An Epidemiology of Adolescent Obesity in Latin America and the Caribbean

GEORGIA STATE UNIVERSITY

An Epidemiology of Adolescent Obesity in Latin America and the Caribbean

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DISSERTATION

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Preface

When I was 10 years old growing up in the Caribbean island of Barbados, one of my classmates was diagnosed with diabetes. It was the first time that I had heard of a young person getting the disease. I remember that she had to change her lifestyle. The school announced that she would be using a special chair with a cushion and she could no longer sit with us. As kids, we speculated that she contracted diabetes because she ate 'tamarind balls' (a traditional snack made from the sour fruit of the tamarind tree and covered in sugar) from our school sweets vendor every morning. No one ever mentioned that her 'plumpness' could have played a role in her getting the disease. Ironically, they told her she had to reduce her physical activity.

In 2016, during my PhD program, the Honorary Consul General for the Government of Barbados in Atlanta asked me to find a speaker on non-communicable diseases for a Barbados government sponsored *Barbados Comes to Atlanta* conference, to be held in Atlanta. I approached Dr. Ike Okosun and through talking to him about his research in preparation for the conference, I realized that obesity was an epidemic in our Latin American and Caribbean region. I decided to conduct this study, under the direction of Dr. Okosun, to better understand the epidemiology of this public health problem to inform efforts to reduce the negative impact on the next generation. I am dedicating this study to *todos los adolescentes* in Latin America and the Caribbean.

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& my friends and family.

Abstract

Background: Adolescent obesity is a serious public health problem in high-income countries of the world. However, despite the sociodemographic, cultural background and structural healthcare access and sustainable development differences among high-income countries, results of obesity studies are often generalize to all high-income countries, including high-income, developing countries. Few studies exist, describing the relationship between obesity and associated factors in high-income, developing countries. Hence this investigation aims to describe the epidemiology of obesity and determinants that may exist among school-based population in six high-income, developing countries in Latin America and the Caribbean.

Methods: Data from the Global School-Based Student Health Survey for Anguilla, Bahamas, Curacao, Uruguay, Chile, and Argentina was used to compare prevalence of obesity and associated risk factors. Multivariate logistic regression analyses were used to estimate risk of obesity between countries.

Results: Regional prevalence rate of obesity was 19%; 31.3% for the Caribbean, 17.6% for Latin America, 35.8% for the Bahamas, 31.7 for Anguilla, 32.3% for Chile, 25.5% for Curacao 17.5% for Uruguay, and 16.5% for Argentina. Increased odds of obesity in the Caribbean was estimated for females (AOR: 1.44, 95%CI: 1.16 - 1.79), and bullying victims (AOR: 1.36, 95% CI: 1.01 - 1.82), and bullying victimization (AOR: 1.99, 95% CI: 1.28 - 3.08) and being 14 years old (AOR: 1.59, 95% CI: 1.02 - 2.47) in Latin America. Decreased odds of obesity was associated with engaging in physical activity in Anguilla (AOR: 0.31, 95% CI: 0.15 - 0.65), whereas increased odds of obesity was associated with female gender in the Bahamas (AOR: 1.65, 95% CI: 1.23 - 2.23), bullying victimization in Curacao (AOR: 2.02, 95% CI: 1.27 - 3.21), Uruguay (AOR: 1.36, 95% CI: 1.06 - 1.81) and Argentina (AOR: 1.28, 95% CI: 1.05 - 1.56), age 14 years olds in Uruguay (AOR: 1.33, 95% CI: 1.02 - 1.73), 15 years in Uruguay (AOR: 1.51, 95% CI: 1.07 - 2.12), Chile (AOR: 2.21, 95% CI: 1.51 - 3.22) and Argentina (AOR: 1.35, 95% CI: 1.02 - 1.79).This dissertation was the first to compare these obesity risk factors between high-income, developing Latin American and Caribbean countries and sub-regions.

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Chapter 1 Introduction and Statement of Purpose

Overview

Obesity is a growing and expensive public health disease that significantly increases risks for many conditions such as cardiovascular diseases, diabetes, musculoskeletal diseases and some cancers (World Health Organization 2018, Feburary 16). Obesity is usually caused by an imbalance between energy intake and energy expenditure (World Health Organization 2018, Feburary 16). In 2016, globally, more than 1.9 billion adults, aged 18 and older, were overweight and 650 million were obese, representing 39% and 13% of adults, respectively (World Health Organization 2018, Feburary 16). Regarding adults who are overweight or obese, if current trends in overweight and obesity continue, 1.35 billion and 573 million persons will be obese and overweight respectively, by 2030 (He, Yang et al. 2008). Globally, approximately 18% (more than 340 million) of children and adolescents aged 5 – 19 years old were obese in 2016 (World Health Organization 2018, Feburary 16) and 1 million children under the age of 5 were either overweight or obese in 2016 (World Health Organization 2018, Feburary 16). Obesity prevalence in Latin America and the Caribbean (LAC) is higher than the global average for children and adolescents (FAO and UNICEF 2018).

Obesity has several adverse health consequences. In the short term, obese children and adolescents can experience obesity-related diseases (Lobstein, Baur et al. 2004, Bjørge, Engeland et al. 2008), which could lead to disability and mortality. In the long term, studies have shown that children and adolescents who are obese are more likely to become obese adults, hence at higher risks of morbidity, mortality and obesity-related non-communicable diseases during adulthood (Guo and Chumlea 1999, Bjørge,

Engeland et al. 2008, Singh, Mulder et al. 2008, World Health Organization 2018, Feburary 16). Although studies have not evidenced the obesity transition from adolescence to adult obesity among LAC populations, high prevalence of premature mortality from obesity-related diseases suggests that there is a need for early intervention. Therefore, it is important to understand predictors for adolescent obesity among LAC countries.

Obesity is a multifactorial disease which is influenced by a complex interaction of individual, behavioral, environmental, and socioeconomic factors (Grundy 1998, CDC 2018). Research indicates that genetics, gender and age play a role in the development of obesity (Grundy 1998). However, the main drivers are behavioral factors such as poor diet, inadequate physical activity and sedentary behavior (Grundy 1998, Han, Lawlor et al. 2010). Globally, increased consumption of high calorie foods, rich in sugar and fats, coupled with reduced physical activity and increasing time spent sedentary has contributed to the obesity epidemic. At the community and country level, these behaviors are further influenced by changing economic, environmental and social factors. For example, as the Latin American region develops studies suggest that changes in nutrition have resulted from increased access to sugar snacks from increased imports of unhealthy foods (under trade agreements between Latin America and the United States) alongside lower intake of fruit and vegetables (Corvalán, Garmendia et al. 2017). In addition, the obesity epidemic has also been caused by lower physical activity from increased use of mechanized transport and higher sedentary behavior (Corvalán, Garmendia et al. 2017). Moreover, the World Health

Organization (WHO) points out that social and economic development and inadequate or lack of policies to regulate the obesogenic environment including agriculture, urban planning for location of fast foods, health, transport, food processing and education are also key influencers of the obesity epidemic (WHO 2015). Among different populations, the influence of risk factors for obesity may differ hence it is important to examine predictors in individual LAC countries.

Historically, most studies have focused on adolescent obesity in high-income, developed countries such as the United States and England (Ogden, Carroll et al. 2012, Bann, Johnson et al. 2018), where obesity levels have plateaued at high levels (Popkin and Doak 1998, Collaboration, Abarca-Gómez et al. 2017). A similar trend of flattening obesity rates has also been identified for high-income countries in the Asia-Pacific region (Collaboration, Abarca-Gómez et al. 2017). However, evidence shows high and rising prevalence of obesity in many developing countries (Popkin and Doak 1998, Gupta 2012, Ng, Fleming et al. 2014, Collaboration, Abarca-Gómez et al. 2017). For example, a study by Gupta et al.(2013) indicated obesity prevalence in developing Latin American and Asian countries was higher than the global average in Mexico (41.8 %), Brazil (22.1 %), India (22.0 %), and Argentina (19.3 %) (Gupta 2012). Moreover, evidence suggests that obesity prevalence differs in high-income versus low- and middle-income countries (LMICs) (Collaboration, Abarca-Gómez et al. 2017). Abarca-Gómez et al. (2017) examined adolescent obesity prevalence in high- and middle-income countries in all regions and found differences between countries of different income levels in the same region. However, in the findings, the study differentiated

between high-income countries in the Asian region but failed to do the same for high-income countries in the LAC region (Collaboration, Abarca-Gómez et al. 2017). In addition, most studies on the LAC region refer to the area as consisting of LMICs but there are several high-income countries in the region (Collaboration, Abarca-Gómez et al. 2017). Few population-based studies have been published on obesity and risk factors in LAC countries due to lack of systematic surveillance. This has resulted in piecemeal attempts to address the obesity problem. Therefore, it is important to further examine whether obesity prevalence and risk factors differ in high-income, developing countries in the LAC region.

Countries can be classified in several ways depending on the institution and the measures. For instance, every year the World Bank uses the economic indicator Gross National Income per capita (Atlas Method) to classify countries into high-, middle- (upper and lower) and low-income countries (World Bank 2012). Generally, low- and middle-income countries are referred to as developing countries (World Bank 2012). Also, the International Monetary Fund (IMF) uses macroeconomic data to publish the World Economic Outlook Report annually to classify countries as advanced or emerging markets and developing economies (Fund 2019). Developing countries can also be classified based on geographic and economic characteristics into Small Island Developing States (SIDS). SIDS share similar economic and structural challenges as developing states but have specific characteristics due to small size, remoteness and vulnerability to global and environmental events including natural disasters (Nations).

In the LAC region, the whole area consists of developing countries, some countries have limited and inequitable sustainable development (such as inadequate access to water, education and health). Moreover, there are several high-, middle- and low-income countries in the region based on different levels of economic development. This study focuses on high-income, developing countries in the LAC region. For the purposes of this study, LAC countries were classified as high-income based on the GNI more than US$12,376 in the year of the Global School-Based Student Health Survey (GSHS) (World Bank 2012). Additionally, developing countries were defined based on the classification under the IMF report in the year of the survey (Nations , Fund 2019). The SIDS classification list was used for countries not included in the IMF list (Nations).

According to the WHO, adolescence is described as the transitional period between childhood and adulthood (Who 2017). It includes primarily school age individuals between 10 and 19 years (Who 2017). According to Patton et al. (2016) adolescence can be divided into early adolescence (ages 10–14 years) and late adolescence (ages 15–19 years) (Patton, Sawyer et al. 2016). This transitional period is characterized by biological, neurodevelopmental, physical and social changes which can affect current and future health of adolescents. During this period, health and other behaviors are learned that will drive the burden of disease across the life-course of an individual (Who 2017). Thus, adolescent health behavior threatens the current health, future health as adults and also by way of exposures, this also poses a risk to the health of their future children (Who 2017). In particular, adolescent health development is influenced by individual characteristics and environmental factors (Who 2017). Moreover, younger

adolescents are still in the process of developing therefore are more vulnerable to unhealthy behaviors (Who 2017). Since most factors influencing obesity are preventable (Ofei 2005), an understanding of the social, behavioral, and environmental determinants that may influence adolescent obesity in the LAC countries can inform early prevention actions.

Adolescent health is critical to the future of LAC countries since adolescents represent the future development of the countries. According to the Pan American Health Organization (PAHO), adolescents represent the health status of countries and good health can lead to independence, security, and productivity across the life-course (Paho/Who 2017). Adolescents also represent the caregivers for future elder populations. Since the LAC region is experiencing a demographic transition, populations are aging due to lower fertility rates and longer life expectancies. For example, 71 million (11.2%) of the LAC population is aged 60 and older (Paho/Who 2017) and the elder population is projected to double in 20 years in the region (The National Academies of Sciences 2015). Moreover, as the region is also experiencing an epidemiologic transition, the burden of disease among LAC populations has shifted from infectious diseases to high prevalence of non-communicable diseases (NCDs). For instance, NCDs caused approximately 5.2 million deaths of adults in the Americas (Hennis 2018). Obesity-related diseases are both affecting the elderly population and causing premature mortality among younger adults. For example, obesity-related diseases caused three-quarters (78%) of deaths in the Caribbean in 2017 (Hennis 2018). The adolescents of today will be future adults who will care for their aging

relatives. Therefore, there is a need to develop evidence-based preventative strategies for obesity to mitigate the effects of premature mortality or disability on adolescent populations.

While there are a range of measures for measuring childhood and adolescent obesity (Who 2019), WHO recommends using WHO growth reference charts, which specify body mass index classifications for severe thinness, thinness, overweight and obesity based on age and gender (Who 2019). Body Mass Index is an indicator used to classify persons by nutritional status (Who 2019). According to WHO, a person aged 5-19 years is classified as overweight if their BMI-for-age is greater than 1 standard deviation above the WHO Growth Reference median (equivalent to BMI 25 kg/m^2 at 19 years); and obese if the BMI-for-age is greater than 2 standard deviations above the WHO Growth Reference median (equivalent to BMI 30 kg/m^2 at 19 years) (Who 2019). For the purposes of this study, BMI is calculated by dividing self-reported weight in kg by height in meters squared (kg/m^2) and classified based on ranges adapted from the WHO age for weight growth charts for boys and girls (WHO 2019, WHO 2019). Adolescents were categorized as normal weight if their BMI>=14.9 & BMI <24.2 and, overweight or obese (hereinafter referred to as obesity) if BMI >=24.2.

Adolescent obesity and related diseases are a huge burden on the wider societies in the region. Firstly, as mentioned above, given the increases in life expectancy in the region, the elderly population will require more care. Younger generations will be important as caregivers for their parents and grandparents. Secondly, the adolescents represent the future workforce of the country. Given the low birth rate in many countries and the aging

populations, adolescents will be critical to economic development of countries. Thirdly, there is a direct financial cost of adolescent obesity for health systems in the region. Lastly, there are indirect costs such as absenteeism from work which will affect economic outputs. No study could be located that examined the financial cost of adolescent obesity on LAC countries. However, as mentioned above, studies have indicated the burden of adult obesity and obesity-related diseases on LAC countries. For example, in 2000 annual estimated direct and indirect costs of obesity-related diabetes in Latin America and the Caribbean was $US 65.2 billion (Hennis 2018). Also, the predicted rise in NCDs by 15% by 2020 is projected to cost the region up to 7% of the Gross Domestic Product (GDP) (Hennis 2018). Thus, it is important to identify individuals with obesity to reduce the human and financial impact of the disease on LAC countries.

An important gap in the literature is that there is a lack of studies on risk factors for obesity in high income countries in the LAC region. As previously stated, the literature has evidenced that there are differences between some determinants for adolescent obesity in high income, developed countries compared to high-income, developing countries. Therefore, this research will examine risk factors for obesity in high-income, developing countries in the LAC region. Moreover, there is a lack of literature comparing adolescent obesity in high-income countries in Latin America and those in the Caribbean sub-regions. This research will compare and contrast determinants for obesity in the two sub-regions. Understanding the determinants of obesity in high income, developing LAC countries will lead to improvements in preventative strategies and evidence-based interventions. Based on the above considerations, the overarching aim of this dissertation is to describe the

epidemiology of adolescent obesity and determinants that may exist among school-based populations in 6 high-income, developing countries in Latin America and the Caribbean. Secondly, we will identify differences and similarities in health and risk behaviors that affect high-income, developing countries. Thirdly, we will investigate the proportion of obesity, and risk factors in the Latin American and Caribbean sub-regions.

In order to achieve these objectives, we will conduct three studies. This dissertation is organized as five chapters. Chapter 1 provides a précis of the current scientific literature on adolescent obesity in LAC countries; their obesity-related risk factors. This chapter also introduces the research questions and purpose for the three studies. It also describes the data sources, methodology, analytic approach used to construct the study database and measures used in the analytical model to test the study hypotheses and limitations of the research. Chapters 2, 3 and 4 present the introduction, methods, results, and discussion for each of the three studies guided by the research questions addressed in this dissertation. Finally, Chapter 5 is a comprehensive summary and discussion of the results of the dissertation. Bringing together the relationships described in each dissertation chapter, it is an overview of the discussion of results and scientific evidence derived from their research and the current literature regarding obesity and health risk disparities among adolescents in high-income, developing LAC countries. This chapter also provides implications for real world application of the findings to public health, policy, practice and directions for future research.

Adolescent Obesity in Latin America and the Caribbean

Adolescent obesity is a serious problem in LAC. Few have examined large scale representative studies of adolescent obesity in LAC (Severi and Fmoratorio 2014, Galante, O'Donell et al. 2016, Collaboration, Abarca-Gómez et al. 2017). However, several smaller non-population based studies indicate rising obesity (Kovalskys, Rausch Herscovici et al. 2010, Correa-Burrows, Burrows et al. 2012, Zhu 2013, Rivera, González de Cossío et al. 2014, Pacheco, Blanco et al. 2017). Research by Rivera et al (2014) (based on a limited number of countries) estimates that 20-25% of adolescents in most Latin American countries are overweight or obese (Rivera et al. 2014). Evidence suggests that rates of obesity (and/ or overweight) are more than 20% in several Caribbean countries (Collaboration, Abarca-Gómez et al. 2017). These rates for both Latin American and the Caribbean sub-regions are higher than the global average of 18% (World Health Organization 2018, Feburary 16) and increasing rapidly. There is evidence of different obesity prevalence levels within and between LAC sub- regions. For example, obesity prevalence rates ranged from 16.6% to 35.8% among adolescents aged 12 to 19 years in Latin America (Rivera, González de Cossío et al. 2014). In addition, gender differences in the LAC region are inconsistent with global averages. For example, obesity prevalence is six percentage points higher for females (33%) than males (27%), among younger adolescents aged 11-13 years in the Caribbean (PAHO/WHO 2011), while globally prevalence rates are similar for males and females (World Health Organization 2018, Feburary 16). Thus, the above-mentioned evidence

suggests that weight gain patterns differ by age, gender and sub-region within the LAC region.

Literature on risk factors for Obesity in Latin America and the Caribbean

Obesity is a multifactorial problem that involves a complex interaction of genetic, behavioral and environmental factors (Grundy 1998, Han, Lawlor et al. 2010). In developing regions such as LAC, behavioral and environmental factors are influenced by the adverse consequences from rapid urbanization and economic growth, increased female workforce, deregulation of markets for imports, greater disposable income and increased motorized transportation; resulting in unhealthy diet and physical activity behaviors (Misra, Center for Diabetes et al. 2008, Corvalán, Garmendia et al. 2017, Tejerina, Pérez-Cuevas et al. 2018). Additional influences stem from greater use of screen based entertainment among middle class populations (Cordero 2017). The end result is that high energy unhealthy foods became more accessible, affordable, popular, frequently marketed and consumed on a daily basis (Tejerina, Pérez-Cuevas et al. 2018). As described by Dr. Miriam Tonietti, Secretary of the nutrition committee of the Argentine Society of Pediatrics, when people migrate for better work opportunities, “People are uprooted, they lose their culture and their diet, and foods rich in fats and sugar becomes prevalent,” (Correspondents 2012).Based on the literature, traditional

risk factors for obesity include age, gender, diet and physical activity (Guo and Chumlea 1999, He, Yang et al. 2008, Ogden, Carroll et al. 2012, World Health Organization 2018, Feburary 16).

Gender and age

Age and gender are determinants of obesity (Premanath, Basavanagowdappa H. et al. 2009, Gupta 2012, Goon, Benjamin et al. 2015). Studies differ on whether obesity increases or decreases as children move from childhood to adolescence (Julia, van Weissenbruch et al. 2008, Premanath, Basavanagowdappa H. et al. 2009). Holthe et al (2018) examined adolescents in Bonaire and found that prevalence of obesity and overweight in Bonaire was higher (19.6% versus 14% and 7.7% versus 5.9%, respectively) among older adolescents (aged 12-14 years) than younger children (aged 4-11 years) (Kist-van Holthe, Blom et al. 2018). According to Popkin et al (2018), there is lack of systematic evidence on older adolescents in LAC (Popkin and Reardon 2018). There are indications that there are gender disparities for obesity within and across LAC. A meta-analysis of obesity in the Caribbean found higher diabetes prevalence in women than men (Sobers-Grannum, M. Murphy et al. 2015). Latin American studies suggest there are higher obesity prevalence rates among adolescent girls in urban areas as well as boys in rural areas (Corvalán, Garmendia et al. 2017, FAO 2017, FAO and UNICEF 2018). Additionally, a global study of 5-19 year old children and adolescents estimates that prevalence rates of obesity are levelling out among girls in the Central and Latin American Andean countries (Collaboration, Abarca-Gómez et al. 2017).

Diet and physical activity

Sugar is highly desired in LAC, but this is confounded by a lack of exercise and increasing sedentary behavior (Aguilar-Farias, Martino et al. 2018, Bank 2018). LAC countries are undergoing a nutritional transition, moving from indigenous staples such as cassava to diets rich in energy dense foods, sugars, salt and fats (Corvalán, Garmendia et al. 2017, FAO 2017). At the same time there are reports of high physical inactivity. The WHO Global Recommendations on Physical Activity Guidelines 2016 recommend that “children and adolescents aged 6 through 17 years should do 60 minutes or more of moderate-to-vigorous physical activity daily” (WHO 2015). However, evidence suggests that LAC adolescents are not meeting these guidelines (Aguilar-Farias, Martino et al. 2018, Bank 2018). For instance, a recent study of GSHS surveys 2007 – 13 in LAC reported 15% prevalence of physical activity (PA) among adolescents aged 11 – 18 years (Aguilar-Farias, Martino et al. 2018). The study showed that 41.9% of respondents used active transportation (walking or riding to school) 3 or more days a week among adolescents. Among participants in 12 countries, 50 % or more reported sedentary behavior for 3 or more hours per day (e.g. playing video games, watching television and surfing the internet). In addition to low PA, the study found disparities in sedentary behavior (SB) by sex and by country (Aguilar-Farias, Martino et al. 2018). The SB prevalence rates ranged from 24.2% (Guatemala) to 65.0% (Barbados) (Aguilar-Farias, Martino et al. 2018). These findings evidence significant differences between countries and indicate high prevalence rates of SB in both Latin American and the Caribbean countries.

Another LAC study by Aguilar-Farias et al. (2018) found that one third of students in LAC participated in physical education (PE) on 3 or more days a week (Aguilar-Farias, Martino et al. 2018). This proportion is increasing due to advances in technology leading to increased television ownership, motorized transportation and increased sedentary behavior (Guthold, Stevens et al. 2018). Consequently, there is not a lot of movement and shifting of the body and time spent sitting or not moving is increasing which is contributing to rising incidence of obesity in the region. However, (Aguilar-Farias, Martino et al. 2018). Aguilar – Farias et al (2018) compared surveys from different years and different countries in their study which did not take account of fixed effects. The study included data for 11 to 18 years old adolescents for comparison; however, since the GSHS respondents are primarily aged 13 to 15 years, WHO recommends that studies comparing GSHS surveys in different countries should focus on data for this age range.

Moreover, a systematic review by Hallal et al (2012) of 105 mostly Low and Middle Income Countries (LMICs) including indicated that LAC was one of the lowest regions for PA globally (Hallal, Andersen et al. 2012). In LAC region, only one-fifth or four out of five of 13-15 year olds were meeting WHO guidelines for physical activity (Hallal, Andersen et al. 2012). The study also suggests that globally, physical inactivity is increasing in high-income as opposed to low-income countries, and that girl adolescents were less active than boy adolescents (Hallal, Andersen et al. 2012). Because of the need to understand obesity prevalence rates in countries with different income levels, gender differences and differences between LAC sub-regions, this study aims to

explore these determinants (PA, PE, AT and SB) among adolescent populations in high-income, developing LAC countries.

In LAC, there is high consumption of fast food and low consumption of healthy fruits and vegetables (Popkin and Reardon 2018). A study by Brathwaite et al. (2014) examining global fast food consumption including in 8 Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru, Venezuela) found high levels but different rates of frequent food consumption, ranging from Uruguay (39%) to Bolivia and Argentina (72%) (Braithwaite, Alistair et al. 2014). Additionally, according, to Pehlke et al (2016) most Guatemalans eat traditional food at home but away from home they eat Western style fast food such as hotdogs, fried chicken from street vendors (*casetas*) located on the street or at schools (Pehlke, Letona et al. 2016). Moreover, Popkin et al (2018) have suggested that consumption of deep fried fast food contributes to rising obesity in the region (Popkin and Reardon 2018). It is possible that visits to these informal street vendors are not captured in these GSHS surveys. Therefore, fast food consumption in LAC could be underreported.

In a similar vein, several studies have reported that there is low intake of fiber-rich fruits and vegetables among adolescents in the region (Pehlke, Letona et al. 2016). The World Health Organization recommends at least 400 grams or five servings of fruit and vegetables per day excluding potatoes and starchy tubers for prevention of obesity-related non-communicable diseases such as cancer, cardiovascular diseases, and diabetes (WHO 2014). Although Latin America is one of the global producers of many types of fruit such as bananas, avocados, mangoes, pineapples, cherries and citrus

fruits are expensive and most of the fruit is exported as cash crops. The results in the literature are contradictory about the amount of fruits and vegetables and the intake in LAC countries.

Despite having enough land to grow and feed all of its inhabitants, hunger remains a public health problem in LAC, particularly in Latin America. As countries in the region developed, many countries went from having high prevalence rates of malnutrition to high rates of over nutrition (Rueda-Clausen, Silva et al. 2008, FAO 2017), which brought unique nutrition challenges. This resulted in the double burden of malnutrition where over and undernutrition coexist. Studies indicate that in LAC, often the same individual, household and country, can experience both over and undernutrition; this is prevalent among lower socioeconomic groups (FAO 2017). Moreover, studies indicate that government feeding programs to eliminate hunger provided high calorie unhealthy food to lower socioeconomic groups. Thus, although the programs reduced hunger, they contributed to rising obesity among this population (Uauy, Albala et al. 2001). Because countries are at different stages of the nutrition transition, it is important to understand the implications of the double burden for obesity among adolescent populations in LAC.

Latin America is one of the major manufacturers of soft drinks. Three of the top five sugar-sweetened beverage consuming countries (Mexico, Argentina and Chile) are located in the region and soft drinks are the main source of sugar for children and

adolescents (Popkin and Reardon 2018). While, the association between soft drink consumption and obesity has been documented, results have been mixed and contradictory (Rhee, Mattei et al. 2012, Singh, Micha et al. 2015, Alderete, Bejarano et al. 2016). For instance, a study among adults in Costa Rica found an association between intake of sugar-sweetened beverages particularly soda and fruit drinks, and increased adiposity including BMI and waist-to-hip ratio (Rhee et al 2012). In contrast, Holthe et al (2018) found no significant difference between adolescent consumers of one or less soft drinks per week among obese and non-obese adolescents aged 10 – 14 years in Bonaire (Kist-van Holthe, Blom et al. 2018).

Psychosocial factors and substance misuse

Psychosocial factors such as bullying and substance misuse have also been identified as determinants of obesity (Janssen, Craig et al. 2004, Pajari, Pietilainen et al. 2010, Sayon-Orea, Martinez-Gonzalez et al. 2011, Brixval, Rayce et al. 2012). Some studies suggest that the high energy density of alcohol (7 kilocalories per gram (kcal/g)), second only to fat, results in positive weight gain. While others could not find an association between alcohol intake and obesity (Pajari, Pietilainen et al. 2010, Sayon-Orea, Martinez-Gonzalez et al. 2011). Statistics show high prevalence of alcohol use among LAC adolescents (Hennis 2018), but to the best of my knowledge, no study could be located that examined the relationship between alcohol use and obesity among adolescents in high-income, developing LAC countries.

Like alcohol use, victimization by bullying has been associated with obesity in different ways (Janssen, Craig et al. 2004, Brixval, Rayce et al. 2012). Victims of bullying may eat more unhealthy foods to cope with the bullying experience and then become obese. Alternatively, because of their obese physical appearance, adolescents may experience bullying (Janssen, Craig et al. 2004). One study also shows that bullies that are obese are more likely to be perpetrators (Janssen, Craig et al. 2004). Regional statistics show high prevalence of bullying in LAC countries. According to the United Nations Educational Scientific Organization (UNESCO), one in three adolescents aged 13-15 years has been a victim of harassment (bullying) (UNESCO 2019). A study by McClanahan et al (2015) examined GSHS surveys and found bullying range from 17% to 39% in 15 countries in LAC (McClanahan, Stephanie et al. 2014). The study found that girl adolescents in 14 countries were bullied because of their looks or physical appearance. Although, to the best of my knowledge, no study was located that compared the relationship between bullying and risk of obesity between high-income developing countries, and sub-regions in LAC. High rates of bullying victimization alongside similarly high obesity prevalence rates indicate a possible correlation. Therefore, this study seeks to explore this potential correlation between psychosocial factors and substance misuse in high-income developing countries in LAC and to fill this research gap.

Six Countries in Latin America and the Caribbean

Anguilla

Anguilla is an island in the Eastern Caribbean, located north of Saint Maarten and East of Puerto Rico (Unicef 2016). Anguilla is a self-governing British Overseas Dependent Territory (Unicef 2016). The island is 92 km^2 with 100% urbanization. The Global School-Based Student Survey (GSHS) was conducted in 2016. In 2016, Anguilla was classified as a high-income country with a Gross National Income (GNI) of US $21,188 (Unicef 2016). The main industry is tourism. Due to poor soil management, much of the land is infertile and the country is at risk of floods and natural disasters (Unicef 2016), which could further compound farming and agricultural activities. The 2016 Anguilla population was aging, 30% were under 18 years (PAHO/WHO 2017). Just over 85% of the population identify as Black and 7.5% are Hispanic (Ruan and Hodge 2015). Life expectancy at birth in 2016 was 81.3 years (78.7 for men and 84 for women) (Unicef 2016).

