



**State of Public Health in the
Caribbean Region
2014 - 2016**

***Building Resilience to Immediate and Increasing
Threats: Vector-Borne Diseases and Childhood
Obesity***

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*Building Resilience to Immediate and Increasing Threats:
Vector-Borne Diseases and Childhood Obesity*



**Caribbean Public Health Agency
Port of Spain, Trinidad and Tobago, 2017**

The Caribbean Public Health Agency is the Caribbean Region's collective response to strengthening and reorienting our health system approach so that we are equipped to address the changing nature of public health challenges, which threaten development.

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Suggested citation.

Caribbean Public Health Agency. State of Public Health in the Caribbean Region 2014-2016. Building Resilience to Immediate and Increasing Threats: Vector-Borne Diseases and Childhood Obesity. Port of Spain, Trinidad, and Tobago: CARPHA; 2017

ISBN 978-976-8114-38-9

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Acknowledgements

The State of Caribbean Public Health Report is dedicated to the health of the Caribbean people and is intended as an informational tool to build their resilience in the face of immediate and increasing threats to health.

The Caribbean Public Health Agency (CARPHA) would especially like to thank personnel in Caribbean countries and territories who have contributed by providing public health data, reports and research on which the current report is based.

CARPHA expresses special thanks to Dr Caroline Allen and Dr Renee West for their extensive work and valuable contribution to the report. Thanks also to the members of the CARPHA Oversight Committee and Sub-Committees for their guidance and management of the project. These are:

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We are also indebted to Dr. C. James Hospedales, Executive Director, for his foresight and leadership in the creation of this Report and valuable comments on drafts. Thanks also to other CARPHA technical officers and support staff who have kindly contributed information and enabled the work.

The authors would also like to express their gratitude to the Pan American Health Organization/World Health Organisation, Trinidad and Tobago Office for their assistance with the section on the International Health Regulations. We are grateful to Ms Marie Beach, Healthy Schools Coordinator, Government of Bermuda; Dr Isabella Francis-Granderson, Public Health Dietician, Lecturer, University of the West Indies, St Augustine; Ms Maisha Hutton, Executive Director, Healthy Caribbean Coalition; and Ms Moira Lindsay, Regional Programme Director, Population Services International for their assistance in providing information on some of the regional initiatives presented in this Report.

Acronyms

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral therapy
CARDI	Caribbean Agricultural Research and Development Institute
CAREC	Caribbean Epidemiology Centre
CARICOM	Caribbean Community
CARPHA	Caribbean Regional Public Health Agency
CCH	Caribbean Cooperation in Health
CDC	US Centres for Disease Control
CDRC	Chronic Disease Research Centre
CEHI	Caribbean Environmental Health Institute
CFNI	Caribbean Food and Nutrition Institute
CHRC	Caribbean Health Research Council
CHTA	Caribbean Hotel and Tourism Association
CMO	Chief Medical Officer
CMS	CARPHA Member States
CO	Childhood Obesity
COHSOD	Council for Human and Social Development
COTED	Council for Trade and Economic Development
CPP	Caribbean Pharmaceutical Policy
CRDTL	Caribbean Regional Drug Testing Laboratory
CR-FELTP	Caribbean Field Epidemiology - Laboratory Training Programme
CRNM	Caribbean Regional Negotiating Machinery
CROSQ	Caribbean Regional Organisation for Standards and Quality
CRS	Caribbean Regulatory System
CSDH	Commission on the Social Determinants of Health
CSME	CARICOM Single Market and Economy
CTO	Caribbean Tourism Organisation
CVO	Chief Veterinary Officer
CWD	Caribbean Wellness Day

CYMP	Core Youth Movement Programme
DHF	Dengue Haemorrhagic Fever
FAO	Food and Agriculture Organisation
FBD	Food-borne disease
FCTC	Framework Convention on Tobacco Control
GBS	Guillain-Barré Syndrome
GHSA	Global Health Security Agenda
GICR	Global Initiative on Cancer Registry Development
HCC	Healthy Caribbean Coalition
HEU	Health Economics Unit
HFLE	Health and Family Life Education
HIV	Human Immunodeficiency Virus
HRH	Human Resources in Health
IAEA	International Atomic Energy Agency
IARC	International Agency for Research on Cancer
IDRC	International Development Research Centre
IGA	Inter-Governmental Agreement
IHR	International Health Regulations
IMPACS	Implementation Agency for Crime and Security
JEE	Joint External Evaluation
MDG	Millennium Development Goal
MICS	Multiple Indicator Cluster Survey
MTCT	Mother to Child Transmission
NCD	Non-Communicable Disease
NFP	Nutritional Facts Panel
NSDS	Nutritional Schools Dietary Services Ltd
OECS	Organisation of Eastern Caribbean States
PAC	Project Advisory Committee
PAHO	Pan American Health Organization
PANCAP	Pan Caribbean Partnership Against HIV/AIDS
PFG	Population Food Goal

PHAC	Public Health Agency of Canada
PHEIC	Public Health Emergency of International Concern
POE	Point of Entry
PPE	Personal Protective Equipment
PYLL	Potential Years of Life Lost
RCM	Regional Coordinating Mechanism
RCME	Regional Coordinating Mechanism on Ebola
RCMHS	Regional Coordinating Mechanism on Health and Security
RDA	Recommended Daily Allowance
RHI	Regional Health Institution
RPG	Regional Public Goods
SDG	Sustainable Development Goal
SDH	Social Determinants of Health
SEM	Socio-Ecological Model
SPHR	State of Public Health Report
SSC	Ship Sanitation Certificate
UC	Underlying cause of death
UHC	Universal Health Care
UKOTs	United Kingdom Overseas Territories
UN	United Nations
UNDP	United Nations Development Programme
UNHLM	United Nations High-Level Meeting
UNICEF	United Nations Children’s Fund
US	United States
USAID	United States Agency for International Development
USG	United States Government
UWI	University of the West Indies
VBD	Vector-Borne Diseases
WHO	World Health Organisation

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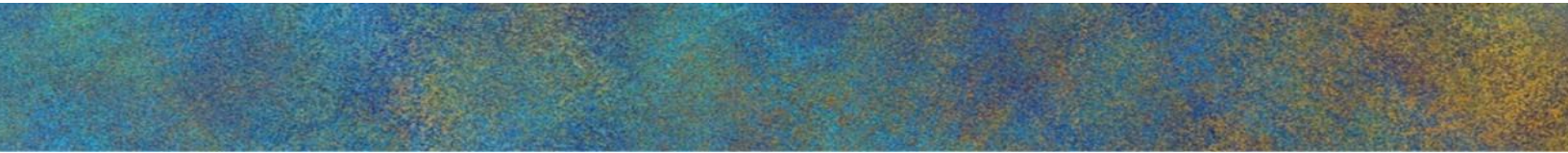
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Chapter 1. Introduction



Public health concerns the promotion and protection of health of people and communities. While a doctor treats people who are ill, those working in public health try to prevent people from getting ill, and to promote wellness by encouraging healthy behaviour (American Public Health Association, 2017). The practice of public health involves the organised efforts of society to promote the health of the population.

This report, from the Caribbean Public Health Agency (CARPHA), examines the State of Public Health across a small and very diverse region of the world. The countries of the Caribbean are small in population and geographical size, and highly vulnerable to external man-made and environmental shocks. The report examines major threats to the health of Caribbean people and the communities where they live, learn, work and play. The focus is on the situation in the three years 2014 to 2016. This involves examining some long-standing issues as well as things that happened in that period. Actions that have been taken to address threats are presented, along with examples of good practice and suggestions for the future.

We introduce this report by first giving a brief profile of the Caribbean and its people. Major health frameworks and public health institutions in the region are then described. We go on to present the Social Determinants of Health conceptual model that will be used for analysis throughout this report.

An overview of public health in the Caribbean is provided in Chapter 2. This involves looking at communicable and non-communicable diseases and injuries, risk factors and social vulnerabilities. Progress in meeting the recommendations and targets of some major health frameworks is presented.

Chapters 3 and 4 focus on two key areas of public health significance for the 2014-'16 period. These are vector-borne diseases (VBDs) and childhood obesity (CO). The 2014-'16 period saw epidemics of chikungunya and Zika: both VBDs that had not been encountered in the Caribbean before. They placed additional strain on existing systems to prevent and treat VBDs and brought new health challenges. They underlined gaps in regional health security given the widespread distribution of the primary vector, the *Aedes aegypti* mosquito. Childhood obesity is an increasing threat; largely the outcome of health behaviours and an obesogenic environment that have previously manifested in non-communicable diseases (NCDs) mostly among older adults, and which are now affecting the next generation. How health is promoted to address CO will affect the economic and social development of the region.

The priority areas of VBDs and CO for the State of Caribbean Public Health Report covering 2014-16 were identified via a poll of Ministries of Health from Caribbean countries.¹ The decision to choose

¹ Participants in the poll of CARPHA Member States (CMS) comprised participants representing Ministries of Health from CMS. They were asked to allocate points to eight subject areas based on: relevance to CMS and regional development, Caribbean Cooperation in Health Priority Areas, economic impact, and alignment to events, partners and funding. The eight subject areas were: childhood obesity/non-communicable diseases, mosquito borne viral diseases, climate change and health, healthy ageing, violence and injury prevention, anti-microbial resistance, universal health coverage, tourism and health, Caribbean regional development through functional cooperation in health, and the Caribbean region's regulatory capacity. Representatives from 22 of CARPHA's 24 Member States responded. The two subject areas that attracted the most points were: childhood obesity/ non-communicable diseases and mosquito-borne viral diseases (Hunte, 2017). Arising from this consultation exercise, the two thematic areas for the SPHR 2014-2016 were determined to be VBD and CO.

areas of focus was based on the recognition that the boundaries of public health are wide and that the Caribbean is diverse. In focussing on one or two key areas while also providing a summary overview of public health issues, the State of Caribbean Public Health Report follows the usual practice of State of Public Health Reports (SPHRs) from around the world. A feature of this SPHR is the use of a social determinants of health framework, introduced in section 1.4, which enables critical analysis of health determinants at the individual, social and structural levels and the building of multi-sectoral alliances and approaches to improving public health.

1.1 The Caribbean Region

The Caribbean comprises multiple islands and low-lying mainland territories and countries. The Region is remarkably diverse, with a mix of languages and ethnicities. Countries have varying sizes, geographic landscapes and political systems.

Population sizes vary from extremely small (approximately 1,900 in Saba) to small (approximately 11.4 million in Cuba). Many of the states are Small Island Developing States (SIDS), which have been identified as facing development challenges resulting from small size, transport costs, coastal weather patterns, vulnerability to climate change, dependence on income from a small range of exports, and high dependence on imports to meet basic nutritional and other needs (International Labour Organization, 2014; United Nations Environment Programme, 2014). The Central America mainland country of Belize and the South American mainland countries of Guyana and Suriname are also considered part of the Caribbean, given a similar political history to the Caribbean islands.

The Caribbean is in the tropical zone and has little temperature variation throughout the year. There are two seasons; a rainy or wet season that runs roughly from June to December, and a dry season from November to May. The region is prone to tropical storms and hurricanes during the rainy season. It is also prone to earthquakes resulting from movement of the Caribbean tectonic plate. Some countries have experienced major natural disasters, and these have set back development, sometimes for several years, and brought grave public health consequences.

An extreme example is the 2010 earthquake in Haiti, which killed 230,000 and displaced 1.5 million people, and was followed by the largest cholera epidemic ever reported in a single country (Domercant et al., 2015). Health programmes, such as those aiming to prevent and treat HIV and tuberculosis, were disrupted, and risk of infection from these and other diseases increased as people were affected by post-traumatic stress and relocation to crowded “tent cities” set up for displaced people (Devieux, 2011; Ghose, Boucicaut, King, Doyle, & Shubert, 2013; Pape et al., 2010; Rahill, Joshi, & Hernandez, 2016; Rouzier, 2011a; Walldorf et al., 2012).

Climate change is having severe consequences for the Caribbean region via increased temperatures, intensity of storms and hurricanes, sea level rise, coral bleaching, and impact on food security. Effects may vary depending on geographic features and level of infrastructure such as drainage and solidity of building construction (Litchveld & Wahid, 2017). In the 2014-'16 period, Tropical Storm Erika and Hurricane Matthew were among the natural disasters experienced by Caribbean people, and highlighted the critical need to improve the precision of weather forecasts and for multi-sectoral collaboration in storm preparation and disaster preparedness. On August 27, 2015, Dominica

experienced Tropical Storm Erika, after which 574 people were left homeless and 713 were evacuated/ displaced, mostly because of flooding and landslides. Interviews with survivors and Ministry of Health officials revealed a need for additional mental health services following the trauma of displacement and destruction of homes and workplaces and loss of social support networks from their home communities. The informants also stressed needs for healthy foods and employment (Ravaliere & Murphy, 2017). In late September/ early October 2016, Hurricane Matthew was the deadliest Atlantic hurricane since 2005, killing 546 in Haiti, 47 in the United States, 4 in Cuba, 4 in the Dominican Republic, 1 in Colombia, and 1 in Saint Vincent and the Grenadines, and damaging many homes in The Bahamas. Preparations for Hurricane Matthew, such as evacuations and closures of airports, schools and businesses affected other Caribbean countries as well, including the Windward Islands, the Dominican Republic, Jamaica, Turks and Caicos and as far south as Aruba, Bonaire and Curacao. Schools and businesses were closed, and people sought shelter in preparation for the hurricane. Infrastructural damage was sustained in several of these countries (Wikipedia, 2017).

Caribbean countries have highly open economies. For historical reasons and because of their small size, their economies are highly import dependent. For instance, 70% of foods consumed are imported from outside the Region. This affects susceptibility to food-borne diseases (FBDs), and to non-communicable diseases (NCDs) associated with the consumption of processed foods high in fat, sugar, artificial flavourings and preservatives. Additionally, the major export of most countries is tourism, which accounts for 25-65% of GDP in most countries. While contributing to prosperity and cultural diversity, this also affects the range of goods available to local people and susceptibility to a wide range of pathogens from around the world.

The Caribbean has a rich mix of people of varying backgrounds. These include indigenous people, Africans, Asian Indians, Europeans, Chinese, Indonesian Javanese and many of mixed ancestry. The population of most countries comprises a mostly people of African descent, but in Guyana, people of Indian descent outnumber them, and in Trinidad and Tobago, the population of Indian descent is slightly smaller than that of African descent. There are four primary languages in the Caribbean: English, Spanish, French and Dutch, and several dialects including Patois, Creole and Papiamentu.

Politically, the countries can be grouped into the Caribbean Community (CARICOM) Member States, the United Kingdom Overseas Territories (UKOTs), the Dutch Caribbean (both municipalities in the Netherlands and countries), the French Departments and the Hispanic Countries. CARICOM consists of fifteen Member States, inclusive of the Organisation of Eastern Caribbean States (OECS), which is made up of nine-member countries that share a common currency and a common market and economy. The UK Overseas Territories (UKOTs) are associate Member States of CARICOM.

Countries vary widely in economic development, and in levels of health expenditure. The following table shows a wide variation in health expenditure as a percentage of government expenditure, bearing little relationship to the national income levels of each country.

Table 1: GDP per capita, and health expenditure as percentage of government expenditure, 2014

	GDP per capita (Purchasing Power Parity, Current International Dollars)	Health expenditure as % of government expenditure
Antigua and Barbuda	20,564	18.1
Barbados	16,114	10.9
Belize	8,480	13.8
Cuba	N.A.	18.0
Dominica	10,927	10.5
Dominican Republic	13,313	17.4
Grenada	12,683	9.2
Guyana	7,259	9.4
Haiti	1,741	6.1
Jamaica	8,483	8.1
St. Vincent and the Grenadines	10,858	14.8

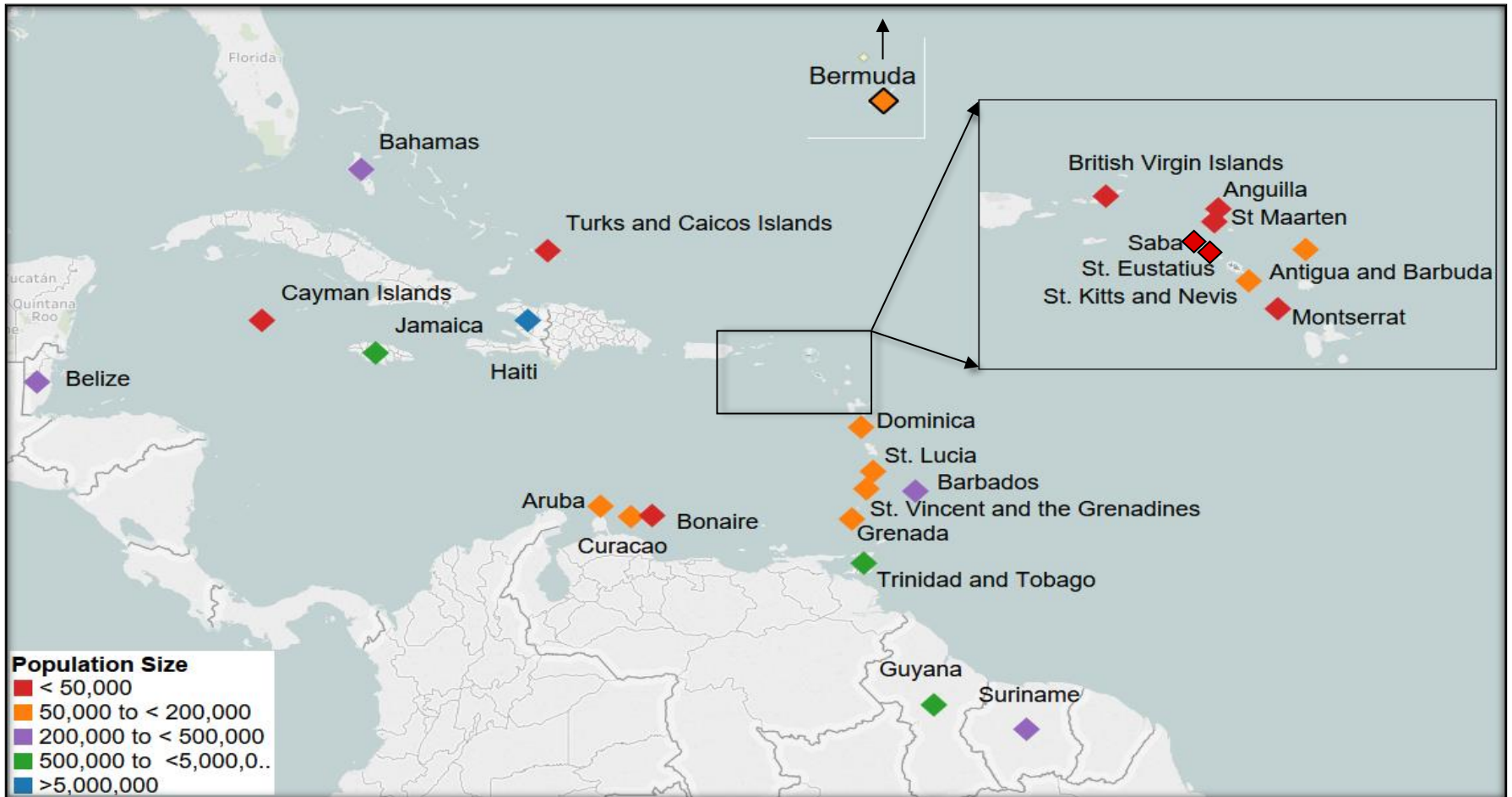
Source: World Bank Databank

This report focuses mostly on Member States of the Caribbean Public Health Agency (CARPHA Member States - CMS). CARPHA, established in 2013, merges pre-existing specialist Caribbean public health agencies, each with a proud history of cooperation and achievements in health. This agency is described in more detail in section 1.3.2. The issues highlighted in this report are likely to be similar in Caribbean countries and territories that are not part of this grouping. CARPHA membership currently includes all CARICOM Member States and associate Member States as well as the Dutch Caribbean (Table 2).

Table 2: CARPHA Member States (CMS)

CARICOM Member States	CARICOM Associate Members	Dutch Caribbean
Antigua and Barbuda*	Anguilla*	Aruba
Bahamas	Bermuda	Bonaire
Barbados	British Virgin Islands*	Curacao
Belize	Cayman Islands	Saba
Dominica*	Turks and Caicos Islands	St. Eustatius
Grenada*		Sint Maarten
Guyana		
Haiti		
Jamaica		
Montserrat*		
Saint Lucia*		
St. Kitts and Nevis*		
St. Vincent and the Grenadines*		
Suriname		
Trinidad and Tobago		
* OECS Member States		

Figure 1: Map showing population sizes among CARPHA Member States

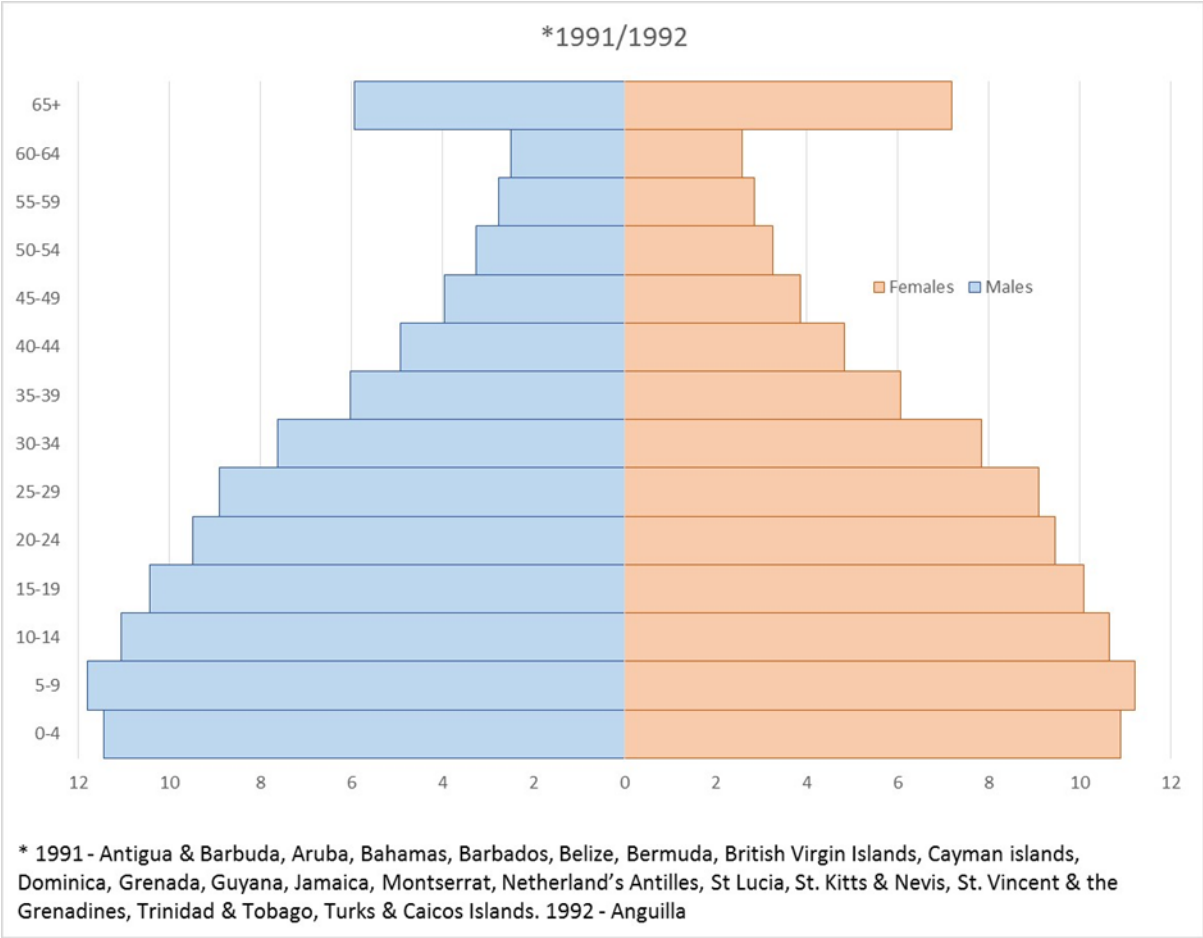


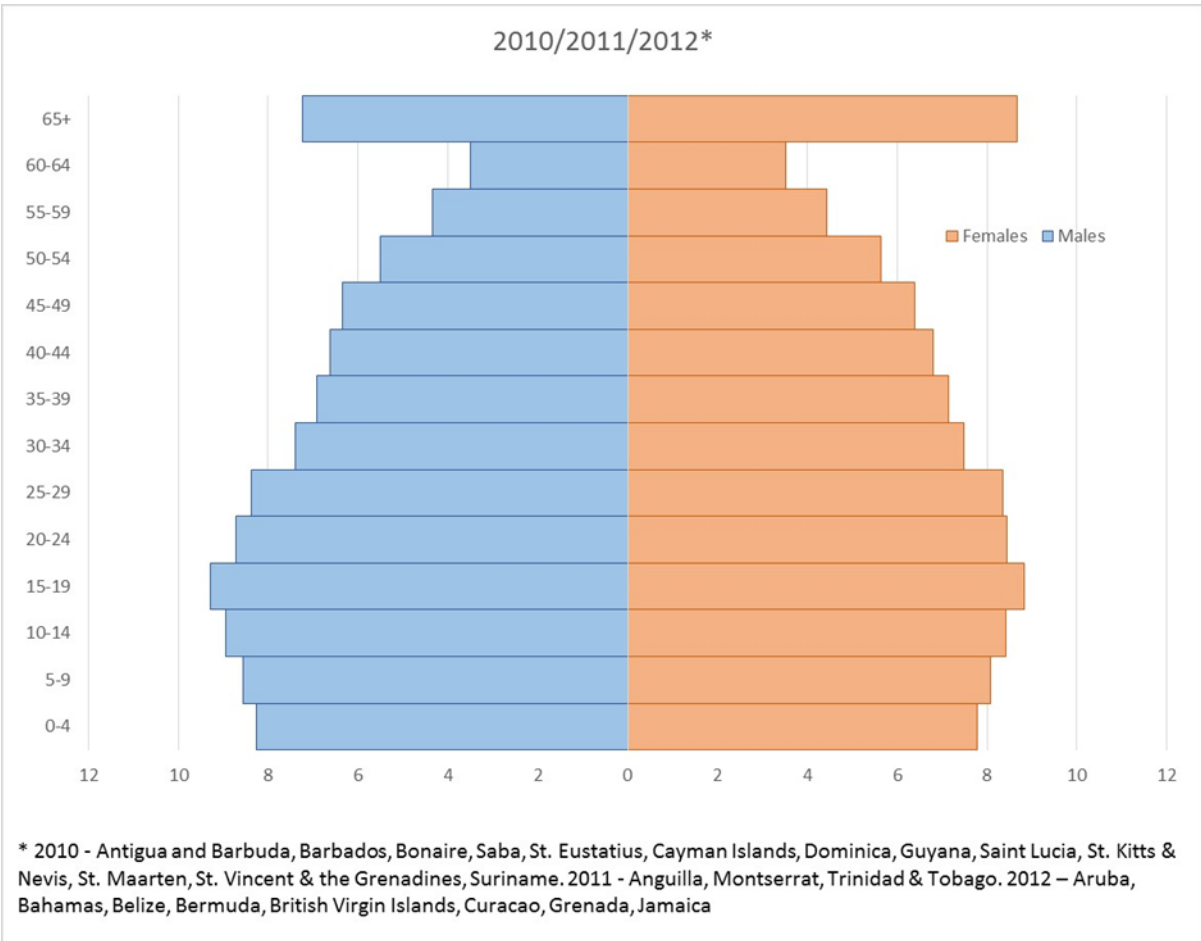
1.2 Demographic overview of CARPHA Member States

Population sizes in CMS range from approximately 1,900 on the island of Saba to over 10.5 million people in Haiti (Figure 2). Population ageing is occurring in almost all countries of the world and has major social, health and financial consequences. There is clear evidence of this effect in CMS when the combined population pyramid from censuses in CMS in the early 1990s is compared to that from censuses conducted two decades later, in 2010, 2011 and 2012 (Figure 2). In the early 1990s, the population aged 65 and over accounted for 6% of the male population and 7% of the female population. By the early 2010s, the oldest age group accounted for 7% of males and 9% of females. At the young end of the age spectrum, in the early 1990s children 14 years and under accounted for 34% of males and 33% of females. By the 2010s these percentages had shrunk to 26% and 24% for males and females respectively.

Figure 2: Population Pyramids

(% distributions by age group and sex) for CARPHA Member States, 1991/1992 and 2010/2011/2012





The demographic shift has resulted from a combination of factors including reductions in the number of children per woman (fertility) and a combination of economic and health care improvements that have tended to increase longevity and reduce infectious disease.

The changing age profile of the population is one of the factors that has given rise to a changing health and disease profile, entailing an increase in the burden of NCDs relative to communicable diseases (CDs) in the population. The specifics of this transition in the Caribbean region will be presented in more detail in Chapter 2.

1.3 Health Frameworks and Institutions

The Caribbean has seen the development of inter-governmental agreements, declarations and institutions which respond to regional needs and supplement those of hemispheric and global agencies. In the sphere of health, there are a number of frameworks to develop a collective and coherent response to health issues identified by governments as being priorities for the Region. Such cooperation is necessary given the small size of individual countries and their low capacity individually. Regional frameworks include, among others, the *Caribbean Cooperation in Health (CCH)* framework and the *Port of Spain Declaration on Non-Communicable Diseases*.

The Caribbean also has a long tradition of institution-building for public health across the region. For instance, a regional institution for medical research was established as early as 1955 and continues as part of the CARPHA today. Agreements, declarations and agencies will be described below.

The CARPHA Member States (CMS) are committed to many regional and international frameworks and agreements. Some of those relating to health are described in section 1.3.1, while others most pertinent to VBDs and CO are listed in the chapters dedicated to those topics. Additionally, there are regional institutions committed to conducting research, increasing surveillance and building collaboration among regional and international health partners. Some of these are described in section 1.3.2.

1.3.1 Regional health frameworks

Caribbean Cooperation in Health Frameworks

The Caribbean Cooperation in Health (CCH) frameworks were originally established in 1984 by agreement between CARICOM Health Ministers. The first framework, CCH I, was adopted in 1986 and went a long way in assisting in the region's eradication of measles. The evaluation of the CCH II (1999-2003) recognised the scaling up of the national and regional response to HIV and AIDS. The third in the series, CCH III, covered the years 2010 to 2015, and thus the years 2014-2016 which are the subject of this SPHR. The CCH III had five main areas of functional cooperation as follows:

- Creation of a healthy Caribbean environment conducive to promoting the health of its people and visitors.
- Improved health and quality of life for Caribbean people throughout the life cycle.
- Health services that respond effectively to the needs of the Caribbean people.
- Adequate human resource capacity to support health development in the region.
- Evidence-based decision making as the mainstay of policy development in the region.

The CCH III had eight priority areas – (1) communicable diseases, (2) non-communicable diseases, (3) strengthening health systems, (4) environmental health, (5) food and nutrition, (6) mental health, (7) family and community health, and (8) human resource development. An evaluation of CCH III is described later in this report (see section 2.5.3), and informed *CCH IV 2016-2025: Focussing on Regional Public Goods for Sustainable Health Development*. CCH IV was also framed in the context of the recently approved Sustainable Development Goals (SDGs) and the CARICOM Strategic Plan 2014-2019. https://issuu.com/caricomorg/docs/caribbean_cooperation_in_health_pha

The Nassau Declaration on Health 2001: The Health of the Region is the Wealth of the Region

The Nassau Declaration on Health was affirmed by the region's Heads of Government in Nassau in 2001. It was historic in establishing the principle of an expanded, multi-sectoral response to health, bringing together a variety of government ministries alongside other agencies within and outside government. It was also important in being based on the recognition of the profound costs of ill-health to Caribbean development.

Here, it was stated that, “...HIV/AIDS may impede such [economic] development through the devastation of our human capital...” and that the HIV/AIDS crisis was to be made a priority for the region. The Declaration, “...formally institutionalized the operationalization of policy transfer by recognizing the importance of pan-Caribbean governance issues...” by endorsing the Pan Caribbean Partnership Against HIV/AIDS (Wiseman, 2012, p. 271). There are seven fundamental tenets of the Nassau Declaration 2001 in which the Caribbean Heads of Government committed to pursue initiatives and targets to be implemented to achieve an improved health status of populations within the following five years, emphasising leadership, strategic planning, management, implementation and resource mobilisation in the context of health sector reform processes, building on current regional and sub-regional initiatives. These tenets can still be seen, for example in the recent formation of CARPHA through the amalgamation of five regional institutions in 2013. http://archive.caricom.org/jsp/communications/meetings_statements/nassau_declaration_on_health.jsp?menu=communications

The Port of Spain Declaration on Non-Communicable Diseases 2007: Uniting to Stop the Epidemic of NCDs

In September 2007, a regional summit of the Heads of Government was held in Port of Spain, Trinidad and Tobago in acknowledgement of the threat to health and socio-economic development posed by the burden of NCDs. This was the world’s first summit of regional heads of governments to be held specifically on NCDs. This led to the Port of Spain Declaration which called on the CARICOM Member States to strengthen regional health institutions, provide leadership to reduce the burden of chronic NCDs and establish NCD National Commissions. Again, a multi-sectoral approach was espoused.

Over the next four years CARICOM advocated for a United Nations (UN) high-level summit on NCDs in several international fora: the Fifth Summit of Americas (2009), Commonwealth Heads of Government (2009), with Brazil and the World Health Organisation (WHO) before the UN representatives (2010) and at the Second CARICOM-Japan Ministerial Conference (2010). At the Thirty-First Regular Meeting of the Conference of Heads of Government of CARICOM, UN Secretary General Ban Ki-Moon gave his full support and congratulated CARICOM on its efforts for addressing the issue of NCDs. Finally, in September 2011, 113-member states met at a UN High Level Meeting (UNHLM) on Non-Communicable Diseases in New York. Following this meeting, WHO agreed to a world-wide target of reducing premature mortality from NCDs by 25% between 2012 and 2025. Later in 2013, UN member states adopted further targets to reduce NCDs at the UN World Health Assembly (Samuels, Kirton, & Guebert, 2014). The mobilisation of international public health efforts around NCDs was a major achievement for the small Caribbean region.

http://archive.caricom.org/jsp/communications/meetings_statements/declaration_port_of_spain_chronic_ncds.jsp

Figure 3: CARICOM Heads of Government at the meeting leading to the Port of Spain Declaration, 2007



Source: Healthy Caribbean Coalition

<https://www.healthycaribbean.org/declaration-port-spain/>

Millennium Development Goals (2000-2015) and Sustainable Development Goals (2015-2030)

While not focussing exclusively on health, the UN Development Goals are internationally-agreed overarching frameworks that seek to integrate health with other development concerns and which frame public health as a critical contributor to national development.

The Millennium Development Goals (MDGs), established in 2000 by the UN General Assembly were a commitment of eight goals by countries and development partners around the world to combat poverty and promote development in low- and middle- income countries. Three of the eight goals specifically focussed on health:

- MDG4: Reduce child mortality
- MDG5: Improve maternal health
- MDG6: Combat HIV/AIDS, malaria and other diseases

All the other MDGs could be said to be relevant to health as well, since they focus on social determinants of health such as poverty (MDG1), education (MDG2), gender equality (MDG3), environmental sustainability (MDG7) and global partnerships (MDG8). A Social Determinants of Health (SDH) conceptual framework is described below, in section 1.4.

The Sustainable Development Goals (SDGs) adopted by the UN General Assembly in 2015, set out the new internationally agreed development agenda, *Transforming our world: the 2030 agenda for*

sustainable development. They integrate the dimensions of sustainable development -economic, social and environmental - and prioritise poverty and hunger, while also focussing on human rights. The SDGs consist of 17 goals with 196 targets. Among the 17 SDGs, only one, SDG3, focuses explicitly on health – “*Ensure healthy lives and promote well-being for all at all ages*”. As with the MDGs, there are many linkages between the health goal and the other goals and targets, such as those on food security, gender equality, water availability and sanitation management, combatting climate change, and violence prevention. Achieving Universal Health Care (UHC), one of the 13 SDG3 targets, provides a framework for achieving SDG3 by 2030 (UNDP, 2015; WHO, 2015a).

1.3.2 Regional health institutions

Caribbean Public Health Agency

CARPHA is the single regional public health agency for the Caribbean. In 2002, CARICOM conducted a review of the five Regional Health Institutions (RHIs) to determine how best they could serve the needs of the Caribbean people. These RHIs were the Caribbean Environmental Health Institute (CEHI); the Caribbean Epidemiology Centre (CAREC); the Caribbean Food and Nutrition Institute (CFNI); the Caribbean Health Research Council (CHRC), and the Caribbean Regional Drug Testing Laboratory (CRDTL). The results of this review determined that the best way forward was to integrate these five agencies into a single regional public health institution in order to face present and emerging public health challenges.

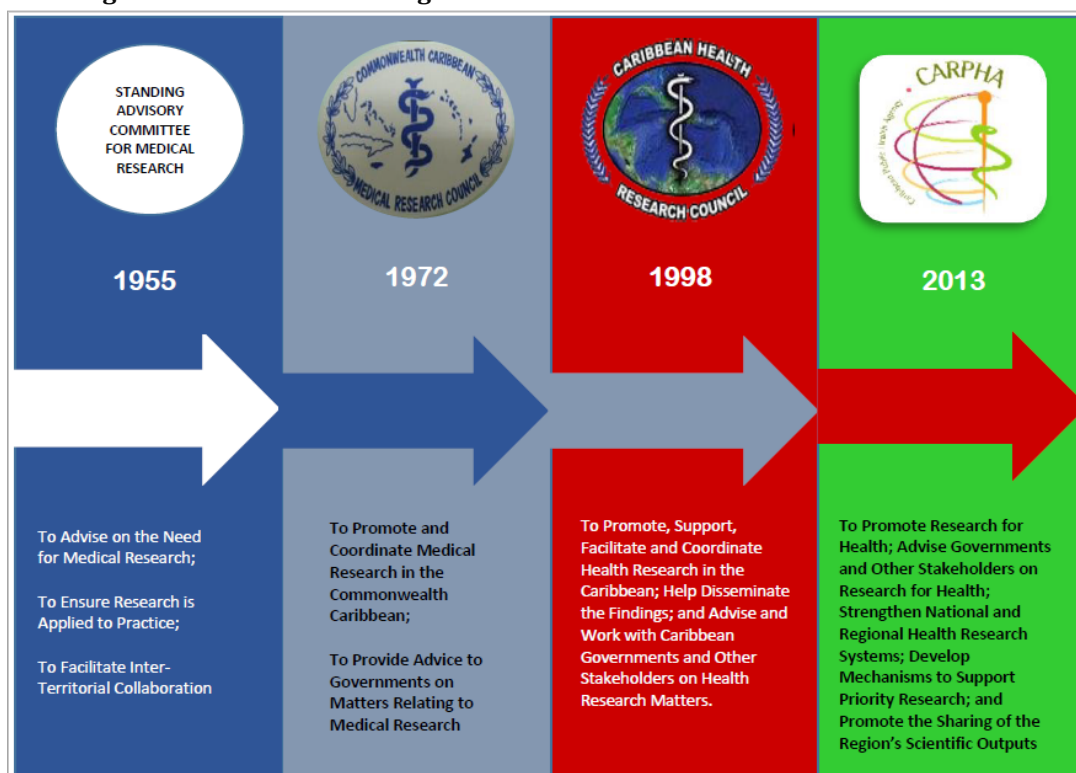
CARPHA was legally established in July 2011 by an Inter-Governmental Agreement (IGA) signed by CARICOM Member States. It began operation in January 2013. The Agency rationalises public health arrangements in the Caribbean by combining the functions of the five RHIs into a single agency, easing coordination of public health responses. As mandated by the IGA, one of its core functions is “...to support the relevant objectives of the CCH...” (CARICOM, 2011, p. 5). CARPHA provides technical support to 24 countries and territories throughout the Caribbean region and provides services to those CMS which are too small to have certain services of their own, such as laboratory testing, public health surveillance and information systems, and training and research programmes (CARICOM, 2011).

CARPHA represents the Caribbean Region’s collective response to strengthening and reorienting the health system approach to address the changing nature of public health challenges. The objectives of CARPHA are to:

- 1) promote the physical and mental health and wellness of people within the Caribbean;
- 2) provide strategic direction, in analysing, defining and responding to public health priorities of CARICOM;
- 3) promote and develop measures for the prevention of disease in the Caribbean;
- 4) support CARICOM in preparing for and responding to public health emergencies and threats;
- 5) support solidarity in health, as one of the principal pillars of functional cooperation in CARICOM; and
- 6) support the relevant objectives of the CCH.

One example of CARPHA’s achievements during the 2014-2016 period, which this SPHR covers, was the hosting of the 60th Annual Caribbean Health Research Conference in 2015 in Grenada. This is the longest-running health conference in Latin America and the Caribbean. The longevity of this annual event is testament to its regional and international value. As an international scientific meeting, it serves principally as a forum for sharing new health research findings from within the Caribbean. The medical and health research council has changed names over the many years of its existence, starting with the Standing Advisory Committee for Medical Research (1955); then to the Commonwealth Caribbean Medical Research Council (1972); the Caribbean Health Research Council (1998) and finally to the present day CARPHA after the historic merger of the RHIs in 2013.

Figure 4: Timeline of the Regional Health Research Councils in the Caribbean



Source: (Hunte, 2015)

Caribbean Community

CARICOM was formed in 1973 through the signing of the Treaty of Chaguaramas by Prime Ministers from Barbados, Guyana, Jamaica and Trinidad and Tobago. It has since grown to include 20 countries – 15 Member States and 5 Associate Members. CARICOM works through four pillars – economic integration; foreign policy coordination; human and social development; and security. CARICOM is the oldest surviving integration movement in the developing world.

Within the governance structure of CARICOM, the Council for Human and Social Development (COHSOD) consists of regional Ministers of Health, Human and Social Development. Their role is to

promote the development of a healthy human environment through the improvement of policies and programmes in health, education, living and working conditions, culture and sports for all citizens of CARICOM, especially the youth and women, and to encourage their participation in social, cultural, political and economic activities.

With regard to health, CARICOM has been responsible for the formation of CARPHA. It also helped establish the Pan Caribbean Partnership Against HIV/AIDS (PANCAP) PANCAP was formed in February 2001 and was endorsed by regional government heads via the Nassau Declaration on Health 2001. PANCAP was one of the first multi-sectoral, multilevel, regional AIDS partnerships. It includes regional governments, regional and international organisations from both health and non-health sectors, organisations of people living with and affected by HIV, donors, UN agencies, and business and religious organisations, working together to reduce the spread and mitigate the impact of HIV and AIDS on human development. <http://caricom.org/>

Healthy Caribbean Coalition

The Healthy Caribbean Coalition (HCC), arising from the 2007 Port of Spain Declaration on NCDs, was formed in 2008. HCC is a civil society alliance established to combat NCDs and their associated risk factors and conditions. It is the only regional umbrella organisation for civil society organisations doing such work. HCC's membership consists of over 60 Caribbean-based health NGOs, over 65 non-health NGOs and more than 350 individual members regionally and internationally.

HCC collaborates closely with national, regional and international partners from Ministries of Health throughout the Caribbean, inter-governmental organisations such as CARPHA, PAHO and WHO and international NGOs such as the NCD Alliance (Healthy Caribbean Coalition, 2017c). HCC's objectives are to:

- (1) contribute and participate in all aspects of advocacy as a tool for influencing positive change around NCDs through mobilisation of Caribbean people and the creation of a mass movement aimed at responding to the NCDs;
- (2) develop effective methods of communication for and among members of the Coalition and the people of the region;
- (3) build capacity among health NGOs and civil society in the region;
- (4) contribute to NCD public education campaigns and programmes;
- (5) advocacy and support for NCD risk factor reduction through: (a) tobacco control and implementation of the Framework Convention on Tobacco Control (FCTC); (b) increased physical activity; (c) improved dietary intake including reduction of salt and sugar, elimination of trans fats, and responsible alcohol use; (d) support of initiatives, plans and programmes at country and organisation level; and (e) advocacy and support for enhanced detection and management of chronic diseases <https://www.healthycaribbean.org/>

University of the West Indies

The University of West Indies (UWI) serves 18 English-speaking countries and territories in the Caribbean. It has three physical campuses in Barbados, Jamaica and Trinidad and Tobago and several satellite campuses in other countries. Additionally, there is an Open Campus which has a physical site in each of the 18 states.

This regional institution plays an important role in human resource capacity building for health. This includes public health teaching programmes in the Faculty of Medical Sciences and through its various other academic programmes oriented to human development. It is also the site of influential health research, conducted by staff of the Faculty of Medical Science and the Faculty of Social Science. The Health Economics Unit (HEU) is a specialist Unit within the Faculty of Social Science, conducting research, training and projects in areas including social insurance, poverty, health and sustainable development, equity, health policy and management. Public health areas of interest include HIV, NCDs, aging, and children and women. <https://sta.uwi.edu/fss/heu/>

The history and characteristics of the agreements and institutions for public health set up by Caribbean people demonstrate their appreciation that health and development are intrinsically linked, and that multi-sectoral and multi-faceted approaches are necessary to address many health challenges. In the following section we present a theoretical framework to conceptualise such expanded approaches to public health. The framework will be used throughout this document to assist in the analysis of determinants of, and strategies for, public health.

1.4 The Social Determinants of Health

In 2005, the then Director-General of the WHO set up the Commission on the Social Determinants of Health (CSDH). The Commission's mandate was to assist in tackling the social causes of poor health and avoidable health inequalities through the gathering and review of evidence on what has to be done to reduce health inequalities within and between countries, and to identify recommendations (WHO, 2017a). The CSDH defined the SDH as, "*the conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life. These forces and systems include economic policies and systems, development agendas, social norms, social policies and political systems*" (WHO, 2017e). For a long time, it had been widely accepted that the SDHs play a large role in the existence of health inequities, defined as, "*...the unfair and avoidable differences in health status seen within and between countries.*" (National Academies of Sciences Engineering and Medicine, 2016; WHO, 2008, 2017g). In order to achieve SDG targets, and in particular, UHC, the SDHs and issues of health equity must be addressed in an "integrated and systematic manner." (WHO, 2017g).

The 2008 report by the CSDH recommends that in order to achieve health equity three principles of action must be adhered to (WHO, 2008, p. 2):

1. Improve the conditions of daily life – the circumstances in which people are born, grow, live, work, and age.
2. Tackle the inequitable distribution of power, money, and resources – the structural drivers of those conditions of daily life – globally, nationally, and locally.
3. Measure the problem, evaluate action, expand the knowledge base, develop a workforce that is trained in the SDH, and raise public awareness about the SDH.

The report also emphasises that, *“action on the SDH must involve the whole of the government, civil society and local communities, business, global fora, and international agencies. Policies and programmes must embrace all the key sectors of society not just the health sector”* (WHO, 2008, p. 1).

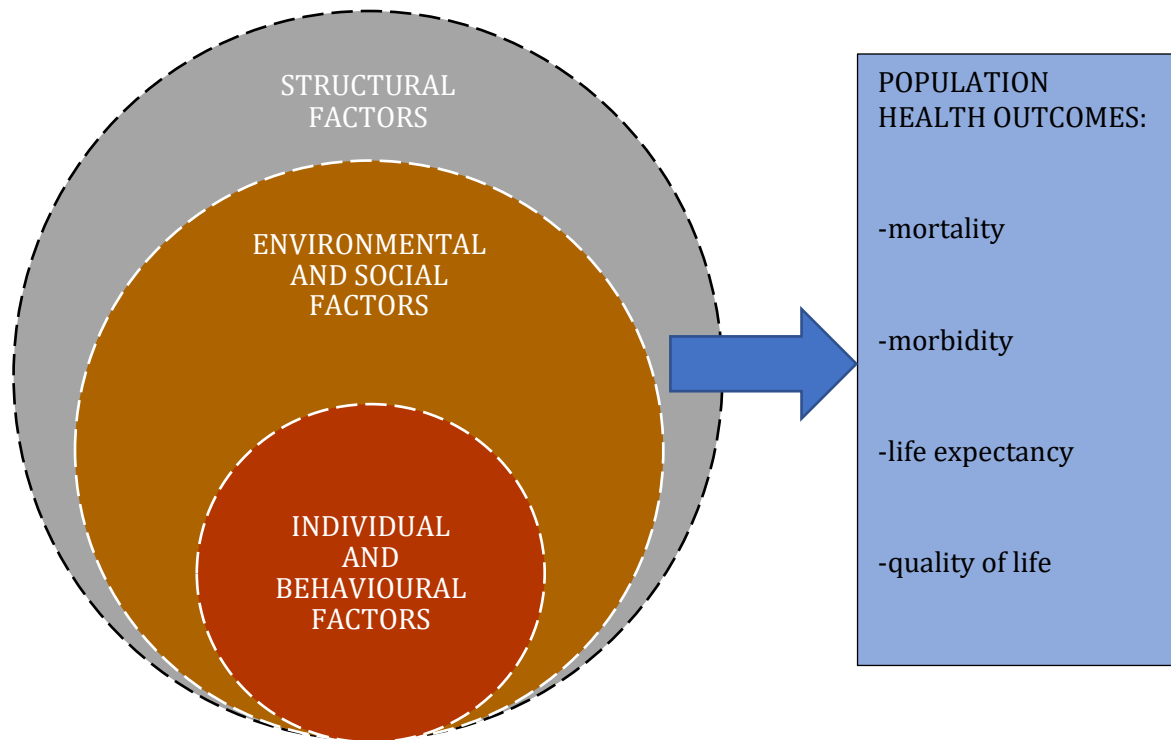
The use of models, or frameworks, can assist in understanding how the SDH impact on individuals, communities, and the population as a whole. They can also assist with policy planning and development by identifying areas of opportunities for both health and non-health sectors to work together in reducing health inequalities as experienced both within and between countries and regions (Canadian Council on Social Determinants of Health, 2015).

There are several models that can be used to depict the SDH. The ecological model used for this report is an adaptation of several models (Framework for addressing the Social Determinants of Health and Well-Being, Queensland Health, 2001; Wider Determinants of Health Model, Dahlgren and Whitehead, 1991; Commission of Social Determinants on Health Conceptual Framework, WHO, 2007;

A Heuristic Framework for the Social Epidemiology of HIV/AIDS, Poundstone et al, 2004; and The Socio-Ecological Model, McLeroy et al, 1988) and uses three basic levels to describe the SDH(Canadian Council on Social Determinants of Health, 2015; McLeroy, Bibeau, Steckler, & Glanz, 1988; Poundstone, Strathdee, & Celentano, 2004; Ruderman, 2013; UNICEF, n.d.):

- (1) individual and behavioural;
- (2) environmental and social; and
- (3) structural.

Figure 5: An Ecological Model to Frame the Social Determinants of Health



Generally, the structural factors are thought of as influencing the environmental and social factors, which in their turn influence the individual and behavioural factors and thereby health outcomes. For example, in considering childhood obesity, one structural factor is macroeconomic policy and how this influences the range and prices of food imported and available in a country. There may also be policies on school feeding. These factors will influence environmental and social factors such as the school “food environment”, including the range of foods available in school and the environs of the school premises (such as private food stalls and vendors), their relative prices and scarcity. Individual and behavioural factors may include the types of food chosen, the quantity and frequency of eating, all of which are associated with childhood obesity. Chapter 3 includes more in-depth analysis of the various levels of factors influencing childhood obesity.

It is important also to observe that the different levels are nested within one another, depicting that individual characteristics and behaviour contribute to the environment and society which in turn contribute to the structural factors. Additionally, the dotted lines between each level indicate that the borders between each level are porous and that the various factors may move between the different levels depending on the priority population, the context and the health issue being examined. This ecological model will be used in the analysis of this report’s thematic areas – CO and VBDs – to organise the information presented on the various levels of influence and interventions to promote better health outcomes.

Table 3 gives examples of factors at each of the levels. Note that the examples are illustrative only and the list of issues is not comprehensive across all health conditions which may be examined; each health condition will be affected by specific factors at each level. Chapters 2 and 3 present specific ecological frameworks for the analysis of VBD and CO.

Table 3: Examples of Factors at Levels of the Ecological Model for Health

Individual and Behavioural Factors	Environmental and Social Factors	Structural Factors
<p><i>Biological & Demographic</i></p> <ul style="list-style-type: none"> • Age • Biological sex • Race/ethnicity • Genetics • Blood pressure • Blood lipid levels • Blood sugar levels • Body mass index <p><i>Psychosocial</i></p> <ul style="list-style-type: none"> • Self esteem • Emotional state • Mental state • Addiction <p><i>Health behavioural</i></p> <ul style="list-style-type: none"> • Diet and nutrition • Smoking and drug consumption • Alcohol consumption • Physical activity • Self-harm and addictive behaviours • Sexual behaviour • Preventative health care use • Adherence to health recommendations • Hygienic and environmental practices 	<ul style="list-style-type: none"> • Social networks and support systems (including family, friends, peers, co-workers, religious networks) • Behaviour of significant others, e.g. peer pressure, violence • Social norms • Stigma associated with disease • Family and personal income • Community connections • Work environment • School environment • Health care setting environment • Education • Employment/unemployment • Environmental factors (e.g. climate, green spaces) • Housing • Agriculture and food security • Health care availability and access • Water and sanitation • Distribution of vectors • Population density • Media 	<ul style="list-style-type: none"> • International, regional, and national health policies • International, regional, and national policies in non-health sectors such as trade, agriculture, sanitation, and security. • Global forces (including patterns and dynamics of investment, migration, and conflict) • Allocation of resources to health care • National income, income distribution and poverty • Discrimination and social exclusion based on gender, race, disability, sexual orientation, and other dimensions of social difference • Interventions to alter environmental, social, individual, and behavioural factors

Chapter 2. Overview of Public Health in the Caribbean

Executive summary

Overview of public health in the Caribbean

This report examines the state of Public Health in Caribbean, a diverse group of countries and territories of the which are, small in population and geographical size, and highly vulnerable to man-made and environmental shocks. Focus is placed on chronic and acute issues between the years 2014-2016 and the actions taken to address health threats identified.

An overview of public health in the Caribbean is provided in Chapter 2. This involves looking at communicable and non-communicable diseases (NCDs), injuries, risk factors and social vulnerabilities. Progress in meeting the recommendations and targets of some major health frameworks is presented. Chapters 3 and 4 focuses on two key areas of public health significance for the 2014-2016 period. These are vector-borne diseases (VBDs) and childhood obesity (CO). VBDs presented immediate threats in the 2014- 2016 period, in which epidemics of chikungunya and Zika: both VBDs that had not been encountered in the Caribbean before had occurred. CO Obesity is an increasing threat, affecting the next generation, and thus the economic and social development of the region.

Health related factors affecting the Caribbean population include (but are not limited to): ageing, import dependency, sedentary lifestyles, climate, and natural disasters. Between censuses conducted around 1990 and those around 2010, the proportion of the Caribbean population aged 14 years and under declined by 9%, while the population aged 65 years and over increased by 2%.² Increased prevalence of non-communicable diseases (NCDs) and increased life expectancy are probable confounding factors to the adjustments in the overall age profile. Seventy percent of foods consumed are imported from outside the region, which may infer increased probability of susceptibility to food borne disease and NCDs associated with the consumption of processed food. The transition towards a service based economy, led by sectors such as finance, and away from agriculture and manufacturing, and the advent of social media and hand-held digital devices, tend to decrease physical activity levels in some populations. The effects of global warming are the inferred cause of the proliferation of infectious diseases and mosquito vectors, and increased the frequency of storms and hurricanes in the Caribbean region. During the 2014-2016 period, Tropical Storm Erika and Hurricane Matthew were among the natural disasters experienced by Caribbean people. Erika displaced or made homeless 1,300 people in Dominica, and revealed a need for additional mental health services in addition to traditional disaster relief. Matthew caused the death of 575 people in the Caribbean, of whom 546 were in Haiti, and led to major economic disruption in many Caribbean countries and territories.

² These population data refer to CARPHA Member States (CMS), as listed in Table 2 of Chapter 1. There are 26 CMS, including CARICOM Member States, CARICOM Associate Members and Dutch Caribbean States.

Disease conditions

NCDs accounted 73% of deaths in the 2000 to 2016 period. Communicable, Maternal, Perinatal and Nutritional Conditions accounted for 13.2%, Injuries for 9.7%, and Symptoms, Signs, and Ill-defined Conditions for 4.1%. A striking finding is the increase in injuries as a cause of death. These accounted for 5% of deaths in 2000 and 10% in 2015.

The three leading causes of death from 2000 to 2016 are cerebrovascular disease, diabetes, and ischemic heart disease, which, collectively, accounted for 29.6% of all deaths over the period. HIV started the 21st century as the fourth leading cause of death, but its rank has declined, and hypertensive diseases are now the fourth leading cause.

Communicable, maternal, perinatal, and nutritional conditions account for two-thirds (66%) of deaths in babies under 1 year old, and more than one-fifth of deaths in the ages between 1 to 4 years old. Similarly, these are the inferred causes of more than 20% of deaths among 30 to 39 years old. NCDs account for more than 40% of all deaths in all age groups except among babies under 1, and adolescents and young adults from the ages of 15 to 34. Among adolescents aged 10+ years through to adults aged up to 34 years, injuries account for more than 40% of deaths, due to the high toll of accidents and violence among young people. Assault is the leading cause of death among males aged less than 65 years, indicating a need for alliances between health, security, and law enforcement agencies to reduce injury related deaths, which may be linked to lifestyles associated with the drug trade, excessive alcohol consumption and gang activity.

The age of death from HIV has risen over time, from the age of 30 years in 1996, to 50 years in 2016, likely due to the increased availability of antiretroviral therapy (ART). Notably, since 2006, CARPHA Member states (CMS) reported fewer AIDS cases, which could be due to increased ART use reducing the probability in number of AIDS related deaths in younger age groups. In 2010, adult ART treatment coverage in 23 Caribbean countries ranged from 57-70% with a sharp 29% increase from 2006. However, there is increasing vulnerability of women and girls to HIV infection, with a ratio of merely 5% increase in males versus female HIV cases being reported by CMS since 2003.

Vaccination has made an important contribution to the reduction in prevalence of some other communicable diseases. In 2015, on average, Caribbean countries had achieved at least 95% vaccination coverage against polio; diphtheria, tetanus, and pertussis; and measles, mumps and rubella. The average coverage for the anti-tuberculosis vaccine, BCG, was 91%.

Viruses for which no effective vaccine exists continue to affect public health. Since 2009, when it was declared a Public Health Emergency of International Concern (PHEIC), H1N1 virus (also known as “swine flu”) has caused considerable illness in CMS, accounting for 17% of respiratory virus illness cases in 2014, 31% in 2015 and 20% in 2016. The three respiratory viruses with the most cases reported were (in descending order of numbers): RSV, H1N1 and H3 in 2014; H1N1, rhinovirus and RSV in 2015, and RSV, H1N1 and rhinovirus in 2016. Peak numbers of respiratory virus cases are in the first and last quarter of each year, reflecting greater travel and visitor arrivals at these times of year.

During the period 2014-2016, there were increased numbers of cases and outbreaks of acute gastroenteritis and food-borne disease pathogens reported by CMS. Since 2005, salmonella accounted for the largest number of reported cases of laboratory-confirmed food-borne disease, followed (in descending order of numbers) by ciguatera, campylobacter, shigella, norovirus and vibrio. In the 2014-2016 period there was a notable sharp increase in the number of cases of salmonella and ciguatera cases in 2014, campylobacter cases in 2015 and norovirus cases in 2015.

Anti-microbial drug resistant pathogens, have been reported in the Caribbean by hospitals and in community settings. Cases of drug resistance by the following pathogens have been identified: pneumococci, *Haemophilus influenzae*, multi-drug resistant *Mycobacterium tuberculosis*, Enterobacteriaceae and carbapenemase-producing bacteria.

Determinants of health

An ecological framework is used throughout this report to describe the determinants of health, at three main levels: individual/ behavioural; social/ environmental, and structural.

Individual/ behavioural determinants have been identified in numerous Caribbean studies, including Stepwise Approach to Surveillance (STEPS) surveys of NCD risk factors, conducted in CMS since 2006. The STEPS surveys showed:

- A wide range in levels of smoking between countries, with a common feature being far higher levels among men than women.
- Rates of harmful use of alcohol ranging from 15% to 48% among men and 3% to 35% among women.
- Low levels of physical activity, ranging from 35% to 63% among women, and 15% to 45% among men.
- Average consumption of fruit and vegetables reported to be far below the recommended amount of five servings per day for both men and women in all countries.
- More than half of women are overweight in all countries, and more than 30% of women are obese in all countries. Levels of overweight and obesity were lower but substantial among men.
- Raised blood pressure affect between 18% and 50% of men and between 16% and 35% of women.

Social and environmental determinants impacting on health are many, and some are specific to health conditions of concern. General determinants include low levels of social inclusion and access to facilities such as health care, education, housing, and sanitation based on poverty and discrimination. For example, these are associated with greater exposure to pathogens, environmental toxins, extreme weather, and consumption of harmful products. Improving environments in which people make choices, for example school meals facilities and the foods available in them, can improve health. Social and environmental determinants relating to VBD and CO are presented in detail in chapters 3 and 4.

Socioeconomic and environmental factors at the local level are influenced by political, economic, and environmental conditions and decisions at global and national levels. Among important structural factors affecting the health of Caribbean people are import dependency, a narrow range of exports (notably tourism), macroeconomic and trade policies, high levels of travel and migratory flows, and climate change.

Public health action

The Caribbean has a long tradition of institution-building for public health across the region. For instance, a regional institution for medical research was established as early as 1955 and continues as part of CARPHA today. CARPHA began operation in 2013, and merges five regional institutions previously working on public health in the region: the Caribbean Environmental Health Institute, the Caribbean Epidemiology Centre, the Caribbean Food and Nutrition Institute, the Caribbean Health Research Council, and the Caribbean Regional Drug Testing Laboratory.

The Caribbean has benefited from the development of inter-governmental agreements, declarations and initiatives which respond to regional needs and supplement those of hemispheric and global agencies. Regional frameworks include, among others, the *Caribbean Cooperation in Health (CCH)* frameworks (since 1984) and the *Port of Spain Declaration on Non-Communicable Diseases (2007)*.

An evaluation of the third in the series of CCH agreements, CCH III (2010- 2015), was published in 2016. The CCH III had contributed to advances in regional cooperation, such as: maintaining success in high-levels of vaccination coverage while decreasing communicable disease transmission; continued progress towards implementing commitments towards the prevention and control of NCDs; building capacity of Human Resources for Health and laboratory services and improving the safety of hospitals. Remaining challenges include, among others, difficulties in monitoring and evaluation given human resource scarcity and complexity of indicators, and lack of a communication strategy across sectors to increase stakeholder knowledge and bring them on board with CCH.

Evaluations completed by CARICOM Member and Associate States from 2012 to 2016 revealed variable success in implementing provisions of the *Port of Spain Declaration on Non-Communicable Diseases (2007)*. By 2016, most had a national NCD policy, strategy or action plan that integrated NCDs and risk factors as well as a budget or allocated funding; Caribbean Wellness Day multi-sectoral, multi-focal celebrations; and had conducted risk factor surveys. Notably, nutrition-related action was much less frequently implemented, such as: policies to reduce salt, limit saturated fats and eliminate trans fats and increase fruits and vegetables; Ministry of Health presence during negotiations on food security; implementation of WHO recommendations on the marketing of foods and beverages to children, and front-of packaging labelling for easy identification of unhealthy foods.

A qualitative evaluation of implementation of the *Port of Spain Declaration* began in 2014 and is ongoing, led by the University of the West Indies in collaboration with regional and international health agencies. Unpublished findings thus far suggest that: implementation of recommendations was more likely with elements where the action needed, and timeframe are clear including activities such as hosting Caribbean Wellness Day. Facilitating structures and resources should be put in place,

facilitated by people at the highest levels of government, and coordinated intervention from relevant CARICOM agencies is needed on nutrition-related action.

During the 2014 - 2016 period some major communicable disease emergencies in the Caribbean, with threats from Ebola, chikungunya and Zika. Actions taken to address these emergencies strengthened institutional capacity for regional health security. No cases of Ebola were detected in the Caribbean over the 2014 - 2016 period, but the epidemic that started in West Africa in December 2013 required massive mobilisation to mitigate the threat because of its severity. Following the WHO's declaration of Ebola as a PHEIC on August 8, 2014, CARPHA launched public education activities and established an Incident Management Team and hosted virtual meetings at least twice a month with Chief Medical Officers, Epidemiologists, and Laboratory Directors. Rapid assessments were carried out in CMS, using the International Health Regulations Core Competencies framework to assess preparedness with respect to aspects such as coordination, isolation facilities, transport of people and samples and skills in use of personal protective equipment. Training and equipment were provided, and a Regional Coordinating Mechanism on Ebola was established on November 4th, 2014. This was later renamed the Regional Coordinating Mechanism on Health Security, building on the experiences of addressing the Ebola threat to develop further the health security mechanisms of the Caribbean.

Conclusion

In the 2014- 2016, period, the PHEIC around Ebola was accompanied by new disease burdens in addition to the rising costs from chikungunya and Zika. These led to unprecedented measures to strengthen regional health security cooperation and infrastructure in infectious disease management. During the same period, the hurricane seasons demonstrated our ongoing and increasing dangers associated with climate change. Longer-term and systemic health challenges accompanied during environmental crises including a rise in respiratory and food-borne diseases, especially those not covered by vaccination, demonstrate the continued vulnerability of the public to environmental conditions and travel of goods and people. Health related impacts of HIV, accidents, and violence are examples that incur some of the costs in social divisions, stress and conflict. NCDs link global issues such as the distribution of food production and access, and individual behaviour such as dietary choices.

Agencies collaborated over the 2014- 2016 period to respond to the abovementioned crises. CARPHA strengthened alliances from the five regional health agencies from which it was formed, as well as other agencies concerned with public health ensuring that multi-sectoral approaches are used to address health including structural, social, environmental, behavioural and individual factors.

Introduction

As indicated by the ecological model above, health in a country or region is subject to a wide variety of internal and external forces. Some key internal characteristics and external policy factors have been presented. Before looking at features of health in the Caribbean, it is helpful to frame them with a consideration of models that seek to explain health transitions and the pattern of health conditions likely to occur under developmental conditions. We now examine such models and go on to look at patterns and trends in mortality, non-communicable diseases (NCDs) and communicable diseases. A final section of this chapter looks at evaluation of public health actions taken in response to the patterns and trends identified.

