Cardiovascular Risk Factors in an Eastern Caribbean Island: Prevalence of Non-communicable Chronic Diseases and Associated Lifestyle Risk Factors for Cardiovascular Morbidity and Mortality in the British Virgin Islands

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ABSTRACT

Background: *The epidemiological transition has seen a trend from communicable to non-communicable diseases in developing countries. At the pinnacle of these chronic diseases is hypertension, pre-hypertension, diabetes and obesity. This leads to increased cardiovascular morbidity and mortality worldwide. In addition, environmental and behavioural changes such as lifestyle habits represent modifiable risk factors for the development of cardiovascular diseases. The Caribbean is not immune to this trend.*

Methods: *This was a cross-sectional survey conducted between June and September 2009 and involved individuals 15–74 years of age. Age-gender was weighted to get as close a representative sample of the general population living in the British Virgin Islands (BVI) for more than two years to a total of 301 (n = 301, M: 144, F: 157; CI 95% ± error 5%). The study was carried out using a handout questionnaire that included variables on age, gender, socio-economic status (SES), income level, cigarette smoking, physical activity, weight, height, body mass index (BMI), blood pressure, fasting blood glucose and cholesterol.*

Results: *This study shows a prevalence of hypertension of 16.6%, pre-hypertension – 29.9%, diabetes mellitus – 10.0% [M: 5.6%, F: 14%,* $p < 0.01$*], impaired fasting glucose (IFG) – 16.9% [M: 13.9%, F: 19.7%,* $p < 0.01$*], overweight – 25.6% (M: 19.4%, F: 31.2%,* $p < 0.001$*), obesity (body mass index > 30) – 23.6% (M: 17.4%, F: 29.3%,* $p < 0.001$*) [all significantly higher in women], smoking habits – 16.6% and alcohol – 51.2% [significantly higher in men: 22.5% and 56.7%, respectively]. Of the respondents, 43.2% had a low/inactive physical activity level. Clustering of greater than one risk factor was more pronounced for women than for men 29.6% (M: 27.1%, F: 31.8%,* $p < 0.05$*). Sedentary lifestyle (low/inactive physical activity) and obesity were the only risk factors that had a positive correlation with all four chronic diseases (*$p < 0.05$*).*

Conclusion: *The above results indicate that a national strategy needs to be implemented to control cardiovascular diseases, educate the population and promote healthy lifestyle habits with particular attention to low physical inactivity and obesity.*

Keywords: British Virgin Islands, cardiovascular risk, Eastern Caribbean, diabetes mellitus, hypertension, impaired fasting glucose, lifestyle, obesity, pre-hypertension

Factores de Riesgo Cardiovascular en una isla del Caribe Oriental: Prevalencia de las Enfermedades Crónicas no Comunicables y Factores de Riesgo Asociados con el Estilo de Vida en Relación con la Morbilidad y la Mortalidad Cardiovasculares en las Islas Vírgenes Británicas

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RESUMEN

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Antecedentes: *La transición epidemiológica ha visto una tendencia a pasar de enfermedades comunicables a enfermedades no comunicables en los países en vías de desarrollo. En la cima de estas enfermedades crónicas se hallan la hipertensión, la pre-hipertensión, la diabetes y la obesidad. Esto conduce al aumento de la morbilidad y la mortalidad cardiovasculares a nivel mundial. Además, los cambios medioambientales y conductuales tales como los hábitos de estilo de vida, representan factores de riesgo modificables para el desarrollo de las enfermedades cardiovasculares. El Caribe no es ajeno a esta tendencia.*

Métodos: *Se trata de un estudio transversal llevado a cabo entre junio y septiembre de 2009, el cual incluyó individuos de 15–74 años de edad. Se ponderó la edad-género con el propósito de obtener una muestra tan representativa como fuera posible de la población general que vive en las Islas Vírgenes Británicas (IVB) por más de dos años para un total de 301 (n = 301, M: 144, F: 157; CI 95% error ± 5%). El estudio fue llevado a cabo usando hojas informativas con un cuestionario que incluían las variables: edad, género, estatus socioeconómico (ESE), nivel de ingresos, hábito de fumar, actividad física, peso, altura, índice de masa corporal (IMC), presión sanguínea, y prueba de colesterol y de glucosa en sangre en ayunas.*

