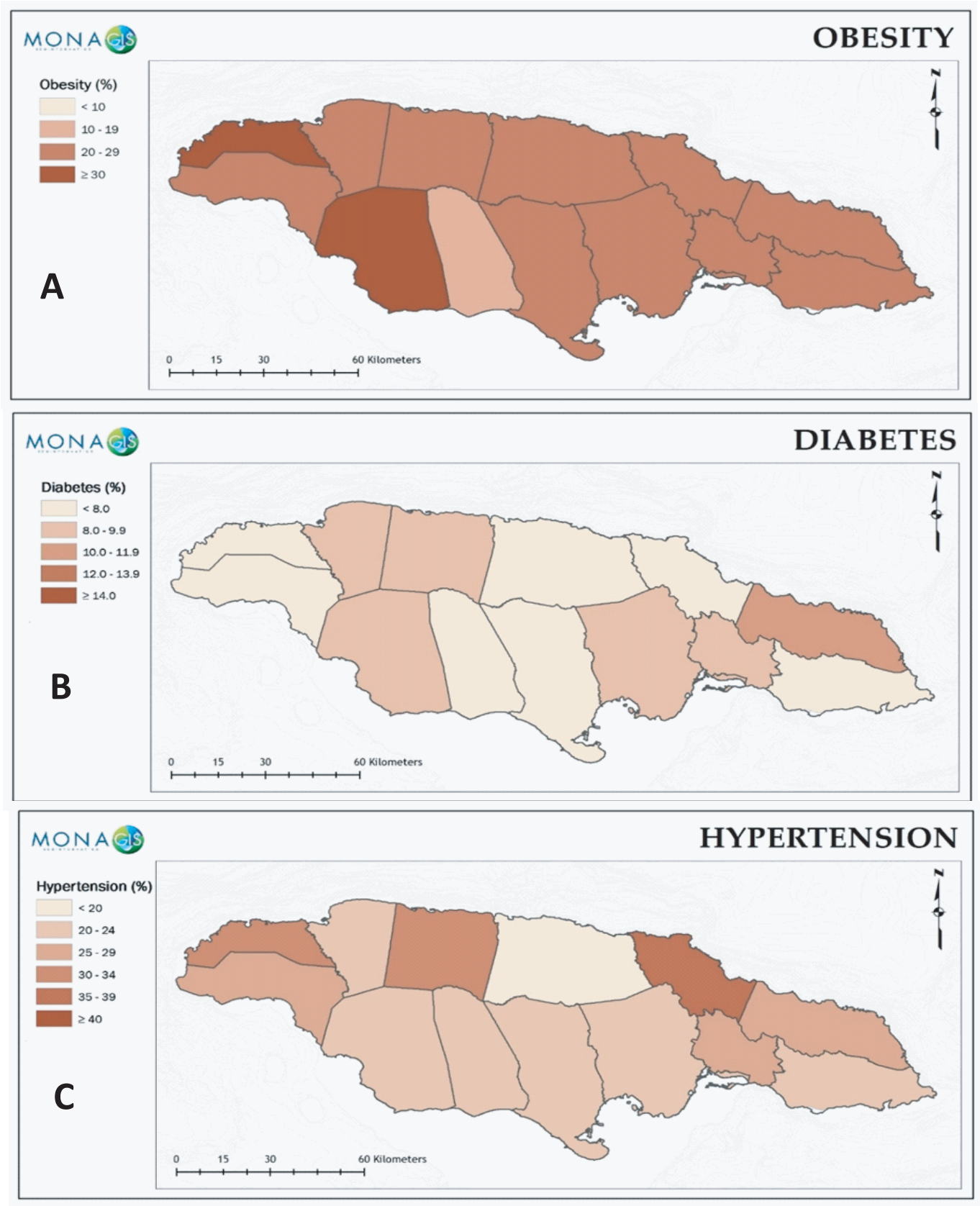

Fig. 2: Age-adjusted percentage of obesity, diabetes and hypertension in Jamaicans by parish, 2008.