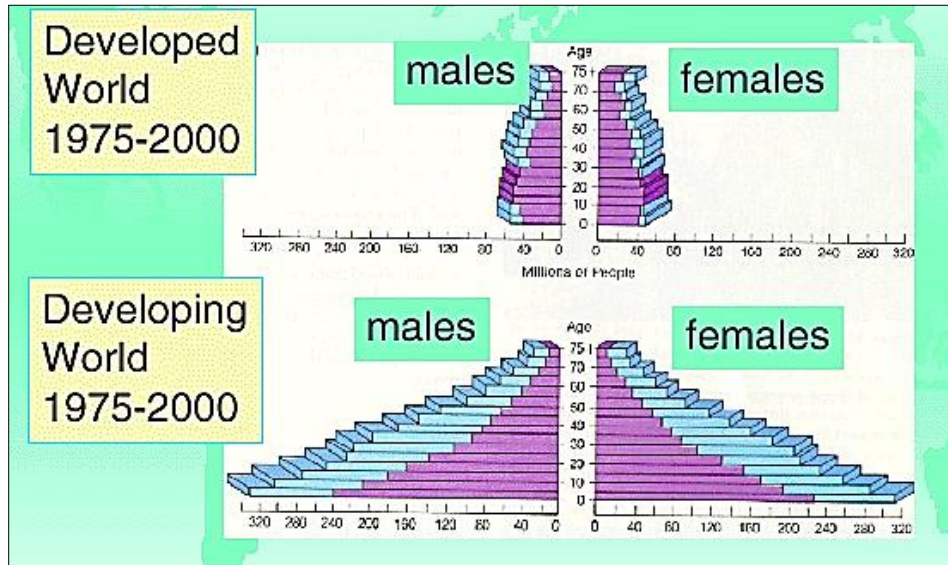
2.1 Transitions: epidemiologic, demographic and nutritional

Epidemiologic transition describes changes in mortality and morbidity patterns within and between countries. The main aspects are a decline in mortality, an increase in life expectancy, and a shift in the leading causes of morbidity and mortality from infectious and parasitic diseases to non-communicable, chronic, degenerative diseases. This transition is believed to result from improved economic conditions, medical care, an ageing population, public health interventions (e.g. vaccination programmes) and advances in nutrition and sanitation and health.

Demographic transition occurs when there is a shift in patterns of population ages usually resulting from periods of high fertility and high mortality to low fertility and low mortality. Nutritional transition can be described as the shift from malnutrition to that of an overabundance of food leading to obesity. As such epidemiologic transition is linked to demographic and nutritional transitions (Adogu, Ubajaka, Emelumadu, & Alutu, 2015; McKee, Karanikolos, Sim, & Pomerleau, 2011).

In 2016, the majority of the CARICOM Member States are classified by the UNDP as High Human Development countries with the exception of Guyana (Medium Human Development) and Haiti (Low Human Development) (UNDP, 2016). Thus, the range of population pyramids found with the Caribbean mirror those of both the developed and the developing worlds. For example, Barbados is classified as a high development country and Haiti as a low development country. The following figure demonstrates the population pyramids for “developed” and “developing” countries.

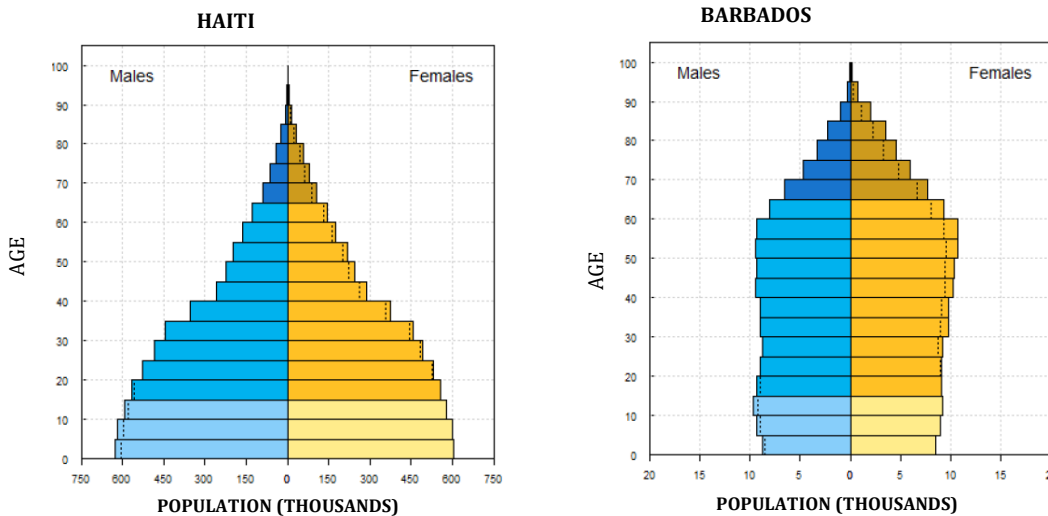
Figure 6: Archetypal population pyramids for the “developed” and “developing” world



Source: Adogu et al, 2015 p153

The following figure shows projected population pyramids for 2017 of Barbados and Haiti respectively. Haiti’s pyramid shape suggested that it is at an “early stage” and that of Barbados that it is at a “later stage” in such a transition. That these are both countries in the Caribbean region demonstrates the enormous variability in demographic conditions and associated challenges in the region. The relative youth of Haiti’s population exposes it to risks of infectious disease, sexually transmitted disease, accidents, and violence. High prevalence of NCDs is associated with Barbados’ relatively old population.

Figure 7: Projected population pyramids for Haiti and Barbados for 2017



Source: United Nations, Department of Economic and Social Affairs, Population Division 2017

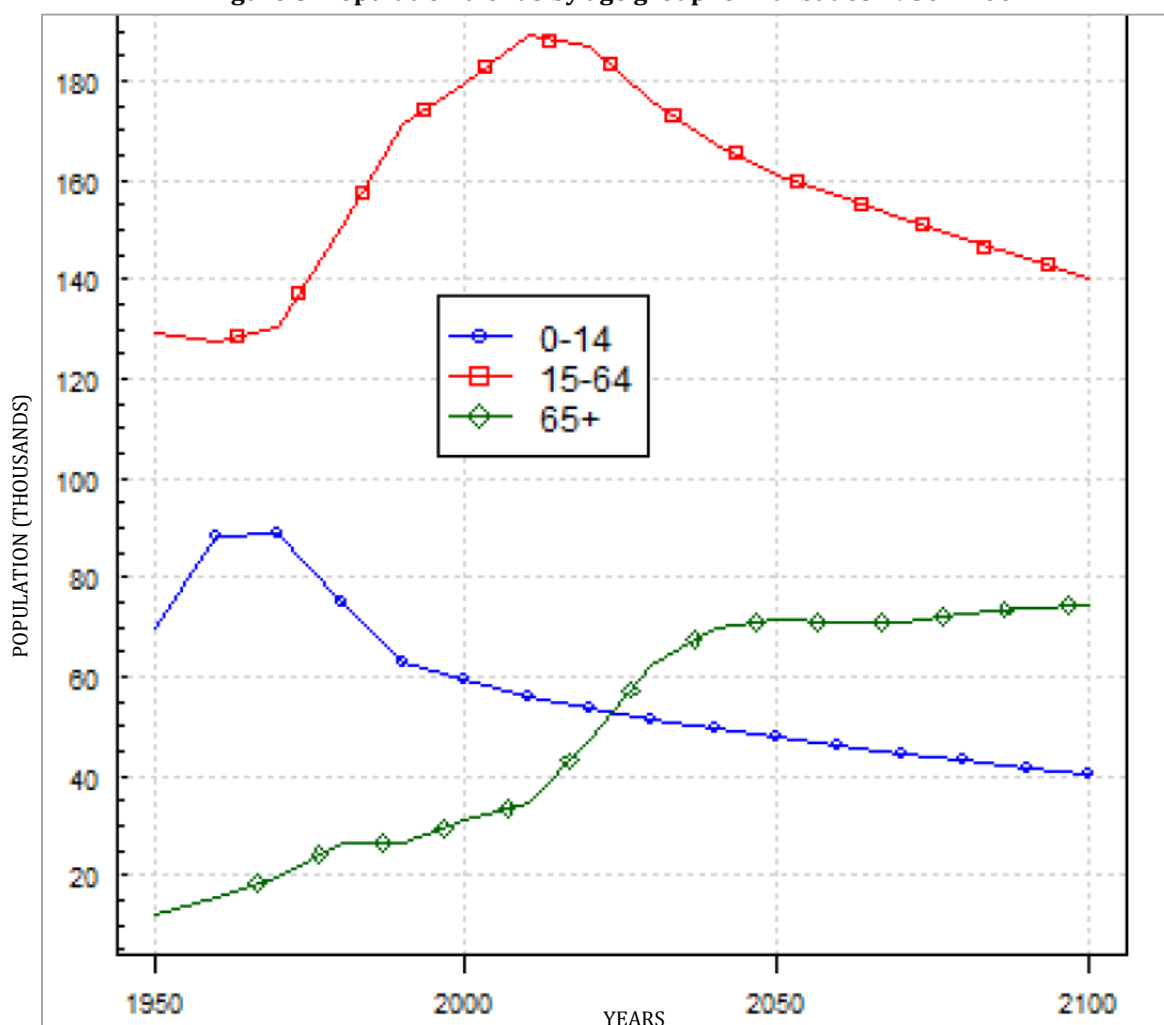
Abdel R Omran is thought to be the founder of epidemiological transition theory in his often-cited paper in 1971, where he stated that, “Conceptually the theory of epidemiologic transition focuses on the complex change in patterns of health and disease and on the interactions between these patterns

and their demographic, economic and sociologic determinants and consequences." (Omran, 2001, p. 1). Omran's paper has been subsequently adapted, adopted, and critiqued but is still important as it gave a framework to the concept of transitioning populations thereby stimulating further enquiry (Caldwell, 2001; McKeown, 2009; Sastre, Rojas, Cyrus, De La Rosa, & Khoury, 2014).

Omran's theory of epidemiologic transition consisted of five propositions. Firstly, the theory states that mortality is a fundamental factor in population dynamics. A period of declining mortality is usually followed by one of declining fertility. The combination of lower birth and death rates as well as higher life expectancies results in a change in the population age distribution. Section 1.2. gives a demographic overview of CARPHA Member States and the demographic transition to an increased elderly population (over 65 years old) coupled with a shrinking younger population (under 14 years old). Secondly, during the transition, a long-term shift occurs in mortality and disease patterns whereby pandemics of infection are gradually displaced by degenerative and man-made diseases as the chief form of morbidity and primary cause of death. Thirdly, during the epidemiologic transition, the most profound changes in health and disease patterns are among children and women. This is characterised by declining infant and maternal mortality and a resultant drop in fertility. Fourthly, the shifts in health and disease patterns that characterise the epidemiological transition are closely associated with the demographic and socioeconomic transitions that are associated with modernisation. This is characterised by lowered fertility and longer intervals between births, improved socioeconomic status leading to better nutrition and sanitation resulting in decreased morbidity and mortality (McKeown, 2009; Omran, 2001).

These epidemiological changes have an enormous impact on public health planning, health care provision, and health care workforce development including political, social, and financial policies. For example, in countries such as Barbados which is a high development country, (as with most of the Caribbean), Figure 8 demonstrates a growing aging population, and a falling working population (15-65 years old) and younger population (0-14 years old). From an economic perspective, the growing population of the elderly will consume a disproportionate amount of health care costs, particularly for continuous treatment and care of NCDs and other debilitating conditions. Such a population has reduced potential for economic income. At the same time there appears to be a decline in numbers of young people to move into the workforce.

Figure 8: Population trends by age group for Barbados 1950-2100



Source: United Nations, Department of Economic and Social Affairs, Population Division 2017

Limitations to Omran’s theory include the fact that it assumes a single trajectory of development. It ignores the history of colonial relationships between countries, whereby diversification of the economy may be stalled, and poverty worsened. It neglects global interdependencies and economic cycles of expansion and contraction. All of these affect living standards, availability of foodstuffs, health care and consumption patterns, and therefore health (Allen, 1999). The model provides a limited account of the roles of poverty and education in affecting disease risk. It has been observed that many “developing” countries now struggle with a “double burden” of high numbers of infectious diseases and NCDs. In sub-Saharan Africa, for example, prevalence rates for type 2 diabetes and cardiovascular diseases have seen a 10-fold increase in the past 20 years, while countries continue to suffer high death rates from communicable diseases (Adogu et al., 2015).

A further issue that has subsequently arisen is that the difference between infectious diseases and chronic diseases is not clear. For example, some infectious diseases have the characteristics of chronic diseases, especially with the emergence of life-prolonging treatment, such as HIV.

Additionally, some infectious agents and related inflammatory processes play a role in chronic disease outcomes e.g. Human Papilloma Virus is associated with development of cervical cancer. (Caldwell, 2001; McKeown, 2009). Thus, acute infections of short duration are accompanied by infections with long-term consequences, adding to health care costs.

For historical and geographical reasons, the Caribbean is highly open to global influences. Globalisation has not favoured all members of the population, and levels of unemployment and poverty are high (Rawwida Baksh and Associates, 2016). Poverty and geographical/ climactic factors are associated with epidemics of CDs. At the same time, the long-term expansion in Caribbean economies, increase in the availability of imported processed food, urban living with reduced green spaces and unhealthy eating have increased NCDs, leading to the “double burden” of CDs and NCDs (Adogu et al., 2015). The Caribbean region has also been undergoing a nutritional transition and is one that faces a dual burden on under- and over-nutrition. The prevalence of low birth weight remains between 4% and 11%, and between 28% and 35% for overweight/obesity among children 4-20 years old in the Caribbean (CARPHA, n.d.-b).

2.2 Mortality

Mortality patterns presented in this section suggest that epidemiological transition has taken place, as they are dominated by NCDs. At the same time, they present the “double burden” of developing areas of the world, with communicable diseases also among top ten causes of death. High prevalence of injuries brings a third burden to these vulnerable societies. There are notable differences by sex, suggesting the need to pay attention to gender in the design of health promotion strategies.

CMS report annual cause of death data to CARPHA. These data are typically presented by age, gender and underlying cause of death (UC). The UC refers to the train of morbid events leading directly to death or the circumstances of the incident (the external cause) that produced the (fatal) injury. The UC is the primary target for disease prevention and control.

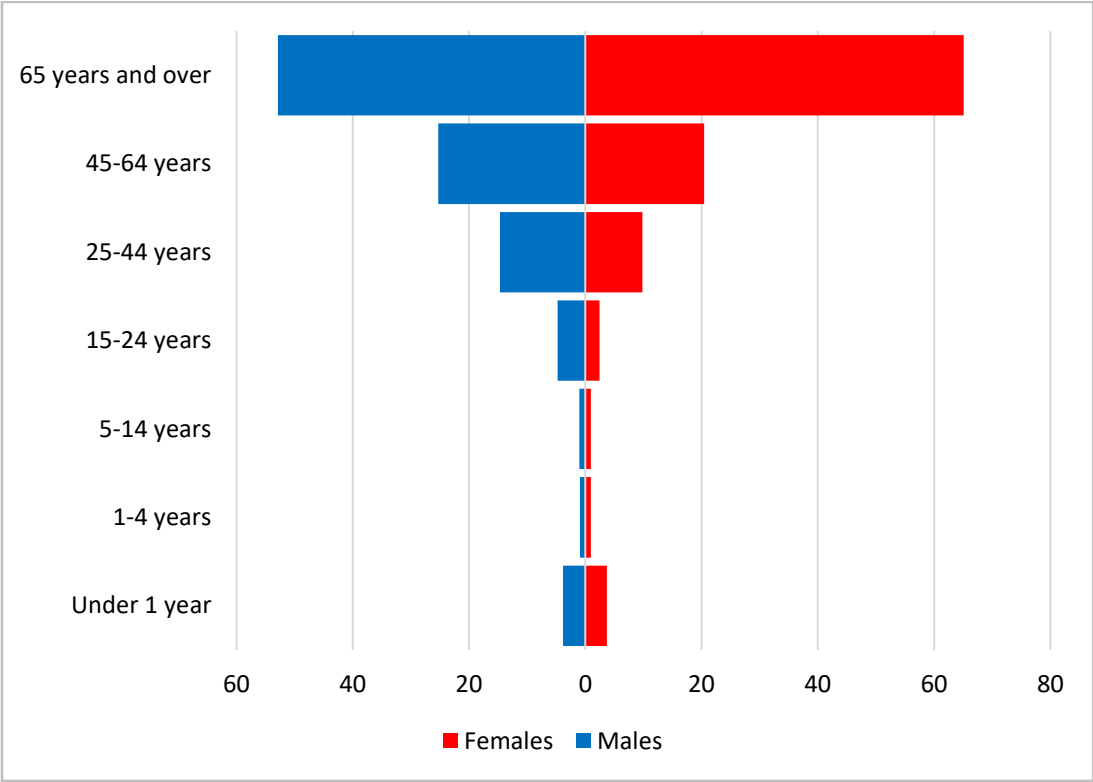
The analyses that follow in this section should be prefaced by the observation that several CMS have not kept their reporting to CARPHA up-to-date. Since 2010, the percentage of countries submitting their reports has been no larger than 80%. Data for the 2014-16 period represents no more than 60% of countries, and the data for those years should therefore be treated with caution especially for 2016 since so far only 4 countries (16.7%) have reported their figures on mortality for that year. Given the lower reporting for recent years, it is important to present longer term trends so that the less representative recent data can be placed in the context of more representative figures. In the analyses that follow, trends are shown from 2000 until 2016, and more recent data appears to reflect the pattern of earlier years, and still permits some trends to be detected.

Over the seventeen-year period 2000 to 2017, 21 CMS reported 579,215 deaths.³ Of these, 318,306 (55%) occurred among males and 260,909 occurred among females (45%). In all age groups except

³ The 21 CMS are: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Curacao, Dominica, Grenada, Guyana, Jamaica, Monserrat, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad And Tobago, Turks And Caicos Islands and UK Virgin Islands.

1-4 years and 65+, there were more male than female deaths. Similar percentages of males and females died in the 1-4 age group, while the disparity between the sexes was far wider in the age group representing senior citizens. Sixty-five percent of female deaths were in the 65+ age group, while only 53% of male deaths occurred in this age group. Put another way, there were 19% fewer male than female deaths in the age group representing senior citizens (Figure 9 and Table 4).

Figure 9: Age and sex distribution of total reported deaths for the English- and Dutch-Speaking Caribbean, 2000-2016



Source: CARPHA

Table 4: Age and gender distribution of total reported deaths for the English- and Dutch-speaking Caribbean, 2000-2016

Age group	% of males	% of females	Male/female ratio
Under 1 year	3.85	3.73	1.03
1-4 years	0.91	0.94	0.97
5-14 years	1.01	0.95	1.07
15-24 years	4.77	2.47	1.92
25-44 years	14.67	9.85	1.49
45-64 years	25.31	20.45	1.24
65 years and over	52.85	65.09	0.81

Source: Data reported to CARPHA by CMS

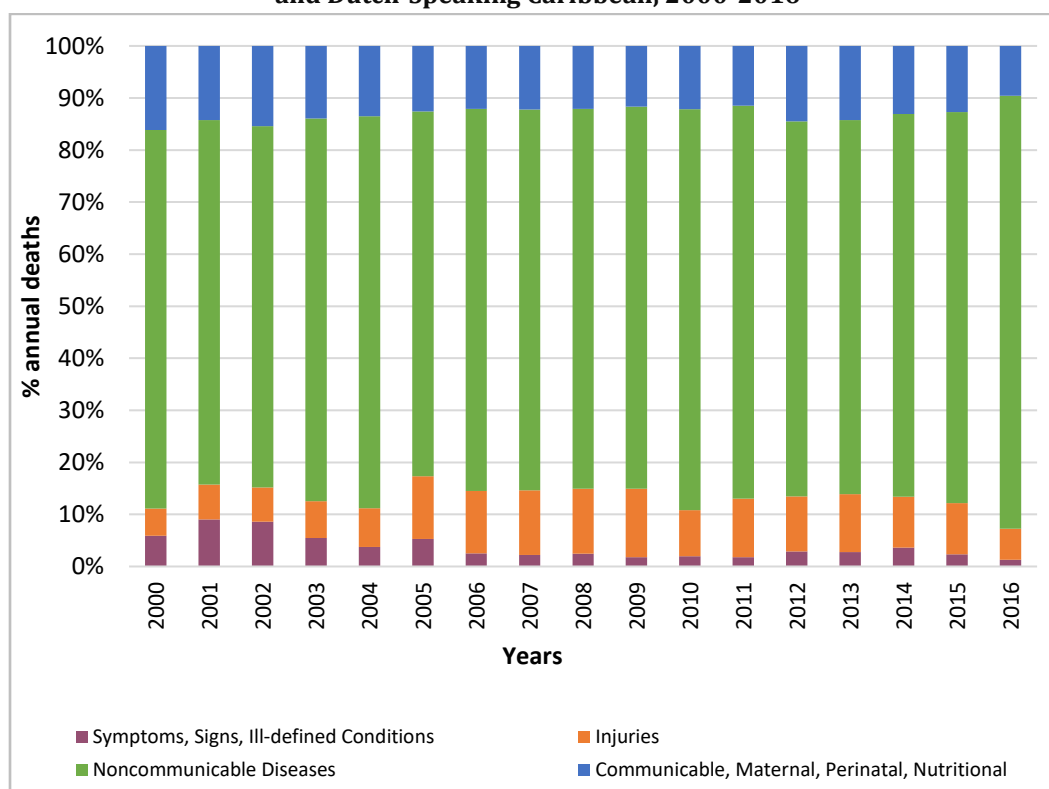
Among males, then, deaths occur on average at an earlier age than among females. In childhood, the difference between the sexes is small. However, among adults until the usual retirement age of around 65 there are wide gender disparities. These are at their widest among youth aged 15-24, where there are 92% more male than female deaths. The disparity tails off as people get older, with a 49% gender gap in the 25-44 age group and a 24% gender gap in the 45-64 age group. Evidently, Caribbean males are at risk from dying young, and they are at greatest risk relative to females in their late adolescence and early adult years. While the gender gap is smaller in later adulthood, the numbers are larger, indicating the need to pay attention to gender-related behavioural and other possible risk factors throughout adulthood.

2.2.1 Top Causes of Regional Mortality

Since the beginning of the 21st Century, Non-Communicable Diseases (NCDs) have been the leading causes of death. They accounted for three-quarters (73%) of deaths in the 2000 to 2016 period. This percentage fluctuated between 69% and 77% with no clear trend. Communicable, Maternal, Perinatal and Nutritional Conditions accounted for 13.2%, Injuries for 9.7%, and Symptoms, Signs and Ill-defined Conditions for 4.1%.

A striking finding is the increase in injuries as a cause of death. These accounted for 5% of deaths in 2000 and 10% in 2015. There was a jump from 7% to 12% in 2004-2005 and since 2005, the average contribution of injuries to total deaths has been 11%. This will be explored further when looking at causes of death by age group and sex.

Figure 10: Percentage contribution to total deaths of broad groupings of conditions in the English- and Dutch-Speaking Caribbean, 2000-2016



Note: Underlying causes of deaths grouped using the Global Burden of Diseases (World Health Organization, 2008)

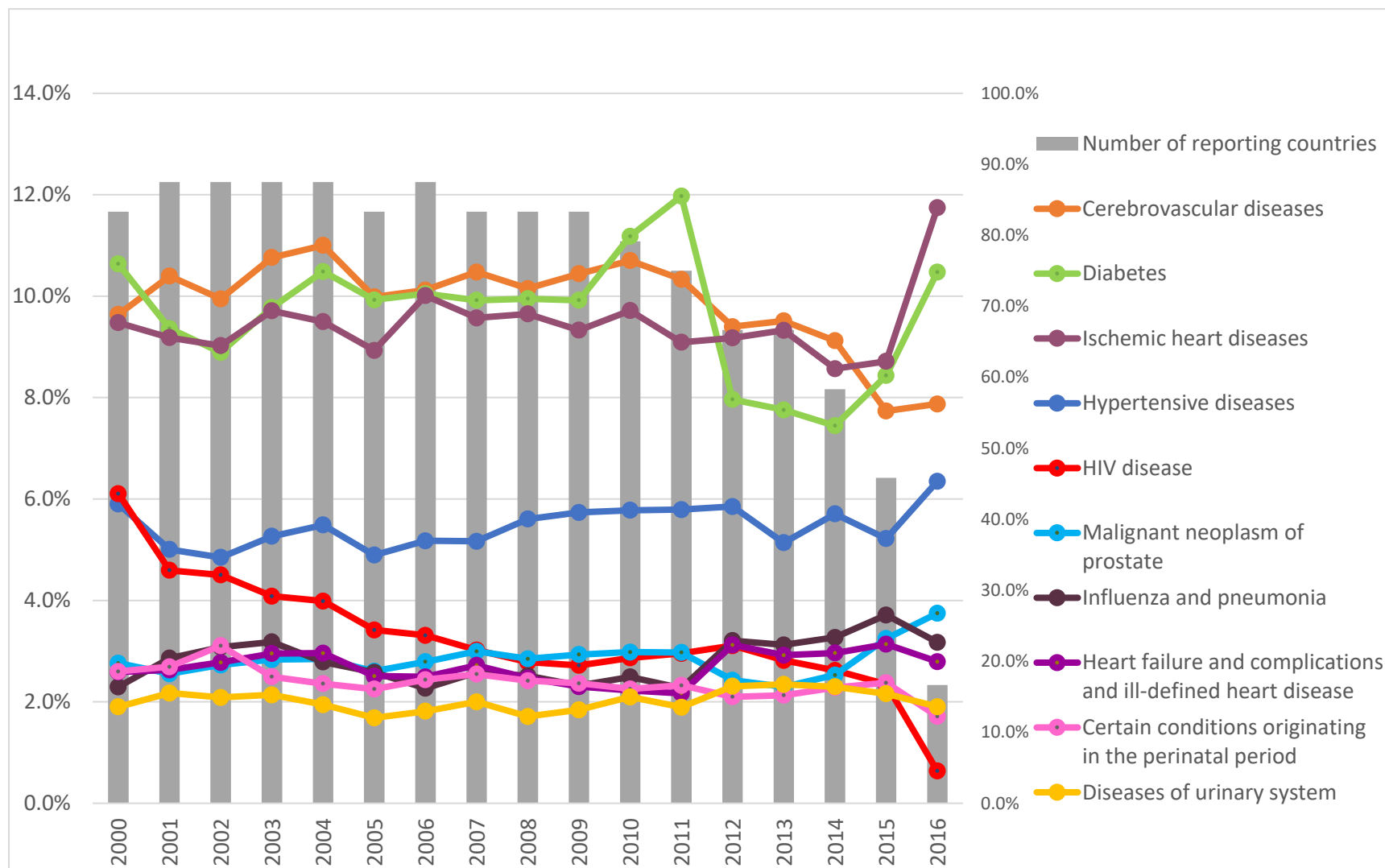
Source: Data reported to CARPHA

In the analyses of leading causes of death, those classified as 'Symptoms, signs and ill-defined conditions' or 'Other' have not been included. Underlying causes of deaths are grouped using the 'Standard list for leading causes of death' (Becker, Silvi, Ma Fat, L'Hours, & Laurenti, 2006).

Figure 11 shows trends in the leading causes of death from 2000 to 2016, along with information on the percentage of countries reporting mortality data. The three leading causes of death are NCDs, with diabetes increasing in importance over the period and becoming the leading cause of death in 2010 and 2011. Collectively, cerebrovascular disease, diabetes and ischemic heart disease account for 29.6% of all deaths for the period. Hypertension – a risk factor for other diseases as well as a cause of death in itself - was the fourth leading cause of death.

HIV started the 21st century as the fourth leading cause of death in CMS, but over the years its rank has declined along with its contribution to the death toll. By 2007 its contribution was roughly equal to that of prostate cancer, influenza and pneumonia, heart failure and complications and ill-defined heart disease, and perinatal conditions. Reasons for the decline in HIV mortality will be examined in section 2.3.7. The following charts present causes of death by age group and sex, enabling a more precise analysis of population groups and conditions where attention should be focused.

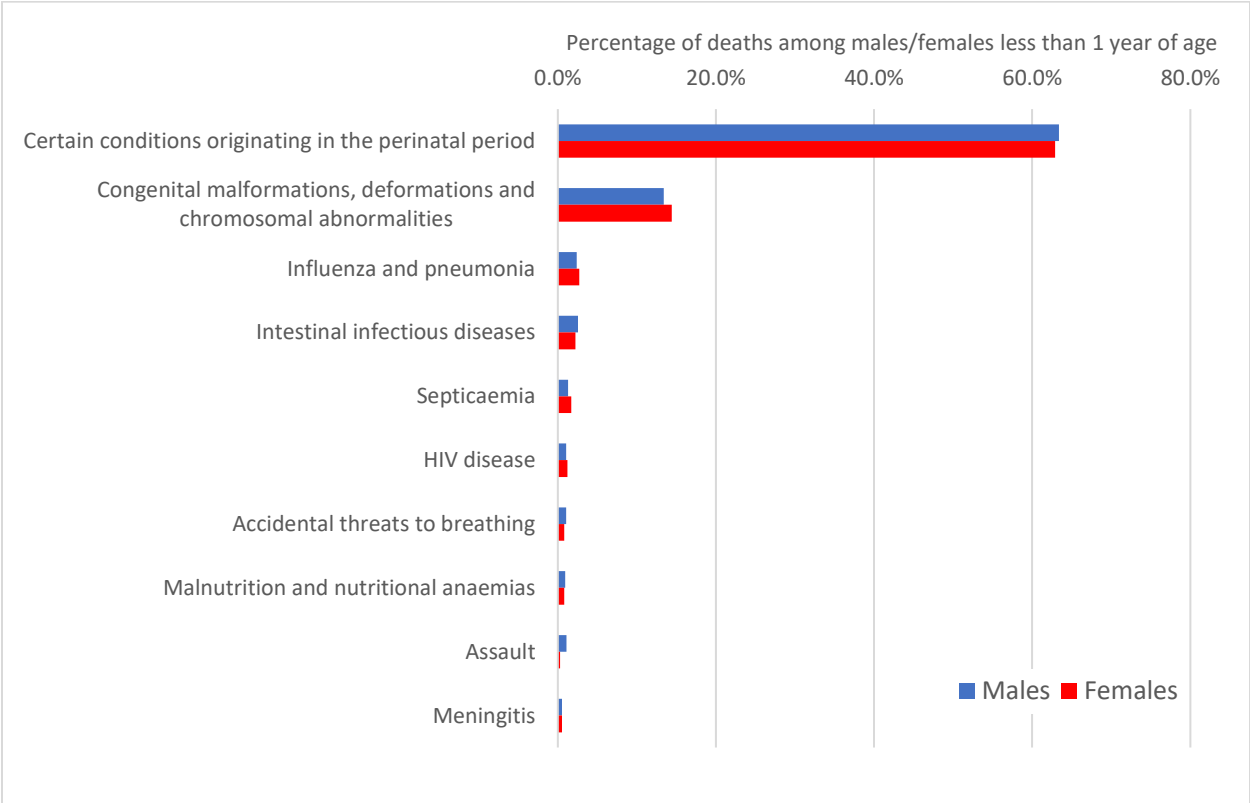
Figure 11: Leading causes of death as percentage of all deaths, and percentage of CARPHA Member States reporting cause of death data, 2000-2016



We now turn our attention to causes of death at different points in the life course.

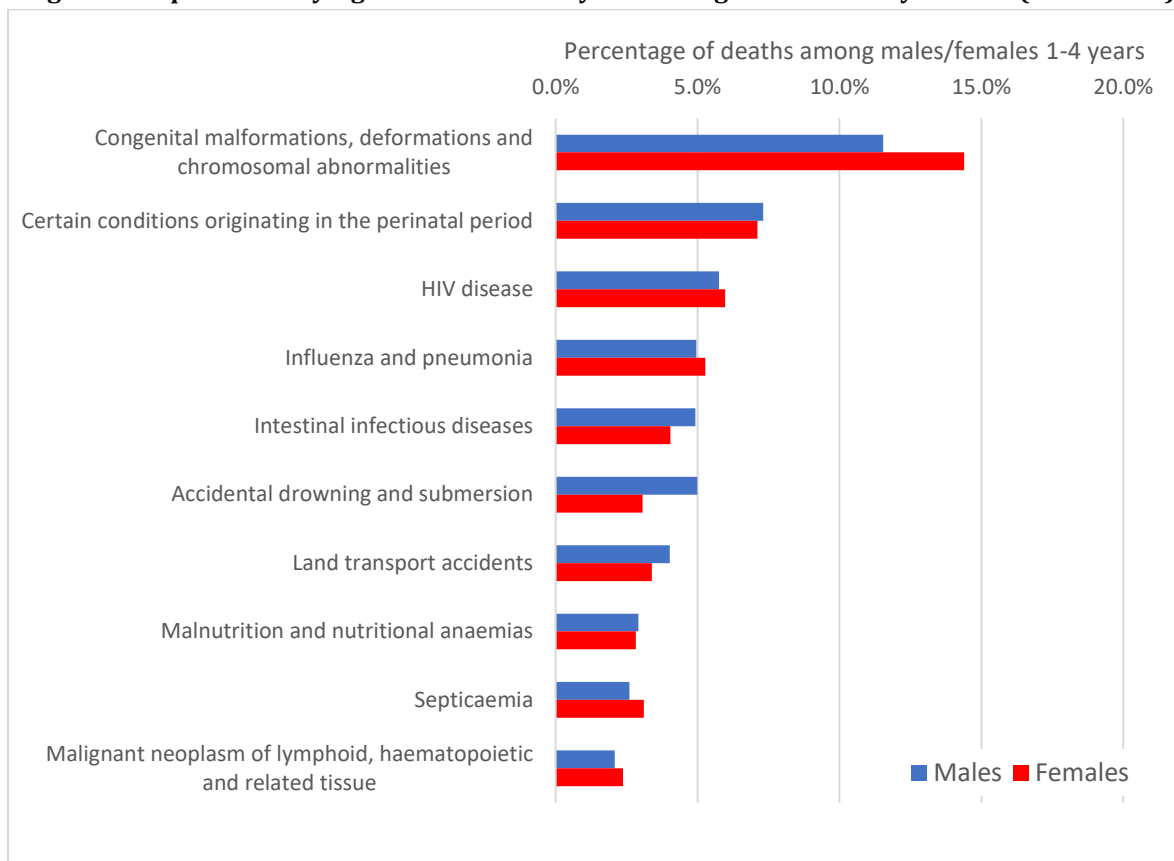
Among babies less than 1 year of age, conditions originating in the perinatal period are the predominant cause of death, accounting for 13,891 deaths reported to CARPHA over the seventeen-year period. Malformations, deformations, and abnormalities account for 3,042 reported deaths. Infections (influenza, pneumonia, intestinal, septicaemia and meningitis) are small as regards cause of death but are striking given the availability of treatment for acute infections, such as antibiotics. That some babies are killed by accident or by assault is shocking. There are small but notable differences by sex in each UC category.

Figure 12: Top 10 underlying causes of death by sex among infants less than 1 year old (2000-2016)



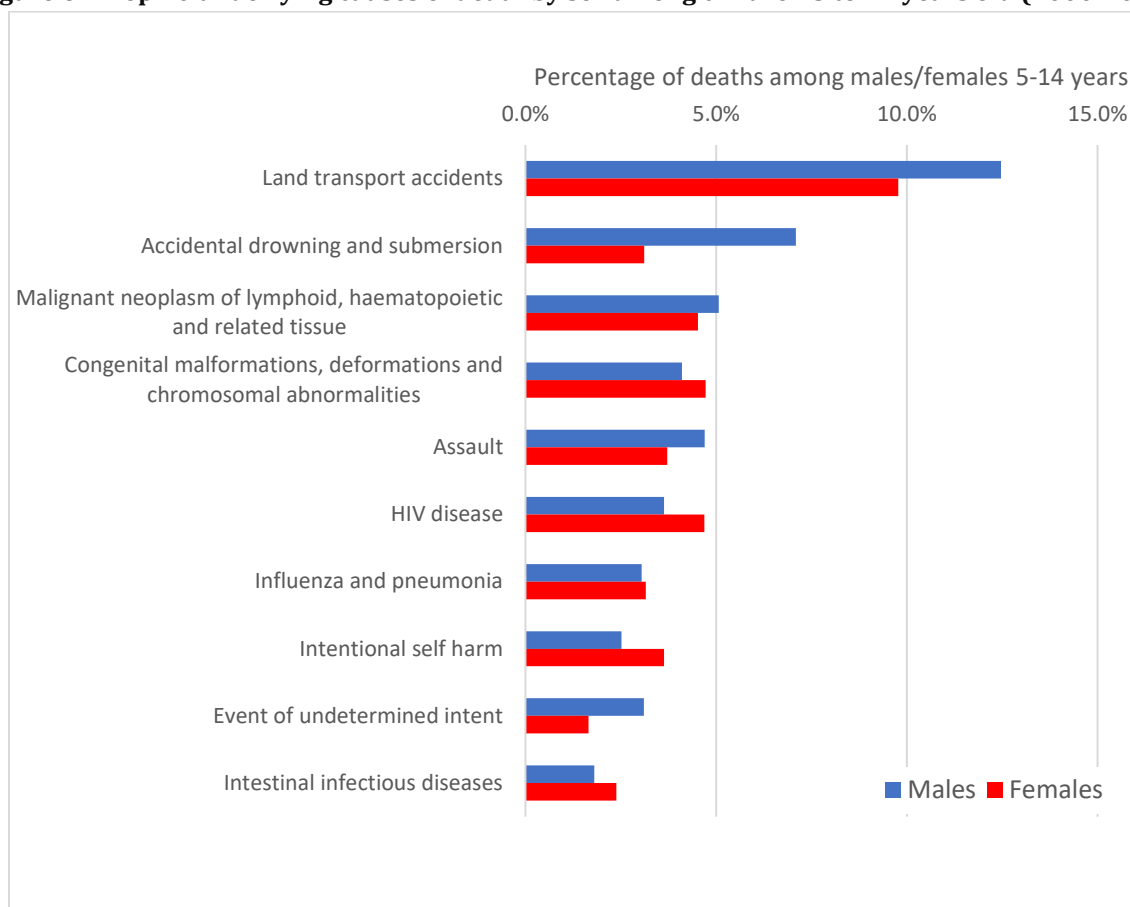
In the infant 1-4 age group, numbers of deaths are smaller than among babies (see Figure 12 above on age and sex distribution of total reported deaths). In this age group, malformations, deformations and abnormalities are the number one cause of death, accounting for 685 reported deaths: fewer than among babies under 1 year of age. As in the under 1 age group, more girls than boys died from this cause. Conditions originating in the perinatal period continued to account for substantial numbers of deaths, causing 385 reported deaths among 1 to 4-year olds. HIV was the third leading cause in this age group, accounting for 312 reported deaths over the period, compared with 245 in total for babies under one year of age. Trends would be needed to ascertain whether HIV has declined as an infant cause of death over the period since the introduction of programmes of prevention of mother-to-child transmission. We continue to see infections as causes of death, and accidental drowning and transport accidents as important public health concerns among young children. We also see cancer (neoplasm) emerge as a leading cause of death in children.

Figure 5: Top 10 underlying causes of death by sex among infants 1 to 4 years old (2000-2016)



Among older children aged 5 to 14, accidents emerge as leading causes of death, and kill more boys than girls. Land transport accidents accounted for 643 reported deaths and accidental drowning for 305 reported deaths. The latter suggest a need for swim training covering Caribbean children and adolescents. Cancer of lymphoid, haematopoietic and related tissue emerge as the third leading cause of death, with 275 cases. Adding to the importance of injury as a cause of death among children, there were 243 deaths from assault, 171 from intentional self-harm and 141 from events of undetermined intent.

Figure 64: Top 10 underlying causes of death by sex among children 5 to 14 years old (2000-2016)

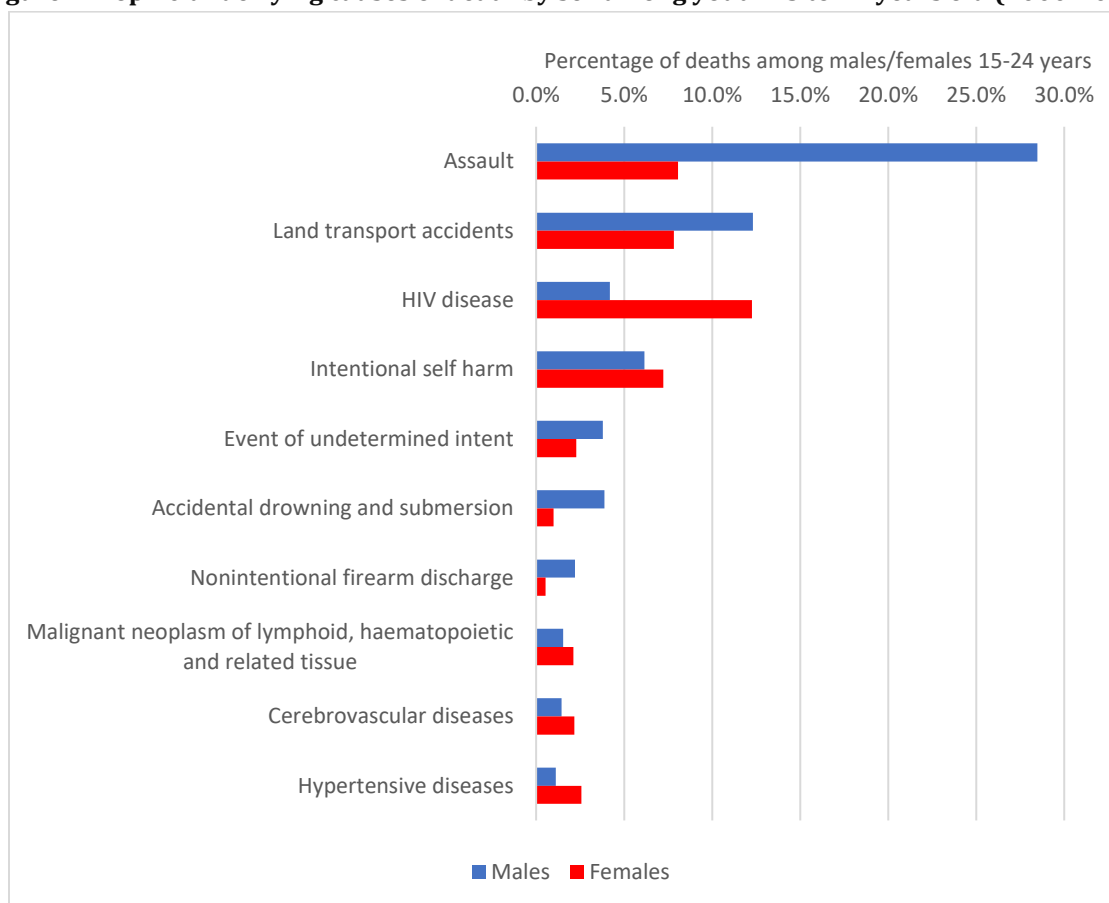


As noted above, there are many more male than female deaths in the youth age group 15-24. Youth are also the group most susceptible to death from accidents and violence. Among youth, there were 4,840 deaths reported from assault. Nine in ten assault deaths were among young men (89.2%). Male youth also accounted for three-quarters of land transport accidents (78.7%), and events of undetermined intent (79.7%), and nine in ten cases of accidental drowning and submersion (90.2%) and non-intentional firearm discharge (90.6%). While intentional self-harm (suicide) accounted for a greater proportion of young women than of young men, in terms of numbers there were more male than female deaths from self-harm (66.7% of self-harm deaths were among males).

HIV/ AIDS was the leading cause of death among young women, and 55.4% of youth deaths from HIV disease were among them.

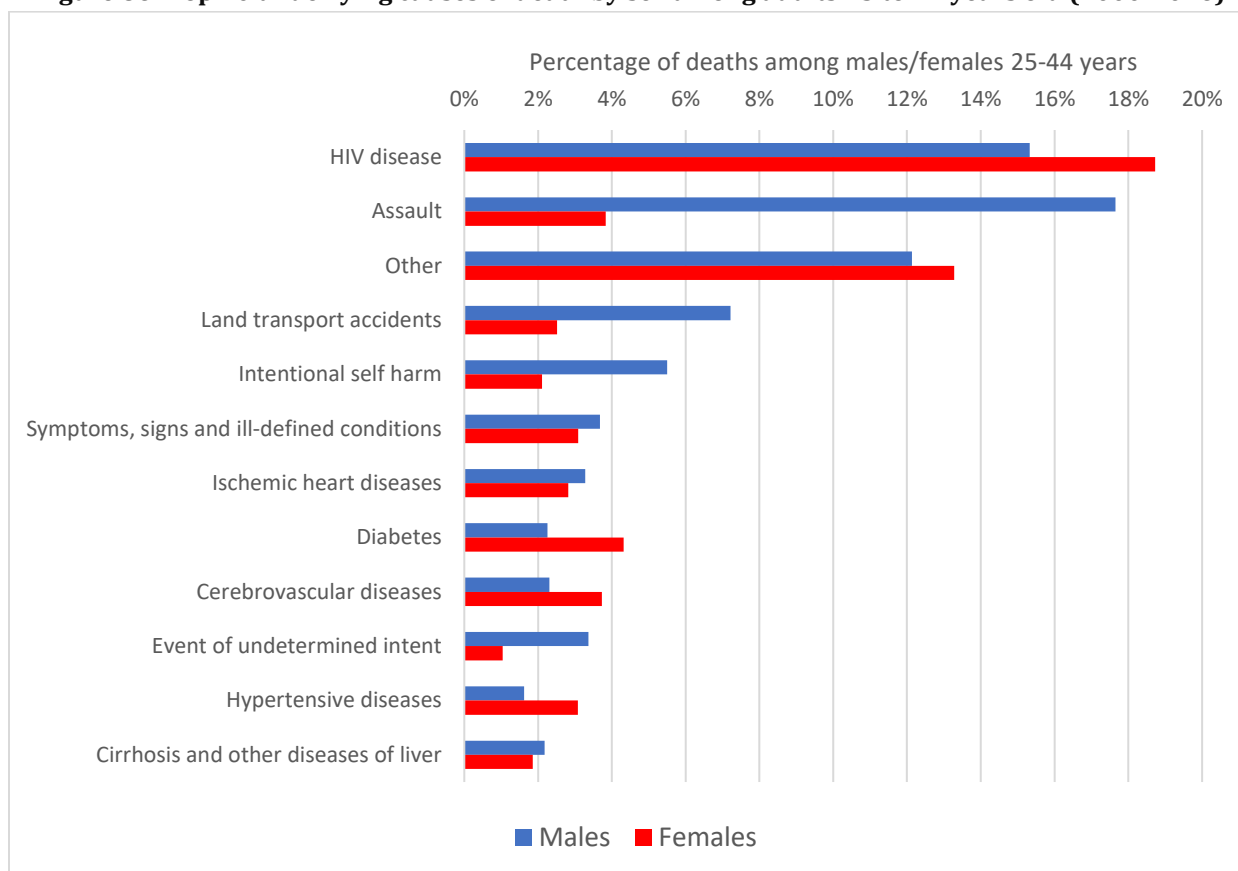
The data demonstrate the importance of addressing violence and accidents with special focus on male youth. For youth as a whole and especially for young women, there is a need to focus on behavioural and social environmental risk factors for HIV. Cancers, cerebrovascular and hypertensive disease also emerge among the top causes of death in this age group.

Figure 7: Top 10 underlying causes of death by sex among youth 15 to 24 years old (2000-2016)



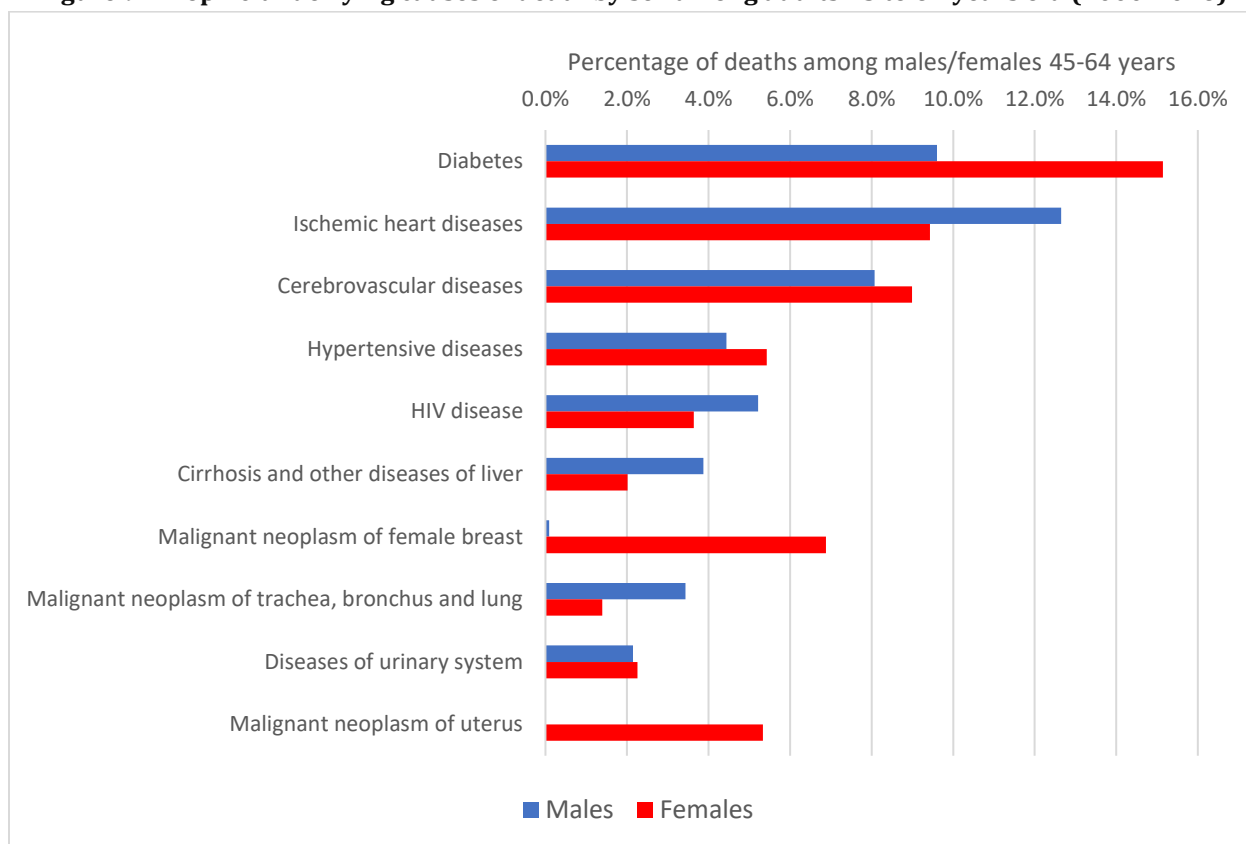
Among adults 25-44 years old, the leading causes of death were HIV and assault. HIV was the leading cause of death for women, and assault the leading cause for men. There were far more deaths among men overall in this age group. The number of reported HIV cases among men actually outnumbered those among women: 7,158 and 4,814 respectively, or 59.8% male. Again, accidents and violence caused far more deaths among men than women. Of 9,223 deaths reported from assault, 89.3% were among men. Land transport deaths were 83.9% male and intentional self-harm deaths were 82.6% male. In this young adult age group, we see five NCDs among the leading causes of death: ischemic heart diseases, diabetes, cerebrovascular diseases, hypertensive diseases and cirrhosis and other diseases of the liver.

Figure 86: Top 10 underlying causes of death by sex among adults 25 to 44 years old (2000-2016)



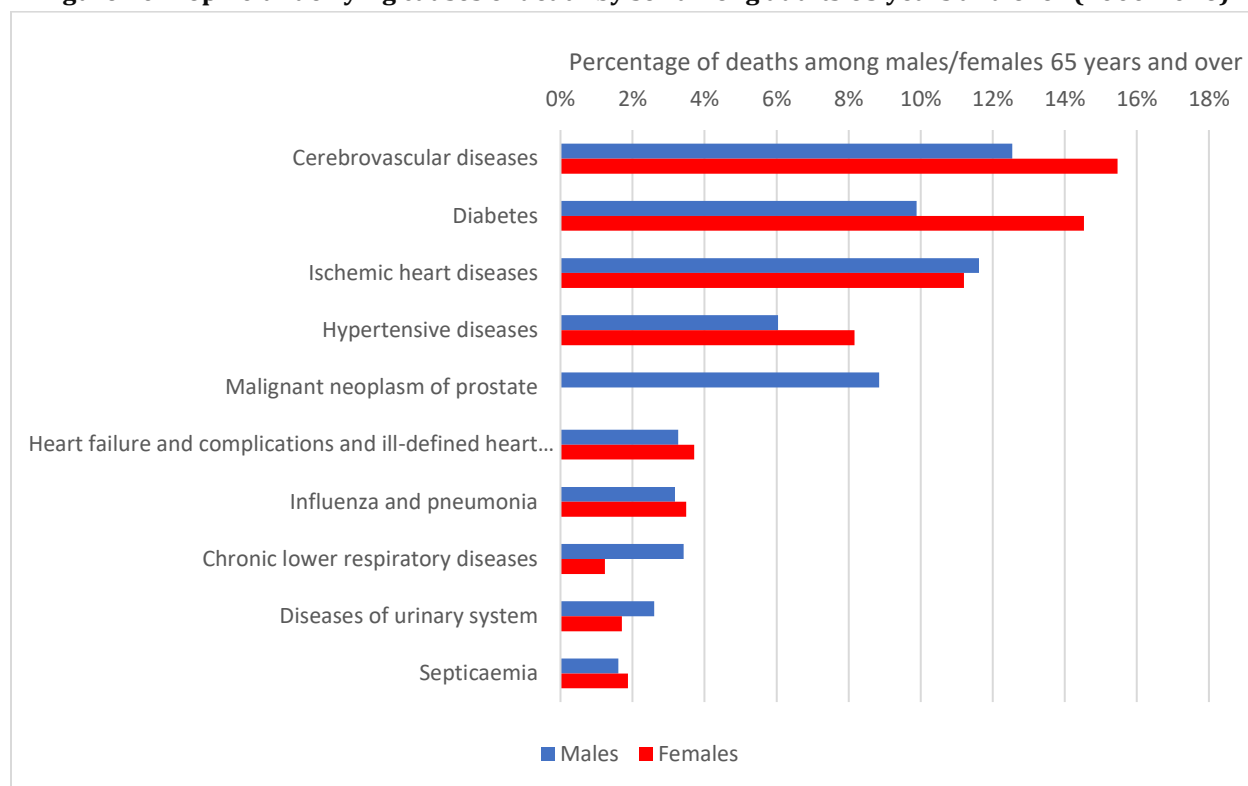
Among adults aged 45-64, NCDs account for 8 out of 10 of the leading causes of death. Diabetes was the leading cause for women, while ischemic heart disease was the leading cause for men. Liver, breast and lung cancer are among the top 10. In this age group, HIV cases are mostly among men (68.9%).

Figure 97: Top 10 underlying causes of death by sex among adults 45 to 64 years old (2000-2016)



In the 2000-2016 period, among elders (65+), where most of deaths occur, NCDs accounted for 6 of 10 leading causes of death. Women account for the majority of the top 2: 55.4% of cerebrovascular deaths and 59.7% of diabetes deaths. Prostate cancer is a leading cause of death among men. Infections, notably influenza and pneumonia, take significant numbers of lives of older people.

Figure 10: Top 10 underlying causes of death by sex among adults 65 years and over (2000-2016)



We see that NCDs and injuries are prominent among adults as causes of death. Over the 16-year period studied, HIV led to more deaths than any other communicable disease (CD). Other CDs were especially important as causes of death among infants, children and elders.

2.2.2 The burden of NCDs, injuries and HIV: premature mortality

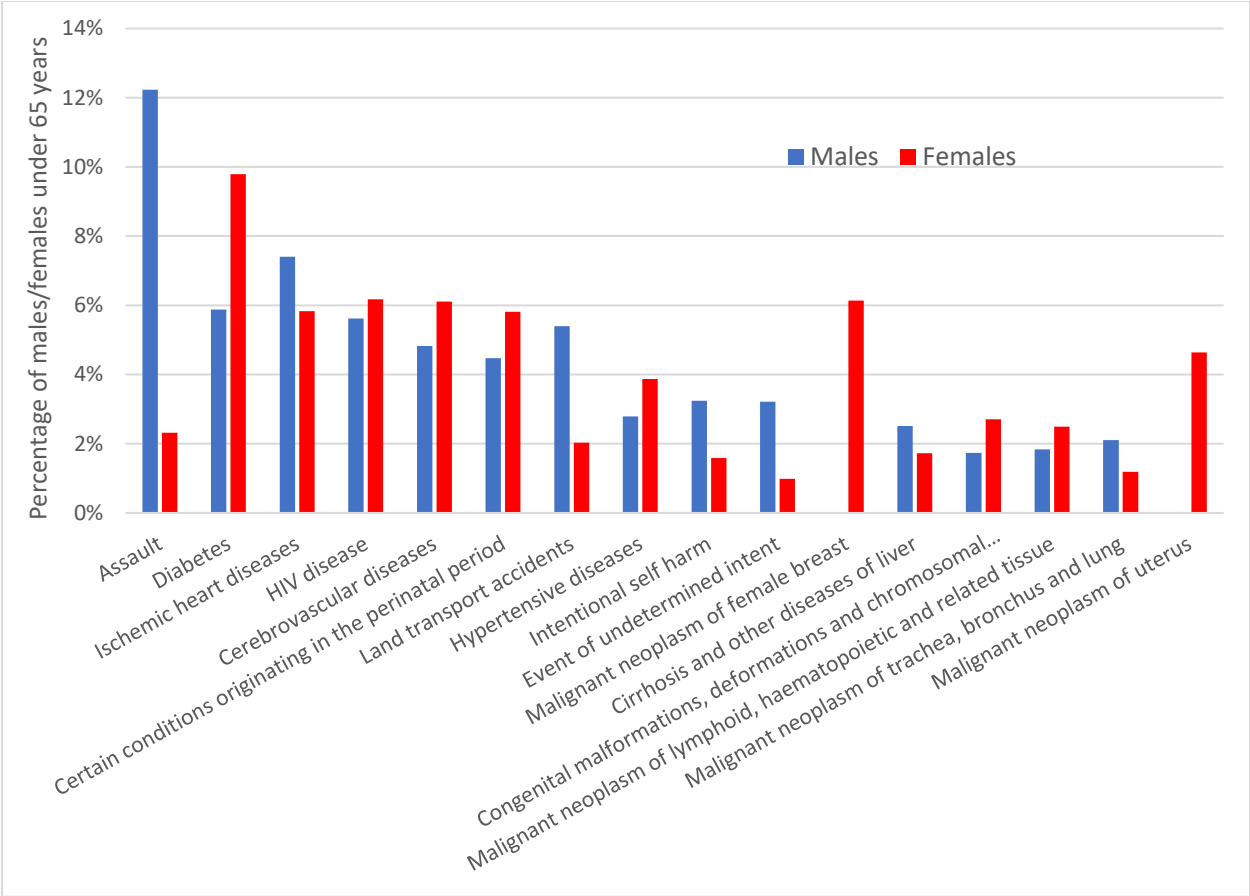
While knowing the number of deaths due to a particular disease or condition is important, so too is the age at which those deaths occur. Here we look at age of death in three ways. First, an overall picture of deaths in people under the age of 65, which can be regarded as “premature mortality”.

Secondly, the number of potential years of life lost (PYLL) through premature mortality to get a better sense of the impact a given disease or condition has on the health of a country’s population. PYLL per 100,000 population are calculated using the latest mortality data from each country and the latest population data (from censuses and mid-year population estimates) and are measured relative to average life expectancy of 72.5 years. Underlying causes of deaths are grouped using the Global Burden of Diseases (WHO, 2004).

Thirdly, specific trends in age at death among people with HIV, which may indicate success in slowing or halting HIV disease progression,

The following figure summarises recent information on leading causes of deaths among people under the age of 65, which may be regarded as premature. NCDs are prominent causes of early deaths, indicating a need to focus on underlying risk factors at early ages (PAHO & CARICOM, 2006). Violence and injuries account for substantial proportions, especially among males. There is a need to focus on underlying causes, such as crime and mental health, as critical public health concerns (Moat & Yearwood, 2015). Since the chart is based on the most recent year of data available, it shows that HIV remains important, ranking third for women and second for men as a cause of early death.

Figure 11: Premature mortality: leading causes of death in people under the age of 65, based on the most recent year of data available



Most recent year of data available: 2007 – Curacao; 2010 – British Virgin Islands; 2011 – Jamaica, Trinidad and Tobago; 2013 – Barbados Cayman Islands, Guyana; 2014 – Bahamas, St. Lucia, Suriname; 2015 – Aruba, Belize, Bermuda, Dominica, St. Kitts and Nevis, St. Vincent and the Grenadines, Turks and Caicos Islands; 2016 – Anguilla, Antigua and Barbuda, Grenada, Montserrat

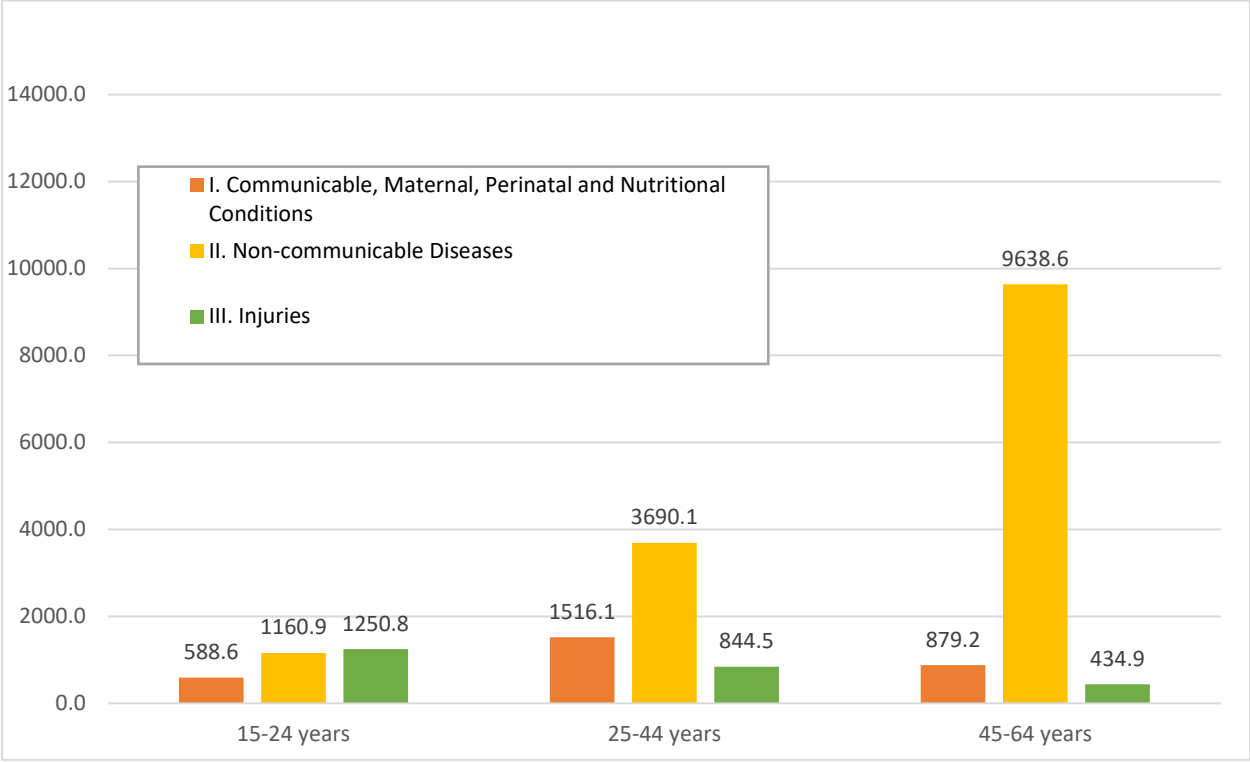
PYLL data are presented by sex, since, as shown above, gender seems to be a critical factor in determining patterns of mortality.

For adolescent girls, PYLL are lower than the other age groups, but it is striking to note that the leading cause of premature mortality among them is injuries. This may reflect violence against women and girls and the rising toll of road traffic and other accidents.

The 25-44 age group accounts for the highest rates of PYLL from communicable, maternal, perinatal and nutritional conditions, possibly reflecting HIV since this is the age group with highest HIV mortality in the Caribbean.

Among women 25-64, NCDs are the major cause of premature deaths, with this peaking in the older adult age group. Overall, the data suggest the need to direct health promotion on NCDs towards girls and women at a young age to prevent premature death.