Resultados: *Este estudio muestra una prevalencia de hipertensión de 16.6%, pre-hipertensión 29.9%, diabetes mellitus 10.0% [M: 5.6%, F: 14%,* $p < 0.01$*], glucosa en ayunas alterada (GAA) 16.9% [M: 13.9%, F: 19.7%,* $p < 0.01$*], sobrepeso 25.6% (M: 19.4%, F: 31.2%,* $p < 0.001$*), obesidad (índice de masa corporal > 30) 23.6% (M: 17.4%, F: 29.3%,* $p < 0.001$*) [todos significativamente más altos en las mujeres], hábito de fumar 16.6% y consumo de alcohol 51.2% [significativamente más altos en los hombres 22.5% y 56.7%, respectivamente]. De los encuestados, el 43.2% tenían un nivel de actividad física inactivo/bajo. La existencia de más de un factor de riesgo fue más pronunciada en las mujeres que en los hombres 29.6% (M: 27.1%, F: 31.8%,* $p < 0.05$*). El estilo de vida sedentario (actividad física inactiva/baja) y la obesidad fueron los únicos factores de riesgo que tuvieron una correlación positiva con las cuatro enfermedades crónicas (*$p < 0.05$*).*

Conclusión: *Los resultados enumerados indican que es necesario implementar una estrategia nacional a fin de controlar las enfermedades cardiovasculares, educar, y promover hábitos de estilo de vida saludables con atención particular a la actividad física baja y la obesidad.*

Palabras claves: Islas Vírgenes Británicas, riesgo cardiovascular, Caribe oriental, diabetes mellitus, hipertensión, glucosa en ayunas alterada, estilo de vida, obesidad, pre-hipertensión

West Indian Med J 2012; 61 (4): 430

INTRODUCTION

In the Caribbean, there has been an epidemiological transition from predominantly infectious diseases to the chronic non-communicable diseases [CNCDs] (1–4). Higher standards of living and innovations in medicine and public health practices have contributed to increased survival and thus persons enduring longer the risk factors for the CNCDs (3, 4). Cardiovascular disease and its associated complications: heart failure, myocardial infarction and cerebrovascular accidents head the list of CNCDs (5). They account for a high morbidity and mortality among individuals in nearly all nations (6–8).

The English-speaking Caribbean countries have all demonstrated that non-communicable diseases are the leading causes of ill health (8–13), hence the Port-of-Spain declaration and the resolution spearheaded by Caribbean countries to have the United Nations hold a high level meeting on CNCDs in 2011. Identification of individuals at high or low risks for cardiovascular events is important to facilitate effective use of resources. Also, modifiable lifestyle risk factors, physical inactivity, alcohol, smoking and obesity play major roles in the aetiology, management and prognosis of these chronic diseases (14).

The primary objective of this study is to determine the prevalence of selected chronic diseases (hypertension, pre-hypertension, diabetes and high cholesterol) and cardiovascular lifestyle risk factors (smoking, physical inactivity and alcohol) from a national representative sample of the British Virgin Islands (BVI). Up to the time of the study, no such data were reported in the international literature for these islands. Ethics approval was obtained after review by the ethics committee of University Hospital of the West Indies/The University of the West Indies/Faculty of Medical Sciences and the BVI ethics review board.

The British Virgin Islands, a British overseas territory, consists of over 50 islands to the east of the Caribbean, only four are inhabited of which the main island is Tortola (15). The others include Jost Van Dyke, Anegada and Virgin Gorda (Fig. 1). The total population as of September 2009 was at 28 882; the national census figures at the time of completion put the ratio of non-nationals to nationals as 1.5 to 1 (Fig. 2).