Table 4: Total and sex-specific age-adjusted diabetes, by parish rank, 2007–8

Rank	Male***		Female		Total	
	Parish	Per cent (95% CI)	Parish	Per cent (95% CI)	Parish	Per cent (95% CI)
1	Portland	26.45 (22.21, 30.68)	Trelawny	14.17 (2.93, 25.42)	Portland	11.23 (1.75, 20.71)
2	St. Elizabeth	11.19 (-0.74, 23.12)	Kingston	12.54 (7.58, 17.50)	St. Elizabeth	9.81 (3.66, 15.96)
3	St. James	10.58 (1.21, 19.95)	St. Thomas	12.23 (4.41, 20.06)	Kingston	9.54 (5.25, 13.83)
4	St. Catherine	10.10 (5.27, 14.93)	Clarendon	11.20 (6.83, 15.56)	St. Andrew	9.50 (5.98, 13.03)
5	St. Andrew	9.75 (3.52, 15.98)	Manchester	10.68 (5.87, 15.48)	Trelawny	8.90 (2.36, 15.45)
6	Kingston	6.09 (0.53, 11.66)	Hanover	10.05 (6.43, 13.68)	St. James	8.84 (6.19, 11.49)
7	Manchester	4.36 (0.24, 8.47)	St. Mary	9.99 (1.65, 18.33)	St. Catherine	8.66 (5.75, 11.57)
8	St. Mary	4.15 (0.14, 8.15)	St. Andrew	9.29 (6.43, 12.15)	Manchester	7.89 (4.71, 11.07)
9	Clarendon	3.43 (1.70, 5.16)	St. Ann	8.74 (3.54, 13.95)	Hanover	7.81 (2.84, 12.79)
10	Trelawny	2.77 (0.17, 5.37)	St. Elizabeth	8.54 (3.30, 13.78)	St. Thomas	7.09 (3.14, 11.04)
11	St. Ann	2.54 (-1.28, 6.35)	St. James	8.28 (3.54, 13.01)	St. Mary	6.85 (1.45, 12.25)
12	Westmoreland	2.13 (-2.62, 6.88)	St. Catherine	7.79 (5.69, 9.89)	Clarendon	6.82 (4.88, 8.75)
13	Hanover	2.07 (-1.94, 6.08)	Westmoreland	7.45 (1.67, 13.23)	St. Ann	6.12 (2.14, 10.10)
14	St. Thomas	0	Portland	7.11 (1.78, 12.44)	Westmoreland	5.08 (1.44, 8.72)
	Median	**4.26**		**9.64**		**8.28**

CI – Confidence Interval
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ for differences with lowest ranked parish as referent category

obese compared to those living in St Ann (OR = 2.34; 95% CI = 1.02, 5.34, $p < 0.05$). In the case of DM, no statistically significant associations were revealed for either sex when parishes were compared to that with the lowest prevalence (Fig. 4). Figure 5 illustrates that men in Portland were approximately seven times more likely to have HTN when compared with those residing in St Ann (OR = 6.89; 95% CI = 3.50, 13.56, $p < 0.001$). For women, those residing in St Mary were three times more likely to be hypertensive when compared with those living in St Thomas (OR = 3.05; 95% CI = 1.63, 5.72, $p = 0.001$).

DISCUSSION

The study revealed statistically significant heterogeneity in sex-specific parish prevalence of obesity, DM and HTN

Table. 5: Total and sex-specific age-adjusted hypertension, by parish rank, 2007-8