Primary and secondary school is compulsory from 5 until the age of 17 under the Anguilla Education Act 2012 (Unicef 2016). Primary and secondary schools are free, although the costs of books and additional activities presents a burden (Unicef 2016). There is one secondary school on the island. The secondary school enrollment ratio could not be located.

Obesity and Risk Factors

Between 2014 and 2015, overweight and obesity prevalence was 37% among sixth grade students (PAHO/WHO 2017). Another source from the School Health Report 2014-2015 indicated lower prevalence rates. According to the report, between 2011 and

2015 overweight prevalence decreased from 16% to 14% (Ruan and Hodge 2015). However, this is unpublished data based on a small sample of 15 students [School Health Service Presentation]. The survey is also based on in school health assessments and could be subject to data error. Obesity and high intake of high calorie drinks and sugar were highlighted as areas of concern in the School Health Report 2014-15 (Ruan and Hodge 2015). Only anecdotal evidence from the School Health Nurse Report was available which suggests there is prevalence of Chronic Non Communicable Diseases (CNCDs) such as asthma, diabetes, hypertension and epilepsy among student populations (Ruan and Hodge 2015).

Limited data on adolescents suggests high prevalence of obesity risk factors. Reasons for this high cost of healthy food due to importation in addition to social and cultural practices encourage consumption of fast food and soft drinks (Unicef 2016). The GSHS in 2009 indicated high prevalence of bullying (25.2%), and alcohol use (50%) (GSHS, 2009).However, due to statistical problems, this data is to be interpreted with caution. In addition, limited evidence suggests a high burden of NCDs for the country. For example, between 2010 and 2014, more than half the deaths were due to NCDs, namely cardiovascular disease (CVD) and cancers (82%), diabetes (16%) and chronic obstructive pulmonary disease (COPD) at (2%) . Approximately one third of the deaths were premature (Ruan and Hodge 2015). Amidst limited data, the economic burden of dialysis care for diabetes and/or hypertensive patients indicates that between 2010 and 2015 the number of patients doubled from 11 to 24 and the government spent approximately US$ 888,050 in 2013 on dialysis for 17 patients; which was double the 2012 expenditure (Ruan and Hodge 2015).

Overall, there is a lack of studies and systematic surveillance information on adolescent obesity in Anguilla. According to the United Nations Children's Fund (UNICEF), information is also inconsistent from sources (Unicef 2016). There have been policy and program interventions implemented at national and school level to address NCDs such as screening (PAHO/WHO 2017).

Bahamas

The Commonwealth of the Bahamas is an archipelago of 700 high-income islands and 2,400 cays located in the Northern Caribbean, to the East of Miami and the North of Jamaica (PAHO/WHO 2017). The country consists of 13,900 km^2 (PAHO/WHO 2017). The GSHS was conducted in 2012. In this year, the country had a population of 383,054 (PAHO/WHO 2017). One-sixth of the population is non-Bahamian (mainly Haitian immigrants) while the number of migrants, including school-age adolescents, is increasing (Conliffe, Frankson et al. 2015, PAHO/WHO 2017). The GNI was US$21,500 with the country primarily dependent on tourism (PAHO/WHO 2017). More than two-thirds (83%) of the population live in urban areas (PAHO/WHO 2017). The population is aging as life expectancy at birth, at the time of the survey was 73.8% (73 years for males and 78 years for females) (PAHO/WHO 2017) .

The Bahamas has the highest prevalence of overweight in the Caribbean, with 69% overweight (FAO/PAHO, 2016). A nationally representative sample found among children and adolescents aged 5 - 19 years that overweight prevalence among male adolescents was 36.6% and female adolescents was 35.6% in addition obesity

prevalence for males was 16.6% and females was 18.6 % (Global Nutrition Report, 2018). One of the reasons for this is inadequate consumption of fruits and vegetables due to the high costs since 90% of food is imported (PAHO/WHO 2017). This has led to consumption of cheaper high caloric alternatives (PAHO/WHO 2017). In addition, high levels of physical inactivity have been reported. Approximately one third of adolescents (30%) were physically active (Tejerina, Pérez-Cuevas et al. 2018). Reasons for lack of PA include high levels of violence and insufficient transport networks (PAHO/WHO 2017, Tejerina, Pérez-Cuevas et al. 2018).

The burden of chronic NCDs is seen through five main diseases (neoplasms, ischemic heart disease, diabetes, chronic lower respiratory disease, cerebrovascular disease, and hypertension) which account for half of all deaths since 2009 and 43% of all potential years of life lost (PYLL) (PAHO/WHO 2017). According to the WHO (2016), 74% of deaths are attributable to NCDs (PAHO/WHO 2017) and increasing NCD prevalence can be seen in school populations. For instance, one study reported 8.9% hypertension prevalence rates among this population (Conliffe, Frankson et al. 2015).

The Government of the Bahamas has initiated some anti-obesity interventions. Multi-sectoral interventions including policies such as The Bahamas Strategic Plan 2000-2004, the Draft National Food and Nutrition Security Policy, the National Dietary Guidelines, and primary care and community-based interventions (Tejerina, Pérez-Cuevas et al. 2018). More recently, the “Healthy Bahamas 2030” strategy and the Healthy Bahamas Coalition was set up in 2017 to reduce risk factors such as tobacco and alcohol intake, physical inactivity, unhealthy eating, psychological and emotional

harm, and lack of environmental and infrastructural safety (PAHO/WHO 2017). Also, there are plans for school specific nutrition initiatives (PAHO/WHO 2017).

Overall, there are few studies on adolescent obesity in the Bahamas. Few studies that exist have examined small populations, but have not examined the association between the full range of risk factors and obesity. The school population is changing with the increase in immigrants which could also influence the obesity rates.

Curacao

Curacao is a high-income constituent territory of the Kingdom of the Netherlands located to the north of Venezuela (PAHO/ WHO 2017). The island was part of the Netherlands Antilles until it became independent in 2010 (PAHO/ WHO 2017). The country consists of 444 km^2 (PAHO/ WHO 2017). The GSHS survey was conducted in 2015. In that year, the population was 158,010, and 19% of the population is under 15 years (UNICEF 2013). According to the 2011 Census, the population consists of 24.0% foreign-born inhabitants from the Netherlands (25.2%), the Dominican Republic (15.2%) and Colombia (12.7%) (PAHO/ WHO 2017). High levels of immigration, including undocumented immigrants, have led to the presence of over 60 different nationalities and three main languages: Papamiento (78.6%), Dutch (9.4%), Spanish (6%) and English (3.5%) (UNICEF 2013). 89.3% of the population live in urban areas. The population was aging; life expectancy at birth was 74.8 years for men and 81.0 years for women (Central Bureau of Statistics Curacao 2010). Curaçao has one of the highest

standards of living in the Caribbean, but there are economic inequalities (UNICEF 2013). For example, a quarter of the population lives below the poverty line (25.1%). The Gross National Income (GNI) was US$ 19,691 (UNICEF 2013). The main economic activities include tourism, oil refining, financial services and Information Communication Technologies (ICTs) (UNICEF 2013).

Primary and secondary school is compulsory from 5 until the age of 17 (Verstraeten 2015). The school enrollment ratio was 87.5% in 2013 (UNESCO 2014). Secondary school is free; however, parents have to pay a monthly stipend to supplement funding for schools (UNESCO 2014). There is a high drop-out rate due to the parents' inability to pay for school supplements and poor academic performance by malnourished children.

The few published studies on obesity in Curacao have focused on adult obesity (Grol, Eimers et al. 1997, Verstraeten 2015). Therefore, there is limited data on obesity and risk behaviors among adolescents. These studies highlighted poor dietary behaviors largely influenced by social and cultural factors. For example, these studies indicated inadequate fruit and vegetable consumption. In addition, approximately half of adults consumed fast food routinely (Verstraeten 2015). Other socio-cultural factors include the cultural attitude that bigger is better, which leads to overfeeding of children, particularly girls. Another effect of these attitudes is that they result in increasing sedentary behavior. The lack of vacation time and non-payment of overtime for workers results in families consuming quicker, cheaper food (UNICEF 2013). Agricultural production is modest, and most consumer and capital goods are imported from the United States or Venezuela (2019).

A quarter of the child and adolescent population is physically inactive (UNICEF 2013). The vast majority of the active adolescents did low-intensity PA, or less than the recommended 60 minutes per day (Grol, Eimers et al. 1997). Studies suggest that low PA is due to high temperatures during the day, unsafe areas at night, and high cost of private sports facilities (UNICEF 2013). Additionally, the lack of PE in the school curriculum (UNICEF 2013) could be a contributory factor. According to UNICEF, young people are targets for ethnic and class discrimination from the colonial past, which could result in marginalization of vulnerable populations and dangerous environments (UNICEF 2013).

There is a high prevalence of NCDs, namely cardiovascular disease (37%), malignant neoplasms (26%), and lifestyle-related illnesses (PAHO/ WHO 2017) . A 2013 population-based survey indicated that 9.3% of the population had diabetes, and 19.9% had hypertension (PAHO/ WHO 2017).

Overall, to the best of our knowledge, no peer-reviewed study could be located on adolescent obesity in Curacao. However, there is a need to further explore several unique socio-cultural factors that could influence the obesity prevalence among adolescent populations.

Uruguay

Uruguay is a high-income country in Latin America, located to the East of Argentina and South of Brazil and is 176,215 km^2 (Paho/Who 2017). The GSHS was conducted in 2013 when the population was 3,396,753 (Paho/Who 2017). The population includes

8.1 % people of African descent and 5.1% indigenous people and there are high levels of immigration and returning Uruguayan emigrants (Paho/Who 2017). Approximately 95% of the population lives in urban areas (Paho/Who 2017). Uruguay has a large middle class and low levels of poverty (Bank 2019). With an aging population, life expectancy at birth is 76 years for males and 73 years for females (Paho/Who 2017). The GNI is US$ 14,272 and the main economic activity is agriculture. Primary and secondary school is compulsory from 4 to 17 years and the country had a 109.3% secondary school enrolment ratio (UNESCO 2014).

There have been studies on childhood and adolescent obesity in Uruguay (Severi and Fmoratorio 2014). Severi et al (2014) examined obesity changes from childhood to adulthood and found that as the child aged, obesity increased from children less than 2 years old (9.5%), 6 years old (18.8%), 11 years old (20.4%), 13 – 15 years old (26.6%) and adults over 18 years (35.3%) (Severi and Fmoratorio 2014). However, the study is based on several surveys conducted in different years using different methodologies and measures. Therefore, this study could be subject to bias. Additionally, according to WHO nationally representative studies indicate 64% adult obesity prevalence (Paho/Who 2017) and one of the highest obesity prevalence rates for children (18.9%) in Latin America (Kaufmann and Pontet-Ubal 2019). Moreover, it is predicted that the obesity problem will get worse. Based on current trends, 72% of the population will be obese by 2030 but if the current trend decreased then there will be 52% obesity prevalence (Kaufmann and Pontet-Ubal 2019), which suggests that either way, obesity prevalence rates will be high and there is greater risk for NCDs.

There is a double burden of malnutrition in Uruguay. A study by Severi et al (2014) found a relationship between obesity and stunting (Severi and Fmoratorio 2014). For example, the study indicated 6.3% prevalence of households with an obese mother and stunted child; stunted children less than 2 years are twice as likely to be obese; 1.9% of stunted children are obese at 6 years and 3.1% at 11 years (Severi and Fmoratorio 2014). Studies suggests that this double burden could be due to undernutrition during early childhood, leading to higher risk of over nutrition and related NCDs (Severi and Fmoratorio 2014). Another study in relation to physical activity found no significant difference between normal weight and overweight adolescents that engaged in sedentary behavior ($p = 0.3$) (Pisabarro 2019).

Statistics indicate among 25 – 64 year olds in 2015, there is low prevalence of other NCDs, such as diabetes (6.7%) but high prevalence of hypertension (34.6%) (Paho/Who 2017). The burden of obesity is projected to cost approximately 1 % of GDP (more than US$ 500 million) by 2020 (Garcia-Garcia 2014).There are public and private initiatives in place to address obesity including the “Interagency Commitment for an appropriate diet in the Uruguayan population,” and a law for healthy eating at schools. However, Kaufman and Pontet-Ubal (2019) suggests that none of these interventions have been working for the last decade (Kaufmann and Pontet-Ubal 2019), and a call is made for multi-sectoral strategies (Severi and Fmoratorio 2014).

Overall, there are few studies on adolescent obesity and risk factors in Uruguay. The declining mortality and premature mortality from NCDs is contradictory to the rising

obesity rates. Therefore, there is a need to further examine adolescent obesity among this population.

Chile

Chile is a high-income country in Southern most part of Latin America, located next to Argentina, Bolivia, and Peru, and has a size of 756,102 km^2 (PAHO/WHO 2019) The GSHS survey was conducted in 2013. At the time of the survey, the population was 17,575, 833 (PAHO/WHO 2019). The GNI was US$15,363 (PAHO/WHO 2019) , primarily based on agriculture, mining and manufacturing (2019). There are low levels of poverty and the rate of urbanization was 89.1% (PAHO/WHO 2019). Life expectancy of the aging population at birth was 78 years for males and 84 years for females (PAHO/WHO 2019). Primary and secondary school is compulsory from 5 to 17 years and free and secondary school enrollment was 99.2% ratio (UNESCO 2014).

In 2012, obesity prevalence was 27.1 % (girls) and 28.6 (boys) among children and adolescents aged 5 to 17 years. Diet is a key determinant of obesity in Chile. The population-based Food Consumption Survey in 2014 indicated that most of the population (86.9%) of Chile consume food in ways that require significant dietary changes (PAHO/WHO 2019). Additionally, cultural practices such as consumption of seven meals daily: breakfast, lunch, “elevenses” (tea-time), supper, and three snacks (morning, afternoon, and night) increased excessive intake of high calories, high fats, sugars, and sodium particularly among lower socioeconomic groups (PAHO/WHO 2019). Moreover, one driver of obesity has been the increase in the availability of high

calorie and low nutrient food and sweeteners which became diet staples. As mentioned above, obesity drivers include reduced physical activity (Correa-Burrows, Burrows et al. 2012) and increased sedentary lifestyles and adoption of high fat Western diets (Albala, Vio et al. 2002) and low consumption of fruit (Economist 2013). According to PAHO/WHO there is high alcohol intake (35.6%) among adolescents aged 14 and 18 (National Service for the Prevention and Rehabilitation of Drug and Alcohol Use) (PAHO/WHO 2019).

Correa-Burrows et al (2012) examined the relationship between health production (based on food intake and physical activity) and nutritional status, gender and socioeconomic characteristics among adolescents in Chile (Correa-Burrows, Burrows et al. 2012). The study found poor quality nutrition among participants, in addition to disparities based on gender and socioeconomic status. For example, people with poor health production had higher rates of obesity (AOR: 1.59; 95%CI: 1.04 - 2.42) and abdominal obesity (AOR: 2.24; 95%CI: 1.35 - 3.40) compared to those with good and intermediate health production (Correa-Burrows, Burrows et al. 2012). Furthermore, females from lower socioeconomic groups were less likely to have good health production (Correa-Burrows, Burrows et al. 2012). However, the scope of this study was limited to urban schools and results cannot be generalized to the entire school population. Additionally, the study used random sampling. However, the small sample size means it was not representative of the national population.

In 2013, NCDs accounted for 82% of the disease burden, mainly malignant neoplasms (13.8%), cardiovascular diseases (12.3%), mental disorders and substance abuse (12.2%) (Institute of Metrics, 2013). Statistics showed 19.8 deaths per 100,000 were

from Type 2 diabetes in 2011 (PAHO/WHO 2019). A 2003 nationally representative survey for adults showed 33.7% hypertension and 6.3% diabetes (PAHO/WHO 2019). Moreover, a longitudinal study indicated that early onset obesity from as early as 5 years can increase metabolic syndrome risk among adolescents (Pacheco, Blanco et al. 2017) A recent study of adolescents by Zhu (2013) found an association between maternal obesity and adolescent obesity in Chile (Zhu 2013). However, this study uses a small sample size therefore, further studies are needed with larger samples.

National level Interventions to reduce NCD risk factors include The National Health Strategy 2011-2020 and the 2013 legislation to establish the "Choose Healthy Living" program. Additionally, Chile was the first country to develop food labeling laws, part of which took effect in 2016, and full implementation was completed in 2019. The law provides warnings for consumption of unhealthy products; bans advertising of food with high content of fats, saturated fats, sugars, sodium, and other ingredients harmful to children under the age of 14, and product promotional gifts, modifies the Food Health Regulations and regulates packaged products (PAHO/WHO 2019). Correa et al (2019) evaluated the implementation of the first phase of the legislation implemented in 2017 (Correa, Fierro et al. 2019). The study found that there was awareness of the law, young children were better informed and promoting change in their families, while preteens/teens were resistant to changes to healthy eating practices (Correa, Fierro et al. 2019). However, the study targeted mothers and did not directly interview children or adolescents. There was a small sample size and the study took place one year after implementation. Therefore, it may have been too early to see all the benefits.

Overall, studies have showed some risk factors for obesity in Chile, but have not covered the full range of sociodemographic, behavioral, and psychosocial and substance misuse factors. Thus, there is a need to understand the determinants for obesity among adolescent populations.

Argentina

Argentina is a high-income country in the southern part of Latin America located next to Chile and Peru. The country consists of 2,780,400 km^2 (PAHO/WHO 2017). The GSHS was conducted in 2012. At the time of the survey, the population was 42,095,229 and 91.3% lived in urban areas (PAHO/WHO 2017) .The population includes 24.3% migrants and 2.4% indigenous inhabitants . Although Spanish is the official language, other languages spoken including English, Italian, German, Welsh, Yiddish, Portuguese, Guarani, Quechua or Mapudungun depending on the region (Wikipedia). The population is aging; life expectancy at birth was 72 years for males and 79.8 years for females (PAHO/WHO 2017).The GNI was US$ 11, 364 (PAHO/WHO 2017) primarily based on agriculture, livestock and energy (Bank 2019). Primary and secondary school is compulsory from 4 to 17 and secondary and there was 105.2 % school enrollment in 2012 (UNESCO 2015).

Several studies have examined adolescent obesity in Argentina (Kovalskys, Rausch Herscovici et al. 2010, Arbex, Rocha et al. 2014, Catalani, Fraire et al. 2016, Galante, O'Donell et al. 2016). A study of school-aged adolescents 10 – 19 years in Buenos Aires indicated 20.8% overweight and 5.4% obesity prevalence rates with statically

significant higher obesity prevalence among boys (p= 0.02) (Kovalskys, Rausch Herscovici et al. 2010). However, that sample size was small, thus, generalization was limited. Additionally, the sample was taken from hospital patients, therefore, the characteristics of the participants could have been similar (Kovalskys, Rausch Herscovici et al. 2010). Similar rates of obesity prevalence were found in a cross-sectional study among 13 year olds in La Pampa province (Catalani, Fraire et al. 2016). The study found 26.4% overweight and 14.1% obesity prevalence rates. Males had higher prevalence rates than female adolescents (27.5% and 16.9% of male adolescents, 25.5% and 11.7% of female adolescents) (Catalani, Fraire et al. 2016). Another study examined adolescent children 10 – 11 public schools in Buenos Aires. The study found obesity prevalence rates were 35.5% (based on WHO BMI cut-offs) 27.9% (based on the US Centers for Disease Control and Prevention (CDC) BMI cut-offs), 27.9% (based on International Obesity Task Force cut-offs), similar numbers for both genders for overweight but higher for boys for obesity (). However, generalization of this survey findings is limited since the sample was small and examined only public schools in the city. The study additionally used random sampling but did not take account of clusters. Because of methodological weakness and small samples sizes, there is a need for further research among this population.

Additionally, the nationally representative GSHS gathered information on additional risk factors. Galante et al (2015) examined GSHS from 2007 to 2015 among a nationally representative sample of adolescents in Argentina (Galante, O'Donell et al. 2016). The study found overweight prevalence was 22.8% and obesity prevalence was 4.4%

(Galante, O'Donell et al. 2016) In addition, the study found significantly higher obesity prevalence rates among participants whose mothers had not completed primary school (8.9%) vs mothers who had completed high school (4.6%) (p =0.002) (Galante, O'Donell et al. 2016). The authors indicated that an adult survey also showed that females with lower educational attainment or lower income were more likely to be obese in the adult population (Galante, O'Donell et al. 2016). Additionally, evidence suggests that obesity causes almost half of the cases of diabetes (44%), approximately 25% of ischemic heart disease cases, and 7 to 41% of cancer cases (Arbex, Rocha et al. 2014). Rubenstein et al (2014) suggests that the rise in self-reported obesity prevalence could be the result of improved access to preventative health services (Rubinstein, Gutierrez et al. 2014).

At the national level, interventions include the Argentinian Federal Law No. 26.396 of 3 September, 2008 ('Ley de Obesidad'), which set up a national policy for anti-obesity initiatives including food labeling and healthy food in schools (He, 2018). Additionally, the government set up the "Argentina 2014 Free of Trans Fats" multi-sectoral campaign which set up a tax and limit on trans-fat quantities in food production (PAHO/WHO 2017). In 2016, Argentina introduced the National Plan for Healthy Diet and Prevention of Obesity, a multi-sectoral plan to promote healthy eating, physical activity, municipal healthy programs, research, and limit advertising to children (He 2019). A key component was to set up healthy kiosks at schools where kids can get fruit, dried fruit and healthy snacks (He, 2018). However, dried fruit contains high levels of sugar. The plan is based on the laws of Chile and other countries (He 2019). Critics believe

legislation is needed to enforce the pieces of the plan which is not evidence-based or comprehensive (Arbex, Rocha et al. 2014).

Summary of demographic characteristics of the 6 countries

Overall, high cost of imports compared to low production of fruits and vegetables contribute to low consumption in the three Caribbean countries (Anguilla, Bahamas and Curacao). Reasons for imports differ between countries. For example, in the Bahamas and Anguilla, there are additional risks to local agricultural production from natural disasters such as floods and hurricanes. In some countries, high imports leads to consumption of cheaper unhealthy alternatives, since healthy food is more expensive. All countries have diets high in sugar compared to low levels of physical activity. However, sources of sugar may vary between them, particularly in Latin America where there is higher consumption of SSB compared to the Caribbean.

Theoretical Basis of the Research for Adolescent Obesity Prevention

The Social Ecological Model provides a useful framework for understanding multiple levels of influence that affect adolescent obesity. According to the Social Ecological Model, health behaviors are influenced by several factors that exist across including intrapersonal, interpersonal, organizational, community and public policy (Sallis, Owen et al. 2008). Socio-cultural factors and environmental factors from the physical environment also have cross-cutting influences on health behaviors across the multiple levels (Sallis, Owen et al. 2008).

Purpose of the Study

Most countries in LAC are classified as developing countries since, despite rising economies, there are economic disparities within the countries. Some inhabitants still face problems associated with sustainable development such as poverty and inadequate access to water and sanitation, education and health resources. Many global studies on obesity that include LAC countries, in their findings refer to the region as consisting of low and middle income countries (LMICs). However, significant economic growth in LAC since the 1990s, has upgraded most countries from low- or middle-income to upper middle- or high-income status. While the vast majority of countries have maintained their high income status, changing economic conditions have resulted in some countries' fluctuating between high-income and middle-income status over the years. Alongside the economic growth, countries have moved from high levels of undernutrition to high levels of over nutrition. As mentioned, above, studies in other regions suggest that risk factors differ in high-income countries; however, no studies were located that examined whether this differentiation applies to high-income countries in LAC.

Many of the studies on adolescent obesity in the region focus on LMICs or developing countries without differentiating the high-income countries in the region. Studies suggest that higher income groups have higher obesity in the Caribbean than low-income (Tejerina, Pérez-Cuevas et al. 2018). Misra and Kharuna (2008) examined obesity prevalence in developing countries (Misra, Center for Diabetes et al. 2008). However, the study only included data on 7 countries in Latin America and no countries in the Caribbean. Therefore, this was a limited focus. While these studies are useful for

indicating prevalence levels, they suggest that there is heterogeneity among countries of different income levels.

Many of the studies in the region focus on either Latin America or the Caribbean. Few studies focus on the whole LAC region. Additionally, studies that focus on the region do not include all of the Caribbean countries. Aguilar-Farias et al (2018) for instance compared GSHS surveys 2007 – 13 in LAC among adolescents aged 11 – 18 years (Aguilar-Farias, Martino et al. 2018). Additionally, in an NCD Risk Factor Collaboration study (2017) published in the Lancet, estimated rising prevalence rates of obesity in LAC (Collaboration, Abarca-Gómez et al. 2017). However, the study did not include the current and former British, French or Dutch Overseas Territories in the Caribbean such as Anguilla and Curacao. As mentioned above, high obesity prevalence was found in Bonaire which suggests adolescent obesity is a problem for the former Dutch territories. Although the studies did not include all of the countries in the region, they highlighted that obesity and risk factors are a problem among adolescents. However, the studies are limited if they do not include all of the countries and all of the risk factors.

Many of the studies that include adolescent obesity and risk factors in Latin America and the Caribbean are not representative of the region since they focus on one or two small populations or small study areas within countries. Rivera et al (2014) for instance suggests that 20-25% of adolescents in most Latin American countries are affected by

overweight or obesity for children aged for 5-19 years old in 2016 (Rivera, González de Cossío et al. 2014). However, this study is based on limited evidence from several studies that were not representative of the region. Even though these studies are not representative and conclusive of obesity prevalence levels, they highlight that adolescent obesity and obesity-related diseases are an alarming problem in LAC.

Many of the studies that examine risk factors do not examine socio-demographic, dietary, physical activity, psychosocial and substance abuse risk factors or only examine a group of similar risk factors independent of obesity prevalence (Schwiebbe, van Rest et al. 2011, Corvalán, Garmendia et al. 2017, Aguilar-Farias, Martino et al. 2018). Aguilar-Farias et al (2018) for instance compared GSHS surveys 2007 – 13 in LAC and found 15% prevalence of PA among adolescents aged 11 – 18 years (Aguilar et Farias, 2018) . The study did not relate PA to obesity prevalence and other risk factors for obesity. Additionally, the authors used surveys from several years and various countries but the study did not use fixed effects methods to control for the differences between countries and years. A cross-sectional study of 10 – 14 year olds in Bonaire by Schwiebbe et al (2011) found inadequate dietary and physical activity risk factors for obesity (Schwiebbe, van Rest et al. 2011). However, this study only asked about participation in PA for one or more hours of physical activity on a school day. This is lower than the recommended guidelines of moderate-vigorous activity and it had a limited sample size from one country. Although the studies are limited in the scope of risk factors, they highlight that the prevalence of risk factors change in different countries in the sub-regions and regionally.

Many of the studies that examine adolescent obesity do not compare the early and late adolescence. Studies examined childhood and adolescence or younger or older adolescents separately (Corvalán, Garmendia et al. 2017). Even though these studies did not compare younger and middle-aged adolescents, they highlighted that obesity was a problem from childhood across different ages of adolescents. Several studies suggest that obesity related non-communicable diseases are rising in the region. In contrast, a study indicated that the average age of standardized mortality for cardiovascular diseases went down by 2.3 % between 2000 and 2009 (Ordunez, Prieto-Lara et al. 2015). However, this analysis grouped all countries in the Caribbean with small populations and number of deaths as one Caribbean Island based on similar factors (Anguilla, Antigua & Barbuda, Aruba, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, French Guiana, Grenada, Guadeloupe, Martinique, Montserrat, Saint Kitts & Nevis, Saint Lucia, Saint Vincent and the Grenadines, Turks & Caicos Islands, Virgin Islands (United Kingdom) and Virgin Islands (United States) (Ordunez, Prieto-Lara et al. 2015). This classification ignores the differences between countries based on social and cultural factors from colonization by French and English; differences in income status and obesity prevalence since some countries have over 30% obesity and differences in population sizes which could influence their food consumption patterns.

This study will provide critical insights into risk factors for obesity and overweight among this population. In addition, this study will contribute to the development of targeted

policies and strategies to prevent obesity among this growing population. To the best of our knowledge, a study assessing the risk factors for overweight and obesity among adolescents using nationally representative data for high-income, developing countries in LAC is novel. This study will also present a better understanding of intra and inter-regional differences and similarities for prevalence and distribution of obesity risk factors. The main goal of this study is to examine the association between obesity and dietary, physical activity, psychosocial and substance misuse risk factors in LAC. This will facilitate an understanding of the health risk behaviors of adolescents in school. Findings from this study will be important in developing effective programs and policies that address the health and healthcare needs of LAC adolescents.

Problem Statement

Researchers have studied health risk behaviors for obesity in high-income, developed countries. There has been a lack of studies on socio-demographics and health risk behaviors associated with obesity in high-income, developing countries such as Latin America and the Caribbean. The problem is that adolescents in these developing countries may be engaging in unhealthy behaviors which puts them at risk for obesity and obesity-related diseases.

The problem is to understand the risk factors for the segment of the population and also to understand whether the risk factors are different for countries within different geographical locations in the region whether within the same sub-region or different sub regions. Would adolescents in the Caribbean have the same health risk behaviors for

obesity as adolescents in Latin America? Would there be similarities for risk factors between countries in LAC? The answers to these questions are unknown and can only be answered with a reexamination of countries in both regions to inform more targeted preventative strategies and policy making.

The current classification of children and adolescents under policies and program ignores the specific issues faced by adolescents and prevents targeted preventative strategies. There is a need to better understand the specific issues facing this population to fill the gaps of policy makers to address them. This study seeks to address these gaps by describing the epidemiology of adolescent obesity and determinants that may exist among school-aged adolescents in six high income, developing countries in Latin America and the Caribbean.

