2021

Prevalence of Metabolic Risk Factors With Abnormal Obesity Measures Among the Tobagonian Adult Population

Joanne Cruickshank
Walden University

Walden University

College of Health Professions

This is to certify that the doctoral dissertation by

Joanne Cruickshank

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Linnaya Graf, Committee Chairperson, Health Education and Promotion Faculty
Dr. Holly Godwin, Committee Member, Health Education and Promotion Faculty
Dr. Carol Spaulding, University Reviewer, Health Education and Promotion Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2021

Abstract

Prevalence of Metabolic Risk Factors With Abnormal Obesity Measures Among the Tobagonian Adult Population

by

Joanne Cruickshank

MEd, University of the West Indies, 2012

MSc, University of Surrey, Roehampton, 2001

BSc, Oxford Brookes University, 1996

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Education and Promotion

Walden University

May 2021

Abstract

An increase of metabolic risk factors is a public health threat to the well-being of the population of Tobago; this increase is poorly documented and understood. According to a review of evidence-based research, studies linked metabolic risk factors to the high prevalence of obesity. However, there was a gap specific to the Tobagonian population. This cross-sectional quantitative study assessed the evidence of metabolic risk factors to determine whether obesity measures correlated with metabolic risk factors among a sample from Tobago. Guided by the social-ecological theory, a self-reported survey was used to collect primary data from 270 participants during a workplace wellness and health-screening initiative. Descriptive statistics, chi-square, and binary logistic regression analysis were used to analyze data. A 43.6% overall prevalence of abnormal obesity measures was found for various metabolic risk factors. The results showed that the prevalence of obesity correlated with diabetes (64.4%) and hypertension risk factors (51.4%). These findings also highlighted a significance for gender specifics in which waist circumference and body mass index had a small effect on blood pressure range ≥ 130/85 mmHg. Despite acknowledged limitations for results, the findings from the current study contribute to positive social changes by adding to the limited resources available on the prevalence of metabolic risk factors with abnormal obesity measures among the Tobagonian population. Implications outline the need for future research and explain how public health practitioners and policymakers can use a holistic approach to channel resources into health awareness and prevention initiatives.

Prevalence of Metabolic Risk Factors With Abnormal Obesity Measures Among the Tobagonian Adult Population

by

Joanne Cruickshank

MEd, University of the West Indies, 2012

MSc, University of Surrey, Roehampton, 2001

BSc, Oxford Brookes University, 1996

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

Health Education and Promotion

Walden University

May 2021

Dedication

Matthew 19:26: “Jesus beheld them, and said to them, with man this is impossible, but with God all things are possible.” I dedicate this study to my entire family especially my late parents who recognized my ability to achieve this PhD and always provided a tower of strength. To Robinson and Thamaline Clovie, thank you so much for having confidence in me and may your souls continue to rest in peace.

Acknowledgments

First of all, thank you Lord for taking me through this journey of my life. My heavenly Father, thank you for the knowledge, wisdom, understanding, strength, and good health that you provided me with throughout this period. In Mathew 7:7 you said, “Ask and you will receive, seek and you shall fine, knock and the door will be open.” I am indeed thankful my dear father for this door that you have opened for me. To God be the glory for the great things you have done. You are great God; there is no one like you.

Second, I am very appreciative for the support and mentorship that my dissertation committee provided to me throughout the journey. Thank you so much Dr. Linnaya Graf and Dr. Holly Godwin for your guidance and encouragement. I really appreciate the advice, time, and expertise you rendered throughout the different stages of the dissertation process. Thank you.

Next, to my husband Dwight Cruickshank and my family including Collis Clovie, Brenda Peterson, Carol Armstrong, Lynette Alleyne, Bona Green, and Pearl Cruickshank, I am thankful for the prayers, motivation, encouragement, love, and support. Thank you.

Finally, to all my family, friends, coworkers, and participants who contributed significantly in making this research a success, thank you.