Figure 20: PYLL per 100,000 population, CARPHA Member States, Females

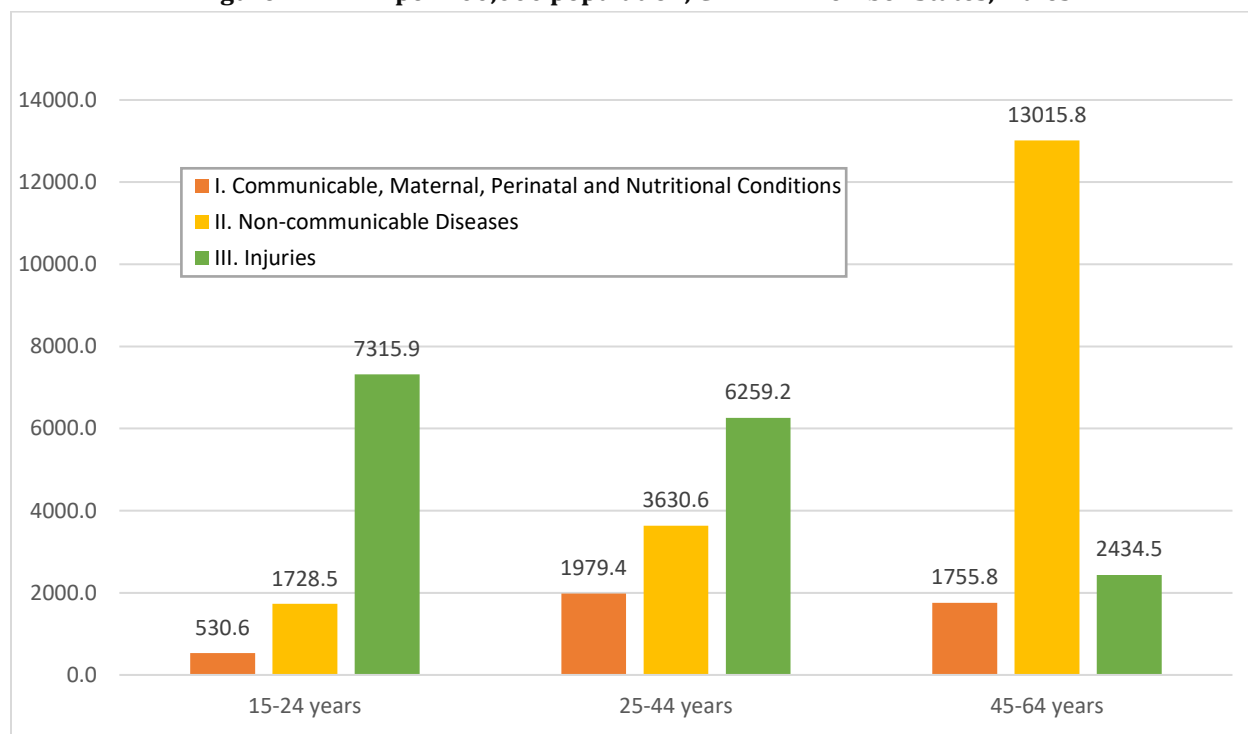


Looking at data for males, the high prevalence of injuries is immediately apparent, especially among youth and adults under the age of 45. Among male youth, the PYLL rate is 7316, as compared with a rate of 1251 among female youth.

PYLL from communicable, perinatal, and nutritional conditions are also higher among men than women, but only from age 25 onwards. In the 25-44 age group, men’s PYLL exceeded women’s by around 30% (male/ female ratio of 1.31) while in the 45-64 age group it was twice as high among men (male/female ratio of 1.99).

Men also experienced greater PYLL from NCDs, which far outstripped the other causes in the 45-64 age group. The male to female ratio was 1.35 in the oldest 45-64 age group and 1.49 in the youngest 15-24 age group, while the PYLL was roughly the same in the middle age group 25-44 (male/female ratio 0.98).

Figure 21: PYLL per 100,000 population, CARPHA Member States, Males



NOTES ON SOURCES OF PYLL DATA: Most recent year of mortality data available: 2007 – Curacao; 2010 – British Virgin Islands; 2011 – Jamaica, Trinidad and Tobago; 2013 – Barbados Cayman Islands, Guyana; 2014 – Bahamas, St. Lucia, Suriname; 2015 – Aruba, Belize, Bermuda, Dominica, St. Kitts and Nevis, St. Vincent and the Grenadines, Turks and Caicos Islands; 2016 – Anguilla, Antigua and Barbuda, Grenada, Montserrat.

Most recent year of census or mid-year population estimates available used: Anguilla – 2011, Antigua and Barbuda – 2010, Aruba – 2012, Bahamas – 2012, Barbados – 2010, Belize – 2012, Bermuda – 2012, British Virgin Islands – 2012, Cayman Islands – 2010, Curacao – 2012, Dominica – 2010, Grenada – 2012, Guyana – 2010, Jamaica – 2012, Montserrat – 2011, St. Lucia – 2010, St. Kitts and Nevis – 2010, St. Vincent and Grenadines – 2010, Suriname – 2010, Trinidad and Tobago – 2011, Turks and Caicos Islands – 2001

One of the striking findings so far has been the importance to mortality of injuries in the Caribbean, and especially injuries to men. The following diagrams illustrate this further by examining data on PYLL from road traffic accidents and assaults. In each age group, PYLL from land transport accidents and assaults are several-fold higher among men than women. Assaults cause more deaths than traffic and road accidents for both sexes, but the differences are far larger for men.

Figure 122: PYLL by sex per 100,000 population for Land Transport Accidents, CARPHA Member States

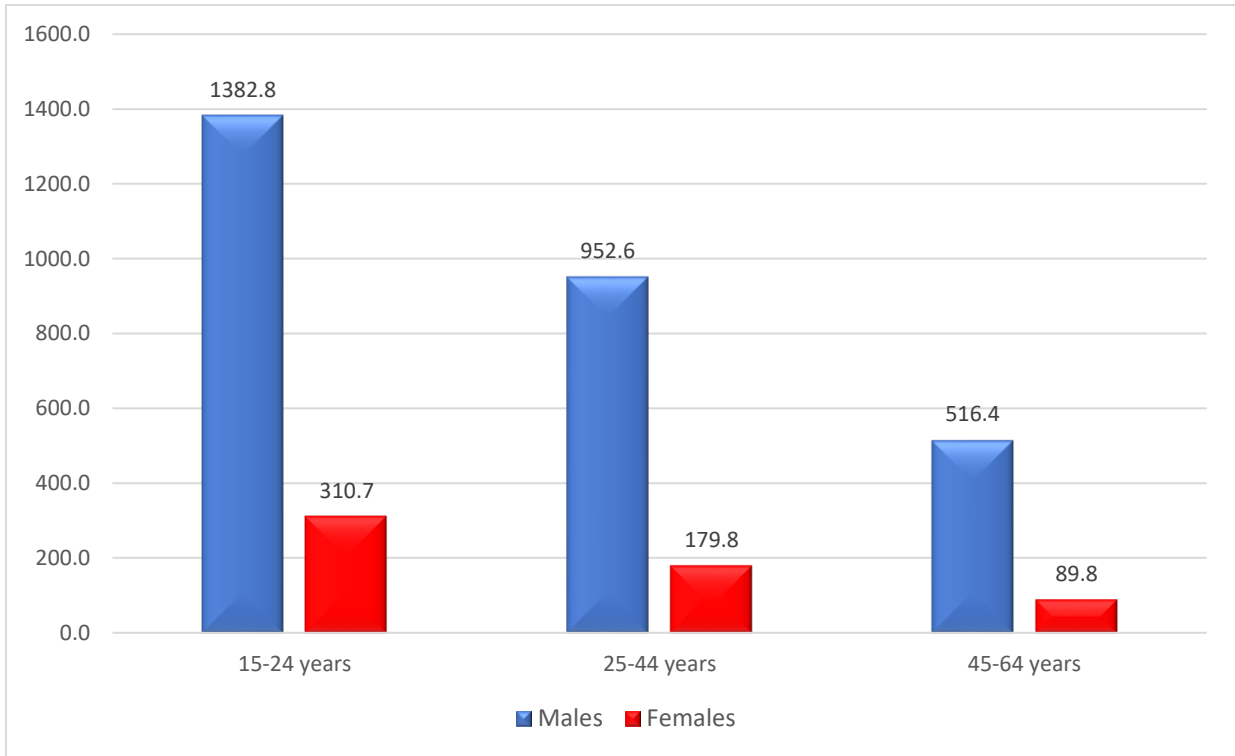
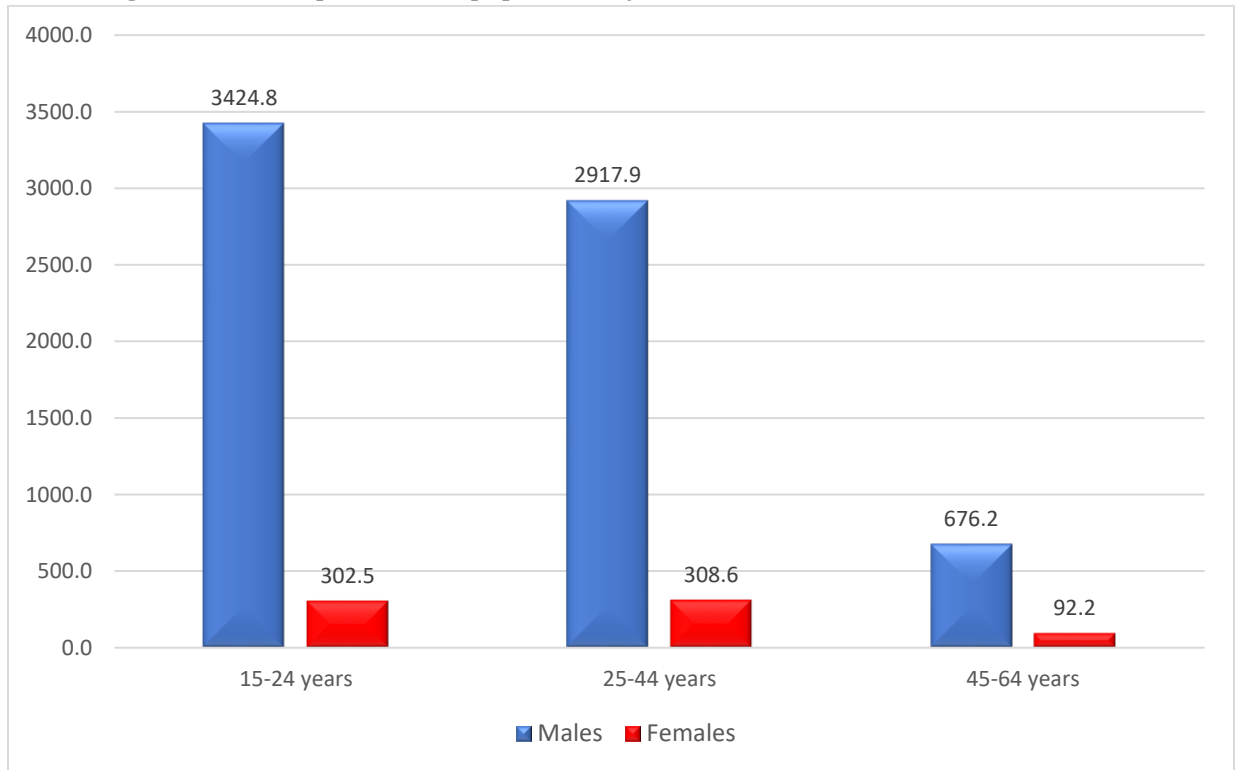


Figure 133: PYLL per 100,000 population by sex for Assaults, CARPHA Member States



NOTES ON SOURCES OF DATA: Same as for PYLL charts above. Assaults refer to deaths classifiable to ICD-10 codes X85-Y09 Land transport accidents refer to deaths classifiable to ICD10 codes V01-V89.

Murders, assaults, and road traffic accidents appear almost daily in the newspapers of many Caribbean countries. The data we have presented show them to be a major public health concern as well as a social scourge. Alliances between health, security and law enforcement agencies are needed, especially to reduce injury mortality among men, which may be linked to a number of social ills such as the illegal drug trade, excessive alcohol consumption, and gang vendettas (UNDP, 2012).

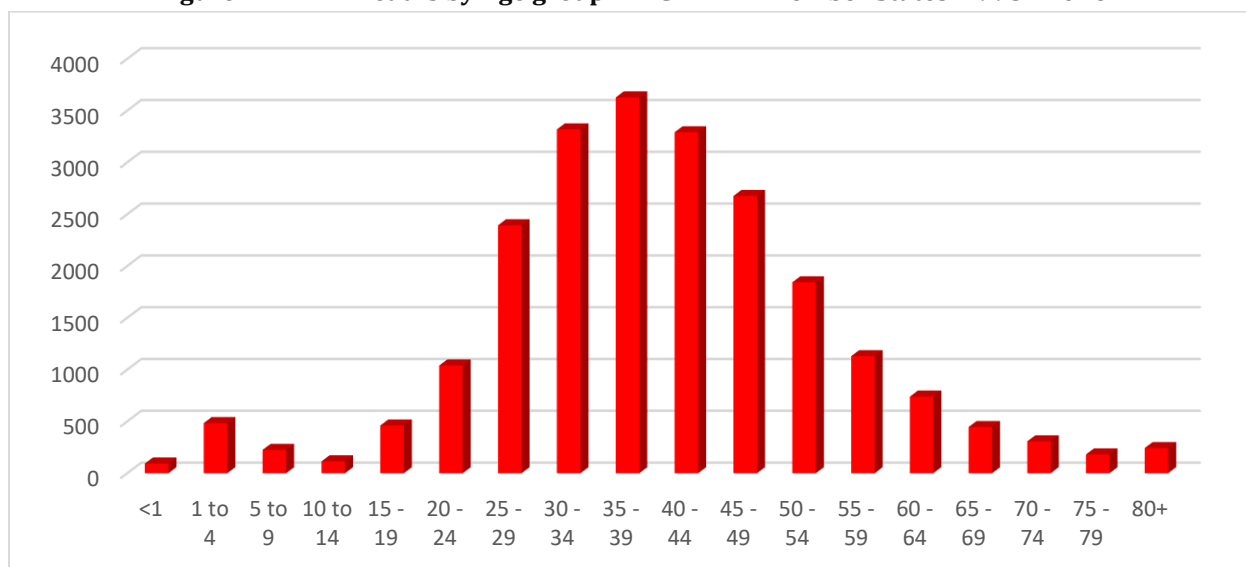
It should be noted, however, that the data present a partial picture of the toll of accidents and violence as they do not include morbidity or indicate the incidence of violent acts. This shortcoming in showing the scale of violence against women and girls, which is less often fatal but is important in the pain and restriction in opportunities it causes. Violence against women and girls is most often perpetrated by someone they know, such as a partner, family member, family “friend” or neighbour. It may be physical, sexual or emotional. Only a minority of cases are reported to the police, and since a minority are fatal, they hardly appear in mortality data (Garcia-Moreno, Jansen, Ellsberg, Heise, & Watts, 2006). It should also be noted that in the Caribbean, some countries have higher rates of female deaths from assault, including homicide, than others.

UN Women is working with several Caribbean countries to improve the quality and quantity of data on violence against women and girls. In the absence of uniform indicators, it is remarkable that studies in several Caribbean countries have found that around one in three women is subjected to domestic or intimate partner violence at some time in their lives (Allen, 2011, 2012; Jones, Da Breo, Trotman Jemmott, Joseph, & Moller, 2017).

To assist in guiding countries on public health strategies to address violence, CARPHA has engaged policy-makers and experts in dialogue and produced an evidence brief (Ciurea, Moat, & Yearwood, 2015; Moat & Yearwood, 2015).

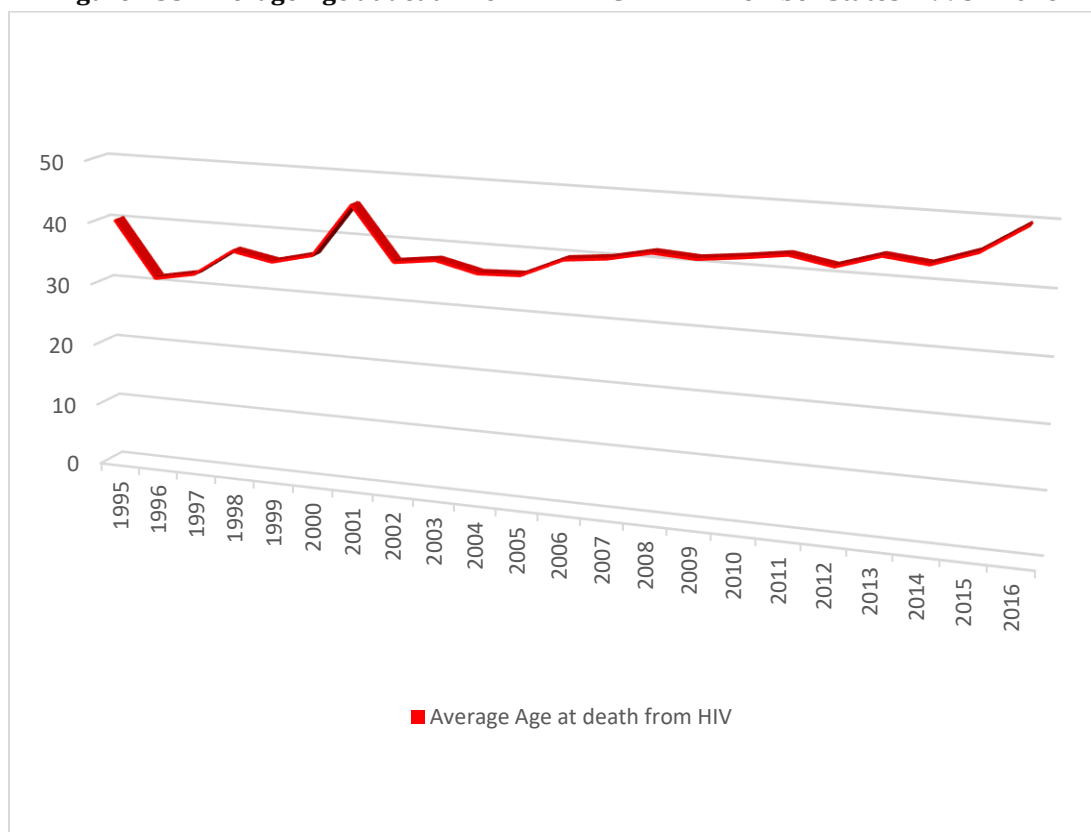
HIV remains a leading cause of death. The following chart shows the distribution of HIV deaths between age groups reported to CARPHA since 1995. The modal age group for HIV deaths was 35-39, and the chart demonstrates that HIV has killed many at the peak of their productive and reproductive lives. It has therefore brought substantial costs in terms of lost economic production and the loss of parents and other young caregivers (La Foucade, Ewan, Theodore, & Beharry, 2004; Theodore & La Foucade, 2001).

Figure 144: HIV Deaths by Age group. All CARPHA Member States. 1995 - 2016



There is evidence, however, that the situation is improving. The following chart shows that over time, the average age at death from HIV has increased. Since 1996, when the age at HIV death hit a low of 30, it has risen, to reach age 50 on average by 2016. While 50 is still too early to die, the figures show success in extending the lives of people with HIV in the Caribbean. This will be explored further in section 2.3.7.

Figure 155: Average Age at death from HIV in CARPHA Member States. 1995 - 2016



2.3 Non-Communicable Diseases

The ecological framework presented in section 1.4 suggests that determinants of health are to be found at the individual/behavioural, social/environmental and structural levels. In this section, we present evidence on each of these levels as they relate to NCDs. Further detail of some factors at each level will be provided in Chapter 4, which concentrates on childhood obesity.

2.3.1 NCD risk factors

Studies of risk factors for NCDs have focussed mainly on individual behaviours. Those looking at the general population are presented here, while Chapter 4 looks at the behaviours of children that are associated with obesity.

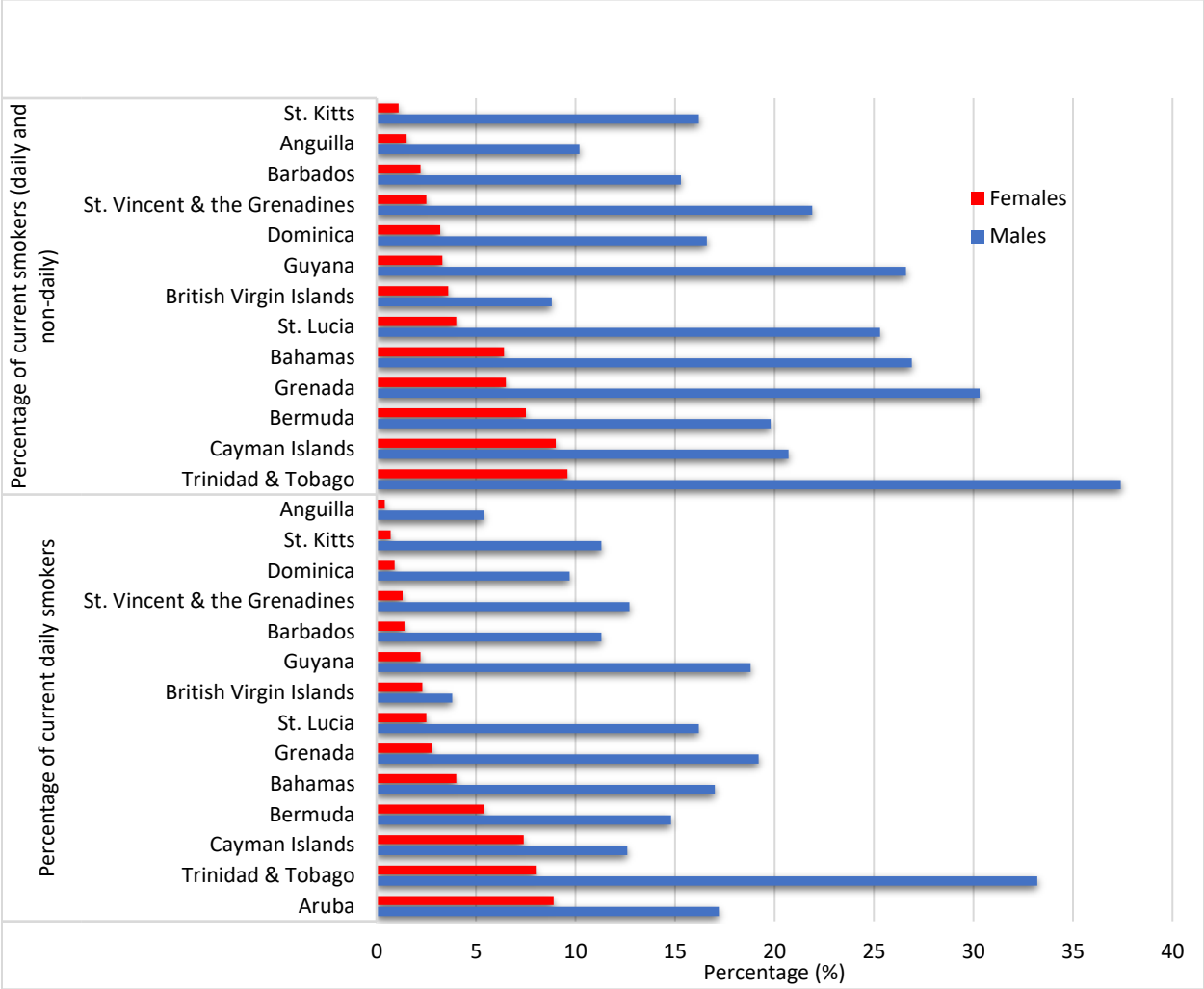
To help meet the enormous challenge of NCDs outlined above, the WHO and CARPHA have collaborated with CMS to conduct a number of risk factor surveys using the Stepwise Approach to Surveillance (STEPS) methodology. These were conducted with adults between 2006 and 2016. They were designed to assess the prevalence among men and women of risk factors that have been shown to be associated with NCDs, such as smoking, alcohol consumption, physical activity, consumption of fruit and vegetables, overweight and obesity, waist circumference and raised blood pressure. As such they provide pointers as to areas appropriate for health promotion interventions in each country.

Table 5: Risk factor surveys completed in CARPHA Member States using the WHO STEPS methodology with technical support provided by CARPHA (2006-2016)

Country	Survey Year	Target Age Group
Aruba	2006	25-64
Barbados	2007	25+
Dominica*	2008	15-64
St. Kitts	2008	25-64
British Virgin Islands	2009	25-64
Grenada	2011	25-64
Trinidad & Tobago	2011	15-64
Bahamas	2012	25-64
Cayman Islands	2012	25-64
St. Lucia*	2012	25-64
St. Vincent & the Grenadines	2014	18-69
Bermuda	2014	18+
Anguilla	2016	18-69
Guyana	2016	18-69
<i>*Response rates too low for survey results to be considered nationally representative</i>		

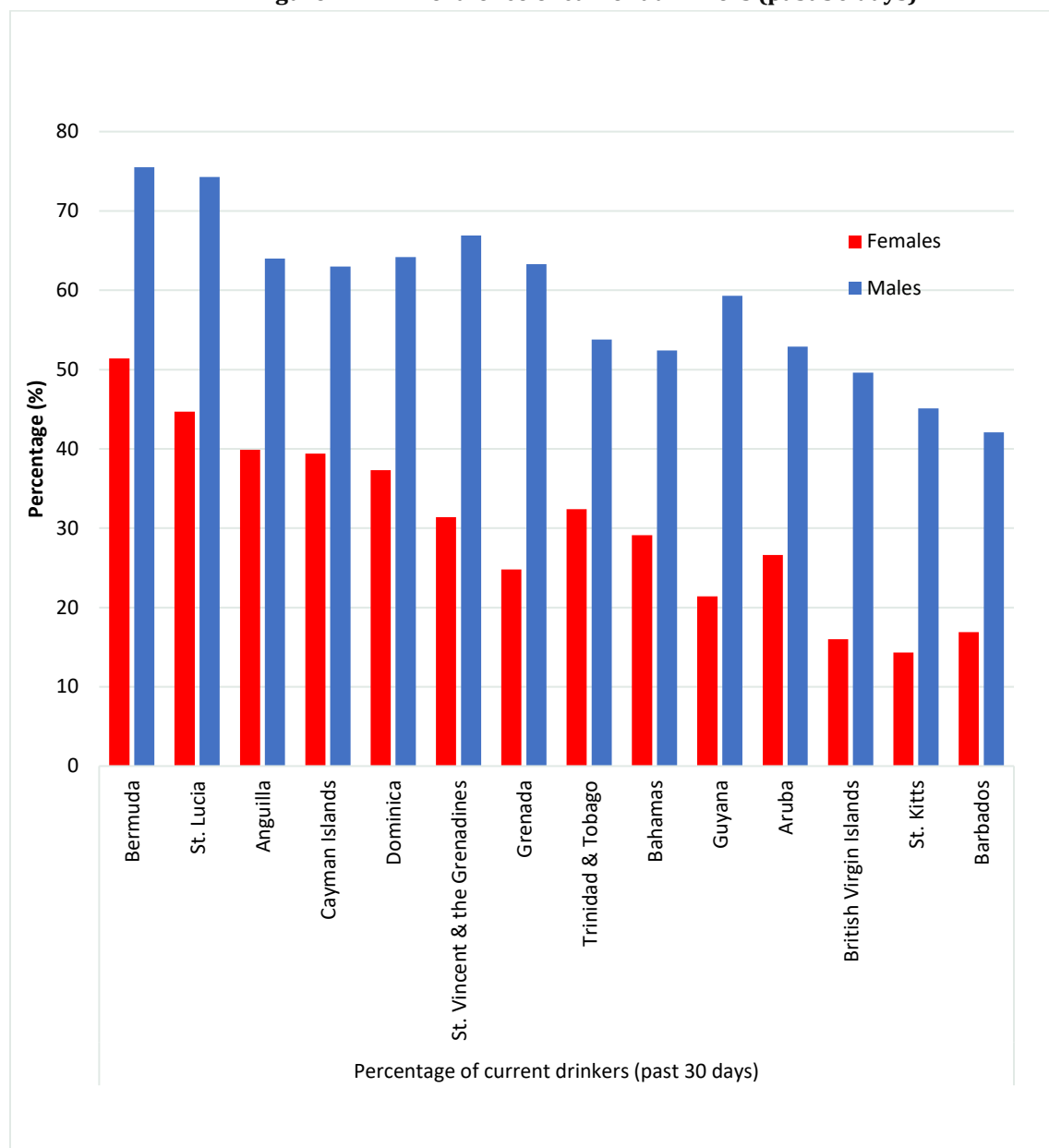
The surveys showed a wide range in levels of smoking between countries, with a common feature being far higher levels among men than women. This applies to both current smoking and daily smoking.

Figure 166: Prevalence of current smokers and current daily smokers



Drinking alcohol is likewise more common among men than women. Greater percentages of Caribbean populations drink than smoke.

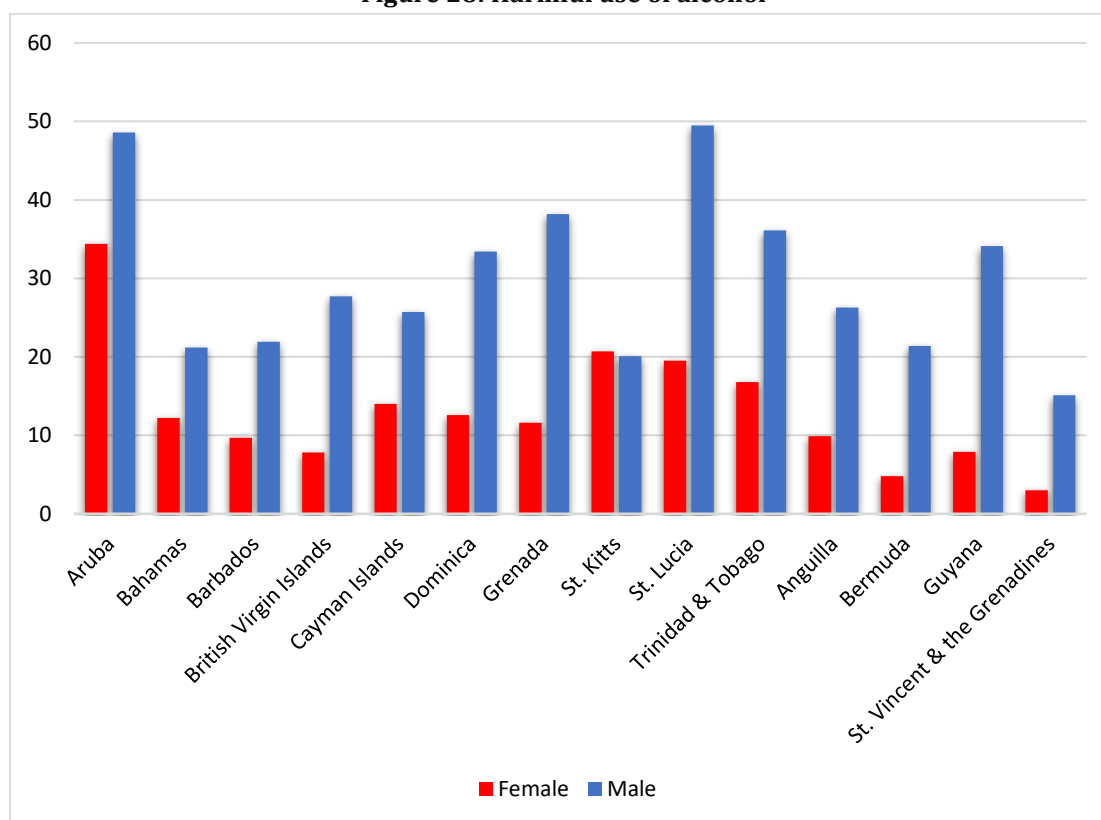
Figure 2717: Prevalence of current drinkers (past 30 days)



Harmful use of alcohol is also much higher among men than women, except in St. Kitts and Nevis. In Anguilla, Bermuda, Guyana and St. Vincent and the Grenadines, a more stringent definition of harmful use was used, resulting in lower estimates for those CMS.

The alcohol and smoking data show that men are more involved in the consumption of harmful substances than women. This may also extend to illegal drug consumption, though this is intrinsically hard to measure and was not included in the STEPS surveys. The consumption of harmful substances may be associated with the high prevalence of accidents and violence among men.

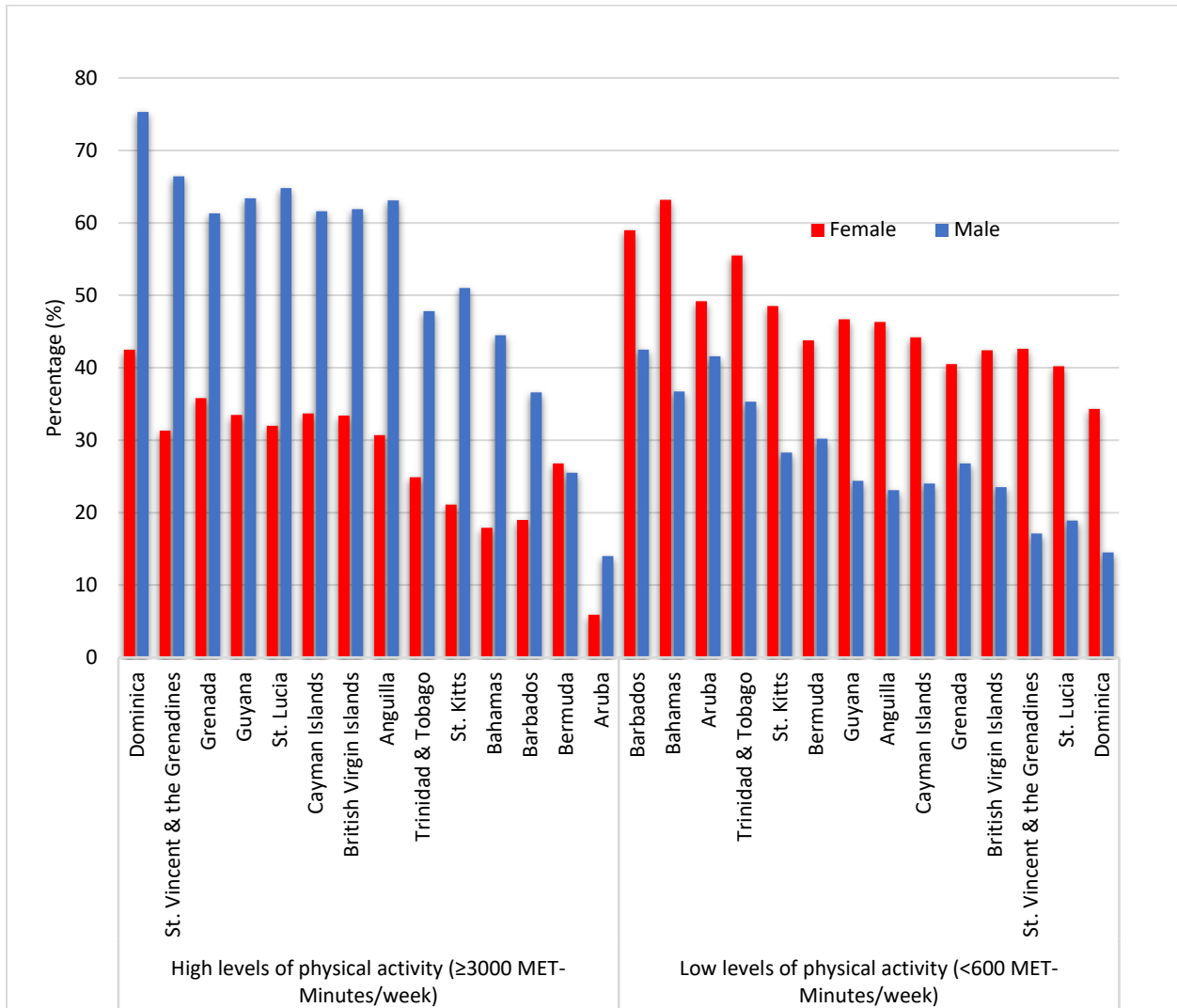
Figure 28: Harmful use of alcohol



NOTE: Definitions of harmful use of alcohol differed by country. For Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Dominica, Grenada, St. Kitts and Nevis, St. Lucia and Trinidad & Tobago, the definitions were: Females having ≥ 4 drinks on any day in last week, and Males having ≥ 5 drinks on any day in last week. For Anguilla, Bermuda, Guyana and St. Vincent & the Grenadines, the definitions were: Females or Males (having ≥ 6 drinks on any occasion in the past 30 days)

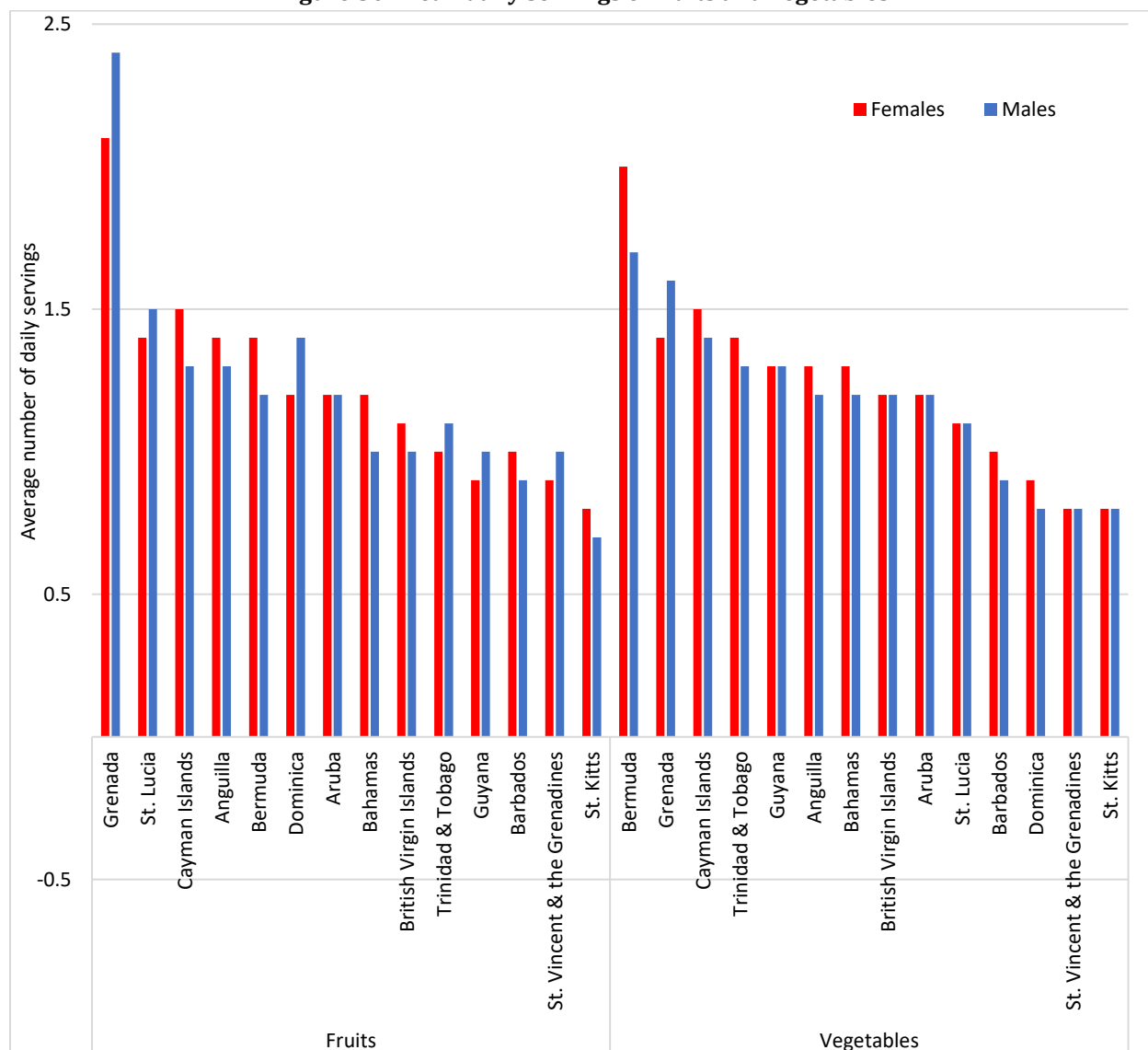
Levels of physical activity vary widely between countries, with those of men almost always exceeding those of women. In nine countries, more than half of men were highly physically active. On the other hand, in three countries, more than half of women reported low levels of physical activity.

Figure 189: Levels of physical activity



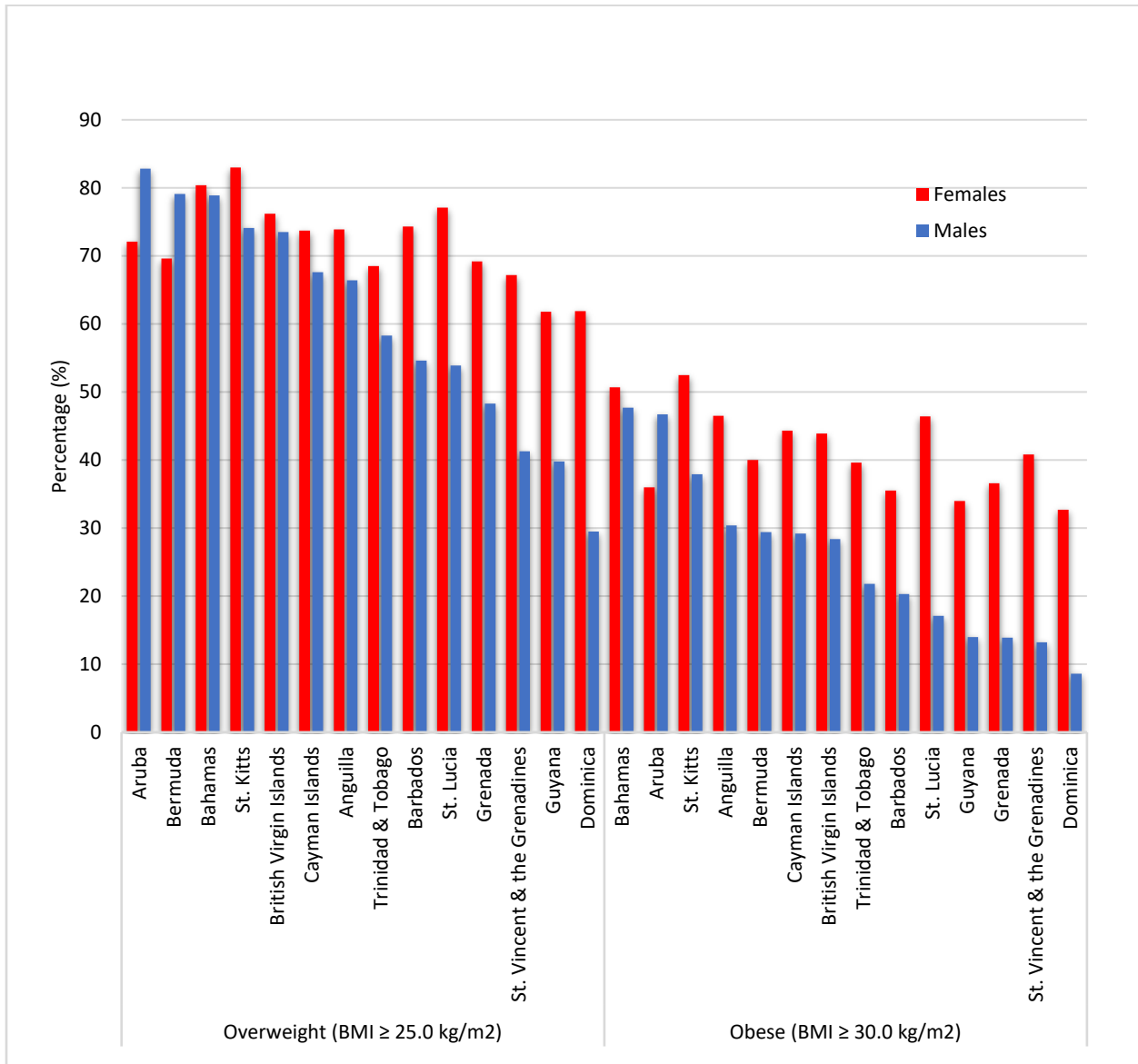
In all countries, average consumption of either fruit or vegetables is far below the recommended amount of five servings per day. In this case, the gender differences are negligible, indicating that poor levels of consumption of fruit and vegetables apply regardless of gender.

Figure 30: Mean daily servings of fruits and vegetables



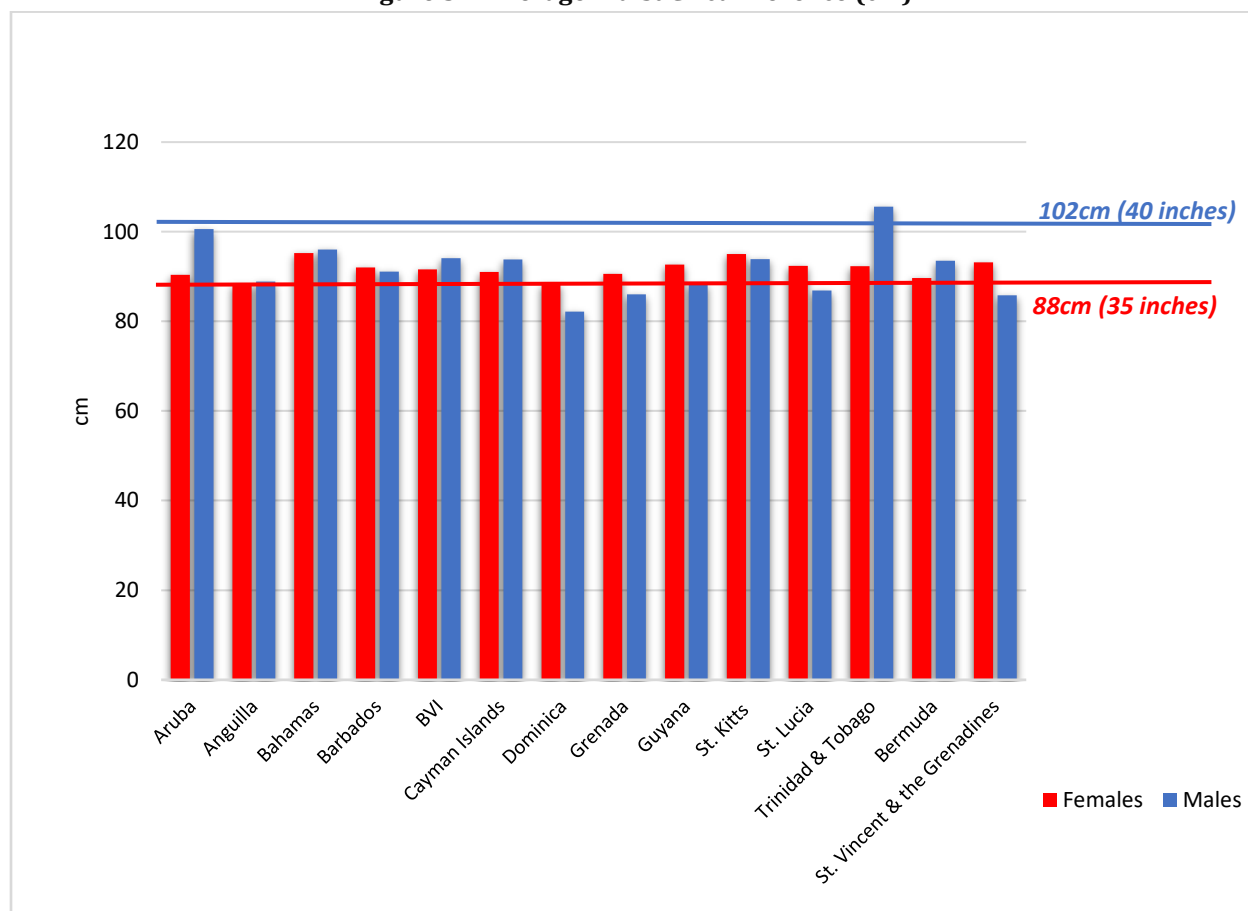
In the Caribbean, there has been a growing rise in obesity and diet-related NCDs over the last five decades. Over 60% Caribbean adults are overweight and over 30% are obese. In some CMS overweight and obesity prevalence rates exceed over 80% and over 50% respectively. More women than men are overweight or obese in almost all countries.

Figure 31: Prevalence of overweight and obesity



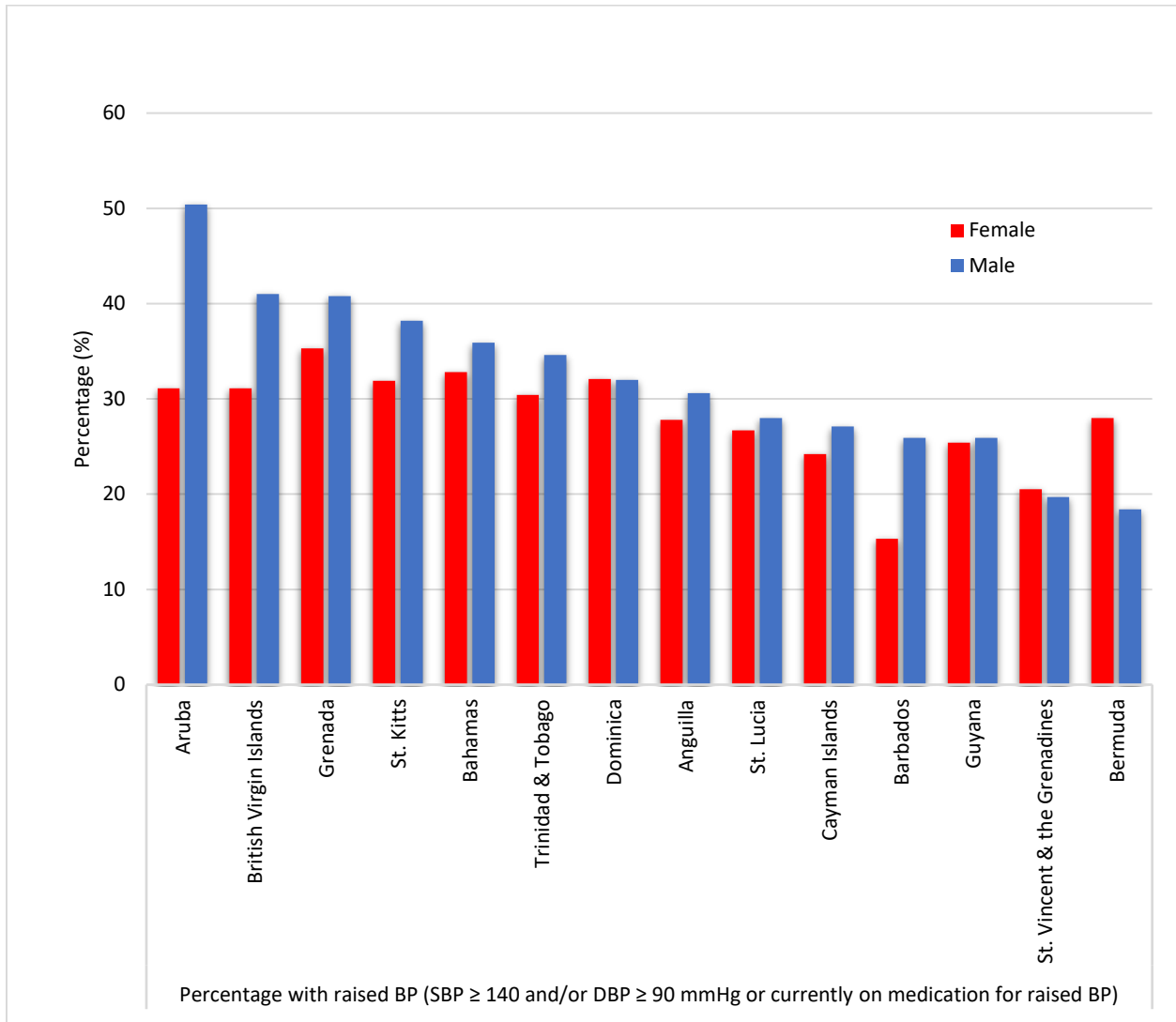
Average waist circumferences are at or above the 35-inch mark for most countries, Two countries had male waist circumferences higher than those of females, with one of these having average male waist circumference size of over 40 inches. In other countries, often, female waist sizes are slightly higher than those of males.

Figure 32: Average Waist Circumference (cm)



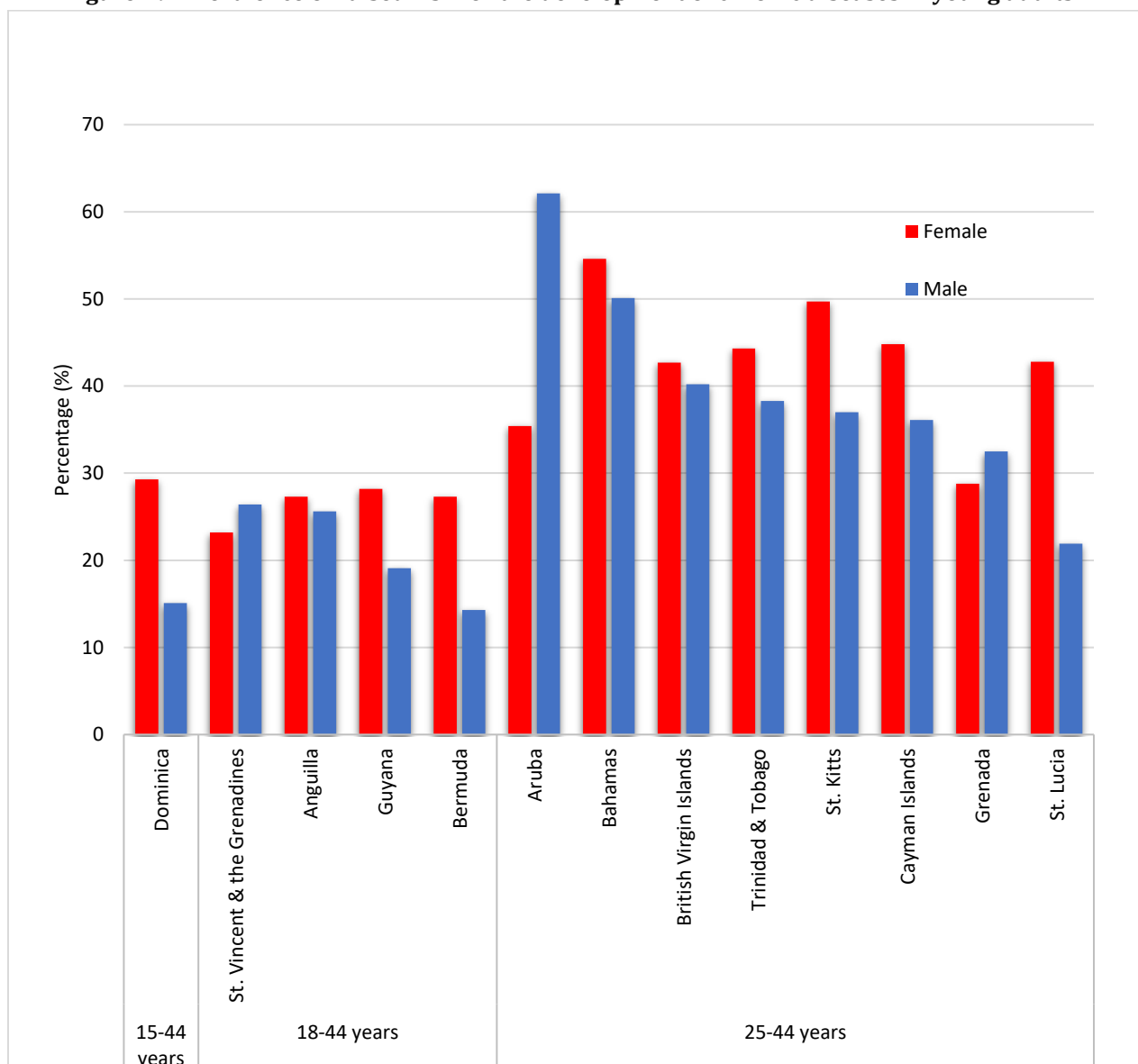
An important risk factor for cardiovascular disease, raised blood pressure, is more prevalent among men than women, though by quite a small margin in most countries. In half of countries surveyed, more than 30% of men had high blood pressure.

Figure 33: Prevalence of raised Blood Pressure



The following figure combines information from the risk factors to present a composite measure of risk of NCD. Note that the surveys with a younger age range tended to show lower levels of risk. In Aruba and Grenada, overall risk was higher for men than for women, but the opposite was true in most other countries.

Figure 19: Prevalence of raised risk for the development of chronic diseases in young adults



Source: (Quesnel-Crooks, 2017)

The risk factor data present an important counterpoint to mortality data, which tend to show more early deaths among men than women. The risk factors are somewhat more prevalent among women, though they tend to die less early than men. The risk factor data suggest that women are more likely to endure long-term illness from NCDs than men. However, men are more likely to use harmful substances, and this may be associated with the high prevalence of accidents and assaults among them, along with other consequences such as lung cancer and cirrhosis of the liver.

2.3.2 Environmental influences on NCDs

Features of the social environment affecting susceptibility to NCDs are many, including: cultural attitudes to body weight and shape; the influence of the media (including, increasingly, social media); parental, religious, educational and peer influence on exercise and eating habits; the local availability and price of fresh foods low in sugar and fat; the existence of “food deserts” where food choice is limited to processed food of low nutritional value, and the local accessibility of green spaces and exercise facilities. These will be explored in detail in Chapter 4 on childhood obesity. Here we present some of the physical environmental influences on NCDs.

There are several direct and indirect impacts of environmental factors on NCD. The human cardiovascular and respiratory systems are sensitive to temperature change, poor air and water quality, and chemical exposure. Thus, climate change and pollution affect susceptibility to NCD. The combination of dietary and exercise practices and external environmental factors can lead to metabolic stresses culminating in NCDs.

Environmental health and sustainable development approaches include the testing of foods and physical environments for toxins and other harmful substances, and legislative and practical action to remove and reduce these. They also include ensuring a safe environment to support wellness and well-being such as green spaces, parks, safe walking and biking paths, to encourage physical activity and mental wellbeing and thus prevent NCDs, and reducing the onset of some non-communicable diseases (Clauzel & Forbes-Robertson, 2017).

2.3.3 Regional Initiatives to address NCDs

Section 1.3, on health frameworks and institutions, provided information on ground-breaking Caribbean initiatives on NCDs, such as the Port of Spain Declaration and the establishment of the Healthy Caribbean Coalition. Some other important initiatives are highlighted below.

International Agency for Research on Cancer (IARC) Caribbean Hub

Cancer is one of the leading causes of mortality in the Caribbean (see section 2.2.1). The most common cause of cancer deaths among males was prostate (33.3%) and lung (14.1%), and among females, breast (21.8%) and cervical (11.0%) (Razzaghi et al., 2016). Mortality and morbidity rates from these cancers can be reduced and prevented through early detection, diagnosis, management and treatment. To do this successfully, as well as develop policies and evaluated strategies, timely and reliable epidemiological data are necessary.

In 2011, the Global Initiative on Cancer Registry Development (GICR) was launched in collaboration with the International Agency for Research on Cancer (IARC). Its aim is to improve population based cancer registries worldwide with the establishment of six regional reference centres including one in the Caribbean. The IARC Caribbean Hub is to be located at CARPHA. Key activities of the Caribbean Hub include building and sustaining the capacity for cancer registration throughout the Caribbean through technical training and support, promoting networking among cancer registries and encouraging research within the region (Global Initiative on Cancer Registry, n.d.).

Caribbean Wellness Day

One of the mandates of the 2007 Port of Spain Declaration was the establishments of Caribbean Wellness Day (CWD). CWD is held every year on the second Saturday in September. The aim is to increase awareness of NCDs in the Caribbean through multi-sectoral activities in support of wellness. The first CWD was held in 2008 and for the first four years, until 2011, the goal was to raise awareness of health issues in general via the event. In 2012, the focus shifted to preventing and controlling NCDs throughout the life course. In 2016 the theme was, “*Healthy Children in Healthy Environments*”, in light especially of the growing epidemic of childhood obesity in the region (Caribbean Public Health Agency, 2017a).

Figure 35: Caribbean Wellness Day Poster, 2016



Source: (Caribbean Public Health Agency, 2017a)

In 2016, progress in meeting the goal of the 2007 Port of Spain Declaration, including Caribbean Wellness Day, was evaluated (see section XX). It was found that CWD was observed in 19 CARICOM Member States, with more than half celebrating it every year and successful involvement of private sector and civil society. Regionally produced CWD material such as the slogan, logo, posters and fact sheets were often adapted by national civil society organisations and private sector participants.

CWD was found to be viewed more as a national than a regional initiative with typical activities such as health fairs, exhibitions, healthy eating demonstrations, sponsored walks, mass public exercise sessions and health screening. Several countries have extended events beyond a single day. For example, the Bahamas, Belize and Guyana celebrate Caribbean Wellness Week, and other countries such as Trinidad and Tobago have events throughout the whole month of September (Samuels & Unwin, 2016a). CWD has experienced global impact; the World Economic Forum and PAHO have

embarked on promotion of “Wellness Week” inspired by the success of Caribbean Wellness (Samuels & Unwin, 2016b).

2.4 Communicable Diseases

The Caribbean has experienced an epidemiological transition, including a shift in the leading causes of morbidity and mortality from infectious and parasitic diseases to NCD. Nevertheless, infectious diseases persist, and we saw earlier that CD are among top causes of death for children and the elderly, indicating that they affect the most physically vulnerable the most severely. Given that substantial proportions of Caribbean people continue to live in poverty and suffer malnutrition, there remain many opportunities for severe consequences from infection. HIV remains a leading cause of death in some age groups.

Epidemics can spread rapidly according to climactic, travel and urbanisation patterns. Underlying all other circumstances is the sanitary conditions for disease transmission through contaminated water and food, poor air quality, poor waste disposal and opportunities for micro-organisms and vectors to proliferate. The impact of climate change appears to favour the resurgence of CDs. Increased rainfall in hot conditions will encourage the reproduction of pathogenic micro-organisms, mosquitoes and other insect pests. Periods of intense rainfall will also increase risks associated with flooding. On the other hand, increased heat in the dry season will reduce water availability and impact sanitation.

Some diseases may be treated with antibiotics, but there is evidence of increasing antibiotic resistance. Viruses are more difficult to treat, and in the case of HIV, have had massive public health and social consequences.

In this section, we examine respiratory and food-borne diseases, HIV, anti-microbial and anti-retroviral resistance, and Ebola, with a focus on what happened in the 2014-'16 period. We also examine the Caribbean public health response to CDs, including immunisation and health security measures. Notably, there was not a single case of Ebola in the Caribbean, but the public health mobilisation was massive, and strengthened the mechanisms for responding to public health emergencies. Responses to vector-borne diseases, notably chikungunya and Zika, which created a huge burden of illness on Caribbean societies from 2014-16, are the subject of the next chapter in this report.

2.4.1 Respiratory diseases

Respiratory diseases are very common among acute infections in the Caribbean. Chronic respiratory illnesses cause significant morbidity and mortality, with cancer of the lung, bronchus and trachea being among leading (top 10) causes of death among 45-64-year olds and chronic lower respiratory disease among leading causes for elders aged 65+. Influenza and pneumonia are among leading causes of death in the under 1, 1 to 4, 5 to 14 and 65+ age groups, indicating that children and elders are especially vulnerable. Tuberculosis has also staged a resurgence as a cause of illness in the region, often as a co-infection with HIV, and generally associated with outcomes of poverty, such as overcrowding, poor sanitation and low health expenditure per capita (Bergonzoli, Castellanos, Rodriguez, & Garcia, 2016; Geoghagen, Farr, Hambleton, Pierre, & Christie, 2004; Munayco, Mujica, Leon, del Granado, & Espinal, 2015; Rouzier, 2011b).

CARPHA conducts respiratory viral illness surveillance for the Caribbean. The following three charts show the pattern of respiratory viruses submitted and identified by CARPHA and the percentage confirmed positive over the years 2014, 2015 and 2016.

The beginning of 2014 saw an outbreak of H1N1 influenza, which dissipated by March 8th. There was a lull in the number of respiratory virus cases between around April 17th and September 13th. After this there were more cases until the end of the year, with rhinovirus, influenza A (non-subtyped), influenza A (H3) and RSV making substantial contributions to the total. The diseases with the most cases in the year were RSV (33%), H1N1 (17%), H3 (14%), influenza A (not subtyped, 9%) and rhinovirus (8%).

In 2015, until week 14 ending 4 April, there were a wide variety of respiratory viruses diagnosed, with 10 of the weeks seeing four or more viruses, and a peak in the week ending 7 March. Between 5 April and 27 June (week 26) there was a relative lull in number of infections detected. Rhinovirus was detected throughout the year, and there was a rise in the number of cases the week ending 4 July (week 27) and the week ending 24 October (week 43). There was an outbreak of H1N1 virus from around 3 October until the end of the year, with a peak in the week ending 31st October. The end of the year also saw relatively large numbers of cases of RSV. H1N1 saw the most cases in 2015 (31% of total), followed by rhinovirus (22%) and RSV (12%).

At the beginning of 2016 there were reports of many infections of various types, only tapering off around the end of May. Prominent among the viruses were H1N1, rhinovirus, influenza B and RSV. In the latter part of the year there was an uneven rise in cases, with the highest levels of infection in the week ending 5th November. Rhinovirus and H3 virus were common causes of infection. There were cases throughout the year, RSV (22%), H1N1 (20%) and rhinovirus (17%).