Research Question

There is a lack of research that has considered a more global assessment of obesity risk among high-income, developing LAC countries. This study addresses this gap in the scientific literature.

Obesity prevalence differs across countries in Latin America and the Caribbean. Based on limited evidence, there are suggestions that the adolescent obesity prevalence in Latin America is higher than in the Caribbean, although the Caribbean includes more countries with higher rates of obesity. Most research on obesity distinguishes between high-income, developed countries in Western regions but does not distinguish between high-income countries in Latin America and the Caribbean. There are suggestions that obesity prevalence has levelled off in high income developed countries while it is

increasing rapidly in low and middle income countries. However, there is lack of information on whether this trend applies to high-income LAC countries. Research has described similarities for adolescent obesity in high-income developed countries such as United States and England but research has not been done to assess whether these risk factors apply to high-income countries in developing regions. Countries that import high levels of food may have higher obesity rates due to the high cost of health foods such as fruits and vegetables. Some Caribbean countries such as the Bahamas import more than 90% of their food (Tribune 2012). This study hypothesizes that Caribbean islands have higher obesity than Latin American countries. This will be assessed among adolescent populations from 3 Latin American and 3 Caribbean countries to answer the following questions:

1. What is the socio-demographic distribution of obesity and associated risk factors within and between high-income, developing countries in LAC?

2. Are the proportion of obesity and risk factors in the Caribbean higher than in Latin American countries?

3. What are the predictors of obesity in high-income, developing LAC countries?

Significance of Study

The above shows that there are gaps in the literature on risk factors for obesity among adolescents in high income LAC countries. First, an understanding of the risk factors

and how to address them will be significant to reduce the burden of obesity on the region. Second, since the adolescents play a key role the future workforce and caregivers for the aging populations, it is important to reduce and prevent unhealthy behavior which can cause premature morbidity and morbidity and hinder their ability to contribute and quality of life. In addition, this will reduce the economic burden of obesity and obesity -related diseases on the region. Finally, this study is significant since it will contribute to a deeper understanding of adolescent health. The study will add to existing literature on obesity and risk factors in high-income countries. The findings will be useful for students, researchers and for policy makers working on obesity to examine disparities for obesity in high income developed and developing countries for which there is a lack of literature. To the best of my knowledge, no other study has used nationally representative data GSHS to assess the full range of socio-demographic, behavioral, psychosocial and substance misuse factors among the target population between and within high-income LAC countries.

Strengths and Limitations

Obesity is a complex and multifactorial disease with several determinants. Some known socio-demographic, psychosocial, dietary predictors of obesity were not available in all surveys therefore will not be used in this study. The study does not address the obesogenic environment and most distal determinants of obesity. Literature on Latin America and the Caribbean include countries classified as high income but often refer to the region as Low and Middle-Income Countries (LMICs). The study uses data from 2 to 7 years ago which does not take account of changes in prevalence since the survey. Survey use of self-reporting could be subject to reporting and social desirability bias. Due to the small sample size for persons with elevated BMI, we did not stratify by overweight

and obesity, which could yield additional insights into targeted risk factors, but this could be a future study.

Despite these limitations there are several significant research and methodological strengths and innovative features of this study. The use of nationally representative samples based on standardized questionnaires from three countries in each sub-region provides a sufficient sample size and will enhance generalizability of the study findings. Moreover, the study will compare risk factors across sub-regions providing information for targeted sub-regional, income specific interventions for adolescent obesity.

Overview of Methodology

This methodological section serves to 1) describe the population and study sample 2) provide details on data preparation, variable selection and measurement 3) describe the analytical, including modeling approaches. This methodological section also includes details on the WHO/CDC recommendations used to guide the analyses on diet and physical activity health risk behaviors.

Global School-Based Student Health Survey (GSHS)

The GSHS is a multipurpose and multi-country probability survey, developed by the World Health Organization in collaboration with the United Nations' UNICEF, UNESCO, and UNAIDS, with technical assistance from the US Centers for Disease Control and Prevention. In the core modules, basic demographic (e.g. age, gender) information is collected as well as health risk and protective factors such as diet, physical activity, psychosocial factors, substance misuse hygiene, and sexual behaviors. The Pan American Health Organization has developed a modified questionnaire which can be tailored for use in Latin American and Caribbean countries.

Between 2002 and 2016, a range of data has been collected from students in randomly selected schools, primarily aged 13 – 17 in 94 countries including : height, weight, and a range of health behaviors (including fast food and soft drink consumption, physical activity, sedentary behavior, alcohol use and bullying (CDC website). In LAC, as of 2018, only one country, Trinidad & Tobago, has conducted three surveys (2007, 2012 and

2017). Three countries have completed two surveys: Anguilla (2008, 2016), Guatemala (2009, 2016) and Suriname (2009; 2016). Most countries have one survey, many of them over a decade ago (GSHS website), and have no immediate plans to conduct surveys (GSHS website and personal communications with GSHS representatives/PAHO/WHO in the region). Two countries were scheduled to have their first surveys in 2018 in addition to Guyana's second survey (personal correspondence PAHO, 2018).

Sample survey and Design

The GSHS used a cross-sectional student survey where sampling was to be conducted every four years. A two-stage cluster sample design was used to allow representation of students in all schools in each country. The survey used data from six countries: Anguilla during (2015- 2016), Bahamas (2012 - 2013), Curacao (2014 - 2015), Uruguay (2011-2012), Chile (2012-2013), and Argentina (2011 – 2012). Two sampling plans were used:

a. The Bahamas, Curacao, Uruguay, Chile and Argentina used the two-stage cluster sampling plan. At the first stage, schools were sampled as the Primary Sampling Units (PSU). At the second stage, within each PSU, random sampling was used to select classes. All students in Grades 6 to 10 were invited to participate irrespective of their actual ages.

b. The Anguilla Survey used a census since there is one secondary school in the country. All students in Grades 6 to 10 were invited to participate irrespective of their actual ages.

The response rate was: Anguilla (88%), Bahamas (78%), Curacao (83%), Uruguay (77%), Chile (60%), and Argentina (71%).

Data for five of the studies was downloaded in SAS 9.4 from the publicly available website CDC (http://www.cdc.gov/GSHS/) and from the Curacao section of the WHO site. The dataset for Anguilla was sourced directly from the government of Anguilla, as it was not publicly available.

Data and variables

Below is a list of the main predictor and outcome variables.

Table 1 Variable Description and Recode

Variable	Question/Description	Response	Recode
Age	How old are you?	1 to 6 from 11 to 16 years and over	1 = 13 yrs. 2 = 14 yrs. 3 = 15 yrs.
Sex	What is your sex?	1 Male or 2 Female	1 = Male 2= Female
BMI = Height/Weight	How much do you weigh without your shoes on? How tall are you without your shoes on?	In meters or kilograms	0 = BMI>=14.9 & BMI <24.2 1 = BMI>=24.2
Hunger	During the past 30 days, how often did you go hungry because there was not	1 Never to 5 Always	0= never/rarely/sometimes 1 = always/most of the time

	enough food in your home?		
Fruit intake	During the past 30 days, how many times per day did you usually eat fruit, such as mangoes, grapes, apples, bananas, or oranges?	1 Did not eat to 7 = 5 or more times per day	0 = did not eat/less than one time p/day 1 = for one time or more per day
Vegetable intake	During the past 30 days, how many times per day did you usually eat vegetables, such as carrots or tomatoes?	1 Did not eat to 7 = 5 or more times per day	0 = did not eat/less than one time p/day 1 = one time or more per day
Soft drinks intake	During the past 30 days, how many times per day did you usually drink carbonated soft drinks, such as Coke, Sprite, or Busta?	1 = Did not drink in past 30 days to 5 = 5 or more times per day	0 = did not eat/less than one time per day 1 = one time or more per day
Fast food intake	During the past 7 days, on how many days did you eat food from a fast food restaurant, such as McDonalds, any burger or pizza place, Chinese restaurants, or food vans?	1 = 0 days to 7 = 7 days	0 = 0 days 1 = 1 to 7 days
Bullying victimization	During the past 30 days, on how many days were you bullied?	1 = 0 days to 7 = 30 days	0 = 0 days 1 = 1 to 30 days

Alcohol intake	During the past 30 days, on the days you drank alcohol, how many drinks did you usually drink per day?	1 = 0 drinks to 5 or more drinks per day	0 = did not drink/less than 1 drink per day 1 = 1 or more drinks per day
Physical Activity	During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day?	1 = 0 days to 8 = 7 days	0 = 0 to 6 days in the past week 1= 7 days in the past week
Active transportation	During the past 7 days, on how many days did you walk or ride a bicycle to or from school?	1 = 0 days to 8 = 7 days	0 = 0 to 2 days 1= 3 or more days
Physical Education	During this school year, on how many days did you go to physical education (PE) class each week?	1 = 0 days to 6 = 5 or more	0 = 0 to 2 days 1= 3 or more days
Sedentary	How much time do you spend during a typical or usual day sitting and watching television, playing computer games, talking with friends, or doing other sitting activities such as playing video games or surfing on the internet?	1 = less than one hour per day to 6 = more than 8 hours per day	0 = for less than one to 2 hours per day 1 = 3 or more hours per day

Analytic Approach to Research Questions

The analytic approach was tailored to each of the research questions. A summary of the approach is outlined below and the full approach is in the study chapters.

The results of Study 1 are presented in Chapter 2. We conducted descriptive analyses on the pooled sample of all participants. Descriptive analyses, including percent and 95% confidence intervals for all variables, are presented for the pooled sample and for each country. We performed further analyses to examine all variables by subgroup for participants with normal and elevated BMI. Although one country sample was based on a census, the same complex statistical analysis was used for all analyses. Chapter 2 has further details on the methodology for this research question.

The results of Study 2 are presented in Chapter 3. Data was stratified by sub-region. We performed descriptive analyses on subgroups by sub-region for all participants. We presented descriptive analyses, including percent and 95% confidence intervals, for each subgroup sample and for persons with normal and elevated BMI. We used multivariable logistic regression to compare sub-groups of participants with normal and elevated BMI for each sub-region sample, while controlling for covariates. Although one country sample was based on a census, the same complex statistical analysis was used for all analyses.

The results of Study 3 are presented in Chapter 4. We used multivariable logistic regression to examine the relationship between BMI and sociodemographic, diet and physical activity, psychosocial and substance misuse variables for the regional pooled sample and for each country sample. We controlled for covariates throughout the analyses. Although one country sample was based on a census, the same complex statistical analysis was used for all analyses

Improving nutrition and physical activity among adolescents will have a significant social, environmental, and economic impact on current and future LAC generations. This is one of the objectives of the 5-year Plan of Action for the Prevention of Obesity in Children and Adolescents adopted by Member States at the 53rd Directing Council of the Pan American Health Organization (PAHO) (which was also the 66th Session of the Regional Committee of the World Health Organization for the Americas) in October 2014. Key measures in the plan, such as food marketing and labeling of food and implementation of fiscal policies (e.g. taxes on sugar-sweetened beverages and high energy foods), could potentially stop the rise of the obesity epidemic, which is eroding LAC society.

Chapter 2

Study 1: Prevalence and socio-demographic distribution of risk factors for adolescent obesity in Latin America and the Caribbean

Introduction

Obesity is a disease with adverse psychological and physical consequences. Obesity is a risk factor for non-communicable diseases such as cancer and diabetes (World Health Organization 2018, Feburary 16). Childhood and adolescent obesity significantly increase risk of obesity, premature morbidity and mortality in adulthood (Guo and Chumlea 1999, Bjørge, Engeland et al. 2008, Singh, Mulder et al. 2008, Who 2017, World Health Organization 2018, Feburary 16). Because obesity-related diseases are one of the leading causes of premature morbidity and mortality in Latin America and the Caribbean (LAC) (Hennis 2018), the prevalence of obesity can be determinant of life expectancy of this generation and countries in the LAC region. Based on limited data, the prevalence of overweight and obesity in Spanish and Portuguese-speaking countries in Latin America and the Caribbean ranges between 20% and 25% in most LAC countries (Rivera, González de Cossío et al. 2014).

Adolescence is a period of physical and psychological development (Who 2017). Obesity can negatively impact the development, achievements, and quality of life of adolescents (Who 2017, World Health Organization 2018, Feburary 16). Adolescent health development is influenced by predisposing factors such as gender and enabling environmental and socio-cultural factors (Who 2017). Obesity prevalence rates have levelled off in high-income, developed countries (Popkin and Doak 1998, Collaboration, Abarca-Gómez et al. 2017). However, in high-income countries in LAC, obesity

prevalence is still increasing, and this paradox may be explained by the unique socio-cultural characteristics, insufficient or infertile land for agriculture, high crime and cultural beliefs in fattening female children in these LAC countries (UNICEF 2013, Unicef 2016). The purpose of the study is to examine the sociodemographic distribution obesity and specific risk factors among adolescents aged 13 – 15 years in the region to inform targeted preventative strategies and programs for adolescents in schools in LAC.

Background

Adolescent obesity is a global public health problem (Who 2017, World Health Organization 2018, Feburary 16). Globally, 140 million children are obese or overweight, representing a tenfold increase in childhood and adolescent obesity 30 years ago (World Health Organization 2018, Feburary 16). More specifically, most of the increasing adolescent obesity is in developing regions such as Africa and Latin America and the Caribbean (Popkin and Doak 1998, Gupta 2012, Ng, Fleming et al. 2014, Collaboration, Abarca-Gómez et al. 2017). Recent studies have highlighted alarming rates in childhood and adolescent obesity in the Latin America and the Caribbean region (Severi and Fmoratorio 2014, Galante, O'Donell et al. 2016, Collaboration, Abarca-Gómez et al. 2017). Additionally, across the Latin American sub-region prevalence of adolescent obesity ranges from 16.6% to 35.8% among adolescents aged 12 to 19 years (PAHO/WHO 2011). Moreover, based on the limited number of studies conducted in Latin American countries, Rivera et al (2014) suggest that between 20 and 25% of adolescents in most Latin American countries are affected

by obesity (Rivera, González de Cossío et al. 2014), which is higher than the 18% global average for children aged 5-19 years old in 2016 (World Health Organization 2018, Feburary 16). The picture in the Caribbean sub-region is similar to that in Latin America. An estimated 27% of males and 33% of females among persons aged 11-13 years are obese (PAHO/WHO 2011) .

Obesity has both short and long term consequences (Guo and Chumlea 1999, Bjørge, Engeland et al. 2008, Singh, Mulder et al. 2008, Who 2017, World Health Organization 2018, Feburary 16). Research has highlighted the association between childhood and adolescent obesity and psychological, psychiatric (Rankin, Matthews et al. 2016) and cognitive development . Obesity can result in long term adverse health outcomes that may remain into adulthood. For example, adolescents who are overweight or obese have a higher risk of being obese in adulthood and developing cardiovascular diseases (World Health Organization 2018, Feburary 16) such as pancreatic cancer, diabetes, insulin resistance, metabolic risk, sleep apnea, and hypertension at younger ages (CDC 2019).

After several decades of rising adolescent obesity rates in high–income countries such as the United Kingdom, France, and the United States, prevalence has stabilized (Popkin and Doak 1998, Collaboration, Abarca-Gómez et al. 2017). However, obesity prevalence continues to rise in other high- income countries such as Latin American and Caribbean countries (Gupta 2012, Collaboration, Abarca-Gómez et al. 2017) Studies show that adolescent exposure to behavioral determinants such as diet, physical activity, and sedentary behavior and environmental factors influence obesity in high-income countries (Popkin and Doak 1998, Collaboration, Abarca-Gómez et al.

2017). With the economic growth of high-income countries in LAC, adolescents are exposed to similar environmental factors such as motorized transport, ultra-processed foods, and screen-based entertainment as their counterparts in other high-income countries (Corvalán, Garmendia et al. 2017, FAO and UNICEF 2018). Because the influence of these factors on obesity may be different between and within high-income countries in the LAC study region, there is a need to assess obesity and associated factors.

Although some studies include high-income LAC countries, the findings are presented as low- and middle-income countries (LMICs). Studies have shown that high-income countries in other regions have different obesity risk factor prevalence rates compared to LMICs (de Onis, Onyango et al. 2007, Collaboration, Abarca-Gómez et al. 2017). For instance, adult physical activity rates in high-income countries are twice as high as low-income countries (WHO). In Latin America and the Caribbean, high-income countries have unique socio-demographic factors that may influence the prevalence and determinants of obesity. Few studies have compared the socio-demographic distribution of health behaviors for adolescents with and without obesity in high-income countries in Latin America and Caribbean (Corvalán, Garmendia et al. 2017). To the best of my knowledge, even fewer studies have used nationally representative data to explore this topic across the range of socio-demographics and risk factors (diet, physical activity, psychosocial, and substance misuse) in high-income countries in Latin America and the Caribbean. We used nationally representative data for six high-income LAC countries to investigate obesity prevalence and socio-demographics, health behaviors,

psychosocial, and substance misuse among adolescents with and those without obesity in order to inform future targeted prevention strategies and interventions for adolescents in schools. The purpose of the study is to model and assess the socio-demographic distribution of overweight and obesity and health determinants among adolescents aged 13 – 15 years in the LAC region to inform targeted preventative strategies and programs for adolescents in schools.

Methods

We used data from the Global School-Based Student Health Surveys. Specifically, we examined data from GSHS surveys in Anguilla during (2015-2016), the Bahamas (2012 - 2013), Curacao (2014 - 2015), Uruguay (2011-2012), Chile (2012-2013), and Argentina (2011 - 2012). The GSHS collects socio-demographic and health behavior information from a representative sample of adolescents in school primarily aged 13 – 15 every four years. Information is collected by self-reporting; all individuals in one class are selected from a two-stage cluster sampling process and administered a questionnaire, including questions on weight, health behaviors such as diet, physical activity and substance misuse. One exception was Anguilla where there is one secondary school hence all students were sampled. The total sample was 28,368 and we included in the study adolescents aged 13 – 15 years (n = 15,320). Our sample included: Anguilla (n= 212), Bahamas (n=766), Curacao (n=538), Uruguay (n=2,234), Chile (n=916), and Argentina (n =10,654).

Study Setting

Countries in Latin America and the Caribbean are culturally, geographically and socio-economically diverse. Figure 1 (Appendix A) shows socio-demographics for each country. The land size of islands varies from 91 km^2 in Anguilla to over 2 million km^2 in Argentina. The populations of the islands also vary in size; Anguilla has a population of 13,572 whereas Argentina's population is in the upwards of 42 million. Life expectancy at birth for males is 72 years in Argentina, 73 years in the Bahamas, 76 years in Uruguay, 77 years in Curacao, and 78 years in Chile, and 81.3 years in Anguilla. The age range is similar among females. Life expectancy at birth for females is 73 years in Curacao and Uruguay, 78 years in the Bahamas, 78.7 years in Anguilla, 79.8 years in Argentina, and 84 years in Chile. While most countries have a high degree of urbanization, 100% of Anguilla's population live in urban areas. Secondary school enrolment ratios range from 87.5% in Curacao to 109.3% in Uruguay (with the exception of Anguilla for which to the best of our knowledge, no information was available).

Assessment of Obesity and Health Behavior Outcomes

Participants self-reported height and weight. Information was used to calculate BMI variables based on WHO BMI-for-age growth chart (WHO reference) and dichotomously coded into presence (BMI =<24.2) or absence of obesity (BMI>=14.9 & BMI <24.2). Hunger was dichotomized into variables based on presence or absence. If participant reported hunger some or all of the time, s/he was coded as hungry. The seven-item Likert-scale for fruit and vegetable consumption was collapsed and recoded into two categories ("did not eat" or "one time or more per day"). Soft drink and fast food consumption were dichotomized from a seven-item and five-item Likert scale

respectively to two categories (“did not consume” and “consumed” fast food or soft drinks). Respondents who reported physical activity for a total of at least 60 minutes a day for the past 7 days, in line with the WHO guidelines, were coded as "active" (WHO Global Recommendations, 2010). Respondents who reported active transportation in line with the WHO guidelines (e.g. walk, riding to and from school on at least 3 days during the past 7 days) were classified as "active transport". Participants who stated participation in physical education (PE) on 3 or more days per week, were classified as “participating in PE”. We assessed “sedentary behavior” as participants who spent 3 or more hours per day sitting outside school in line with the WHO guidelines (WHO Global Recommendations 2010). If respondents answered yes to one or more days of bullying, it was coded as "bullying victimization". Respondents that reported drinking alcohol on one or more days in the past were coded as “drinkers”.

Covariates/Socio-demographics

We investigated social and demographic characteristics of the sample population to identify correlations with the predictor variables mentioned above. This included age, gender, and country of survey. Age was divided into three categories (“13 years”, “14 years” and “15 years”). The dichotomized gender variable for “Male” and “Female” was used. Country location of participant was divided into six categories “Anguilla”, “Bahamas”, “Curacao”, “Uruguay”, “Chile,” and “Argentina”.

Statistical Analyses

We used STATA 15.3 for data management and analyses which has functions to analyze complex design weighted data. We performed descriptive analyses for the

regional sample and the six countries for persons with elevated and normal BMI. We further performed between country comparisons for obese participants.

Socio-demographic, dietary, physical activity, psychosocial, and substance misuse variables were calculated as percentages. We used SVYSET procedure to apply survey weights and other survey design variables from the datasets to adjust for each country sample. This improves the point estimates and allows for generalization of the estimation sample to the national population. SVY TAB was performed to find weighted chi square for those with and without obesity. Chi square and percent are presented for the socio-demographic characteristics and other factors.

Results

The socio-demographic, behavioral and psychosocial and substance misuse characteristics for persons with normal and elevated BMI in studied countries are shown in Table 1. Overall, there were statistically significant differences between rates of sex, age, country of residence, hunger, fruit intake, fast food intake and physical education ($p<0.05$).

The distribution of sociodemographic, health behaviors and psychosocial and substance misuse factors among participants from each of the six countries is shown in Table 2. Overall, comparing across the six countries, there were statistically significant differences between rates of all variables except sex, age and physical activity ($p<0.05$). Among all countries, rate differences were reported for BMI, with the highest rate in the Bahamas (35.8%). Further analysis of sex variable showed that there was a rate difference between countries, and Uruguay presented the highest rate of female participants (55%). An analysis of the age variable showed that the Bahamas presented

the highest rates for 13 year old (40.8%) and 14 year old (41.4%), whereas Anguilla presented the highest rates for 15 year old (46.1%). An analysis of hunger variable showed that there were rate differences between countries, with two countries (Uruguay and Chile) reporting the highest rates (98.8%). Further analysis of fruit intake showed that there were rate differences between countries and the highest rate was reported in Chile (68.0%). Additional analysis of vegetable intake indicated rate differences between countries with the highest rate in Curacao (76.7%). Among the studied countries, there were rate differences reported for soft drink intake, with the highest rate reported in the Bahamas (68.6%). We also found rate differences for fast food consumption with the Bahamas reporting the highest rate of 73.3%. Further analysis of physical activity showed no rate differences, unlike other variables rates were consistently low across countries, ranging from 10.5% in Curacao to 23.8% in Anguilla. Additional analysis of active participation indicated that there were rate differences, with the highest rate presented in Argentina (57.2%). Additional analysis of physical education showed rate difference and the highest rate presented in Anguilla (41.9%). Upon further analysis, we found rate differences for sedentary lifestyles, with the highest rates presented in Curacao (60.7%). Additional analysis of bullying victimization indicated rate differences between countries, with the highest rate reported in Anguilla (26.0%). We also found rate differences for alcohol intake, after further investigation of the variable, with Argentina reporting the highest rate of 51.6%. Additional analysis of BMI showed rate differences across the studied countries, with the highest rate reported in the Bahamas (35.8%).

The socio-demographic, behavioral, psychosocial and substance misuse characteristics of obese subjects in the study countries are shown in Table 3. Overall, there are statistically significant differences between the six countries for rates of hunger, fruit intake, vegetable intake, fast food intake, physical activity, bullying victimization, alcohol intake, physical education, and sedentary lifestyles ($p<0.05$) . In Anguilla, there were rate differences between obese and non-obese who participated in physical activity and sedentary lifestyle. In the Bahamas, there were rate differences for female gender. In Curacao, only obese people showed a higher rate of bullying victimization. In Uruguay, obese participants had a higher rate for fruit intake. In Chile, only obese participants had a higher rate for being 15 years old and fast food intake. Obese participants from Argentina had a higher rate for female gender, fruit intake and bullying victimization.

Further analysis of sex showed that the differences between obese and non-obese within countries were only apparent in two countries (The Bahamas and Argentina), with the highest rate presented in the Bahamas (61.3%). An additional analysis of age showed differences between obese and non-obese subjects within countries for 15 year olds for two countries (Chile and Argentina). However, Chile and Anguilla presented the highest rates (42.8%). Further analysis of hunger showed that unlike every other country investigated, two countries (Uruguay and Chile) presented higher rates (<99%) compared to others. Additional analysis of fruit intake showed that the differences between obese and non-obese was only apparent in Uruguay, which reported one of the lowest rates (44.7%). An analysis of the vegetable intake showed no statistically significance difference between obese and obese within countries. However, unlike every other country presented, Uruguay had the lowest rate for vegetable intake

(39.1%). Further analysis of fast food intake, showed that unlike every other country in the study, differences between obese and non-obese were apparent in Chile, which presented the lowest rates (27.2%), whereas the Bahamas presented the highest rates (71.9%). An additional analysis of physical activity, showed that unlike every other country, differences between obese and non-obese were only apparent in Anguilla, which presented the one of the lowest rates (12.4%). Unlike other variables investigated, physical activity was extremely low in all countries, ranging from 11% in Curacao to 16.8% in Argentina. Additional analysis of physical education showed no statistically significant difference between obese and non-obese within countries. However, unlike other countries, the Bahamas reported the lowest rate for attendance at physical education classes (21.5%). Additional analysis of sedentary behavior showed that Anguilla was the only country that showed differences between obese and non-obese with the third highest rate of 45.6%. On closer analysis of bullying victimization, two countries (Curacao and Argentina) showed differences for obese and non-obese participants. Curacao presented the highest rate of 31.3% whereas Argentina had one of the highest rates of 27.6%. Further analysis of alcohol intake showed that there were no statistically significant differences between obese and non-obese within countries. However, Argentina reported the highest rate for alcohol intake (54.6%).

Discussion

We investigated the prevalence and socio-demographic distribution of factors associated with obesity (diet, physical activity, psychosocial and substance misuse) using Global School Based Student Health Survey data from six high-income,

developing countries (Anguilla, the Bahamas, Curacao, Uruguay, Chile, Argentina) in Latin America and the Caribbean.

Adolescent obesity prevalence has been rising in the region. Our study revealed patterns of different obesity prevalence rates across the six countries ranging from 16.5% in Argentina to 35.5% in the Bahamas, higher than the regional average of 19%, in all countries except Uruguay and Argentina. The findings support previous studies on adolescent obesity in the region (Rivera, González de Cossío et al. 2014, Corvalán, Garmendia et al. 2017). We also found an association between countries with higher Gross National Income and high obesity prevalence within the study population except for Chile which had the second obesity prevalence and the 4th highest Gross National Income. The reason for this is not clear. However, one possible explanation is that there is widespread consumption of cheap unhealthy foods. For example, Chile has cultural practices that encourage frequent consumption of meals (seven per day), high in fat and sugar and sodium, plays a role in the higher prevalence of obesity (PAHO/WHO 2019). Another cultural practice is consumption of soft drinks with meals that contributes to additional weight gain (Essman, Popkin et al. 2016) .

The findings indicate that the Bahamas had the highest Gross National Income and the highest obesity prevalence rates. The Bahamas is one of the 20 countries globally projected to have a childhood obesity problem in the next decade according to the First Child Obesity Atlas (Federation 2019). Adolescents may be influenced by the purchasing patterns of adults therefore, they may be eating the same unhealthy foods. Reasons for high prevalence of obesity in the Bahamas include low physical activity, low fruit and vegetable consumption, and sedentary lifestyles. For instance, a study by

Tejerina et al (2018) found 30% physical activity among adults and children, less than 8% consumption of fruits and vegetables, and prevalence of sedentary behavior primarily among young people (Tejerina, Pérez-Cuevas et al. 2018)

The findings reveal a pattern of different socio-demographic distribution of health behaviors, psychosocial between obese and on obese participants at the regional level, and country levels. In line with the literature, the results show a trend of inadequate physical activity (PA) levels in the region particularly, for participants with obesity, ranging from 11% (Bahamas) to 16.8% (Argentina). Our low PA findings are consistent with a recent study of GSHS surveys 2007 – 13 in LAC reported that 15% prevalence of PA among adolescents aged 11 – 18 years, but this study did not compare participants with and without obesity (Aguilar-Farias, Martino et al. 2018). Moreover, LAC is one of the two WHO regions with the lowest levels of physical activity globally (Hallal, Andersen et al. 2012). Several reasons in literature for low PA in the study countries include high levels of violence (Tejerina, Pérez-Cuevas et al. 2018), hot temperatures, and lack of structured sports activities (UNICEF 2013). However, our physical activity rates may be underestimated since our surveys did not ask about the intensity of the PA. Therefore, further research is needed to understand whether the adolescents are meeting the WHO recommended guidelines of 60 minutes of moderate-vigorous physical activity. This could also be a recommendation for changing the measure in the GSHS.

The results show a pattern of different prevalence rates for fast food intake among obese participants from the six countries, ranging from 25.9% in Argentina to 71.9% in

the Bahamas. The reasons for this alarming difference in fast food intake is not clear. A study by Brathwaite et al. (2014) examining fast food consumption in 8 Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, Peru, Venezuela) found high levels but different rates of frequent food consumption, ranging from Uruguay (39%) to Bolivia and Argentina (72%) (Braithwaite, Alistair et al. 2014) Additionally, according, to Pehlke et al (2016) most Guatemalans eat traditional food at home but away from home they eat Western style fast food such as hotdogs, fried chicken from street vendors (*casetas*) located on the street or at schools (Pehlke, Letona et al. 2016). Moreover, Popkin and Reardon (2018) have suggested that consumption of deep fried fast food contributes to rising obesity in the region (Popkin and Reardon 2018). It is possible that participants are not reporting visits to these informal street vendors in the GSHS surveys. Therefore, fast food consumption in LAC could be underreported.