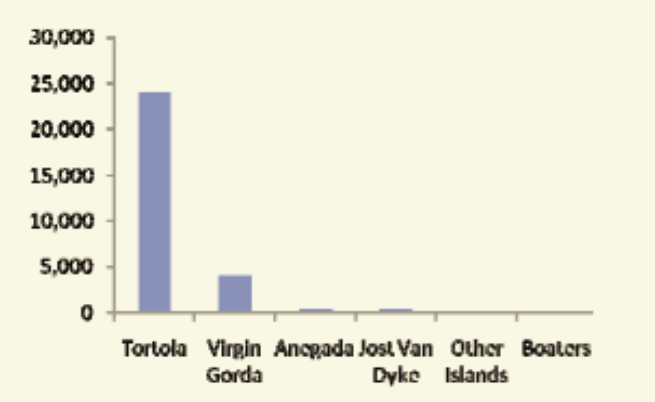

Fig. 1: Population by islands.

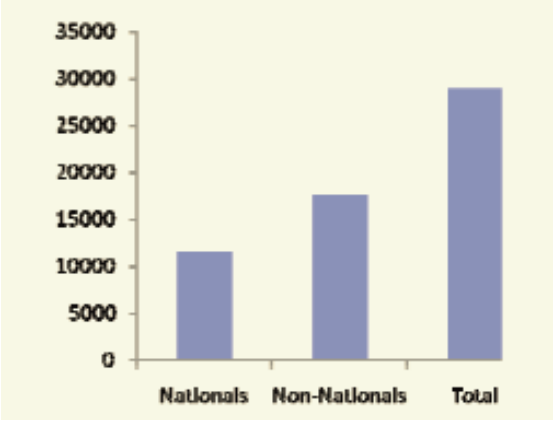

Fig. 2: Population by nationality.

SUBJECT AND METHODS

Study design: This is a community based cross-sectional observational epidemiological study. Subjects for the study were chosen in a two sampling tier based on random sampling of districts and household members, with each individual in the population being studied having an equal and unbiased chance of being chosen. The subjects were recruited from mainly Tortola, but some came from Jost Van Dyke, Anegada and Virgin Gorda. Subjects were included if they were nationals and/or had lived in the BVI for more than two years, were between the ages of 15–74 years old and belonged to a particular district or housing scheme. The British Virgin Islands is a multicultural society, however, the majority of the population is of African descent. Hispanics, mainly from neighbouring Puerto Rico and the Dominican Republic, contribute < 10% followed by East Indians then Caucasians. For practical reasons, the occupations of the population under study were divided into three categories: employed, unemployed and 'other' (*eg* pensioners, housewives, students *etc*).

A total sample size of 301 was chosen (n = 301, M: 144, F: 157; CI 95% ± error 5%, CO 80%). The sample was age and gender matched to get as close a representative sample of the general population.

Enrolment period was June – September 2009; participants completed a written consent and after meeting eligibility criteria, were required to:

1) Fill out a questionnaire on demographic variables: age, gender, island of residence, socio-economic factors, lifestyle assessment, chronic diseases and dietary assessment.
2) Have anthropometric measurements taken: weight by a balance-standardized scale calibrated under international methods, height and body mass index (BMI) calculated using the World Health Organization (WHO) formula. BMI = weight (kg)/height (m^2).
3) Have blood pressure measurement taken using calibrated mercury sphygmomanometer by international guidelines. Blood pressure readings were taken with the subject seated, on the right and left arm with appropriate cuff size. The higher of two consistent readings was used. Subjects were asked to abstain from caffeine and smoking from the day prior to having their blood pressure done.
4) Have fasting glucose and cholesterol done by pinprick and if high, further confirmation was carried out by venous sampling. Fasting was done eight hours prior to testing in keeping with international guidelines.

Physical activity was based on a graded standardized scale of four variables. These were leisure activity, mode of transport to work, type of work done and routine planned physical activity. Individuals were then graded accordingly as inactive, low, moderate or high physical activity (16).