Figure 20: Distribution of influenza virus and other respiratory viruses by epidemiological week, 2014

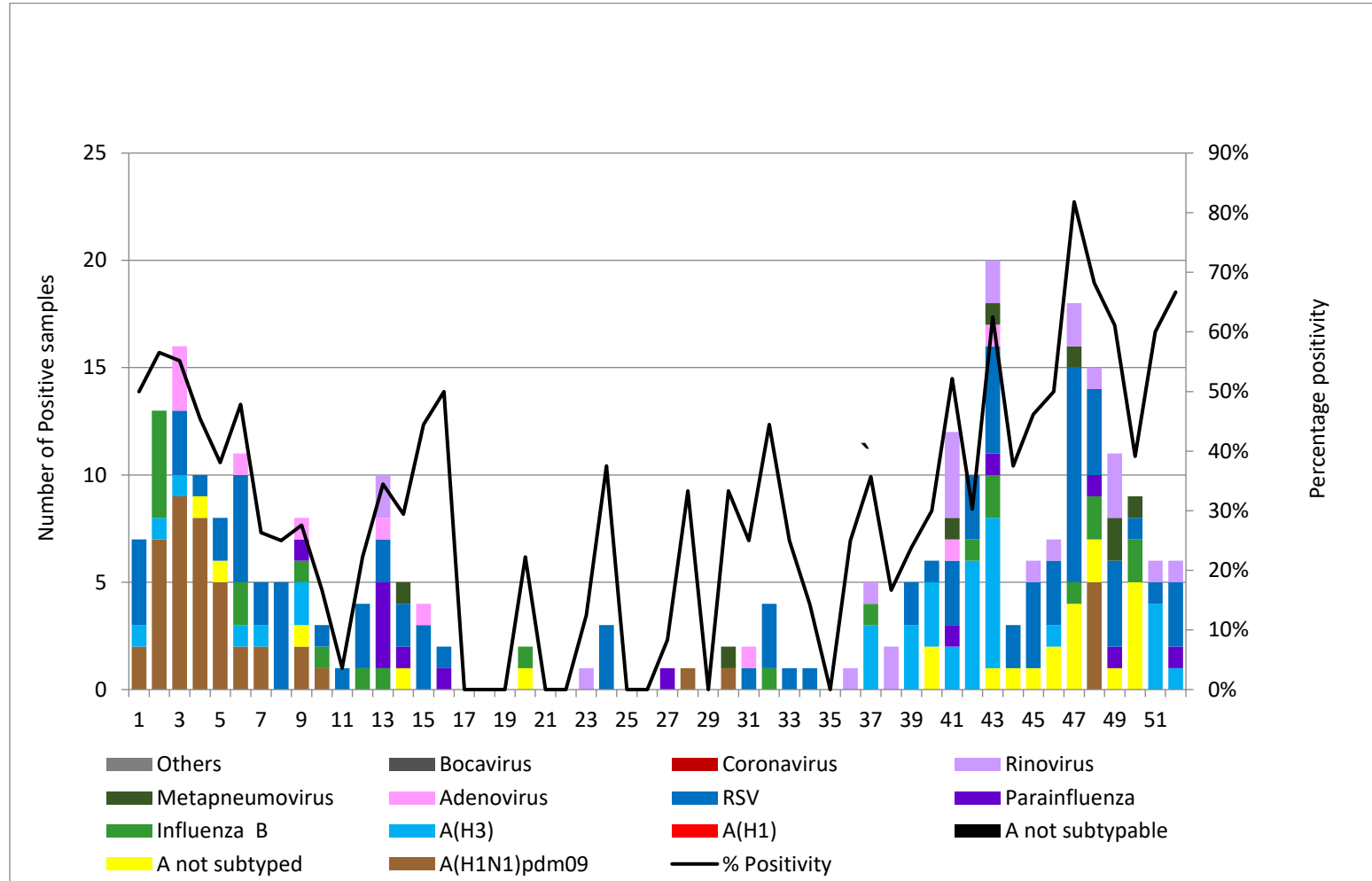


Figure 21: Distribution of Influenza virus and other respiratory viruses by epidemiological week, 2015

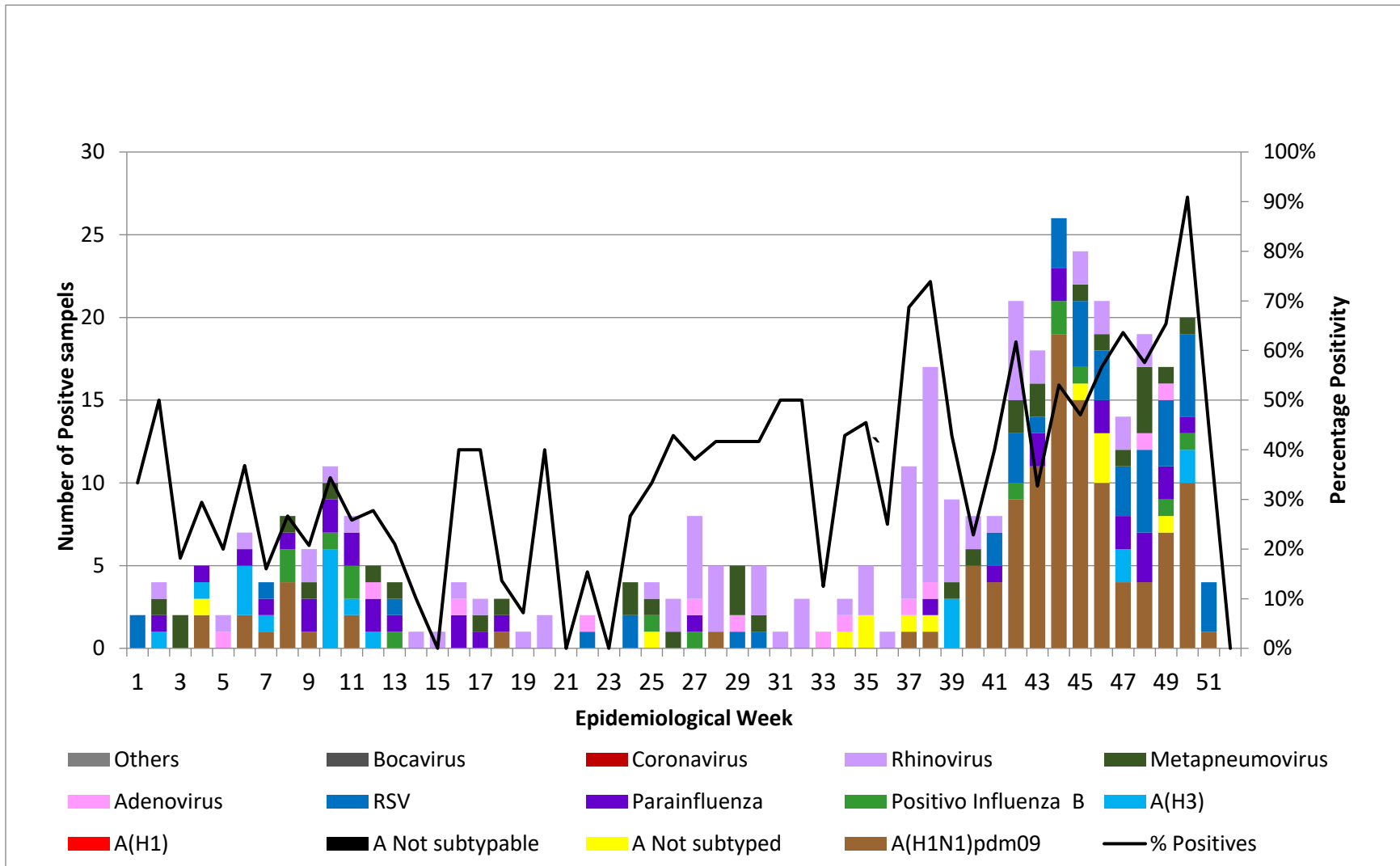
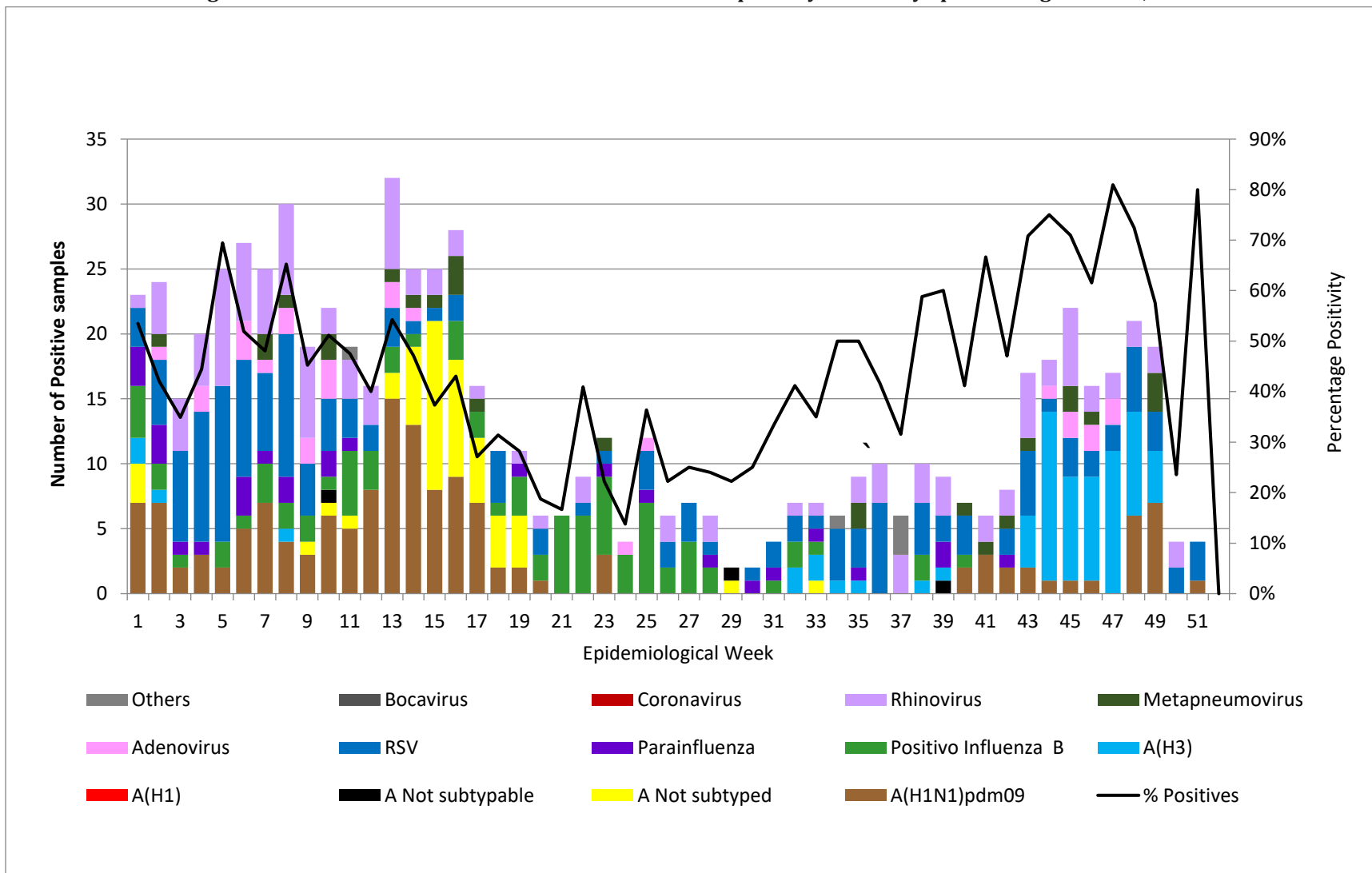


Figure 228: Distribution of influenza virus and other respiratory viruses by epidemiological week, 2016



The following three figures look at influenza subtype distributions over the three years. We see that in 2014, H1N1 was the most widespread at the beginning of the year, while type A (H3) and A (not subtyped) made up the bulk of influenza cases later in the year.

There two outbreaks of influenza of various strains in 2015. The smaller outbreak lasted until the week ending 28 March and included four subtypes. The larger outbreak started from around 4 September and was dominated by H1N1, which reached a peak in the week ending 31st October.

The relatively large number of H1N1 cases persisted into 2016, only easing off around the middle of May, and with a further peak between April 3 and 16. There were also relatively large numbers of influenza B cases in the first half of the year, and an outbreak of not-subtyped flu between 21 February and 7 May. Towards the end of the year, H1N1 emerged again and there was an outbreak of H3 virus.

Figure 239: Distribution of Influenza (types and subtypes) by epidemiological week, 2014

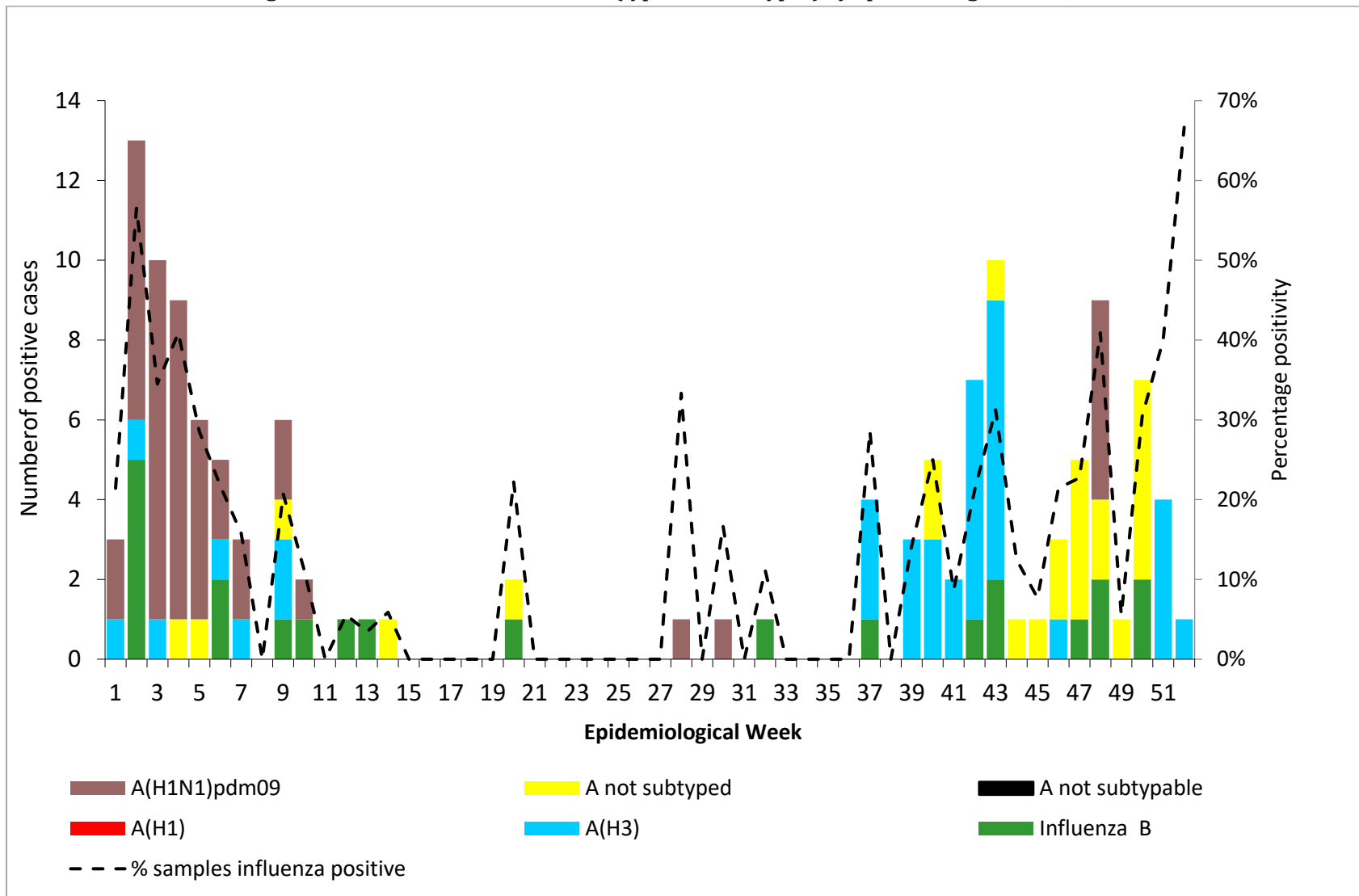


Figure 24: Distribution of Influenza (types and subtypes) by Epidemiological Week, 2015

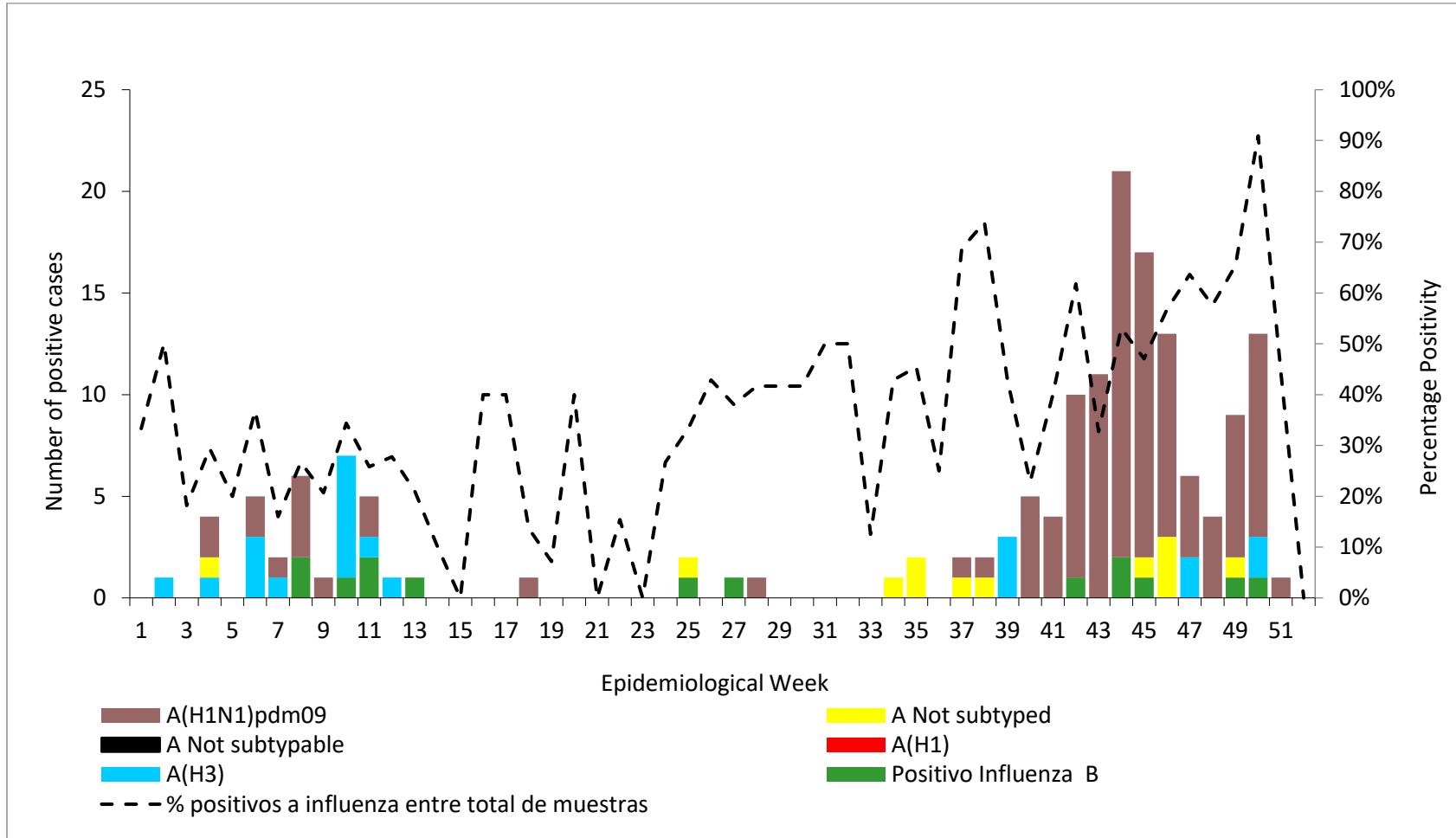
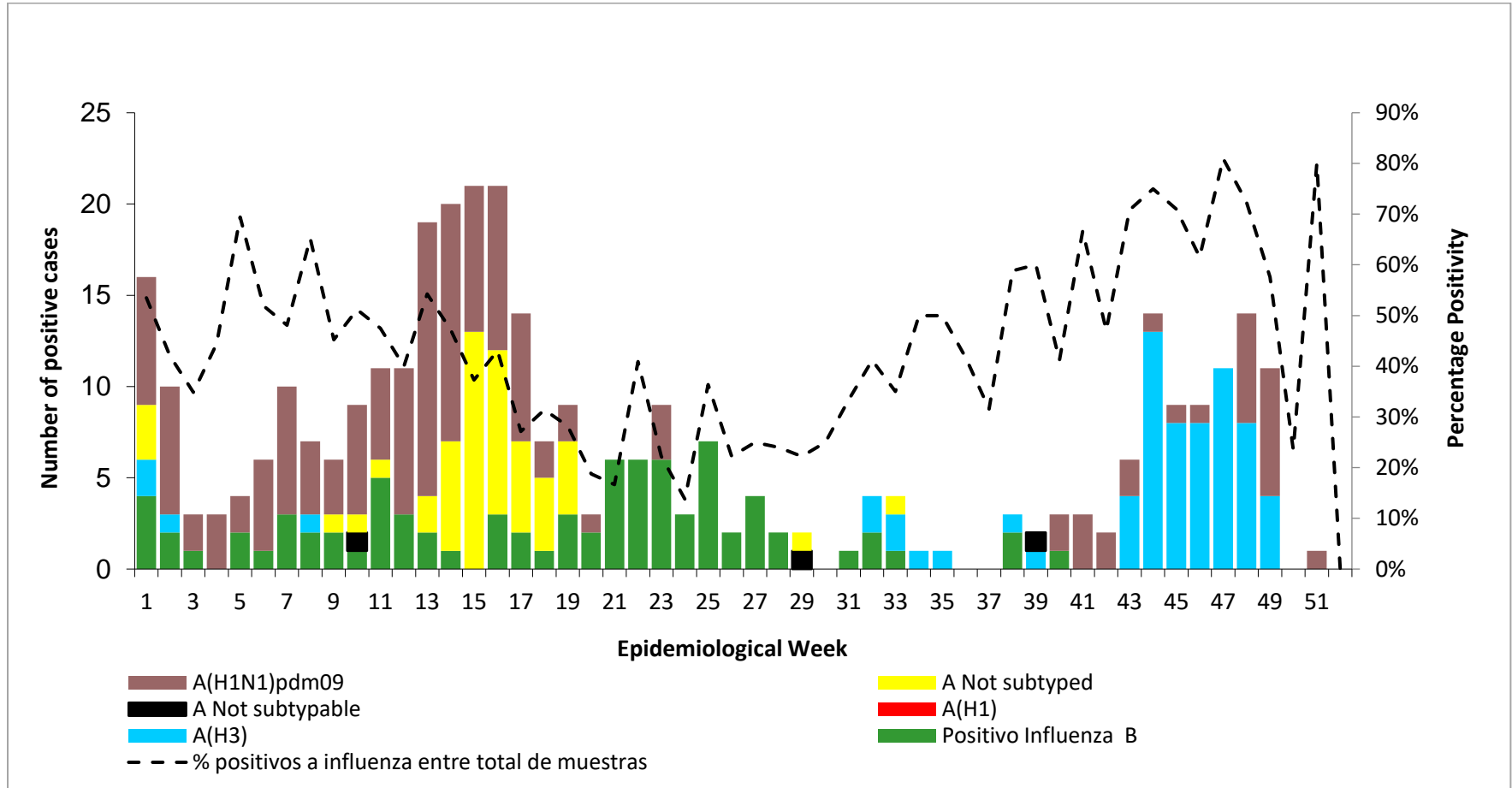


Figure 41: Distribution of Influenza (types and subtypes) by epidemiological week, 2016



2.4.2 Food-borne diseases

Increased food production, globalisation, travel, trade and the emergence of new or antibiotic-resistant pathogens are increasingly challenging food safety and security. These factors have brought increasing numbers of large outbreaks. The WHO adopted Resolution WHA 53.15 in 2002, establishing food safety and the surveillance, prevention and control of food-borne illness as priority in 2002 and again in 2010.

Globally, *Salmonella*, *Norovirus*, *Clostridium botulinum*, *Shigella*, *pathogenic Escherichia coli (E-coli)*, *Campylobacter*, *Vibrio cholera* and parasites are the most important human food-borne illnesses, among more than 250 food-borne diseases (FBDs) that have been described.

Since 1990, increasing numbers of reported cases and outbreaks of acute gastroenteritis and FBD pathogens have been reported to CAREC, then CARPHA. A Foodborne Disease Programme was established at CAREC in 2003. The purpose was to strengthen national and regional capacity to develop and sustain integrated surveillance, prevention and control systems. This integrated the epidemiological, laboratory, environmental and veterinary aspects of FBD surveillance into a coordinated programmatic approach.

CARPHA continues this integrated farm to table multi-sectoral approach to FBD surveillance. Challenges include variation in national surveillance systems for FBD in CMS, and in laboratory capacity. There are almost no CMS with a fully integrated FBD surveillance system that integrates human, food and animal surveillance data. Reporting frequency and completeness vary by country. Stool specimens are also not commonly collected from patients with acute gastroenteritis, significantly affecting the determination of the aetiology and prevalent FBD that cause human illness. This is perhaps the single most limiting factor for FBD surveillance in the Caribbean.

In 2014, with support from the Inter-American Development Bank, CARPHA set up an integrated surveillance system for the tourism sector, including the monitoring of FBD as one of the major areas of surveillance capacity-building.

Food-borne disease trends 2005-2016

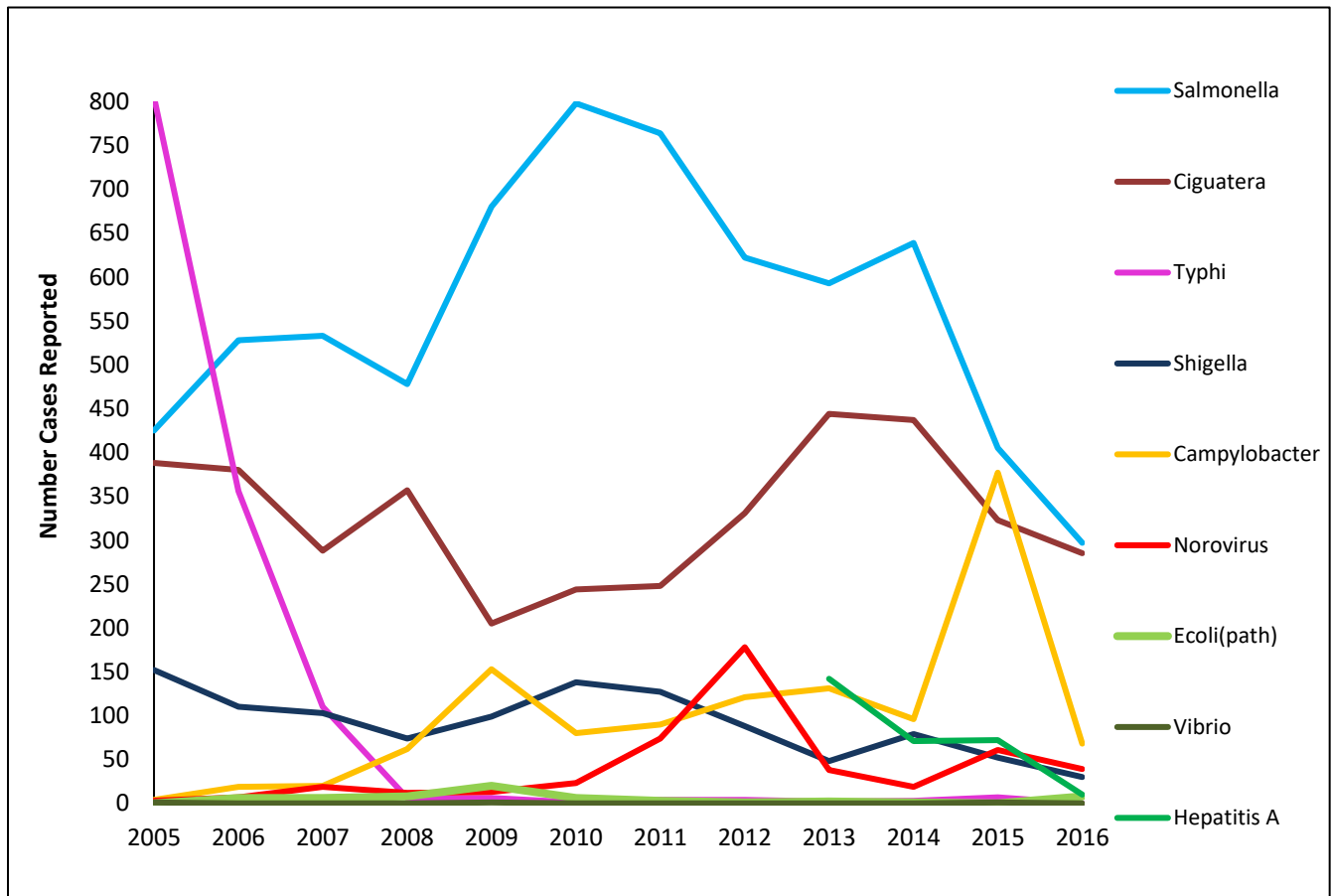
The following chart show a fluctuating picture of laboratory-confirmed food-borne diseases reported to CARPHA since 2005.

- *Salmonella* accounted for the largest number of cases, with average 564 cases per year, peaking at 798 in 2010, and falling to a low of 297 cases in 2016. There were 639 salmonella cases and 405 in 2015.
- Ciguatera cases averaged 328 cases per year, ranging from 205 cases in 2009 to 444 in 2013, with 427 cases in 2014, 323 cases in 2014, and 285 in 2016.
- Cases of typhi fell dramatically from 805 in 2005 to 6 in 2008, and thereafter did not exceed 7 in any year.
- *Shigella* and *campylobacter* accounted for similar number of cases per year, with the average for *shigella* being 92 and that for *campylobacter* being 102. *Shigella* showed a downward trend while *campylobacter* showed an upward trend. Figures for *shigella* were 79, 52 and 30

for 2014, 2015 and 2016 respectively. There was a spike in campylobacter cases in 2015. Figures for campylobacter were 96, 377 and 68 in 2014, 2015 and 2016 respectively.

- Around a yearly average of 41 cases, there was a rise in the number of norovirus cases until 2012 when 178 cases were confirmed. Figures for norovirus were 19, 61 and 39 in 2014, 2015 and 2016 respectively.
- There was an average of 5 laboratory-confirmed cases of E-coli every year, ranging from 0 to 20. Figures for E-coli were 1, 0 and 8 in 2014, 2015 and 2016 respectively.
- Numbers of vibrio cases were very small, with a total of 3 cases over the period, in 2005, 2009 and 2015.
- Hepatitis A cases have only been reported since 2013, when 142 cases were reported. There were 71 cases in 2014, 72 in 2015 and 10 in 2016.

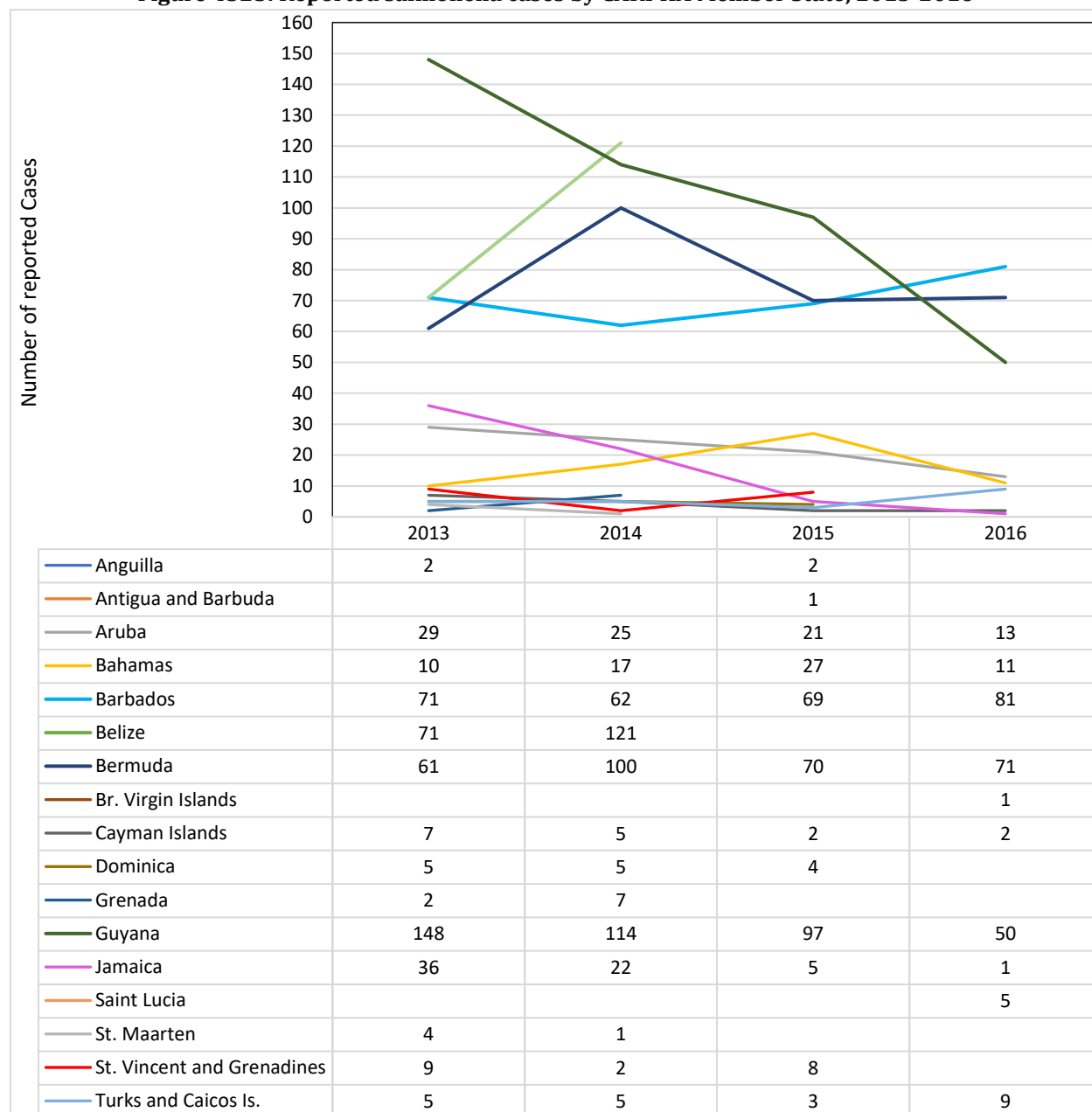
Figure 42: Reported Laboratory-confirmed Cases of Foodborne Diseases Pathogens, CARPHA Member States, 2005-2016



Source: CARPHA

Laboratory confirmed salmonella cases by country for the years since 2013 are presented below. The highest numbers were in Guyana, Bermuda, Barbados and Belize, though cases were only reported in Belize for two of the years. which saw an increase from 71 to 81 cases over the period. Numbers of cases in Jamaica were small given the larger population of this country. Numbers of cases of salmonella did not exceed 29 in any other CMS in any year since 2013.

Figure 4325: Reported salmonella cases by CARPHA Member State, 2013-2016



2.4.3 Immunisation and Vaccine-Preventable Diseases

The Governments of the Caribbean Community (CARICOM), CARPHA and its predecessor CAREC and PAHO have been committed to supporting the WHO's Expanded Programme on Immunization since its beginning in 1974. The objectives of the EPI programme in the Caribbean are:

- To achieve equity in the provision of vaccine services by achieving and maintaining >95% coverage for all antigens
- To maintain polio eradication status
- To maintain measles, rubella and congenital rubella syndrome elimination status
- To maintain and strengthen surveillance for Vaccine Preventable Diseases
- To advocate for the introduction of new and underutilized vaccines using an evidence-based approach.

CARPHA promotes and supports regional vaccination planning. Monitoring activities such as laboratory surveillance and implementation evaluation are key factors in which CARPHA is engaged.

Stock-outs caused by shipping problems have occasionally caused a drop off in coverage. Some municipalities within countries have lower rates of coverage. CARPHA continues to support countries in strategies to increase equitable access to vaccination.

Table 6: Vaccination coverage by antigen and by Caribbean country, 2015

	BCG	Polio	DTP3-cv	MMR1	Municipalities with DTP3 coverage ≥ 95%
Anguilla	100	100	100	97	100
Antigua & Barbuda	n/a	86	100	100	88
Aruba	n/a	92	92	92	...
Bahamas	n/a	95	95	94	67
Barbados	38	97	97	96	60
Cayman Islands	75	93	93	81	33
Dominica	100	98	98	96	86
Grenada	n/a	99	92	99	57
Guyana	99	92	95	100	31
Jamaica	100	91	91	91	46
Montserrat	79	100	100	100	100
Saint Kitts & Nevis	95	91	94	95	47
Saint Lucia	100	100	100	97	89
Saint Vincent & the Grenadines	100	100	100	100	100
Sint Maarten (Dutch)	n/a	100	100	98	100
Suriname	n/a	89	89	94	10
Trinidad and Tobago	n/a	88	96	89	44
Turks and Caicos Islands	100	94	94	95	75
Virgin Islands (UK)	100	95	97	100	25
AVERAGE	91	95	96	95	64

Key: n/a = not applicable ; BCG = Anti-tuberculosis vaccine (Bacille Calmette-Guerin); Polio 3 = Oral polio vaccine or inactivated polio vaccine, third dose; DTP3-cv = Diphtheria-tetanus-pertussis containing vaccine, third dose; MMR1 = Measles, Mumps and Rubella, first dose.

Source: (Pan American Health Organization / World Health Organization, 2016)

The table above provides data for 2015, the latest available year. It shows that, on average, Caribbean countries have achieved at least 95% vaccination coverage against polio, diphtheria, tetanus and pertussis and measles, mumps and rubella. The average coverage for BCG was less than 95% and was pulled down by a rate of 38% in one country.

Of the nineteen countries listed, nine had not achieved 95% coverage for polio, seven had not achieved it for DTP and four had not achieved it for MMR. On the other hand, some countries achieved universal coverage: five for polio, six for DTP and five for MMR.

Within countries, 95% or greater coverage of DTP across municipalities was achieved by four countries. The range of rates of 95% coverage across municipalities varied widely by country, from as low as 10% through to 100%. Geographic coverage of vaccination is clearly a challenge in some countries.

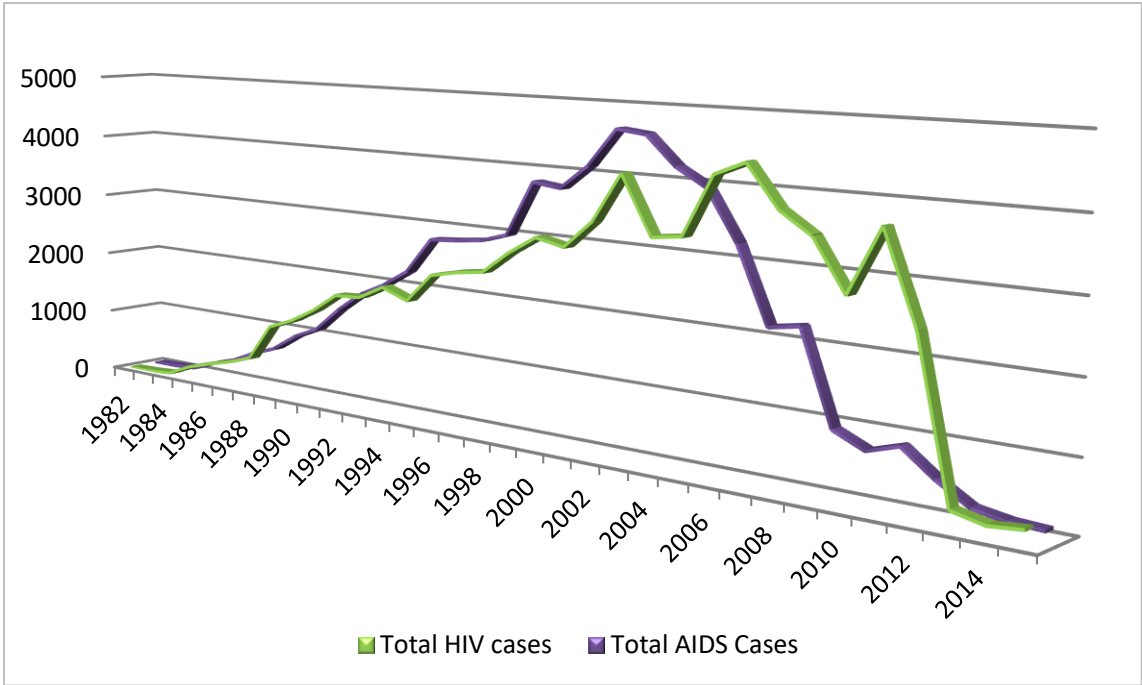
2.4.4 HIV and AIDS: the story as told by CARPHA Member State data

Aggregate data on new cases of HIV, AIDS and AIDS deaths have been reported to one of CARPHA’s predecessor agencies, CAREC, dating back to 1982. Though the data received over this time-period vary in their completeness and, to some extent, their absolute accuracy, they paint a general picture of the development of the HIV pandemic, in the Caribbean region, over the last three decades.

It should be noted that Haiti is a relatively new CARPHA Member State and has not reported HIV data to CARPHA. Haiti is the largest CMS with relatively high HIV prevalence (Figueroa, 2008) and the absence of its data from this country reduces the overall numbers of HIV and AIDS cases reported by CMS considerably.

General Trends

Figure 44: Reported HIV Cases and AIDS Cases, 1982 - 2015. All CARPHA Member States.

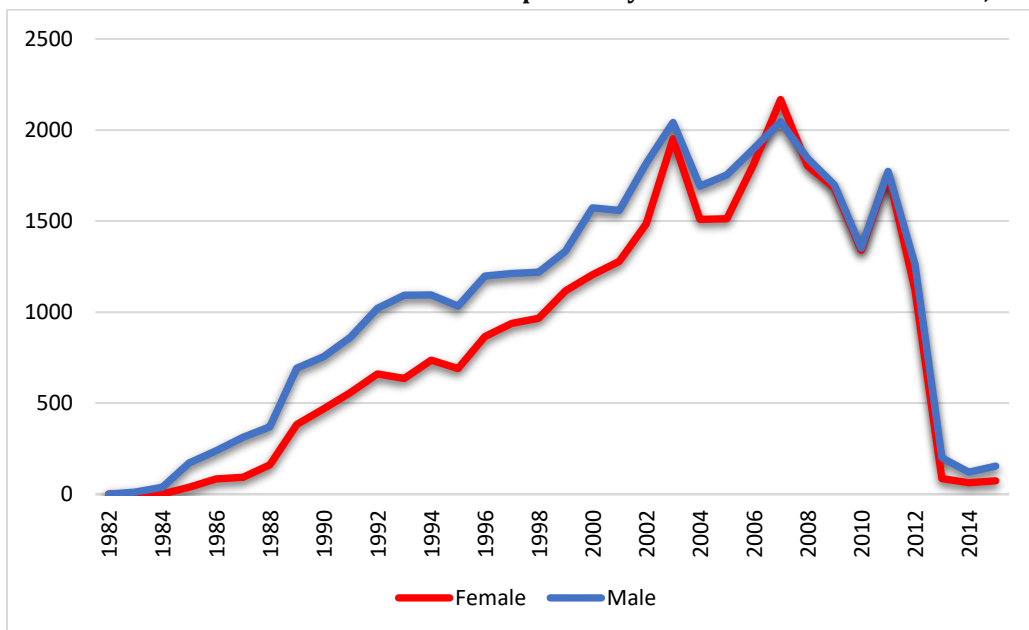


Regionally, reported HIV Cases gradually increased from single digits, in the early 1980s to the early 2000s, peaking in 2007 with 4383 cases reported throughout the region followed by a gradual decline, which transitioned to an apparent precipitous “drop off” from 2011. (Figure 44). This data, however, must be interpreted cautiously. The completeness of reporting for the region achieved a plateau of 80-90% of CMS reporting annually, from the late 1980s through to 2008. After this, reports from CMS became more sporadic, with 60-70% of CMS reporting up to 2012, dipping further, to approximately 30-40%, over the last 3 years of available data. The rapidity of the decline in total new HIV cases in the database since 2008 is therefore largely an artefact of reporting. It is important to look at data from individual countries to find out whether incidence has declined; this is done later in this section.

Data on AIDS diagnoses in the region follows a similar pattern both in terms of numbers of cases and completeness of reporting. Initially more AIDS cases than HIV cases were diagnosed in the first 3 years of the pandemic, with HIV diagnoses eventually outpacing their more severe counterpart from 1985 to 1992. AIDS cases again outstripped HIV cases reported between 1993 and 2005, before finally falling behind from 2006 onward. A large gap emerged between the number of HIV cases and the number of AIDS cases reported from 2006, which could in part be explained by the success of widespread antiretroviral therapy (ART) use in reducing the number of AIDS cases. In 2010 adult ART treatment coverage in 23 Caribbean countries ranged from 57%-70% with a 29% increase from 2006 (Jack, Gebre, Del Riego, & Francis, 2012). In total, >69,000 cases of HIV and >62,000 cases of AIDS were reported to CAREC/CARPHA over the period 1982 to 2015.

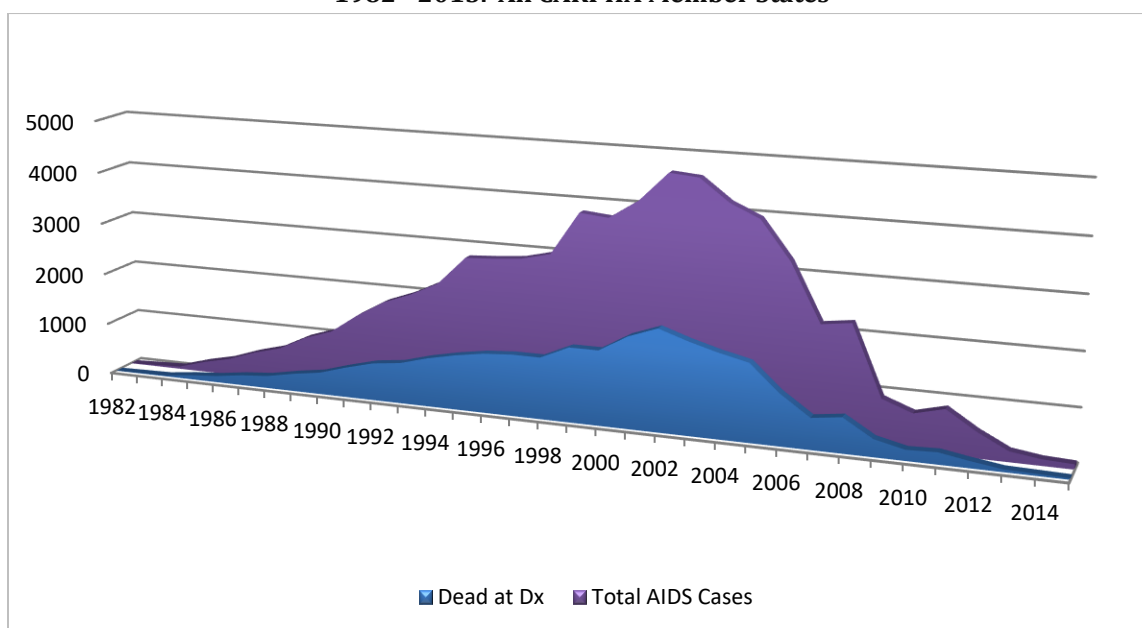
Gender differences were noted in both HIV and AIDS reports, with men outnumbering women in almost all years of the epidemic. The “gender gap” narrowed considerably from 2003. Prior to that year, there were 20% or more male than female HIV cases every year. In 2003, there were 5% more male than female cases, and from 2006 until 2011, there were no more than 2% more. Small reporting numbers thereafter make it difficult to be confident in the male/ female ratio. The evidence suggests a transition from concentration of HIV cases among men who have sex with men in the early days of the epidemic to a more generalized epidemic with substantial heterosexual transmission in more recent years (Allen, 2015; Bokazhanova & Rutherford, 2006; Cleghorn et al., 2000; De Groulard et al., 2000).

Figure 45: Total new male and female HIV cases reported by CARPHA Member Countries, 1982-2014



The proportion of AIDS cases that were already deceased at the time of diagnosis (Dx) declined only modestly over the past 3 decades from a high of 43% in 1984 to a low of 26%, in 2013 with significant fluctuations in the intervening years. This, to some extent, is reflective of the ongoing challenge of reaching infected persons at earlier stages to improve both their quality and duration of life. The fairly steady proportion of persons dead at AIDS diagnosis is evident in the following figure, as the “Number dead at diagnosis” graph remains largely congruent with the graph for total cases, throughout the time-period.

Figure 46: Total Reported AIDS Cases and total numbers of people dead at the time of AIDS reporting, 1982 - 2015. All CARPHA Member States



The seven most populous countries in the region contribute the vast majority (> 86%) of the total number of HIV cases, overshadowing reports from other smaller, though more numerous, territories. To appreciate the subtler differences in pattern that may exist between various CARPHA Member States (CMS), the region's countries were sub-divided into three main groups:

- i) the seven largest countries - Jamaica, Trinidad and Tobago, Guyana, Suriname, Belize, The Bahamas and Barbados;
- ii) the CMS belonging to the Organisation of Eastern Caribbean States (OECS) – Antigua and Barbuda, Dominica, Grenada, St. Kitts and Nevis, St. Lucia and St. Vincent and the Grenadines;
- iii) the United Kingdom's Overseas Territories – Anguilla, Bermuda, the British Virgin Islands, the Cayman Islands, Montserrat, and Turks and Caicos Islands alongside the Dutch Islands, represented by two reporting loci – Aruba and Curacao and the remaining Netherlands Antilles which report the aggregated data from Bonaire, Saba, St. Eustatius

At the sub-regional level, gaps in the data, especially for the smaller CMS, become more evident. Jamaica only reported HIV and AIDS data for one year and this explains the absence of data from this country in the analyses that follow.

In several of the larger countries and OECS countries, a fall in the incidence of HIV shown in the following charts is apparent in the graphs below from around the 2006-2008 period. This suggests that the fall in numbers of HIV cases observed earlier in this section is not merely the result of lower reporting in later years. There is evidence that HIV prevention and control efforts are successfully reducing HIV incidence in the Region.

Figure 47: New HIV Cases per year in larger CARPHA Member States, 1982-2014

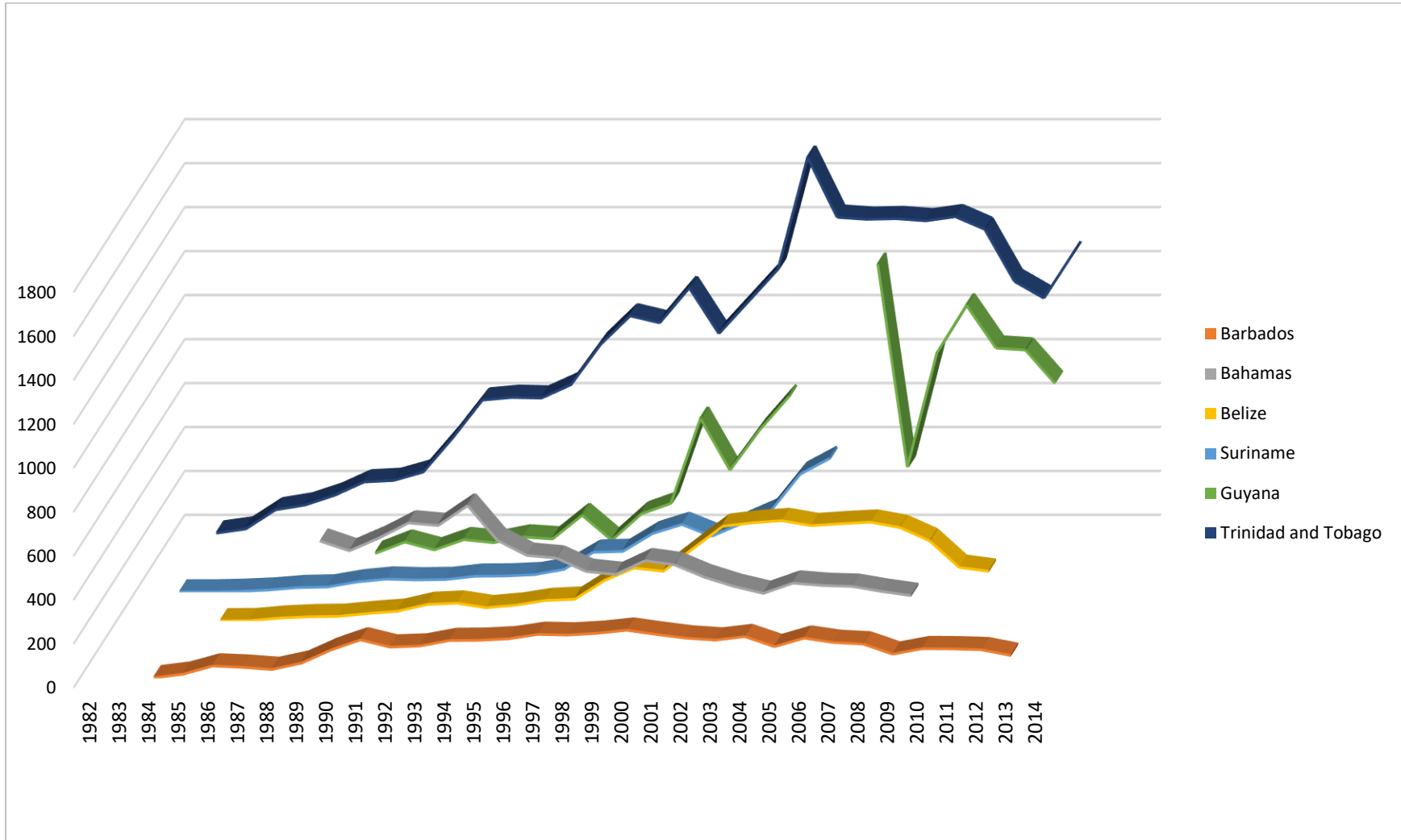


Figure 26: New HIV Cases per year in the Organisation of Eastern Caribbean States, 1982-2014

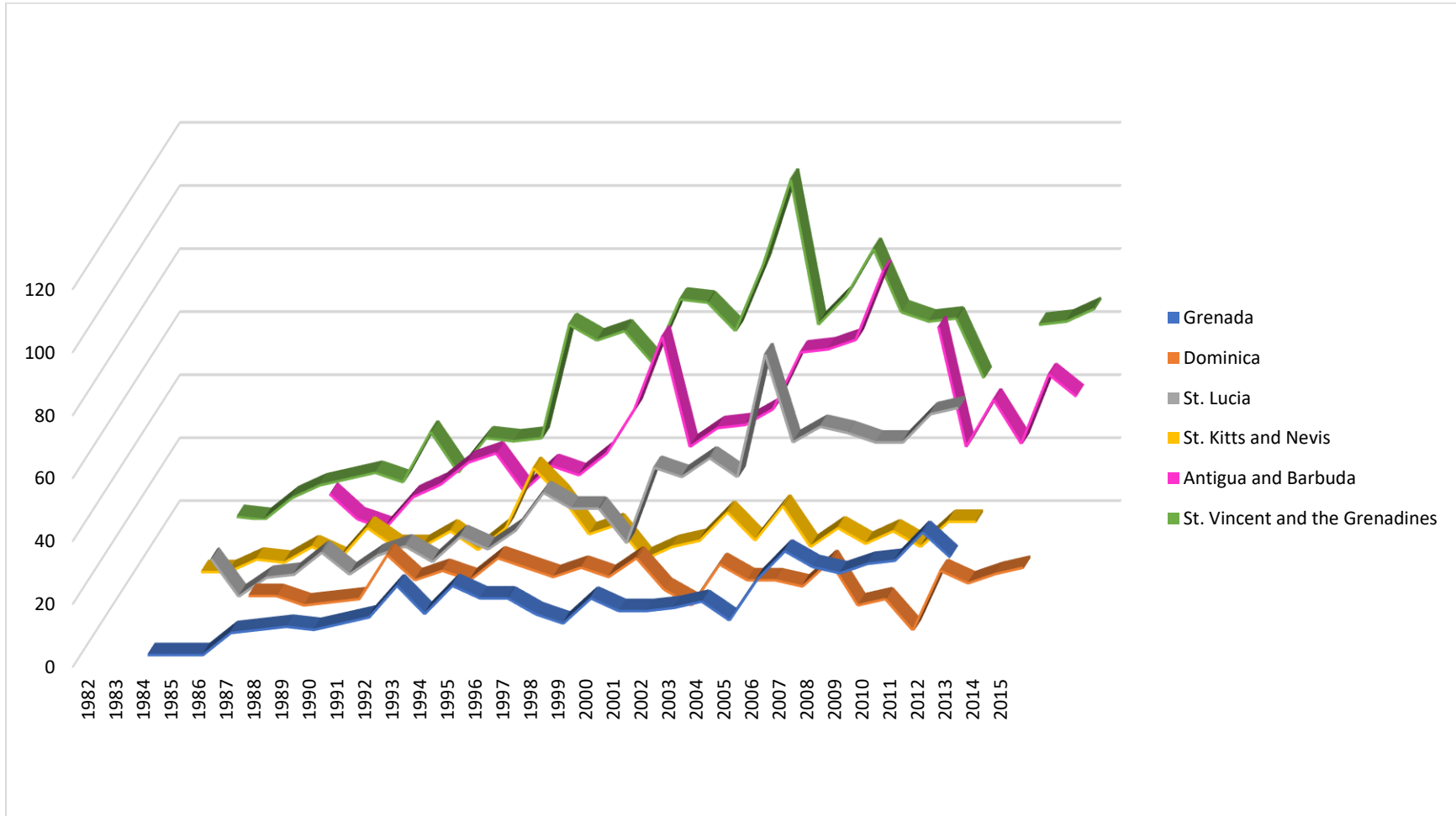
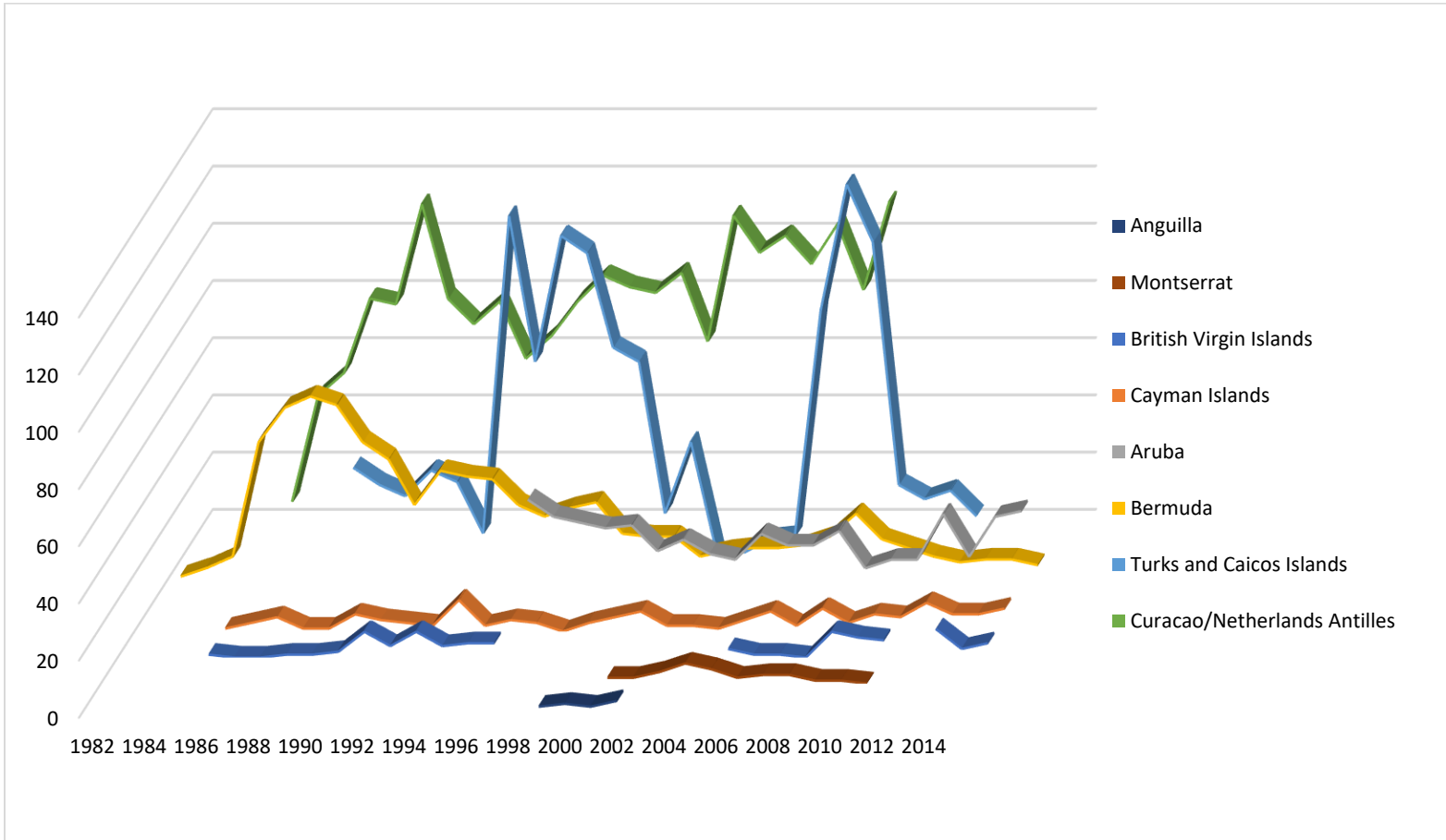


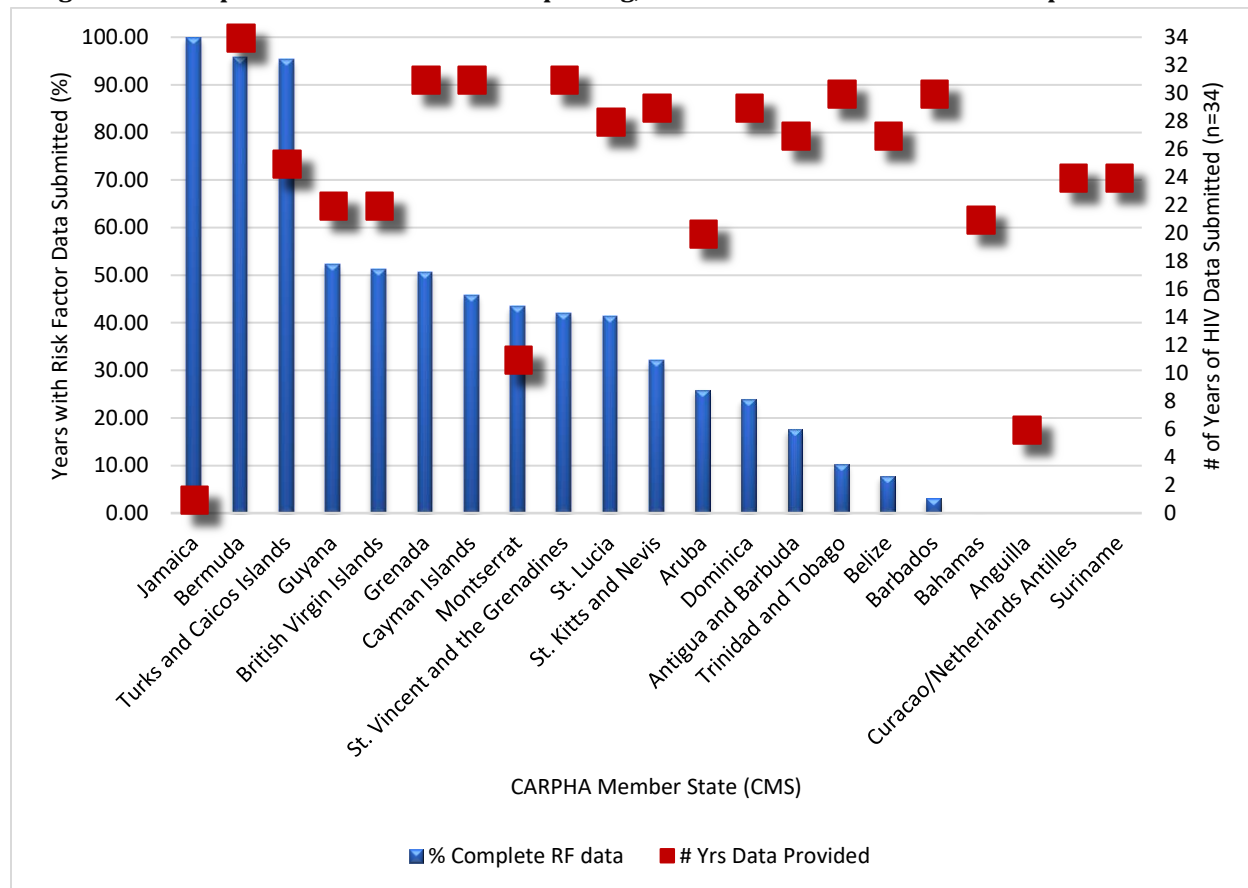
Figure 49: New HIV Cases per year in UK Overseas Territories, Aruba, Curacao & the Netherlands Antilles, 1982-2014



Reporting on HIV and AIDS

The collection of risk factor data for both HIV and AIDS diagnoses has been a perennial challenge for most CMS. Completeness of risk factor data collection varies by country and year.

Figure 50: Completeness of Risk Factor reporting, and Number of Years HIV data reported. All CMS



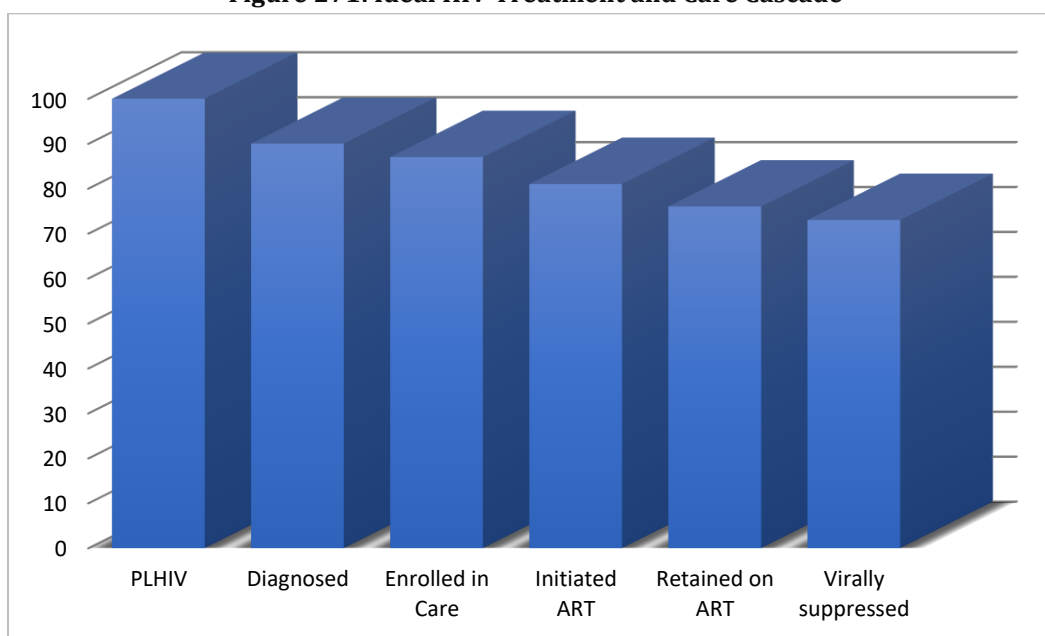
On average ~20% of HIV and ~36% of AIDS risk factor data were reported across the region for all member states, throughout the course of the pandemic. Some countries, notably some of the UK Overseas Territories (UKOTs) and some of the OECS islands maintained higher proportions completeness for risk factor reporting, but, in general no more than 6 countries achieved >50% completeness of risk factor reporting for either HIV or AIDS. These highlights systemic challenges in data collection for potentially sensitive, though epidemiologically important, data from patients and presents an opportunity for intervention in strengthening systems for strategic information across the region.