Strengths and weaknesses of this study

The research aims to compare and contrast the socio-demographics and associated factors for obesity among adolescents from high-income countries in the developing region of Latin America and the Caribbean, which has been a gap in the literature and can provide an evidence-base for targeted interventions. A global standardized survey instrument, the GSHS, is used for the study, which is the best way to record this information among this age group (cite). Additionally, using the standardized instrument facilitated comparison of the findings across variables and countries. While use of six

years of pooled and country weighted data provided a large enough sample size to identify socio-demographic distribution patterns, and to generalize findings to specific country populations.

Our study was performed with some limitations. Since our work is based on data from GSHS surveys conducted three to seven years ago therefore it may not consider recent changes. However, due to lack of systematic surveillance of youth health behaviors in the region, this data is the most recent data available. Recent studies indicate similar adolescent obesity prevalence rates in these countries therefore the surveys are still relevant to the current situation. Self-reported data was used to measure participant's perceptions of health behaviors and physical characteristics including weight and height. For the diet questions, there is also a risk of social desirability bias where respondents want to give responses that reflect positively on them (Rosen man et al 2011). This could lead to underreporting of diet activity. The study did not categorize the fruit variable according to the World Health Organization Guidelines recommended fruit consumption of five servings per day (WHO 2015). This could have influenced the positive association between fruit consumption and obesity. The list of demographic variables was limited since we only used measures that were common in all six surveys. For example, all of the GSHS surveys did not include measures on mother's educational attainment. This could have provided some additional information since this has been found to be a determinant of adolescent obesity in Argentina (Galante, O'Donell et al. 2016). We did not have a sociodemographic variable for ethnicity which has been identified as a risk factor for non-communicable diseases in the region

(Corvalán, Garmendia et al. 2017, PAHO/WHO 2019) .A recent study by the PAHO Health Inequities Commission (PAHO 2019) has indicated that obesity is higher among afro-descendants and indigenous groups within LAC (PAHO/WHO 2019)+. Future research could examine stratification of adolescents by ethnic origin.

Conclusion

This study paints a picture of variance in distribution of obesity prevalence and risk factors between high-income developing countries in LAC. Our findings suggest that since several risk factors are high levels, there is a need for more systematic surveillance using GSHS or national mechanisms. Since one person in each country is trained to lead on GSHS. Based on similar risk factors, the Caribbean can develop a shared cadre of people to conduct surveillance activities. Our findings are exploratory therefore future research needs to be conducted with more countries and larger sample sizes to establish risk factors that cause obesity. To the best of our knowledge, this is the first study to compare obesity prevalence and associated socio-demographic, behavioral, and psychosocial and substance misuse factors within and between high incomes developing countries in LAC. This study is lays a foundation for further research to inform country-specific strategies for adolescent obesity prevention.

Chapter 3

A sub-regional picture of adolescent obesity in 6 high income Latin American and the Caribbean countries

Introduction

Both Latin America and the Caribbean have rising obesity and lack of systematic standardized surveillance for adolescent health. Because adolescent obesity prevalence and premature mortality rates from non-communicable diseases vary between sub-regions, risk factors may be different between sub-regions. The two sub-regions are characterized differently based on their sociocultural differences, geographic locations and colonial pasts, which may affect risk factors for adolescent obesity. Most of the Caribbean islands are classified as high-income; due to their small nature, most of their food is imported which makes them vulnerable to relying on expensive imports. Latin American countries are vast countries, with agricultural industries, known as global producers of fruit and healthy grains. But healthy food is also imported, which makes it expensive. The lack of accessible healthy food has contributed to the rising obesity among adolescents in both sub-regions.

As the number of high-income countries grows in the two sub-regions, health policies will need to be developed to tailor to their unique characteristics. Understanding differences and similarities in drivers for obesity in these two sub-regions will help to design targeted anti-obesity sub-regional policies and preventative strategies. Using nationally representative LAC data for six high-income countries, we compare and contrast sociodemographic, diet, physical activity, psychosocial and substance misuse behaviors for adolescents. The study aimed to assess whether the proportion of adolescents in Latin America was higher than the proportion in the Caribbean to inform sub-regional specific preventative strategies and policies for school-based adolescents.

Background

Obesity is a problem for all age groups in many Latin America and the Caribbean countries. In both sub-regions, there is evidence of high prevalence for adolescent obesity ranges from 16.6% to 35.8% among youths aged 12 to 19 years in Latin America (Rivera, González de Cossío et al. 2014). While in the Caribbean, 27% and 33% of 11-13 year old males and females respectively are obese (PAHO/WHO 2011). However, these rates only give an indication of adolescent obesity as they cannot effectively be compared since, they cover different age groups and are based on limited studies. In addition, rates for obesity-related diseases indicate differences between the two sub-regions (Hennis 2018). For example, 9 of the top 10 countries with the highest probability of premature mortality from non-communicable diseases are from the Caribbean (Hennis 2018). There is some evidence based on individual studies that prevalence levels for obesity and risk factors are higher in more Caribbean countries than Latin American countries For example, among 15 year olds, more than half of the 13 countries with high alcohol per capita (APC) of 7- 8.9 liters are Caribbean countries whereas, Chile and Argentina had the highest APC's in the region between 9.0 and 9.1 liters (Hennis 2018).

Adolescent nutrition and environmental exposures could differ between the two sub-regions since they are characterized differently based on size, food supply and culture. The Caribbean consists of primarily small island archipelagos, mostly independent, with high urban areas, and mostly imported and expensive food. Due to their position, many are prone to the effects of violence from drug trade (Alvarado 2018) and natural disasters. The islands share some similar characteristics but differ based on languages and culture from diverse colonial roots. In contrast, Latin American independent

countries have several million inhabitants and are global producers and suppliers of fruits as food processing manufacturers. All countries except Brazil share the same Spanish language but there are also language influences from immigrants.

Though some studies have examined adolescent obesity in Latin America and the Caribbean sub-regions, most of these were small studies focusing on country populations or one risk factor. To the best of our knowledge no study was located that compared and contrasted health behaviors and risk factors for adolescents in high-income Latin American and Caribbean sub-regions across the range of diet, physical activity, psychosocial and substance misuse factors/covariates.

Methods

We used data from the Global School-Based Student Health Surveys. Specifically, we examined data from GSHS surveys in Anguilla during (2015-2016), the Bahamas (2012 - 2013), Curacao (2014 - 2015), Uruguay (2011-2012), Chile (2012-2013), and Argentina (2011 - 2012). The GSHS collects socio-demographic and health behavior information from a representative sample of adolescents in school primarily aged 13 – 15 every four years. Information is collected by self-reporting; all individuals in one class are selected from a two-stage cluster sampling process and administered a questionnaire, including questions on weight, health behaviors such as diet, physical activity and substance misuse. One exception was Anguilla where there is one secondary school hence all students were sampled. The total sample was 28,368 and we included in the study adolescents aged 13 – 15 years (n = 15,092). Our sample

included: Anguilla (n= 212), Bahamas (n=538), Curacao (n=538), Uruguay (n=2284), Chile (n=986), and Argentina (n =10,664).

Study Setting

Countries in Latin America and the Caribbean are culturally, geographically and socio-economically diverse. Table 1 shows socio-demographics for each country. The land size of islands varies from 91 km2 in Anguilla to over 2 million km2 in Argentina. The populations of the islands also vary in size; Anguilla has a population of 13,572 whereas Argentina's population is in the upwards of 42 million. Life expectancy at birth for males is 72 years in Argentina, 73 years in the Bahamas, 76 years in Uruguay, 77 years in Curacao, and 78 years in Chile, and 81.3 years in Anguilla. The age range is similar among females. Life expectancy at birth for females is 73 years in Curacao and Uruguay, 78 years in the Bahamas, 78.7 years in Anguilla, 79.8 years in Argentina, and 84 years in Chile. While most countries have a high degree of urbanization, 100% of Anguilla's population live in urban areas. Secondary school enrolment ratios range from 87.5% in Curacao to 109.3% in Uruguay (with the exception of Anguilla for which no information was available).

Assessment of Obesity and Health Behavior Outcomes

Participants self-reported height and weight. Information was used to calculate BMI variables based on WHO BMI-for-age growth chart (WHO reference) and dichotomously coded into presence (BMI =<24.2) or absence of obesity (BMI >=14.9 & BMI <24.2). Hunger was dichotomized into variables based on presence or absence. If participant reported hunger some or all of the time, s/he was coded as hungry. The seven-item

Likert-scale for fruit and vegetable consumption was collapsed and recoded into two categories (“did not eat” or “one time or more per day”). Soft drink and fast food consumption were dichotomized from a seven-item and five-item Likert scale respectively to two categories (“did not consume” and “consumed” fast food or soft drinks). Respondents who reported physical activity for a total of at least 60 minutes a day for the past 7 days, in line with the WHO guidelines, were coded as "active" (WHO Global Recommendations, 2010). Respondents who reported active transportation in line with the WHO guidelines (e.g. walk, riding to and from school on at least 3 days during the past 7 days) were classified as "active transport". Participants who stated participation in physical education (PE) on 3 or more days per week, were classified as “participating in PE”. We assessed “sedentary behavior” as participants who spent 3 or more hours per day sitting outside school in line with the WHO guidelines (WHO Global Recommendations 2010). If respondents answered yes to one or more days of bullying, it was coded as "bullying victimization". Respondents that reported drinking alcohol on one or more days in the past were coded as “drinkers”.

Covariates/Sociodemographic

We investigated social and demographic characteristics of the sample population to identify correlations with the predictor variables mentioned above. This included age, gender, and country of survey. Age was divided into three categories (“13 years”, “14 years” and “15 years”). The dichotomized gender variable for “Male” and “Female” was used.

Statistical Analyses

We used STATA 15.3 for data management and analyses which has functions to analyze complex design weighted data. We performed descriptive for the two sub regions. Socio-demographic, dietary, physical activity, psychosocial and substance misuse variables were calculated as percentages. We used SVYSET to apply survey weights from the datasets to adjust for each country sample. This improves the point estimates (STATA Richard 2018) and allowed for generalization of the estimation sample to the national population. SVY TAB was performed to find weighted chi square for those with and without obesity. Chi square and per cent are presented for the sociodemographic and health risk behaviors. SVY LOGIT was used to perform weighted multivariable logistic regression to identify the predictor variables significant for obesity in the sub-region sample: sociodemographic (Model 1), health behaviors (Model 2), psychosocial and substance misuse (Model 3). All variables were used in Model 4. Socio-demographic characteristics, health risk behaviors, substance misuse and abuse were taken as independent variables $p < 0.05$ was considered significant. Unadjusted and adjusted odds ratios are presented with 95% confidence intervals (CIs).

Results

Latin America and Caribbean sub-regions

The distribution of sociodemographic, health behaviors and psychosocial and substance misuse factors among participants from Latin America and the Caribbean sub-regions is shown in Appendix B Table 1. Overall, comparing the distribution for participants across the two sub-regions, there were statistically significant differences between rates for hunger, fast food intake, physical activity, physical education, sedentary lifestyles and alcohol intake ($p<0.05$).

Further analysis of sex variable showed that there were no rate differences, with the Caribbean presenting the highest rate for females (53.5%). An analysis of the age variable indicated that there were no rate differences and the highest rate was reported in the Caribbean for 13 year olds (36.4%) and 14 year olds (39.5%), whereas Latin America reported the highest rate for 15 year olds (33.9%). Additional analysis of hunger variable showed that were rate differences, with the highest rate reported in Latin America (59.2%). After further investigation of fruit intake, no differences were shown between sub-regions, and the rates were similar with 55.7% in the Caribbean presenting, and 56.0% in Latin America. We found no rate differences, with similar rates, upon further investigation of vegetable intake, where 56.7% was reported in Latin America and 56.6% was reported in the Caribbean. Additional analysis of soft drink intake indicated rate differences between sub-regions, with the highest rate presented in the Caribbean (65.6%). We also found rate differences and higher rates for fast food intake among participants from the Caribbean sub-region. Unlike other variables, physical activity was similarly low in both sub-regions, with Latin America reporting the highest rate of 15.7%, and the Caribbean reporting (14.5%). Additional analysis of active transportation showed rate differences between sub-regions, with the highest rate of 54.5% reported in Latin America. We found rate differences for physical education, and the highest value of 29.0% presented in the Caribbean. Upon further analysis of sedentary lifestyles, there were rate differences between the two groups, with the Caribbean group presenting higher rates (56.7%). Among participants in the sub-regions, further investigations of bullying victimization indicated no rate difference, with

participants from the Caribbean presenting higher rates (21.4%). Additional analysis of alcohol intake evidenced rate differences, and the higher rate was reported in the Latin American cohort (39.0%).

The sociodemographic, behavioral and psychosocial and substance misuse characteristics for persons with normal and elevated BMI in Latin American and Caribbean sub-regions are shown in Table 1. Overall, there were statistically significant differences between rates of sex, age, country of residence, hunger, fruit intake, fast food intake, active transportation, physical education, sedentary, bullying victimization, and alcohol intake ($p<0.05$). In Latin America, there were rate differences between obese and non-obese for sex, age, fruit intake, and soft drink intake. In the Caribbean, there were rate differences for sex and bullying victimization.

Further analysis of sex showed that the differences between obese and non-obese between both sub-regions, with the highest rate for obese female participants presented in the Caribbean (59.5%). An additional analysis of age showed differences between obese and non-obese subjects within only the Latin American sub-region. However, the Caribbean reported the highest rates for obese 13 year olds (37.9%), and 14 year olds, whereas Latin America only reported the highest rate for obese 15 year olds (41.7%). Further analysis of hunger showed that the differences between obese and non-obese subjects was only apparent among Latin Americans with the highest rate presented for obese participants (72.7%). Additional analysis of fruit intake showed that the differences between obese and non-obese was only apparent in the Latin American group. However, Caribbean residents reported the highest rates (57.8%). An analysis of

the vegetable intake showed no statistically significance difference between obese and obese within sub-regions. However, the Caribbean had the highest rate for vegetable intake (60.1%). An analysis of soft drink intake showed no statistically significant difference between obese and non-obese within sub-regions, with the highest rate of 62.3% presented in the Caribbean. Further analysis of fast food intake showed that differences between obese and non-obese were apparent in Latin America, however, the highest rate was in the Caribbean group (71.3%).

An additional analysis of physical activity showed no statistically significant differences between obese and non-obese. Unlike other variables investigated, physical activity was extremely low in both sub-regions, with the highest rate of 14.2% in Latin America. Additional analysis of active transportation none of the sub-regions showed rate differences, with Latin America reporting the highest value of 53.4%. Additional analysis of physical education showed no statistically significant difference between obese and non-obese within countries. However, Latin American students reported the highest rate for attendance at physical education classes (32.5%). Additional analysis of sedentary behavior showed none of the sub-regions showed differences between obese and non-obese with the highest rate of 55% presented in the Caribbean. On closer analysis of bullying victimization, there were differences for obese and non-obese participants from the Caribbean, where the highest rate was reported (24.9%). Further analysis of alcohol intake showed that there were no statistically significant differences between obese and non-obese within sub-regions. However, the Latin American cohort reported the highest rate for alcohol intake (36.3%).

The Caribbean

Table 2 displays the demographic, behavioral, psychosocial and substance misuse factors and risk of obesity in the Caribbean. Among all variables univariately, girls (OR: 1.44, 95%CI: 1.16 - 1.79) and victims of bullying (OR: 1.36, 95%CI: 1.01 - 1.82). Were shown to have significant increased odds of obesity in this sub-region. Among sociodemographic variables that were investigated, similar results to the univariate analysis, compared to boys, girls was also associated with obesity, after controlling for age (AOR: 1.44, 95%CI: 1.16 - 1.79). In Model 2, that analyzed the issue between each of the behavioral characteristics, we did not find any statistically significant association when tested. We found an association between bullying victimization and obesity (AOR: 1.36, 95%CI: 1.01 - 1.84) in Model 3, after adjusting for alcohol intake. In Model 4, that included all variables (demographic, behavioral, psychosocial and substance misuse, we found that females (AOR: 1.44, 95%CI: 1.16 - 1.79), and bullying victimization (AOR: 1.36, 95% CI: 1.01 - 1.82) remained significant for increased odds of obesity, similar to what was observed in the univariate analysis.

Latin America

The results of the univariate association between study demographic, behavioral, and psychosocial and substance misuse factors and risk of obesity are shown in Table 3. As shown, being 14 years old (OR: 1.59; 95% CI: 1.02 - 2.48) and bullying victimization (OR: 1.91; 95% CI: 1.24 - 1.93) was associated with increased odds of obesity. In Model 1 that controlled for all the variables, upon investigation of socio-demographics

such as gender and age, being 14 years old was associated with increased odds of obesity (AOR:1.58, 95% CI: 1.01 - 2.47) compared to 13 year olds. In Model 2, controlling for other behavioral factors, none of the variables were significantly associated with obesity. When the psychosocial and substance misuse variables were controlled in Model 3, bullying victimization was associated with increased odds of obesity (AOR: 1.99, 95% CI 1.28 - 3.08). In a multivariate analysis that included all variables (socio-demographics, behavioral, psychosocial and substance misuse), being 14 years old (AOR: 1.59, 95% CI: 1.02 - 2.47), and bullying victimization (AOR: 1.99, 95% CI: 1.28 - 3.08) were associated with increased odds of obesity. In this model, unlike previous models, hunger was associated with decreased odds of obesity (AOR: 0.98, 95%CI: 0.58 - 1.53), but this was not significant.

Discussion

We examined the association between obesity and associated sociodemographic, behavioral, psychosocial and substance misuse factors by sub-region using frequency distributions, univariate, and multivariate analysis. The findings reveal a pattern of different prevalence rates and socio-demographic distribution of health behaviors, psychosocial between obese and on obese participants at the regional level, and country levels between the two sub-regions. For example, obesity prevalence in the Caribbean was nearly twice as high as the rate in Latin America. The results support the hypothesis that the proportion of obesity is higher in the Caribbean has proven to be true. Reports (based on limited evidence and age groups) in LAC by the Food and Agricultural Organization in 2017, and 2018 evidence higher rates of obesity in the Caribbean compared to Latin America (FAO 2017, FAO and UNICEF 2018). The reasons for higher prevalence rates in the Caribbean are not clear. One possible

explanation is high prevalence of fast food intake has contributed to increased obesity. We found a significant difference in fast food intake between the two sub-regions, which was more than twice as high in the Caribbean compared to Latin America. The reasons for this are not clear. Literature suggests that fast food consumption is part of the culture in some of the countries. Another possible explanation is that due to the Caribbean countries importing more of their food than Latin American countries, this could lead to consumption of higher amounts of fast foods. For example, Bahamas imports 90% of its food (Tribune 2012).

The findings reveal patterns that being 15 year olds was associated with obesity at the regional level. To the best of our knowledge, previous research on LAC has not compared obesity in the region among these early and late adolescence age groups. The results provide an indication for further research stratified by adolescent age groups. The findings reveal patterns that different sociodemographic correlates may be associated with increased odds of obesity in Latin America and the Caribbean. In the Caribbean, being female is associated with obesity. Previous studies on adolescents indicate that girl adolescents aged 11 –13 years had higher rates of obesity compared to boys (PAHO/WHO 2011) . We found an interesting association between obesity and bullying victimization in both sub-regions. Research in the region suggests that bullying is increasing (UNESCO 2019) and limited studies suggest a relationship with obesity (Kovalskys, Rausch Herscovici et al. 2010) or bullying due to physical appearance (McClanahan, 2015). Further research is needed with larger samples to understand the reasons for higher obesity among bullying victims compared to non-victims in the Latin American and Caribbean sub-regions.

This potential correlation between bullying and obesity in the region could be explained by adolescents being bullied because of their weight. A study by Kovalskys (2010) in Argentina found obese adolescents were significantly more likely to be victims of general bullying ,verbal, and physical bullying, whereas, overweight adolescents were more likely to experience physical bullying (Kovalskys, Rausch Herscovici et al. 2010). In addition, the GSHS Curacao 2015, suggests that 26% of female students who reported bullying because of their physical appearance while males were bullied for reasons associated with sexual activities (Verstraeten 2015) . Similarly, McClanahan et al (2014), found that females in 14 countries were bullied because of their body or physical appearance (McClanahan, Stephanie et al. 2014). Studies in high-income, developed countries also suggest a relationship between obesity and bullying. For example, a study in the United States reported that 84% of high school students reported seeing their peers teased because of their weight status (Puhl, Latner et al. 2016). Weight-based teasing is a major cause of bullying at school (Lumeng, Forrest et al. 2006, Brixval, Rayce et al. 2012, Puhl, Latner et al. 2016) particularly during adolescence and can lead to adverse consequences including additional weight gain (Puhl, Latner et al. 2016). Another consequence of bullying is that victims can become perpetrators. A study by Bacchini et al (2015) showed that severely obese adolescents can also bully others (Bacchini 2015), which could increase the number of victims.

The presence of weight-based bullying in the two sub-regions is concerning. Our study found that within LAC there is a lack of anti-bullying legislation. A study by Woolley et al. (2019) identified that approximately 30% of all LAC countries have school-based anti-bullying laws (Woolley and Macinko 2019). This included high income countries such as

Brazil, Colombia and Argentina laws (Woolley and Macinko 2019). There is no mention whether countries with laws specify weight-based bullying. This could be an area for further research to better understand the association with obesity and bullying in the region.

Our findings reveal patterns that suggest gender disparities for obesity prevalence in the region. As previously mentioned, a previous study found female obesity was 6 percentage points higher than males in Caribbean countries (PAHO/WHO 2011). Further research stratified by gender is needed to understand causal factors for these disparities. These findings suggest that different gender-specific strategies are needed for obesity in this region. Our study suggests gender-specific strategies are needed for obesity prevention in this region. Our findings suggest that strategies that target males are needed for Latin American countries, but this may not apply to the Caribbean where female obesity is more prevalent.

Strengths and weaknesses of the study

Our findings should be interpreted within the limitations of our study. Our sample size for the Caribbean was significantly smaller than the sample size for Latin America. However, we adjusted for the sample size to ensure that the findings could be generalized to the country populations. Cross-sectional data is used for three countries in each sub-region at different time points; therefore, the data does not take account of different obesity prevalence rates and drivers within sub-regions at the same time point. Therefore, the study cannot be generalized to reflect the whole sub-region. However,

the study pooled data across three countries in each sub-region to provide a larger sample size than by individual country, which presents valuable insights.

Although the studies use nationally representative data, the findings cannot be generalized to the Caribbean sub-region since the two countries have similar socio-demographics. Other countries with high obesity prevalence such as Barbados, and Trinidad and Tobago were not included in the study. Based on the literature, they have higher prevalence for risk factors such as soft drink consumption which could have changed the study's findings.

Despite these limitations there are several strengths of our study. By pooling countries from the two sub-regions, our study has provided an indication that there are significant differences in prevalence rates, risk and protective factors between the two sub-regions. Our study also highlighted similarities of risk and protective factors between the two sub-regions that could be used for regional preventative strategies.

Conclusion

To the best of our knowledge, previous research on LAC has not compared obesity prevalence and a full range of risk factors (socio-demographic, behavioral, psychosocial and substance misuse) between the Latin American and Caribbean sub-regions. This study lays a foundation for further research stratified by gender and adolescent age groups.

Chapter 4

Predictors of obesity among school-age adolescents in high-income, developing countries in LAC

Introduction

Obesity affects a growing proportion of the population of Latin America and the Caribbean (LAC). Obesity-related diseases are becoming more prevalent among younger age groups causing premature morbidity and mortality (Hennis 2018). Several countries have achieved high-income status in the LAC region, yet are still developing, since economic disparities exist, which are reflected by inequitable access to sustainable development resources such as health and education. LAC adolescents have grown up during the economic transition from low- or middle- to high-income status, and with the increase in disposable incomes, adolescents and their families' have adopted more Western lifestyles. These lifestyles such as consumption of fast food, use of motorized transport, screen-based entertainment and sedentary behaviors have contributed to rising obesity among adolescents (Corvalán, Garmendia et al. 2017, FAO and UNICEF 2018). Due to limited health resources and support systems in high-income, developing countries, safeguarding the health of this generation of adolescents is critical to the future economic and social sustainability of these countries.

Lack of systematic surveillance of risk factors for non-communicable diseases poses a challenge to understanding risk factors for obesity among the adolescent population in this region. Traditional risk factors in high-income developed countries that influence obesity rates include age, gender, diet and physical activity (Grundy 1998, Han, Lawlor et al. 2010). Because of development challenges, risk factors may differ in high-income, developing countries compared to high-income, developed countries. Therefore there is a need to examine the relationship between health behaviors and obesity

prevalence in high-income, developing countries in LAC. As the number of LAC adolescents with obesity and related diseases who contract non-communicable diseases at younger ages continues to grow, an urgent need arises for targeted for targeted prevention strategies in the region to reduce the risks of obesity. The purpose of this study was to model and assess the relationship between health behaviors and obesity status for school-going adolescents aged 13 – 15 years in six LAC countries.

Background

The public health burden of childhood and adolescent obesity can be seen globally (de Onis, Onyango et al. 2007, Collaboration, Abarca-Gómez et al. 2017). In the last few years, obesity rates have stabilized for most groups in developed countries such as England and the United States (Ogden, Carroll et al. 2012). Today, obesity rates are higher in developing countries (Popkin and Doak 1998, Gupta 2012, Ng, Fleming et al. 2014, Collaboration, Abarca-Gómez et al. 2017). For example, a study by Gupta et al. (2012) indicated that obesity prevalence in developing Latin American and Asian countries was higher than the global average of 18% in Mexico (41.8 %), Brazil (22.1 %), India (22.0 %) and Argentina (19.3 %) (Gupta, Goel et al. 2012).

Developing countries are usually classified as low- and middle-income countries (LMICs) (World Bank 2012). However, some developing countries have achieved, high-income status but continue to face development challenges. Due to economic inequalities, all inhabitants do not have equal access to basic resources such as health, (Caribya 2019)education, and water hence the countries are classified as developing or emerging economies (Fund 2019). For example, some high-income LAC developing

countries have specific challenges from environmental threats from natural disaster (UN 2019), which could restrict their capacity to grow crops. As a result, most of the healthy food is imported and expensive and therefore less consumed than cheaper high calorie alternatives. Additionally, unlike-high income, developed countries, several LAC developing countries are dealing with the double burden of addressing over and undernutrition among their populations (FAO 2017), which presents further challenges such as hunger. Given these unique challenges facing these LAC countries, it is important to identify which obesity risk factors have greater or lesser implications for high-income developing LAC countries.

With limited health and financial resources, the predicted rise of obesity is a threat to the economic development of these high-income, developing states (Gupta, Goel et al. 2012, Hennis 2018) . In these countries, premature mortality from NCDs is reducing the current labor force but also threatens the future workforce since NCDs are presenting in younger and younger populations such as school-going adolescents (Conliffe, Frankson et al. 2015). Moreover, if the obesity epidemic is not stopped, countries will have to spend more of their Gross Domestic Product (GDP) on healthcare, which will divert spend from other areas of the economy. For example, in 2000 annual estimated direct and indirect costs of obesity-related diabetes in Latin America and the Caribbean was $US 65.2 billion (Hennis 2018). Also, it is predicted that rise in NCDs by 15% by 2020 will cost the region up to 7% of GDP (Hennis 2018).

Although there have been studies of obesity in developing countries, most refer in their findings to LMICs (Collaboration, Abarca-Gómez et al. 2017). Yet there are several high-income, developing countries. High-income LAC developing countries may have

unique characteristics based on the complex relationship between economic status and development challenges that influence determinants for obesity for adolescents. Using nationally representative LAC data for six countries; we compare the socio-demographics, diet, physical activity, psychosocial and substance misuse behaviors for adolescents with and without obesity in the region to inform preventative strategies and policies for school based adolescents. Our work is based on the research question: what are the predictors what are the predictors for obesity in high-income, developing countries in LAC?

Methods

We used data from the Global School-Based Student Health Surveys. Specifically, we examined data from Anguilla during (2015-2016), the Bahamas (2012 - 2013), Curacao (2014 - 2015), Uruguay (2011-2012), Chile (2012-2013), and Argentina (2011 - 2012). The GSHS collects socio-demographic and health behavior information from a representative sample of adolescents in school primarily aged 13 – 15 every four years. Information is collected by self-reporting; all individuals in one class are selected from a two-stage cluster sampling process and administered a questionnaire, including questions on weight, health behaviors such as diet, physical activity and substance misuse. One exception was Anguilla where there is one secondary school hence all students were sampled. The total sample was 28,368 and we included in the study adolescents aged 13 – 15 years (n = 15,320). Our sample included: Anguilla (n= 212), Bahamas (n=766), Curacao (n=538), Uruguay (n=2,234), Chile (n=916), and Argentina (n =10,654).

Study Setting

Countries in Latin America and the Caribbean are culturally, geographically and socio-economically diverse. The land size of islands varies from 91 km^2 in Anguilla to over 2 million km^2 in Argentina. The populations of the islands also vary in size; Anguilla has a population of 13,572 whereas Argentina's population is in the upwards of 42 million. Life expectancy at birth for males is 72 years in Argentina, 73 years in the Bahamas, 76 years in Uruguay, 77 years in Curacao, and 78 years in Chile, and 81.3 years in Anguilla. The age range is similar among females. Life expectancy at birth for females is 73 years in Curacao and Uruguay, 78 years in the Bahamas, 78.7 years in Anguilla, 79.8 years in Argentina, and 84 years in Chile. While most countries have a high degree of urbanization, 100% of Anguilla's population live in urban areas. Secondary school enrolment ratios range from 87.5% in Curacao to 109.3% in Uruguay (with the exception of Anguilla for which no information was available).