The number of people scheduled for testing was no more than 20 per working day. The same measuring instruments and personnel were used for the entire sample population.

Blood pressure was defined as per the Joint National Committee 7 (JNC7):

	Systolic (mmHg)	Diastolic (mmHg)
Normal	< 120	< 80
Pre-hypertension	120–139	80–89
Hypertension		
Stage 1	140–159	90–99
Stage 2	> 160	> 100

Impaired fasting glucose (IFG) and diabetes mellitus (DM) were defined by the revised expert committee on the diagnosis and classification of DM:

Impaired fasting glucose (IFG)	5.6–7 mmol/L
Diabetes mellitus (DM)	> 7 mmol/L

Body mass index was calculated using the WHO classification:

Underweight	< 18.5
Normal	18.5–24.9
Overweight	25–29.9
Obese	> 30
High cholesterol	> 5.2 mmol/L

All data were entered and analysed using the Statistical Package for the Social Sciences (SPSS) 12.0 for Windows and the Pearson's correlation Sig (two-tailed) test. Demography was compared to the chronic diseases, frequency tables were used and adjusted for prevalence of diseases and lifestyle risk factors. Correlations were made between lifestyle risk factors and the chronic diseases and comparison made between national and non-national groups.

RESULTS

A total of 301 subjects were enrolled during the study period. Subjects were selected once the specified eligibility criteria were met. All eligible participants (n = 301; 47.8% male, 52.2% female) who agreed to participate gave written informed consent; blood pressure, height and weight were measured. Fasting blood glucose was obtained by pin-prick for glucose and cholesterol analysis. Study data were then entered directly into the electronic case report on dedicated laptop computers. The study population was well matched to age groups, ethnic group, island, gender and nationality (Table 1).

Ethnic group: Classification of the population according to ethnic group showed 84.30% of the sample to be of African ancestry. The sample was weighted for ethnic group so as not to confound the results.

Occupation: The statistics revealed that 74.4% of the sample were employed, 20.6% unemployed, and less than 5% were 'other' occupations.

Marital status: In terms of family status, 43.5% of the sample was married/common law relationship, 37.9% were single, 8% were widowed/divorced and 1.7% had visiting relationships.

Nationality: The majority of participants in the study were non-nationals, 59.2% with only 40.8% being from BVI originally.

Islands: Almost 92% of the participants were from the main island of Tortola.

The mean age of the study population was 35.5 years and only height and weight were significantly different between the genders ($p < 0.01$). Men were taller and women were heavier (Table 2).

Blood pressure: The results of the measurements revealed that 53.5% of the population had normal blood pressure, 29.9% had pre-hypertension and 16.6% hypertension [$p > 0.05$] (Table 3). There were slightly more pre-hypertensive males than females (34% to 26.1% CI 95%, $p > 0.05$) and more hypertensive females than males but this was not statistically significant ($p > 0.05$).

Diabetes mellitus and impaired fasting glucose: The data revealed more diabetes and IFG among females (19.7% *versus* 13.9% and 14.0% *vs*. 5.6% CI 95%, $p < 0.01$).