Variability in data completeness and in consistency of reporting both indicate that alternative approaches to collecting HIV and AIDS data may be of benefit. The significant decline in completeness of reporting in the last 5 years of data make it difficult to assess the status of HIV in the regions from the data currently available to CARPHA. Adjustments in data collection strategy have, however been proposed and supported by development partners working with the region in the field of strengthening country responses to HIV. The approach and inherent challenges therein are now outlined.

Changes in Reporting Strategy

International development partners (IDPs), including UNAIDS, PAHO, CDC and others, have engaged in activities to improve the reach of prevention activities and the provision of care. Alongside this aid, has been the drive toward the collection of data more reflective of the treatment and care outcomes of Persons Living with HIV (PLHIV) in the region. While approaches have varied between IDPs, there has been regional and global consensus on the need to gather data on key aspects of healthcare systems' responses to HIV. Among these, the elements commonly described as the Cascade of Care and Treatment (Gardner, McLees, Steiner, Del Rio, & Burman, 2011) have been emphasised as the sine qua non of current HIV reporting. The Cascade focuses on estimating numbers of PLHIV, using a mathematical model, and ascertaining what proportion PLHIV know their HIV Status; are initiated on Anti-Retroviral Treatment (ART); and achieve viral suppression. The target is to have 90% of PLHIV know their status, 90% of those diagnosed initiated on ART, and 90% of those on ART virally suppressed by the year 2020 (UNAIDS, 2017). An example of the treatment cascade is given below.

Figure 271: Ideal HIV Treatment and Care Cascade



There is additional interest in producing similar cascades for vulnerable subgroups in the population, e.g. Men who have Sex with Men (MSM) or Commercial Sex Workers (CSW), which would require the collection of near-universal risk-behaviour data, in order to generate reliable information for these Key Populations. Challenges exist, however in the collection of the data to supply the treatment and care (T&C) cascade information. Strategic Information systems in-country are not currently designed to produce outputs that match these requirements, leading to gaps in the resultant country “Cascades”. Table 7 below highlights this challenge by reflecting the issues identified in a recent year of data provided from 14 CMS, in accordance with the newer, Cascade-related, reporting system. Several issues relating to missing data and queried data sources were identified, relating to the capacities of CMS health information systems, to collect and collate this data from disparate parts of the treatment and care system, in-country.

Table 7: Record of reporting on stages of the HIV treatment cascade by 14 CMS

	Subgroup	PLHIV	HIV + and know status	On ART	Virally Suppressed
Country 1	Math Problems with subgroup data	All subgroup data available and tallying	Missing all data	All subgroup data available and tallying	Query data source
Country 2	Math Problems with subgroup data	Sub groups < total	Subgroups > total	Subgroups > total	Sub groups < total
Country 3	Math Problems with subgroup data	All subgroup data available and tallying	Missing all data	Subgroups > total	Subgroups > total
Country 4	Math Problems with subgroup data	Query data source	Sub groups < total	All subgroup data available and tallying	Missing subgroup data
Country 5	Math Problems with subgroup data	All subgroup data available and tallying	All subgroup data available and tallying	All subgroup data available and tallying	Sub groups < total
Country 6	All subgroup data available and tallying	All subgroup data available and tallying	Missing subgroup data	All subgroup data available and tallying	Missing subgroup data
Country 7	Math Problems with subgroup data	Subgroups > total	Query data source	Sub groups < total	Subgroups > total
Country 8	All subgroup data available and tallying	Query data source	Missing subgroup data	All subgroup data available and tallying	All subgroup data available and tallying
Country 9	Math Problems with subgroup data	All subgroup data available and tallying	Query data source	Sub groups < total	Missing all data
Country 10	All subgroup data available and tallying	Query data source	All subgroup data available and tallying	All subgroup data available and tallying	Missing all data
Country 11	All subgroup data available and tallying	Missing all data	Missing subgroup data	All subgroup data available and tallying	All subgroup data available and tallying
Country 12	Math Problems with subgroup data	Missing all data	Sub groups < total	All subgroup data available and tallying	All subgroup data available and tallying
Country 13	Math Problems with subgroup data	All subgroup data available and tallying	Query data source	Subgroups > total	Missing subgroup data
Country 14	Math Problems with subgroup data	Missing all data	All subgroup data available and tallying	All subgroup data available and tallying	Sub groups < total

Ten of the 14 (10/14) reporting States had mathematical errors in the disaggregate data; 3 had no estimates of PLHIV; 3 had PLHIV estimates that equated to the number of people diagnosed, and therefore warranted further investigation; 3 had testing data that warranted a review of the data source; while 2 had no testing data at all; one country had viral suppression data that surpassed the number of people on treatment; and two other countries could not produce viral suppression data; finally, 6 countries were missing sub-group data for the pillars of the cascade.

This challenge has been the focus of CARPHA’s Strategic Information (SI) and Monitoring & Evaluation (M&E) teams over the past 3 years, with a view to building sustainable systems, in-country, for the collection and processing of all the data needed to drive the production of the treatment and care cascades and inform decision-making on the areas of focus needed to strengthen national and regional response to HIV.

2.4.5 Anti-microbial and anti-retroviral Resistance

Antimicrobial Resistance (AMR) has been highlighted by WHO as a growing global concern. In the Caribbean, infections due to resistant pathogens have been reported by hospitals and in community settings. There have been reports of penicillin-resistant pneumococci, chloramphenicol-resistant *Haemophilus influenzae* and multi-drug resistant *Mycobacterium tuberculosis*. Extended-spectrum beta-lactamase producing Enterobacteriaceae have been observed in tertiary care facilities in Jamaica and Trinidad and Tobago, and carbapenemase-producing bacteria, which can pose serious challenges for national health services, have already been identified in Barbados. In response to this potential emerging threat, CARPHA hosted a workshop for CMS in December 2014 to identify issues around AMR and explore key steps to tackle AMR in the region. Senior technical advisors and policy officials from 19 CMS attended together with representatives from CARPHA, CMS, Public Health England and PAHO/WHO (CARPHA, 2014c).

2.4.6 Challenges and Risks of Imported Diseases: the 2014-'16 Ebola Crisis

The 2014-'16 period saw some major communicable disease emergencies in the Caribbean, with threats from Ebola, chikungunya and Zika. The situation and response with respect to Zika and chikungunya will be analysed in looking at vector-borne diseases in Chapter 3 of this report. In this section, we tell the story of the Caribbean response to the potential threat of Ebola; a disease for which no cases were detected in the Region over the 2014-'16 period, but which nevertheless required massive mobilisation to mitigate the threat because of its severity. We also look at general issues concerning the necessity to establish systems to curtail the risks of imported diseases.

Ebola virus disease (EVD) is one of numerous viral haemorrhagic fevers. It is a severe, often fatal disease in humans and nonhuman primates, such as monkeys, gorillas, and chimpanzees. When infection occurs, symptoms usually begin abruptly anywhere from two to twenty-one days thereafter. These include sudden fever, headache, joint and muscle pain and weakness. Additional symptoms include rash, diarrhoea, vomiting and abdominal (stomach) pain. The infected person may bleed internally, as well as from the ears, eyes and mouth (CARPHA, 2014f). About half of people infected die from the disease; the average case fatality rate is 50% and varied from 25% to 90% in previous outbreaks (WHO, 2017b).

The first Ebola virus species was discovered in 1976, in what is now the Democratic Republic of the Congo, near the Ebola River. Since then, outbreaks have appeared sporadically. The largest outbreak to date started in Guinea in West Africa in December 2013 and was concentrated in that country, Liberia and Sierra Leone (CARPHA, 2014f), with a few cases that were successfully contained in Nigeria, Senegal, Mali, the United States, the United Kingdom and Spain (Berry, 2014).

The WHO declared the Ebola epidemic a Public Health Emergency of International Concern (PHEIC) on August 8, 2014, following evidence that the epidemic was not confined to a limited geographical area after the return of two US health care workers to the United States for treatment on August 4 and 5. In August 2014, an Incident Management Team was set up by CARPHA in response to questions from Member Countries, especially regarding testing facilities. CARPHA hosted virtual

meetings at least twice a month with Chief Medical Officers, Epidemiologists and Laboratory Directors. On September 11, 2014, CARPHA hosted a Regional Press Conference on Ebola, to inform the public of key facts about the disease and answer questions about the potential for spread to the Caribbean and measures being put in place. This was one of many public education and engagement activities by CARPHA for the duration of the PHEIC, which also for example saw the maintenance of a webpage with information about the epidemic and advice to Caribbean people to avoid travel to the most affected countries.

Also in September, CARPHA provided advice on Ebola to the CARICOM Council on Human and Social Development, where Health Ministers deliberated on the threat to the Region. In October, the CARPHA Executive Director met with Health Ministers of the OECS to provide them with evidence to inform their response efforts (CARPHA, 2014b).

In collaboration with PAHO, rapid assessments were conducted in nine Member States of Ebola preparedness. These utilised a WHO checklist to assess preparedness with respect to aspects such as coordination and control, capacity for isolation, transport of people and samples, availability of and skills in using PPE (CARPHA, 2014e).

A grant from the Inter-American Development Bank helped CARPHA strengthen the response to Ebola, especially in assessing capacity and providing training and certification on safety in handling and processing samples and how to use Personal Protective Equipment (PPE). CARPHA conducted a survey of Member States preparedness for Ebola using the preparedness tool of the International Health Regulations Core Capacities as the framework for analysis. The IHR core capacities are presented and discussed below, in section 2.5.1. The survey was conducted at a meeting of Laboratory Epidemiologists and therefore reflects their perceptions of preparedness, at that time (September 2014), based on experience of being on the ground in developing response capacity.

A Technical Meeting of Specialists and Directors on the Response to the Ebola Virus was hosted on October 30th and 31st in Cuba for countries in the Americas and regional agencies such as CARICOM. This was also attended by multilateral agencies such as WHO and PAHO. Strategies and resource mobilisation for the Ebola response were discussed. The meeting was followed by training of key health personnel from countries and regional agencies which focussed on a model of how to set up an Ebola Treatment Centre.

The hosting by Cuba followed the tradition of its government in providing support for public health systems around the world. The WHO sent an appeal to health experts around the world to join a roster of people to assist the most affected countries. Cuba was among the first governments to send health personnel to address the Ebola crisis. In early October 2014, it sent 103 nurses and 62 doctors to Sierra Leone, the largest contribution of health staff by any country (Kirk, 2015). CARPHA provided a list to WHO of its own technical officers who stood ready to assist as part of the Global Outbreak Alert and Response Network.

The Regional Coordinating Mechanism on Ebola (RCM-E) was established on November 2nd, 2014 at a meeting of CARICOM Heads of Government. Bearing in mind the possibility of the devastating economic and social outcomes that could occur, the Heads of Government decided that the regional response was to be a community effort and a 10-point plan was devised to address Ebola. The RCME

consisted of CARPHA, as Chair, CARICOM and OECS Secretariats, CARICOM Implementation Agency for Crime and Security (IMPACS), Caribbean Disaster Emergency Management Agency (CDEMA), PAHO/WHO and CMS by responsibility and national capacity (Bahamas (Tourism), Barbados (Economy), St Kitts and Nevis (Health), Trinidad and Tobago (Security), Haiti, Jamaica, Suriname) and Cuba (by invitation). An action plan entitled 'Stop Ebola There and Here' was adopted with CARPHA as Chair, coordinating its implementation and providing technical and administrative support to the RCME (CARPHA, 2014g; Hospedales & Olowokure, 2016; PAHO, 2017). The RCME eventually expanded its focus to become the Regional Coordinating Mechanism on Health Security (RCMHS), using the Ebola experience to initiate a strengthened approach to Regional health security. This will be described further in section 2.5.1.

By December 22nd, 2014, the Ebola epidemic stood at 19,340 cases and 7,518 deaths in eight countries (Berry, 2014). Throughout 2015, the Incident Management Team at CARPHA worked on the regional response and regular virtual meetings continued with CMOs, Laboratory Directors and Epidemiologists. In July 2015, a regional simulation of the Ebola response was coordinated by CARPHA and CARICOM Implementation Agency for Crime and Security (IMPACS), liaising with countries. This examined issues such as the availability and adequacy of PPE and Advance Passenger Information Systems to advise when persons were travelling from most affected countries.

The full range of tests for Ebola can only safely be conducted in a Level 4 Bio-Safety Laboratory, of which there are none in the Caribbean. Level 4 Bio-Safety Laboratories exist at the United States Centers for Disease Control (CDC) and the Public Health Agency of Canada. CARPHA in collaboration with PAHO liaised with CDC and PHAC to facilitate access by CMS to these facilities in the event of a suspected Ebola case (CARPHA, 2014a). Some countries made bilateral arrangements with these agencies for testing. Discussions in meetings with country stakeholders examined systems of sample collection and processing to use in the event of a suspected case of Ebola, and whether CARPHA should pool samples from Member States to send for testing in the specialised laboratories in Canada or the US. CARPHA has a Level 3 Bio-Safety Laboratory (BSL3) at CARPHA, launched in May 2014 with support from the Government of Canada. This level of safety enables the testing of de-natured samples.

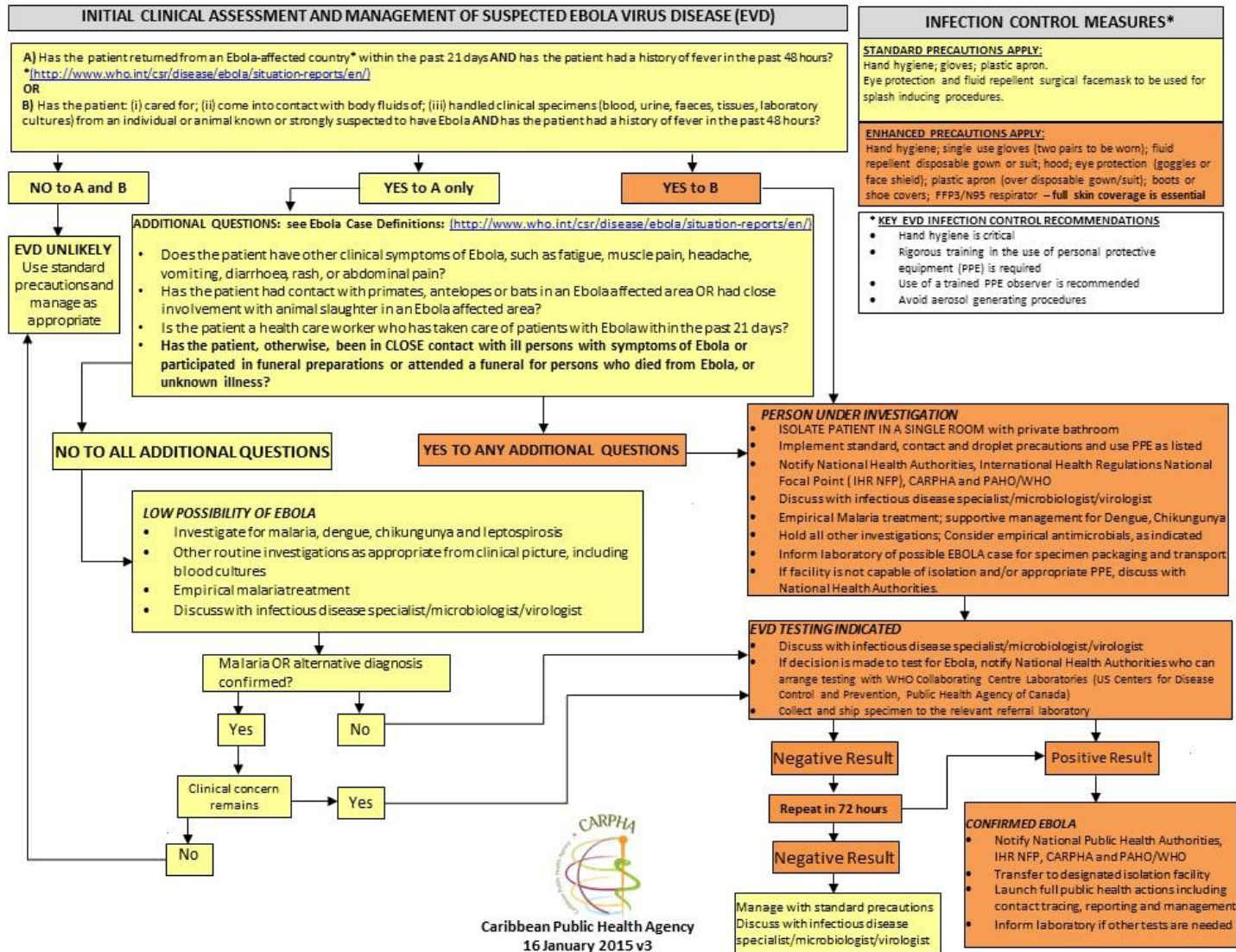
CARPHA played an important role in advising countries on their response. In response to public concern, most countries put a travel ban of some description in place. CARPHA maintained the position that travel bans were not supported by scientific public health evidence, as a means for reducing international spread of communicable disease but upheld its obligation to respect the sovereignty of Member States in their decision-making. CARPHA advised on the best ways to frame the chosen public health actions to maximise public health impact while minimising disruption and discrimination against people from countries in Africa that were unaffected by Ebola or where the epidemic had been contained and controlled.

CARPHA also provided guidance on screening travellers on the basis of their exposure risk, as opposed to their nationality, placing emphasis on minimising travel between the Caribbean and the most affected countries. CARPHA advised that these countries had instituted exit screening procedures to detect people who had been in contact with someone with Ebola and/ or with Ebola symptoms and prevent them from travelling abroad (CARPHA, 2014a). Advice was also provided on

the length of time that should be covered by the travel ban. Since the WHO had stated that people could be declared cured of Ebola if they had no symptoms in the past 21 days, a 21 day period since travelling to affected countries was recommended to be the appropriate period for a travel ban, rather than longer periods (CARPHA, 2014d).

CARPHA developed an algorithm, the Ebola Risk Assessment Flow Chart, on procedures to follow in the event of a suspected Ebola case. This was used and continues to be used as the basis for training on Ebola.

Figure 52: Ebola Risk Assessment Flow Chart, CARPHA 2015



Disclaimer: All due care has been taken to ensure that the content of this algorithm is current and accurate. This algorithm has been provided as a guide for EVD testing and infection control measures, it is not intended to supersede professional clinical judgment.

In March 2016, the WHO declared the Public Health Emergency of International Concern officially over. Despite never having had a case, the Ebola epidemic left a legacy in the strengthening of public health institutions in the Region. Among the continuing mechanisms and programmes are:

- Strengthened capacity within national health systems to respond to health emergencies, including health care workers trained and sensitised on Ebola and appropriate responses. The Ebola response algorithm is an important tool.
- Ongoing CARPHA visits to countries to train teams in bio-safety, the use of Personal Protective Equipment and other aspects of preparedness. Some training follows on from previous training, while some new cohorts have also been trained. This is necessary in the light of turnover of staff since the 2014-16 period of the PHEIC, and to develop capacity for a broad range of infectious disease emergencies.
- The RCMHS, mandated by Caribbean governments to oversee strategy for health security.

The Ebola crisis was an extreme example of a Caribbean-wide response to a serious infectious disease threat. Such responses are necessary for other internationally circulating diseases as well, especially in view of the high volume of travel to and from the region.

We now consider evaluations of public health action in the Caribbean, including of the application of International Health Regulations designed to reduce the threat to health security posed by infectious diseases such as Ebola or by other means such as natural or man-made disasters.

2.5 Evaluations of Public Health Action

2.5.1 International Health Regulations and Regional Health Security

In today's world interconnected through travel, trade and communication, outbreaks can have a significant impact on the economic and social development of a country and its surrounding neighbours (CDC, 2017). Disease outbreaks can weaken the workforce and scare visitors away. The latter is especially important in the Caribbean region which is heavily dependent on tourism. Globalisation brings other increasing threats as well, such as those from chemical and radiation emergencies.

The International Health Regulations (IHR) were first written in 1969 and underwent a major revision in 2005. The IHR are a legal framework, *...to prevent, protect against, control and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade*" (WHO, 2005, p. 1). The revised IHR 2005 entered into force on 15 June 2007 and were agreed upon by all WHO Member States, including the 24 CARPHA Member States (CMS). WHO Member States then had two years, until June 2009, to assess their national public health core capacities and develop a national IHR action plan to achieve them.

The capacities are those required, “...to detect, assess, notify and report events ... and respond promptly and effectively to public health emergencies of national and international concern...” as stipulated in Articles 5 and 13, and Annex 1, of the IHR 2005 (WHO, 2005, pp. 11, 15). These capacities can be grouped under the following headings as follows (Hardiman, 2012; WHO, 2005, 2017c):

- A. Surveillance and response
 - a. National legislation, policy and financing
 - b. Coordination and communications
 - c. Surveillance
 - d. Response
 - e. Preparedness
 - f. Risk communication
 - g. Human resources capacity
 - h. Laboratory diagnostic and confirmation capacity
- B. Development of capacities at Points of Entry (POE)
- C. Potential health hazards
 - a. Zoonotic events
 - b. Food safety
 - c. Chemical events
 - d. Radiological and nuclear events

Most countries having not met the 2009 deadline to assess their national public health core capacities and develop a national IHR action plan, they were then given an additional three years, until June 2012. However, by this date fewer than 20% of all WHO Member States had implemented an IHR action plan and achieved the required core capacities. All 24 CMS requested and obtained two two-year extensions of the IHR deadline; the first until June 2014 and the second to June 2016 (CDC, 2017; Hospedales & Olowokure, 2016; WHO, 2015b).

While previous versions of the IHR required that countries report incidents of diseases such as cholera, plague and yellow fever, the revised IHR 2005 are more “flexible and future-oriented, requiring countries to consider the possible impact of all hazards, whether they occur naturally, accidentally, or internationally” (Gostin, 2004, p. 606). The IHR 2005 are important in that they ensure that countries can detect and report all events that maybe considered to be a potential PHEIC. Since the revised IHR 2005 came into force, WHO has declared four PHEICs: H1N1 influenza (2009), Polio (2014), Ebola (2014) and Zika (2016).

A monitoring framework has been used to monitor twenty indicators that assess the implementation of a country’s eight core capacities, development of capacities at points of entries, and development of capacities for the IHR-relevant hazards. This information is collected annually (Hardiman, 2012; WHO, 2017c). However, it should also be noted that in 2015, the Review Committee of the IHR agreed that, “...the work to develop strengthen and maintain the core capacities under the IHR should be viewed as a continuing process for all countries...implementation of the IHR should now advance beyond simple ‘implementation checklists’ to a more action-oriented approach to periodic evaluation of functional capacities” (WHO, 2015b, pp. 4, 7). As such the IHR should be viewed as a tool to support the continuous inter-sectoral public health preparedness process.

The current draft of the IHR Monitoring and Evaluation Framework is based on four components: an annual report to the World Health Assembly based on a self-assessment, an After-Action Review, Simulation Exercises, and Joint External Evaluation (JEE). The annual report is mandatory while the other three are optional. In the Caribbean, JEE's have been conducted in Belize and Haiti (WHO, 2016).

To date, in compliance with the IHR, CMS have all appointed National Focal Points (NFP), which are usually an organisation/agency rather than a person. The role of the NFP is largely that of communications within their country and internationally on all aspects of the IHR. This is conducted by notifying WHO of any relevant health related events, and responding to WHO with any requests for information (Hardiman, 2012). The 14 CARICOM Member States continue to be generally compliant with the submission of annual reports; annual confirmations or updates of contact details for their NFPs; routine connectivity tests between the WHO IHR contact point and the CARICOM Member States NFPs; and authorisation of ports to issue the Ship Sanitation Certificate (SSC) (WHO, 2016).

Tables 8 and 9 shows there has been an overall improvement in all of the core competencies throughout the 14 Caribbean countries from 2014 to 2016. Even though core capacities of human resources, chemical events, radiation emergencies demonstrated the most development, they still remained the most challenging areas for the CARICOM Member States. (WHO, 2013, 2015c, 2017d).

Table 8: Implementation of International Health Regulations (2005) Core Competencies in Caribbean countries as of 2014

Core Capacity	Antigua & Barbuda	Bahamas	Barbados	Belize (2013)	Dominica	Grenada (2012)	Guyana	Haiti	Jamaica	St Kitts & Nevis (2013)	St Lucia	St Vincent & the Grenadines	Suriname	Trinidad & Tobago
Legislation /Policy/ Financing	100	75	75	25	75	50	100	0	50	50	25	75	50	50
Coordination & Communication	100	83	53	56	100	83	83	46	73	83	20	73	83	56
Surveillance	100	100	70	85	90	90	90	95	60	80	65	80	90	95
Response	82	70	82	82	83	52	100	69	75	89	58	66	100	76
Preparedness	73	41	70	26	60	0	100	20	73	36	25	53	83	71
Risk Communication	71	86	71	57	100	57	86	86	57	57	86	43	71	71
Human Resources	100	40	80	40	20	0	100	40	20	60	40	20	40	20
Laboratory	81	96	86	73	73	41	100	96	53	81	73	35	100	81
Points of Entry	86	74	97	12	64	64	38	6	70	45	6	48	84	77
Zoonotic Events	100	44	89	67	89	100	100	44	67	100	89	100	67	89
Food Safety Events	100	47	60	27	87	67	73	27	47	67	60	40	87	87
Chemical Events	85	38	46	15	31	23	62	0	38	8	23	8	62	62
Radiation Emergencies	23	0	38	0	23	23	0	0	31	0	23	0	0	77

KEY %	Implementation
80-100%	
50-79%	
0-49%	

Source: World Health Assembly, World Health Organisation

Table 9: Implementation of International Health Regulations (2005) Core Competencies in Caribbean countries as of 2016

Core Capacity	Antigua & Barbuda	Bahamas	Barbados	Belize (2013)	Dominica	Grenada	Guyana (2015)	Haiti	Jamaica	St Kitts & Nevis (2013)	St Lucia	St Vincent & the Grenadines	Suriname	Trinidad & Tobago
Legislation /Policy/ Financing	100	75	75	25	50	100	100	0	50	50	75	100	50	50
Coordination & Communication	73	83	63	56	100	83	83	47	100	83	100	67	83	57
Surveillance	85	100	100	85	80	95	90	85	90	80	80	70	90	95
Response	83	76	76	82	78	69	100	64	100	89	100	94	100	83
Preparedness	73	62	70	26	60	33	100	73	92	36	60	28	100	80
Risk Communication	86	100	100	57	100	86	86	71	71	57	100	71	71	86
Human Resources	100	40	80	40	40	60	100	40	60	60	100	80	40	20
Laboratory	68	96	96	73	43	49	100	80	96	81	96	76	86	82
Points of Entry	100	78	100	12	30	52	36	9	88	45	97	72	78	100
Zoonotic Events	89	56	100	67	100	100	100	100	78	100	89	100	78	100
Food Safety Events	100	87	80	27	100	67	73	40	87	67	73	73	93	93
Chemical Events	69	69	77	15	15	46	62	69	77	8	23	8	62	100
Radiation Emergencies	23	54	69	0	15	15	0	54	85	0	8	0	0	100

KEY %	Implementation
	80-100%
	50-79%
	0-49%

Source: Pan American Health Organization/World Health Organisation

When there is the occurrence of a potential PHEIC, the Director-General of WHO will seek the advice of an IHR Emergency Committee with members selected from the IHR Roster of Experts (WHO, 2017f). Each WHO Member State can nominate a national with the relevant expertise for consideration to the Roster of Experts. To date there are very few experts from CARICOM Member States on the IHR Roster of Experts. The advantage of having CARICOM nationals on the Roster of Experts allows the region to have direct input into, and the channel through which the Caribbean perspective can be presented, any recommendations and policies being formulated with regards to the relevant PHEIC.

With respect to radiation-related emergencies, an increasing number of countries are becoming members of the International Atomic Energy Agency (IAEA), which is beneficial for not only strengthening core capacity related to radiation in health, but also in other sectors. Eleven CARICOM Member Countries were members of IAEA as of 2016. Further training has been developed through the Caribbean Field Epidemiology and Laboratory Training Programme (CR-FELTP) and three PAHO Skills On-line Epidemiology courses which were developed to strengthen in-country human resource capacity for preparedness and response.

In 2014, the Global Health Security Agenda (GHSa) was launched. It is a multilateral and multi-sectoral approach bringing together approximately 50 countries, NGOs and international stakeholders to, “*strengthen both global and national capacity to prevent, detect and respond to infectious disease threats*”. The GHSa seeks to accelerate the implementation of the IHR 2005 and similar global health frameworks (Global Health Security Agenda, 2017).

In November 2015, CARICOM agreed to work with the United States as a GHSa Phase II partner (CARPHA, 2016). It was decided that the Regional Coordinating Mechanism (RCM) on Ebola should be now called the Regional Coordinating Mechanism on Health Security (RCMHS) to encompass health security issues of not only Ebola, Chikungunya, Zika and Yellow Fever but any public health threat including a response to public health hazards of chemical and radio nuclear emergencies as in the IHR 2005 (CARPHA, n.d.-a). In September 2016, COHSOD agreed to support a joint planning meeting for a 5-year Roadmap for the Caribbean Region Global Health Security Agenda. CARPHA, CARICOM, US government representatives, and PAHO led a collaborative and facilitative approach to engaging stakeholders in the GHSa internal self-assessment and roadmap. The Roadmap for the Caribbean GHSa was developed between September and December 2016 and in the context of the CCH IV. This included a five-day workshop facilitated by United States Agency for International Development (USAID) with over seventy participants including Chief Medical Officers (CMOs) and Chief Veterinary Officers (CVOs) from thirteen Caribbean nations, representatives from regional institutions, private sector, development partners, civil society and universities. The draft Caribbean Regional Global Health Security Agenda 5-year Roadmap (2017-2021) “...serves to document and guide regional health security activities in the Caribbean, identify milestones for future work and detect areas where additional support is needed to achieve [19 themes] of the GHSa targets” (CARPHA, 2016, p. 4).

2.5.2 Evaluation of the Port of Spain Declaration

The Port of Spain Declaration on Non-Communicable Diseases 2007: “*Uniting to Stop the Epidemic of NCDs*” was the outcome of a regional meeting of CARICOM Heads of Government (see Section 1.3.1). The implementation of the Port of Spain Declaration was monitored using a grid developed in 2008 and later revised in 2010. It was completed twice by CARICOM countries, the first time between 2012 to 2014 and then in 2016.

The grid showed that some elements of the Declaration were implemented successfully, while others proved to be challenging. Overall elements of commitment, education, surveillance and treatment were relatively well implemented while those of nutrition were less well addressed. For example, by 2016 across the 20 CARICOM Member States and Associate States, most had a national NCD policy, strategy or action plan that integrated NCDs and risk factors as well as a budget or allocated funding; Caribbean Wellness Day multi-sectoral, multi-focal celebrations; had conducted a STEPS survey, Global Youth Tobacco Survey and Global School Health Survey. Nutrition-related action, such as implementation of policies to reduce salt, limit saturated fats and virtually eliminate trans fats and increase fruits and vegetables, were noticeably absent in most countries. Also absent was Ministry of Health presence during negotiations on food security; implementation of WHO recommendations on the marketing of foods and beverages to children and the implementation of front-of packaging labelling for easy identification of unhealthy foods.

This led to the development of a more thorough evaluation, the overall goal of which was, *“to evaluate, seven years on, the implementation of the CARICOM NCD Summit Political Declaration in order to learn lessons that will support and accelerate its further implementation and will inform the attainment of the UNHLM NCD commitments.”* (Samuels & Unwin, 2016b, p. 7). This goal was broken down into eight objectives. The first six objectives were used to guide research conducted in order to add regional knowledge on the status of implementation of the Declaration and its regional and international impact. There were two additional objectives that were used to communicate the knowledge gained and to build capacity to improve the implementation of NCD policy responses in CARICOM Member States.

The evaluation was supported by the Canadian International Development Research Centre (IDRC) and coordinated by the Department of Public Health, Faculty of Medical Science and the Chronic Disease Research Centre (CDRC), both of UWI, Cave Hill. Research was conducted by a multidisciplinary project team from the following regional and international agencies:

- Department of Public Health, (UWI), Cave Hill
- Chronic Disease Research Centre, (UWI)
- Department of Community Health and Psychiatry (UWI), Mona
- HEU, Centre for Health Economics, (UWI), St. Augustine
- Institute of International Relations, (UWI), St. Augustine
- G8 Research Group, University of Toronto
- Caribbean Public Health Agency
- Pan American Health Organization
- The Healthy Caribbean Coalition

The evaluation was guided by a Project Advisory Committee (PAC) which consisted of regional and international experts in public health, policy analysis, economics, social science and implementation science. The PAC included advisors from Caribbean Ministries of Health, international advisors from

the Washington University, St Louis, PAHO, Emory University, University of Washington, and Oxford University. The evaluation began in 2014 and runs until 2017.

The following summarises some of the key findings for each of the six research objectives:

- A. National and regional trends in NCD mortality
 - There are large variations in life expectancy and in NCD-related mortality between CARICOM members. Except for Haiti, NCDs cause 65% to over 80% of all deaths with cardiovascular disease and diabetes causing the majority of premature NCD deaths followed by cancers.
 - There are high burdens of risk factors, including obesity, hypertension and diabetes. Risk factor patterns differ by gender: higher obesity and diabetes in women, higher smoking and excess alcohol consumption in men.
- B. National policy responses to NCDs and lessons learned
 - No country has met all of the indicators, but all have met at least one on the monitoring grid.
 - Indicators with the lowest levels of implementation concern nutrition.
 - Indicators with the highest levels of implementation are those where the action needed is clear and there is support from regional or international organisations. For example, Caribbean Wellness Day and WHO STEPS risk factor surveys and the WHO's Framework Convention on Tobacco Control (FCTC).
 - Achieving true multi-sectoral action, between government, civil society and the private sector, and within government between different ministries, requires appropriate facilitating structures to be in place and to be properly resourced. Leadership and support is required from the highest level of government.
- C. International institutions' support for the Declaration
 - Of the 27 commitments made by CARICOM members at the 2007 Port of Spain Summit, 8 identified specific international institutions (both within and outside the Caribbean), which were expected to provide assistance.
 - The poor performance by CARICOM members on commitments related to the macro-determinants of nutrition, demonstrates the need for greater coordinated intervention from relevant CARICOM agencies. There is concern that support for action by CARICOM members on nutrition is weaker now that the CFNI has been subsumed into CARPHA.
- D. International impact of the 2007 Port of Spain Declaration
 - The 2007 Heads of Government Port of Spain Summit had significant influence on shaping global governance of NCDs and paved the way for the 2011 UNHLM on NCDs.
 - There have been several activities arising out of the Declaration that are being adopted internationally. For example, in 2014 WHO recommended the formation of National Commissions to the global community.
- E. Surveillance and monitoring
 - There are too many overlapping demands for reporting being made from several agencies. Collaboration is needed to reduce the demands on individual countries while still meeting agencies' requirements.

- Some key surveillance activities need better support and capacity building to ensure that the countries make full use of the data collected. This applies in particular to STEPS NCD surveys, where many have been done but few analysed beyond providing limited summary data.
- F. Financing NCD prevention and control in CARICOM: potential role of tobacco and alcohol taxes.
- There is significant potential for revenue generation from increased taxes on tobacco and alcohol. Other forms of taxation, such as taxes on sugar-sweetened beverages should also be considered.
 - The evidence suggests that targeted taxation can lead to reduced consumption of unhealthy products *and* significantly contribute to the cost of interventions to respond to NCDs. (Healthy Caribbean Coalition, 2017d; Samuels & Unwin, 2016a, 2016b).

Major conclusions and observations from this evaluation indicated that NCDs are still given relatively low political priority, both within countries and regionally, and this has acted as a barrier to policy development and implementation. Specific national and regional mechanisms are necessary to promote an effective response, e.g. NCD Commissions and a joint NCD Secretariat, led by CARICOM/PAHO, to provide leadership. A drop in political buy-in is evident by the fact that at the 2011 UNHLM on NCDs, at least nine CARICOM Heads of Government were in attendance as compared to no CARICOM Heads of Government at the 2nd UNHLM in 2014 (Healthy Caribbean Coalition, 2017b). Additionally, specific funding is required to support national and regional NCD responses. National health budgets are rapidly consumed as governments focus on secondary and tertiary treatment (Healthy Caribbean Coalition, 2017d).

An implementation workshop was held 24-25 February 2016 in Port Spain, Trinidad and Tobago to determine the way forward for the prevention and control of NCDs in the region. Participants included, but were not limited to regional Ministers, journalists and experts in health, economics, agriculture and social security. Findings were presented, and the participants were asked to validate them and draft an action plan for presentation at the 2017 CARICOM Heads of Government meeting. The major issues addressed at the implementation workshop were as follows:

- ✓ Diet, food and food security: relevant policy on agriculture and trade;
- ✓ Reducing alcohol-related harm;
- ✓ Tobacco control;
- ✓ Promoting health in different settings: workplaces (including the health sector), schools, faith-based institutions etc;
- ✓ Investing in NCD prevention and control;
- ✓ Media and social communications, health promotion and advocacy; and
- ✓ Physical activity and the built environment.

At the Caribbean Heads of Government meeting 4-6 July 2016, in Guyana, the issue of NCDs was discussed and pledges were given to address, *“the banning of smoking in public places; trade related measures; banning advertisements of potentially harmful foods which specifically target children; and elevating taxes on foods high in sugar, salt and trans-fats”* (Samuels & Unwin, 2016a, p. 78)

Figure 53: CARICOM Heads of Government Meeting, 4-6 July 2016, Guyana



Source: CARICOM

2.5.3 Evaluation of the Caribbean Cooperation in Health III

The Caribbean Cooperation in Health III (CCH III) is the third in a series of CCH documents which provide framework for functional cooperation in health. It has five areas of cooperation and eight priority areas; the priority areas were retained from CCH II (see section 1.3.1). The purpose of the evaluation of the CCH III was to provide a comprehensive evidence-based report for the development of the CCH IV.

The evaluation was conducted using a three-pronged approach: communication with the steering committee; review of extant documents, on-line media data, and literature from peer-reviewed journals; and interviews and consultations from stakeholders. Stakeholder input was gained from telephone interviews and consultations. There were two preliminary consultations: 2015 CARPHA and PAHO/WHO Environmental Health Conference in St Lucia and a 2015 PAHO/WHO and CARICOM Sub-Regional Workshop on the Development of Competencies for Nurse Educators in Belize. A final regional consultation occurred in Trinidad and Tobago which allowed attendees (stakeholders, governments, civil society, academic, donors, the private and public sectors) an opportunity to provide feedback on the initial CCH III evaluation findings and final document.

Challenges to conducting the CCH III evaluation included: limited resources over a short five-month time frame; indicators having not been measured (only 27 out of the 192 indicators were collected by countries); CCH III lacked a regional monitoring, evaluation and accountability framework and therefore it was challenging to collect evidence; and the fact that many of the key informants were not aware of the CCH III (Ferguson & Owens-Ferguson, 2016a, 2016b).

Data was obtained from over 40 key organisational documents, over 70 peer reviewed publications and an on-line media analysis that resulted in viewing 97 webpages from on-line news outlets and social media platforms. Additionally, results of 27 of the 192 CCH III indicators were analysed. Analysis of this data produced the following summary of advancements in regional cooperation (Ferguson & Owens-Ferguson, 2016a, 2016b):

- ✓ Establishment of CARPHA
- ✓ Maintaining success in high-levels of vaccination coverage while decreasing the transmission of communicable diseases
- ✓ Continued progress towards implementing commitments towards the prevention and control of NCDs
- ✓ Building capacity of Human Resources for Health (HRH)
- ✓ Increasing capacity of laboratory services for the region
- ✓ Caribbean Wellness Day
- ✓ Implementation of core capacities of the IHR 2005
- ✓ Creating safe and environmentally-friendly hospitals

At the two consultations in St Lucia and Belize the attendees were asked to identify their priority areas with respect to their areas of expertise. The following figure demonstrates these findings (Ferguson & Owens-Ferguson, 2016a, 2016b).

Figure 54: Top Environmental Health Priority Areas and Top Human Resources for Health Priority Areas as Identified by Key Stakeholders



Twenty-one key stakeholders were also interviewed. These included leaders from public health agencies and government officials (including the architects of CCH and CARPHA), representatives from Ministries of Health of select CARICOM Member States, academia and civil society. The stakeholders identified key strengths and challenges of CCH III and key recommendations for CCH IV. These are summarised in the following figures (Ferguson & Owens-Ferguson, 2016a, 2016b).

Figure 55: Strengths and Challenges of CCH III identified by stakeholders

Strengths

- CCH III is a needed framework to ensure regional cooperation.
- Regional cooperation has and is occurring as a result of the CCH III.
- Examples of regional cooperation cited the most by stakeholders included: the 2007 Port-of-Spain Declaration, CARPHA, immunizations, PANCAP, laboratory services and PAHO/WHO's Human Resources for Health and Health Systems Strengthening strategic plans.

Challenges

- Burden on Ministries of Health to gather and report on all the indicators to different agencies.
- Countries have limited capacity to deploy their own surveillance systems to capture risk factor indicators.
- Acknowledged that countries are very diverse in terms of population size, health system needs and political geography.
- Indicators were not flexible and difficult to fit country needs and national strategic plans.
- Some were not aware of the CCH III framework.
- Some noted there was no communication and dissemination strategy.

Figure 56: Recommendations for CCH IV identified by stakeholders

Recommendations

- Create a CARICOM/CARPHA-mandated basic indicator set that is better aligned to the UN SDGs and all other required country-level indicators.
- The eight CCH III priority areas are still relevant. However, consider including Food and Nutrition under NCDs, and have HRH and HSS as a cross-cutting issue rather than separate priority areas.
- Include the following areas in CCHIV: climate change, aging, childhood obesity, alcohol abuse, tourism and health, emergency and disaster preparedness, men's health, violence and injury prevention, food insecurity, health financing, and enhanced regional laboratory services.

Based on the evaluation results, the following were presented as recommendations for CCH IV (Ferguson & Owens-Ferguson, 2016a, 2016b):

- a. The need for multi-sectoral approach.
- b. A better governance and accountability system.
- c. An increased awareness of CCH framework.
- d. Develop an achievable timeline, perhaps over two or three five-year periods.
- e. Create and select indicators aligned with PAHO/WHO's basic indicators and SDGs.
- f. Create a centralised surveillance system for data collection that is easy to access and use.
- g. Re-organise the priority areas as suggested by the key stakeholders.
- h. Encourage all sectors to utilise the CC HIV framework to mobilise human, financial and material resources.
- i. Develop more national and international partnerships across private, public and civil society sectors to ensure CCH IV's overall cooperative goals are met.

Conclusion

2014-'16 was a remarkable period in the history of public health in the Caribbean. Chikungunya and Zika brought new disease burdens and costs, which will be further explored in Chapter 3. Along with the public health emergency around Ebola, they highlighted gaps in regional health security, and led to unprecedented measures to strengthen regional health security cooperation and infrastructure. The period also saw major storms and Hurricane Matthew, damaging public health and other facilities along with mental and physical health in several countries. The damage provides troubling signs of the ongoing and increasing dangers associated with climate change.

The immediate crises of these CDs and weather events were accompanied by longer-term and systemic health challenges. Respiratory and food-borne diseases demonstrate the continued vulnerability of the public to environmental conditions associated with travel of goods and people and variations in weather conditions. The importance of vaccine development and coverage and environmental action are highlighted. HIV, accidents and violence expose some of the costs of social

divisions, stress and conflict. NCDs are outcomes of chains of events linking global issues such as the distribution of types of food production, social and environmental issues such as access to fresh food, and individual behaviour such as dietary choices.

A number of national, regional and international agencies have partnered over the 2014-'16 period to respond and build capacity to increase the resilience of Caribbean people to the threats facing them. CARPHA, having been formed in 2013, was faced with responding to public health emergencies along with systemic health challenges at an early stage in its existence. It drew on the strengths of the five regional health agencies from which it was formed, and forged and strengthened alliances with national, regional and international agencies. Increasingly, it and other agencies concerned with public health in the region espoused multi-sectoral approaches which were based on acknowledgement that health results from the interplay of structural, social, environmental, behavioural and individual factors.

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Chapter 3: Vector-Borne Diseases



Executive summary

Vector-Borne Diseases

The WHO defines vectors as living organisms that can transmit infectious diseases between humans or from animals to humans. Challenges related to addressing VBDs encompass not only to the disease but also to controlling the vector. It is this latter feature that distinguishes public health strategies for vector-borne diseases (VBDs) from those of other communicable diseases.

The role of mosquitoes

Mosquitoes account for the majority of VBD infections in the region, with *Aedes aegypti* being the principal vector, transmitting diseases such as chikungunya, dengue, yellow fever and zika (among others). Mosquitoes require standing water to breed. *Aedes aegypti* tend to inhabit densely populated human habitats with discarded items that collect water and water containers. People in areas with inadequate or sporadic sanitation or water supply, which are associated with poverty and unplanned urbanisation, are especially vulnerable.

Social determinants of VBDs

Poverty and urbanization are social determinants of health contributing to VBD. Other social determinants include international travel and tourism, which increase contact between infected and uninfected populations. Climate change exacerbates the vulnerability of Caribbean people to VBD, since warmer temperatures accelerate mosquito reproduction, and floods increase the sites where they can breed.

VBDs in the Caribbean, 2014-'16

The 2014-'16 period saw the arrival in the Caribbean of two mosquito-borne diseases that had not previously existed in the region: chikungunya virus and zika virus. Chikungunya, first reported in the island of Saint Martin in October 2013, does not often result in death, but its symptoms of joint pain and arthritis can cause disability. Average incidence rates per 100,000 population in Caribbean countries and territories were 4,470 in 2014, 546 in 2015 and 85 in 2016. There was wide geographical variation, with no reported cases in Cuba and more than one in every hundred persons reported to have chikungunya in Antigua and Barbuda, Curacao, Dominica, Dominican Republic, French Guiana, Grenada, Guadeloupe, Martinique, Montserrat, St. Barthelemy, St. Martin, St. Kitts and Nevis, St. Vincent and the Grenadines, the British Virgin Islands and the US Virgin Islands in 2014.

Zika cases began to be reported to CARPHA by CMS in October of 2015 and reached a peak in the week ending 2 January 2016. Reported incidence was generally lower than for chikungunya, with the following states reporting more than one in a hundred people with Zika: Dominica, French Guiana, Guadeloupe, Martinique, St. Barthelemy, St. Martin and the US Virgin Islands.

The prevalence of Zika is likely to be under-estimated as most people infected have no or mild symptoms. Concern about Zika arises mainly because of its association with neurological birth defects, including microcephaly, and Guillain-Barre Syndrome (GBS), a condition that affects the nervous system. Zika may be sexually transmitted, necessitating additional health promotion strategies, including condom promotion.

On 1 February 2016, the WHO declared Zika a Public Health Emergency of International Concern (PHEIC) because of its association with microcephaly and neurological disorders. By the end of 2016, nine Caribbean countries and territories had cases of congenital syndrome, including the CMS Grenada, Haiti, Suriname and Trinidad and Tobago. Eleven Caribbean countries and territories had cases of GBS associated with Zika, including the CMS Grenada, Haiti, Jamaica, Suriname and Trinidad and Tobago.

Dengue has existed in the Caribbean since the 17th century. Infection with one subtype confers immunity from that subtype but can increase vulnerability to more severe symptoms, including Dengue Haemorrhagic Fever (DHF), if a person is infected with another subtype. It is therefore troubling that in recent years subtypes 1 to 4 have been circulating in the Caribbean. Of fifteen countries reporting dengue subtype data to CARPHA in 2014-‘16, eight reported cases of more than one subtype. Since the 1980s, cases of dengue have risen in the region, with several major outbreaks and a transition from an endemic-epidemic state to a highly endemic state with annual outbreaks in multiple locations. The 2014 - ‘16 period saw a decline in the number of laboratory-confirmed dengue cases as compared with the years since 2011. This decline should be interpreted with caution, as reports may have fallen because health care workers focussed on chikungunya and Zika during the 2014- ‘16 period. Given that dengue shares the same mosquito vector with these two diseases, it is apparent that vector control strategies have had limited success.

In contrast, there were no cases of yellow fever reported by CMS in the 2014-‘16 period, though this disease is also transmitted by *Aedes aegypti*. The relative success in controlling yellow fever can be attributed to the existence of an effective vaccine and strong public health measures, including high vaccination coverage in countries where a risk of yellow fever is present, in that animal reservoirs of the disease exist. These countries are French Guiana, Guyana, Suriname and Trinidad and Tobago. There are also yellow fever vaccination regulations and recommendations for travellers to and from these countries.

Malaria differs from chikungunya, zika, dengue and yellow fever in being transmitted by a different mosquito (*Anopheles spp.*) and being caused by a protozoan parasite rather than a virus. Malaria can cause severe fever and death, and is endemic in the Dominican Republic and the CMS of Belize, Haiti, Guyana and Suriname. Other CMS – The Bahamas and Jamaica, – report small numbers of locally transmitted cases, while most CMS have reported at least one case of malaria from a person who travelled abroad and “imported” the disease.

Lymphatic filariasis can cause massive swelling around lymph nodes and is caused by microscopic worms transmitted by *Culex* mosquitoes. The disease is endemic in the Dominican Republic, Guyana and Haiti, with a few cases in Trinidad and Tobago.

Three VBDs in the Caribbean are transmitted by vectors other than mosquitoes. Leishmaniasis – reported in the Dominican Republic, French Guiana, Guyana and Suriname – is caused by parasites spread by sand-fly bites. Schistosomiasis – reported in Suriname and St. Lucia - is caused by parasitic worms spread by freshwater snails. Leptospirosis is transmitted by contact with the urine of infected animals. This may be present, for example on the covers of foodstuffs such as drink cans stored in warehouses, or in floodwaters or in gardens and farmyards. In the 2014-'16 period, there were 347 laboratory-confirmed cases of leptospirosis reported by CMS, of which one third were reported by Guyana and 14% by Jamaica.

Impact and cost of VBDs

With the arrival of chikungunya and Zika, the 2014-'16 period saw increased absenteeism from work, and “present-eeism”, where people attended work but were less productive because of illness. There were also additional costs of health care and health promotion. These economic costs were compounded by the impact on tourism, especially after the WHO declared zika a PHEIC, and travel advisories were issued in tourism source markets in response to these diseases.

Responses to VBD

In February 2003, PAHO approved the adoption of the Integrated Management Strategy for Dengue Prevention and Control (IMS-dengue), consisting of six components; epidemiology, entomology, healthcare, laboratory, social communication, and environment. This Strategy has guided approaches to mosquito-borne diseases by Caribbean governments and CARPHA.

A Special Meeting of Heads of Government, hosted by CARICOM and CARPHA 4 November 2014, focussed on the health crises of chikungunya and Ebola and led to the establishment of a Regional Coordinating Mechanism on Health Security. In relation to VBDs, the Heads endorsed a multi-sectoral approach, public education, strengthened vector control capacity and bulk purchase of public health supplies.

A Global Health Security Cooperative Agreement with CDC included funding to address zika starting in 2016, including enhanced surveillance by use of Geographic Information Systems, improved laboratory and insectary facilities, and building of a Caribbean vector-borne disease network of experts and professionals (CariVecNet).

Tourism Ministries, the Caribbean Tourism Organisation, the Caribbean Hotel and Tourism Association and CARPHA have collaborated to develop strategies on mosquito-borne diseases, including guidelines and training for tourism personnel on how to eliminate breeding sites on tourism premises and how to engage tourists in VBD prevention.

All CMS responded to the additional public health challenges brought by chikungunya and by intensifying vector control measures, expanding public education and increasing public health surveillance.

Health systems strengthening activities in which CARPHA was involved included:

- Establishment of an Incident Management Team, which held regular meetings on VBD strategy with National Laboratory Managers, Epidemiologists and CMOs
- A project in nine countries, including insecticide resistance testing to guide the use of technologies for vector control
- Laboratory and health care worker capacity-building and laboratory strengthening activities
- Collaboration with Ministries of Health and regional academic institutions to conduct research on VBDs
- Working with scientists in regional and national institutions and international agencies to examine the potential and advise governments on the use of technologies for vector control, including: biological control by using fish to eat larvae; using *Bacillus thuringiensis israelensis* (BTI) bacteria to kill larvae; use of Aquitaine AMF, a silicone-based liquid that spreads across the surface of standing water and blocks the mosquito's respiration; sterilisation of male mosquitoes by radiation; infection of mosquitoes with *Wolbachia* bacteria; genetic modification of male mosquitoes so that their offspring do not survive and the use of n2Care mosquito traps.

Community mobilisation activities around the region included Mosquito Awareness Week, set up by CARICOM and CARPHA in 2016 and occurring in the second week in May. 2016 activities included educational fairs in several countries. CARPHA communicated with the public on chikungunya and zika via dedicated webpages, media releases, press conferences and videos. An interactive app, *Zap-a-quito*, was made available for download and aimed to increase children's knowledge about breeding sites and their involvement in vector control.

Research suggests that reductions in vector populations can be achieved by partnering with communities to clean up mosquito breeding sites and deploy available technology. To date there are few examples of agencies putting skilled human resources into such initiatives in the Caribbean. One constraint has been the availability of such personnel in small countries, where often there are no specialist staff dedicated to vector control, and vector control is among several environmental and public health responsibilities of a small team or individual.

Conclusion

In the 2014-'16 period, CMS and partner agencies collaborated in health systems strengthening, behavioural intervention, community participation, policy, inter-agency cooperation and advocacy. The capacity building in all these spheres should continue to address the multiple contributing factors contributing to vector borne diseases encompassing both human and vector behaviour. This can be supplemented by strategic approaches to make optimal use of resources, which are usually limited. Targeted approaches, including mobilisation of local communities in clean-up and deployment of vector-control technologies, should be informed by needs assessments, monitoring of insecticide resistance and knowledge of relevant mosquito abatement technologies. Monitoring and evaluation and strategic planning should be central to approaches in addressing VBD. There is also a need to address poor sanitation services, especially in poor communities and unplanned settlements, as part of a comprehensive approach to social determinants of health.

Introduction

The World Health Organisation (WHO) defines vectors as living organisms that can transmit infectious diseases between humans or from animals to humans. Vector-borne diseases (VBDs) account for over 17% of all infectious diseases globally (World Health Organisation, 2017), with a heavier burden in tropical regions such as the Caribbean, where the vectors are concentrated. While the prevalence of some infectious diseases has declined globally due to factors such as vaccination, improved access to health care and economic growth, cases of some VBDs, notably most of those borne by mosquitoes, have increased. Indeed, among the factors promoting the spread of mosquito-borne diseases are some associated with economic growth and modernization, such as increasing international travel, urbanization and climate change (Diaz-Quijano & Waldman, 2012; Guzman & Kouri, 2003).

The 2014-'16 period saw the dramatic arrival in the Caribbean of two mosquito-borne diseases that had not previously existed in the region: chikungunya and zika. It is apt to focus on vector-borne diseases given this historic development in the years covered by the current *Caribbean State of Public Health Report*. This chapter sets this development against the background of the other VBDs that exist in the region, and how public policy has sought to reduce the prevalence and impact of these diseases. The heightened response due to the arrival of chikungunya and Zika is also described. The responses are appraised with respect to findings on social and other determinants of VBDs.

The chikungunya and zika outbreaks of 2014 to 2016 spread rapidly because of a lack of immunity in the population. This led to a sharp decline in economic productivity and left health and social services struggling to cope, as many people were off work sick. Health insurance and care expenditures escalated rapidly. A further cause for concern was the impact on tourism in the Caribbean, which is the most tourism-dependent region in the world (CARPHA, 2014b). Tourism accounts for 14.0% of Caribbean Gross Domestic Product and 12.3% of Caribbean employment. It provides the majority of foreign exchange currency earnings, necessary given the largely import-dependent profile of Caribbean economies (Hospedales, 2016). Zika is both a VBD and a sexually transmitted infection, and this duality served to increase concern about risks that may be associated with tourism in the Caribbean.

In 2015, a case of Mayaro virus was diagnosed in a boy with chikungunya-like symptoms in Haiti. In the Americas, this disease was previously known in Brazil, the Amazon and other parts of tropical South America. It is spread by mosquitoes, including *Aedes aegypti* (John et al., 2016). The emergence of this case highlights the pressing need to persist with vector control efforts in the Caribbean.

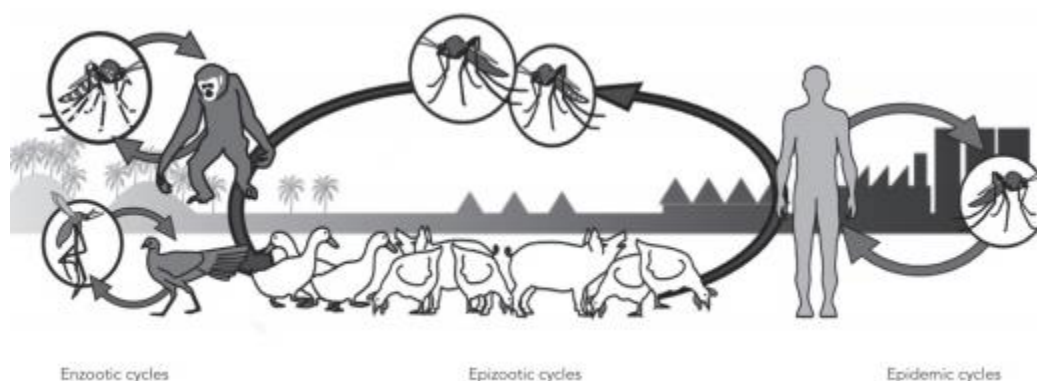
3.1 How vectors cause diseases

VBDs are caused by a variety of animal vectors, mainly insects. The animal vectors responsible for transmitting diseases with the greatest toll in terms of illness and death in the Caribbean are described under each disease section below. Challenges of addressing VBDs relate not only to the disease but to controlling the vector. It is this latter feature that distinguishes public health strategies for VBDs from those of other communicable diseases...

Vector-borne diseases involve *cycles* of transmission between vectors and hosts. These take place in different types of physical *environments*: natural, rural and urban. Natural environments are those unmodified (or little modified) by human activity, such as forests. Here, cycles are mostly *enzootic*, i.e. between animals. For example, insects may transmit diseases to non-human primates (monkeys and apes) or birds. Occasionally, human activity in natural settings (such as hiking in the rainforest) may result in human infection, which may then spread in the human population as the person (hiker) returns to rural or urban environments. In rural environments, there may be cycles of transmission between animals (e.g. between insects and farm animals) and between animals and humans (e.g. arising from animal urine or insect-bites). The high density of animals in these settings may lead to *epizootic cycles*, with rapid and widespread animal infection. Human activity dominates urban environments, and here VBDs are spread primarily by the interaction of vectors and humans. When a disease is established on a permanent basis in a population it is described as endemic. High population density leads to *epidemic cycles* of VBDs.

The following figure assists understanding of the role of the three types of environment in VBDs. In this example, mosquitoes are depicted as the principal vector in transmission to and from animals and humans. It is important to note that mosquitoes are not the only insect vectors. For example, *Triatomine* bugs, colloquially known as kissing bugs, are blood-sucking insects that spread Chagas disease, which is an important cause of illness in rural areas of Latin America and the mainland countries of Belize, French Guiana, Guyana and Suriname. Furthermore, not all vectors are insects. Other animals, including mammals, can spread diseases. For example, leptospirosis is spread by the urine of infected animals.

Figure 28: Vector-Borne Disease transmission cycles



Source: (Ellis & Wilcox, 2009)

3.1.1 Disease vectors and habitats: the central role of *Aedes aegypti* mosquitoes in VBD transmission in the Caribbean

In the Caribbean, most cases of VBD are transmitted by mosquitoes. Therefore, the majority of this chapter focuses on mosquito-borne diseases, and efforts to control mosquito populations which transmit these diseases. Information is also presented on leptospirosis and schistosomiasis, VBDs not transmitted by mosquitoes.

The public health crises associated with VBDs in 2014-'16 invite reflection, in particular, on the devastating impact of mosquitoes in the tropics. The *Aedes aegypti* mosquito is the principal vector transmitting disease in the Americas (Istúriz, Gubler, & Castillo, 2000), and is responsible for the transmission of the vast majority of cases of chikungunya, dengue and zika in the Caribbean. These are all *arboviruses*, meaning viruses borne by arthropods (animals having an exoskeleton, a segmented body, and paired jointed appendages). Other mosquitoes of the *Aedes* family can transmit these diseases, but *Aedes aegypti* is, by far, the most widespread and numerous in the region. It is worth noting that mosquitoes reputedly cause more deaths to human beings than any other animals, including human beings themselves (Spielman & D'Antonio, 2001). As such, public health measures in the Caribbean must place major emphasis on mosquito reduction and control, with *Aedes aegypti* being the main target.

Figure 58: *Aedes aegypti* mosquito



Source: (Centers for Disease Control and Prevention, 2017a)

Aedes aegypti is a small mosquito, with black and white horizontal stripes on its long, thin legs. It prefers to live near human beings, and thus is concentrated in urban areas of high population density. The female often lays eggs in man-made containers commonly found in and around homes, such as water containers (for example, barrels, drums or buckets), old automobile tyres, flower vases, and any trash items that collect water (Istúriz et al., 2000). They prefer human dwellings for resting and host-seeking (Yearwood & Polson-Edwards, 2017). Higher levels of rainfall increase breeding sites, while higher temperatures speed the development and maturation of larvae. Therefore, the climactic impact of global warming, bringing both increased rain and temperatures, is expected to increase the frequency and intensity of epidemics of arboviruses.

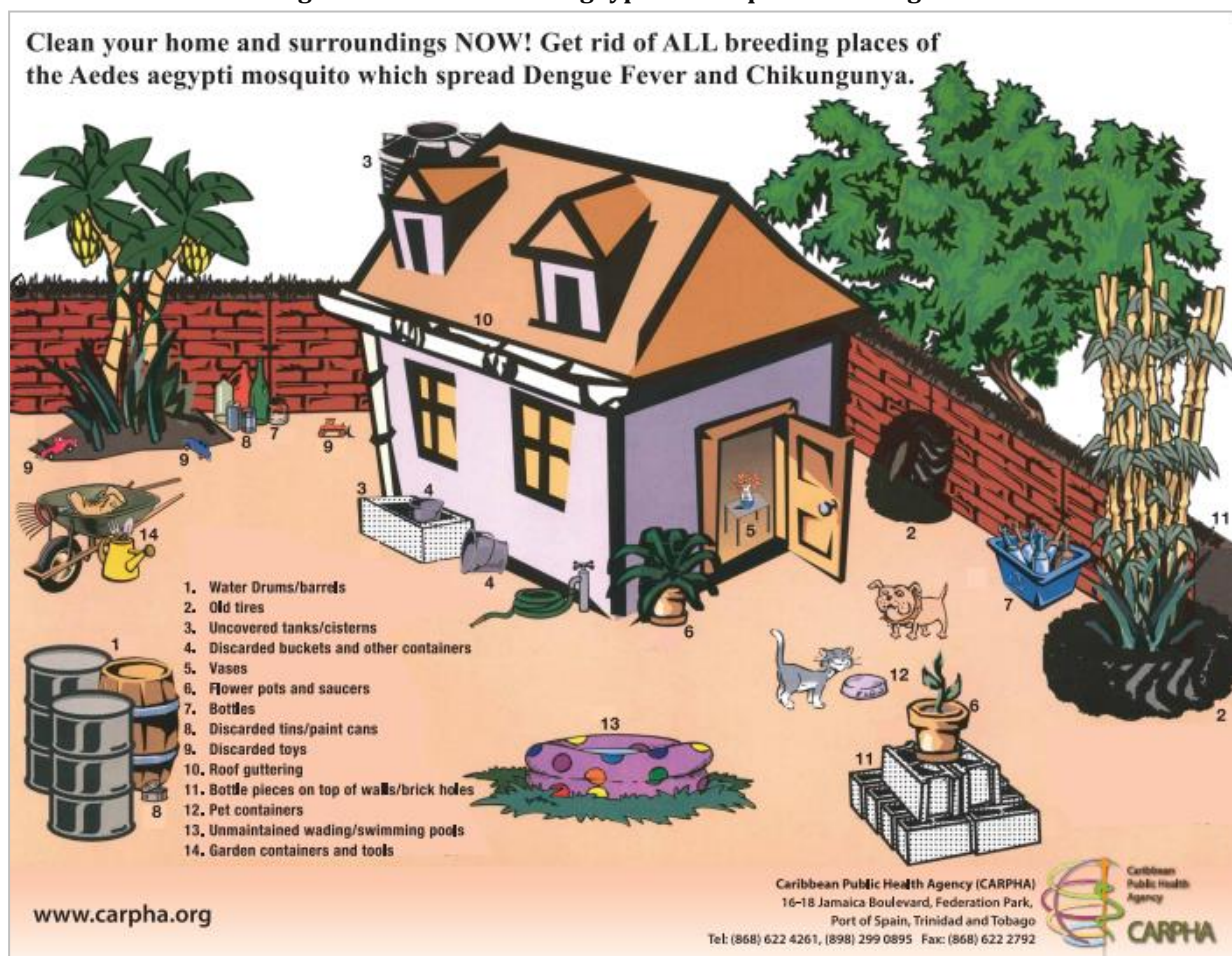
All mosquitoes feed on plant nectar. Only female mosquitoes suck blood, which they need to produce eggs. Female mosquitoes are infected by ingesting a virus when they take a blood meal. Virus replication in the salivary glands renders a mosquito infectious for life. *Aedes aegypti* females often discontinue the feeding process and restart on the same or another individual soon after, thus potentially infecting several people in a short space of time (Istúriz et al., 2000).

A characteristic feature of VBDs is the central role of *habitats* in affecting epidemiology. Each species has specific habitat requirements. Health, whether it be that of humans and vectors, is affected by the environments they inhabit.

As habitats change, whether due to natural or human processes involving a range of possible causal mechanisms and factors, so too does disease epidemiology (Ellis & Wilcox, 2009, p. S158)

Aedes aegypti has adapted to specific features of human habitats, favouring human-dominated urban environments. Since humans control most features of these environments, humans can, in principle, control *Aedes aegypti*. Humans can also exert control over vector habitats in rural and natural settings. The following poster developed by CARPHA illustrates features of habitats that favour mosquito reproduction.

Figure 59: Poster showing typical mosquito breeding sites



Source: CARPHA

Multiple interacting factors pose challenges to vector control. We now turn our attention to social determinants as applied to VBDs, using the ecological framework outlined in Chapter 1.