Assessment of Obesity and Health Behavior Outcomes

Participants self-reported height and weight. Information was used to calculate BMI variables based on WHO BMI-for-age growth chart (WHO reference) and dichotomously coded into presence (BMI =<24.2) or absence of obesity (BMI >=14.9 & BMI <24). Hunger was dichotomized into variables based on presence or absence. If participant reported hunger some or all of the time, s/he was coded as hungry. The seven-item Likert-scale for fruit and vegetable consumption was collapsed and recoded into two categories ("did not eat" or "one time or more per day"). Soft drink and fast food consumption were dichotomized from a seven-item and five-item Likert scale respectively to two categories ("did not consume" and "consumed" fast food or soft

drinks). Respondents who reported physical activity for a total of at least 60 minutes a day for the past 7 days, in line with the WHO guidelines, were coded as "active" (WHO Global Recommendations, 2010). Respondents who reported active transportation in line with the WHO guidelines (e.g. walk, riding to and from school on at least 3 days during the past 7 days) were classified as "active transport". Participants who stated participation in physical education (PE) on 3 or more days per week, were classified as “participating in PE”. We assessed “sedentary behavior” as participants who spent 3 or more hours per day sitting outside school in line with the WHO guidelines (WHO Global Recommendations, 2010). If respondents answered yes to one or more days of bullying, it was coded as "bullying victimization". Respondents that reported drinking alcohol on one or more days in the past were coded as “drinkers”.

Covariates/Socio-demographics

We investigated social and demographic characteristics of the sample population to identify correlations with the predictor variables mentioned above. This included age, gender, and country of residence. Age was divided into three categories (“13 years”, “14 years” and “15 years”). The dichotomized gender variable for “Male” and “Female” was used.

Statistical Analyses

We used STATA 15.3 for data management and analyses which has functions to analyze weighted data. We used SVYSET to apply survey weights from the datasets to adjust for each country sample. This improves the point estimates and allows for generalization of the estimation sample to the national population. SVY LOGIT was

used to perform weighted multivariable logistic regression to identify the predictor variable significant for obesity in the pooled sample: socio-demographics (Model 1), health behaviors (Model 3), psychosocial and substance misuse (Model 3). All variables were used in Model 4. SVY LOGIT was used to perform weighted multivariable logistic regression to identify the predictor variable significant for obesity in the country sample: socio-demographics (Model 1), health behaviors (Model 2), psychosocial and substance misuse (Model 3), and all variables were used in Model 4. Socio-demographic characteristics, country, health risk behaviors, psychosocial factors and substance misuse were taken as independent variables $p < 0.05$ was considered significant. Unadjusted and adjusted odds ratios are presented with 95% confidence intervals.

Results

Latin America and Caribbean

The results of the univariate association between study demographic, behavioral, and psychosocial and substance misuse factors and risk of obesity in Latin America and the Caribbean are shown in Table 1. As shown, being female (OR: 0.69, 95%CI: 0.55 - 0.88), fruit intake (OR: 0.75, 95% CI: 0.62 - 0.91) were associated with decreased odds of obesity. However, subjects who were 15 years old (OR: 1.70, 95% CI: 1.34 - 2.15), and participated in regular physical education (OR: 1.24, 95% CI: 1.01 - 1.53) were associated with increased odds of obesity. In Model 1 that controlled for all the variables, upon investigation of socio-demographics such as gender and age, being

female was associated with decreased odds of obesity (AOR: 0.70, 95%CI: 0.55 - 0.88), whereas being 15 years old had a much higher odds (AOR: 1.70, 95% CI: 1.34 - 2.15) compared to 13 year olds. In Model 2, controlling for other behavioral factors, only fast food was significant (AOR: 0.75, 95%CI: 061 - 0.91) among behavioral characteristics. When the psychosocial and substance misuse variables were controlled, none of them was associated with increased odds of obesity. In a multivariate analysis that included all variables (socio-demographics, behavioral, psychosocial and substance misuse), only fast food (AOR: 0.74 ,95%CI: 060 - 0.90), female gender (AOR: 0.70, 95%CI: 0.57 - 0.86) were associated with decreased odds of obesity whereas being 15 years old was associated with increased odds (AOR: 1.70, 95% CI: 1.34 - 2.15).

Anguilla

The demographic, behavioral, psychosocial and substance misuse factors and risk of obesity in Anguilla are shown in Table 2. An analysis of the univariate model showed that only physical activity (OR: 0.35, 95% CI: 0.16 - 0.77) and sedentary behavior (AOR: 0.46, 95% CI: 0.26 - 0.83) were significantly associated with obesity in Anguilla. In our Model 1 analysis, controlling for sociodemographic variables of age and gender, none of the variables were associated with obesity. The results of the behavioral model in Model 2, showed a similar result to the univariate model, that physical activity (AOR: 0.32, 95% CI: 0.16 - 0.34) and sedentary lifestyle (AOR: 0.38, 95% CI: 0.19 - 0.73) were associated with obesity, after controlling for diet and other behavioral factors. We found no significant association for obesity after controlling for the two variables (bullying victimization and alcohol intake) in Model 3. The results of Model 4 showed that engaging in physical activity (AOR: 0.31, 95% CI: 0.15 - 0.65), and leading a sedentary

lifestyle (AOR: 0.36, 95% CI: 0.16 - 0.81) was associated with decreased odds of obesity.

The Bahamas

Among all variables univariately, compared to boys, girls were shown to have significant increased odds of obesity in the Bahamas (OR: 1.61, 95% CI: 1.24 - 2.09). Among sociodemographic variables that were investigated, similar results to the univariate analysis, female was also associated with obesity, after controlling for age (AOR: 1.61, 95% CI: 1.25 - 2.07). In Model 2, that analyzed the issue between each of the behavioral characteristics, we did not find any statistically significant association when tested. We also did not find any association between lifestyle factors that included bullying victimization and alcohol intake in Model 3. In Model 4, that included all variables (demographic, behavioral, psychosocial and substance misuse, we found that females remained significant, similar to what was observed in the univariate analysis (AOR: 1.65, 95% CI: 1.23 - 2.23).

Curacao

In the univariate analysis, only bullying victimization was associated with much higher odds compared to other variables (OR: 1.94, 95% CI: 1.23 - 3.07). For Model 1 and Model 2, none of the variables were found to be statistically significant. In the psychosocial and substance misuse model (Model 3), only bullying showed a significant association for obesity, after controlling for alcohol intake (AOR: 1.95, 95% CI: 1.23 - 3.08). A similar finding was observed after controlling for all variables in Model 4, bullying victimization remained significant (AOR: 2.02, 95% CI: 1.27 - 3.21). .

Uruguay

The results of a univariate analysis showed that being 15 years old (OR: 1.42, 95% CI: 1.03 - 1.95) and fruit intake (OR: 0.74, 95% CI: 0.59 - 0.93) were significantly associated with obesity in Uruguay. Further analysis of sociodemographic variables in Model 1, showed a similar result to the univariate model, being 15 years old was associated with obesity, after controlling for gender (AOR: 1.42, 95% CI: 1.03 - 1.95). An analysis of behavioral and lifestyle factors in Model 2, showed only fruit intake was associated with obesity, after controlling for the other behavioral variables (AOR: 0.74, 95% CI: 0.58 - 0.96). In the psychosocial and substance misuse model (Model 3), none of the variables were significant. The results of Model 4 which controlled for all variables (sociodemographic, behavioral, psychosocial and substance use), showed that fruit intake was associated with decreased odds of obesity (AOR: 0.74, 95% CI: 0.57 - 0.96) , whereas being 14 years olds (AOR: 1.33, 95% CI: 1.02 - 1.73), adolescents aged 15 years (AOR: 1.51, 95% CI: 1.07 - 2.12), and bullying victimization (AOR: 1.36, 95% CI: 1.06 - 1.81) was associated with increased odds of obesity.

Chile

In our univariate model, being 14 years old (OR: 1.37, 95% CI: 1.02 - 1.84), 15 year old adolescents (OR: 2.16, 95% CI: 1.49 - 3.14), and fast food intake (OR: 0.72, 95% CI: 0.53 - 0.97) were significantly associated with obesity. The socio-demographic model showed after controlling for female gender, being 15 years old (AOR: 2.15, 95% CI: 1.47 - 3.14) was the only variable associated with obesity. In Model 2, we found that

fast food intake was significantly associated with obesity, after controlling for other behavioral characteristics. None of the variables in the psychosocial and substance misuse model (Model 3) were significantly associated with obesity. In Model 4, after controlling for all variables (socio-demographic, behavioral, psychosocial and substance misuse), being female (AOR: 0.68, 95% CI: 0.68 - 0.98), fruit intake (AOR: 0.75, 95% CI: 0.57 - 0.98), and fast food intake (AOR: 0.67, 95% CI: 0.50 - 0.91) was associated with decreased odds of obesity, whereas being 15 years old was associated with increased odds of obesity (AOR: 2.21, 95% CI: 1.51 - 3.22) .

Argentina

In the univariate model, being female (OR: 0.67, 95% CI: 0.55 - 0.81), being 15 years (OR: 1.37, 95% CI: 1.03 - 1.82), and bullying victimization (OR: 1.26, 95% CI: 1.04 - 1.53) are significantly associated with obesity. We found similar results to the univariate model in Model 1, after controlling for sociodemographic variables, being female (AOR: 0.67, 95% CI: 0.55 - 0.82) and being 15 years old (AOR: 1.38, 95% CI: 1.04 - 1.83), is associated with obesity. None of the behavioral and lifestyle variables showed significant association with obesity after controlling for other behavioral factors in Model 2. We found that bullying victimization was significantly associated with obesity, after controlling for alcohol intake in Model 3 (AOR: 1.25, 95% CI: 1.02 - 1.53). The results in Model 4 after adjusting for covariates (age, sex, diet, physical activity, psychosocial and substance misuse), displayed that being female (OR: 0.67, 95% CI: 0.56 - 0.80) was associated with decreased odds of obesity, whereas being aged 15 years (OR: 1.35,

95% CI: 1.02 - 1.79), and bullying victimization (AOR: 1.28, 95% CI: 1.05 - 1.56) were associated with much higher odds of obesity.

Table 8 summarizes the significant associations from Model 4, which examined the association between sociodemographic, behavioral, psychosocial and substance misuse variables and increased risk of obesity among participants from the Latin America and the Caribbean and the studied countries (Anguilla, Bahamas, Curacao, Uruguay, Chile and Argentina), after adjusting for covariates (age, sex, diet, physical activity, psychosocial and substance misuse).

Discussion

We examined the association between obesity and associated socio-demographic, behavioral, psychosocial and substance misuse factors by sub-region using frequency distributions, univariate, and multivariate analysis. The findings reveal a pattern of different risks of obesity among boy and girl adolescents in the study countries.

Gender

In the Bahamas, being female was associated with increased risk of obesity whereas in in Chile, Argentina and regionally, females had lower odds of obesity. This findings support gender disparities for obesity prevalence in countries. As previously mentioned, a previous study found female obesity was higher in the Bahamas while studies in Argentina show higher male obesity.

Age

Older adolescence is also associated with obesity in two countries Chile and Argentina. Our study covered a narrow age range from early to late adolescence. Since 14 and 15 year olds have greater independence and access to financial resources to purchase unhealthy foods, compared to 13 year old adolescents, one would expect higher age groups to have higher risk of obesity. Also, older age groups have greater independence for socializing and extra-curricular activities, and they are more likely to eat less healthy food prepared outside of the home due to the influence from peers (Cohen, Dastidar et al. 2012) . For instance, adolescent girls in the United States reported consumption of 3.5 servings of snacks, with a higher content of sugar and fat, at a friend's house compared to 3.0 servings at retail food outlets (Cohen, Dastidar et al. 2012) .

Hunger

Hunger appears to be a problem in the region particularly in Latin American countries. Although it is not significant, in some countries hunger seems to be a risk factor for obesity. According to the Food and Agriculture Organization (FAO), for the third consecutive year, hunger is rising in Latin America where severe food insecurity increased form 7.6 % in 2016 to 9.8 % in 2017 (FAO 2018). Our findings show a pattern suggesting an association between obesity and hunger in Latin America which supports previous research (Rueda-Clausen, Silva et al. 2008, FAO 2017). Casey et al (2006) study of Mexican households indicated a significant association between food-insecure

adolescents (ages 12 to 17 years) and being at risk of obesity or overweight when measured at both the child and household levels (Casey, Simpson et al. 2006). It is also possible that students may have been hungry from skipping breakfast due to being late to catch transportation to school or lack of money to buy breakfast. Studies in other high income countries in North America and Europe evidence high prevalence (10-30%) of skipping breakfast among children and adolescents (Rampersaud, Pereira et al. 2005). Studies suggest that girl adolescents are more likely to skip breakfast due to lack of time, and reduced appetite as a result of concerns about their body image (Affinita, Catalani et al. 2013). Forkert et al (2019) examined adolescents in Brazil and Europe and found increased body mass index among adolescents who skip breakfast since skipping breakfast leads to unhealthy food choices (Forkert;, Moraes; et al. 2019). Further research is needed in this area to understand reasons for hunger in LAC.

Fast food

In a related finding, the results show patterns that fast food consumption is associated with decreased risk of obesity at the regional level and in Chile. One would have expected that fast food consumption would have contributed to increased obesity. This contradicts the extant literature which suggests that consumption of energy dense and high calorie fast food is the main culprit for rising obesity (Rivera, González de Cossío et al. 2014, Corvalán, Garmendia et al. 2017). However, our findings may be explained by another study. Poti et al (2013) suggest that fast food does not cause obesity since obesity is caused by poor eating habits of low fruits and vegetables and processed foods (Poti, Duffey et al. 2013). Our findings support the results of a study by

Brathwaite et al (2014), which examined frequency of fast food intake among adolescents aged 13 to 14 years in 36 low- and middle- income countries including Uruguay and Mexico from Latin America (Braithwaite, Alistair et al. 2014). The study found that frequent fast food consumption was significantly associated with lower BMI with stronger associations for countries with high Gross National Income (Braithwaite, Alistair et al. 2014).

Soft drink consumption

In our study, soft drink consumption is associated with lower risk of obesity among adolescents. This is in stark contrast to previous studies that suggest that soft drink consumption contributed to BMI among adolescents. Our inverse relationship may be explained by the limitation of our soft drink variable which is measuring soft drink intake while other studies measure soft drink as part of sugar sweetened beverage sugar-sweetened beverages (covering soft drinks, packaged juices and powdered juices containing sugar , which are prevalent among LAC populations (FAO 2017). One would have expected higher consumption rates in Latin America since a study of 153 countries, found Latin American countries had the highest consumption rates of sugar sweetened beverages globally (Lara-Castor 2019). However, our study did not include countries with the highest prevalence rates such as Mexico, Suriname and Jamaica. Another reason for our negative association could be the underreporting of soft drink consumption due to a narrow definition for soft drinks. For example, if students do not report consumption of energy drinks. Studies in the US indicate that children and adolescents do not do enough exercise to necessitate use of energy drinks (Cordrey, Keim et al. 2018). Energy drink consumption is high in the region. For example, among

university students in the Trinidad & Tobago, a study found 86% use energy drinks whereas Latin American includes some of the top consuming countries for energy drinks globally (Nasdaq 2017). Energy drinks are also consumed with alcohol (Cordrey, Keim et al. 2018). We found more than a quarter of obese participants drank alcohol therefore this could be an area for further research.

Physical activity

As expected, in Anguilla, physical activity was associated with decreased risk of obesity. One would have expected physical activity to be a risk factor in other countries. However, our physical activity rates may be underestimated since our survey did not ask about the intensity of the physical activity. Therefore this could be an area further research is needed to understand whether the adolescents are meeting the World Health Organization recommended guidelines of 60 minutes of moderate-vigorous physical activity . This could also be a recommendation for ensuring that this measure is in all Global School-Based Student Health Surveys.

Sedentary behavior

There was an interesting finding among adolescents from Anguilla and a few other countries, sedentary behavior was associated with lower rates of obesity. This is in direct contradiction to the literature (Corvalán, Garmendia et al. 2017). Our finding for Anguilla could be due to the small sample size for the study. However, the reason for this inverse association in other countries is unclear. One possible explanation is that since sedentary behavior is linked to poor food choices will lead to obesity increase, it is possible that adolescents who are sedentary are making better food choices due to

healthy food campaigns and interventions in the regions or information gained from the internet. Another possible explanation for our inverse relationship is that adolescents be participating in new forms of sedentary behavior such as using phones, tablets or laptops, for which studies are yet to confirm the association with increased BMI among adolescents (Rideout VJ, Foehr UG et al. 2010). Another possible explanation is that since there are high levels of sedentary behavior, there may be no difference in risk factors for those with and without obesity. For example, a study in Uruguay found no significant difference between normal weight and overweight adolescents that engaged in sedentary behavior (p = 0.3) (Pisabarro and Kaufmann 2004)

Bullying victimization

Trends in the findings reveal a potential correlation between bullying and obesity in the region could be explained by adolescents being bullied because of their weight. A study by Kovalskys (2010) in Argentina found obese adolescents were significantly more likely to be victims of general bullying , verbal, and physical bullying, whereas, overweight adolescents were more likely to experience physical bullying (Kovalskys, Rausch Herscovici et al. 2010). In addition, the GSHS Curacao (2015), suggests that 26% of female students who reported bullying because of their physical appearance while males were bullied for reasons associated with sexual activities (Verstraeten 2015). Similarly, McClanahan et al (2015), found that females in 14 countries were bullied because of their body or physical appearance (McClanahan, Stephanie et al. 2014). Studies in high-income developed countries also suggest a relationship between obesity and bullying. For example, a study in the United States reported that 84% of

high school students reported seeing their peers teased because of their weight status (Puhl, Latner et al. 2016). Weight-based teasing is a major cause of bullying at school (Lumeng, Forrest et al. 2006, Brixval, Rayce et al. 2012, Puhl, Latner et al. 2016), and can lead to adverse consequences including additional weight gain (Puhl, Latner et al. 2016).

Countries of concern in the region may consider enacting legislation or those that have legislation should add weight-based bullying to existing bullying legislation which is translated into school level policies. The literature suggests that within LAC there is a lack of anti-bullying legislation. A study by Woolley et al. (2019) identified that approximately 30% of all LAC countries have school-based anti-bullying laws (Woolley and Macinko 2019). This included high income countries such as Brazil, Colombia and Argentina laws (Woolley and Macinko 2019). There is no mention whether countries with laws specify weight-based bullying. This could be an area for further research.

Strengths and limitations

Our findings should be read in the context of the limitations of our study. The use of cross-sectional data for the GSHS survey limits the ability to determine causation. However, the study was able to determine the association between obesity and the risk factors which can be used for further research. The use of data for six countries means that the findings cannot be generalized to the whole region; however, the study

identified some similarities between countries which provided valuable insights. The variable for hunger did not have a separate measure for skipping breakfast. Skipping breakfast is a key risk factor for adolescents and would provide insights into the type of hunger. This is a recommendation for future research given the prevalence of malnutrition in the region.

The strengths of the study include the use of pooled data for 6 years which provide a large sample size for generalization of the data to the region. The complex design of the GSHS data provided opportunities for theory-based modeling to better understand key associations between risk factors and individual countries. In this study, logistic regression analyses were used to control the influence of covariates. This provided a valuable insight into the specific variables that need to be targeted in individual countries for obesity preventative strategies. Among lack of research on high income developing countries in the sub-region, this study's goal was to examine associations between the variables to inform targeted strategies for unique adolescent populations in high income countries in the region. Future studies could use larger sample sizes.

Conclusion

To the best of our knowledge, previous research on LAC has not compared the full range of factors (socio-demographic, behavioral, psychosocial and substance misuse) associated with obesity between high-income, developing countries in Latin America and the Caribbean. This study provides an indication for additional research on risk factors for obesity to inform targeted for preventative initiatives.

Chapter 5 Discussion

Summary of Studies

The motivation for this study comes from the question of rising obesity among adolescents in Latin America and the Caribbean despite the evidence of its impacts across the life course on health and quality of life. It stems from the fact that most literature on obesity in the region refers in the findings to lower and middle income countries. Additionally, most literature on adolescent obesity in high-income countries, refer in their findings to high-income developed countries. Thus, either ignoring adolescents in high-income, developing countries in LAC or assuming that adolescents in all high-income countries have the same risk factors for obesity, irrespective of their different sociodemographic, cultural background and structural healthcare access and sustainable development limitations. Prior to this project, the literature on adolescents in high-income LAC countries referred to them as developing countries but did not take account of their high-income status. However, the results have so far shown that there are differences in determinants for obesity for school-going adolescents in high-income developing countries in LAC compared to other high-income developing countries. Additionally, differences exist between high-income, developing LAC countries in the same sub-region and region.

Currently, the region is implementing three action plans to reduce adolescent obesity and improve adolescent health including the PAHO Child Obesity Action Plan and anti-adolescent obesity initiatives such as the NCD Alliance Preventing Childhood Obesity

Plan 2017 - 2021 and the Recommendations of the PAHO Adolescent Health Plan. However, there has been limited implementation of the PAHO Plan of Action and Global NCD strategies in the Caribbean region (Murphy, Unwin et al. 2018) , which may be partly due to the limited resources of these high-income countries. Additionally, evaluations of anti-obesity initiatives in some countries indicated limited of lack of effectiveness (Correa, Fierro et al. 2019, Kaufmann and Pontet-Ubal 2019) In particular, there were concerns that the Chile Laws on food-labelling had less of an effect on pre-teens and early teens than younger children (Correa, Fierro et al. 2019). Therefore, efforts aimed at reducing adolescent obesity in LAC should prioritize country, sub-regional and regional differences in prevalence and risk factors when designing strategies and policies for this population.

In our first study, we investigated the prevalence and socio-demographic distribution of factors associated with obesity (diet, physical activity, psychosocial and substance misuse) in six high-income, developing countries (Anguilla, the Bahamas, Curacao, Uruguay, Chile, Argentina) in Latin America and the Caribbean. We conducted cross-tabulations and Pearson's Chi Square for persons with normal and elevated BMI using data from the Global School-Based Student Health Survey for from six countries: Anguilla during (2015-2016), the Bahamas (2012 - 2013), Curacao (2014 - 2015), Uruguay (2011-2012), Chile (2012-2013), and Argentina (2011 - 2012). We classified overweight and obesity based on BMI cut-offs from the WHO BMI-for-age growth chart (WHO reference).The WHO BMI-for-age growth chart is frequently used due because it takes account of child development. We calculated the prevalence and Pearson's Chi Square for socio-demographic, behavioral and psychosocial and

substance misuse characteristics among persons with normal and elevated BMI. We also calculated the distributions and Pearson's Chi Square by country for factors associated factors with obesity among persons with normal and elevated BMI in the studied countries. We further calculated distributions and Pearson's chi square by country for socio-demographics and behavioral, lifestyle, psychosocial and substance misuse factors among obese persons from the six countries. We calculated overweight and obesity prevalence levels of 19% for the region, with the highest rate presented in the Bahamas (35.8%), followed by Anguilla (31.7%), Chile (32.3%), Curacao (25.5%), Uruguay (17.5%), and Argentina (16.5%). We found statistically significant differences between persons with normal and elevated BMI in the region for rates of sex, age, country of residence, hunger, fruit intake, fast food intake and physical education ($p<0.05$). We also found rates differences for all variables except sex, age and physical activity ($p<0.05$) when comparing across the six countries. In this comparative analysis, Bahamas reported the highest rate for 13 years olds (40.8%), and 14 year olds (41.4%), soft drink intake (68.6%), and fast food intake (73.3); Anguilla reported the highest for 15 year olds (46.1%), physical activity (23.8%), physical education (41.9%), and bullying victimization (26.0%); Bahamas reported the highest rate for 13 years olds (40.8%), and 14 year olds (41.4%), soft drink intake (68.6%), and fast food intake (73.3); Curacao reported the highest rate for vegetable intake (76.7%); Chile reported the highest rates for fruit intake (68.0%) and hunger along with Uruguay (98.8%) ; Uruguay reported the highest rate for female participants (55%) ;and Argentina presented the highest rate for active transportation (57.2%), and alcohol intake (51.6%).

In our analyses of obese participants, we found statistically significant differences between the six countries for rates of hunger, fruit intake, vegetable intake, fast food intake, physical activity, active transportation, physical education and sedentary lifestyles ($p<0.05$). In our comparative analysis among obese participants, Anguilla (and Chile) reported the highest rates for 15 year olds (42.8%), physical activity (61.3%), the Bahamas reported the highest for female gender (61.3%) and fast food intake (71.3%), Curacao reported the highest rates for bullying victimization (31.3%), Chile for 15 years old (42.8%), hunger (99.8%), Uruguay reported the highest for soft drink intake (65.9%), and Argentina presented the highest for fruit intake (69.7%), and vegetable intake (74.6%), physical activity (16.8%) and alcohol intake (54.6%). We also estimated statistically significant differences within countries between obese and non-obese for sex (The Bahamas and Argentina), 15 year olds (Chile and Argentina), fruit intake (Uruguay), fast food intake (Chile), physical activity (Anguilla), sedentary behavior (Anguilla), bullying victimization (Curacao and Argentina).

In our second study, we examined the association between obesity and associated factors by sub-region. We classified countries into Latin America (Uruguay, Chile, and Argentina) and the Caribbean (Anguilla, the Bahamas, and Curacao) sub-regions. Our hypothesis was that the Caribbean countries have a higher proportion of obesity and risk factors compared to Latin America. We calculated distributions and Pearson's chi square for all variables among persons with normal and elevated BMI in the two sub-regions. We conducted multivariate analysis to estimate the odds of obesity by sub-region, controlling for covariates (socio-demographic, health behaviors and psychosocial and substance misuse factors). We calculated obesity prevalence rates of

31.3% in the Caribbean and 17.6% in Latin America. We found statistically significant differences for rates for hunger, soft drink intake, physical activity, physical education, sedentary lifestyles and alcohol intake ($p<0.05$) between sub-regions among persons with normal and elevated BMI. In this comparative analysis, Latin America presented highest rates for 15 year olds (33.9%), hunger (59.2%), vegetable intake (56.7%), physical activity (15.7%), active transportation (54.5%), and alcohol intake (59%). In the same analysis, The Caribbean presented the highest rates for females (53.5%), 13 year olds (36.4%) and 14 year olds (39.5%), fruit intake (55.7%), soft drink intake (65.6%), fast food intake (71.8%), physical education (29.0%), sedentary lifestyle (56.7%), and bullying victimization (21.4%). We estimated statistically significant differences between rates of sex, age, hunger, fruit intake, fast food intake, active transportation, physical education, sedentary, bullying victimization, and alcohol intake ($p<0.05$) between obese and non-obese persons within sub-regions. We estimated that within Latin America, there were rate differences for sex, age, fruit intake, and soft drink intake whereas within the Caribbean, there were rate differences for sex and bullying victimization, among obese and non-obese persons. We found that the Caribbean presented the highest rates for female (59.5%), 13 year olds (37.9%), and 14 year olds (41.0%), fruit intake (57.8%), vegetable intake (60.1%), soft drink intake (62.3%), fast food intake (71.3%), sedentary lifestyle (55.0%), bullying victimization (24.9%) whereas Latin America only reported the highest rate for obese 15 year olds (41.7%), hunger (72.7%), physical activity (14.2%), active transportation (53.4%), physical education (32.5%), and alcohol intake (36.3%). Our finding that the Caribbean reported higher rates for obesity and more risk factors than Latin America supports our hypothesis. We estimated risk of

obesity in a multivariate model, controlling for covariates (socio-demographic, health behaviors and psychosocial and substance misuse factors), in each sub-region. We estimated increased odds of obesity for females (AOR: 1.44, 95%CI: 1.16 - 1.79), and bullying victims (AOR: 1.36, 95% CI: 1.01 - 1.82) in the Caribbean countries whereas being 14 years old (AOR: 1.59, 95% CI: 1.02 - 2.47), and bullying victimization (AOR: 1.99, 95% CI: 1.28 - 3.08) were associated with increased odds of obesity in Latin America. Our finding that bullying victims are nearly twice as likely to be obese compared to non-victims in both regions suggests an area for further research. Our finding that higher obesity among 14 year olds compared to 13 year olds could suggest the needs for age specific strategies which to the best of our knowledge, has not been specified in literature.