Rank	Male***		Female**		Total***	
	Parish	Per cent (95% CI)	Parish	Per cent (95% CI)	Parish	Per cent (95% CI)
1	Portland	48.39 (35.90, 60.87)	St. Mary	36.61 (30.61, 42.61)	St. Mary	36.02 (30.83, 41.21)
2	Hanover	45.90 (37.92, 53.87)	Trelawny	33.13 (25.13, 41.12)	Hanover	32.61 (26.96, 38.26)
3	St. Mary	32.58 (22.27, 42.88)	St. Elizabeth	27.92 (21.14, 34.69)	Trelawny	31.21 (27.04, 35.38)
4	St. Andrew	31.38 (23.97, 38.80)	St. Ann	27.79 (15.79, 39.79)	St. Andrew	28.97 (24.69, 33.26)
5	Trelawny	28.61 (17.11, 40.11)	Hanover	27.74 (18.93, 36.56)	Portland	28.79 (22.97, 34.60)
6	Westmoreland	26.79 (14.59, 38.99)	St. Andrew	26.98 (23.72, 30.24)	Westmoreland	25.56 (17.61, 33.51)
7	St. Thomas	26.03 (18.59, 33.47)	Clarendon	26.35 (22.59, 30.11)	St. Catherine	23.91 (15.24, 32.58)
8	St. Catherine	24.95 (13.97, 35.94)	St. James	25.60 (21.13, 30.07)	St. Thomas	23.60 (16.57, 30.63)
9	Manchester	20.96 (13.89, 28.03)	Kingston	24.66 (13.64, 35.67)	St. James	23.08 (19.74, 26.43)
10	St. James	18.71 (9.94, 27.48)	Westmoreland	23.79 (15.77, 31.80)	Clarendon	22.00 (18.09, 25.92)
11	Clarendon	18.07 (13.43, 22.70)	St. Catherine	22.94 (15.64, 30.24)	Manchester	21.90 (17.21, 26.59)
12	Kingston	17.87 (11.48, 24.27)	Manchester	22.59 (17.79, 27.39)	Kingston	21.42 (15.86, 26.99)
13	St. Elizabeth	15.51 (6.58, 24.43)	Portland	19.85 (14.02, 25.68)	St. Elizabeth	21.39 (14.40, 28.37)
14	St. Ann	10.94 (6.13, 15.75)	St. Thomas	18.85 (15.62, 22.08)	St. Ann	19.50 (15.00, 24.01)
	Median	**25.49**		**25.98**		**23.76**

CI – Confidence Interval
*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$ for differences with lowest ranked parish as referent category