3.1.2 Determinants of VBDs

In section 1.4 of this report, the ecological framework has been presented, whereby health outcomes are resulting from the interaction of three levels of factors: individual and behavioural, environmental and social, and structural. In the case of VBDs, the situation is complicated by the fact that infections and their effects arise from a combination of human and vector characteristics, behaviours and environments. Ellis and Wilcox (2009) propose that to understand VBDs it is necessary to examine not only levels of observation – ranging from structural to individual – but the continuum of habitats, from natural to human-dominated. The issue of habitats has been considered above. While the ecological framework outlined in Chapter 1 pays little attention to dynamics of interaction between human and natural factors, it remains a useful organisational framework to examine determinants of VBDs. It points to targets for intervention at the individual, behavioural, social/ environmental and structural levels.

Individual characteristics

At the individual level, a range of personal biological characteristics can affect susceptibility to disease, and types and ranges of symptoms once infected. For instance, age can affect disease susceptibility. Examination of dengue virus cases confirmed by the Caribbean Epidemiology Centre in the 1990s showed that specific dengue serotype cases were concentrated in particular age groups. A combination of levels of existing immunity by age group and biological differences by age were thought to contribute to this (Campione-Piccardo, Ruben, Vaughan, & Morris-Glasgow, 2003). Age is also important in affecting the impact of chikungunya, since this disease is associated with arthritic symptoms, which can exacerbate existing symptoms which are concentrated among older people, while also creating new cohorts of people with symptoms usually associated with ageing. Sex is an important factor in affecting the outcomes of Zika infection, since it is associated with congenital abnormalities in children born to infected women. Pre-existing allergies and other underlying health conditions can also affect the health impact of VBDs.

Immunity following exposure to different VBDs varies by disease as well as human characteristics. Some viral VBDs, including chikungunya and zika, confer lifetime immunity to re-infection. The situation with dengue is complicated by the existence of different serotypes and genotypes. Infection with one dengue serotype does not confer immunity from others, except for a period of (generally) up to twelve weeks. In fact, infection with a second or subsequent serotype has been shown to increase risk of severe symptoms, including Dengue Haemorrhagic Fever (DHF), with longer time since last infection aggravating this risk. Vaccines have been developed against yellow fever, but no effective vaccine has been developed against chikungunya, dengue or zika. Malaria, also transmitted by a mosquito, is caused by a plasmodium parasite rather than a virus. The parasite can cause long-term debilitating illness, but some people are able to recover partially or fully, and to develop some resistance to such severe illness if they are re-infected.

Characteristics of the vector also affect disease transmission. *Vector competence* refers to the ability of vectors to acquire, maintain, and transmit disease agents, or pathogens. A pathogen must overcome obstacles before being transmitted to another host. In the case of arthropods, the gut wall must be bypassed; the pathogen must survive (even develop) in arthropod tissues; and finally, the

pathogen must penetrate the salivary glands for injection into a new host. There may be interactions between different pathogens, preventing the insect from being able to transmit more than one type of disease agent. Efficient vector-borne disease transmission is also affected by such factors such as longevity of the mosquito, host feeding preferences, and mosquito population levels. These factors fall under the term *vectorial capacity* (Goddard, 2002).

The complex interaction and variation of human, pathogen and vector characteristics pose challenges to the development of effective medical and other interventions against VBDs. All three categories of characteristics should be considered to maximise the effectiveness of interventions.

Behaviour and demographics

Insect vectors are predictable in their behaviour. *Aedes aegypti* females need blood meals to nourish their eggs and lay them in standing water. Adult males of the species do not stray far from the waters where the females lay their eggs and try to re-impregnate the females as soon as they have laid their eggs. The average *Aedes aegypti* mosquito does not travel more than five hundred metres in its lifetime. Urban settings are therefore ideal for this mosquito, since human-inhabited buildings are close together. *Aedes aegypti* mosquitoes can bite and spread infection at any time of day or night, though they most commonly feed at dusk and dawn, indoors, in shady areas, or when the weather is cloudy.

Areas of high population density are likely to present a high number and variety of breeding sites for mosquitoes, such as discarded containers, tyres and water receptacles. Drums where people store water or deposit their trash are the number one breeding site in the Caribbean (CARPHA, 2014b). Potential breeding sites are more common in low income areas, especially those consisting of informal settlements arising from unplanned urbanisation. These areas generally have lower access to amenities such as garbage collection and running water, increasing the likelihood of water in discarded items or being collected and stored deliberately for domestic purposes (Sommerfeld & Kroeger, 2015).

Environmental and social factors

It should be noted that the demographic issue of high population density and the environmental issues of garbage disposal and water storage are social issues that are difficult to address at the individual level. Most people in the Caribbean live in urban areas; where urbanisation and population density have been steadily increasing over the twentieth and into the twenty-first century. As in Latin America, some of this urbanisation has been unplanned, with several Caribbean countries having some areas of informal settlement where sanitation services are poor or non-existent (Campione-Piccardo et al., 2003; Guzman & Kouri, 2003). Furthermore, public water supply is intermittent in many areas of Caribbean countries, especially in the dry season. Many people store water as back-up; some in uncovered containers.

Rural to urban migration has been exacerbated by factors such as the decline in agricultural production, for example in the face of withdrawal of preferential access to European markets for

Windward Islands bananas and increased competition from large multinational food producers. Labour market surveys in Caribbean countries show that services, such as tourism, banking, retail, arts and entertainment, account for a large and increasing share of employment and national income, with the majority of employment opportunities in services to be found in urban areas. Poverty is a major driving force behind urbanisation. Unplanned urban settlements, high population density, poor water supply and garbage disposal and concentration of potential breeding sites are all more prevalent in poorer communities (Diaz-Quijano & Waldman, 2012; Guzman & Kouri, 2003). Deterioration of national public sanitation and health programmes as a result of economic recession, especially since the 2008 global economic downturn, has tended to damage vector control efforts.

Social and cultural norms surrounding sanitation and waste disposal may develop in response to environmental conditions. If people usually see neighbours and relatives disposing of garbage or accessing water a certain way, some tend to regard this as normal. It then becomes difficult to alter behaviour unless interventions are made at the community rather than the individual level. This also applies in communities such as schools and places of work and leisure. Community-level interventions against VBDs are described below.

A further critical factor in the proliferation of arboviruses is travel. Economic migration is a long-standing feature of Caribbean societies, with many families having members in more than one country and visiting each other regularly or when affordable. Business travel is frequent between Caribbean countries and increasingly from the Caribbean to other parts of the world. Increasing numbers of Caribbean people take vacations abroad. Tourism is a critical mainstay of Caribbean economies, making a major contribution to national income. Reduced cost of travel, especially air travel, has increased the movement of people around the world, often associated with the term *globalisation*. There is also increased economic activity in previously “unspoilt” natural areas of the Caribbean, such as nature tours and logging in rainforests. Travel increases the likelihood of encountering disease vectors and of contracting VBDs that were previously unknown or had declined in the Caribbean.

Structural factors

Beyond local social and environmental conditions are global trends and forces that affect them. Globalisation has already been mentioned. This is associated with increased interconnectedness between parts of the world, through travel and other forms of technological and economic change. Pathogens are transported in people, and sometimes animals, more widely and frequently across the globe. Migration is accelerating due to political upheaval and conflict, often from areas with poor health conditions.

The Internet, mobile phones and associated communications technologies have increased access to information – and misinformation – which can influence behaviour. Information about VBDs (or other diseases) in the Caribbean can influence tourist arrivals, as a combination of scientific data and “health scares” are proliferated. A major role for agencies concerned with Caribbean health, including CARPHA and its regional and international partners, has been to present scientifically valid information on VBDs and other health issues using easily accessible messaging and modes of communication, so that people around the world are enabled to respond rationally to the health issues affecting the region. Examples are presented below.

The Caribbean is a region of small countries strongly influenced by what happens in former colonising and North American countries, and by the actions of multinational companies. Action to address VBDs within the Caribbean is conditioned by the commercial and political balance of forces between Caribbean and other global interests. Technical products for diagnosis, treatment and vector control are generally produced by multinational companies, with prices and supplies having to be negotiated with them. Public health agencies based in metropolitan countries play important intermediary roles, often partnering with CARPHA and other agencies to assist in obtaining favourable procurement terms and in providing training and technical assistance.

Governments, public health agencies and commercial travel companies outside the region are involved in issuing travel advisories relating to VBDs and other public health threats, that can affect Caribbean economies substantially. International Health Regulations and trade agreements, and how they are interpreted and applied in countries with political and economic links to the Caribbean, condition the sphere of public health action in the region. This can be illustrated by travel advisories about zika issued in major Caribbean tourism source markets in Europe and North America. On the other hand, the presence of Caribbean diaspora populations in other countries assists in advocacy and public health action on behalf of the region, in areas such as fundraising, public awareness and remittances to those affected by disease.

Climate change is a significant factor contributing to the VBD challenge in the Caribbean (Litchveld & Wahid, 2017; Rawlins, Chen, & Chadee, 2006). As mentioned in section 3.1.1, global warming is associated with higher levels of rainfall as well as increasing temperatures. There is evidence of increased intensity and frequency of hurricanes, causing damage to buildings and infrastructure such as roads. All these factors increase the number and locations for mosquito breeding, while higher temperatures accelerate mosquito reproduction cycles. It has previously been observed that dengue cases rise during and up to two to three months after the rainy season in Caribbean countries (Campione-Piccardo et al., 2003). More recently, it has been found that disease outbreaks, such as the Chikungunya epidemic, were associated with water storage in drums, linked to coping with dry climatic conditions (Clauzel & Forbes-Robertson, 2017).

Storms and hurricane damage contribute to increased numbers of breeding sites in building materials and displaced household items that can hold water. While Caribbean governments have signed the Paris Agreement on Climate Change, they have little influence globally on the factors determining climate change, such as the massive production of greenhouse gases by factories, livestock and aircraft. Regional agencies such as CARICOM and CARPHA play important roles in advocacy to mitigate the effects of climate change on Caribbean public health and to push for the implementation of environmental agreements.

At local level, it is evident from the above that factors affecting VBDs extend substantially beyond the health sector, making a multi-sectoral approach critical. An “all of government” approach to public health is increasingly important, with roles to be played by every Ministry, notably those responsible for communications, economics, education, health, infrastructure, law, local government, media, research, science, social services, technology, tourism and trade.

The private sector should be engaged; both local and branches of multinational companies. One of many areas of intervention concerns public health legislation, which should be updated and enforced to support fines to persons who are in violation of the public health laws by continued inaction when advised to remove mosquito breeding sites on their premises (Polson-Edwards, 2016). As suggested above, action should accompany this to address poverty and lack of coverage of sanitation facilities.

3.1.3 VBD diagnosis and surveillance

CARPHA offers a Reference Laboratory in disciplines of Medical Bacteriology, Virology, Parasitology and Entomology to CMS. The Reference Laboratory provides support for surveillance and disease prevention and control activities in CMS and at CARPHA itself (Gonzalez-Escobar, 2014).

An important aspect of disease surveillance is syndromic surveillance. This facilitates detection and monitoring of cases. CMS report syndromic data weekly to CARPHA, transmitting data from hospitals, health centres, private physicians/ sentinel sites and laboratories. Some of the syndromes reported to CARPHA include (but are not restricted to) possible symptoms of VBDs, such as Fever and Haemorrhagic Symptoms, Fever and Neurological Symptoms, and Undifferentiated Fever (Fever and Rash is reported to PAHO). Syndromic surveillance indicators are monitored weekly for early alerts to possible events such as major outbreaks. As shown below, cases of VBD can increase and fall quite rapidly, and syndromic surveillance can pinpoint potential hotspots for investigation. Suspected cases should be notified immediately to trigger control actions (case investigation and vector control). Data itself should be monitored for completeness, timeliness, and quality.

CARPHA policy on testing of samples from CMS for chikungunya, dengue and zika follows public health principles. Samples from people in newly affected areas of a country are tested at CARPHA to confirm that a virus is present and circulating in that community. People in hospital displaying symptoms are tested. Tests are also conducted on samples from persons in other high-risk groups: pregnant women, children under 5 years old, adults over 65 years old, and persons with underlying chronic health conditions. This procedure means that CARPHA does not test every single case. Rather, when cases are confirmed within a community, prevention measures are advised for that community. CARPHA data on these diseases thus largely reflects what was reported to CARPHA at points when there was concern about new outbreaks and concentrations of disease in certain geographical areas (CARPHA, 2014b). The ability of CARPHA to assist in identifying risk is constrained by the amount of information supplied by countries about cases they report. For each laboratory test required, information should be provided on demographics (age and sex), recent travel history, symptoms, date of onset of symptoms and date of collection of specimen.

The numbers tested therefore do not reflect the numbers of cases in each country. Doctors examine patients and make diagnoses often without the use of a test, except in cases of considerable uncertainty or to confirm the presence of a newly-emerging or re-emerging disease. Figures on VBD thus represent the “tip of the iceberg” of cases of VBD and are likely to underestimate prevalence considerably.

Samples of suspected chikungunya, dengue or Zika sent to CARPHA for confirmatory testing are tested using the blood serum and urine- validated CDC Trioplex kit. This detects nucleic acids from chikungunya, dengue or Zika at the same time (Polson-Edwards, 2016).

3.2 Description and epidemiology of major VBDs in the Caribbean

3.2.1 Chikungunya

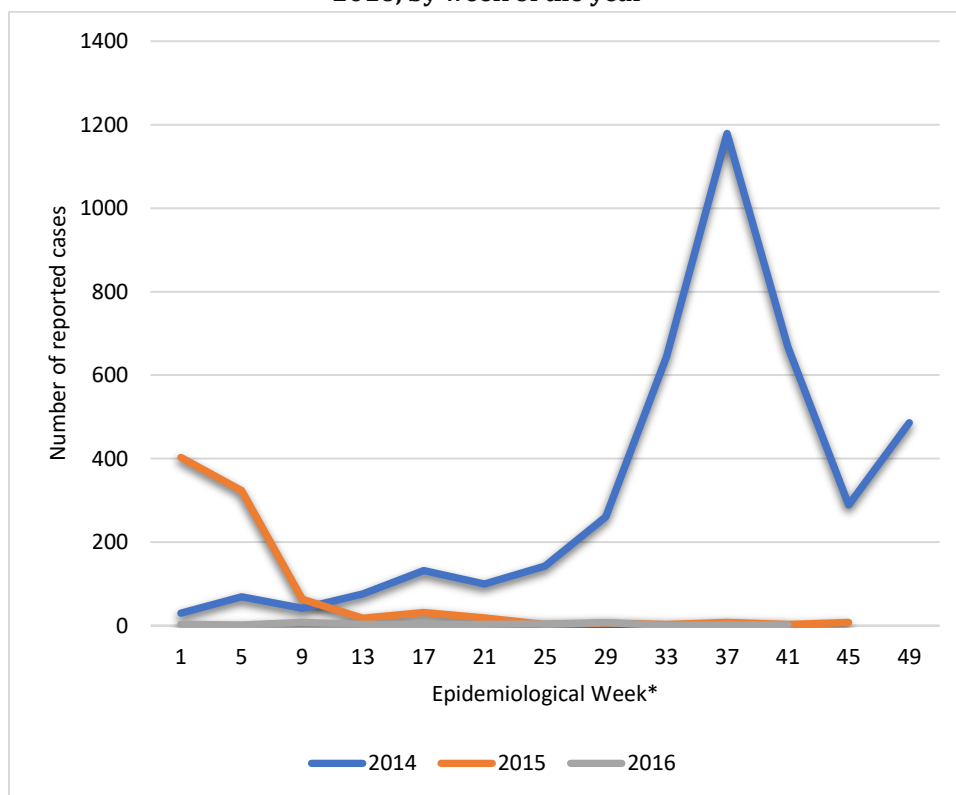
Chikungunya is a viral disease transmitted mainly by the bite of infected *Aedes aegypti* mosquitoes. It can also be transmitted by *Aedes albopictus* mosquitoes. The virus can cause high fever, rash, joint and muscle pain, and headache. The disease's name, chikungunya, is believed to have been derived from a description in the Makonde language, meaning "that which bends up", referring to the contorted posture of people affected with the severe joint pain and arthritic symptoms associated with this disease. Chikungunya does not often result in death, but the joint pain may last for months or years and may become a cause of chronic pain and disability. There is no specific treatment for chikungunya infection, nor any vaccine to prevent it. Pending the development of a new vaccine, the only effective means of prevention is to protect individuals against mosquito bites (PAHO, 2017a).

Chikungunya in the Caribbean was first reported in the island of Saint Martin (comprising the French territory of Saint Martin and the Dutch territory of Sint Maarten) in October 2013, and probably originated in a traveller returning from an affected area overseas (Olowokure et al., 2014). By January 9, 2014, 757 cases on that island were either suspected, confirmed, probable, waiting for results or hospitalised (of which 161 were confirmed at that time). By January 2014, cases had also been confirmed in other French territories: Guadeloupe, Martinique, French Guiana and St. Barthelemy (CARPHA, 2014c). This was the beginning of severe epidemics of VBD that affected the region in the 2014-'16 period. CARPHA and PAHO carried out a joint mission to Sint Maarten (a CARPHA Member State), January 7-9, 2014. The mission focussed on capacities for surveillance, awareness raising and skills of healthcare providers and strengthening integrated vector management. A further mission by CARPHA was conducted to Dominica shortly thereafter on the request of the Dominican government. Engagement with agencies concerned with vector control in CMS was then scaled up to address the chikungunya epidemic.

The following figure shows that reports of chikungunya cases to CARPHA began in January 2014 and were concentrated in that year. They reached a peak of 1,137 in the week ending 13th September 2014. Thereafter the number of reported cases declined to below 10 cases in any reporting week from June 2015 to the end of 2016.

The figures indicate that reports to CARPHA rose to a dramatic high in September 2014, but the ascent and descent in numbers of cases in countries may not in reality be so steep. As mentioned above, CARPHA data on these diseases largely reflects what was reported to CARPHA at points when there was concern about new outbreaks and concentrations of disease in certain geographical areas. The data would tend to under-represent the true scale of the epidemic and are presented here as an aggregate picture of the Caribbean response to a major public health crisis.

Figure 60: Number of cases of chikungunya reported by CARPHA Member States in 2014, 2015 and 2016, by week of the year



Note: Epidemiological week 1 is generally the first week in January

The following table shows incidence rates (autochthonous suspected plus autochthonous confirmed cases of chikungunya per 100,000 population) for each Caribbean state, from PAHO data. Most countries experienced the highest incidence of chikungunya in 2014, with Aruba and Guyana experiencing higher rates in 2015. By 2016, incidence rates were generally relatively low. Average incidence rates across the territories listed were 4,469.6 in 2014, 545.6 in 2015 and 84.6 in 2016. A striking finding is the degree of variation in incidence of the virus in the Caribbean region, with some countries and territories affected to a far greater extent than others.

Table 9: Incidence of chikungunya per 100,000 population, by Caribbean state, 2014 to 2016

	2014	2015	2016
Anguilla	612.5	193.8	58.8
Antigua and Barbuda	1,604.40	17.4	42.55
Aruba	443.1	863.4	821.93
Bahamas	24.4	2.6	19.34
Barbados	615.6	28.3	29.55
Bermuda	0	-	4.2
Belize	0.9	-	16.1
Cayman Islands	379.6	121.4	84.21
Cuba	0	-	0
Curacao	1,818.40	-	-
Dominica	5,154.80	0	366.22
Dominican Republic	5,182.50	0.6	1.05
French Guiana	5,650.60	3,360.50	298.19
Grenada	2,814.50	-	92.79
Guadeloupe	17,517.20	33.4	7.22
Guyana	9.5	661.6	19.33
Haiti	627.2	-	0.03
Jamaica	54.2	10.6	7.31
Martinique	56,703.80	84.2	-
Montserrat	2,380.00	140	100
Puerto Rico	941.2	27.8	4.84
St Barthelemy	17,247.20	3,561.80	0
St Martin (French part)	15,755.10	1,686.70	50.43
St Kitts and Nevis	1,284.30	-	53.85
St Lucia	541.7	-	69.51
St Vincent and the Grenadines	1,352.40	0	151.96
Sint Maarten (Dutch part)	1,175.00	-	34.15
Suriname	224.5	-	0.55
Trinidad and Tobago	21.7	3.8	43.22
Turks and Caicos Islands	39.6	-	43.14
Virgin Islands (UK)	1,231.30	-	32.35
Virgin Islands (US)	1,620.00	114.6	-

Source: (PAHO, 2017a)

Deaths attributed to chikungunya were concentrated in 2014, with only three such deaths in 2015 (two in French Guiana and one in Puerto Rico) and none in 2016. In 2014, 158 people died from chikungunya, of which 150 were in the French islands of Guadeloupe and Martinique (67 in Guadeloupe and 83 in Martinique). These islands were also the territories with the highest incidence of chikungunya in the Caribbean. It is remarkable that territories with similar levels of incidence to Guadeloupe, St. Barthelemy and Saint Martin (French part), there were few deaths, with three recorded in Saint Martin and none in Saint Barthelemy. Other countries that experienced deaths from chikungunya in 2014 were Barbados (2 deaths), Suriname (1 death) and the US Virgin Islands (2 deaths).

3.2.2 Zika

As the chikungunya epidemic died down in 2015, the zika epidemic started around October, bringing a further VBD crisis in the Caribbean.

Zika virus was first isolated from a monkey in the Zika forest in Uganda in 1947. Since 2015, an outbreak of zika virus infection has been occurring in the Caribbean, Central and South America, Oceania (Melanesia, Micronesia and Polynesia) and some parts of Asia and Africa (Public Health England, 2017a).

Like chikungunya, zika is spread mostly by the bite of an infected *Aedes* species mosquito (*Aedes aegypti* and *Aedes albopictus*). Also like chikungunya, there is no vaccine or specific treatment for zika. Unlike chikungunya, zika can also be passed through sex from a person who has zika to his or her sex partners, even if the person does not have symptoms. Zika is both a VBD and a sexually transmitted infection (STI). Thus, health promotion aiming to prevent Zika infections has to operate on two fronts, adding to VBD control measures the promotion of condom use during sexual activity and other STI prevention measures.

The first symptoms of Zika usually develop three to twelve days after the bite of infected mosquito in humans. Most people infected with Zika virus have no symptoms. For those with symptoms, Zika virus tends to cause a mild illness lasting two to seven days. Symptoms suggestive of Zika virus infection include rash, itching, fever, headache, joint pain, arthritis, muscle pain, lower back pain, conjunctivitis and pain in the eye ball or eye socket. There is no specific antiviral treatment for Zika. Supportive nursing care and relief of symptoms are the standard treatment (Public Health England, 2017b).

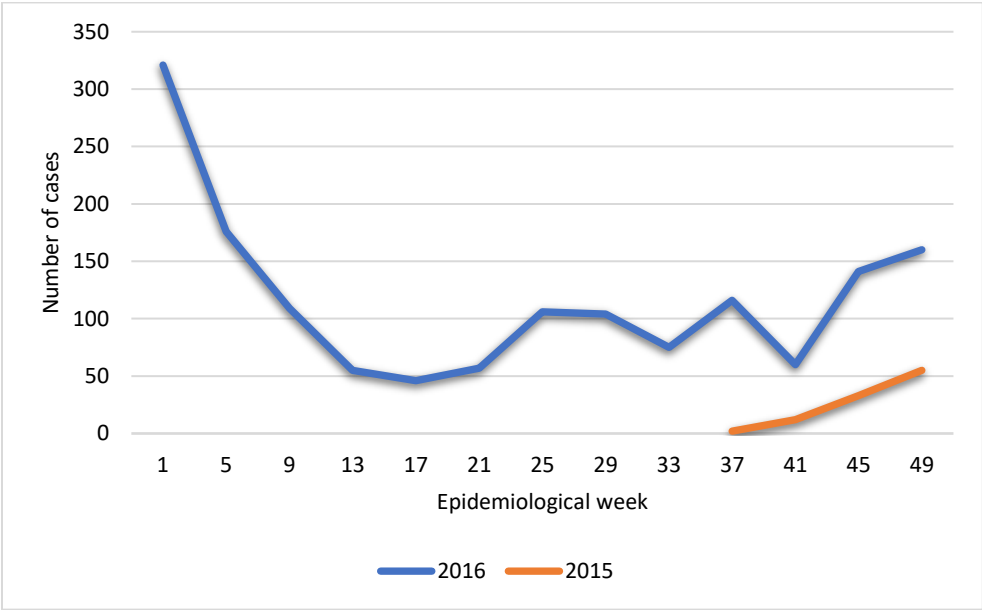
Zika infection during pregnancy can cause a serious birth defect called microcephaly (one in a spectrum of disease called Congenital Zika syndrome), where the baby's head is much smaller than average, and brain development is incomplete. This generally leads to a range of intellectual and physical disabilities. Doctors have also found other problems in pregnancies and among fetuses and infants infected with Zika virus before birth (Centers for Disease Control and Prevention, 2017i). It has been noted that symptoms of Zika are similar to other infectious disease that can cause birth defects: Rubella. Therefore the Zika virus testing algorithm at CARPHA includes testing of 10% of Rubella-negative samples for Zika (Gonzalez-Escobar, 2016).

A temporal association between clinical symptoms of Zika virus infection and the onset of Guillain-Barré Syndrome (GBS) has been demonstrated in population- and individual-level studies in several countries (World Health Organization, 2016). GBS is a condition that affects the nervous system; a person’s own immune system damages the nerve cells, causing muscle weakness, and sometimes paralysis. It is an uncommon outcome of Zika infection, but the development of the syndrome has been shown to be more likely in people who have been infected with Zika.

On 1 February 2016, following systematic review of the scientific literature on Zika outbreak, the World Health Organization (WHO) declared that the clusters of cases of microcephaly and neurological disorders occurring in areas with Zika virus transmission constituted a Public Health Emergency of International Concern (World Health Organization, 2016).

Zika cases began to be reported to CARPHA by CMS in October of 2015 and reached a peak of 321 cases at the beginning of 2016, falling to 46 cases by week 17 (late April) and then fluctuating throughout the year. The total number of cases reported by CMS in 2015 and 2016 was 1,628.

Figure 61: Number of cases of Zika reported by CARPHA Member States in 2015 -2016, by epi week



The 102 cases reported in 2015 were in persons of unknown sex and were in Suriname (99 cases) and Barbados (3 cases). Suriname continued to have the most reported cases in 2016, followed by Grenada and St Maarten. The remaining countries reported fewer than one hundred cases each.

For most cases, the sex of the person with Zika virus was not reported. Of the remainder, 68.3% were women. This reflects the greater likelihood of Zika testing in pregnancy given concerns about links between the virus and congenital abnormalities in babies. Mean age of people infected with Zika reported by CMS was 32 years (Gonzalez-Escobar, 2016).

Table 10: Zika cases reported to CARPHA, by sex and by CARPHA Member State, 2015-2016

	Female	Male	Unknown sex	TOTAL
Anguilla	11	7	5	23
Antigua and Barbuda	10	3		13
Aruba	12	10	8	30
Bahamas	19	6		25
Barbados	7		21	28
Bermuda	4	1		5
Br. Virgin Islands	28	15	7	50
Cayman Islands		1		1
Dominica	41	20		61
Grenada	74	27	223	324
Jamaica	2	1	69	72
St. Lucia	1			1
St. Kitts and Nevis	14	12		26
St. Maarten	28	15	127	170
St. Vincent and Grenadines	53	23		76
Suriname			723	723

PAHO provides data on Zika cases for the Americas. The following table shows data on the total number of cases reported by Caribbean states until the end of 2016.

Table 11: Cumulative Zika cases, incidence, deaths, and congenital syndrome, by Caribbean state, as at 29 December 2016

Country	Autochthonous Suspected	Autochthonous Confirmed	Imported cases	Incidence Rate ^b	Deaths among Zika cases ^c	Confirmed congenital syndrome associated with Zika virus infection ^d
Anguilla	23	18	1	241.18	0	0
Antigua and Barbuda	465	14	2	509.57	0	0
Aruba	676	28	7	617.54	0	0
Bahamas	0	22	3	5.60	0	0
Barbados	699	46	0	256.01	0	0
Belize	756	68	0	224.52	0	0
Bonaire, St Eustatius and Saba	0	85	0	340.00	0	0
Cayman Islands	211	30	10	422.81	0	0
Cuba	0	3	30	0.03	0	0
Curacao	0	820	0	550.34	0	0
Dominica	1,150	79	0	1660.81	0	0
Dominican Republic	4,903	331	0	49.15	0	22
French Guiana	9,700	483	10	3689.49	0	16
Grenada	314	111	0	382.88	0	1
Guadeloupe	30,845	379	0	6629.30	0	6
Guyana	0	37	0	4.80	0	0
Haiti	2,955	5	0	27.29	0	1
Jamaica	7,052	186	0	258.22	0	0
Martinique	36,680	12	0	9265.66	0	18
Montserrat	2	5	0	140.00	0	0
Puerto Rico	0	35,870	1	974.46	5	10
St. Barthelemy	975	61	0	11511.11	0	0
St. Kitts and Nevis	549	33	0	1119.23	0	0
St. Lucia	822	50	0	531.71	0	0
St. Martin	3,115	200	0	9208.33	0	0
St. Vincent and the Grenadines	508	83	0	579.41	0	0
Sint Maarten (Dutch part)	168	62	0	560.98	0	0

Country	Autochthonous Suspected	Autochthonous Confirmed	Imported cases	Incidence Rate ^b	Deaths among Zika cases ^c	Confirmed congenital syndrome associated with Zika virus infection ^d
Suriname	2,758	723	0	635.22	4	2
Trinidad and Tobago	0	643	1	47.11	0	1
Turks and Caicos Islands	179	17	3	384.31	0	0
Virgin Islands (UK)	74	52	0	370.59	0	0
Virgin Islands (US)	1,028	877	0	1849.51	0	0

Source: (PAHO, 2017d)

Notes:

^aPAHO/WHO Case definitions for suspected and confirmed Zika cases is available at:

http://www.paho.org/hq/index.php?option=com_content&view=article&id=11117&Itemid=41532&lang=en

^bIncidence rate (autochthonous suspected + autochthonous confirmed) / 100,000 pop.

^cDeaths among Zika cases do not include deaths related to Guillain-Barre syndrome (GBS) or congenital malformations associated with Zika virus infection. As of 12 May 2016, previously reported deaths related to GBS were removed from this total.

^dConfirmed congenital syndrome associated with Zika virus infection case definition: Live newborn who meets the criteria for a suspected case of congenital syndrome associated with Zika virus AND Zika virus infection was detected in specimens of the newborn, regardless of detection of other pathogens. Case definitions for congenital syndrome associated with Zika virus infection is available at: http://www.paho.org/hq/index.php?option=com_content&view=article&id=11117&Itemid=41532&lang=en

As compared to chikungunya, rates of Zika virus varied widely across the Caribbean. Some countries which had been hard hit by chikungunya, also experienced high rates of Zika, with the French territories of Guadeloupe, Martinique, Saint Barthelemy and Saint Martin all experiencing incidence rates exceeding 6,500 per 100,000 population by the end of 2016. Other countries that experienced incidence rates in excess of 1,000 were Dominica, French Guiana, St. Kitts and Nevis and the US Virgin Islands. There were small numbers of deaths attributed to Zika in Puerto Rico and Suriname.

It should be noted that reported cases of Zika may represent the “tip of the iceberg” of the number of cases, since many or even most cases may have mild or no symptoms, be self-medicated or untreated and thus never reported to health authorities. This means that many people may be unaware of their risk of contracting Zika from people around them, since people who are carrying the virus are themselves not aware of it (Gonzalez-Escobar, 2016). This emphasises the importance of public health measures such as public education and vector-control, in the light of potentially serious neurological complications of the disease.

There were seventy-seven (77) cases of congenital syndrome associated with Zika virus infection in nine of the Caribbean countries or territories, with Dominican Republic, French Guiana, Martinique and Puerto Rico each having ten or more cases. CMS that had cases of congenital syndrome were Grenada, Haiti, Suriname and Trinidad and Tobago.

By the end of 2016, Caribbean countries with cases of GBS, of which at least one was associated with Zika infection included Dominican Republic, French Guiana, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Puerto Rico, Saint Martin, Suriname and Trinidad and Tobago (World Health Organization, 2017).

The following table compiles data available on GBS in CMS from the start of the Zika epidemic in 2013 until the end of 2016. This shows that there were 121 GBS cases across ten of the countries, with larger countries (Guyana, Jamaica, Suriname and Trinidad and Tobago) having the greatest numbers of cases. Thirteen cases were laboratory-confirmed for Zika in four countries. This should not be taken to mean that the remaining GBS cases were not associated with Zika, since they may not have been tested for Zika or the data may not have been reported. This table compiles data from different data sources, and it should also be noted that some of the reports were for periods ending before December 2016. The data may therefore be incomplete, pointing to the need to strengthen surveillance for GBS in the light of its links to Zika.

Table 12: Cases of Guillain-Barre Syndrome in CARPHA Member States: October 2015 - December 2016

Country	Reported cases of GBS	Cases of GBS laboratory-confirmed for Zika
Anguilla	0	0
Antigua and Barbuda	0	0
Barbados	4	0
British Virgin Islands	0	0
Cayman Islands	0	0
Dominica	2	0
Grenada	10	3
Guyana	13	0
Jamaica	30	4
Montserrat	0	0
St. Lucia	6	0
Sint Maarten	0	0
St. Kitts and Nevis	1	0
St Vincent and the Grenadines	7	0
Suriname	15	4
Trinidad and Tobago	33	2
Turks and Caicos Islands	0	0
Grand Total	121	13

Sources: Compiled by CARPHA from country PAHO office websites and Ministry of Health reports.

3.2.3 Dengue

Dengue is considered a Neglected Tropical Disease (NTD), in that it affects more than a billion people globally and is relatively neglected as it has been virtually wiped out in the more developed parts of the world (Centers for Disease Control and Prevention, 2017d). It is spread principally by *Aedes*

aegypti. Most human infections are asymptomatic (Brathwaite Dick et al., 2012). After being bitten by an infected mosquito, symptoms generally develop between two and fourteen days later. They include fever, headache, nausea, vomiting, rash, and pain in the eyes, joints, and muscles. These “classic dengue” symptoms generally subside within a week. Patients require rest, fluids, and relief of fever or pain. In severe cases, symptoms may include intense stomach pain, repeated vomiting, and bleeding from the nose or gums (Centers for Disease Control and Prevention, 2017a). Dengue Haemorrhagic Fever (DHF) involves spontaneous internal and external bleeding and may manifest after the first week of classic dengue symptoms. In extreme cases, Dengue Shock Syndrome may occur, with circulatory failure and rapid or weak pulse, cold, clammy skin and restlessness and agitation, sometimes culminating in profound shock and death. PAHO has developed a categorisation of four grades of dengue fever, with Grade I being classic dengue, Grade II the manifestation of DHF symptoms, and Grades III and IV constituting Dengue Shock Syndrome. No vaccine has been developed for dengue (Istúriz et al., 2000).

Dengue has four number of serotypes with subgroups designated genotypes. The serotypes circulating in the Caribbean are types 1 to 4. Infection with one serotype results in specific, lifelong immunity to that serotype. Protection against other serotypes lasts less than 12 weeks (Campione-Piccardo et al., 2003). Exposed individuals can theoretically be infected with all serotypes, and the probability of DHF increases with infection with a further serotype. Longer intervals between infections with different serotypes, and the sequence of dengue infections and association with certain genotypes are also important in determining risk of DHF (Guzman & Kouri, 2003). Different serotypes and strains vary in the symptoms and severity of illness they cause, with further differential impact according to host characteristics such as age, sex, ethnic group and pre-existing allergies (Campione-Piccardo et al., 2003). Systematic isolation and typing of dengue viruses has been carried out by the Caribbean Epidemiology Centre, and then CARPHA, since 1975 (Campione-Piccardo et al., 2003).

Dengue has a long history in the Caribbean, with the first outbreaks of a disease with symptoms compatible with dengue reported in the French West Indies in 1635, and several further outbreaks recorded thereafter. The *Aedes aegypti* mosquito is thought to have brought the disease from Africa to the Caribbean aboard slave ships (Rawlins et al., 2006). In the twentieth century, rapid population growth, urbanisation and the growth of international travel created ideal conditions for the proliferation of mosquitoes; conditions which persist in the twenty-first century (Guzman & Kouri, 2003). Dengue fever was identified in the Caribbean basin during World War 2, and the dengue 2 serotype was isolated in 1953 in Trinidad (Campione-Piccardo et al., 2003). *Aedes aegypti* eradication programmes were carried out during the 1940s, ‘50s and ‘60s to prevent urban epidemics of yellow fever. Eventually *Aedes aegypti* developed resistance to DDT (dichlorodiphenyltrichloroethane), the main insecticide used, and the centralised administrative structure of the programme often prevented rapid response (Brathwaite Dick et al., 2012).

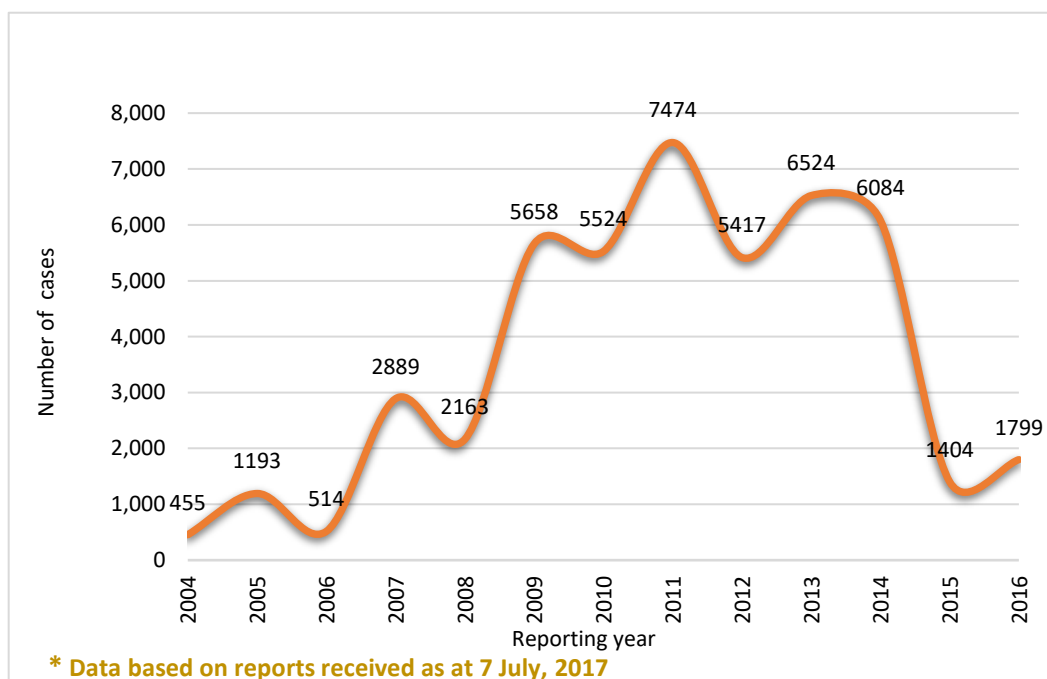
Concerns about the wider ecological impact of DDT spraying also contributed to the termination of the eradication initiative (Ellis & Wilcox, 2009). When these programmes were discontinued in the 1970s, *Aedes aegypti* had been eradicated in some Caribbean countries, but in most there were remaining reservoirs of the vector, which, along with factors such as rapid urbanisation and travel, resulted in re-infestation, with increasing numbers of cases and epidemics of dengue fever (Istúriz et al., 2000).

Until the 1970s, dengue serotypes 2 and 3 were present in the Caribbean. In 1977, dengue 1 was introduced to the Americas, causing a devastating pandemic, with epidemics that lasted until 1981 in virtually every Caribbean island. In 1981, dengue 4 was introduced and caused numerous outbreaks. In 1981, a new strain of dengue 2 was introduced into Cuba, causing the first major DHF epidemic in the Americas. DHF/ dengue shock syndrome emerged as a major public health problem. Analysis of samples submitted to the Caribbean Epidemiology Centre from 17 Member States between 1977 to 1996 shows that during that period, serotypes 1, 2 and 4 were circulating in the region (Campione-Piccardo et al., 2003). Since that time, serotype 3 has also re-appeared in CMS.

From the 1980s to 2007, there was a 4.6-fold increase in reported cases of dengue in the Americas (~1 million cases during the 80s to 4.7 million during 2000–7). During 2000 to 2010 an unprecedented increase in the number of cases was reported in the Americas, circulating all four serotypes and reaching the highest record of cases ever reported during a decade. Two Pan-American outbreaks occurred in 2002 and 2010. In the 2002 outbreak, Trinidad and Tobago had the second-highest incidence rate of dengue in the Americas. The Caribbean was the American subregion most affected by the 2010 outbreaks, with Guadeloupe and Martinique experiencing highest incidence in the Americas. The occurrence of recurring outbreaks every 3–5 years with an increasing number of cases over time shows the transition from an endemic-epidemic state to a highly endemic state in recent years (Brathwaite Dick et al., 2012). The pattern shifted from intermittent epidemics at long intervals to annual outbreaks in multiple locations and simultaneous circulation of several serotypes and genotypes (Guzman & Kouri, 2003).

In CMS, there was an increasing trend in the number of laboratory-confirmed cases of dengue from 2004 until 2011. From 2014, there was a sharp decline in the number of cases, with the number cases in 2015 falling to close to the number a decade earlier, followed by a slight rise in 2016.

Figure 62: Laboratory-Confirmed Cases of Dengue in the English- and Dutch-speaking Caribbean, 2004 – 2016*



Source: CARPHA

While the decline in the number of dengue cases over the period is, at first sight, encouraging, caution must be exercised in interpreting the decline in numbers as a measure of success. In the 2014-'16 period, CARPHA saw fewer submissions of samples for dengue confirmatory testing than in the few years prior. It appears that health practitioners in CMS may have been more concerned with chikungunya and Zika, so that requests for confirmatory testing focussed more on these two diseases than dengue, especially in the midst of the crisis in 2015.

A second part of the explanation may be that the high prevalence of chikungunya and Zika over the period actually served to reduce the prevalence of dengue. This is based on the idea of “vector competence”, since it has been shown that co-infection of mosquitoes with more than one virus is unlikely. Similarly, while Zika, chikungunya and dengue were all circulating in the Caribbean at the same time, and CARPHA tests for all three viruses using a single triplex test, few cases of co-infection were found. Given the populations’ immunological naiveté to the newly-introduced viruses, chikungunya and Zika may have out-competed dengue among people exposed to either chikungunya or Zika and dengue.

Number of cases disaggregated by country, as presented in the table below, show, considerable variation, suggesting difficulty in applying explanations to the general trend across the region as a whole. Close to half of cases from 2012 to 2016 were in Belize, where the number of people infected with dengue rose to a peak in 2014 then plummeted. Several CMS reported more than a thousand laboratory-confirmed dengue cases since 2012: Aruba, Barbados, Belize, Guyana and the Turks and Caicos Islands. From 2014 to 2016 in the Turks and Caicos Islands, the number of cases increased,

while the opposite occurred in Aruba and Belize, which experienced a decrease. In Guyana and Barbados, the number of cases reached a low in 2015, then increased in 2016. An increase in the number of laboratory-confirmed cases between 2015 and 2016 was experienced in eight of the twenty CMS that reported in 2014-'16.

Of the 157 cases of dengue haemorrhagic fever (DHF) reported by CMS in 2014, 146 of these were in Belize. Of the other DHF cases, two were in Barbados and 9 in Suriname. Most of the fall in the number of dengue cases since 2014 can be attributed to Belize alone, and it is possible that the development of immunity to the strain circulating in Belize led to the decline. Among CMS, there were only 3 DHF cases in 2015 (in Barbados, Belize and British Virgin Islands), and 2 in 2016 (in Jamaica).

Table 13: Laboratory-confirmed dengue cases by CARPHA member state, 2012-2016

	2012	2013	2014	2015	2016	Country total
Anguilla	10	4	8		2	24
Antigua and Barbuda	10	3	14	14	3	44
Aruba	436	108	237	131	104	1016
Bahamas	5	1	15	2	1	24
Barbados	481	1093	336	113	429	2452
Belize	1950	3016	4310	245		9521
Bermuda		1	1			2
Bonaire, Saba, St. Eustatius	93	64				157
Br. Virgin Islands	313	166	34	114	108	735
Cayman Islands	36	2	2	2	2	44
Curacao	226	86	8			320
Dominica	32	24	15	5	6	82
Grenada	77	162	31	24	91	385
Guyana	758	1125	713	363	667	3626
Jamaica	545	154	30	12	169	910
Montserrat	1					1
St. Lucia	35	183	30	25	80	353
St. Kitts and Nevis	2	14	4	1		21
St. Maarten	39	208	26	9	10	292
St. Vincent and Grenadines	197	100	10	13	7	327
Suriname	155	3	10			168
Turks and Caicos Islands	16	7	250	331	484	1088
Year total	5417	6524	6084	1404	2163	21592

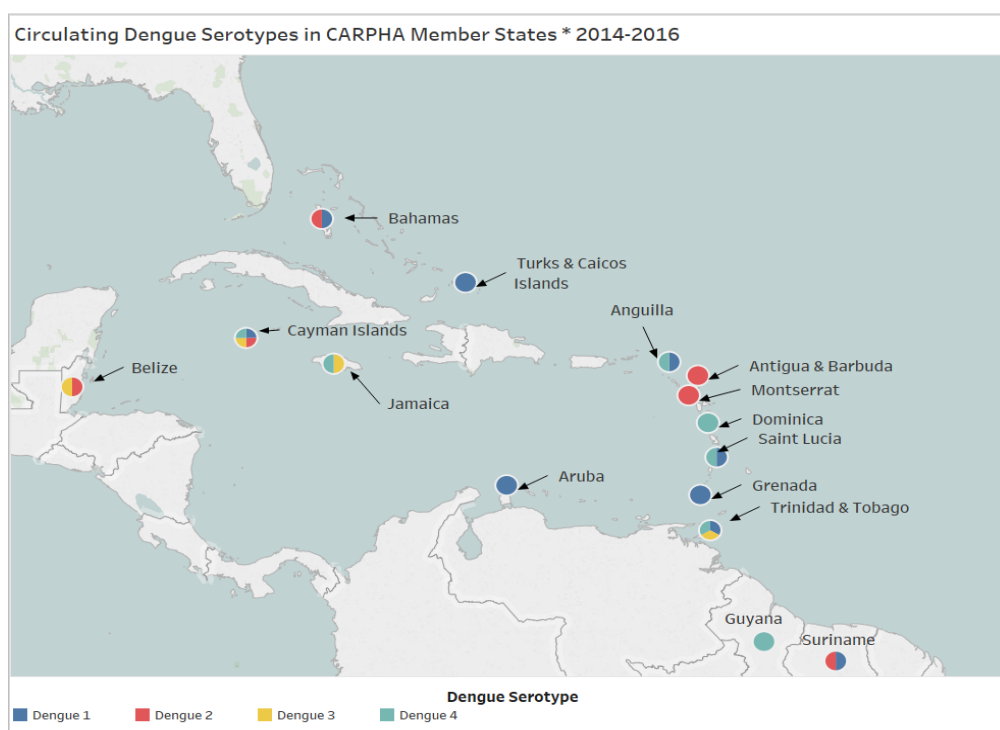
Note: No data on laboratory-confirmed dengue cases was received from Haiti or Trinidad and Tobago for 2012-'16 period

The following table and map show dengue serotypes in CMS. Over the three-year period, there was wide variation in the serotypes of dengue experienced across the region. This variation in itself constitutes a risk, since travellers between countries can bring another serotype, increasing the chances of severe illness, including DHF. Some countries had only one serotype, while the Cayman Islands experienced all four over this short period. Belize, which experienced the largest number of dengue cases in 2014, did not report serotype information for that year.

Table 14: Circulating Dengue Serotypes reported in CARPHA Member States 2014-2016

Country	2014	2015	2016
Anguilla	1 4		
Antigua and Barbuda			2
Aruba	1		
Bahamas	1 2		
Belize	NA	2	3
Cayman Islands	1 3	2 3 4	3
Dominica	4		
Grenada			1
Guyana	4		
Jamaica	3	4	3 4
Montserrat	2		
St. Lucia	4	1	1
Suriname	2		1
Trinidad and Tobago	1 4	1	1 3
Turks and Caicos Islands	1		

Figure 63: Map of circulating dengue serotypes in CMS, 2014-16



3.2.4 Malaria

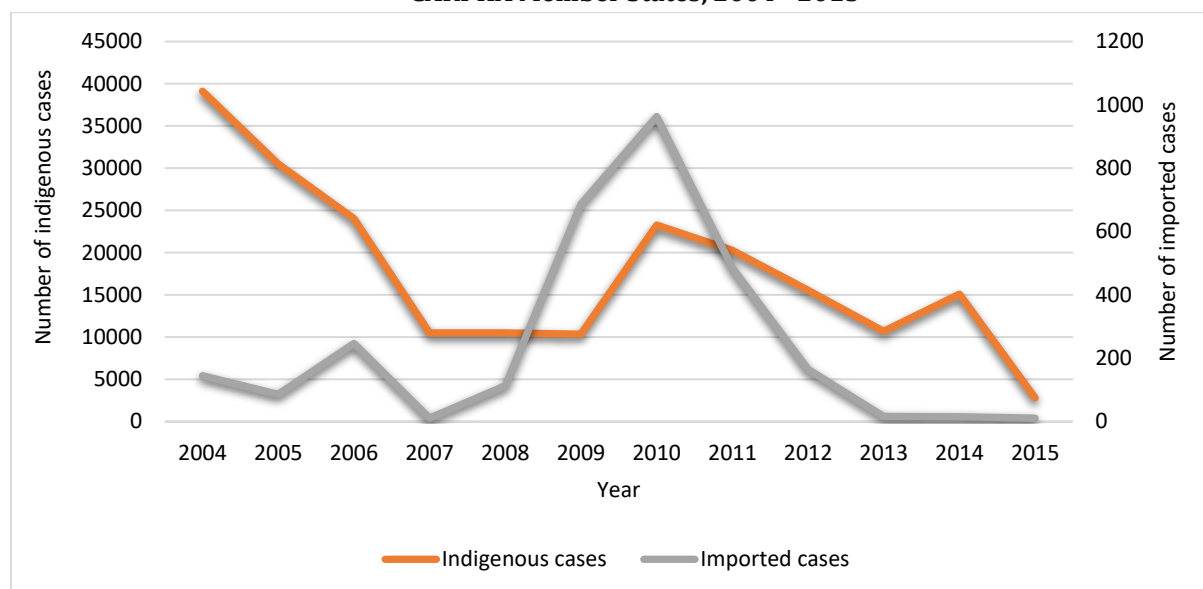
Malaria is a mosquito-borne disease caused by a parasite. Malaria is transmitted among humans by female mosquitoes of the genus *Anopheles*. This differentiates it from other mosquito-borne diseases in the Caribbean, which are transmitted primarily by *Aedes Aegypti* mosquitoes, which is more widespread than *Anopheles*. People with malaria often experience fever, chills, and flu-like illness. Left untreated, they may develop severe complications and die. In 2015 an estimated 212 million cases of malaria occurred worldwide and 429,000 people died, mostly children in the African Region.

Malaria was eradicated from most of the Caribbean when global eradication efforts were undertaken in the 1950s and 1960s. However, malaria continues to be endemic in the Dominican Republic and the CARPHA Member States of Belize, Haiti, Guyana and Suriname.

Large numbers of indigenous malaria cases were reported for the 2005 to 2014 period by the following countries: Belize (2,485 cases), Guyana (154,447) and Suriname (13,544). Total indigenous cases also include smaller numbers of locally transmitted cases (250 or fewer per country) from the following CMS: The Bahamas, Jamaica, Trinidad and Tobago. The data show a general decline in the number of indigenous cases, from 39,113 in 2004 to 2,808 in 2015. Indigenous cases rose between 2007 and 2010 to reach a peak of 23,251. On average, 17,424 cases were reported per year.

Imported cases are on a much smaller scale, with an average of 245 cases per year in all CMS. Numbers fluctuated, with a peak of 963 cases in 2010. This was also a peak year for indigenous cases, suggesting the outbreaks may be connected. All CMS have reported at least one case of imported malaria between 2004 and 2015.

Figure 64: Indigenous and imported cases of malaria reported by CARPHA Member States, 2004 - 2015



3.2.5 Yellow Fever

Yellow fever virus differs from most mosquito-borne diseases in that there is an effective vaccine available, which has effectively reduced the health burden of this disease. It is transmitted to people primarily through the bite of the infected *Aedes* or *Haemagogus* species mosquitoes. Given the large *Aedes aegypti* population in the Caribbean, the people of the region are vulnerable. In yellow fever, non-human primates (monkeys) play an important part in the transmission cycle. Mosquitoes acquire the virus by feeding on infected primates (human or non-human) and then can transmit the virus to other primates (human or non-human) (Centers for Disease Control and Prevention, 2017f).

The majority of persons infected with yellow fever virus may display no symptoms or only mild symptoms. The initial symptoms include sudden onset of fever, chills, severe headache, back pain, general body aches, nausea, and vomiting, fatigue, and weakness. Most persons improve after the initial presentation. After a brief remission of hours to a day, roughly 15% of cases progress to develop a more severe form of the disease. The severe form is characterized by high fever, jaundice (involving yellowing of the skin – hence the name), bleeding, and eventually shock and failure of multiple organs. Among those who develop severe disease, 20–50% may die. Those who recover from yellow fever generally have lasting immunity against subsequent infection.

No specific treatment has been found to benefit patients with yellow fever. Treatment is focused on symptomatic relief. Rest, fluids, and use of pain relievers and medication to reduce fever may relieve symptoms of aching and fever. Use of certain medications which may increase the risk of bleeding should be avoided. (Eg. nonsteroidal anti-inflammatory drugs) (Centers for Disease Control and Prevention, 2017f).

In the Caribbean, French Guiana, Guyana, Suriname and Trinidad and Tobago are countries where a risk of yellow fever transmission is present, because yellow fever has been reported in the past or currently, plus mosquito vectors and animal reservoirs currently exist. The animal reservoirs are mostly red howler monkeys who live in the rainforest canopies of these countries. In Trinidad and Tobago, only Trinidad is affected. Public health measures include reporting of monkey deaths to environmental health officials. This provides surveillance information, so that risks to nearby populations can be monitored. The most important public health measure, however, is vaccination of the entire population of these countries. Yellow fever vaccination is generally administered to babies at around one year of age. *As a result, no human cases of yellow fever were reported in these countries in the 2014-'16 period.* Any such cases would be reported to CARPHA by national health authorities, as yellow fever is a reportable disease.

Under International Health Regulations, there are country entry requirements for proof of yellow fever vaccination. A few countries (none of them Caribbean) require yellow fever vaccination from travellers arriving from all countries while some countries require vaccination only for travellers coming from a country with risk of yellow fever virus transmission (Centers for Disease Control and Prevention, 2017b). For countries where yellow fever is endemic, these requirements serve to protect visitors and are important as part of tourism strategies. The following table presents entry requirements and CDC recommendations for visitors.

Table 15: Yellow fever vaccination requirements and recommendations for travellers to Caribbean countries where yellow fever is endemic

Country	Yellow fever (YF) vaccination requirements for arriving travelers	CDC YF vaccination recommendations for arriving travelers
French Guiana	Required from all countries if the visitor is over one year of age	Recommended for all visitors over 9 months of age
Guyana	Required if travelling from a country with risk of YF transmission and over one year of age, including transit in an airport located in a country with risk of yellow fever virus transmission	Recommended for all visitors over 9 months of age
Suriname	Required from all countries if the visitor is over one year of age	Recommended for all visitors over 9 months of age
Trinidad and Tobago	Required if traveling from a country with risk of yellow fever virus transmission and over six months of age, including transit in an airport located in a country with risk of yellow fever virus transmission	Recommended for all visitors over 9 months of age, restricted to those traveling to densely-forested areas on the island of Trinidad. It is not recommended for cruise ship passengers and airplane passengers in transit, or travelers whose itineraries are limited to the island of Tobago.

Source: (Centers for Disease Control and Prevention, 2017g).

In Caribbean countries where yellow fever is not endemic, the most common requirement is that yellow fever vaccination be obtained if traveling from a country with risk of yellow fever virus transmission and over one year of age, including transit more than twelve hours in an airport located in a country with risk of yellow fever virus transmission. This sometimes affects intra-Caribbean business and other travel, since certificates of yellow fever vaccination are sometimes required from the four affected countries (and other affected countries around the world). Notably, Barbados has waived this requirement for Guyana and the island of Trinidad, possibly to facilitate the frequent travel between the three countries and in view of the successful public health measures taken in Guyana and Trinidad and Tobago (Centers for Disease Control and Prevention, 2017g).

In December 2016, the first human cases of a yellow fever outbreak were reported in the State of Minas Gerais, Brazil (Centers for Disease Control and Prevention, 2017h). The cases were transmitted during visits to the jungle, where mosquitoes transmitted the disease from monkeys to humans and possibly between humans. Since *Aedes aegypti* is present in the Caribbean, should the transmission cycle change to urban, with human to human transmission via the vector, this would result in serious public health challenges for the region (WHO, 2016). Given travel between Latin America and Caribbean countries, it is important for Caribbean countries to remain vigilant and to persist with vaccination programmes and policies against the disease.

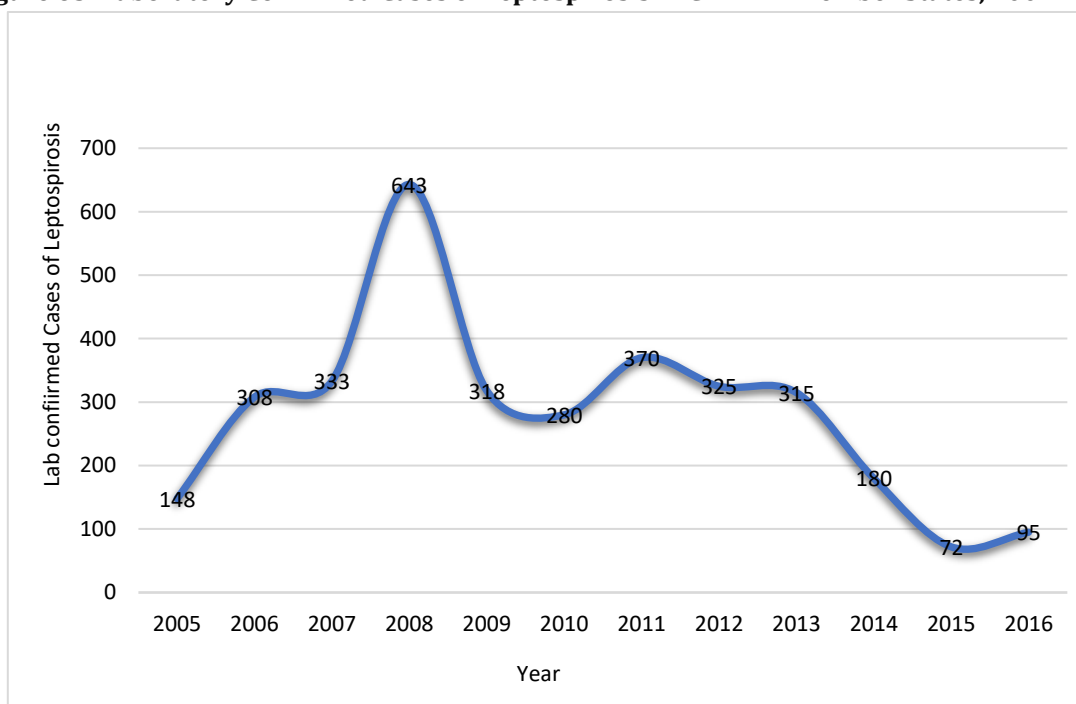
3.2.6 Leptospirosis

Leptospirosis is a bacterial disease that affects both humans and animals. The bacteria that cause leptospirosis are spread through the urine of infected animals. It can get into water or soil and can survive there for weeks to months. Many types of domestic and wild animals carry the bacteria. Leptospirosis causes symptoms which can be confused with dengue, malaria and other vector-borne diseases, and therefore is sometimes misdiagnosed and underreported. Without treatment, leptospirosis can lead to kidney damage, meningitis (inflammation of the membrane around the brain and spinal cord), liver failure, respiratory distress, and even death. The risk of infection can be greatly reduced by not swimming or wading in water that may contain animal urine, and by avoiding contact with animals who may be infected (Centers for Disease Control and Prevention, 2017c).

Sources of infection include floodwaters, which affect many parts of the Caribbean during the rainy/hurricane season. Mice or rats infected with leptospirosis may urinate on drink or food cans and other containers in warehouses, which then pose a risk to health when opened by consumers.

The following figure shows a total of 3,387 laboratory confirmed cases as reported by CMS to CARPHA for the 2004-2016 period. Cases reached a peak of 643 cases in 2008, of which 56.1% were reported by Jamaica and 30.5% by Guyana. There was a lower peak of 370 cases in 2011, with Guyana accounting for the largest number of cases (41.4%), followed by Jamaica (18.2%) and Barbados (10.3%). Thereafter there was a consistent decline in cases reported per year.

Figure 65: Laboratory Confirmed Cases of Leptospirosis in CARPHA Member States, 2004-2016



Source: CARPHA

The following table shows the number of laboratory-confirmed leptospirosis cases reported by CMS in the 2014-16 period. Guyana and Jamaica accounted for the largest number of cases, with St. Vincent and the Grenadines and Barbados also accounting for more than 10% of cases each. Two of the countries that had reported cases in 2015 had not yet reported in 2016 at time of writing.

Table 16: Laboratory-Confirmed Cases of Leptospirosis by country, CARPHA Member States, 2014-16

Country	2014	2015	2016	TOTAL	Percentage (%) of Total
St. Vincent and Grenadines	7	9	23	39	11.2
St. Kitts and Nevis	7	2	16	25	7.2
St. Lucia	3	4	23	30	8.6
Jamaica	24	24	2	50	14.4
Guyana	100	16		116	33.4
Grenada	6	8	2	16	4.6
Dominica	6	6	14	26	7.5
Belize	7	1		8	2.3
Barbados	20	1	15	36	10.4
Bahamas		1		1	0.3
TOTAL	180	72	95	347	100%

Source: CARPHA

3.2.7 Lymphatic filariasis

Lymphatic filariasis, considered globally to be a NTD, is a parasitic disease caused by microscopic, thread-like worms. The main worm vector globally is *Wuchereria bancrofti*. The adult worms only live in the human lymph system and can cause fluid collection and swelling of the legs, arms, breasts, and male scrotum. In the Americas, *Culex* mosquitoes are the most common vectors. In the Caribbean, the disease is endemic in areas of the Dominican Republic, Guyana and Haiti, with a few cases in Trinidad and Tobago. PAHO support an elimination strategy involving mass drug administration of two anthelmintic drugs: Diethylcarbamazine citrate and Albendazole (Albenza), to all individuals living in endemic areas. Drug treatment is available to kill the worms, but does not treat the lymphatic swelling, which may take place after the infection is eliminated (CDC, 2017b; PAHO, 2017b).

3.2.8 Schistosomiasis

Cases of schistosomiasis have been reported in Suriname and St. Lucia (PAHO, 2017c). It is caused by parasitic worms (*Schistosoma*) spread by freshwater snails. Symptoms of schistosomiasis are caused by the body's reaction to the worms' eggs. Intestinal schistosomiasis can result in abdominal pain, diarrhoea, and blood in the stool, and liver damage. People may be infected during routine agricultural, domestic, occupational, and recreational activities, which expose them to infested water. Lack of hygiene and certain play habits of school-aged children such as swimming or fishing in infested water make them vulnerable to infection. Schistosomiasis control focuses on reducing disease through periodic, large-scale population treatment with praziquantel. A more comprehensive approach including access to potable water, adequate sanitation, and snail control would also reduce transmission (WHO, 2017).

3.2.9 Leishmaniasis

Leishmaniasis has been reported in mainland Caribbean countries of French Guiana, Guyana and Suriname and in the Dominican Republic (PAHO, 2017c). It is caused by leishmanial parasites spread by sand-fly bites. The disease causes skin sores (cutaneous leishmaniasis) and can affect internal organs (visceral leishmaniasis, usually affecting the spleen, liver, and bone marrow). Treatment depends on the form of the disease, the *Leishmania* species that caused it, the potential severity of the disease and the patient's underlying health (CDC, 2017a).

3.3 Economic implications

Tourism, a mainstay of most Caribbean economies, is heavily affected by VBDs. These are diseases that are only rarely seen in the metropolitan countries from which most tourists come. Policies have been developed according to the International Health Regulations, including recommendations regarding vaccinations and practical precautions to take when visiting countries affected by tropical diseases. The health impact of VBDs was compounded by impact on tourism in the 2014-'16 period, especially after the WHO declared Zika Virus a PHEIC. Agencies including the US CDC and Public Health England recommended that pregnant women should not travel to areas with risk of Zika and warned that people who had travelled to areas with zika cases, , and were unknowingly infected, could transmit the disease via sex (Centers for Disease Control and Prevention, 2017i; Public Health England, 2017a). CDC advised that women who are pregnant should not travel to Caribbean countries (among other countries affected by zika), that partners of pregnant women and couples considering pregnancy should know the risks to pregnancy and take prevention steps, and all travellers should prevent mosquito bites and sexual exposure to Zika virus (Centers for Disease Control and Prevention, 2017e).

Zika brought additional cost and ethical considerations, given its association with congenital abnormalities and neurological complications. Ethical issues concerned the potential for abortion when Zika was detected in pregnancy. Costs considerations included:

- Additional screening of pregnant women who test positive for Zika;
- Long-term care for those born with microcephaly;
- Increase in acute care (Intensive Care Unit-ICU) for those with neurological complications;
- Provision of care for the differently abled due to GBS (which is transient and patients usually make a full recovery) or Zika congenital syndrome (Polson-Edwards, 2016).