We explored whether there were differences in the relationship between obesity and associated factors in the region and six countries in our third study. We conducted multivariate logistic regression to estimate odds of obesity in LAC region and each country. We estimated that in LAC region, after controlling for all variables (socio-demographics, behavioral, psychosocial and substance misuse), fast food (AOR: 0.74 ,95%CI: 060 - 0.90) and female gender (AOR: 0.70, 95%CI: 0.57 - 0.86) were associated with decreased odds of obesity whereas being 15 years old was associated with increased odds (AOR: 1.70, 95% CI: 1.34 - 2.15). We estimated that in Anguilla, engaging in physical activity (AOR: 0.31, 95% CI: 0.15 - 0.65), and leading a sedentary lifestyle (AOR: 0.36, 95% CI: 0.16 - 0.81) was associated with decreased odds of obesity. We estimated that in the Bahamas, being female was associated with

increased odds of obesity (AOR: 1.65, 95% CI: 1.23 - 2.23). We estimated that in Curacao, bullying victimization was associated with increased odds of obesity (AOR: 2.02, 95% CI: 1.27 - 3.21). We estimated that in Uruguay, fruit intake was associated with decreased odds of obesity (AOR: 0.74, 95% CI: 0.57 - 0.96), whereas being 14 years olds (AOR: 1.33, 95% CI: 1.02 - 1.73), adolescents aged 15 years (AOR: 1.51, 95% CI: 1.07 - 2.12). and bullying victimization (AOR: 1.36, 95% CI: 1.06 - 1.81) was associated with increased odds of obesity. We estimated that in Chile, being female (AOR: 0.68, 95% CI: 0.68 - 0.98), fruit intake (AOR: 0.75, 95% CI: 0.57 - 0.98), and fast food intake (AOR: 0.67, 95% CI: 0.50 - 0.91) was associated with decreased odds of obesity, whereas being 15 years old was associated with increased odds of obesity (AOR: 2.21, 95% CI: 1.51 - 3.22) . We estimated that in Argentina, being female (AOR: 0.67, 95% CI: 0.56 - 0.80) was associated with decreased odds of obesity, whereas being aged 15 years (AOR: 1.35, 95% CI: 1.02 - 1.79), and bullying victimization (AOR: 1.28, 95% CI: 1.05 - 1.56) were associated with much higher odds of obesity. Many of these findings are consistent with the literature as discussed below.

Implications for policy and practice

Our study reveals a pattern of risk factors in all countries and sub-regions which support the literature that adolescent obesity is a problem for LAC high-income countries. Of equal importance is that some of the risk factors such as bullying victimization have additional consequences which can further affect the quality of life of adolescents in the regions. Our findings reinforced the critical need for early intervention to address adolescent obesity since adolescents are the future workforce and caregivers in these

countries. As mentioned, these countries have limited financial resources to deal with this obesity epidemic. National and regional level interventions should be developed that target anti-bullying strategies to reduce bullying of obese persons. Socio-demographic factors such as gender and age will require group level interventions targeted at individuals in these age groups.

Moreover, given their high-income status, these countries are not eligible for grants and loans from development grants from international institutions such as the World Bank, therefore global initiatives that consider cross-sectoral partners and sharing of resources would benefit from utilizing an approach such as Collective Impact to address this epidemic. Thus, our implications are for policy, practice, public health, funders and academic sectors.

An interesting finding is that we found some similar obesity levels and risk factors between countries and sub-regions. This included countries in different sub-regions. Since all countries in the region are working to implement the PAHO Child Obesity Plan and global recommendations to reduce NCDs, governments in these countries could consider pooling resources to work together on multi-country strategies for specific risk factors. Countries that are geographically co-located such as Argentina and Chile could also work together on multi-country anti-obesity strategies. Gender-specific strategies are needed for obesity prevention in this region. Further, strategies that target males are needed for Latin American countries, but this may not apply to the Caribbean where

female obesity is more prevalent. Additionally, risk factors are different for early and late adolescents in some countries therefore adolescent age specific strategies need to be developed. The Pan American Health Organization Regional Strategy and Plan of Action on Adolescent and Youth Health 2010 - 2018 (PAHO/WHO 2018) highlighted there were gaps in interventions targeted at younger adolescents aged 10-14 years. Therefore, the implementation of recommendations from this Plan is an opportunity to conduct age-specific research to find out what works for different aged adolescents in the region.

Moreover, hunger could be associated with obesity in Latin America. Although it is not at a significant, it could warrant early intervention to prevent escalation of the problem. However, this may be voluntary hunger not due to lack of food. Further research is needed to understand the relationship between hunger and obesity. If this is voluntary hunger, then adolescents need to be educated on the risks of skipping breakfast. However, if this is hunger due to lack of food then school-based policies need to be developed that ensure that every child has a healthy breakfast in the countries of concern. The presence of weight-based bullying in the region is concerning. Comprehensive adolescent specific strategies should be developed to target psychosocial factors which appear to be more likely to be risk factors than traditional diet and physical activity in this region.

Furthermore, physical activity levels are low in the region. Every country reported low levels of physical activity. Since we did not test whether the physical activity being performed is in line with the WHO guidelines, there needs to be additional research in this area and research on barriers to inform evidence-based school interventions. Additionally, our study suggests that the GSHS should include a measure of the intensity of physical activity performed by participants, to ensure they are meeting the global standards.

Our research revealed patterns associated with risk factors that impact three Sustainable Development Goals, to reduce bullying, hunger, and gender inequality. Therefore, the PAHO Child Obesity Action Plan and anti-adolescent obesity initiatives such as the NCD Alliance Preventing Childhood Obesity Plan 2017 - 2021 (NCD Alliance 2017) should be prioritized by United Nations Agencies and other development agencies in the region. Our research found that there are some organizations working on obesity in the region and this work should be extended to the other high income countries in the region.

Conclusion

In conclusion, our research reveals trends that provide valuable insights into specific risk factors affecting individual high-income developing countries in Latin American and the Caribbean region based on their unique characteristics. The study used descriptive, univariate, bivariate and multivariate analyses to model and assess socio-demographic,

health behaviors and psychosocial factors for obesity in the study population. We found high levels of traditional risk factors of diet and physical activities in all countries, but we did not find an association between them and obesity in all countries. Our findings reveal patterns that confirm our assumption that traditional risk factors for high income countries did not apply in all of the countries. We found different socio-demographic distribution by gender and age in most countries. We also noted similar and concerning levels of low physical activity. We identified similar risk factors for bullying and age in several countries. After controlling for covariates, we identified higher proportions of obese adolescents associated with bullying in several countries and the sub-regions. Additionally, we found a potential association with hunger in Latin American countries. Our research findings supported our hypothesis that the proportion of obese adolescents is higher in the Caribbean than Latin America and the Caribbean has higher prevalence in more risk factors than Latin America. After controlling for covariates, both sub-regions, had two risk factors.

Moreover, there is lack of systematic surveillance in the region and research to inform evidence-based strategies. We identified several areas for further research to better understand the risk factors. In particular longitudinal research to track adolescent health behaviors over time to establish whether these are causal factors for obesity among this population. Further, some fiscal and policy interventions for obesity have not been evaluated therefore we recommend that these are evaluated, and the lessons learned shared to encourage other countries to adopt them. For example, a few countries have adopted Sugar Sweetened Beverages tax, but this has not been evaluated.

Our research showed patterns for three risk factors – bullying, hunger and gender equality that align with three United Nations Sustainable Development Goal indicators. Obesity prevention is also linked to a Sustainable Development Goal targets. Therefore, our this is a call to action for all urgent action by the United Nations and other development agencies, NGO and private sector actors in the region to prioritize prevention of adolescent obesity. Our research illustrates that adolescent obesity is a cross-cutting issue threatening the future development of high-income countries in this region. Thus, more funding should be provided for obesity initiatives. Our findings suggest that if early intervention measures are not taken, the human and financial costs to the region could be significant.

Our research suggested that given unique characteristics of high-income countries to attract multinational companies. Government and NGOs could explore innovative public-private partnerships to address risk factors. Additionally, based on shared risk factors, countries in the region could explore multi-country strategies to address risk factors which could facilitate shared resources for surveillance. High-income countries also attract international private universities for offshore medical schools. We suggest that countries could explore research partnerships between the medical schools and local government institutions. Our recommendations need to be implemented within the realities of the region, since the research started, two countries were devastated by hurricanes. As the countries rebuild, the threat of obesity could increase as inhabitants lose control over purchasing food since they rely on food donations from overseas. Additionally, anti-obesity efforts may be deprioritized as countries focus on rebuilding infrastructure.

The results of these analyses illustrate that there are differences in adolescent obesity patterns in LAC high-income countries. As the countries in LAC develop and the number of adolescents with obesity increases, it will be important for parents, teachers, researchers, policymakers, NGOs, inter-governmental organizations to address this threat to this population. This study provides a foundation for future research to inform targeted evidence-based interventions to drive social and environmental changes to reduce the human and economic costs of the obesity epidemic on vulnerable adolescent populations.

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AbstractBackground. Latin America and the Caribbean (LAC) countries, have been historically under-represented due to the lack of surveillance of physical behav

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OBJECTIVES: The purpose of this study was to analyse the determinants and consequences of the nutrition transition in Chile and describe the related health promotion policies. DESIGN AND SETTING: This is a descriptive, population-based study including data on demographic, diet, nutrition and biomedical related variables. Data came from the Food and Agriculture Organization (FAO), the National Institute of Statistics (INE), the Ministries of Planning, Health and Education surveillance systems, and national surveys. RESULTS: As malnutrition decreased during the 1980s, obesity increased rapidly in all age groups. In adults, currently about 25% of women are obese (body mass index >30 kg m(-2)); particularly those from low socio-economic levels. Among preschoolers, obesity is now 10% while in 6-year-old children it is 17.5% (weight/height greater than two standard deviations (>2SD) of the World Health Organization reference). Nutritional risk factors are prevalent, diet is changing to a 'Western diet' with an increasing fat consumption, and sedentarianism is constant in all groups. High blood pressure (>140/90) is greater than 10% in adults. Diabetes is increasing in urban areas, including in the indigenous population, and more than 40% of adults have a cholesterol level of more than 200 mg ml(-1). CONCLUSIONS: Promotion of healthy lifestyles is the main strategy to cope with this situation, particularly changing behaviour in food habits, physical activity and psychosocial factors. Changes in lifestyles will not only allow the prolonged life expectancy to be of better quality, but also will favour a decrease in the morbidity and mortality from chronic diseases, mainly cardiovascular diseases.

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Sugar sweetened beverages (SSB) are thought to play an important role in weight gain. We examined the relationship between the intake of caloric and noncaloric beverages (SSB and water) and the nutritional status of children. In 2014, we randomly selected 16 public health

clinics in four cities of Northwest Argentina and conducted a survey among mothers of children 0-6 years of age. Children's beverage intake was ascertained by 24-h dietary recall provided by the mothers. Children's weight and height measures were obtained from clinic's registries. We calculated the body mass index using the International Obesity Task Force standards. The analysis included 562 children 25 months to 6 years of age with normal or above normal nutritional status. Children's beverage consumption was as follows, water 81.8%, carbonated soft drinks (CSD) 49.7%, coffee/tea/cocoa 44.0%, artificial fruit drinks 35.6%, flavored water 17.9%, natural fruit juice 14.5%. In multivariate logistic regression models the likelihood of being obese v. being overweight or having normal weight doubled with an intake of one to five glasses of CSD (OR=2.2) and increased by more than three-fold with an intake of more than five glasses (OR=3.5). Drinking more than five glasses of water decreased the likelihood of being obese by less than half (OR=0.3). The percentage of children drinking more than five glasses of other beverages was low (3.3-0.9%) and regression models did not yield significant results. The study contributed evidence for reducing children's CSD intake and for promoting water consumption, together with the implementation of comprehensive regulatory public health policies.

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The obesity epidemic is rapidly advancing in South America, leading to inevitable health consequences. Argentinian and Brazilian health policies try to become adapted to the new economic and social framework that follows from this epidemic. It is in incipient and ineffective control so far since the prevalence of obesity was not restrained. The Argentine national legislation is more advanced, through the so-called “Ley de Obesidad.” In Brazil, there are numerous local initiatives but still not a comprehensive law. National policies relating to decisions regarding obesity are discussed in this paper. Trends in decisions issued in higher courts of Argentina (Supreme Court of Justice of the Nation—CSJN) and Brazil (Supreme Court of Justice—STF), in the last 15 years, seek to clarify the approach of each country and court's resolutions. Marked differences were found in their positions. Finally, legal and health solutions to this obesity epidemic are proposed.

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Argentina is one of the largest economies in South America. In recent years, the government has focused in promoting economic development along with social inclusion with the support of the World Bank.

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Uruguay has weathered the global recession better than other emerging economies due to its sound macroeconomic framework, creating, at the same time, inclusion and opportunities for all.

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Abstract. The prevalence of obesity in childhood and adolescence has increased worldwide. Long-term effects of adolescent obesity on cause-specific mortality a

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BACKGROUND: The purpose of this study was to examine the association between weight status and exposure to bullying among 11-, 13- and 15-year-old Danish school children. Furthermore, the purpose was to investigate the potentially mediating effect of body image. METHODS: Data from the Danish contribution to the international cross-sectional research project Health Behaviour in School-aged Children (HBSC) 2002 was used. Data were assessed from questionnaires and 4781 students aged 11-, 13- and 15-years old were included in the analyses. Logistic regression was used for the analyses. RESULTS: The regression analyses showed that overweight and obese students were more exposed to bullying than their normal weight peers. Among boys, odds ratios (ORs) for exposure to bullying were 1.75 (1.18-2.61) in overweight and 1.98 (0.79-4.95) in obese boys compared with normal weight. Among girls, the corresponding ORs were 1.89 (1.25-2.85) in overweight and 2.74 (0.96-7.82) in obese girls. The mediation analyses showed that body image fully mediated the associations between weight status and exposure to bullying in both boys and girls. CONCLUSIONS: This study shows that overweight and obese boys and girls are of higher odds of being exposed to bullying than their normal weight peers. Moreover, this study finds that body image may statistically explain this

association between overweight and exposure to bullying. However, the study is cross-sectional, and hypotheses of possibilities for opposite causality are possible.

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INTRODUCTION: While different epidemiological studies as part of their survey include data of adolescents of the province of La Pampa regarding overweight and obesity prevalence, their experimental designs have certain limitations as far as the description of the regional reality. OBJECTIVE: To obtain a diagnosis of the situation regarding the body composition profile among 13 year old adolescents in the Province of La Pampa. POPULATION AND METHODS: A cross-sectional study was conducted in a sample of male and female adolescents born in 2001. Weight, height, waist circumference, scapular and tricipital skinfolds were measured. RESULTS: Of the 711 adolescents assessed, 5 subjects (0.7%) had a weight below the third percentile for age and sex. In relation to overweight and obesity, the sample values were 26.4% and 14.1%, respectively (27.5% and 16.9% of male; 25.5% and 11.7% of female adolescents). Of the total sample, 15.8% (16.5% of male and 15.6% of female adolescents) had waist circumference values compatible with abdominal obesity. As far as body fat values, 36.8% (37.4% of male and 36% of female adolescents) had above normal values according to skinfold thickness measurements. CONCLUSIONS: In contrast with the small prevalence of low weight in the region, overweight and obesity are a significant problem among the studied population in La Pampa.

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The rising trends in children's and adolescents' BMI have plateaued in many high-income countries, albeit at high levels, but have accelerated in parts of Asia, with trends no longer correlated with those of adults.

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Objective:: To determine the prevalence of elevated blood pressure (EBP) in Bahamian adolescents. Methods:: A cross-sectional survey employing a self-administered questionnaire, and concurrently obtaining anthropometric measurements, was conducted involving selected grades 9, 10 and 11 students of all targeted public high schools in The Bahamas. Statistical analyses correlated blood pressure with body mass index (BMI), age and gender. Results:: The mean age of the 785 participants was 14.6 (± 1.153) years, and 87.6% were Bahamian. The prevalence of elevated systolic blood pressure (SBP) was 4.7% and 6.6% for elevated diastolic blood pressure (DBP). Elevated blood pressure prevalence was 8.9%. Elevated blood pressure was more common among grade 9 students (12–14-year olds), who had the largest proportion of EBP (55.7%). Both SBP and DBP increased with age in the males. Overall, students' prevalence of overweight/obesity was 32.2% (14.4% overweight, 17.8% obese). Body mass index, number of days per week eating fast food and perception of body weight were predictive of EBP. Body mass index, age and perception of body weight were found to be predictive of SBP (βBMI = 0.25, $p < 0.001$; βAge = 0.14, $p < 0.001$; βWeight = 0.08, $p < 0.037$) and DBP (βDBP = 0.192, $p < 0.001$). Overweight/obese students were 2.7 times more likely to have EBP. Elevated blood pressure was markedly associated with BMI, family history of hypertension and parents' overweight/obese status. Conclusion:: The estimated prevalence of EBP in adolescent school children in New Providence, Bahamas, was comparable with neighbouring nations.

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Background: Adolescent obesity is associated with high cardiovascular and metabolic risk. Western diet and reduced physical activity are strong environmental determinants. The “Health Production” model posits that individuals born with a certain amount of health stock, which depreciates over life, but can be augmented by individual behaviors, including exercise and dieting. Objective: To study the association between health production and obesity in a random sample of 1692 Chilean adolescents (14.8 ± 0.7 years old), and to study the effect of gender and socioeconomic characteristics on health production. Method: We used an indicator that considered the quality of food intake and physical activity, establishing three categories: good (GHP), intermediate (IHP) and poor health producers (PHP). Multivariate analysis was used to study the odds of obesity and good health production. Results: There was 31% of GHP, 32% of IHP and 38% of PHP. Obesity (Adj. OR: 1.59; 95%CI: 1.04 - 2.42) and abdominal obesity (Adj. OR: 2.24; 95%CI: 1.35 - 3.40) were significantly higher in the PHP group, compared to the GHP and

IHP group. Health production was significantly associated with socioeconomic factors and gender. Female sex and coming from a less wealthy household significantly reduced the odds of good health production. Conclusions: Poor health production in adolescence, as defined by food intake and physical activity, depreciates individuals' "health stock", increasing the risk of obesity. In our sample, health production was strongly associated with socio-economic factors and gender.

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BACKGROUND: In line with calls for action from international health organizations, Chile implemented in June 2016 a set of regulations to tackle the obesity epidemic. The new regulation includes the mandatory use of front-of-package warning labels on packaged foods/beverages high in energy, sugars, saturated fats and sodium. Additionally, such foods cannot be sold nor offered in daycares/schools and cannot be promoted to children under 14yo. The law is targeted to children; thus, this study examined mothers' understanding, perceptions, and behaviors associated with the regulation one year after its implementation, using a qualitative approach. METHODS: Nine focus groups of mothers (7-10 people each) of children (2-14yo) were conducted in July 2017 in Santiago-Chile. They were stratified by socioeconomic status (SES) and children's age. Macrocodes were developed by three researchers, combining an iterative process of deductive and inductive thematic analyses. Quotations representing each category were selected. RESULTS: Mothers understood the new regulation as a policy to fight child obesity and were aware that products with more labels were less healthy than products with fewer labels. Attention and use of labels in the buying decision-making process ranged from participants who did not pay attention to others who relied on them as a quick shortcut (mostly from middle and upper-SES); many mothers indicated changing their purchase habits only when buying new products. Mothers declared that young children accepted school environment changes while teens/preteens resisted them more. Many mothers agreed that schools have become key promoters of food behavioral change. Mothers were less aware about the food marketing regulations. Mothers declared that they perceived that the regulation was changing the perceptions, attitudes and behaviors toward healthier eating patterns. CONCLUSION: After the first year of implementation, the regulation was well known by mothers of diverse SES and different children ages. The degree of use of warning labels was heterogeneous among participants, but most of them agreed that their children, particularly the youngest have positive attitudes toward the regulation and have become promoters of change in their families. Many mothers also expressed that they perceived an important shift toward healthier eating, which may lead to a change in eating social norms. This information contributes to better understand how regulatory actions may influence people's consumer behaviors.

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OBJECTIVE: The aim of the article is to report the prevalence of obesity, abdominal fatness and waist circumference in different socioeconomic classes in Curacao. DESIGN: In 1993/1994 a health interview survey (the Curacao Health Study) was carried out among a random sample (n = 2248, response rate = 85%) of the adult non-institutionalized population of Curacao. METHODS: We analyzed the association between obesity (BMI > or = 30), abdominal fatness (waist hip ratio (WHR) > or = 0.95 for men, WHR > or = 0.80 for women) waist circumference (WC > or = 100 cm for men, WC > or = 91 cm for women) and socioeconomic status (SES) by age adjusted logistic regressions, for men and women separately. RESULTS: The prevalence of obesity was about 27%: 36% of the women and 19% of the men were obese. An at risk WHR was reported among 62.2% of the women and among 20.4% of the men. A WC above the cut-off point was reported for 44.3% women and 25.3% men. Compared to women of higher SES, the lower SES women have a two to three times higher risk of a BMI, WHR or WC exceeding the cut-off points. Among men, no statistically significant difference between an increased BMI, WHR or WC and SES factors was found. The overlap between the three measures is large, about 56% of the women scored similarly on all three measurements. Among men the overlap is even greater (73%). CONCLUSIONS: The prevalence of obesity in Curacao is alarming. Low SES women are at the greatest risk of an increased BMI, WHR or WC. The obesity figures can be placed between industrialized societies and less modernized cultures. Action and additional research on the prevention of obesity in Curacao are deemed necessary. The cut-off points in our study for WC in the non-white population are preliminary and need to be elucidated further.

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ABSTRACT. Obesity threatens to become the foremost cause of chronic disease in the world. Being obese can induce multiple metabolic abnormalities that contribu

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ABSTRACT. Body mass index (BMI; in kg/m2) values at or above the 75th percentile are associated with increased morbidity and mortality in adulthood, and there

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Rapidly changing dietary practices and a sedentary lifestyle have led to increasing prevalence of childhood obesity (5–19 yr) in developing countries recently:

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BACKGROUND: Insufficient physical activity is a leading risk factor for non-communicable diseases, and has a negative effect on mental health and quality of life. We describe levels of insufficient physical activity across countries, and estimate global and regional trends. METHODS: We pooled data from population-based surveys reporting the prevalence of insufficient physical activity, which included physical activity at work, at home, for transport, and during leisure time (ie, not doing at least 150 min of moderate-intensity, or 75 min of vigorous-intensity physical activity per week, or any equivalent combination of the two). We used regression models to adjust survey data to a standard definition and age groups. We estimated time trends using multilevel mixed-effects modelling. FINDINGS: We included data from 358 surveys across 168 countries, including 1.9 million participants. Global age-standardised prevalence of insufficient physical activity was 27.5% (95% uncertainty interval 25.0-32.2) in 2016, with a difference between sexes of more than 8 percentage points (23.4%, 21.1-30.7, in men vs 31.7%, 28.6-39.0, in women). Between 2001, and 2016, levels of insufficient activity were stable (28.5%, 23.9-33.9, in 2001; change not significant). The highest levels in 2016, were in women in Latin America and the Caribbean (43.7%, 42.9-46.5), south Asia (43.0%, 29.6-74.9), and high-income Western countries (42.3%, 39.1-45.4), whereas the lowest levels were in men from Oceania (12.3%, 11.2-17.7), east and southeast Asia (17.6%, 15.7-23.9), and sub-Saharan Africa (17.9%, 15.1-20.5). Prevalence in 2016 was more than twice as high in high-income countries (36.8%, 35.0-38.0) as in low-income countries (16.2%, 14.2-17.9), and insufficient activity has increased in high-income countries over time (31.6%, 27.1-37.2, in 2001). INTERPRETATION: If current trends continue, the 2025 global physical activity target (a 10% relative reduction in insufficient physical activity) will not be met. Policies to increase population levels of physical activity need to be prioritised and scaled up urgently. FUNDING: None.

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To implement effective non-communicable disease prevention programmes, policy makers need data for physical activity levels and trends. In this report, we describe physical activity levels worldwide with data for adults (15 years or older) from 122 countries and for adolescents (13-15-years-old) from 105 countries. Worldwide, 31.1% (95% CI 30.9-31.2) of adults are physically inactive, with proportions ranging from 17.0% (16.8-17.2) in southeast Asia to about 43% in the Americas and the eastern Mediterranean. Inactivity rises with age, is higher in women than in men, and is increased in high-income countries. The proportion of 13-15-year-olds doing fewer than 60 min of physical activity of moderate to vigorous intensity per day is 80.3% (80.1-80.5); boys are more active than are girls. Continued improvement in monitoring of physical activity

would help to guide development of policies and programmes to increase activity levels and to reduce the burden of non-communicable diseases.

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The country has developed an ambitious plan to tackle overweight and obesity, but has seen some of its efforts derailed by industry objections. Now advocates are pushing for legislation that would codify the plan.

He, T. K., et al. (2008). "Global burden of obesity in 2005 and projections to 2030." International Journal of Obesity **32**(9): 1431-1437.

To estimate the overall prevalence and absolute burden of overweight and obesity in the world and in various regions in 2005 and to project the global burden in 2030. Pooling analysis We identified sex- and age-specific prevalence of overweight and obesity in representative population samples from 106 countries, which cover approximately 88% of the world population, using MEDLINE and other computerized databases, supplemented by a manual search of references from retrieved articles. Sex- and age-specific prevalence of overweight and obesity were applied to the 2005 population to estimate the numbers of overweight and obese individuals in each country, each world region and the entire world. In addition, the prevalence, with and without adjusting for secular trends, were applied to the 2030 population projections to forecast the number of overweight and obese individuals in 2030. Overall, 23.2% (95% confidence interval 22.8–23.5%) of the world's adult population in 2005 was overweight (24.0% in men (23.4–24.5%) and 22.4% in women (21.9–22.9%)), and 9.8% (9.6–10.0%) was obese (7.7% in men (7.4–7.9%) and 11.9% in women (11.6–12.2%)). The estimated total numbers of overweight and obese adults in 2005 were 937 million (922–951 million) and 396 million (388–405 million), respectively. By 2030, the respective number of overweight and obese adults was projected to be 1.35 billion and 573 million individuals without adjusting for secular trends. If recent secular trends continue unabated, the absolute numbers were projected to total 2.16 billion overweight and 1.12 billion obese individuals. Overweight and obesity are important clinical and public health burdens worldwide. National programs for the prevention and treatment of overweight, obesity and related comorbidities and mortalities should be a public health priority.

Hennis, A. (2018). Looking beyond 2018 towards 2030 in CARICOM: Regional NCD Priorities and WHO Best-Buys. HCC Caribbean NCD Forum Supporting National Advocacy in Lead up to the 2018 High Level Meeting on NCDs Kingston, Jamaica

Department of NCDs and Mental Health Pan American Health Organization**:** April 23-25, 2018.

Janssen, I., et al. (2004). "Associations between overweight and obesity with bullying behaviors in school-aged children." Pediatrics **113**(5): 1187-1194.

OBJECTIVE: The prevalence of overweight and obesity in children is rising. Childhood obesity is associated with many negative social and psychological ramifications such as peer aggression. However, the relationship between overweight and obesity status with different forms of bullying behaviors remains unclear. The purpose of this article is to examine these relationships. METHODS: We examined associations between bullying behaviors (physical, verbal, relational, and sexual harassment) with overweight and obesity status in a representative sample of 5749 boys and girls (11-16 years old). The results were based on the Canadian records from the 2001/2002 World Health Organization Health Behaviour in School-Aged Children Survey. Body mass index (BMI) and bullying behaviors were determined from self-reports. RESULTS: With the exception of 15- to 16-year-old boys, relationships were observed between BMI category and peer victimization, such that overweight and obese youth were at greater relative odds of being victims of aggression than normal-weight youth. Strong and significant associations were seen for relational (eg, withdrawing friendship or spreading rumors or lies) and overt (eg, name-calling or teasing or hitting, kicking, or pushing) victimization but not for sexual harassment. Independent of gender, there were no associations between BMI category and bully-perpetrating in 11- to 14-year-olds. However, there were relationships between BMI category and bully-perpetrating in 15- to 16-year-old boys and girls such that the overweight and obese 15- to 16-year-olds were more likely to perpetrate bullying than their normal-weight classmates. Associations were seen for relational (boys only) and overt (both genders) forms of bully-perpetrating but not for sexual harassment. CONCLUSIONS: Overweight and obese school-aged children are more likely to be the victims and perpetrators of bullying behaviors than their normal-weight peers. These tendencies may hinder the short- and long-term social and psychological development of overweight and obese youth.

Julia, M., et al. (2008). "Tracking for underweight, overweight and obesity from childhood to adolescence: a 5-year follow-up study in urban Indonesian children." Horm Res **69**(5): 301-306.

AIMS: To assess tracking of body mass index (BMI) of urban Indonesian children from childhood to adolescence and to compare the prevalence of underweight, overweight and obesity in 6- to 8-year-old children from two surveys: years 1999 and 2004. METHODS: A longitudinal study assessing BMI tracking of 308 urban children followed from age 6-8 to 11-13 years and two cross-sectional surveys comparing the prevalence of underweight, overweight and obesity in 6- to 8-year-old children: year 1999 (n = 1,524) and 2004 (n = 510). RESULTS: Childhood BMI determined 52.3% variation of later BMI. After 5.1 (0.6) years the prevalence of overweight and obesity increased from 4.2 and 1.9% in childhood to 8.8 and 3.2% in adolescence. The prevalence of underweight decreased from 27.3 to 18.8%. All obese children remained obese, 84.6% overweight children stayed overweight, 56.0% underweight children remained underweight. In cross-sectional comparison the prevalence of overweight and obesity raised from 5.3 to 8.6% and from 2.7 to 3.7%, respectively. The prevalence of underweight remained constant. CONCLUSIONS: The prevalence of overweight and obesity increases as children grow into adolescence. Overweight or obese children are more likely to remain overweight or obese. Cross-sectional comparison shows, while the prevalence of underweight stays constant, the prevalence of overweight and obesity increases.

Kaufmann, R. and N. Pontet-Ubal (2019). "The challenge of tackling the obesity economic burden: The case of Uruguay." Emerald Open Research 2019 1:11 **1**(11).

The estimation of the burden of a disease is one of the tasks with the longest tradition in Health Economics, which allows us to know the volume of resources that a country allocates to a specific health problem, and to compare countries and diseases. Although the fundamental objective of Health Systems is not to reduce the cost of the disease, but to improve the health of the population, the studies of burden of disease establish the economic seriousness of the problem, orienting the priorities of action. Government-funded medical expenditure in Uruguay for the last ten years has tripled in US dollars. The increase in the prevalence of overweight and obesity has contributed to this growth. According to the World Health Organization, Uruguay has the highest growing trend in the prevalence of both overweight and obesity in South America. We have previously estimated that economic burden linked to obesity will be more than US$500 million by 2020, a figure close to 1% of the country's GDP. In this study, we tried to generate a measure of value to ascertain the cost of inaction in the fight against obesity and its consequences linked to several non-communicable diseases. The cost of inaction is not defined as the cost of not doing, but as the cost of not implementing the right policies (in this case health prevention policies) at the right time.