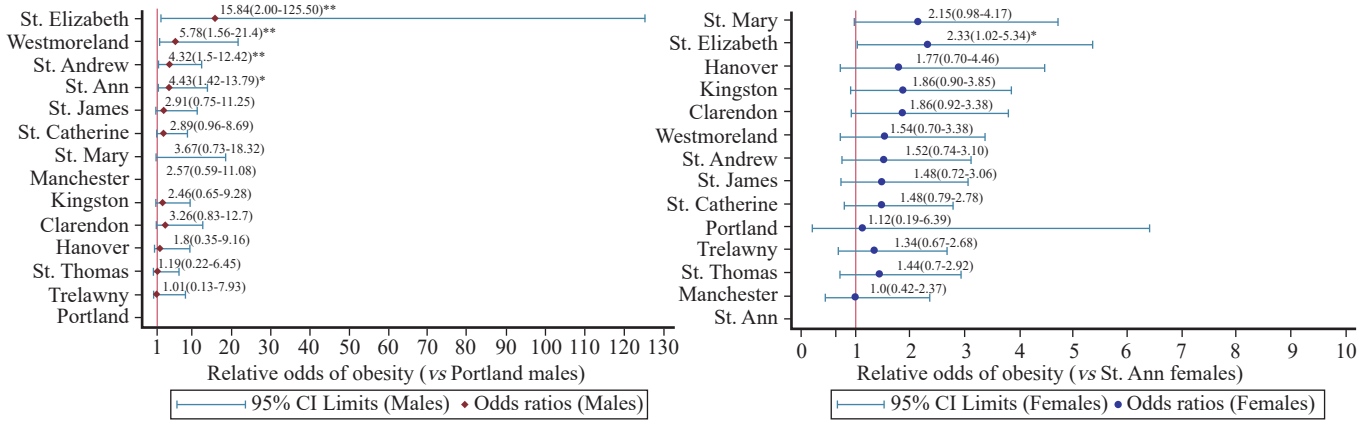

Fig. 3: Adjusted odds ratio for obesity in males and females

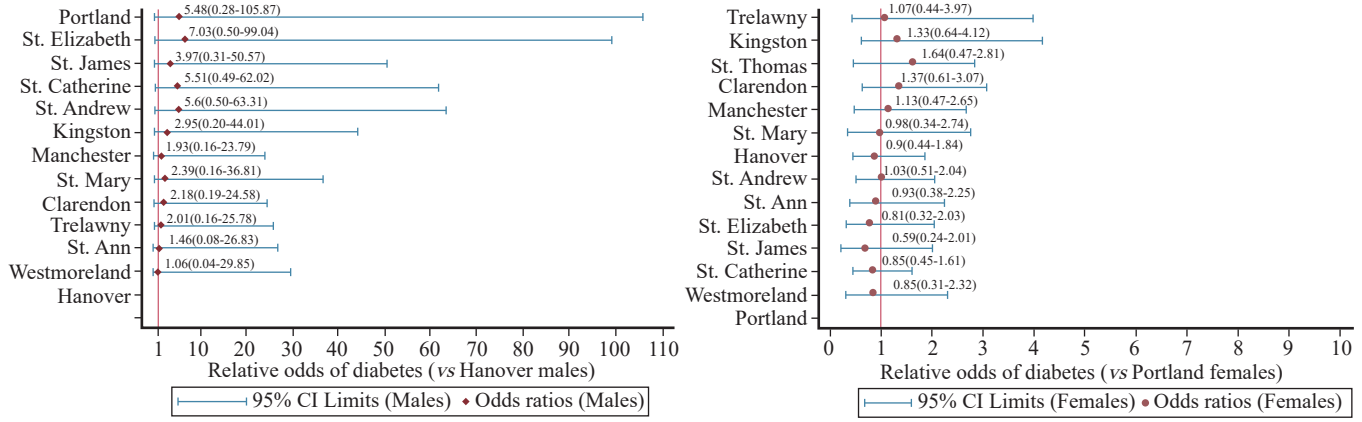

Fig. 4: Adjusted odds ratio for diabetes in males and females.

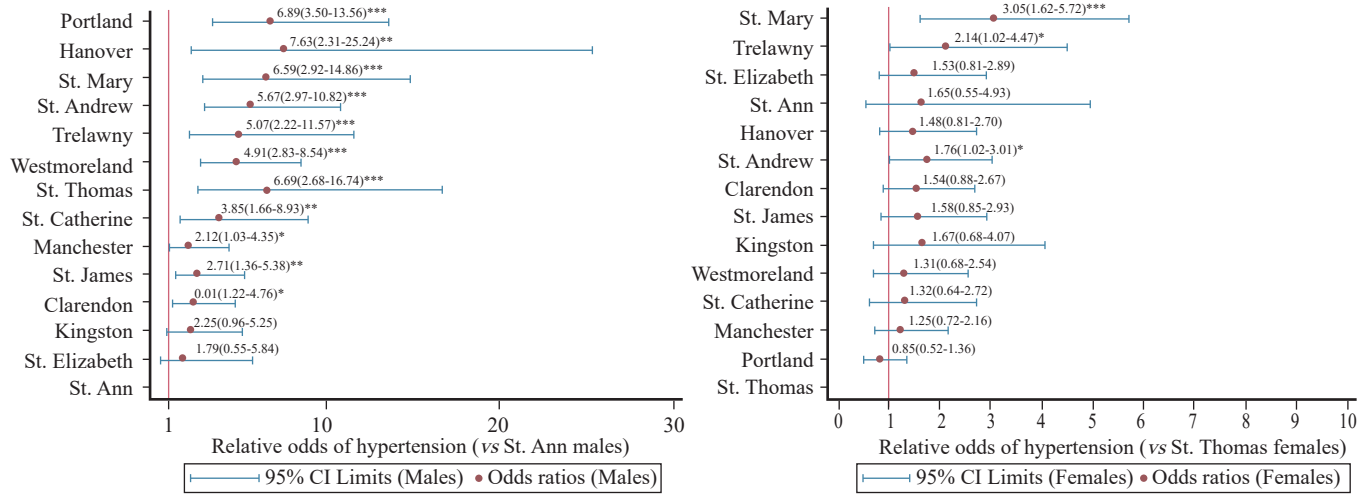

Fig. 5: Adjusted odds ratio for hypertension in males and females.