A socio-economic impact assessment study of the cost of Zika, with focus on Brazil, Colombia and Suriname, noted that the largest cost was the lost earnings of people with microcephaly who may not be able to join the workforce, and their carers (mostly poorer women) whose labour force participation was curtailed. Unmet need for family planning was one of the important causes. It meant that many women who were concerned about the risk of Zika were unable to prevent pregnancy and thus reduce the risk of having babies with microcephaly. Religious and other restrictions on women's sexual and reproductive rights thus contributed to the cost and the human suffering associated with the Zika epidemic. Costs related to detection, diagnosis and treatment; lost productivity due to missed work; direct and indirect cost of GBS and congenital Zika syndrome, and cost associated with "avoidance behaviour", notably lost tourism revenues. UNDP modelled the loss in tourism revenues under various scenarios. One such scenario was that tourism receipts would fall by 4% in the Caribbean, representing 0.29% of GDP in the region; more than any other American sub region (UNDP, 2017).

A 2015 study of economic costs of chikungunya categorised them under the headings: government/ public health; individual/ household; business, and national development/ macroeconomic. Government costs included health education messages and equipment/ insecticides/

materials/personnel for vector control, public health inspections and screening at ports of entry, in addition to health care costs. Individual and household costs included missed work, medical consultation, injections, medications, gels/ rubs, physiotherapy, costs of travel for treatment and mosquito control supplies such as insect repellent and bed nets. Intangible costs were associated with pain and depression. There were business costs associated with absenteeism and medical insurance, and “presenteeism”, when workers were present but not working at full capacity. The study reported on a survey by the Jamaica Manufacturers Association, in which 81% of businesses reported workers affected by chikungunya, with affected workers staying away from work for an average of four days in total. National costs included opportunities foregone due to cancellation of social events and tours and education of affected schoolchildren. Dollar cost estimates were said to vary by study, but an overall finding was that the majority of the cost burden was borne by individuals, households, and businesses (Ramrattan, 2015).

3.4 Responses to VBDs in the Caribbean

Over the past two to three decades, much international cooperation of Caribbean countries on VBDs has been oriented to addressing dengue, as this has been the VBD with the largest health impact in the region, at least until the arrival of chikungunya and Zika in 2014 and 2015 respectively. It is helpful to trace some of the history of dengue control efforts, as they provide background to VBD initiatives in the 2014 to 2016 period, enabling understanding of how they evolved.

In 1994, in recognition of the need to establish systems of VBD surveillance and control, PAHO produced guidelines for the American region. Active disease surveillance with laboratory support and vector surveillance were recommended. Serological, virological and, more recently, molecular surveillance complemented each other to identify circulating serotypes of dengue. Case definition and classification, vector control strategies including the principles of control were established and recommended to the region (Pan American Health Organization, 1994). Collaborating centres, including (at the time) the Caribbean Epidemiology Centre, established surveillance systems, integrating laboratory and data collection systems in Member States (Guzman & Kouri, 2003).

The strengthening of surveillance and diagnostic capacity was boosted with commitment to control and response measures when, in September 2001, the Ministries of Health of PAHO member countries approved a resolution on the prevention and control of dengue and DHF. This document urges States to promote inter-sectoral collaboration, sanitation measures including the improvement of water supply and community education (Guzman & Kouri, 2003; Organizacion Panamericana de la Salud, 2002). PAHO approved the adoption of the Integrated Management Strategy for Dengue Prevention and Control (IMS-Dengue) in February 2003. This strategy is based on a model consisting of six components; epidemiology, entomology, healthcare, laboratory, social communication, and environment. The laboratory network, RELDA (Red de Laboratorios de Dengue de Las Américas) was also strengthened through a comprehensive training, monitoring and assessment plan (Brathwaite Dick et al., 2012). Integrated Management Systems were set up in some countries to address dengue, but it was found, when chikungunya and Zika arrived in the Caribbean, that some were not operational (CARPHA, 2014c).

We see here a progressive move towards a multi-pronged approach to VBD surveillance and control. According to the ecological framework presented above, to supplement health systems strengthening, action is needed at several levels, including behavioural, environmental/ social, and political/structural. In the rest of this section we examine actions that have been taken in 2014-'16 to respond to VBDs. The ecological framework is used to structure the findings and assists in analysis of actions taken.

3.4.1 Health system strengthening

The risk of introduction of chikungunya into the Americas was anticipated prior to 2013. Partly in recognition of the frequency of travel between the Caribbean and countries endemic for chikungunya, PAHO, with collaboration from the CDC Division of Vector-Borne Diseases (DVBD), established a working group to assess the potential threat of this virus to the region, and proposed measures to mitigate the public health threat. The working group produced preparedness guidelines. Subsequently, PAHO, with the support of the DVBD, ran a training workshop, *Preparedness and Response Plan for Chikungunya Virus Introduction in the Caribbean Sub-Region*, in 2012. The objective of this workshop was to increase the capacity of Caribbean countries for clinical management, epidemiological surveillance, laboratory surveillance and vector control (Olowokure et al., 2014; PAHO, 2013).

Soon after cases of chikungunya were identified in Saint Martin, CARPHA established an Incident Management Team (IMT) to coordinate the response of CMS to the situation. The IMT held a virtual conference with Chief Medical Officers (CMOs) on December 12th, 2013 to provide them with a situation update and outline the guidelines to be used as part of a CMS preparedness strategy (CARPHA, 2014d). Following this, multiple strategies were used by CARPHA and CMS to respond to chikungunya and Zika.

PAHO and CARPHA received support in 2016 from the UK Department for International Development for a project in nine countries to control the spread of Zika virus. This project worked with four Member States to build capacity for insecticide resistance testing. It also aimed to increase laboratory capacity at CARPHA for testing samples from pregnant women, and in two CMS for testing of Zika and other arboviral diseases.

All CMS responded to outbreaks of chikungunya and Zika by intensifying vector control measures, expanding public education and increasing public health surveillance. Some CMS developed country specific plans using the framework of the Integrated Management Strategies for Dengue (IMS-Dengue) and re-activated their IMS-Dengue committees. Via a CDC project on Zika, Ministries of Health in CMS have collaborated with regional academic institutions such as the University of the West Indies, Ross University School of Veterinary Medicine, St. George's University and the Windward Islands Research and Education Foundation, to conduct research on arboviral diseases (CARPHA, 2017).

Health systems strengthening initiatives in specific areas have included the following.

Laboratory strengthening

The capacity of CARPHA laboratory to test specimens to support CMS was strengthened. With support from CDC, the Trioplex diagnostic kit was obtained, which enables testing for chikungunya, dengue and Zika in one run. Diagnostic services were assisted by the establishment of a Level 3 Bio-Safety Laboratory at CARPHA in 2014, with support from the Government of Canada (CARPHA, 2014a). The UK Department for International Development through PAHO also provided funds to CARPHA for strengthening laboratory capacity for both Zika diagnosis and insecticide resistance testing in a few MS (CARPHA, 2017).

The IMT hosted regular meetings with National Laboratory Managers, Epidemiologists and CMOs over the 2014-'16 period, to share information based on monitoring regional and global developments and to plan and coordinate strategies. CARPHA has collaborated with international agencies and the Caribbean Med Labs Foundation to develop capacity-building initiatives for laboratory workers. CARPHA, CDC and PAHO collaborated to deliver the Regional Laboratory Training Workshop for the Molecular Diagnostic Detection and Surveillance of Arboviruses, April 25-29, 2016, hosting participants from Barbados, Bahamas, Grenada, Guyana, Jamaica and Suriname (Polson-Edwards, 2016).

Health care worker capacity-building

Since 2014, CARPHA has focussed parts of its general health care capacity-building work on VBD training and establishing a communication network for early detection, adequate management and timely reporting of cases, including coordination with and submission of samples to laboratories (via a specimen-routing algorithm). At country level, diagnostic capabilities have been strengthened using standardised case definitions, to enable clinicians to differentiate between different VBDs (CARPHA, 2017). Clinicians have also received training on reporting structures and methods and been encouraged to fill out all variables on case reporting forms.

Vector surveillance

Section 3.1.3 described syndromic and disease surveillance as they apply to VBDs. It is also critical to conduct surveillance of disease vectors as part of vector control. This has several dimensions.

Entomological surveillance involves collecting data on mosquito densities by trapping adult mosquitoes or ovitrapping to enable counts of mosquito eggs laid per quantity of water. International Health Regulations recommend ovitrapping at ports of entry as part of vector surveillance, to assist in prevention of transmission of pathogens brought from abroad (CARPHA, 2014c).

Mosquito collection may also be done for insecticide-resistance testing, which is being carried out at CARPHA and in some CMS as part of the DFID-funded project started in 2016. It has been observed that there is increasing resistance by *Aedes aegypti* to several insecticides commonly used for fogging and to kill mosquito larvae in the Caribbean. Local evidence is needed of this to guide the use of

appropriate and effective control strategies. CARPHA breeds mosquitoes in its insectary and tests them against different types and strengths of insecticides. CARPHA then informs national programmes on the effectiveness of the insecticides on local mosquito populations and advises them on alternate, more effective methods of control.

Complementary to vector surveillance is ecological surveillance. This involves risk stratification based on factors such as the condition of premises, water supply and frequency of garbage collection. Ecological and entomological indicators are needed to identify “hot spots” for targeted intervention.

Perhaps the most effective means of managing mosquito borne disease, is to properly manage the environments in which mosquitoes breed. CARPHA has been engaged in supporting new approaches that involve participating in the development of a modelling framework to provide spatio-temporal probabilistic forecasts for *Aedes aegypti* proliferation. Being able to predict periods of vector proliferation based on climatic factors would assist with mitigation strategies. Correlating this with epidemiological data would assist with identifying and targeting susceptible and vulnerable populations for customized interventions (Clauzel & Forbes-Robertson, 2017).

Vector control methods

Partly in response to concerns about insecticide resistance, a number of other vector control methods have been developed. Two that are increasingly used are described here.

Bacillus thuringiensis israelensis, or Bti, is a group of bacteria used as biological control agents for larvae of mosquitoes, black flies and fungus gnats. Bti contains spores that produce toxins that kill the larvae and is applied to standing water. These bacteria are not harmful to humans (United States Environmental Protection Agency, 2017). Aquatain AMF is a silicone-based liquid which spreads instantly across the surface of a water body, forming a very thin film and blocking the mosquito lifecycle. Unlike other conventional pesticides, it has a physical action rather than chemical action and is non-toxic (Mbare, Lindsay, & Fillinger, 2014). Insect Growth Regulators mimic insect hormones and inhibit the moulting of exo-skeletons by juvenile insects and therefore stop them from maturing and reproducing, causing death within a few days (National Pesticide Information Center, 2015). These technologies are being examined by CARPHA with regard to their possible application in the region.

Biological control involves the use of natural predators of the vector. Most natural predators, such as some birds, other insects and fish, have little impact on the size of mosquito populations. However, certain species of fish can reduce populations substantially by feeding on mosquito larvae if the fish are distributed in areas at risk. In Barbados, the Ministry of Health has received support from PAHO for a fish-rearing facility to assist in reducing mosquito populations.

The fish are available for distribution to communities throughout the country to provide households with a biological method to control mosquitoes as the fish can be placed in ponds, water storage tanks as well as other bodies of water which can be potential breeding sites for mosquitoes. The project was part of the Global Environment Facility funding under the heading, “*Piloting climate change adaptation to protect human health*” which has developed innovative methods to achieve its

outcomes. The launch of the fish rearing facility was also part of the activities that Barbados carried out during the PAHO/CARPHA Caribbean Mosquito Awareness Week, 2016 (PAHO Office Barbados and the Eastern Caribbean, 2016).

Technological advances in control methods

Three techniques currently being evaluated involve modifying mosquitoes and releasing them into the wild.

The *Sterile Insect Technique (SIT)* involves releasing large numbers of sterile insects. The released insects are preferably male, and the development of genetic sexing systems is under investigation to achieve male-only mosquitoes for release. The sterile males compete with wild males to mate with the females. Females that mate with the sterile male produce no offspring, reducing the next generation's population. The males are sterilised by radiation targeting the reproductive cells of the insects. There are some challenges in selecting only males for release. (Food and Agriculture Organisation & International Atomic Energy Agency, 2017; Oliva et al., 2012).

The International Atomic Energy Agency (IAEA) has developed a Technical Cooperation Project to strengthen regional capacity in Latin America and the Caribbean for integrated vector management approaches with a sterile insect technique component (International Atomic Energy Agency, 2016). Technical support has been offered by IAEA to Caribbean countries interested in the technique. CARPHA has held meetings with the IAEA and has agreed to assist in monitoring the use and effectiveness of the technology in countries that use it.

A further approach to vector control is to infect mosquitoes with *Wolbachia*, naturally occurring bacteria which are found in up to 60% of insect species, but rarely in *Aedes aegypti*. *Wolbachia* can stop RNA viruses, including chikungunya, dengue and Zika, from growing inside *Aedes aegypti* and being transmitted to people. Furthermore, *Wolbachia*-infected females will pass the bacterium onto their offspring. If a *Wolbachia*-infected male mates with an uninfected female, she will lay eggs, but they will not hatch. The technique involves releasing large numbers of *Wolbachia*-infected mosquitoes into the wild (Eliminate Dengue Program, 2017b). The ten *Wolbachia* sites set up by the agency Eliminate Dengue around the world, none are in the Caribbean, but two are in Latin America (Eliminate Dengue Program, 2017b).

A further technique involves genetic modification (GM) to produce *transgenic* mosquitoes. OX513A is a transgenic strain of *Aedes aegypti*. Genetic engineering creates "self-limiting" male insects which seek out and mate with females. After a modified male mosquito has successfully mated with a wild female, any offspring that result will not survive to adulthood, so the mosquito population declines. Studies of this technique have been conducted in the Cayman Islands since 2010 (Harris et al., 2012; Oxitec, 2016). Data from the Cayman Islands Mosquito Research and Control Unit (MRCU) showed that the genetically modified males successfully mated with females in the wild. The MRCU statistics also showed a significant reduction in *Aedes aegypti* eggs found in traps in the targeted zone compared with a non-treatment area (Whittaker, 2017b). The MRCU applied for a new import permit and outlined a proposal for a two-year roll-out programme (Whittaker, 2017a). The company reported that 69% of local residents favoured the use of the technology. However, there were local

protests (Whittaker, 2017b), and an activist against genetically-modified organisms, based in the United States, brought a law suit and lobbied for the deployment of *Wolbachia* technology instead (Whittaker, 2017a).

These three techniques offer promising approaches to vector control based on substantial research and international investment. However, cost considerations may prevent widespread adoption. The public acceptability in the Caribbean of releasing large batches of mosquitoes appears likely to be a challenge, as illustrated by the experience in the Cayman Islands. In the Colombia trial of *Wolbachia* by Eliminate Dengue, the release of mosquitoes came after almost two years of extensive engagement with the local community (Eliminate Dengue Program, 2017a). All three techniques have the advantage of focussing on *Aedes aegypti*, without environmental impact on other species. This feature presents ecological advantages over the mass use of insecticides, and may be more effective, given evidence of insecticide resistance.

While these technologies seem promising, the WHO has indicated that even though there may be evidence of entomological success through mosquito population suppression, epidemiological proof of concept in reducing human infections is required. As the regional public Health agency, CARPHA will conduct independent monitoring and evaluation of pilot studies of these and other new technologies as a service to CMS. More trials are needed before broad adoption occurs for the implementation of these technologies to complement existing vector control programmes.

3.4.2 Behavioural intervention and community mobilisation

CARPHA has been engaged in a variety of public education and communication initiatives around VBDs in the 2014-'16 period, including media releases, news conferences, videos and dedicated sections of the CARPHA website (<http://carpha.org/What-We-Do/Public-Health-Activities/Chikungunya> and <http://carpha.org/zika>). For example, at the start of 2016, CARPHA convened a regional media conference “Zero in on Zika” to discuss issues related to the virus. During this conference technical officers engaged the media on facts about the disease, the impacts on tourism and health, and surveillance and ethical issues (CARPHA, 2017). Emphasis has been on providing current and accurate information to avoid communication and miscommunication, stressing the importance of people inspecting their homes and surroundings and involving their communities in eliminating potential breeding sites and protecting their families against being bitten by mosquitoes.

Caribbean Mosquito Awareness Week was launched in 2016 on the impetus of CARICOM and CARPHA in collaboration with PAHO. Occurring in the second week of May, it aims to promote education, community awareness and community participation in vector control, and maintain vector control activities on the political and community agenda.

Figure 66: Caribbean Mosquito Awareness Week logo



Source: CARPHA

In 2016, activities included school involvement in producing educational materials about vector control, and a mini fair for the public hosted by CARPHA in Trinidad and Tobago

Figure 67: Caribbean Mosquito Awareness Week activities 2016



School children take part in a mosquito awareness rally in St. Lucia



Students examine mosquitoes under the microscope at CARPHA's Mini Fair

An interactive app, Zap-a-quito, was developed by CARPHA and aims to increase involvement of children and communities in action to reduce mosquito populations via knowledge of breeding sites (<https://play.google.com/store/apps/details?id=com.caribbeancoders.culicidae.android&hl=en>).

An important CARPHA initiative was the development of an evidence brief to assist in strengthening household and community action for prevention and control of arboviral diseases. This drew on a range of scientific evidence, largely from systematic reviews, on behaviour change. Findings included, firstly, that participation in environmental enhancement and conservation activities produces positive personal, social, physical and psychological benefits, and these benefits foster individual change to benefit the community. Secondly, electronically-generated health promotion interventions,

presented via electronic devices and the media, help achieve behaviour modification, especially if combined with text messaging, online support and decision support tools. Thirdly, financial incentives, positive and negative, have been successfully used to achieve behaviour modification related to risks such as smoking, alcohol use and use of vaccination services, and could be applied successfully to arboviral disease prevention. The brief also considers potential barriers to the implementation of these elements (Yearwood & Polson-Edwards, 2017).

CARPHA conducted research in 2016 in five CMS on Zika knowledge and attitudes to guide its messaging. It was found that, when asked to define Zika, the vast majority of people knew it was a virus, but fewer than half mentioned that it was transmitted by mosquitoes. Belief in the necessity of protecting themselves from mosquito bites differed by demographic group, with seniors least likely to see the need for extra precautions and pregnant women most likely to perceive such a need. On the other hand, seniors were most likely to mention maintaining clean yards and drains to prevent VBD, while respondents across multiple population segments thought this was one of the most difficult precautionary measures to put into practice. Respondents across all segments thought that using insect repellent on their skin was the easiest measure to implement (Gregorio, 2016).

There is potential for further approaches to vector control through community mobilisation. An example is the initiative of Eliminate Dengue, Australia, to set up Dengue Action Response Teams, whereby government health workers work with local field teams of trained laypersons in community clean-up operations. Mobile phones offer the potential for community participation in surveillance activities, by citizen reporting on areas of high mosquito density and breeding sites, sending pictures as well as location data. Such approaches should be adopted with caution, deploying trained and trusted persons, because of risks to privacy and the potential for push-back and retaliation from people who feel accused of mosquito breeding.

Internationally, there is an increasing body of evidence of the success of community interventions for vector control. Studies in various Latin American countries deployed various strategies, involving communities for example in removing discarded containers, cleaning backyard areas, covering large water containers, covering windows and large containers with insecticide-treated material, elementary school education with practical skill development. These interventions all showed reduction in mosquito populations compared with *status quo* control communities (Sommerfeld & Kroeger, 2015). Questions remain about the mobilisation cost of these activities and means to sustain them.

While international research, such as that conducted in Latin America, has shown that reductions in vector populations can be achieved by professionals working with communities to clean up potential breeding sites and deploy available technology, to date there are few examples of agencies putting skilled human resources into such initiatives in the Caribbean. A constraint has been the availability of such personnel in small countries, where often there are no specialist staff dedicated to vector control, and vector control is among several environmental and public health responsibilities of small teams or individuals.

3.4.3 Policy

A Special Meeting of Heads of Government, hosted by CARICOM and CARPHA in Trinidad on 4 November 2014, focussed on the health crises of chikungunya and Ebola and led to the establishment of a Regional Coordinating Mechanism on Health Security (see section 2.4.5). In relation to chikungunya, the following were the main decisions of the Heads:

1. There must be a multi-sectoral approach to fighting the disease that would include education, tourism, media, local government and other sectors and capabilities, including private enterprises, and explore the use of new technologies;
2. There must be a well-coordinated, continuous public education campaign on how the disease is spread, targeting the citizenry, travellers, and tourism stakeholders;
3. That vector control response capacity will be strengthened, and
4. That PAHO will facilitate bulk purchase of essential public health supplies, such as bed nets, insecticides and repellent. (CARICOM, 2014)

Thus, the Heads of Government embraced the multi-sectoral approach, which is critical in addressing social, environmental and structural factors that influence VBD susceptibility and impact. The Head of Government stopped short of specifying action to be taken on structural drivers of VBDs such as poverty, unplanned urbanisation, poor sanitation infrastructure and climate change.

The advent of Zika, and the February 1st, 2016 declaration by WHO of a PHEIC, led CARPHA, on February 5th, 2016, to issue a position paper on Zika to Caribbean Heads of Government. This highlighted the potentially damaging impact on tourism and travel of the PHEIC and emphasised the need to unite in the fight against mosquitoes to minimize human and economic damage. Heads were asked to mobilise resources for a multi-sectoral approach to fighting the *Aedes aegypti* mosquito, including health, education, tourism, media, local government, environment and other sectors, including private enterprises. Among other recommendations, they were asked to also enforce the public health nuisance laws in respect of action against *Aedes aegypti* (CARPHA, 2016).

In January 2014, CARPHA and the Caribbean Tourism Organisation (CTO) collaborated to establish the Caribbean Tourism and Health Programme, with activities relating to surveillance, capacity-building, standards and healthy workforce. VBDs have been included in the programme. CARPHA and CTO attended the 2014 State of Industry conference with Caribbean Tourism Ministers and the Caribbean Hotel and Tourism Association, to stress the importance of the chikungunya epidemic and stress their potential role in prevention. A Caribbean Travel Health Network was established, and has provided advice and guidelines on eliminating breeding sites on tourism premises and providing information for visitors on protective measures (Indar, 2016). Since 2014, CARPHA has worked closely with CDC, the Public Health Agency of Canada and the UK public health agencies to develop messages to tourists on the need to adopt enhanced protective measures in view of the chikungunya and Zika epidemics (CARPHA, 2014b). Regionally, the Caribbean Hotel and Tourism Association and the Caribbean Tourism Organisation, in collaboration with CARPHA, mounted sensitization and training webinars for staff in tourism establishments, and reached out to their stakeholders (CARPHA, 2016).

3.4.4 Regional and international cooperation and advocacy

The section on health service strengthening above has shown a number of ways that CMS and CARPHA have collaborated with regional and international agencies. Drawing on global expertise is an important way to optimise the effectiveness of the VBD response. Working with international partners helps efforts to modify the external environment and have an influence on global structural issues, such as travel advisories, access to health technologies and climate change, which influence regional susceptibility to VBDs and their impacts.

The Global Health Security Cooperative Agreement with CDC included funding for activities against Zika starting in 2016, including training for enhanced *Aedes* surveillance; improvement of entomology laboratories and insectaries; strengthening of *Aedes* control in an integrated vector management framework, and building of a Caribbean vector-borne disease network (CariVecNet) (Polson-Edwards, 2016). An important aspect of the CDC project is the provision of training and equipment to CMS for Geographic Information Systems to map Zika cases and mosquito breeding sites. Equipment provided includes handheld Global Positioning System units to enable data entry. CariVecNet is to bring together CMS representatives, with working groups on surveillance, vector control, laboratory and clinical dimensions of VBDs. In the long term, a network of professionals and experts extending beyond CMS to other Caribbean countries is envisaged. The project also supports the conduct of vector control needs assessments by CARPHA in five countries. CARPHA utilises a checklist to identify areas of need and make recommendations.

In 2016, CARICOM Heads of Government launched several initiatives to address arboviruses in the Caribbean. This included calling on academic institutions, CARPHA and PAHO, to conduct research on the *Aedes aegypti* vector, including development of new technologies and approaches; and pledged to promote partnerships within existing frameworks with Brazil, Cuba, France and Puerto Rico, which have centres of excellence which can provide support to the Region in areas where there is deficiency (Polson-Edwards, 2016)

A regional network on surveillance, diagnosis, research and control of VBDs was set up, comprising a consortium led by CARPHA and including the Institut Pasteur, Guadeloupe; Pedro Kouri Institute, Cuba; Ross University, St Kitts and Nevis; St. George's University, Grenada and the University of the West Indies. This received a grant from the WHO Special Programme for Research and Training in Tropical Disease (WHO/TDR). CARPHA also held discussions with UWI regarding collaboration on Zika-related research projects following the establishment of a UWI Task Force on Zika (Polson-Edwards, 2016).

Resource mobilization led to a number of research projects between Caribbean and Latin American academic institutions, with support from Canadian, European and United States agencies. Topics included new techniques for detection of Zika, biological control by infection of mosquitoes with *Wolbachia* bacteria (Eliminate Dengue Program, 2017b), and enhanced surveillance capacity-building. CARICOM and CARPHA also collaborated with PAHO and CDC to mobilize resources for the Stop Epidemics There and Here (SETH) Fund in the CARPHA Foundation.

Conclusion

The Caribbean is one of the regions most affected by VBDs globally, with severe impacts being felt economically and socially, especially by marginalised populations. People who are living in close proximity to each other, with limited or no access to sanitation services or reliable supply of potable water, are the most likely to become infected. These infections aggravate marginalisation for the sick and their care givers, who are less likely to participate in the labour force. VBD initiatives should include enhanced access to sanitation services, especially in poorer communities and unplanned settlements. Community involvement and engagement is especially important in these locations. A comprehensive approach to VBDs should include strategies to address social and environmental drivers to supplement the important work done in 2014-2016.

In the HIV field, the concept of “combination prevention” is now widely accepted, comprising a range of medical, behavioural, social and structural interventions to maximise impact at the population level. This concept can usefully be applied to VBDs. In this chapter, we have outlined how CMS and partner agencies have collaborated in the 2014-'16 period in a variety of ways, spanning health systems strengthening, behavioural intervention, community participation, policy, inter-agency cooperation and advocacy. The institution-building in all these spheres must continue to address the multiple determinant factors relating both to human and vector behaviour.

Much of the emphasis over the period has been on achieving multi-sectoral collaboration and public knowledge and engagement. To supplement these, strategic approaches are needed to make optimal use of resources, especially the limited human resources available “on the ground” for vector control within government ministries. Targeted approaches, including mobilisation of local communities in clean-up and deployment of vector-control technologies, should be based on knowledge derived from needs assessments and monitoring of insecticide resistance and the effectiveness of other technologies. Monitoring and evaluation and strategic planning should be central to approaches to addressing VBDs.

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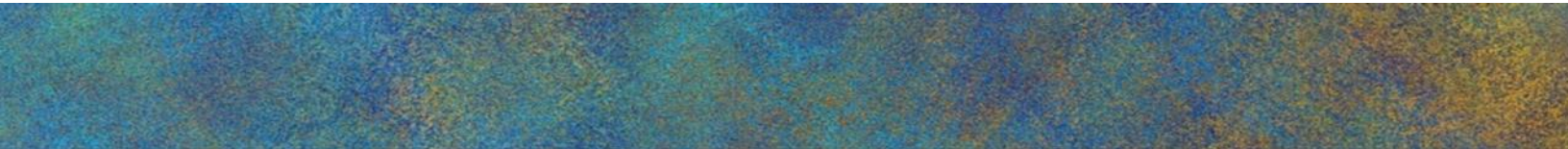
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Chapter 4. Childhood Obesity



Executive summary

Childhood Obesity

Childhood obesity (CO) is important as a risk factor for adult NCDs. It is also associated with a range of physical, emotional and social problems for children, and thus can affect their development and social prospects for life.

In the Caribbean, unprocessed food has been gradually replaced by processed foods, that have been imported and marketed in the region. Consistent with global trends, there has been an increase in dietary energy availability in the Caribbean, and a shift from malnutrition to an over-abundance of food, consistent with the notion of nutritional transition. By 2013, all CARICOM Member States, except Haiti, had met and exceeded their Population Food Goal (PFG) for energy (2250Kcal/caput/day), protein (56.3g/caput/day), fat (62.5g/caput/day) and sugar (45g/caput/day). Guyana was the only other country that did not meet the fat PFG by 2013.

The worldwide prevalence of childhood overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010 and was expected to increase to 9.1% in 2020. Projections were made by De Onis et al (2010) to estimate prevalence rates of young children (0-5 years old), based on modelling from 28 Caribbean surveys. These overweight and obesity rates demonstrated a growing trend from 4.6% prevalence in overweight and obesity in 1990, to 6.9% in 2010, with a predicted prevalence of 8.3% in 2020. For school aged children and adolescents aged 6 to 20, independent studies conducted in nine different Caribbean countries and territories demonstrated an overweight prevalence between 10.6% and 21.2% and an obesity prevalence between 7.1% and 25.4%.

Overweight and obesity pose significant health complications for the younger Caribbean population. Obese children suffer from complications of dyslipidaemia, hypertension, fatty liver, early sexual maturation, orthopaedic problems, respiratory problems such as asthma, sleep apnoea and psychological consequences of stigmatisation, low self-esteem, depression and discrimination. There is also the risk of chronic NCD health problems into adulthood as obese children have a greater risk of becoming obese in adulthood. Risk factors for hypertension, diabetes and cardiovascular diseases have already started to emerge in school-aged Caribbean children

Social determinants of health as applied to childhood obesity

The ecological model demonstrates that the individual interacts with the immediate environment or settings such as schools, workplaces, homes, restaurants and fast food outlets. These settings are in turn influenced by more distal environments or sectors such as the food industry and government. These sectors are controlled by national, regional and international policies and frameworks such as trade policies as well as issues of food security and economics.

Individual level factors are concerned with biology and demographics, psychosocial and health behaviours, attitudes, and practices including healthy eating and physical activity. Biological factors include age, sex, genetics, and body mass index, among others. Caribbean people are mainly of African and Indian descent, and these ethnicities are known to be at risk of obesity and specific chronic diseases. Overweight or obese women are more likely to deliver babies who have a predisposition to

store excessive amounts of fat very early in life, and so become overweight or obese themselves. However, the dramatic rise in obesity has occurred within a short time frame, implying that it is not biological factors alone that account for the escalating problem of obesity, but rather the obesogenic environments in which people of African and Indian descent live in the Caribbean.

There have been Caribbean studies that suggest that eating breakfast is associated with a lower BMI in children and adults. However, there are also other studies that suggest this association is not statistically significant and emphasis needs to be placed on the consistent eating of breakfast, the components of breakfast and stressing the importance of physical activity.

WHO recommends that sugar consumption be limited; fruits and vegetables, whole grains and legumes increased, and energy derived from fats should be unsaturated fats rather than saturated fats. Children and adolescents consume a large amount of fast foods which are usually high in fat and salt, and carbonated soft drinks, high in sugar.

WHO recommends that children between 5 and 17 years old take at least 60 minutes of moderate to vigorous-intensive physical exercise daily. The shift in today's recreational activities for children to the inside of living accommodation, rather than outside could be attributed to increased screen time using electronic media. This has been shown to play a significant role in increasing the likelihood of being overweight and obese. Global Health School Surveys have demonstrated low levels of physical activity among Caribbean adolescents. Here the percentage of children involved in at least 60 minutes of physical activity on five or more days during the seven days before the survey ranged only between 21.3% in Guyana and 31.8% in Antigua and Barbuda.

The environment in which people live influence their dietary behaviours and food choices. Swinburn and Egger (2002) indicated that the obesogenic environment is the sum of influences that the surroundings, opportunities, or conditions of life have on promoting obesity in individuals or populations. It is this obesogenic environment that is fuelling the obesity and NCD-related epidemic.

Parents, communities, and schools are among the social groups that may be targeted with information regarding nutrition and physical activity, to facilitate healthy choices among their children. To promote local availability of healthy foods and places to be physically active, policies and programmes addressing communities may be developed and implemented at the local level. Aggressive advertising and marketing of energy dense foods and those high in fat, salt and sugar are also among societal factors that influence childhood obesity.

Part of the parental role is to also monitor children's screen time, as too much screen time promotes sedentary behaviour and is positively associated with increased levels of inactivity and BMI. Social media plays an increasingly important role in the lives of children and adolescents. Caribbean children and adolescents have not been immune to advances in electronic technologies and the use of social media, and screen time has increased dramatically among them.

A growing number of caregivers have access to motor vehicles, and many are concerned about threats to their children's security if they walk or take public transport. As a result, many Caribbean children are driven to school. Additionally, children are under increasing pressure to perform academically, with greater amounts of homework than in previous eras. School time previously

allocated to sport and physical education is often replaced by further academic study. After school, many children go to “extra lessons”, generally requiring them to be sedentary for even longer periods.

Globally and within the Caribbean, aggressive and creative marketing of energy dense foods and beverages is common. Advertisements for fast food meals accompanied by toys and other promotional material are directed at children and adolescents through electronic media, billboards and posters. Hours of screen time also allow for exposure to aggressive dietary advertising. Young persons who are impressionable and highly influenced by their peers are particularly susceptible to these types of strategies.

Caribbean studies demonstrate that the media and especially cable television has had much impact on dietary perceptions, attitudes, values and lifestyles of the Caribbean people, particularly among women, youth, unemployed, nursing mothers, housewives and the overweight.

Finally, it is important to consider the school environment. Obesity in school aged children is influenced by the meals and snacks they have at school. Some government schools provide free or subsidised meals in efforts to provide adequate nutrition to children from low income backgrounds. These generally consist of a protein and starch, such as chicken and rice, with little vegetable content except what may be mixed with the rice (e.g. vegetable rice or rice and peas). Many children choose other options if they can afford them. Private individuals often run school canteens and shops to make a profit. They sell goods that they believe children will buy, which are usually similar to what is available in fast food restaurants, e.g. pizza or fried chicken and fries, with soft drinks. Some schools have vending machines, generally filled with mostly high-sugar, high-fat items. Assessment of school meal options in several CMS over a period of years indicate that many children are consuming a diet high in saturated fats and sugars and low in iron and calcium. Fruit, vegetables and to a lesser extent, legumes were not adequately available in school meals and, as such, the children were not receiving their recommended daily allowance of five servings of fruit and vegetables. A study in the inner-city areas of Kingston, Jamaica, found over 75% of the students chose fast food or snack items for lunch.

Structural level factors are those concerned with international, regional, and national economic status and cycles, legislation, policies and frameworks. Government action to prevent and control childhood obesity must include the non-health sector. For example, policies in trade, agriculture, sanitation and food security affect the quantity and quality of foodstuffs available and consumed. Socioeconomic status also influences the ability to purchase healthy foods.

Global increases in obesity can be attributed to trade liberalisation of food systems and consumer culture. In the Caribbean, trade liberalisation has been linked to an increased dependence on export crops and food imports thus creating challenges for food security, nutritional quality, and food prices in the region. Most CARICOM countries import more than 60% of the food they consume, with half of them importing more than 80%. Trade liberalisation and increased foreign investment has led to the proliferation of multinational food corporations – the “Coca-Colonisation” and “McDonaldisation” in the 1980s and 1990s – creating fast and cheap food and drinks that are high in sugar, fat, and salt.

Examples of Regional Initiatives

The Farm to Fork project ran between 2011 and 2014 and was implemented chiefly in St Kitts and Nevis and Trinidad and Tobago. It attempts to modify environmental factors by increasing food security by facilitating local agricultural production, adapting school menus and offering healthy school lunches. The project aimed to improve children's diets by increasing the quantity of fruit, vegetables, and animal sourced products in school meals; increase procurement of produce from local farmers for the school meals; and equip small farmers to produce local fruits and vegetables throughout the year. Also, individual level factors are adapted as children and parents' nutritional knowledge increased.

In Bermuda, the Healthy Schools Nutrition Policy, including the School Vending Machine and Cafeteria Policy, targets social determinants at all levels. The Vending Machine and Cafeteria Policy required that government schools ban sodas and snacks from vending machines on the schools' premises and offer only plain unsweetened water and/or 100% juice and healthy snacks. Within one year of introducing the Vending Machine and Cafeteria Policy, all government schools had implemented it; private schools became compliant within two years.

The Core Youth Movement Programme, in Trinidad, targets youth (male and female aged 13-16 years old) and focuses on changing individual level behaviour by using education to improve participants' concept of physical activity, self-confidence and self-worth and acceptance of the idea of food as a fuel. Youth involved in the programme are engaged in diet, exercise and self-esteem programmes that are monitored for success with respect to defined targets.

Frameworks and Guidelines

The Caribbean has a long history of public health cooperation. Regional frameworks and guidelines for addressing NCDs and childhood obesity include the 2007 Port of Spain Declaration; the Strategic Plan of Action for the Prevention and Control of NCDs in Countries in the Caribbean Community (2011-2015); and the CARPHA Plan of Action for Promoting Healthy Weights in the Caribbean: Prevention and Control of Childhood Obesity (2014-2019).

Special mention must be made of CARPHA's 6-Point Policy Package. Realising that a societal approach was necessary to reduce the burden of obesity and diet-related NCDs, in 2015, CARPHA developed a *Technical Brief: Promoting Healthy Diets, Food Security, and Sustainable Development in the Caribbean Through Joint Policy Action*. This Technical Brief promoted and described six policy areas – food labelling; nutrition standards and guidelines for schools and other institutions; food marketing; nutritional quality of food supply; trade and fiscal policies; and food chain incentives - which become known as the CARPHA's 6-Point Policy Package.

Conclusion

In the Caribbean, the social and structural determinants of NCD and obesity are not only affecting adults, but also affecting children. While there are promising interventions at the levels of schools and important regional policy initiatives, such as the Port of Spain Declaration, childhood obesity is not receiving the attention it deserves. More active efforts need be made to increase levels of activity among Caribbean young people in outdoor sporting and recreational activity. These efforts are likely to pay off in terms of economic prosperity by enabling productivity and avoiding unnecessary costs of health and psycho-social care for people who were obese when they were children.

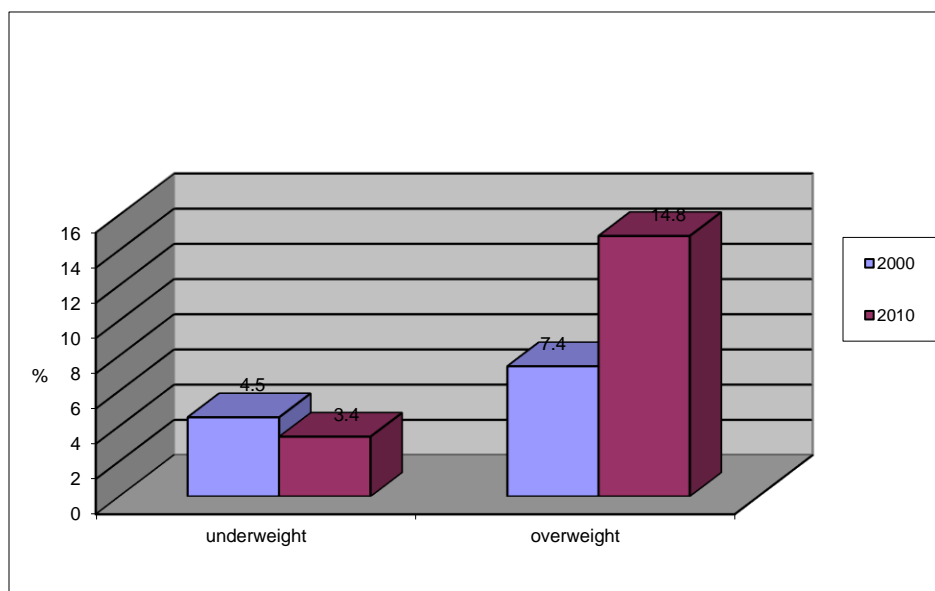
Introduction

The traditional epidemiological transition model attributes much of the rise in NCDs to the ageing of the population. However, as seen in section 2.2.1, NCDs appear to be occurring at younger and younger ages, with risk factors, including obesity, occurring as early as childhood. Childhood obesity (CO) is not only important as a risk factor for adult NCDs, but because it is associated with a range of physical, emotional and social problems for children, it can thus affect their development and social prospects for life.

There have been two major factors contributing to the global rise in obesity – the increase in food processing and trade liberalisation – which have made cheap, highly processed foods readily available. The nutritional transition of increased consumption of energy dense foods, high in fat and sugars, together with a reduction in the availability of plant-based fibres, have contributed to the global rise in obesity. There has also been a decline in activity energy expenditure largely due to motorised transport and less demanding manual tasks in the workplace (CARPHA, n.d.-b). In the Caribbean, this nutritional transition has been taking place over the last several decades, as unprocessed food from the land has been replaced by processed foods, that have been imported and marketed in these countries (Yearwood & Samuels, 2016).

According to a report by the Caribbean Food and Nutrition Institute (2011), within a decade from 2000 to 2010, there was a dramatic change among children 0-5 years old, where overweight and obesity rates moved from 6% to 14%. Global prevalence estimates for pre-school children range from 3-7%. However, those for Caribbean children can be seen to be much higher (See Figure 68) (De Onis, Blossner, & Borghi, 2010; Henry, 2016a, 2016b), thus indicating that CO is a significant challenge in the Caribbean.

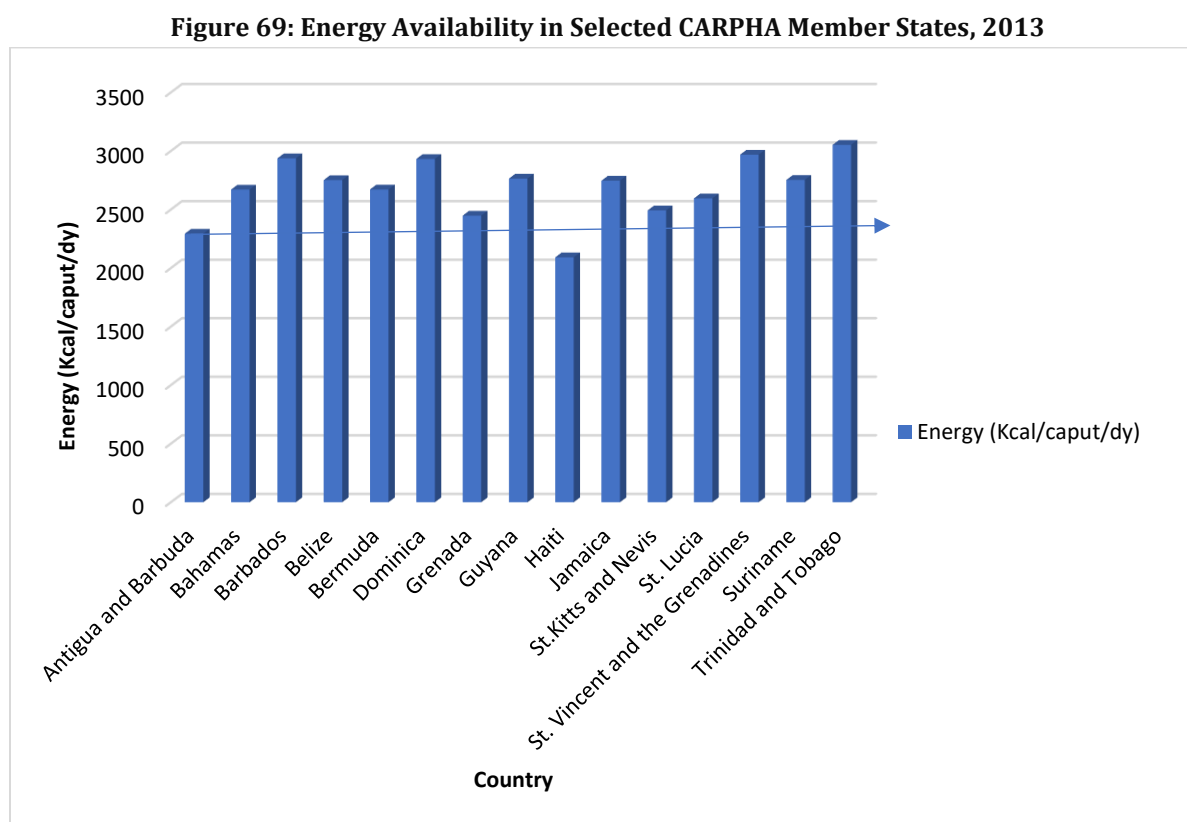
Figure 29: Changes in underweight and overweight status of Caribbean children aged 0-5 yrs 2000 and 2010



Source CFNI, 2011

4.1 Overconsumption and obesity

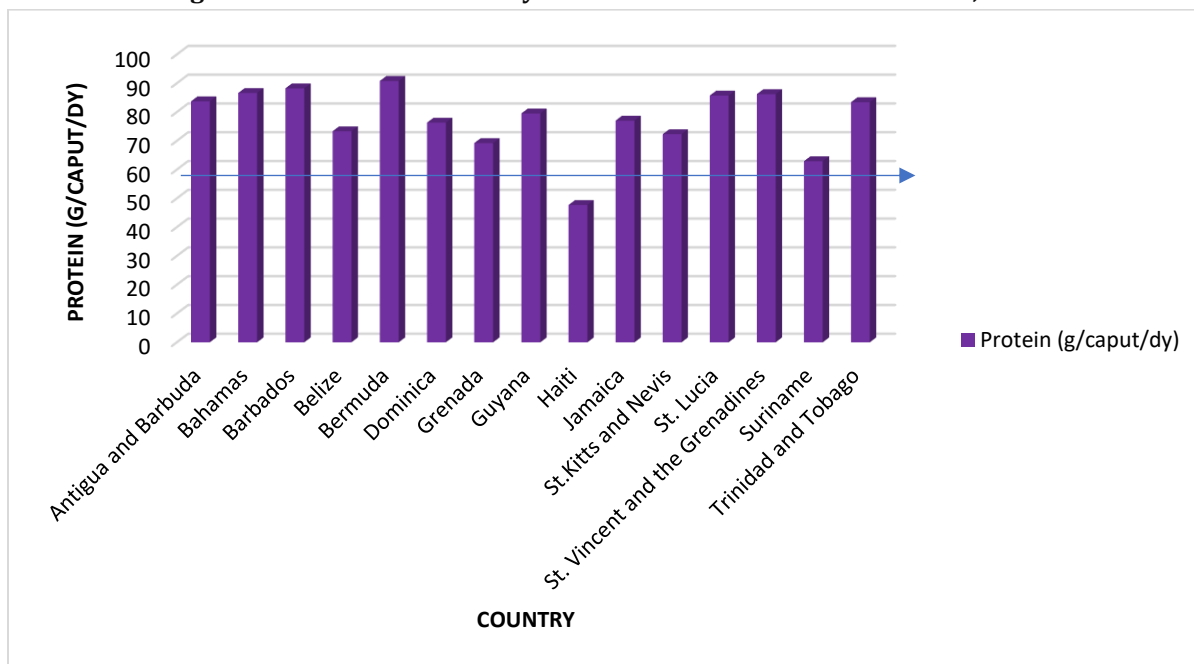
The rise in the obesity epidemic in the Caribbean is linked to the economic development of the region. Since the 1970s, the urban population has grown more rapidly than the rural population, and this has affected people's ability to pursue active lifestyles. Additionally, consistent with global trends, there has been an increase in dietary energy availability in the Caribbean. Since the 1970s, the average daily energy supply per caput in the Caribbean has been exceeding the Recommended Daily Allowance (RDA) and by 2000, this excess was about 17%. (CARPHA, n.d.-b). By 2013 all CMS except Haiti had achieved the Population Food Goal (PFG) for energy (2250Kcal/caput/day). The energy availability for Barbados, Dominica, St Vincent and the Grenadines and Trinidad and Tobago were well above the target PFG with Trinidad and Tobago having the largest daily energy consumption of over 3000kCal (See Figure 69) (Bocage & Salandy, 2017).



Source: Bocage and Salandy, 2017

The PFG for protein, fats and sugars contribute significantly to the excess caloric intake. In 2013, the PFG for protein availability used was 56.3g/caput/day. All Caribbean countries except Haiti had met and passed this target (see Figure 70) (Bocage & Salandy, 2017).

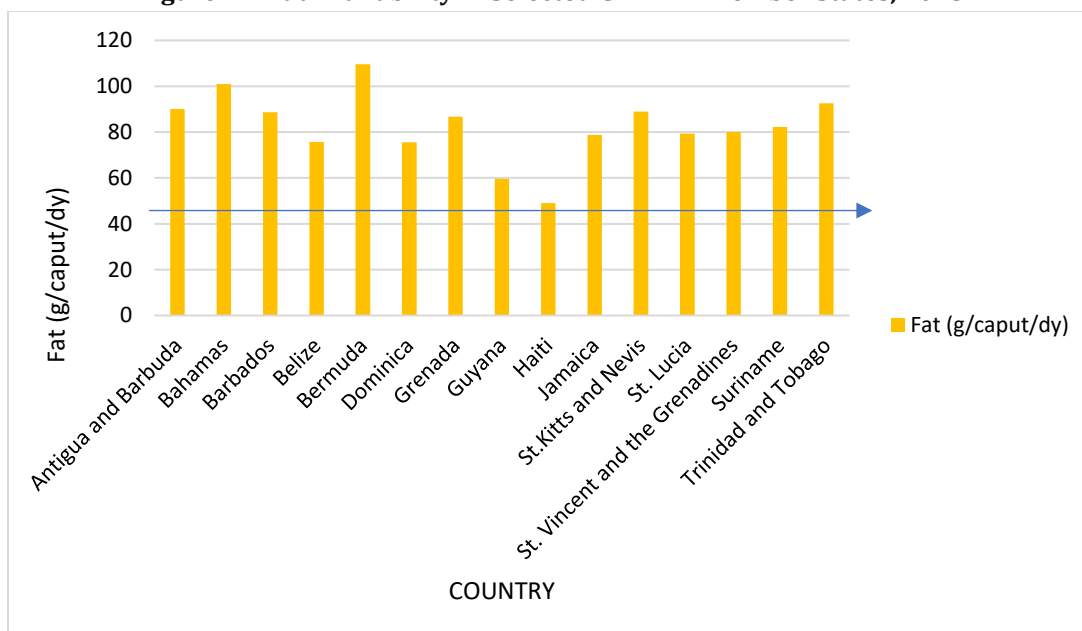
Figure 70: Protein Availability in Selected CARPHA Member States, 2013



Source: (Bocage & Salandy, 2017)

Bermuda had the highest fat availability for 2013, with 62.1% over the target of 62.5g/caput/day. Guyana and Haiti were the only countries that did not meet the PFG for 2013 (see [Figure 71](#)) (Bocage & Salandy, 2017).

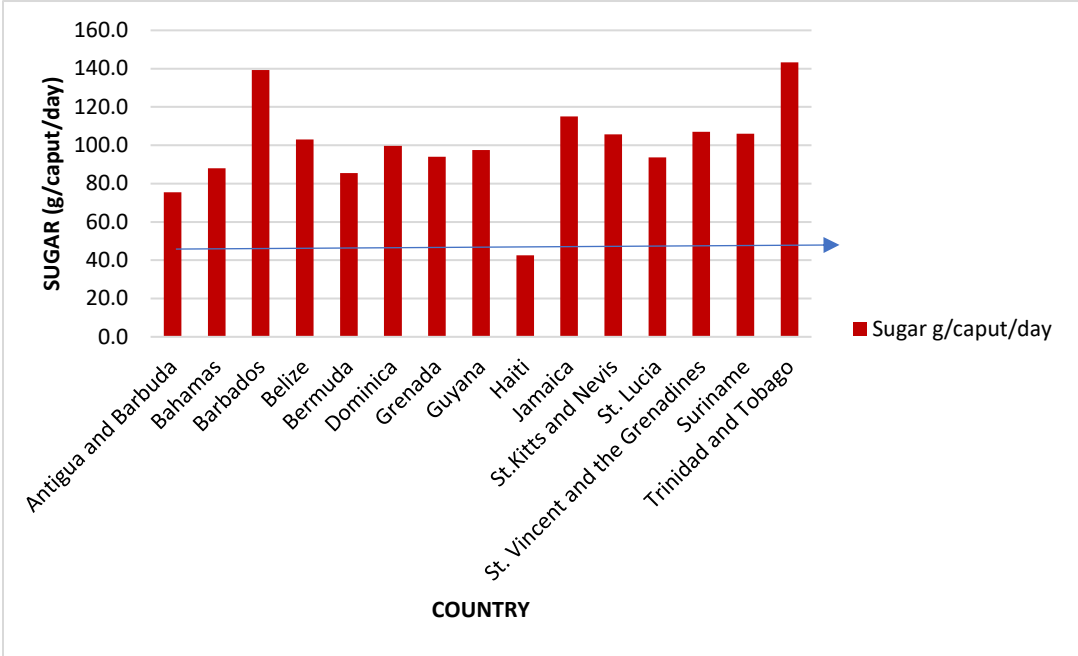
Figure 71: Fat Availability in Selected CARPHA Member States, 2013



Source: (Bocage & Salandy, 2017)

The latest sugar availability data was for 2013, when all the selected Caribbean countries except Haiti surpassed the target of 45g/caput/day (See Figure 72) (Bocage & Salandy, 2017).

Figure 72: Sugar Availability in Selected CARPHA Member States, 2013



Source: (Bocage & Salandy, 2017)

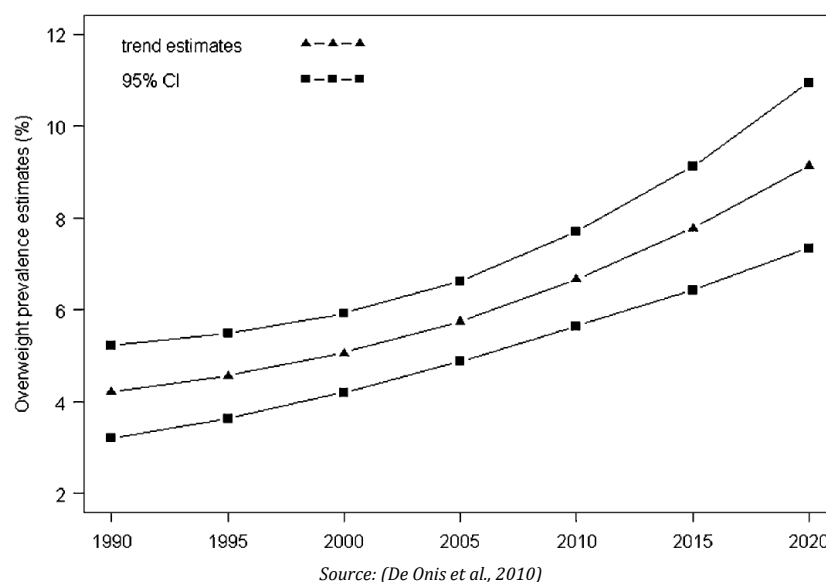
It is important, however, to acknowledge that overconsumption is not the only nutritional challenge in the Caribbean. In this region, as in many developing countries, there exists a double burden of overnutrition and undernutrition (Kapoor & Anand, 2002). In nearly all CMS, even though the greater challenge is one of over-nutrition, nutritional deficiencies have also been observed. These occurrences of undernutrition tend to be in children whose families are at the economic margins of society and cannot meet their basic food needs (CARPHA, n.d.-b; Gaskin, Nielsen, Willie, & Durant, 2014; Henry, 2016a).

4.2 Nutritional status (obesity) in infants, young children, school aged children and adolescents

4.2.1 Overweight and obesity in infants and young children

De Onis et al conducted a cross-sectional study of 450 nationally representative surveys from 144 countries globally to quantify the worldwide prevalence and trends of overweight and obesity among pre-school children (0-5 years old) based on WHO standards⁴. It was found that in 2010, there were 43 million children (35 million from developing countries) who were overweight and obese and 92 million at risk of becoming overweight. The worldwide prevalence of childhood overweight and obesity increased from 4.2% in 1990 to 6.7% in 2010 and was expected to increase to 9.1% (or approximately 60 million children) in 2020. See Figure 73 (De Onis et al., 2010).

Figure 73: Trends in Global Prevalence of Overweight and Obesity Among Children 0-5 yrs, 1990-2020



In addition to the increasing trends in children 0-5 years old as reported by CFNI (see Figure 68), De Onis et al made projections to estimate prevalence rates of children (0-5 years old) based on modelling from 28 surveys of regional Caribbean data. These overweight and obesity rates also demonstrated a growing trend from 4.6% prevalence in overweight and obesity in 1990, to 6.9% in 2010, with a predicted prevalence of 8.3% in 2020 (see Table 17) (De Onis et al., 2010).

⁴ The World Health Organisation defines overweight and obesity as "abnormal or excessive fat accumulation that presents a risk to health" (WHO, 2017b). For adults, this is usually measured by the Body Mass Index (BMI) defined as the weight in kilograms divided by the square of the height in meters (kg/m²). For children and adolescents there is no one simple index of measurement as their bodies undergo numerous physiological changes as they grow. For separate definitions of children under 5 years of age and children between 5 and 19 years of age see: <http://www.who.int/mediacentre/factsheets/fs311/en/>

Table 17: Trend in prevalence of overweight and obesity among children 0-5 years old, Caribbean region, 1990 - 2020

Year	1990	1995	2000	2005	2010	2015	2020
Overweight and Obesity Rates	4.6%	5.1%	5.6%	6.2%	6.9%	7.6%	8.3%

Source: (De Onis et al., 2010)

The United Nations Children’s Fund (UNICEF) Multi-Indicator Cluster Survey (MICS) have recently started to collect data on overweight prevalence in children 0-5 years old. Belize (data collected in 2015) reported overweight prevalence to be 7.3% (Statistical Institute of Belize Government of Belize & UNICEF, 2016) and Guyana (data collected in 2014) reported overweight prevalence to be 5.3% (Bureau of Statistics Ministry of Health Government of Guyana & UNICEF, 2015).

4.2.2 Overweight and obesity in school age children and adolescents

Independent studies conducted in nine different Caribbean countries and territories demonstrated an overweight prevalence between 10.6% and 37% and an obesity prevalence between 7.1% and 25.4% in school aged children and adolescents (see Table 18) (Batson, Teelucksingh, Maharaj, & Cockburn, 2014; Blake-Scarlett et al., 2013; Conliffe, Frankson, Smith, Hanna-Mahase, & Oriakhi, 2015; Gardner, Bird, Canning, Frizzell, & Smith, 2011; Gaskin et al., 2012; T. Maitland & Handfield, 2016; Radix et al., 2015; Schwiebbe et al., 2012; Visser, 2008)

Table 18: Prevalence of overweight and obesity among children and adolescents aged 5 to 19, from selected Caribbean studies

Study	Country	Year of study	No of participants	Age range (years)	Overweight prevalence (%)	Obesity prevalence (%)
Visser 2008	Aruba	2004-2005	3952	6-11	37	Included in 37% overweight prevalence
Conliffe et al 2015	Bahamas	2011-2012	382	12-19	14.4	17.8
Gaskin et al 2012	Barbados	Not stated	62	9-11	37.1	Not stated
Schwiebbe et al 2012	Bonaire	2008	2023	5-16	17	12
Radix et al 2015	Grenada	Not stated	689	11-14	17.6	7.6
Blake-Scarlett et al 2013	Jamaica	2008-2009	5710	6-10	10.6	7.1
Gardner et al 2010	St Lucia	2006-2007	425	5-6	14.4	9.2
Batson et al 2014	Trinidad	2009-2010	2130	7-18	17	15
T Maitland & Handfield 2016	Turks and Caicos Islands ⁵	Not stated	2319	10-15	21.2	25.4

The Caribbean Food and Nutrition Institute (2011) report presented the prevalence for overweight and obesity in early adolescence (boys and girls 11-13 years old) in the Caribbean at 27% for boys and 33% for girls (see Table 29) (Henry, 2016b).

⁵ There have been several papers published on nutritional studies in the Turks and Caicos Islands. The results from this particular paper were chosen due to the high number of participants.

Table 19: Prevalence of overweight and obesity in Children in the Caribbean, 11-13 years old

	Boys	Girls
	%	%
Thin < 2 SD+	6	4
Normal	67	63
Overweight > 1 SD	14	19
Obese > 2 SD	13	14
+ SD = Standard Deviations of the WHO standards median		

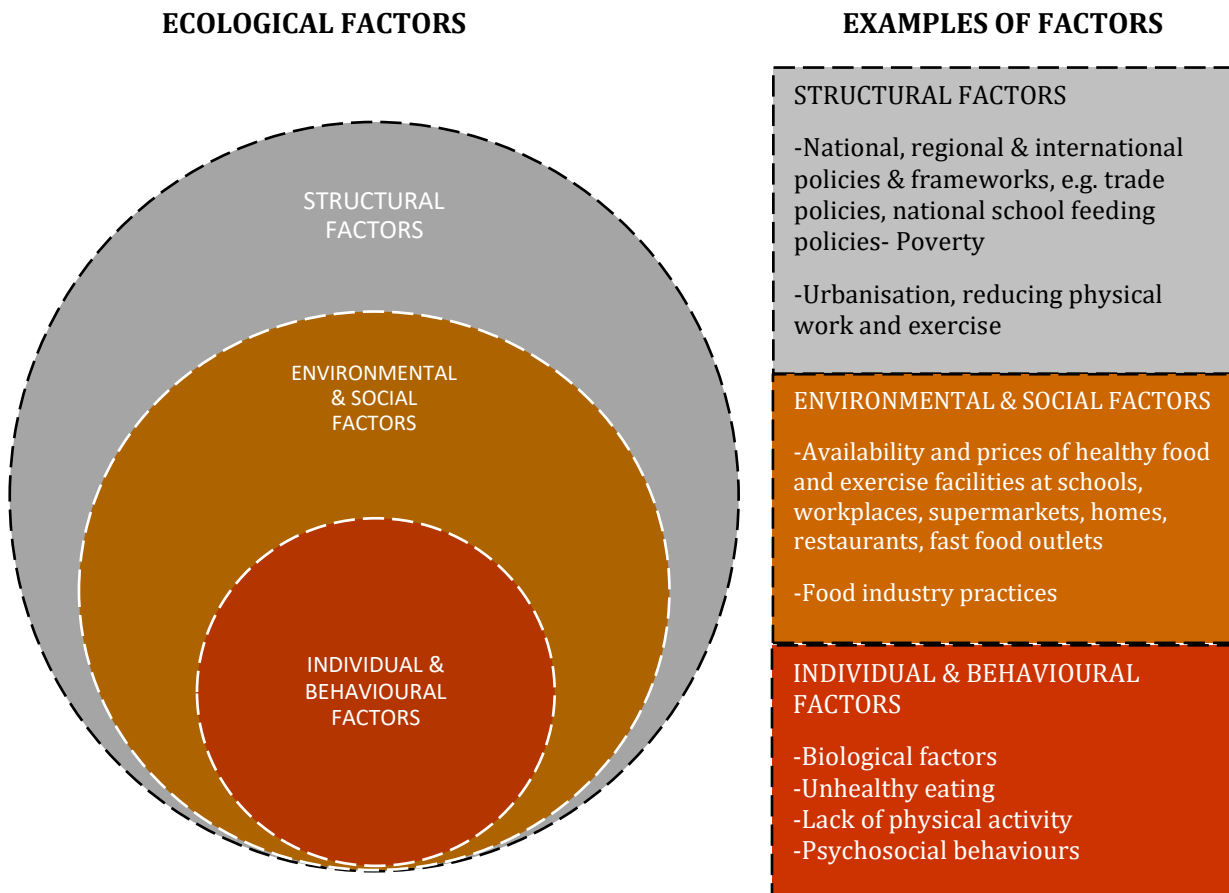
Source: (Henry, 2016b)

Studies in Tobago (12-15 years old) (Nichols & Cadogan, 2007), Bonaire (4-16 years old) (Schwiebbe et al., 2011), Jamaica (6-10 years old)(Blake-Scarlett et al., 2013), Grenada (11-14 years old)(Radix et al., 2015), the Turks and Caicos Islands (9-11 years old) (McCartney et al., 2015), and the Bahamas (12-19 years old)(Conliffe et al., 2015) demonstrated that girls tended to be significantly more overweight/obese than the boys. However in a study in Trinidad boys had a higher proportion of overweight and obesity than girls (7-18 years old) (Batson et al., 2014). Additionally in Barbados, in a study amongst 9-11 year olds, boys were heavier with higher BMI but this finding was not statistically significant (Gaskin et al., 2012).

4.3 Social Determinants of Health as applied to childhood obesity

Using the ecological model developed earlier in this report (see Section 1.4), the individual interacts with the immediate environment or settings such as schools, workplaces, homes, restaurants and fast food outlets. These settings are in turn influenced by more distal environments or sectors such as the food industry and government (Becker, Silvi, Ma Fat, L'Hours, & Laurenti, 2006). These sectors are controlled by national, regional and international policies and frameworks such as trade policies as well as issues of food security and economics (See Figure 74).

Figure 74: Ecological Representation of the Obesogenic Environment



Source: Adapted from Framework for addressing the Social Determinants of Health and Well-Being, Queensland Health, 2001; Wider Determinants of Health Model, Dahlgren and Whitehead, 1991; Commission of Social Determinants on Health Conceptual Framework, WHO, 2007; A Heuristic Framework for the Social Epidemiology of HIV/AIDS, Poundstone et al, 2004; and The Socio-Ecological Model, McLeroy et al, 1988)

Overweight and obesity are caused by energy intake from food consumption being in excess of what is required for normal growth, body functioning and physical activity levels. There are several interrelated factors that influence and affect childhood obesity. The ecological model described in Section 1.4 uses three different levels – individual and behavioural, environmental, and social, and structural.

Generally, the structural factors are thought of as influencing the environmental and social factors, which in their turn influence the individual and behavioural factors and thereby health outcomes. The dotted lines between each level indicate that the borders between each level are porous and that the various factors may move between the different levels depending on the priority population, the context and the health issue being examined. For example, even though unhealthy eating and lack of physical activities are direct “individual and behavioural” level factors, the activities may be strongly influenced by parents, advertising and other community practices at the “environmental and social” level.

4.3.1 Individual and behavioural level factors

Individual level factors are concerned with biology and demographics, psychosocial and health behaviours, attitudes, and practices including healthy eating and physical activity. Biological factors include age, sex, race, genetics, and body mass index, among others. Obesity would not be possible if the human genome did not have genes for it but the human being only becomes obese under particular circumstances.

Caribbean people are mainly of African and Indian descent, and these ethnicities are known to be at risk of obesity and chronic diseases (Henry, 2016b; Higgins, 2008). Overweight or obese women are more likely to deliver new-borns who have a predisposition to store excessive amounts of fat very early in life, and so become overweight or obese themselves. Evidence suggests that gene expression is affected through environmental exposures (e.g. nutritional and endocrinological) during pregnancy and infancy. These environmental-genomic interactions are known as epigenetic mechanisms and are complex, since body weight and composition vary within a population (Perez-Escamilla & Kac, 2013). However the dramatic rise in obesity has occurred within a short time frame thus encouraging one to believe that it is not biological factors alone that account for the escalating problem of obesity, but rather the obesogenic environments in which people of African and Indian descent live in the Caribbean (Henry, 2016b; Hill, Wyatt, & Melanson, 2000).