Kist-van Holthe, J., et al. (2018). "Stabilization of the obesity epidemic and increasing thinness in children in Caribbean Bonaire | SpringerLink." BMC Paediatrics **18**(168).

Background In 2008, the prevalence of overweight and obesity among children in Bonaire was twice as high as the prevalence in northern Europe but comparable to that of other Caribbean islands and the...

Kovalskys, I., et al. (2010). "Nutritional status of school-aged children of Buenos Aires, Argentina: data using three references." Journal of Public Health **33**(3): 403-411.

AbstractBackground. Childhood overweight has been reported in developing countries. The World Health Organization (WHO) has recommended a standardized classifi

Lara-Castor, L. C., F.; Karageorgou, D.; Shi, P.; Zhang, J.; Miller, V.; Onopa, J.; Reedy, J.; Singh, G.; Mozaffarian, D.; Micha, R. (2019). "Global, Regional and National Consumption of Major Beverages in 2015: Systematic Analysis of Country-Specific Nutrition Surveys Worldwide (P10-038-19)." Curr Dev Nutr **3**(Supplement 1).

Lobstein, T., et al. (2004). "Obesity in children and young people: a crisis in public health - Lobstein - 2004 - Obesity Reviews - Wiley Online Library." Obesity Reviews **5**(s1): 4-85.

Lumeng, J. C., et al. (2006). "Weight Status as a Predictor of Being Bullied in Third Through Sixth Grades." Pediatrics **125**(6): e1301-1307.

McClanahan, M., et al. (2014). "Forms of bullying reported by middle-school students in Latin America and the Caribbean." http://dx.doi.org/10.1080/1754730X.2014.978118.

Misra, A., et al. (2008). "Obesity and the Metabolic Syndrome in Developing Countries." The Journal of Clinical Endocrinology & Metabolism **93**(11_supplement_1).

ABSTRACTContext. Prevalence of obesity and the metabolic syndrome is rapidly increasing in developing countries, leading to increased morbidity and mortality d

Murphy, M. M., et al. (2018). "Evaluating policy responses to noncommunicable diseases in seven Caribbean countries: challenges to addressing unhealthy diets and physical inactivity." Rev Panam Salud Publica **42**: e174.

Nasdaq (2017). "How Has Coca-Cola Turned Around Its Fortunes In Latin America?". from https://www.nasdaq.com/articles/how-has-coca-cola-turned-around-its-fortunes-latin-america-2017-12-14.

Nations, U. "Small Island Developing States .:. Sustainable Development Goals Knowledge Platform." Retrieved August 3, 2019, from https://sustainabledevelopment.un.org/topics/sids.

Ng, M., et al. (2014). "Global, regional, and national prevalence of overweight and obesity in children and adults during 1980-2013: a systematic analysis for the Global Burden of Disease Study 2013." Lancet **384**(9945): 766-781.

Ofei, F. (2005). Obesity - A Preventable Disease. Ghana Med J. **39:** 98-101.

Obesity is a common and preventable disease of clinical and public health importance. It is often a major risk factor for the development of several non-communicable diseases, significant disability and premature death. There is presently a global epidemic of obesity in all age groups and in both developed and developing countries. The increasing prevalence of obesity places a large burden on health care use and costs. Weight loss is associated with significant health and economic benefits. Effective weight loss strategies include dietary therapy, physical activity and lifestyle modification. Drug therapy is reserved for obese or overweight patients who have concomitant obesity-related risk factors or diseases. Population-wide prevention programmes have a greater potential of stemming the obesity epidemic and being more cost-effective than clinic-based weight-loss programmes. Ghana is going through an economic and nutrition transition and experiencing an increase in the prevalence of obesity and obesity-related illnesses, especially among women and urban dwellers. A national taskforce to address this epidemic and to draw up a national policy on related non-communicable diseases is urgently needed.

Ogden, C. L., et al. (2012). "Prevalence of Obesity and Trends in Body Mass Index Among US Children and Adolescents, 1999-2010." JAMA **307**(5): 483-490.

ContextThe prevalence of childhood obesity increased in the 1980s and 1990s but there were no significant changes in prevalence between 1999-2000 and 2007-2008

Ordunez, P., et al. (2015). "Premature Mortality from Cardiovascular Disease in the Americas – Will the Goal of a Decline of “25% by 2025” be Met?" Plos One **10**(10).

Background: Cardiovascular diseases (CVD) are the underlying cause 1.6 million deaths per year in the Americas, accounting for 30% of total mortality and 38% of by non-communicable deaths diseases (NCDs). A 25% reduction in premature mortality due four main NCDs was targeted by the 2011 High-level Meeting of the General Assembly on the Prevention and Control of NCDs. While overall CVD mortality fell in the Americas during the past decade, trends in premature CVD mortality during the same period have not been described, particularly in the countries of Latin America and the Caribbean. Methods: This is a population-based trend-series study based on a total of 6,133,666 deaths to describe the trends and characteristics of premature mortality due to CVD and to estimates of the average annual percentage of change during the period 2000–2010 in the Americas. Findings: Premature mortality due to CVD in the Americas fell by 21% in the period 2000–2010 with a -2.5% average annual rate of change in the last 5 year—a statistically significant reduction of mortality—. Mortality from ischemic diseases, declined by 25% - 24% among men and 26% among women. Cerebrovascular diseases declined by 27% -26% among men and 28% among women. Guyana, Trinidad and Tobago, the Dominican Republic, Bahamas, and Brazil had CVD premature mortality rates over 200 per 100,000 population, while the average for the Region was 132.7. US and Canada will meet the 25% reduction target before 2025. Mexico, Costa Rica, Venezuela, Dominican Republic, Panama, Guyana, and El Salvador did not significantly reduce premature mortality among men and Guyana, the Dominican Republic, and Panama did not achieve the required annual reduction in women. Conclusions: Trends in premature mortality due to CVD observed in last decade in the Americas would indicate that if these trends continue, the Region as a whole and a majority of its countries will be able to reach the goal of a 25% relative reduction in premature mortality even before 2025.

Pacheco, L. S., et al. (2017). "Early Onset Obesity and Risk of Metabolic Syndrome Among Chilean Adolescents." Prev Chronic Dis **14**: E93.

INTRODUCTION: Obesity and metabolic syndrome (MetS) indicators have increased globally among the pediatric population. MetS indicators in the young elevate their risk of cardiovascular disease and metabolic disorders later in life. This study examined early onset obesity as a risk factor for MetS risk in adolescence. METHODS: A cohort of Chilean participants (N = 673) followed from infancy was assessed at age 5 years and in adolescence (mean age, 16.8 y). Adiposity was measured at both time points; blood pressure and fasting blood samples were assessed in adolescence only. Early onset obesity was defined as a World Health Organization z score of 2 standard deviations (SDs) or more for body mass index (BMI) at age 5 years. We used linear regression to examine the association between early onset obesity and adolescent MetS risk z score, adjusting for covariates. RESULTS: Eighteen percent of participants had early onset obesity, and 50% of these remained obese in adolescence. Mean MetS risk z score in adolescence was significantly higher among those with early onset obesity than among those without (1.0; SD, 0.8 vs 0.2; SD, 0.8 [P < .001]). In the multivariable model, early onset obesity independently contributed to a higher MetS risk score in adolescence (beta = 0.27, P < .001), controlling for obesity status at adolescence and sex, and explained 39% of the variance in MetS risk. CONCLUSION: Early onset obesity as young as age 5 years relates to higher MetS risk.

PAHO/ WHO (2017). "CuraÃ§ao : Overall Context." Retrieved August 3, 2019, from https://www.paho.org/salud-en-las-americas-2017/?p=2382.

PAHO/WHO (2011). The Contribution of CFNI to Caribbean Development 2001-2010, Pan-American Health Organization.

Paho/Who (2017). "Adolescents & Non-Communicable Diseases at a GLANCE." NCD Adolescent Factsheet. from https://www.paho.org/hq/dmdocuments/2017/ncds-adol-factsheet-2017.pdf.

PAHO/WHO (2017). "Anguilla : Overall Context." Retrieved August 3, 2019, from https://www.paho.org/salud-en-las-americas-2017/?p=1637.

PAHO/WHO (2017). "Argentina." from https://www.paho.org/salud-en-las-americas-2017/?p=2706.

PAHO/WHO (2017). "Bahamas : Overall Context." Retrieved August 3, 2019, from https://www.paho.org/salud-en-las-americas-2017/?p=2291.

Paho/Who (2017). "Country Report: Uruguay." Retrieved August 3, 2019, from https://www.paho.org/salud-en-las-americas-2017/?page_id=161.

PAHO/WHO (2019). "Chile." Retrieved August 4, 2019, from https://www.paho.org/salud-en-las-americas-2017/?p=2518.

PAHO/WHO (2019). The Final Report of the Commission of the Pan American Health Organisation on Equity and Health Inequalities in the Americas.

Pajari, M., et al. (2010). "The effect of alcohol consumption on later obesity in early adulthood--a population-based longitudinal study." Alcohol Alcohol **45**(2): 173-179.

AIMS: The study aimed to determine whether alcohol use during late adolescence contributes to the weight gain from adolescence to young adulthood or risk of obesity or waist circumference at young adulthood. METHODS: A population-based, longitudinal study of 5563 Finnish twins born in 1975-1979 and surveyed at ages 16 (T1), 17 (T2), 18 (T3) and 23-27 (T4) years. Drinking habits, height and weight were self-reported at T1, T2, T3 and T4; waist circumference was self-measured at T4. As potential confounders, we used smoking, diet, physical activity, place of residence, socio-economic status and parents' body mass index (BMI). RESULTS: Compared to the reference group (drinking once to twice per month), the BMI increase from T3 to T4 was less among abstaining men (-0.62 kg/m(2), (95% CI -1.04, -0.20)) and among women in those drinking less than monthly (-0.38 kg/m(2), (-0.71, -0.04)). In women, at least weekly drinking was associated with larger waist circumference (Beta 1.55 cm, (0.48, 2.61)), but this became statistically non-significant after adjusting for potential confounders. In a multilevel model for change, drinking frequency was not associated with weight change in women; in men, a negative association was seen, but it was statistically non-significant after adjusting for potential

confounders. CONCLUSIONS: These results from a population-based study with a large set of confounding variables suggest that alcohol use during adolescence has at most a minor effect on weight gain or development of abdominal obesity from adolescence to young adulthood.

Patton, G. C., et al. (2016). "Our future: a Lancet commission on adolescent health and wellbeing." Lancet **387**(10036): 2423-2478.

Pehlke, E. L., et al. (2016). "Guatemalan school food environment: impact on schoolchildren's risk of both undernutrition and overweight/obesity." Health Promot Int **31**(3): 542-550.

Guatemala suffers the double burden of malnutrition with high rates of stunting alongside increasing childhood overweight/obesity. This study examines the school food environment (SFE) at low-income Guatemalan elementary schools and discusses its potential impact on undernutrition and overweight/obesity. From July through October 2013, direct observations, in-depth interviews with school principals (n = 4) and food kiosk vendors (n = 4, 2 interviews each) and also focus groups (FGs) with children (n = 48, 8 FGs) were conducted. The SFE comprises food from school food kiosks (casetas); food from home or purchased in the street; and food provided by the school (refacción). School casetas, street vendors and children's parents largely provide sandwiches, calorie-rich snacks and sugar-sweetened beverages. Refacción typically serves energy dense atol, a traditional beverage. The current school food program (refacción), the overall SFE and the roles/opinions of vendors and principals reveal persistent anxiety concerning undernutrition and insufficient concern for overweight/obesity. Predominant concern for elementary schoolchildren remains focused on undernutrition. However, by the time children reach elementary school (ages 6–12+), food environments should encourage dietary behaviors to prevent childhood overweight/obesity.

Pisabarro, R. and P. Kaufmann (2004). "Prevalence of obesity in Uruguay." Obesity Reviews **5**(4).

Pisabarro, R. K. P. (2019). "Prevalence of obesity in Uruguay." Obesity Reviews **5**(4).

Popkin, B. M. and C. M. A. Doak (1998). "The Obesity Epidemic Is a Worldwide Phenomenon." Nutrition Reviews **56**(4): 106-114.

Abstract. Obesity is not just a disease of developed nations. Obesity levels in some lower-income and transitional countries are as high as or higher than thos

Popkin, B. M. and T. Reardon (2018). "Obesity and the food system transformation in Latin America." Obes Rev **19**(8): 1028-1064.

The Latin America and the Caribbean (LAC) region faces a major diet-related health problem accompanied by enormous economic and social costs. The shifts in diet are profound: major shifts in intake of less-healthful low-nutrient-density foods and sugary beverages, changes in away-from-home eating and snacking and rapid shifts towards very high levels of overweight and obesity among all ages along with, in some countries, high burdens of stunting. Diet changes have occurred in parallel to, and in two-way causality with, changes in the broad food system -

the set of supply chains from farms, through midstream segments of processing, wholesale and logistics, to downstream segments of retail and food service (restaurants and fast food chains). An essential contribution of this piece is to marry and integrate the nutrition transition literature with the literature on the economics of food system transformation. These two literatures and debates have been to date largely 'two ships passing in the night'. This review documents in-depth the recent history of rapid growth and transformation of that broad food system in LAC, with the rapid rise of supermarkets, large processors, fast food chains and food logistics firms. The transformation is the story of a 'double-edged sword', showing its links to various negative diet side trends, e.g. the rise of consumption of fast food and highly processed food, as well as in parallel, to various positive trends, e.g. the reduction of the cost of food, de-seasonalization, increase of convenience of food preparation reducing women's time associated with that and increase of availability of some nutritious foods like meat and dairy. We view the transformation of the food system, as well as certain aspects of diet change linked to long-run changes in employment and demographics (e.g. the quest for convenience), as broad parameters that will endure for the next decades without truly major regulatory and fiscal changes. We then focus in on what are the steps that are being and can be taken to curb the negative effects on diet of these changes. We show that countries in LAC are already among the global leaders in initiating demand-related solutions via taxation and marketing controls. But we also show that this is only a small step forward. To shift LAC's food supply towards prices that incentivize consumption of healthier diets and demand away from the less healthy component is not simple and will not happen immediately. We must be cognizant that ultimately, food industry firms must be incentivized to market the components of healthy diets. This will primarily need to be via selective taxes and subsidies, marketing controls, as well as food quality regulations, consumer education and, in the medium term, consumers' desires to combine healthier foods with their ongoing quest for convenience in the face of busy lives. In the end, the food industry in LAC will orient itself towards profitable solutions, ie those demanded by the broad mass of consumers.

Poti, J. M. i., et al. (2013). "The association of fast food consumption with poor dietary outcomes and obesity among children: is it the fast food or the remainder of the diet?" The American Journal of Clinical Nutrition **99**(1): 162-171.

Premanath, M., et al. (2009). "Mysore childhood obesity study | SpringerLink." Inidan Paediatrics **47**(2): 171-173.

We conducted this study to document the prevalence of obesity, overweight and underweight in the school children aged 5 to 16 years from Mysore. 5 Principal Investigators and 13 Co-Investigators...

Puhl, R., et al. (2016). "Cross-national perspectives about weight-based bullying in youth: nature, extent and remedies " Pediatric Obesity

Rampersaud, G. C., et al. (2005). "Breakfast habits, nutritional status, body weight, and academic performance in children and adolescents." J Am Diet Assoc **105**(5): 743-760; quiz 761-742.

Rankin, J., et al. (2016). "Psychological consequences of childhood obesity: psychiatric comorbidity and prevention." Adolesc Health Med Ther **7**: 125-146.

Rhee, J. J., et al. (2012). "Association between commercial and traditional sugar-sweetened beverages and measures of adiposity in Costa Rica." Public Health Nutr **15**(8): 1347-1354.

OBJECTIVE: Increasing trends in the consumption of commercial sugar-sweetened beverages (SSB) have occurred in parallel with rising levels of obesity in Latin America, but data showing the relationship between these SSB and obesity are limited. The current study examined the association between commercial and traditional SSB and measures of adiposity in Costa Rica. DESIGN: A cross-sectional analysis was conducted in which the exposure, SSB intake, was defined as frequency of daily servings of 'fresco' (a traditional home-made beverage), fruit drink (commercially available SSB), soda and fruit juice (made from fruits at home). Multivariate linear regression was used to estimate associations between SSB intake and BMI, waist-to-hip ratio and skinfold thickness. SETTING: Central Valley, Costa Rica. SUBJECTS: Controls (n 2045) of a case-control study on diet and heart disease in Costa Rica. RESULTS: Fresco, fruit drink, soda and fruit juice were consumed >/=1 time/d by 47 %, 14 %, 4 % and 14 % of the population, respectively. One serving/d of soda, fruit drink and fresco was associated with 0.89, 0.49 and 0.21 kg/m2 higher BMI, respectively (all P < 0.05). Fruit drink (>/=1 serving/d) was associated with higher waist-to-hip ratio (P = 0.004), while soda and fresco were associated with higher skinfold thickness (P = 0.02 and 0.01, respectively). Associations with fruit juice intake were modest and not statistically significant. Other factors associated with higher BMI were higher income and less education, smoking and physical inactivity (all P < 0.05). CONCLUSIONS: Increasing intake of commercially available SSB could be in part responsible for the high prevalence of obesity among Hispanic adults.

Rideout VJ, et al. (2010). Generation M2: media in the lives of 8- to 18-year-olds. A Kaiser Family Foundation Study. A Kaiser Family Foundation.

Rivera, J. Á., et al. (2014). "Childhood and adolescent overweight and obesity in Latin America: a systematic review." The Lancet **2**(4): 321-332.

Ruan, D. and M. Hodge (2015). School Health Annual Report 2014 - 2015. Anguilla.

Rubinstein, A., et al. (2014). "Increased Prevalence of Diabetes in Argentina Is Due to Easier Health Care Access Rather than to an Actual Increase in Prevalence." Plos One **9**(4).

Introduction: According to the Argentine National Risk Factor Survey (ANRFS), between 2005 and 2009, self-reported Diabetes increased in Argentina from 8.4% to 9.6%, accompanied by a raise in the prevalence of obesity and low physical activity. In the same period, it also increased blood sugar checks from 69.3% to 75.7%. Since surveillance data in Argentina rely on self-reports, the estimated prevalence of diabetes may be affected by an increase in the proportion of subjects with access to preventive services. We evaluated the independent effect of a recent blood sugar check, on the increase in self-reported diagnoses of diabetes between 2005 and 2009. Materials and Methods: A secondary analysis of data from the 2005 and 2009 ANRFS was performed. Diabetes was defined as having been diagnosed Diabetes or high blood sugar by a

health professional, obesity was calculated as BMI≥30 kg/m2, based on self-reported height and weight and physical activity was measured using the International Physical Activity Questionnaire. We used logistic regression models to explore the relationship between prevalence of self-reported diabetes and recent blood sugar check as the main predictor. Results: The prevalence of diabetes rose from 8.4% to 9.6%; obesity from 14.5% to 18% and low physical activity from 46.2% to 55%, between 2005 and 2009. Among those who recently checked their blood sugar no differences were found in the prevalence of diabetes: 13% in 2005 vs. 13.2% in 2009. Findings of the multivariable analysis showed that obesity and low physical activity were significantly associated with self reported diabetes in the adjusted model (OR = 1.80 for obesity, and OR = 1.12 for low physical activity but the strongest predictor was recent blood sugar check (OR = 4.75). Discussion: An increased prevalence of self-reported diabetes between 2005 and 2009 might indicate an improvement in the access to preventive services rather than a positive increase in the prevalence of diabetes.

Rueda-Clausen, C. F., et al. (2008). Epidemic of overweight and obesity in Latin America and the Caribbean. Int J Cardiol. Netherlands. **125:** 111-112.

Sallis, J. F., et al. (2008). Ecological Models of Health Behavior Health Behavior and Health Education: Theory, Research, and Practice. R. Glanz, Viswanath, Jossey-Bass.

Sayon-Orea, C., et al. (2011). "Alcohol consumption and body weight: a systematic review." Nutr Rev **69**(8): 419-431.

Based on the fact that energy content in 1 gram of alcohol is 29 kJ or 7.1 kcal, alcohol consumption can lead to weight gain. The present review was conducted to analyze the effects of alcohol consumption on body weight. A search of the Medline database for the period 1984 to March 2010 was conducted to identify cross-sectional, prospective cohort studies and intervention trials investigating the relationship between alcohol consumption and the risk of weight gain. Thirty-one publications were selected on the basis of relevance and quality of design and methods. The findings from large cross-sectional studies as well as from well-powered, prospective, cohort studies with long periods of follow-up were contradictory. Findings from short-term experimental trials also did not show a clear trend. The overall results do not conclusively confirm a positive association between alcohol consumption and weight gain; however, positive findings between alcohol intake and weight gain have been reported, mainly from studies with data on higher levels of drinking. It is, therefore, possible that heavy drinkers may experience such an effect more commonly than light drinkers. Moreover, light-to-moderate alcohol intake, especially wine intake, may be more likely to protect against weight gain, whereas consumption of spirits has been positively associated with weight gain. Further research should be directed towards assessing the specific roles of different types of alcoholic beverages. Studies should also take the effect of consumption patterns into account. In addition, a potential effect modifier that has not been evaluated before but might be important to consider is the subjects' previous tendency to gain weight.

Schwiebbe, L., et al. (2011). "Childhood obesity in the Caribbean." West Indian Med J **60**(4): 442-445.

Severi, C. and X. Fmoratorio (2014). "Double burden of undernutrition and obesity in Uruguay." The American Journal of Clinical Nutrition **100**(6): 1659S-1662S.

ABSTRACT. Background: Uruguay is at an advanced stage of the epidemiologic transition; like other Latin American countries, it bears a nutritional double burde

Singh, A. S., et al. (2008). "Tracking of childhood overweight into adulthood: a systematic review of the literature - Singh - 2008 - Obesity Reviews - Wiley Online Library." Obesity Reviews **Volume 9**(5): 474-488.

Summary Overweight and obesity in youth are important public health concerns and are of particular interest because of possible long-term associations with adult weight status and morbidity. The ai...

Singh, G. M., et al. (2015). "Estimated Global, Regional, and National Disease Burdens Related to Sugar-Sweetened Beverage Consumption in 2010." Circulation **132**(8): 639-666.

BACKGROUND: Sugar-sweetened beverages (SSBs) are consumed globally and contribute to adiposity. However, the worldwide impact of SSBs on burdens of adiposity-related cardiovascular diseases (CVDs), cancers, and diabetes mellitus has not been assessed by nation, age, and sex. METHODS AND RESULTS: We modeled global, regional, and national burdens of disease associated with SSB consumption by age/sex in 2010. Data on SSB consumption levels were pooled from national dietary surveys worldwide. The effects of SSB intake on body mass index and diabetes mellitus, and of elevated body mass index on CVD, diabetes mellitus, and cancers were derived from large prospective cohort pooling studies. Disease-specific mortality/morbidity data were obtained from Global Burden of Diseases, Injuries, and Risk Factors 2010 Study. We computed cause-specific population-attributable fractions for SSB consumption, which were multiplied by cause-specific mortality/morbidity to compute estimates of SSB-attributable death/disability. Analyses were done by country/age/sex; uncertainties of all input data were propagated into final estimates. Worldwide, the model estimated 184 000 (95% uncertainty interval, 161 000-208 000) deaths/y attributable to SSB consumption: 133 000 (126 000-139 000) from diabetes mellitus, 45 000 (26 000-61 000) from CVD, and 6450 (4300-8600) from cancers. Five percent of SSB-related deaths occurred in low-income, 70.9% in middle-income, and 24.1% in high-income countries. Proportional mortality attributable to SSBs ranged from <1% in Japanese >65 years if age to 30% in Mexicans <45 years of age. Among the 20 most populous countries, Mexico had largest absolute (405 deaths/million adults) and proportional (12.1%) deaths from SSBs. A total of 8.5 (2.8, 19.2) million disability-adjusted life years were related to SSB intake (4.5% of diabetes mellitus-related disability-adjusted life years). CONCLUSIONS: SSBs are a single, modifiable component of diet that can impact preventable death/disability in adults in high-, middle-, and low-income countries, indicating an urgent need for strong global prevention programs.

Sobers-Grannum, N., et al. (2015). "Female Gender Is a Social Determinant of Diabetes in the Caribbean: A Systematic Review and Meta-Analysis." Plos One.

Background Diabetes (DM) is estimated to affect 10–15% of the adult population in the Caribbean. Preventive efforts require population wide measures to address its social determinants. We undertook a systematic review to determine current knowledge about the

social distribution of diabetes, its risk factors and major complications in the Caribbean. This paper describes our findings on the distribution by gender. Methods We searched Medline, Embase and five databases through the Virtual Health Library, for Caribbean studies published between 2007 and 2013 that described the distribution by gender for: known risk factors for Type 2 DM, prevalence of DM, and DM control or complications. PRISMA guidance on reporting systematic reviews on health equity was followed. Only quantitative studies (n>50) were included; each was assessed for risk of bias. Meta-analyses were performed, where appropriate, on studies with a low or medium risk of bias, using random effects models. Results We found 50 articles from 27 studies, yielding 118 relationships between gender and the outcomes. Women were more likely to have DM, obesity, be less physically active but less likely to smoke. In meta-analyses of good quality population-based studies odds ratios for women vs. men for DM, obesity and smoking were: 1.65 (95% CI 1.43, 1.91), 3.10 (2.43, 3.94), and 0.24 (0.17, 0.34). Three studies found men more likely to have better glycaemic control but only one achieved statistical significance. Conclusion and Implications Female gender is a determinant of DM prevalence in the Caribbean. In the vast majority of world regions women are at a similar or lower risk of type 2 diabetes than men, even when obesity is higher in women. Caribbean female excess of diabetes may be due to a much greater excess of risk factors in women, especially obesity. These findings have major implications for preventive policies and research.

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Latin America is undergoing a rapid demographic and nutritional transition. A recent WHO/PAHO survey on obesity in the region revealed an increasing trend in obesity as countries emerge from poverty, especially in urban areas. In contrast, in middle income countries, obesity tends to decline as income increases; this is especially so in women. Dietary changes and increasing inactivity are considered the crucial contributory factors that explain this rise. The end result is a progressive rise in overweight and obesity, especially in low income groups who improve their income and buy high fat/high carbohydrate energy-dense foods. Intake of these foods increases to the detriment of grains, fruits and vegetables. Most aboriginal populations of

the Americas have changed their diet and physical activity patterns to fit an industrialized country model. They now derive most of their diet from Western foods and live sedentary and physically inactive lives. Under these circumstances they develop high rates of obesity, insulin resistance and type 2 diabetes. Supplementary feeding programs are common in the region; the number of beneficiaries significantly exceeds the malnourished. Weight-for-age definition of undernutrition without assessment of length will overestimate the dimension of malnutrition and neglect the identification of stunted overweight children. Providing food to low income stunted populations may be beneficial for some, although it may be detrimental for others, inducing obesity especially in urban areas. Defining the right combination of foods/nutrients, education and lifestyle interventions that are required to optimize nutrition and health is a present imperative.