among Jamaicans. No other similar studies that include colour-coded maps or reporting age-adjusted parish estimates for the outcomes investigated in this study, have been found in Jamaica or similar countries in terms of size and development. Direct comparison with previous research in Jamaica or the Caribbean context is, therefore, not possible. There are a number of noteworthy findings, as discussed below.

With respect to obesity, women had statistically significantly higher percentages. Special studies targeting women are needed to further understand the behavioural and other upstream determinants influencing this disparity. St Elizabeth, a parish regarded as the bread-basket of the country, and with one of the highest percentage of farmers, had the highest rate of obesity overall and ranked 1st and 2nd for obesity among parishes for men and women, respectively. This finding was surprising given the parish had lower than the national proportions of physical inactivity (14). This may suggest the influence of other determinants. Possible mechanistic pathways for further exploration should include analysis of the role of wealth and SES, as well as genetic predisposition to DM, a well-recognised co-morbidity.

For DM, statistically significant heterogeneity was seen among men. In addition, St Elizabeth was also ranked among the top three parishes for men, hence the recommendation in the previous paragraph for further explorations of the strength of association between blood sugar levels and obesity in St Elizabeth. Previous research has reported statistically significant sex differences in the burden of DM and the statistically significant population attributable fraction of DM due to the risk factors of obesity, low/no PAL and increased WC based on the JHLS II dataset (15). The results presented in this report confirm the need for further investigation into the main drivers behind the sex differences across parishes.

There was statistically significant variation in HTN across parishes for both total and sex-specific estimates. The estimates of HTN using the internationally accepted cut-points (12), were consistently higher in men and highest in the North-eastern part of the Island with the parishes of St Mary and Portland topping the ranking. Both St Mary and Portland were ranked as having the 2nd (21%) and 4th (17.3%) highest prevalence rates of poverty in 2008, the year when the JHLS II data collection was completed (16). Closer examination of the role of SES and cumulative biological risk as potential causal factors for HTN at the parish level is warranted.

Strengths and limitations of the study

The major strength of this study is that it is groundbreaking. Specifically, this pioneering study is the first in Jamaica to utilize GIS to geocode nationally representative health and lifestyle data of the comprehensiveness and large sample size of the JHLS II. Secondly, this is the first study to characterise and contrast the total and sex-specific spatial patterns of obesity, DM and HTN at the parish level with the aid of colour-coded digitally created maps. These maps facilitated quick visualization of the complex relationship between individuals and features of the environment over space. They will represent baseline diagrams for future trend analysis.

A few potential limitations must be mentioned. Firstly, the JHLS II was designed to provide national estimates of the Jamaican population 15 to 74 years old and was not powered to make reliable estimates at the parish level. Secondly, although the outcomes were objectively assessed the outcomes included self-reported data on a single individual representing a household, which may introduce information bias. Thirdly, the operational definitions and related cut-points used to signal increased CVD risk are mainly derived from European populations. Studies on persons of African descent (17) have suggested higher threshold cut-points for increased CVD risk.

CONCLUSION

There are significant parish variations in obesity, DM and HTN in Jamaica. Given the economic burden of DM and HTN (2) and the limited resources available for government programmes in general and for the health sector, the need for more cost-effective approaches in CNCD prevention and control is now an imperative. Based on the study findings, we recommend a more targeted approach to prevention and control at the parish-level with further analyses necessary to determine what compositional or contextual influences may account for this variation to inform prevention and control efforts.

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AUTHORS' NOTE

CCM conceived the study and wrote the manuscript. LG and PLA created the digital maps. CCM and NYC analysed the data. RW and KT provided epidemiological expertise and edited the paper. All authors approved the final manuscript.

DISCLOSURE

The authors declare no conflict of interest.

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