Table 1: Baseline demographic characteristic of the study population

	Male	Female	Total
Gender	144 (47.8%)	157 (52.2%)	301 (100%)
Age (years)			
15–24	24 (8.0%)	21 (7.0%)	45 (15.0%)
25–34	26 (8.6%)	33 (11.0%)	59 (19.6%)
35–44	38 (12.6%)	36 (12.0%)	74 (24.6%)
45–54	32 (10.6%)	39 (13.0%)	71 (23.6%)
55–64	12 (4.0%)	18 (6.0%)	30 (10.0%)
65–74	12 (4.0%)	10 (3.3%)	22 (7.3%)
Ethnic group			
Black	124 (41.2%)	130 (43.1%)	254 (84.3%)
Hispanic	14 (4.7%)	17 (5.6%)	31 (9.4%)
Indian	5 (1.7%)	10 (3.3%)	15 (5.0%)
Caucasian	1 (0.3%)	3 (0.9%)	4 (2.1%)
Employment status			
Employed	107 (74.3%)	117 (74.0%)	224 (74.4%)
Unemployed	30 (20.8%)	32 (20.4%)	62 (20.6%)
Other	5 (3.5%)	7 (4.5%)	12 (4.0%)
Marital status			
Single	50 (16.6%)	64 (21.3%)	114 (37.9%)
Married/common law	70 (23.3%)	61 (21.3%)	131 (43.5%)
Divorced/separated	12 (4.0%)	12 (4.0%)	24 (8.0%)
Visiting	2 (0.7%)	3 (1.0%)	5 (1.7%)
Nationality			
Nationals	62 (20.0%)	61 (19.2%)	123 (40.8%)
Non-nationals	83 (27.8%)	95 (31.5%)	178 (59.2%)
Islands			
Tortola	122 (42.2%)	147 (48.8%)	274 (91.0%)
Anegada	2 (0.7%)	0 (0)	2 (0.7%)
Jost Van Dyke	3 (1.0%)	5 (1.7%)	8 (2.7%)
Virgin Gorda	12 (4.0%)	5 (1.7%)	17 (5.6%)

Table 2: Average measurements of the study population

Parameters	Male	Female	Total
Systolic blood pressure (mmHg)	124.4	125.4	124.9
Diastolic blood pressure (mmHg)	77.5	77.3	77.4
Fasting blood glucose (mmol/L)	4.9	5.3	5.2
Height (cm)*	174.1	167.7	170.7
Weight (kg)	77.5	79.9	76.9
Body mass index (BMI)**	24.5	27.3	26.5
Age (years)	38.2	36.8	35.5
Cholesterol (mmol/L)	4.24	4.16	4.1

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

Table 3: Prevalence (%) of non-communicable chronic diseases (pre-hypertension, hypertension, impaired fasting glucose, diabetes, high cholesterol and body mass index) by gender

	Male	Female	Total
Blood pressure (mmHg)			
Normal	73 (50.7%)	88 (56.1%)	161 (53.5%)
Pre-hypertension	49 (34%)	41 (26.1%)	90 (29%)
Hypertension	22 (15.3%)	28 (17.8%)	50 (16.6%)
Fasting blood glucose (mmol/L)			
Normal	116 (80.6%)	104 (66.2%)	220 (73.1%)
Impaired fasting glucose	20 (13.9%)	31 (19.7%)	51 (16.9%)
Diabetes	8 (5.6%)	22 (14.0%)	30 (10%)
Cholesterol (mmol/L)			
Normal	130 (90.3%)	143 (91.1%)	273 (90.7%)
High	14 (9.7%)	14 (8.9%)	28 (9.3%)
Body mass index (kg/m^2)			
Underweight	1 (0.7%)	4 (2.5%)	5 (1.7%)
Normal	90 (62.5%)	58 (36.9%)	148 (49.2%)
Overweight	28 (19.4%)	49 (31.2%)	77 (25.6%)
Obese	25 (17.4%)	46 (29.3%)	71 (23.6%)

Overall, prevalence of IFG and DM in the population was 16.9% and 10%, respectively (Table 3).

Cholesterol levels: The mean total cholesterol level of the sample population was 4.1 mmol/L ± 0.48 and the prevalence of high cholesterol between the genders was similar with an overall prevalence of 9.3% [$p > 0.05$] (Table 3).

Body mass index: Calculation of the BMI for each person showed that 49.2% of the sample was of normal weight, 49.2% was overweight/obese and 1.7% was underweight. The prevalence of overweight (BMI 25–30) and obesity (BMI > 30) was more common in females [CI 95%, $p < 0.001$] (Table 8). Underweight (BMI < 18.5) was also more common in females ($p < 0.001$). The overall prevalence in the population was 25.6% and 23.6%, respectively (Table 3)

Figures 3–6 demonstrate the trend of increasing prevalence of disease as BMI increases for hypertension, IFG, DM and high cholesterol. Other lifestyle risk factors (smoking, alcohol and diet) did not show a correlation with the chronic diseases apart from sedentary/low activity ($p < 0.01$).