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Appendices A, B C

Appendix A Study 1 Tables

Table 1. Sociodemographic distribution of obesity and associated factors among the study population: GSHS 2012-2016+

		BMI		
	Sample (15,320)	Normal (12,412) (81%)	Elevated (2,908) (19%)	P value
Characteristics	%	%	%	
Socio-demographics				
Sex				0.0030*
Male	47.8	47.7	56.7	
Female	52.2	52.3	43.3	
Age				<0.001*
13 years	25.6	30.2	23.5	
14 years	37.4	38.4	35.0	
15 years	37.0	31.4	41.5	
Country of residence				<0.001*
Anguilla	1.4	68.3	31.7	
Bahamas	5.0	64.2	35.8	
Curacao	3.5	74.5	25.5	
Uruguay	14.6	82.5	17.5	
Chile	6.0	67.7	32.3	
Argentina	69.5	50.9	16.5	
Dietary behaviors				
Hunger	32.1	54.7	72.1	<0.001*
Fruit intake	63.3	57.8	50.6	0.0034*
Vegetable intake	67.7	57.6	53.7	0.1695
Soft drink intake	63.5	64.0	60.0	0.1232
Fast food intake	35.1	33.4	27.9	0.0101*
Physical activity behaviors				
Physical activity	17.4	16.3	14.2	0.1937
Active transportation	52.5	54.7	53.0	0.5711
Physical education	26.9	27.8	32.4	0.0391*
Sedentary lifestyle	47.8	46.7	43.9	0.2940
Psychosocial and substance misuse				
Bullying victimization	23.4	19.4	19.2	0.8920
Alcohol intake	47.1	39.7	36.2	0.1781

*Variables significant at p<0.05 for elevated and normal BMI

+Pooled sample of six countries

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Table 2

Table 2. Socio-demographic distribution of obesity and associated factors among adolescents by country of residence: GSHS 2012-2016

	Countries						
	Anguilla N (212)	Bahamas N (766)	Curacao N (538)	Uruguay N (2,234)	Chile N (916)	Argentina N (10,654)	P value
Characteristics	%	%	%	%	%	%	
Socio-demographics							
Sex							0.2612
Male	49.5	46.3	47.1	54.3	47.9	49.9	
Female	50.5	53.7	52.9	48.7	52.1	50.1	
Age							0.5976
13 years	23.0	40.8	21.0	27.3	30.2	27.0	
14 years	30.9	41.4	36.2	35.3	36.2	39.2	
15 years	46.1	17.8	45.8	37.4	33.6	33.8	
Dietary Behaviors							
Hunger	20.5	28.7	9.6	98.8	98.8	14.0	<0.001*
Fruit intake	67.5	54.0	60.7	50.9	68.0	56.1	<0.001*
Vegetable intake	71.5	50.8	76.7	40.6	41.8	73.9	<0.001*
Soft drink intake	54.2	68.6	55.5	66.3	62.2	63.4	0.3288
Fast food intake	71.8	73.3	69.6	44.2	31.9	30.0	<0.001*
BMI							<0.001*
Normal	68.3	64.2	74.5	82.5	67.7	83.4	
Elevated	31.7	35.8	25.5	17.5	32.3	16.6	
Physical activity behaviors							
Physical activity	23.8	15.3	10.5	16.1	14.6	17.0	0.1128
Active transportation	17.2	24.2	26.0	56.8	51.6	57.2	0.0193*
Physical education	41.9	20.9	35.2	35.5	33.0	24.0	<0.001*
Sedentary	58.4	55.6	60.7	37.1	41.1	51.9	<0.001*
Psychosocial and substance misuse							
Bullying victimization	26.0	21.1	22.1	18.8	14.9	23.9	<0.001*
Alcohol intake	31.3	28.2	29.8	45.2	25.8	51.6	<0.001*

*Variables significant at p<0.05 across all countries

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Table 3. Socio-demographic distribution factors associated with obesity among obese adolescents from country of residence: GSHS 2012-2016

	Anguilla N (64) (31.7%)	Bahamas N (274) (35.5%)	Curacao N (135) (25.5%)	Uruguay N (396) (17.5%)	Chile N (277) (32.3%)	Argentina N (1,761) (16.5%)	P value
Characteristics	%	%	%	%	%	%	
Socio-demographics							
Sex							0.4841
Male	48.8	38.7	49.1	54.6	57.3	56.4	
Female	51.2	61.3*	50.9	45.4	42.7	43.7*	
Age							0.5462
13 years	18.7	42.4	16.2	22.7	22.8	24.4	
14 years	38.5	42.0	36.1	35.8	34.4	36.0	
15 years	42.8	15.6	47.7	41.5	42.8*	39.7*	
Dietary Behaviors							
Hunger	27.9	26.8	9.4	99.3	99.4	16	<0.001+
Fruit intake	61.5	56.2	65.3	44.7*	41.3	69.7	<0.001+
Vegetable intake	72.1	57.5	72.7	39.1	44.0	74.6	<0.001+
Soft drink intake	49.0	64.2	53.8	65.9	59.6	60.0	0.6038
Fast food intake	70.3	71.9	68.9	40.1	27.2*	25.9	0.0007+
Physical activity behaviors							
Physical activity	12.4*	12.3	11	14.4	12.9	16.8	0.1807
Active transportation	14.0	20.8	30.0	57	50.9	57.8	0.0604
Physical education	39.7	21.5	40.1	35.1	35.1	26.0	0.0143+
Sedentary	45.6*	53.4	65.2	39	41.2	49.6	0.0727
Psychosocial and substance misuse							
Bullying victimization	31.1	23.6	31.3*	22.2	14.6	27.6*	0.0004+
Alcohol intake	27.6	26.9	29.8	43.2	26.7	54.6	<0.001+

*Variables significant within country for normal and elevated BMI at p<0.05

+Variables significant among country comparison for normal and elevated BMI at p<0.05

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Figure 1 Basic Socio-demographic Characteristics of Six Countries

Country	Anguilla (2016)	Bahamas (2013)	Curacao (2015)	Uruguay (2012)	Chile (2013)	Argentina (2012)
Land area (km2)	91	13,900	444	176,215	756,102	2,780,400
Total population	13,572	383,054	158,010	3396753	17575833	42095224
Population aged 10 - 14 m/f	530/539	13024/ 383054	129834 /130328	129834/130328	644286/ 620705	1771582 / 1713107
Population aged 15-19 m/f	466/450	15894/ 15585	5104/5155	80.368/134764	688712 / 659024	1755452 / 1699692
Gross national income per capita Atlas Method (in U	21,188	21, 500	19,691	14,272	15,363	11,364
Percentage of population in urban areas	100	83	89.3	94.8	89.1	91.3
Life expectancy (in years) at birth m/f	81.3 / 78.7	73/78	77/73	76/73	78 / 84	72/79.8

Sources: World Bank, PAHO website and UNICEF Situation Analysis of Children in Anguilla

Appendix B Tables for Study 2

Table 1. Socio-demographic distribution of factors associated with obesity among obese and non-obese adolescents by sub-region: GSHS 2012-2016

	Latin America	Caribbean		Latin America		Caribbean		
				BMI				
	Sample (13,094)	Sample (1,516)	p value	Normal (11,370)	Elevated (2,234) (17.6%)	Normal (1,042)	Elevated (474) (31.3%)	p value
Characteristics	%	%		%		%	%	
Socio-demographics								
Sex			0.2004					<0.001*
Male	49.9	46.5		47.7	56.9+	49.5	40.5+	
Female	50.1	53.5		52.3	43.1	50.5	59.5	
Age			0.0583					
13 years	28.5	36.4		30.2	23.3+	35.7	37.9	0.0030*
14 years	37.6	39.5		38.4	34.9	38.6	41.0	
15 years	33.9	24.1		31.4	41.7	25.7	21.1	
Dietary Behaviors								
Hunger	59.2	24.6	<0.001*	51.3	72.7+	24.9	24.2	<0.001*
Fruit intake	56.0	55.7	0.8684	54.9	50.5+	54.6	57.8	0.0375*
Vegetable intake	56.7	56.6	0.9603	57.8	53.6	54.7	60.1	0.1043
Soft drink intake	63.0	65.6	0.3561	57.7	60.0	67.3	62.3	0.6017
Fast food intake	31.7	72.5	<0.001*	64.0	27.3+	73.1	71.4	<0.001*
Physical activity behaviors								
Physical activity	15.7	14.5	0.4341	16.3	14.2	15.8	12.1	0.3811
Active transportation	54.5	24.4	<0.001	54.9	53.4	25.6	22.0	<0.001*
Physical education	24.3	29.0	0.0139*	27.8	32.5	24.1	24.7	0.0234*
Sedentary	45.9	56.7	<0.001*	46.7	43.8	57.5	55.0	0.0090*
Psychosocial and substance misuse								
Bullying victimization	19.4	21.4	0.2671	19.4	19.1	19.7	24.9+	0.0205*
Alcohol intake	39.0	28.6	0.0001*	39.8	36.3	29.3	27.4	0.0352*

*Variables significant at p<0.05

+ Variables significant within country for normal and elevated BMI at p<0.05

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Table 2 Adjusted odds ratio predicting factors associated with obesity among adolescents in the Caribbean sub-region after adjusting for covariates : GSHS 2012-2016

Factors	Univariate OR (95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
	1.44 (1.16 - 1.79)*	1.44 (1.16 - 1.79)*			1.44 (1.16 - 1.79)*
14 years	1.00 (0.75 – 1.33)	1.02 (0.76 – 1.35)			1.04 (0.76 - 1.42)
15 years	0.77 (0.53 - 1.13)	0.78 (0.53 - 1.14)			0.81 (0.54 - 1.22)
Hunger	0.96 (0.71 - 1.30)		1.05 (0.77 - 1.42)		1.00 (0.74 - 1.36)
Fruit intake	1.14 (0.95 - 1.36)		1.09 (0.87 - 1.37)		1.09 (0.87 - 1.37)
Vegetable intake	1.25 (0.85 - 1.83)		1.22 (0.81 - 1.83)		1.22 (0.82 - 1.80)
Soft drink intake	0.80 (0.62 - 1.04)		0.82 (0.63 - 1.06)		0.82 (0.62 - 1.08)
Fast food intake	0.92 (0.73 - 1.16)		0.93 (0.74 - 1.16)		0.91 (0.72 - 1.15)
Physical activity	0.74 (0.51 - 1.06)		0.74 (0.51 - 1.06)		0.79 (0.53 - 1.18)
Active transportation	0.82 (0.59 – 1.13)		0.86 (0.61 - 1.21)		0.86 (0.61 - 1.21)
Physical education	1.04 (0.81 - 1.33)		1.05 (0.82 - 1.35)		1.11 (0.85 - 1.45)
Sedentary	0.90 (0.66 - 1.23)		0.94 (0.69 - 1.28)		0.94 (0.68 - 1.29)
Bullying victim	1.36 (1.01 - 1.82)*			1.36 (1.01 – 1.84)*	1.36 (1.02 -1.82)*
Alcohol intake	0.91 (0.70 - 1.18)			0.90 (0.67 - 1.17)	0.98 (0.73 - 1.31)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant $p < 0.05$
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
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Table 3 Adjusted odds ratio predicting factors associated with obesity among adolescents in Latin America sub-region after adjusting for covariates : GSHS 2012-2016

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	0.90 (0.58 - 1.42)	0.91 (0.58-1.43)			0.91 (0.57 - 1.47)
14 years	1.59 (1.02 - 2.48)*	1.58 (1.01-2.47)*			1.59 (1.02 - 2.47)*
15 years	1.46 (0.93 - 2.27)	1.46 (0.93 - 2.27)			1.56 (0.94 - 2.58)
Hunger	1.08 (0.67 - 1.74)		1.10 (0.67 - 1.83)		0.98 (0.58 - 1.63)
Fruit intake	1.25 (0.79 - 1.99)		1.39 (0.86 - 2.25)		1.49 (0.88 - 2.51)
Vegetable intake	0.76 (0.49 - 1.18)		0.68 (0.44- 1.04)		0.68 (0.44 - 1.06)
Soft drink intake	0.90 (0.64 – 1.26)		0.82 (0.59 – 1.15)		0.80 (0.57 – 1.14)
Fast food intake	0.96 (0.66 - 1.39)		0.95 (0.65 - 1.40)		0.93 (0.64 - 1.37)
Physical activity	0.98 (0.52 - 1.84)		0.86 (0.46 - 1.61)		0.79 (0.41 - 1.50)
Active transportation	1.26 (0.78 - 2.03)		1.28 (0.79 - 2.06)		1.22 (0.75 - 1.97)
Physical education	1.29 (0.86 - 1.95)		1.25 (0.85 - 1.84)		1.20 (0.82 - 1.77)
Sedentary	1.20 (0.81 - 1.77)		1.20 (0.82 - 1.76)		1.15 (0.78 - 1.71)
Bullying victimization	1.91 (1.24 - 2.93)*			1.92 (1.24 - 2.94)*	1.99 (1.28 -3.08)*
Alcohol intake	0.99 (0.59 - 1.66)			0.94 (0.55 - 1.59)	0.90 (0.54 - 1.52)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant $p < 0.05$
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
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Table 4. Variables significant for risk of obesity in Latin American and Caribbean sub-regions, after adjusting for all covariates GSHS: 2012 - 2016

Factors	Caribbean (AIH, BSH, CUR)+ AOR(95%CI)	Latin America (UGY, CHL, AGH)+ AOR(95%CI)
Female	1.44 (1.16 - 1.79)*	-
14 years	-	1.59 (1.02 - 2.47)*
15 years	-	-
Hunger	-	-
Fruit intake	-	-
Vegetable intake	-	-
Soft drink intake		
Fast food intake	-	-
Physical activity	-	-
Active transportation	-	-
Physical education	-	-
Sedentary	-	-
Bullying victimization	1.36(1.02 -1.82)*	1.99 (1.28 -3.08)*
Alcohol intake	-	-

*variables significant p <0.05
Adjusted Odds Ratio , 95% Confidence Interval
Reference categories are 13 years, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
+ Anguilla, Bahamas, Curacao, Uruguay, Chile, Argentina
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AOR Adjusted Odds Ratio
95% CI Confidence Interval
- Variable not significant

Appendix C Tables for Study 2

Table 1. Adjusted odds ratio for factors associated with obesity among LAC adolescents : GSHS 2012-2016

Factors	Univariate	Model 1	Model 2	Model 3	Model 4
	OR(95%CI)	AOR(95%CI)	AOR(95%CI)	AOR(95%CI)	AOR(95%CI)
Female	0.69 (0.55 - 0.88)*	0.70 (0.55 - 0.88)*			0.70 (0.57 - 0.86)*
14 years	1.17 (0.95 - 1.44)	1.18 (0.95 - 1.44)			1.23 (0.99 - 1.51)
15 years	1.70 (1.34 - 2.15)*	1.70 (1.34 - 2.15)*			1.80 (1.42 - 2.28)*
Bahamas	1.20 (0.82 - 1.76)				1.50 (0.98 - 2.29)
Curacao	0.74 (0.51 - 1.07)				0.74 (0.50 - 1.10)
Uruguay	0.46 (0.32 - 0.65)*				0.38 (0.25 - 0.59)
Chile	1.03 (0.72 - 1.47)				0.87 (0.55 - 1.36)
Argentina	0.43 (0.31 - 0.59)*				0.41 (0.28 - 0.60)*
Hunger	2.14 (1.76 - 2.59)		2.09 (1.74 - 2.51)*		1.23 (0.93 - 1.63)
Fruit intake	0.75 (0.62 - 0.91)*		0.86 (0.72 - 1.03)		0.88 (0.74 - 1.04)
Vegetable intake	0.85 (0.68 - 1.07)		1.10 (0.89 - 1.37)		1.20 (0.98 - 1.47)
Soft drink intake	0.84 (0.68 - 1.05)		0.88 (0.70 - 1.10)		0.87 (0.69 - 1.10)
Fast food intake	0.77 (0.63 - 0.94)		0.75 (0.61 - 0.91)*		0.74 (0.60 - 0.90)*
Physical activity	0.85 (0.67 - 1.09)		0.86 (0.67 - 1.11)		0.91 (0.70 - 1.17)
Active transportation	0.93 (0.74 - 1.18)		0.96 (0.76 - 1.22)		0.95 (0.74 - 1.22)
Physical education	1.24 (1.01 - 1.53)*		1.19 (0.97 - 1.47)		1.14 (0.93 - 1.40)
Sedentary	0.89 (0.72 - 1.10)		0.96 (0.78 - 1.19)		0.95 (0.77 - 1.16)
Bullying victim	0.98 (0.77- 1.25)			1.00 (0.78 - 1.27)	1.18 (0.90 - 1.54)
Alcohol intake	0.86 (0.68 - 1.07)			0.86 (0.69 - 1.07)	1.00 (0.80 - 1.26)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization. GSHS is the Global School-Based Student Health Survey for the six countries

Appendix C Tables for Study 2

Table 2. Adjusted odds ratio predicting factors associated with obesity among Anguillan adolescents : GSHS 2016

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	1.04 (0.59 - 1.83)	1.15 (0.61 - 2.15)			1.07 (0.50 - 2.31)
14 years	1.90 (0.68 - 5.25)	1.96 (0.65 - 5.92)			2.07 (0.64 - 6.68)
15 years	1.20 (0.43 - 3.34)	1.22 (0.43 - 3.50)			1.75 (0.59 - 5.17)
Hunger	1.88 (0.88 - 4.05)		1.61 (0.81 - 3.22)		1.51 (0.70 - 3.28)
Fruit intake	0.68 (0.41 - 1.12)		0.80 (0.39 - 1.65)		0.84 (0.41 - 1.70)
Vegetable intake	1.04 (0.55 - 1.98)		1.37 (0.67 - 2.83)		1.27 (0.61 - 2.62)
Soft drink intake	0.74 (0.39 - 1.39)		0.64 (0.32 - 1.30)		0.69 (0.31 - 1.51)
Fast food intake	0.90 (0.42 - 1.92)		1.07 (0.47 - 2.42)		1.05 (0.45 - 2.45)
Physical activity	0.35 (0.16 - 0.77)*		0.32 (0.16 - 0.64)*		0.31 (0.15 - 0.65)*
Active transportation	0.70 (0.34 - 1.43)		1.02 (0.45 - 2.35)		0.99 (0.43 -2.26)
Physical education	0.88 (0.38 - 2.03)		0.99 (0.38 - 2.59)		1.01 (0.36 - 2.86)
Sedentary	0.46 (0.26 - 0.83)*		0.38 (0.19 - 0.73)*		0.36 (0.16 - 0.81)*
Bullying victimization	1.46 (0.50 - 4.32)			1.47 (0.50 - 4.32)	1.29 (0.36 - 4.61)
Alcohol intake	0.77 (0.32 - 1.87)			0.76 (0.31 -1.89)	0.76 (0.25 - 2.38)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for Anguilla
AOR – Adjusted Odds Ratio OR Odds Ratio

Appendix C Tables for Study 2

Table 3. Adjusted odds ratios predicting factors associated with obesity among Bahamas adolescents : GSHS Survey Bahamas 2013

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	1.61 (1.24 - 2.09)*	1.61 (1.25 - 2.07)*			1.65 (1.23 - 2.23)*
14 years	0.96 (0.70 - 1.34)	0.98 (0.71 - 1.36)			1.02 (0.71 - 1.47)
15 years	0.77 (0.45 - 1.30)	0.78 (0.45 - 1.32)			0.85 (0.50 - 1.48)
Hunger	0.86 (0.60 - 1.24)		0.97 (0.67 - 1.40)		0.94 (0.65 - 1.34)
Fruit intake	1.15 (0.93 - 1.43)		1.04 (0.79 - 1.37)		1.06 (0.81 - 1.39)
Vegetable intake	1.51 (0.93 - 2.46)		1.52 (0.91 – 2.55)		1.50 (0.90 - 2.49)
Soft drink intake	0.73 (0.53 - 1.02)		0.73 (0.52 - 1.04)		0.73 (0.49 - 1.08)
Fast food intake	0.89 (0.66 - 1.20)		0.90 (0.68 - 1.20)		0.87 (0.65- 1.17)
Physical activity	0.70 (0.45 - 1.06)		0.68 (0.44 - 1.06)		0.74 (0.45 - 1.22)
Active transportation	0.74 (0.49 - 1.10)		0.80 (0.52 - 1.22)		0.79 (0.51 - 1.23)
Physical education	1.05 (0.75 - 1.47)		1.08 (0.77 - 1.52)		1.17 (0.82 - 1.66)
Sedentary	0.87 (0.59 - 1.28)		0.94 (0.42 - 1.05)		0.91 (0.60 - 1.38)
Bullying victimization	1.26 (0.85 - 1.85)			1.26 (0.85 - 1.87)	1.26 (0.85 - 1.87)
Alcohol intake	0.90 (0.66 - 1.23)			0.89 (0.65 - 1.23)	1.03 (0.72 - 1.47)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for the Bahamas
AOR – Adjusted Odds Ratio OR Odds Ratio

Appendix C Tables for Study 2

Table 4. Adjusted odds ratio predicting factors associated with obesity among Curacao adolescents : GSHS 2015

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	0.90 (0.55-1.45)	0.90 (0.55 - 1.46)			0.91 (0.55 - 1.53)
14 years	1.57 (0.98 - 2.54)	1.57 (0.98 - 2.54)			1.56 (0.97 - 2.51)
15 years	1.48 (0.92 - 2.37)	1.48 (0.92 - 2.38)			1.58 (0.92- 2.72)
Hunger	0.97 (0.55 - 1.71)		0.99 (0.55 - 1.78)		0.89 (0.49 - 1.63)
Fruit intake	1.30 (0.79 - 2.15)		1.46 (0.86 - 2.47)		1.56 (0.88 - 2.77)
Vegetable intake	0.75 (0.47 - 1.20)		0.66 (0.41 - 1.04)		0.66 (0.41 - 1.06)
Soft drink intake	0.91 (0.63 - 1.31)		0.83 (0.58 - 1.18)		0.80 (0.55 - 1.18)
Fast food intake	0.96 (0.64 - 1.43)		0.94 (0.62 - 1.43)		0.93 (0.61- 1.39)
Physical activity	1.08 (0.54 - 2.15)		0.94 (0.48 - 1.89)		0.86 (0.42 - 1.76)
Active transportation	1.31 (0.79 - 2.16)		1.30 (0.78 - 2.17)		1.24 (0.74 -2.07)
Physical activity	1.33 (0.86 - 2.06)		1.26 (0.83 - 1.91)		1.20 (0.79 - 1.81)
Sedentary	1.29 (0.84 - 1.98)		1.30 (0.86 - 1.96)		1.20 (0.81 - 1.90)
Bullying victimization	1.94 (1.23 - 3.07)*			1.95 (1.23 - 3.08)*	2.02 (1.27 - 3.21)*
Alcohol intake	1.00 (0.57 - 1.75)			0.95 (0.54 - 1.68)	0.92 (0.52 - 1.61)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant $p < 0.05$
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for the Curacao
AOR – Adjusted
Odds Ratio OR
Odds Ratio

Appendix C Tables for Study 2

Table 5. Adjusted odds ratio predicting factors associated with obesity among Uruguay adolescents: GSHS 2012

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	0.98 (0.81 - 1.19)	0.98 (0.80 - 1.19)			1.02 (0.84 - 1.25)
14 years	1.27 (1.00 - 1.62)	1.27 (1.00 - 1.62)			1.33 (1.02 - 1.73)*
15 years	1.42 (1.03 - 1.95)*	1.42 (1.03- 1.95)*			1.51 (1.07- 2.12)*
Hunger	2.07 (0.43 - 9.95)		1.98 (0.40 - 9.72)		2.04 (0.41 - 10.07)
Fruit intake	0.74 (0.59 - 0.93)*		0.74 (0.58 - 0.96)*		0.74 (0.57 - 0.96)*
Vegetable intake	0.92 (0.73 - 1.17)		0.98 (0.75 - 1.28)		0.98 (0.77 - 1.28)
Soft drink intake	0.98 (0.76 - 1.27)		0.99 (0.77 - 1.28)		0.83 (0.64 - 1.08)
Fast food intake	0.82 (0.63 - 1.05)		0.82 (0.64 - 1.06)		0.84 (0.64 - 1.08)
Physical activity	0.85 (0.60 - 1.19)		0.86 (0.61 - 1.21)		0.86 (0.60 - 1.22)
Active transportation	1.01 (0.77 - 1.32)		1.03 (0.78 - 1.25)		1.04 (0.79 -1.37)
Physical education	0.98 (0.74 - 1.30)		1.00 (0.74 - 1.33)		1.02 (0.76 - 1.38)
Sedentary	1.10 (0.87- 1.40)		1.12 (0.88 - 1.12)		1.10 (0.86 - 1.40)
Bullying victim	1.29 (0.99 - 1.69)			1.30 (0.99 - 1.69)	1.36 (1.03 - 1.81)*
Alcohol intake	0.91 (0.75 - 1.10)			0.90 (0.74 - 1.09)	0.86 (0.70 - 1.06)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for Uruguay
AOR – Adjusted Odds Ratio OR Odds Ratio

Appendix C Tables for Study 2

Table 6. Adjusted odds ratio predicting factors associated with obesity among Chile adolescents: GSHS 2013

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	0.70 (0.48 - 1.02)	0.70 (0.49 - 1.02)			0.68 (0.47 - 0.98)*
14 years	1.37 (1.02 - 1.84)*	1.34 (0.98 - 1.84)**			1.34 (0.99 - 1.82)
15 years	2.16 (1.49 - 3.14)*	2.15 (1.47 - 3.14)*			2.21 (1.51 - 3.22)*
Hunger	2.41 (0.42 - 13.8)		2.34 (0.40 - 13.79)		2.12 (0.34 - 13.02)
Fruit intake	0.80 (0.58 - 1.10)		0.76 (0.57 - 1.02)		0.75 (0.57 - 0.98)
Vegetable intake	1.14 (0.85 - 1.55)		1.24 (0.92 - 1.67)		1.32 (1.00 - 1.74)
Soft drink intake	0.85 (0.58 - 1.24)		0.90 (0.61 - 1.33)		0.89 (0.60 - 1.32)
Fast food intake	0.72 (0.53 - 0.97)*		0.69 (0.51 - 0.93)*		0.67 (0.50 - 0.91)*
Physical activity	0.82 (0.52 - 1.28)		0.81 (0.51 - 1.28)		0.93 (0.56 - 1.52)
Active transportation	0.95 (0.62 - 1.48)		0.97 (0.63 - 1.51)		0.91 (0.57 -1.46)
Physical education	1.18 (0.82 - 1.69)		1.23 (0.85 - 1.77)		1.17 (0.83 - 1.66)
Sedentary	1.00 (0.71 - 1.41)		1.02 (0.73 - 1.42)		0.98 (0.70 - 1.37)
Bullying victimization	0.97 (0.57 - 1.63)			0.96 (0.57 - 1.64)	1.10 (0.64 - 1.87)
Alcohol intake	1.07 (0.66 - 1.74)			1.07 (0.66 - 1.74)	0.97 (0.61 - 1.54)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for Chile
AOR – Adjusted
Odds Ratio

Appendix C Tables for Study 2

Table 7. Adjusted odds ratio factors associated with obesity among Argentinian adolescents : GSHS 2012

Factors	Univariate OR(95%CI)	Model 1 AOR(95%CI)	Model 2 AOR(95%CI)	Model 3 AOR(95%CI)	Model 4 AOR(95%CI)
Female	0.67 (0.55 - 0.81)*	0.67 (0.55 - 0.82)*			0.67 (0.56 - 0.80)*
14 years	1.01 (0.77 - 1.34)	1.05 (0.79 - 1.38)			1.04 (0.79 - 1.37)
15 years	1.37 (1.03 - 1.82)*	1.38 (1.04 - 1.83)*			1.35 (1.02 - 1.79)*
Hunger	1.21 (0.93 - 1.57)		1.22 (0.94 - 1.59)		1.18 (0.89 - 1.56)
Fruit intake	1.10 (0.92 - 1.30)		1.12 (0.93 - 1.36)		1.17 (0.96 - 1.42)
Vegetable intake	1.04 (0.84 - 1.30)		1.03 (0.81 - 1.32)		1.06 (0.83 - 1.36)
Soft drink intake	0.84 (0.66 - 1.07)		0.85 (0.66 - 1.09)		0.84 (0.66 - 1.07)
Fast food intake	0.78 (0.60 - 1.02)		0.80 (0.62 - 1.04)		0.81 (0.63- 1.04)
Physical activity	0.98 (0.80 - 1.20)		0.95 (0.78 - 1.16)		0.89 (0.73 - 1.09)
Active transportation	1.03 (0.86 - 1.24)		1.02(0.85 -1.22)		1.00 (0.83 -1.20)
Physical education	1.14 (0.95 - 1.37)		1.15 (0.73 - 1.16)		1.10 (0.92 - 1.31)
Sedentary	0.89 (0.71- 1.12)		0.91 (0.73 - 1.16)		0.90 (0.72 - 1.13)
Bullying victimization	1.26 (1.04 - 1.53)*			1.25 (1.02 - 1.53)*	1.28 (1.05 - 1.56)*
Alcohol intake	1.15 (0.96 - 1.38)			1.14 (0.94 - 1.37)	1.13 (0.94 - 1.36)

Model 1 adjusted for socio-demographics including age and gender
Model 2 adjusted for health behavior variables including diet and physical activity
Model 3 adjusted for psychosocial and substance misuse variables including alcohol and bullying victimization
Model 4 adjusted for variables including sex, age, hunger, fruit intake, vegetable intake, soft drink intake, fast food intake, physical activity, active transportation, physical education, sedentary, victim bully and alcohol
*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for Argentina
AOR – Adjusted Odds Ratio OR Odds Ratio

Appendix C Tables for Study 2

Table 8. Variables significant from multivariable logistic regression analyses for factors associated with obesity among adolescents from Anguilla, Bahamas, Curacao, Uruguay, Chile and Argentina, after adjusting for covariates: GSHS 2012-2016

Factors	Anguilla AOR(95%CI)	Bahamas AOR(95%CI)	Curacao AOR(95%CI)	Uruguay AOR(95%CI)	Chile AOR(95%CI)	Argentina AOR(95%CI)	LAC+ AOR(95%CI)
Female	-	1.65 (1.23 - 2.23)*	-	-	-	0.67 (0.56 - 0.80)*	0.70 (0.57 - 0.86)*
14 years	-	-	-	1.33 (1.02 - 1.73)*	1.34 (0.99 - 1.82)*	-	
15 years	-	-	-	1.51 (1.07 - 2.12)*	2.21 (1.51 - 3.22)*	1.35 (1.02- 1.79)*	1.80 (1.42 - 2.28)*
Hunger	-	-	-	-	-	-	-
Fruit intake	-	-	-	0.74 (0.57 - 0.96)*	0.75 (0.57 - 0.98)*	-	-
Vegetable intake	-	-	-	-	-	-	-
Soft drink intake	-	-	-	-	-	-	-
Fast food intake	-	-	-	-	0.67 (0.50 - 0.91)*	-	0.74 (0.60 - 0.90)*
Physical activity	0.31 (0.15 - 0.65)*	-	-	-	-	-	
Active transportation	-	-	-	-	-	-	
Physical education	-	-	-	-	-	-	
Sedentary	0.46 (0.26 - 0.83)*	-	-	-	-	-	
Bullying victimization	-	-	2.02 (1.27 - 3.21)*	1.36 (1.03 - 1.81)*	-	1.28 (1.05 - 1.56)*	
Alcohol intake	-	-	-	-	-	-	

*variables significant p <0.05
Reference categories are 13 years old, no hunger, no fruit intake, no vegetable intake, no fast food intake, no soft drink intake, no physical activity, no active transportation, no physical education, no sedentary lifestyle, no alcohol intake, no bullying victimization
GSHS is the Global School-Based Student Health Survey for the six countries
LAC is Latin America and the Caribbean, did not include country of residence

AOR – Adjusted Odds Ratio OR Odds Ratio