There have been studies that suggest that eating breakfast is associated with a lower BMI in children and adults. For example, in a study in the Turks and Caicos Islands with students of mean age 11 years old, the 297 primary school children who were breakfast eaters were 54% less likely to be obese than non-breakfast eaters (T. E. Maitland, Malcolm, & Handfield, 2015). The 2004 Aruban Childhood Obesity Study demonstrated that close to three-quarters (71.9%) of children between 6-11 years did not eat breakfast and 37% of them were overweight (Visser, 2008). There are also other studies that suggest this association is not statistically significant and emphasis needs to be placed on the consistent eating of breakfast, the components of breakfast and stressing the importance of physical activity (International Food Information Council Foundation, n.d.).

WHO recommends that sugar consumption be limited; fruits and vegetables, whole grains and legumes increased, and energy derived from fats should be unsaturated fats rather than saturated fats (WHO, 2000). Children and adolescents consume a large amount of fast foods which are usually high in fat and high in salt, and carbonated soft drinks, high in sugar. In Trinidad and Tobago, Mungrue et al (2013) found that in a survey of 1896 adolescents (13-18 years old), where 30.4% of the study population was overweight and obese, 79.8% consumed fast foods (Mungrue, Fyzul, Ramroop, Persad, & Asgarali, 2013). In a study in Turks and Caicos Islands, primary school children who “ate out” less than twice a day (including lunch) were less likely to be overweight (T. E. Maitland et al., 2015). The Global Health School Surveys (GHSS) from 13 Caribbean states demonstrated that at least 55% school aged children (13-15 years old) drank carbonated soft drinks, at least once per day during the 30 days prior to the survey (see Table 20). (WHO, 2017a).

Table 19: Percentage of students aged 13-15 who usually drank carbonated soft drinks once or more times per day over the past 30 days, in selected Caribbean countries

Country	Year	No of students	Percentage
Anguilla	2016	813	55.2
Antigua and Barbuda	2009	1266	58.8
Bahamas	2013	1357	69.0
Barbados	2011	1629	73.3
Belize	2011	2112	66.9
British Virgin Islands	2009	1664	63.9
Curacao	2015	2765	62.4
Dominica	2009	1642	55.8
Guyana	2010	2392	70.9
Jamaica	2010	1623	72.5
St Kitts and Nevis	2011	1740	61.6
Suriname	2016	2126	79.1
Trinidad and Tobago	2011	2811	74.6

Source: Global Health School Surveys

The WHO recommends that children between 5 and 17 years old take at least 60 minutes of moderate to vigorous-intensive physical exercise daily (Henry, 2016a). The shift in today's recreational activities for children to the inside of living accommodation, rather than outside could be attributed to increased screen time using electronic media. This has been shown to play a significant role in increasing the likelihood of being overweight and obese (J. K. O'Hara & L. Haynes-Maslow, 2015; Strasburger, Mulligan, & Altmann, 2011). The move to crowded urban areas which lack outdoor space and parental concerns for security will have also contributed to the move indoors (CARPHA, n.d.-b; Henry, 2016a). The GHSS demonstrated low levels of physical activity among Caribbean adolescents (see Table 21). Here the percentage of children involved in at least 60 minutes of physical activity on five or more days during the seven days before the survey ranged only between 21.3% in Guyana and 31.8% in Antigua and Barbuda (WHO, 2017a). In a National Youth Physical Activity and Nutritional Survey in Guyana 54% of the students reported participating in physical activity that raised their heart beat for at least 20 minutes on three or more of the days previous to the survey. 48.7% admitted to playing video or computer games for one or more hours on a school day and 56.3% reported not attending physical education classes at all in school (Stephanas, 2017). In Barbados in a study of 9-11-year-old boys and girls, Gaskin et al found that those of normal weight were 3.9% more likely to engage in active activities⁶ than overweight children. In this same study, it was noted that screen time constituted 21% of the children's activities (Gaskin et al., 2012).

⁶ Active activities included engaging in sports such as football and cricket, walking, weekly physical education class, hand games, dancing, ball games, tag, hide and seek, hop scotch, and household chores (Gaskin et al., 2012).

Table 20: Percentage of students aged 15-17 who were physically active at least 60 minutes per day on 5 or more days during the 7 days before the survey, in selected Caribbean countries

Country	Year	No of students	Percentage
Antigua and Barbuda	2009	1266	31.8
Barbados	2011	1629	29.1
Belize	2011	2112	29.0
British Virgin Islands	2009	1664	27.4
Dominica	2009	1642	23.7
Guyana	2010	2392	21.3
St Kitts and Nevis	2011	1740	25.6
Trinidad and Tobago	2011	2811	29.2

Source: Global School Health Surveys

Perceptions and beliefs can influence behaviour change in eating and physical activity habits. Some of these, such as norms about the ideal body shape and size of women and men, can be regarded as cultural, since they vary around the world. Regional studies by CFNI revealed the following (Higgins, 2008):

- Body size was important in perceived beauty, social adequacy, functioning and responsiveness;
- The “triggers” that resulted in immediate action regarding diet and physical activity were doctor’s advice and the need to change, likely loss of love from a spouse, vanity, and diagnosis of ill-health of spouse;
- For women, “having size” and “being solid” were the preferred state and men’s perceptions were very important in achieving this state. Men seemed relatively unconcerned about their own size, build, dietary intake or exercise regime;
- Fruit and vegetable intake were restricted and varied, yet influenced by cost;
- Regular physical activity was deemed “work” and difficult, even though the benefits were well known

4.3.2 Environmental and social level factors

Environments in which people live, develop their dietary behaviours and make food choices, while having a profound influence on what they eat, are very complex. Swinburn and Egger (2002) indicated that the obesogenic environment is the sum of influences that the surroundings, opportunities or conditions of life have on promoting obesity in individuals or populations. It is this obesogenic environment that is fuelling the obesity and NCD-related epidemic. A broad definition of the food environment includes the physical, economic, policy and sociocultural surroundings and conditions that influence people's food and beverage choices and subsequent nutritional status. This entails the food supply, food retail mix and food advertising and marketing environments (CARPHA, 2015).

Parents, communities and schools are among the social groups that may be targeted with information regarding nutrition and physical activity, to facilitate healthy choices among their children. In order to promote local availability of healthy foods and places to be physically active, policies and programmes addressing communities may be developed and implemented at the local level (Brown, 2011; Henry, 2016a). Aggressive advertising and marketing of energy dense foods and those high in fat, salt and sugar are also among societal factors that influence childhood obesity.

Poor nutritional choices associated with overweight and obesity in children and adolescents result from practices related to food supply (including breastfeeding), food processing, food marketing and transport.

Inadequate breastfeeding practices can lead to overweight infants which can in turn lead to overweight children. WHO recommends that for the first six months of his/her life an infant should be exclusively breastfed. Breastfeeding should continue until two years of age and beyond, where possible but can be supplemented with safe and appropriately nutritious foods. Sugars and salts should not be added to these complementary foods (WHO, 2015).

In the Caribbean, the majority of mothers breastfeed at birth (average 88%) (CARPHA, n.d.-b). In Jamaica, only 15% of mothers were still breastfeeding at six months. Between six and eleven months, 85% of mothers who were still breastfeeding had introduced complementary foods. The authors of the Jamaican study noted that that women who do not breastfeed spend more than they need to on infant formula (Statistical Institute of Jamaica Government of Jamaica & UNICEF, 2005).

In the 2004-2005 Aruban Childhood Obesity Study it was demonstrated that 50% of the children who were not breastfed or breastfed for less than four months were overweight and obese as compared to 28.2% who were breastfed for four or more months (Gréaux et al., 2013).

Children whose parents are overweight or obese tend to be overweight or obese themselves. At the environmental level, this may be because such parents tend to feed their children the same types of food that they themselves eat. Parents need to support their children by being an example and providing suitable nutritional food and drink, as deemed appropriate by national dietary guidelines. Parents are also influential in encouraging their children to evaluate their physical activity habits and again lead by example by having physically active lifestyles themselves (Henry, 2016a; J. K. O'Hara & L. Haynes-Maslow, 2015).

Part of the parental role is to also monitor children's screen time, as too much screen time promotes sedentary behaviour and is positively associated with increased levels of inactivity and BMI (J. K. O'Hara & L. Haynes-Maslow, 2015; Reid Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016; Strasburger et al., 2011). Screen time activities include viewing cable television, or videos and games on computer, tablets, or smart phones. Sufficient time must be allowed both during school hours (through physical education classes and regular breaks) as well as after school hours (by not overloading the children with after school academics) for children to participate in sufficient physical activities (Henry, 2016a; J. K. O'Hara & L. Haynes-Maslow, 2015; Strasburger et al., 2011). Box 1 provides recommendations for screen time from the American Paediatric Association (American Pediatric Association, 2016).

Box 1: American Paediatric Association Guidelines for Screen Time for Children

- For children younger than 18 months, avoid use of screen media other than video-chatting. Parents of children 18 to 24 months of age who want to introduce digital media should choose high-quality programming and watch it with their children to help them understand what they're seeing.
- For children ages 2 to 5 years, limit screen use to 1 hour per day of high-quality programs. Parents should co-view media with children to help them understand what they are seeing and apply it to the world around them.
- For children ages 6 and older, place consistent limits on the time spent using media, and the types of media, and make sure media does not take the place of adequate sleep, physical activity and other behaviors essential to health.
- Designate media-free times together, such as dinner or driving, as well as media-free locations at home, such as bedrooms.
- Have ongoing communication about online citizenship and safety, including treating others with respect online and offline.

Source: (American Pediatric Association, 2016)

Social media plays an increasingly important role in the lives of children and adolescents. Social media sites include those for social networking (e.g. Snapchat, Instagram, Facebook, Twitter), gaming and video (e.g. YouTube), virtual worlds, texting (e.g. WhatsApp) and blogs. There are both positive and negative sides to social media. Positive dimensions include increased social interaction, enhanced learning opportunities and access to health information. Negatives include cyber bullying, depression⁷ and lack of exercise and communication with people "offline".

⁷ O'Keefe and Clarke-Pearson speak of "Facebook depression", defined as, "*depression that develops when preteens and teens spend a great deal of time on social media sites, and then begin to exhibit classic symptoms of depression*" (O'Keefe & Clarke-Pearson, 2011, p. 802). Being accepted by their peers is very important to adolescents and they will spend a great deal of their time trying to be "liked" and "part of the crowd". This, coupled with the high stress of the online world, has been known to trigger anxiety and depression.

The number of pre-adolescents and adolescents using social media sites has increased dramatically. According to a recent poll, in the US, 22% of teenagers log onto a social media site more than ten times a day and more than half of the adolescents log onto a social media site more than once a day. Seventy-five percent of teenagers own a phone; 25% of teens are reported to use phones for social media; 54% for texting and 24% for instant messaging (O’Keeffe & Clarke-Pearson, 2011). In the Caribbean, children and adolescents have not been immune to advances in electronic technologies and the use of social media is also increasingly a part of their daily lives.

Communities include geographical areas arranged administratively and/or socially and usually have their own social institutions such as churches and schools. There are also “communities of interest”, such as people interested in swimming or women’s rights. In some communities, churches, youth clubs and community centres have formed groups which teach and promote healthy eating and physical activity. Some of these are supported by funding from regional or international organisations; for example, the CORE Youth Movement Program by Population Services International-Caribbean, which is described below (see Section 4.4) (Population Services International Caribbean, 2017). City and county councils can play important roles in community action for healthy living by ensuring that there are enough green spaces for young people to be involved in recreational activities, especially in urban areas. This promotes community cohesion as well as healthy lifestyles, as people come together in these spaces (Henry, 2016a).

Sedentary lifestyles appear to be substantially higher in countries with greater incomes. The WHO STEPS methodology was used to compare physical activity around the world among persons 15-21 years old in high income countries compared to middle income countries. In high income countries, low levels of physical activity were found among 45% of participants, whereas in middle income countries, 28% had low levels of physical activity (PAHO, 2016). We see that the amount of exercise among adolescents in the Caribbean conforms roughly with that for middle income countries globally and it is believed that physical activity may decrease if economic prosperity improves.

A growing number of caregivers have access to motor vehicles, and many are concerned about threats to their children’s security if they walk or take public transport. As a result, many Caribbean children are driven to school. Additionally, children are under increasing pressure to perform academically, with greater amounts of homework than in previous eras. School time previously allocated to sport and physical education is often replaced by further academic study. After school, many children go to “extra lessons”, generally requiring them to be sedentary for even longer periods (Henry, 2016a).

The food environment consists of the overall food supply (what foods are available and at what cost), the food retail mix (the location of the food retail stores, the foods that are available for sale, the cost of the foods, the promotional strategies that are used, and the nutrition-related activities that are implemented) and the food advertising and marketing environment designed to encourage consumers to adopt a particular dietary behaviour (CARPHA, 2015). Evidence is emerging that there are “urban food deserts” where there is insufficient availability of fresh fruits, vegetables and unprocessed protein, and which are inhabited mostly by poor and at-risk populations. In food deserts, the only available foods, at least at prices affordable to people in lower income brackets, may be highly processed, with sources including supermarkets and fast food restaurants. The cheaper,

more accessible food may be calorie-dense, high in fat and high in salt (Yearwood & Samuels, 2016). It has also been demonstrated that living in close proximity to fast-food restaurants results in higher BMI and lower fruit and vegetable consumption (Kruger, Greenberg, Murphy, DiFazio, & Youra, 2014).

Globally and within the Caribbean, aggressive and creative marketing of energy dense foods and beverages is common. Here, advertisements for fast food meals accompanied by toys and other promotional material are directed at children and adolescents through electronic media, billboards, and posters. Hours of screen time also allow for exposure to unsuitable advertising. Young persons who are impressionable and highly influenced by their peers are particularly susceptible to these types of strategies.

Hastings et al (2006) conducted a review on the extent, nature and effects of food promotion on children. In both developed and developing countries it was found that children can easily remember those foods that were advertised, and that marketing and promotional activities influence their food preferences, consumption and diet-related behaviours. Television advertising promotes what is known as the Big Five: pre-sugared breakfast cereals, soft-drinks, confectionary, savoury snacks, and food from fast food outlets. Food advertisements that were among the children's favourites were for chocolate, sweets, soft drinks and other foods high in fat, sugar and salt. Survey results found that children were often very open to trying the advertised foods or drinks and would often ask their parents to buy them. Parents of disadvantaged backgrounds may be especially likely to yield to this pressure, since often the snacks and processed foods are priced affordably, making it possible to grant their children a "treat". Lack of parental education on the dangers of fast food may contribute to this. There is also evidence that there is a positive association between children's exposure to television commercials promoting fast food toy meals and more frequent visits to fast food restaurants (Hastings, McDermott, Angus, Stead, & Thompson, 2006). Studies by CFNI demonstrate that the media and especially cable television has had much impact on perceptions, attitudes, values and lifestyles of the Caribbean people particularly the women, youth, unemployed, nursing mothers, housewives and the overweight (Higgins, 2008).

Finally, it is important to consider the school environment. Children and adolescents spend the majority of the day at school. Obesity in school aged children is influenced by the meals and snacks they have at school. Some government schools provide free or subsidised meals in efforts to provide adequate nutrition to children from low income backgrounds. These generally consist of a protein and starch, such as chicken and rice, with little vegetable content except what may be mixed with the rice (e.g. vegetable rice or rice and peas). Many children choose other options if they can afford them. Private individuals often run school canteens and shops to make a profit. They sell goods that they believe children will buy, which are usually similar to what is available in fast food restaurants, e.g. pizza or fried chicken and fries, with soft drinks. Some schools have vending machines, generally filled with mostly high-sugar, high-fat items. Mobile food vendors operate outside schools. They may sell freshly-made items such as pies, cakes and juice alongside commercial products such as packaged cakes and chips. Generally, these are all high in sugar or fat. Some sell prepared fresh fruit, such as peeled oranges or seasoned mango, which provide relatively healthy options.

Researchers have found a positive association between children's BMI and the number of food vendors around schools, with more mobile food vendors around public schools (where access to healthy food options is generally lower) than private schools (Barrera, Rothenberg, Barquera, & Cifuentes, 2016). Vending machine availability has been found to have a positive association with BMI among children (J. O'Hara & L. Haynes-Maslow, 2015). These and other studies demonstrate a positive correlation between money given to children to buy food at school and overweight and obesity. In a study in the inner-city areas of Kingston, Jamaica, it was found that the percentage of obesity was twice as high in those children given US\$2.50 for lunch, as compared to those only given US\$0.80. It was also found over 75% of the students chose fast food or snack items for lunch (Ross, 2013).

Ideally, children should be able to take a nutritious lunch together with snacks and beverages to school. However, this is not always the case due largely to time constraints and possibly even a lack of knowledge by the caregiver. Shifts in labour market conditions may be behind some of the challenges, with care givers, especially women, increasingly engaged in full-time employment, making it difficult for them to prepare and pack food for their children to take to school every day. Rises in overall costs of living relative to incomes have forced many care givers into working increasing numbers of hours. Therefore, increasing onus is on the school to provide a healthy environment for the child by offering healthy eating choices and sufficient recreational time and space for physical activity. Assessment of school meal options in several CMS over a period of years indicate that many children are consuming a diet high in saturated fats and sugars and low in iron and calcium. Fruit, vegetables and to a lesser extent, legumes were not adequately available in school meals and, as such, the children were not receiving their recommended daily allowance of five servings of fruit and vegetables (CARPHA, n.d.-b).

Several Ministries of Education around the Caribbean have developed or are developing policies around enhancing exercise and food facilities to improve child health and reduce obesity. Some countries have national food and nutrition policies, including consideration of NCDs. As part of the 2015 data collection for the evaluation of the implementation of the 2007 Port of Spain Declaration on NCDs, stakeholders involved in such initiatives were interviewed. The Port of Spain Declaration was generally acknowledged to have provided an important impetus to the development of initiatives to improve the food and exercise environments in schools. Meetings had been held with Ministry of Health officials to develop strategies. In Trinidad and Tobago, for example, officials from both Ministries had met with private operators of school canteens along with dietitians and the national school feeding programme. The Ministry of Education official interviewed noted that it was challenging to persuade the private operators to provide healthy food options as they were concerned that the children would not buy them. This highlights that the success of health promotion efforts is conditioned by changes in food culture. The Ministry of Education representative and a representative of National Schools Dietary Services Ltd. (NSDS) noted that contracting out school meals on a mass basis to NSDS was more successful, as the company was able to minimise costs through economies of scale and develop options using fresh produce and ingredients with less fat, salt and sugar content while taking account of the evolving tastes of children. However, it was noted that at the time there was no legislation regarding mandatory labelling of nutritional content of foods (Samuels & Unwin, 2016a, 2016b).

4.3.3 Structural level factors

Structural level factors are those concerned with international, regional and national economic status and cycles, legislation, policies and frameworks. Government action to prevent and control childhood obesity must include the non-health sector. For example, policies in trade, agriculture, sanitation and food security affect the quantity and quality of foodstuffs available and consumed. Socioeconomic status also influences the ability to purchase healthy foods (Brown, 2011). Caribbean countries have a limited range of locally produced foodstuffs, for historical reasons and as functions of their small size and vulnerability to natural disasters. They are therefore especially vulnerable to international economic cycles that determine prices and production, and to consuming large quantities of processed food since they are often cheaper than fresh alternatives. Larger countries have the benefit of economies of scale in food production and processing; these are scarcely available in the small countries of the Caribbean.

Global increases in obesity can also be attributed to trade liberalisation of food systems and consumer culture. Trade and investment agreements have found to affect availability, nutritional quality, price and promotion of foods. Even though trade liberalisation has global economic benefits, there are some negative effects such as homogenisation, with a fall in the variety of foods available and in the amount produced locally. At the regional and national level, trade liberalisation has been linked to increased food imports, increased consumption of high fat and high sugar beverages and foods, expansion of food markets and promotion of domestic meat production. For example, the introduction of the North America Free Trade Agreement (NAFTA) led to an increase in exports of corn, sugar, snack foods, and dairy and meat products from the US into Mexico. This has been accompanied by a large amount of direct foreign investment in the food and manufacturing sector thus causing the food systems in Mexico to look more like that of the industrialised US (Chavez, 2002; Clark, Hawkes, Murphy, Hansen-Kuhn, & Wallinga, 2012). These changes were associated with a 12% rise in overweight and obesity rates.

In the Caribbean, trade liberalisation has also been linked to an increased dependence on export crops and food imports thus creating challenges for food security, nutritional quality and food prices in the region. Most of CARICOM countries import more than 60% of the food they consume with half of them importing more than 80%. Belize, Guyana and Haiti are the only countries which produce more than 50% of their food, and it is notable that these three countries have lower (or negative) rates of overconsumption than those countries with higher rates of importation (See Section 4.1.0 Trade liberalisation and increased foreign investment has led to the proliferation of multinational food corporations – the “Coca-Colonisation” and “McDonaldisation” in the 1980s and 1990s – creating fast and cheap food and drinks that are high in sugar, fat and salt (Blouin, Hawkes, Henson, Drager, & Dube, 2010; FAO, 2015).

It is necessary to have a whole of government and whole of community approach and create policies and strategies aimed at creating an environment conducive to healthy eating and exercise. In order to create such an environment, public sector agencies concerned with food and agriculture, trade and education must come together to develop strategies that will shift the obesogenic environment in which we live to one which encourages more physical activity, better healthy eating and decreased sedentary lifestyle. When designing such strategies and action plans one must be mindful of the

Caribbean region's small and fragile economies within the ever-increasing global food trade. Public policies must target those individual, social and structural determinants of obesity – food security and safety, access and availability to healthy foods, information and spaces for recreational physical activity. (Henry, 2016b). Advantages to a multi-sectoral approach, outside of direct health impacts include poverty reduction, employment opportunities, increased food security, reduced food imports and preservation of culture and culinary heritage (CARPHA, 2015).

4.3.4 Impact of childhood obesity

Overweight and obesity pose significant health complications for the younger Caribbean population. Obese children suffer from complications of dyslipidaemia, hypertension, fatty liver, early sexual maturation, orthopaedic problems, respiratory problems such as asthma, sleep apnoea and psychological consequences of stigmatisation, low self-esteem, depression and discrimination. Studies have demonstrated that obese children have been ranked as the least likely to be desired as friends by their peers. There is also the risk of chronic NCD health problems into adulthood as obese children have a greater risk of becoming obese in adulthood. (Brown, 2011; Henry, 2016a; International Labour Organization, 2014; Yearwood & Samuels, 2016). WHO has listed some of these problems as cardiovascular disease, insulin resistance (often an early sign of diabetes), musculoskeletal disorders (in particular osteoarthritis), some cancers (endometrial, breast and colon) and generalised disability (WHO, 2014). In cohort study, after 20 years of follow-up, adolescents over 18 years old were found to die younger if they had a BMI greater than 25kg/m² as compared to those with a BMI less than 25kg/m² (Hoffmans, Kromhout, & de Lezenne Coulander, 1988).

Risk factors for hypertension, diabetes and cardiovascular diseases have already started to emerge in Caribbean children. Batson et al (2012) and Rivers et al (2013) demonstrated the presence of type 2 diabetes in school children aged 5-17 years old in Trinidad and Tobago and children aged 13-19 years old in the Bahamas, respectively. Studies by Walwyn et al (2012) and Taylor et al (2011) in Antigua and the Bahamas have established elevated blood pressure in children ages 4-20 in Antigua and 15-16 in the Bahamas respectively (Bocage, 2016; CARPHA, n.d.-b).

4.4 Examples of Regional Initiatives

In 2014 CARPHA undertook a literature search to determine, inter alia, the characteristics of interventions for preventing obesity in children and adolescents that have proven to be effective. Interventions with the following features were found to be the most effective (Yearwood, 2014):

1. Targeted behaviours – interventions designed to address health education or promotion, in general were more effective than those targeting weight management alone.
2. Multicomponent strategies – education in combination with environmental changes is more successful than either strategy being used alone.
3. Thorough theoretical basis – social cognitive theory in combination with social learning theory is found to be a most successful behaviour change model.
4. Duration and intensity of intervention – for an effective intervention, it should be at least 1-2 years duration with an average of 1-2 hours contact time per week.
5. Location or setting of intervention – schools, home, primary health care facility and community. Schools are ideal and should involve family, the community and other interest groups.
6. Whole of the community strategy – involves targeting the entire community in a specific geographic area with a multiple component prevention intervention, and possibly in multiple settings.

Following are three Caribbean examples of initiatives to reduce overweight and obesity in children and adolescents.

- The Farm to Fork project attempts to modify environmental factors by increasing food security, adapting school menus and offering healthy school lunches. Also, individual level factors are adapted as children and parents' nutritional knowledge increased.
- The Healthy Schools Nutrition Policy including the School Vending Machine and Cafeteria Policy targets social determinants at all levels. By the government introducing a structural level policy (the Healthy Schools Nutrition Policy), the environment of the school changed to offer healthier school meals and snacks. By creating such an environment, the individual level behaviours of the children changed to that of healthy eating.
- The Core Youth Movement Program, in Trinidad, focuses on changing individual level behaviour by using education to improve participants' concept of physical activity, self-confidence and self-worth and acceptance of the idea of food as a fuel.

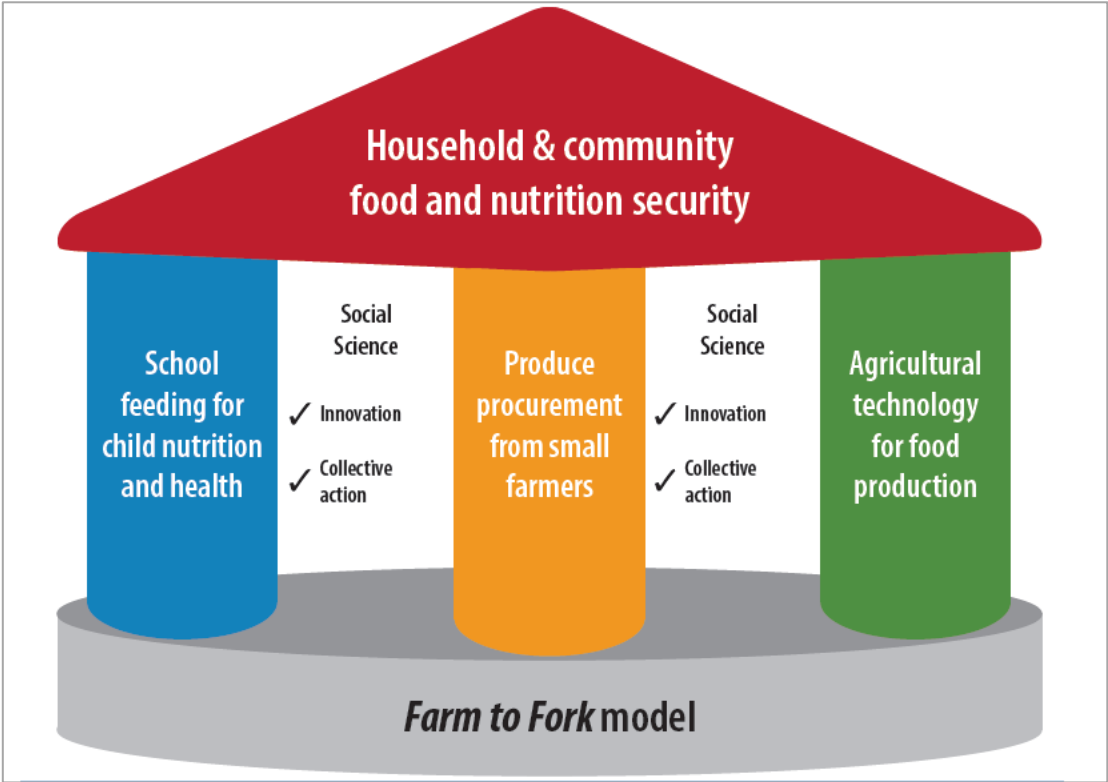
4.4.1 Farm to Fork

The Farm to Fork project is a collaboration between the International Development Research Centre (IDRC), in Canada and the University of the West Indies which uses a “farm to fork” approach to support the production of healthy fruits and vegetables and improve nutrition and health outcomes

in the Caribbean. The project focusses chiefly on St Kitts and Nevis and Trinidad and Tobago with some work in Guyana and Saint Lucia. The project ran between 2011 to 2014 and involved ministries responsible for food production, education and health.

The model used for this project incorporated social science research about innovation and collective action and was based on three fundamental pillars: improving children’s diets by increasing the quantity of fruit, vegetables, and animal sourced products in school meals; procurement of produce from local farmers for the school meals; and equipping small farmers to produce local fruits and vegetables throughout the year. This model takes an integrated approach involving industrial changes, capacity building, promotion of new agricultural technologies and changes in school feeding while also targeting women as innovators of technology (see Figure 75) (Granderson, Gray-Donald, Patterson-Andrews, Webb, & Johnston, 2014; Phillip, Johnston, & Granderson, 2014).

Figure 7530: Model for Farm to Fork project

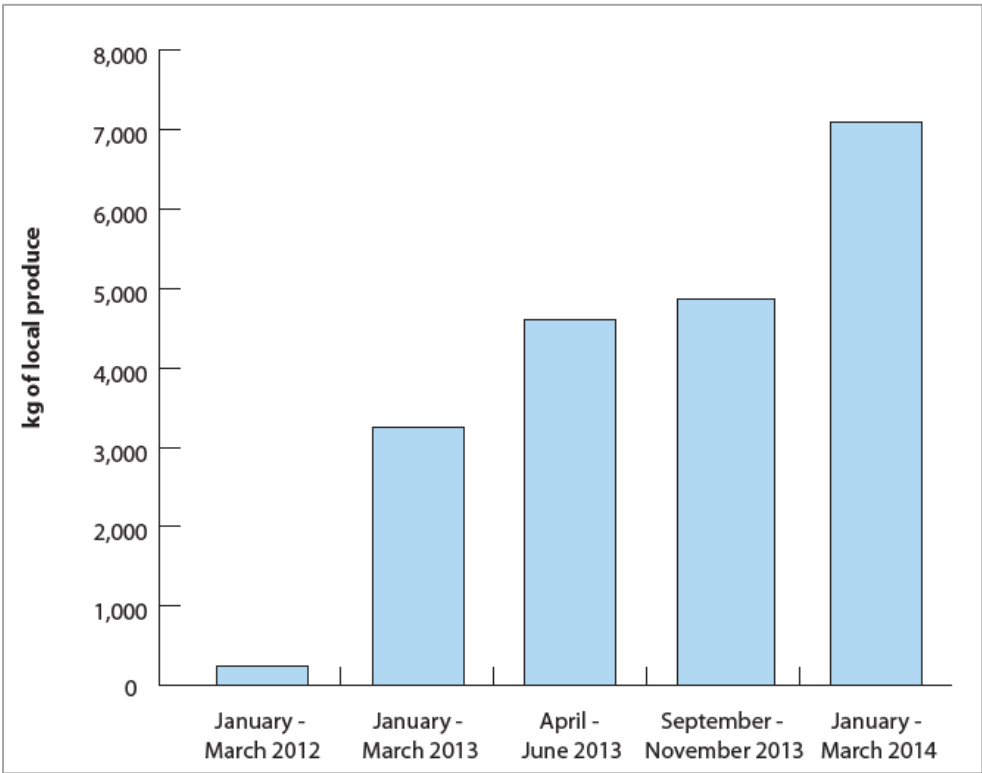


Source: International Development Resource Centre & Global Affairs Canada, Government of Canada

In St Kitts and Nevis, non-health Ministries responsible for agriculture and education worked with the Ministry responsible for health to prevent and control childhood obesity. A joint communications committee to enhance public awareness of this project was also established by the government. In Trinidad and Tobago, a system of tracking the use of local produce in schools was introduced by NSDS. After the introduction of this project a primary school in Trinidad and Tobago banned the sale of carbonated drinks in its cafeteria (Phillip et al., 2014).

It was believed that by offering a healthy lunchtime meal to children in schools, this could reduce consumption of high-energy unhealthy foods while teaching children about healthy eating. Interventions aimed at primary school children (ages 5-9) and their parents were implemented in St Kitts and Nevis and Trinidad and Tobago. Schools not involved in the intervention were also monitored to provide a comparison. School meal menus were revised and tested for nutritional quality and acceptability by the children, and local farmers were included to increase the quantity and variety of fruits and vegetables used in school lunches and at school meal centres. Over a 15-month period, menu changes integrated approximately 20,000 kg of fruit and vegetables into the School Meals Centre in St Kitts and Nevis which feeds approximately 800 children (See Figure 76).

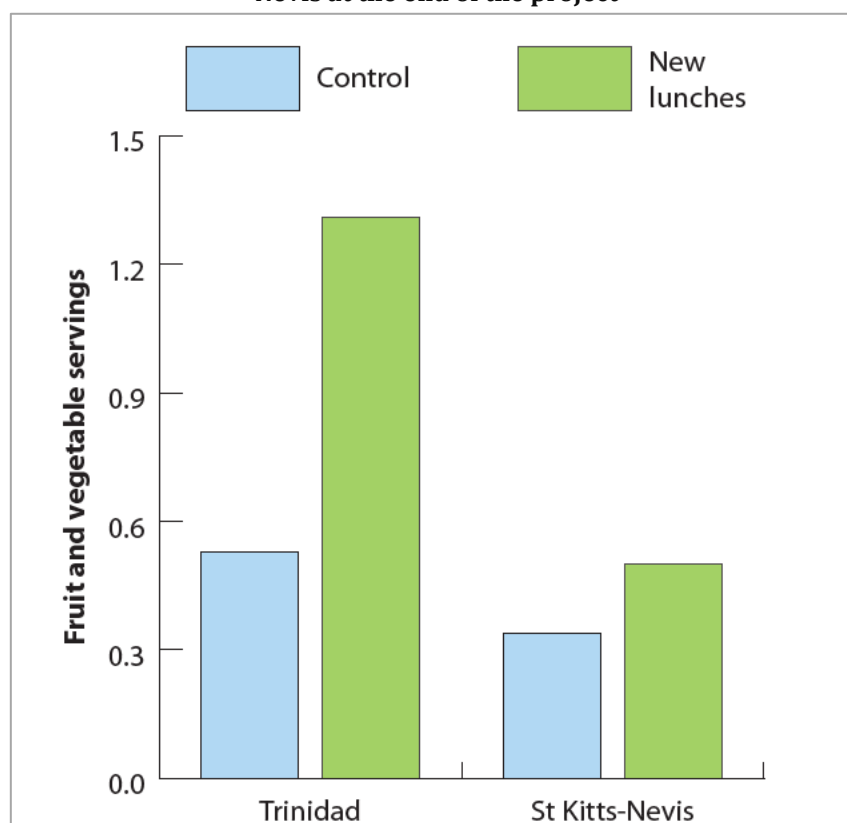
Figure 76: Produce purchased from local farmers for school lunches for 800 children in St Kitts and Nevis



Source: International Development Resource Centre & Global Affairs Canada, Government of Canada

In Trinidad and Tobago, children in the intervention consumed 55% more fruit in a day than the control schools. In St Kitts and Nevis, children in the intervention schools consumed 75% more vegetables in a day than those in non-intervention schools (see Figure 77) (Granderson et al., 2014).

Figure 31: Fruits and vegetables consumed by children in school lunches in Trinidad and St Kitts and Nevis at the end of the project



Source: International Development Resource Centre & Global Affairs Canada, Government of Canada

In St Kitts and Nevis, the project began with only offering three imported vegetables – carrots, onions, and Irish potatoes. As the project was implemented local fruit and vegetables, such as, tomatoes, cucumbers, string beans, sweet potatoes, cabbage and watermelon, became available. In Trinidad and Tobago, there was an increase in vegetable serving sizes (typically by an additional half a cup of vegetables per child), the addition of local fruits such as watermelon, bananas, tangerines, and oranges (typically half a large fruit or one whole small fruit per child, per day), and a serving of fish once per week. Menus with an improved nutritional value were tested for acceptability, notably by taste, to determine if the children would eat the foods and the results were used to inform the development of the menus. Plate waste measured acceptance. For example, watermelon demonstrated a waste of only 15% while only 50% of the children ate carrots. Overall plate waste decreased from 29% to 12% after revising the menus in Trinidad and Tobago (Granderson et al., 2014).

In Trinidad and Tobago, the nutritional education aspect of the project was geared towards both children and parents. Registered dieticians or teachers who were trained by dieticians conducted classroom activities with approximately 290 children. The children were taught about serving sizes from the six major food groups, healthy snacking, how to read and interpret nutrition labels, physical activity, home gardening, food safety and hygiene and cooking methods. One school revived its school

garden, allowing children to grow their own food, and prepare and eat it (see Figure 78). Approximately 135 parents were taught about balanced diets and portion control, healthy snacks for children and how to manage food costs. An analysis of changes in nutritional knowledge demonstrated an improved level among those children who received the nutrition education compared to those who did not, suggesting that changes to school menus alone does not improve nutrition (Phillip et al., 2014).

Figure 32: Children growing their own fruit and vegetables in a school in Trinidad



Copyright Jeff Mayers

Source: International Development Resource Centre & Global Affairs Canada, Government of Canada

Small local farmers were connected to the school feeding programmes in both St Kitts and Nevis and Trinidad and Tobago (see Figure 79). Agricultural technologies, such as drip irrigation on selected crops, were introduced to the farmers. This new expertise increased tomato yields from 18 to 32 metric tonnes/hectare, string beans from 3 to 10 metric tonnes/hectare and pumpkin from 17 to 25 metric tonnes/hectare. This technology also allowed a consistent supply of local crops for the school meals as the farmers could now produce crops throughout the year. A water balance model was also introduced to farmers allowing them to irrigate crops according to their specific requirements. This prevented the over-watering of fruits and vegetables, the reduction of production costs and the conservation of water. Other technologies included in the project introduced improved varieties of vegetables such as tomatoes, use of locally-made greenhouses, and the establishment and cultivation of specialised feed such as drought-tolerant mulato grass and sorghum forages for small ruminants such as sheep. Particular attention was paid to the role of women in how farmers made decisions, for

example, on whether or not to adopt a certain technology. An interesting outcome of this project was the formation of the Small Ruminant Farmers' Association which enables the stimulation and growth of the agricultural sector (Phillip et al., 2014).

Figure 79: Local farmer involved in the production of ingredients for school meals



Copyright: Raffaella Carvalho

Source: International Development Resource Centre & Global Affairs Canada, Government of Canada

Positive spin-offs of this project included the capacity-building of over two thousand participants in farming techniques such as drip irrigation, protected agriculture, and forage conservation. This increased the cropping area by 32% and the area for cultivating fodder crops by six times the original amount at the start of the project. Also included in the capacity-building exercises was skills training in food hygiene and service practices for catering staff. This addition of increased capacity and new technologies resulted in a thousand lunch meals with improved nutritional quality being delivered daily (Phillip et al., 2014).

Based on the positive outcomes of this project, which addresses improved healthy meals for school children and food security through equipping local farmers with the appropriate technology, the “farm to fork” project can now be scaled up regionally in a long term, sustainable fashion (Phillip et al., 2014).

4.4.2 Healthy Schools Nutrition Policy including the Vending Machine and Cafeteria Policy

In 1997, Bermuda introduced its mandatory Healthy Schools Nutrition Policy. School food guidelines addressed:

- the provision of whole fruits and vegetables in food service cafeteria menus and all school events that provide food;
- limitations on the use of food high in salt and sugar;
- provision of low-fat dairy products, leaner meats and whole grains, and
- the use of lower-fat cooking methods.

School lunches had to be consistent with recommendations from Bermuda's Daily Dietary Guidelines Eat Well Plate. Since 2008, the Healthy Schools programme of Bermuda has partnered with a charity to provide a healthy breakfast to vulnerable school-age children whilst ensuring the provision of low fat milk (Healthy Caribbean Coalition, 2017; Ministry of Education and Department of Health Partnership, 2006; World Cancer Research Fund International, 2017).

After consultation with the schools' Principals and the companies supplying the schools' vending machines, the Ministry of Health and Seniors and the Ministry of Education approved a Vending Machine and Cafeteria Policy, in 2006. This policy required that government schools ban sodas and snacks from vending machines on the schools' premises and offer only plain unsweetened water and/or 100% juice and healthy snacks. Within one year of introducing the Vending Machine and Cafeteria Policy, all government schools had implemented it; private schools became compliant within two years (Healthy Caribbean Coalition, 2017; Ministry of Education and Department of Health Partnership, 2006; World Cancer Research Fund International, 2017).

In 2009, a government primary school (St George's Preparatory) became the first school to adopt a Water-only Policy, which allows only water on the school premises, including in lunches being sent from home. Since the introduction of the Vending Machine and Cafeteria Policy in 2006, over fifteen private and public schools, including preschools, have introduced a Water-only Policy. A further four have promoted water-only behaviours during school hours. In 2016, the Ministry of Education installed filtered water fountains in all government schools and installed reusable water fountains in five schools. Students are encouraged to re-fill their reusable water containers throughout the day and sip water while at their desks or make frequent trips to the water fountains (Bernews, 2017; Healthy Caribbean Coalition, 2017; Ministry of Education and Department of Health Partnership, 2006; World Cancer Research Fund International, 2017).

Figure 80: Students at Refillable Water Station in Bermuda



Source: Healthy Caribbean Coalition

4.4.3 Core Youth Movement Programme

With financial support from JB Fernandes Memorial Trust 1, Population Services International Caribbean (PSI-C) developed and implemented a youth-focussed programme which addressed behavioural risk factors associated with the four major NCDs in Trinidad and Tobago – cardiovascular disease, diabetes, cancer and chronic respiratory disease. In 2015, a landscape analysis was undertaken to better understand the determinants of unhealthy lifestyle behaviours within the country, identify any previous research conducted, and locate any organisations with which PSI-C could collaborate.

The landscape analysis showed that, at that time, there was a Regional (PAHO-CARICOM) Strategic Plan of Action on NCDs for the Caribbean (2011-2015) but no nationally approved multi-sectoral plan for the prevention and control of NCDs in Trinidad and Tobago⁸. There were initiatives, strategies and programmes that did exist, but few operated in tandem with the broader strategic Plan of Action. Additionally, even though some research had been conducted, much of it was not readily available and shared and therefore had little impact on programming. Components of an intervention were recommended to include healthy lifestyle behaviours, self-concept, practical and cognitive tools, take home materials, a focus away from weight management, and involvement of families, peers, and professionals (West, 2016).

⁸ Subsequent to the 2015 landscape analysis a National Strategic Plan for the Prevention and Control of Non-Communicable Diseases: Trinidad and Tobago 2017 – 2021 was developed.

The Core Youth Movement Programme (CYMP) was developed and implemented in collaboration with a local organization – Movement Mechanics – which specializes in the improvement of physical performance, athletic development and healthy lifestyles. The overall aim of the CYMP was to prevent NCDs by developing healthy lifestyles habits among the youth. This included improving the mindset of the youth around physical activity; increasing movement and physical activity; improving self-confidence and self-worth; and embracing the idea of food as fuel. The first round (CYMP) (January-April 2017) targeted males and females (13-16 years old) who were not currently active and may be overweight, and who were willing to commit to the full eight-week Programme. Fifteen youths (eight males and seven females) between 11-17 years old (average age 14-15 years old) took part. Three youths did not complete, citing medical issues, school priorities and family commitments.

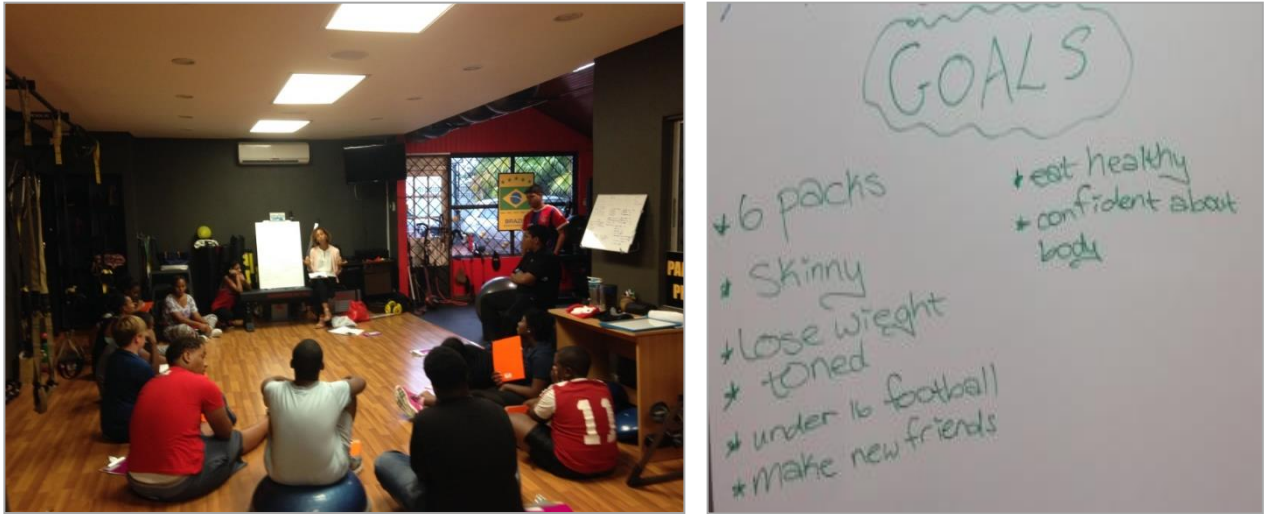
The Programme consisted of four sessions per week for eight weeks. Three of the sessions were focused on physical activity and were conducted by performance specialists. One session per week was conducted by a psychologist and covered topics that included healthy eating (e.g. portion size, sugar content) and psychological issues (e.g. self-confidence). The following photos show aspects of the physical, psychological and nutritional components of the Programme (see Figures 81, 82 and 83 respectively) (Population Services International Caribbean, 2017).

Figure 81: Physical Component of the Core Youth Movement Programme



Source: Population Services International-Caribbean

Figure 82: Psychological component of the Core Youth Movement Programme



Source: Population Services International-Caribbean

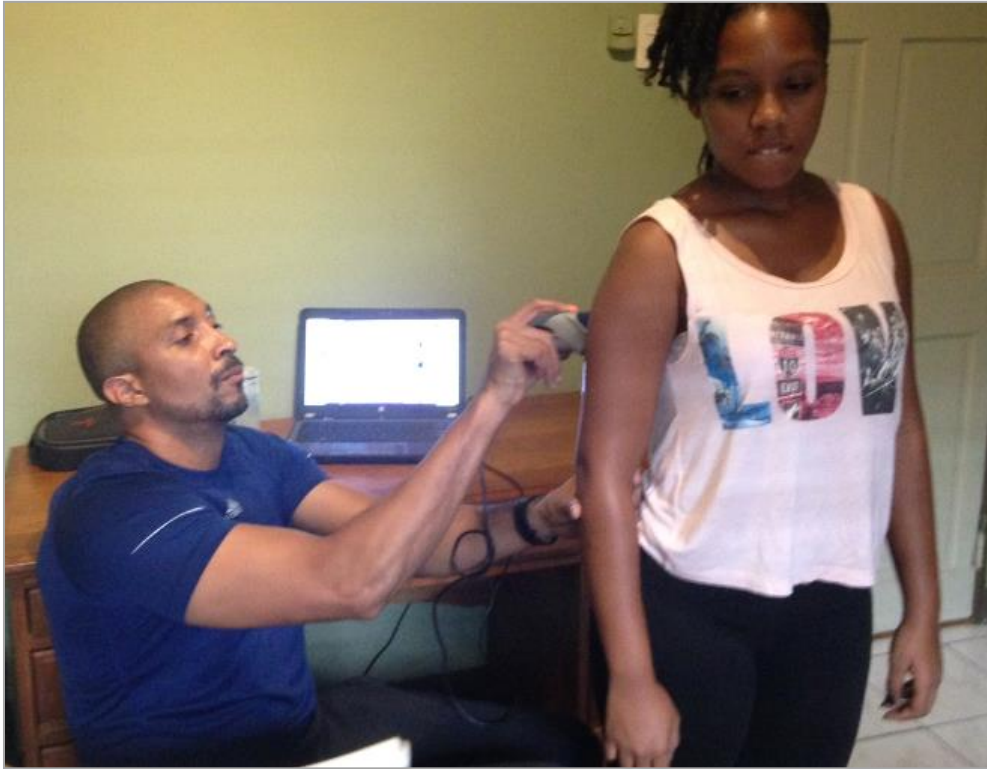
Figure 83: Nutritional component of the Core Youth Movement Programme



Source: Population Services International-Caribbean

Baseline and end-line monitoring and evaluation indicators for functional movement, body composition analysis, strength tests, psychological assessment, and knowledge improvement regarding diet and exercise were collected and analysed for this first round. The following picture (Figure 84) shows a member of the professional team taking measurements to determine body fat composition. (Population Services International Caribbean, 2017).

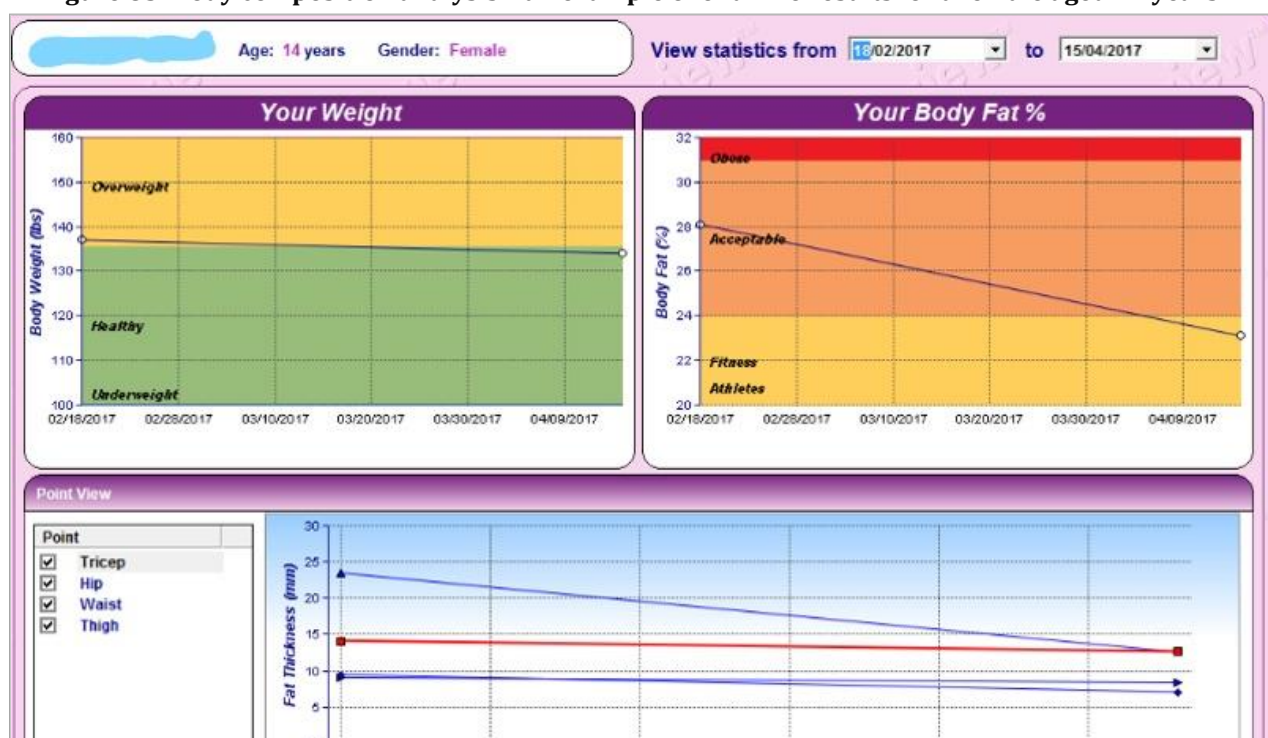
Figure 33: Taking measurements for the Core Youth Movement Programme



Source: Population Services International-Caribbean

Figure 85 shows examples of end-line body composition analysis for a female aged 14. Here the female participant's weight went from being "overweight" to "healthy". Her body fat decreased by 5% (from 28% to 23%); from being "acceptable" to being "fit". (Population Services International Caribbean, 2017).

Figure 85: Body composition analysis – an example of end-line results for a female aged 14 years



Source: Population Services International-Caribbean

Feedback from the participants was positive:

On body image

"I have lost weight, and because of that I am more confident of my body image. I drink more water, I eat more often, and I watch what I eat and how healthy it is." – Girl age 15 years

On self-confidence

"I found the Friday evening sessions helpful because I learned to believe in myself." – Boy age 16 years

On nutritional habits

"I learnt that it is important to eat balanced and not to eat too much dairy and starch. I changed the portion size of my meals and eat fruits daily" – Boy age 13 years

"I've started eating fruits on a regular basis and I've stopped drinking soda. I've lost a lot of weight, so I feel good about my body." – Girl age 14 years

From the physical activity coaches:

"I think it's very important that this programme continues. There is an epidemic in Trinidad right now in regard to lifestyle diseases- such as diabetes, heart diseases,

hypertension etc. A lot of it comes from poor eating and it needs to be taught from the ground up. And from the ground up I mean, from the youths- upward.”

“A programme such as this is important because there are lots of kids who are inactive; who would like to become active; and just don’t know how to do it. And are afraid to inquire, as to how to do it. So, this is a very good stepping stone for them.”

Two challenges were identified in the implementation process: finding the right partners to execute the CYMP with the correct mix of physical, nutritional and psychological skills together with recruiting the youth participants. Two rounds of tendering were conducted to find a suitable partner. The first potential partner had the correct technical expertise but did not fall within budget. A local NGO involved in NCD prevention and control was willing to collaborate but were only interested in the nutritional component of the CYMP. After the second round of tenders Movement Mechanics was identified and was also willing to offer their services at a reduced rate because they recognized the value of the CYMP and wanted to positively contribute to society. In order to qualify for the CYMP, youth had to commit to four days per week; fit the target criteria; and be motivated to make a lifestyle change. A variety of recruitment strategies were used – circulation of flyers on social media (see Figure 86); speaking and using advertisements on local radio stations; advertisements in the local newspapers; visits to local high schools; and presentations at parent teacher association meetings. It was found that even though families were interested, potential participants could not make the commitment or were living or going to school too far away from the Programme’s venue. (Population Services International Caribbean, 2017).

Figure 86: Flyer for the Core Youth Movement Programme



Source: Population Services International-Caribbean

Population Services International-Caribbean has understood the importance of taking these programmatic challenges on board for future rounds, the second of which started in July 2017. For the CYMP to have continuity throughout the different rounds and continue the motivation, participants from the first round will be involved with the second cohort of youths. The long term vision of the CYMP is to offer the CYMP to a wider cadre of youths; include more outreach activities in communities to promote NCD prevention; offer movement and nutrition support in the workplaces; ensure alignment with national policy and trends; and advocate for greater investment in NCDs, particularly among youth (Population Services International Caribbean, 2017).

4.5 Frameworks and Guidelines

The Caribbean has a long history of public health cooperation. Regional frameworks and guidelines for addressing NCDs and childhood obesity include (CARPHA, 2015):

- 2001: The Nassau Declaration on Health: the health of the Region is the wealth of the Region was signed by CARICOM Heads of Government.
- 2007: The Declaration of Port of Spain: Uniting to stop the epidemic of chronic non-communicable diseases was signed by CARICOM Heads of Government at the world's first high-level summit on NCDs.
- 2007: The Declaration of St Ann's: Implementing Agriculture and Food Policies to prevent Obesity and NCDs was signed by CARICOM Ministers of Agriculture. They committed to exploring and supporting the use of agricultural and trade policy to ensure the availability and affordability of healthy foods, promoting greater use of indigenous and regionally-produced agricultural products and foods, and to strongly supporting the elimination of trans-fats from our food supply and mandatory labelling of food.
- 2008: The Bridgetown Declaration for Tackling the Epidemic of Chronic Diseases was released by a regional civil society umbrella organisation, the Healthy Caribbean Cooperation.
- 2008: Georgetown Declaration on Building a Region Fit for Children was focussed for the education and social sectors and committed to by the CARICOM Ministers with the responsibility for children.
- 2010: Regional Food and Nutrition Strategy (RFNSP) (2011-2025) and Action Plan. The RFNSP highlights the importance of trade policy, and the need to address the disconnect between food production, processing, health and nutrition and trade and investment policies.
- 2011: Strategic Plan of Action for the Prevention and Control of NCDs in Countries in the Caribbean Community (2011-2015) which was borne out of the POS Declaration.
- 2012: OECS Regional Plan of Action for Agriculture (2012-2022) and Growth and Development Strategy also identify NCDs as priorities for action.
- 2014: PAHO Plan of Action for the Prevention and Control of NCDs in the Americas (2013-2019) which corresponds to the PAHO Strategy for the Prevention and Control of Non-Communicable Diseases (2012-2025).
- 2014: PAHO Plan of Action for the Prevention of Obesity in Children and Adolescents (2014-2019).
- 2014: CARPHA Plan of Action for Promoting Healthy Weights in the Caribbean: Prevention and Control of Childhood Obesity (2014-2019).

All four phases of the Caribbean Cooperation in Health have recognised NCDs as a regional priority. CCH1 was adopted in 1986; CCHII covered the years 1999-2003; CCHIII from 2010 to 2015 and finally CCHIV from 2016 to 2025. Special mention must be made of CARPHA's 6-Point Policy Package and the recommendations from the Evaluation of the Port of Spain Declaration that will mould the region's action to reduce childhood obesity and map the way forward to assist in the prevention and reduction of childhood obesity.

4.5.1 CARPHA's 6-Point Policy Package

As noted above there have been many regional strategies relating to reducing and preventing NCDs and childhood obesity, with the 2007 POS Declaration having the potential to be the most influential. Despite several successes with the implementation of the Declaration (see Section 2) by 2014, it was apparent that progress with regard to achieving the goals set for the area of food and nutrition was too slow. These include, but not limited to, the fact that none of the English-speaking Caribbean states had yet put into place legislation to prevent and control obesity, diabetes and cardiovascular diseases; there was no legislation to prevent advertising of unhealthy foods to children, and compulsory nutrition labelling of food and drinks had yet to be enacted (CARPHA, 2015).

Realising that a whole of society approach was necessary to reduce the burden of obesity and diet-related NCDs, in 2015, CARPHA developed a *Technical Brief: Promoting Healthy Diets, Food Security, and Sustainable Development in the Caribbean Through Joint Policy Action*. This Technical Brief promoted and described six policy areas – food labelling; nutrition standards and guidelines for schools and other institutions; food marketing; nutritional quality of food supply; trade and fiscal policies; and food chain incentives – which became known as the CARPHA's 6-Point Policy Package (CARPHA, 2015). Table 22 describes this 6-Point Policy Package and the policy options offered.

Table 21: CARPHA's Six Point Policy Package

Objective	Policy Options
<p>1. Food labelling: product packaging and appeal.</p> <p>Objective: to enable consumers to make informed food choices and to prevent misleading claims about nutrition and health benefits.</p>	<p>1.1. Mandatory uniform Nutrition Facts Panels (NFP) on all packaged retail grocery foods and beverages sold within the region, to support informed consumer choice</p> <p>1.2. Standardised, interpretative/graphical nutrition labels on all packaged retail grocery foods and beverages, for use in conjunction with nutrition facts panel</p> <p>1.3. Regulate all on pack marketing, including nutrient content, nutrient function, and health claims, and promotional offers and characters, on all packaged retail grocery foods and beverages sold within the region</p> <p>1.4. Mandatory nutrition labelling on menus and menu boards in chain restaurants, vending machines, movie theatres, and other entertainment venues.</p>
<p>2. Nutrition standards and guideline for schools and other institutions: what is provided at school and work.</p> <p>Objective: to ensure that food provision in school and (government-funded settings), encourages dietary choices that are aligned with dietary guidelines.</p>	<p>2.1. Mandatory national nutrition standards for all foods provided and sold in schools and early childhood services, based on generic regional guidelines.</p>

Objective	Policy Options
<p>3. Food marketing: advertising, promotion, product appeal and presentation.</p> <p>Objective: to minimise the impact (exposure and power) of unhealthy food and beverage advertising on children.</p>	<p>3.1. Reduce children’s overall exposure to unhealthy food advertising through all channels.</p>
<p>4. Nutritional quality of food supply (levels of harmful ingredients): taste.</p> <p>Objective: to minimise the energy density and unhealthy consumption (ie foods with high levels of salt, sugar, saturated and trans fats) of processed foods and foods prepared for sale.</p>	<p>4.1. Mandatory removal of artificial trans-fats in all food products.</p> <p>4.2. Set regional standards and time-bound salt and sugar reduction targets for specific food product categories.</p> <p>4.3. Improve nutritional quality of ingredients and foods sold by food service outlets and street vendors.</p>
<p>5. Trade and fiscal policies: price, domestic availability and affordability.</p> <p>Objective: to protect national and regional food sovereignty and to promote demand for healthy domestic food.</p>	<p>5.1. Selectively adjust sales taxes to align with the nutritional value of foods.</p> <p>5.2. Align tariff schedules with the healthfulness of foods by selectively adjusting import duties on foods and beverages NOT originating outside CSME.</p> <p>5.3. Tailor public assistance, such as subsidies and welfare payments, to incentivise healthy food consumption.</p>
<p>6. Food chain incentives: availability of fruit and vegetables.</p> <p>Objective: to ensure agricultural and food systems policies are in coherence with healthy eating.</p>	<p>6.1. Preferentially target agricultural supports and incentives towards nutrient-rich commodities, especially fruits and vegetables.</p> <p>6.2. Promote demand-side incentives for healthy domestic food chains.</p> <p>6.3. Identify and address bottlenecks in domestic healthy food chains.</p> <p>6.4. Work with food processors/suppliers to promote use of healthier ingredients.</p> <p>6.5. Promote and support community food production.</p>

In November 2015, at the 41st Meeting of Council of Trade and Economic Development (COTED), upon consideration of the Technical Brief, COTED agreed that review and further consideration on adopting CARPHA's 6-Point Policy Package for healthier food environments was necessary. The following year at the 43rd Meeting of COTED (November 2016) it was decided that national multi-sectoral action and interagency collaboration be taken to advance the agenda on the reduction of childhood obesity in the region(CARPHA, n.d.-a).

In order to prevent childhood obesity, the policy options and recommendations for the implementation of CARPHA's 6-Point Policy Package can be presented under the categories structural, environmental and social, and individual and behavioural as described in the ecological framework outlined above. At the structural level, the policy options and recommendations focus on regional guidelines which offer clear strategies for the advertising and marketing of healthy foods and drink including the development of a regional toolkit for healthy food advertising. The recommendations offered at the environmental level focus on the obesogenic environments of the schools and communities and attempt to ensure that the school children are offered healthy meals and snacks, both within the school premises as well as the school environs. These recommendations also focus on the farmers and providers of food to ensure that fresh, wholesome and local food is readily available and accessible throughout the year. At the individual and behavioural level, the recommendations attempt to create an environment in which it is easy for adults and children to eat well. An objective is that all artificial trans-fats will be removed from food products and there will be a reduction in the salt and sugar added to food. Recommendations include use of education to raise awareness and regulate food content labelling and food marketing to achieve these goals. The CARPHA 6-Point Policy Package will also hopefully lead to other indirect health benefits such as improved incomes, greater food availability and affordability together with reduced food imports.

Evaluation of Port of Spain Declaration

The 2014-16 evaluation of the Port of Spain Declaration on NCDs included recommendations specific to childhood obesity and to ensure that children live in a non-obesogenic environment (Port of Spain Declaration Evaluation Secretariat, 2017). These included:

At the structural level:

- Ban advertising, promotion and sponsorship related to unhealthy foods that target children.
- Review, update and standardize the Health and Family Life Education curriculum to include NCD risks.
- Make physical activity mandatory from pre-primary to tertiary level.
- Promote a wider range of physical activities in school programmes.
- Develop an overarching regional school nutrition policy; introducing school feeding programmes and encouraging more water consumption.
- Conduct an evaluation of the nutritional value of typical school meals.

At the environmental and social level (in schools):

- Develop school health programmes that encourage healthy eating, physical activity and zero tolerance for tobacco and alcohol. Involve parents and the wider community.
- Caribbean Wellness Day (the second Saturday in September) can be used as a launch pad for many of the suggested interventions and activities below.

At the individual and behavioural level:

To promote healthy diets

- Introduce healthy food options in school canteens/among vendors.
- Educate food vendors, parents and students on healthy (and tasty) food options. Let students have a say in what they want to eat and drink.
- Train school canteen staff in child nutrition.
- Introduce a wider range of foods at school and at home, including ground provisions, fruit and vegetables.
- Organise healthy eating challenges/competitions for the children to complete.
- Ensure students have access to water throughout the day.
- Plant vegetable/kitchen gardens in schools and let the children look after them.
- Use 'creative' and home economics classes to teach children how to make healthy snacks and easy meals.

To promote physical activity

- Organize physical activity challenges for students that are inclusive and fun, involving children irrespective of their physical abilities. (And allow sweaty children back into the classroom!).
- Promote sixty minutes of activity a day.
- Hold after-school exercise clubs (aerobics, line dancing, etc.)
- Organize debates/song competitions on healthy lifestyle topics.
- Ask approved and relevant private sector companies to donate branded sports equipment.

Note that although the promotion of healthy diets and physical activities are intended to occur in the schools (at the environmental level) they involve elements of behaviour change and therefore overlap with individual and behaviour level factors.

4.6 Conclusion

In the Caribbean, the social and structural determinants of NCD and obesity are not only affecting adults but are now affecting children. While there are promising interventions at the levels of schools and important regional policy initiatives, CO is not receiving the attention it deserves. Important aspects of the Port of Spain declaration relating to trade and the importation of unhealthy food and advertising have not been implemented as well as they should (see chapter 2, section 2.5.2). There is a need to address home, retail and recreational environments and not just school environments in attempting to tackle CO. More active efforts should be made to re-engage Caribbean young people in outdoor sporting and recreational activity. These efforts are likely to pay off in terms of economic prosperity by enabling productivity and avoiding unnecessary costs of health and psycho-social care for people who were obese when they were children.

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