High prevalence of physical inactivity and low physical activity was associated with the majority of subjects who were obese, almost doubling the risk for same. Figure 7 also demonstrates that prevalence of obesity increases as physical activity decreases ($p < 0.001$). This trend was not observed with the other lifestyle factors examined in this study.

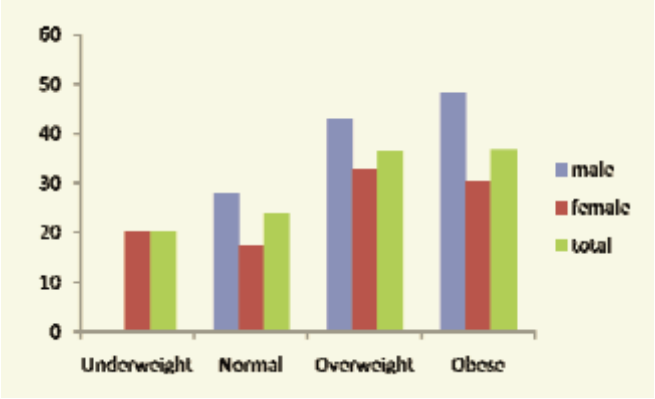

Fig. 3: Prevalence (%) of hypertension by body mass index.

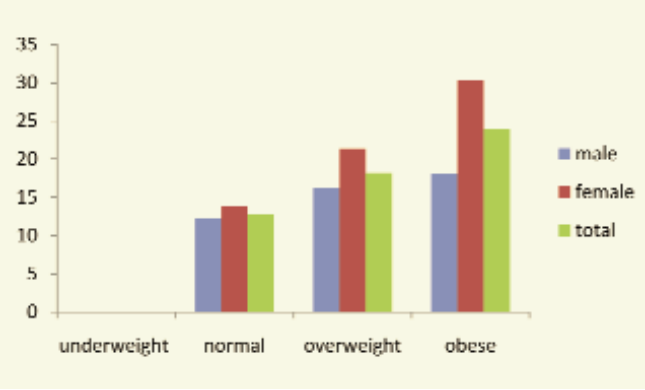

Fig. 4: Prevalence (%) of impaired fasting glucose by body mass index.

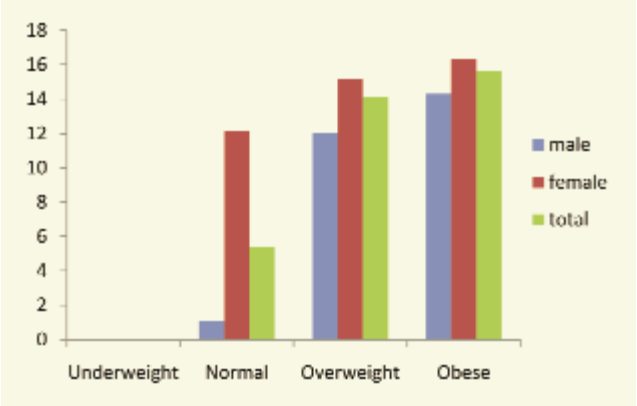

Fig. 5: Prevalence (%) of diabetes mellitus by body mass index

Smoking: Cigarette smoking occurred in 16.6% of the population and non-smokers accounted for 85.4% (Fig. 8). Men smoked more: 22.2% *versus* 11.5% of females ($p < 0.05$). Marijuana usage was documented as 14% overall. These data included only current cigarette smokers, but past and current use of marijuana was included.

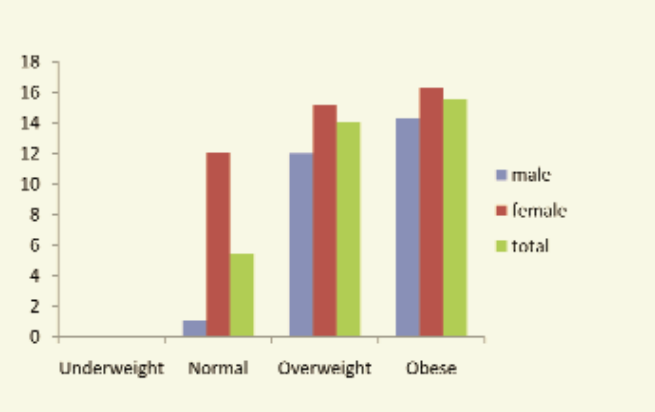

Fig. 6: Prevalence (%) of high cholesterol by body mass index.

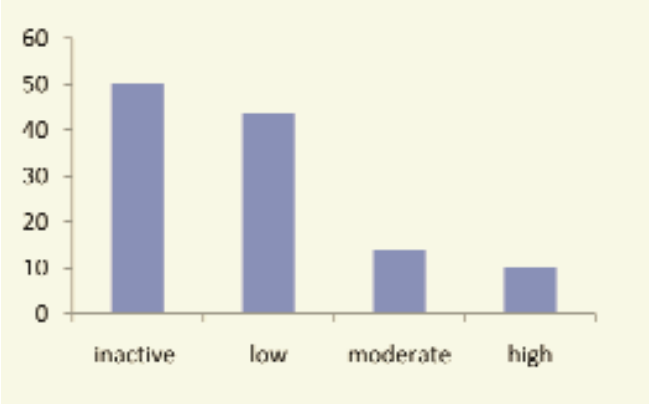

Fig. 7: Prevalence (%) of physical activity of obese subjects.

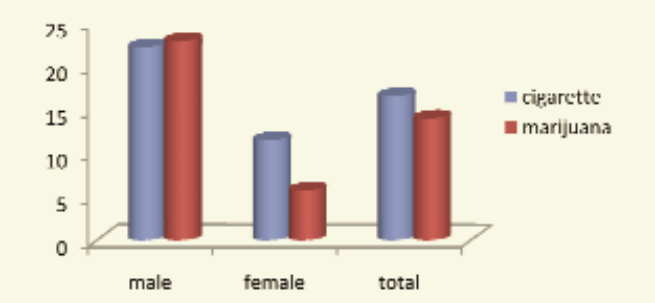

Fig. 8: Prevalence (%) of smoking by gender.

Clustering of co-morbidities: Risk factors included age > 45 years, cigarette smoking, diabetes mellitus, pre-hypertension or hypertension, high cholesterol and BMI > 25 kg/m^2. Within the hypertension and obese group, there was a significant percentage of clustering: 27.7% *versus* 38.2% of more than three risk factors (Table 4).

Nationality: The prevalence of the chronic diseases in terms of nationality showed significantly more nationals having higher cholesterol and being more overweight and obese. There were no differences between the other chronic diseases of significance, however, more non-nationals had pre-hypertension, hypertension and IFG (Table 5).

Table 4: Clustering (%) of risk factors

Risk factors	None	One	Two	More than three
Blood pressure				
Pre-hypertension	23	23.1	24.1	28
Hypertension	32	14	26	27.7
Body mass index				
Overweight	19	31.2	22.1	26.8
Obese	11	25.4	23.9	38.2

Table 5: Disease prevalence by nationality

Disease	Nationals	Non-nationals	Total
Pre-hypertension	28	31	29.9
Hypertension	14.4	18.2	16.6
Diabetes mellitus	11.6	9.2	10
IFG	14.9	17.8	16.9
Overweight*	33.2	21.5	25.3
Obesity**	37.6	19.5	23.6
High cholesterol*	10.1	5.6	9.3
Total	**48.9**	**51.1**	**100**

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

DISCUSSION

The British Virgin Islands are part of the English-speaking Caribbean. Despite its small population it has not escaped the burden of chronic diseases. Unique to these islands is that more than half of its citizens are immigrants from surrounding islands, who bring their own cultural practices, behavioural lifestyle and disease prevalence of their islands.

The prevalence of chronic diseases was found to be cholesterol – 9.3%, DM – 10.0%, IFG – 16.9%, hypertension – 16.6%, pre-hypertension – 29.9%, obesity – 23.6% and overweight – 25.3%. There was significant difference between the genders for DM, IFG, overweight and obesity with females having a higher percentage of prevalence in each category. There was no statistically significant difference for each chronic disease among the different age groups or socio-economic variables.

In comparison with the rest of the English-speaking Caribbean, the above prevalence of chronic diseases is similar (17–20). The exception, however, seems to be a slightly higher prevalence of high cholesterol, 9.3% compared to the average of less than 7% (21). It is of some concern for such a small population to have these high rates. Compounding this fact is that most of the chronic diseases are prevalent among immigrants with the exception of overweight and obesity (Table 5). Greater efforts should go

into targeting these groups for interventions and evaluating the accessibility to healthcare.

Lifestyle risk factors such as smoking were higher in men (Fig. 8) and low physical activity more common in women (Fig. 9). There was a positive correlation between

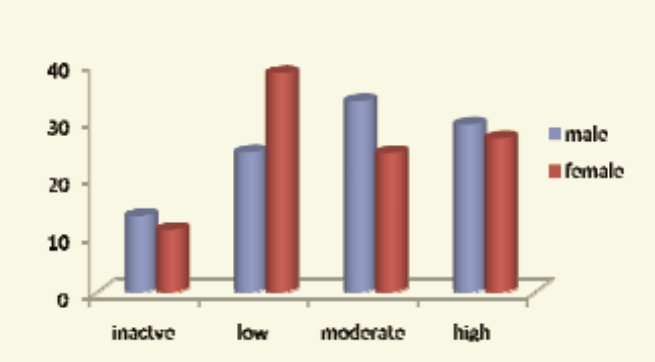

Fig. 9: Prevalence (%) of physical activity by gender.

decreasing physical activity and increasing BMI, as one would expect. In addition, BMI was the only lifestyle risk factor found to influence greatly the prevalence of DM, IFG, pre-hypertension, hypertension and high cholesterol. This trend is expected as the obesity epidemic alone accounts for the increasing trend in chronic diseases in the Western Hemisphere in such a short space of time (16). The factors or aetiology for this may be due to the metabolic syndrome and its strong association with obesity that was not examined in this study. It therefore means that theoretically curtailing this epidemic by itself may lead to a decrease in the non-communicable illnesses.

One good indicator that came out of this study was that the prevalence of smoking was low –16.6% overall, however, males still far outweighed females in smoking; even less prevalent was marijuana use at 5.3%.

Clustering of co-morbidities was also high in this small population, higher in females 31% *versus* 29% with more than three risk factors. The more risk factors that are present, the more likely cardiovascular risk would increase in a linear relationship (21–24). There was also a high percentage of clustering within the obesity, overweight and hypertensive groups (Table 4). Limitation of the study was the small sample size.

CONCLUSION

The study shows that the prevalence of chronic diseases in this small population is high and in keeping with that of the English-speaking Caribbean except for the high prevalence of cholesterol. Reason for this high cholesterol may need additional research. There is also a high level of low/inactive sedentary lifestyle and clustering of risk factors. Health promotion education should aim to modify lifestyle risk factors with special efforts made to curtail the obesity epidemic as well as promote more active lifestyle. These were associated with increased frequency among those with hypertension, pre-hypertension, DM, IFG and high cholesterol.

Special mention must be made of the non-nationals, who are at increased risk because of the high prevalence of disease among their population. A national strategy towards primary prevention should be implemented while continuing secondary preventative measures.

ACKNOWLEDGEMENT

The authors wish to thank the staff of the epidemiology centre, University Hospital of the West Indies, the staff of Peebles Hospital, British Virgin Islands and British Virgin Islands Development Planning Institute who helped to facilitate this study.

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