Table of Contents

List of Tables ... vi

Chapter 1: Introduction to the Study ... 1

Study Background ... 3

Etiology of Metabolic Risks ... 5

Diet and Metabolic Risk ... 6

Physical Activity and Metabolic Risk ... 6

Problem Statement ... 8

Purpose of the Study ... 9

Research Questions and Hypotheses ... 9

Theoretical Framework ... 11

Nature of the Study ... 12

Definitions ... 13

Assumptions ... 16

Scope and Delimitations ... 17

Limitations ... 17

Significance ... 18

Summary ... 19

Chapter 2: Literature Review ... 20

Literature Search Strategy ... 20

Obesity ... 21

Obesity Classification ... 22

Obesity Measures....23
Body Mass Index 24
Waist Circumference 26
Waist-to-Hip Ratio.... 28
Prevalence of Obesity 30
Trinidad and Tobago Prevalence of Obesity 30
Regional Prevalence of Obesity.... 31
Identification of the Metabolic Syndrome 33
Trinidad and Tobago Prevalence of Metabolic Syndrome 36
Regional Prevalence of Metabolic Syndrome.... 38
Theoretical Framework....41
Social-Ecological Framework....41
Microsystem.... 42
Mesosystem.... 43
Exosystem.... 43
Macrosystem.... 43
Chronosystem 44
Summary and Transition....46
Chapter 3: Research Methodology....47
Research Design and Rationale 47
Research Variables....48
Methodology....48

Population ... 48
Sampling and Sampling Procedure ... 49
Data Collection Strategies and Research Instrument ... 50
Questionnaire ... 50
Definition of Obesity Measures ... 51
Definition of Metabolic Risk Factors ... 52
Reliability and Validity of Instrument ... 52
Questionnaire ... 53
Self-Reporting of Obesity and Clinical Measure ... 54
Pilot Study ... 56
Data Collection Analysis Plan ... 56
Research Questions and Hypotheses ... 59
Ethical Consideration and Negotiation Access ... 60
Summary and Transition ... 61
Chapter 4: Results ... 62
Pilot Study ... 63
Data Collection ... 64
Statistical Analysis ... 67
Demographic Characteristics of Sample ... 68
Obesity Measures of Sample ... 71
Metabolic Risk Factors of Sample ... 74
Behavior Risk Factors of Sample ... 76

Research Questions and Hypotheses 79
RQ1 81
RQ2 86
RQ3 88
RQ4 90
Post Hoc Analysis on Behavior Risk Factors 93
Summary and Transition 98
Chapter 5: Discussion, Recommendation, and Conclusion 101
Interpretation of the Findings 101
Prevalence of Abnormal Obesity Measures 101
Prevalence of Metabolic Risk Factors 103
Identification of Metabolic Syndrome 105
Relationship of Obesity Measures and Metabolic Risk Factors 106
Relationship of Metabolic Risk Factors and Covariates 108
Limitations of the Study 109
Recommendations for Action 110
Implications for Social Change 112
Conclusion of the Study 113
References 115
Appendix A: Research Instrument/Questionnaire 166
Appendix B: Research Advertisement 175
Appendix D: Letter of Approval TRHA 177

Appendix E: Letter of Approval THA Ethics Committee 178

List of Tables

Table 1. Samples Demographic Characteristics 702

Table 2. Descriptive Statistic for the Average Obesity Measures and Metabolic Risk Factors (Mean ±SD)... 724

Table 3. Prevalence of Abnormal Obesity Measures (AOM) in Relation to Gender 746

Table 4. Prevalence of Elevated Metabolic Risk Factors in Relation to Gender............ 757

Table 5. Average Metabolic Risk Factors (Mean ±SD) 78

Table 6. Frequency Table of Behavioral Risk Factors 780

Table 7. Prevalence of Fasting Blood Sugar ≥100mg/dl and Abnormal Obesity Measures Based on Gender 824

Table 8. Abnormal Obesity Measures Based on Gender 835

Table 9. Prevalence of Elevated Blood Pressure ≥130/85mm Hg and Abnormal Obesity Measures Based on Gender... 857

Table 10. Chi Square Analysis for Elevated Blood Pressure ≥130/85mm Hg and Abnormal Obesity Measures Based on Gender 857

Table 11. Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors, BP Range ≥ 130/85mm Hg Predicted by Obesity Measures of WHR, WC and BMI ≥ 30 kg/m²... 913

Table 12. Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors**,** FBS ≥ 100mg/dl, Predicted by Obesity Measures of WHR, WC and BMI ≥ 30 kg/m² 935

Table 13. Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors**,** BP≥ 130/85mm Hg, Predicted by WHR, WC BMI, Physical Activity Pattern, Salt Intake and Sugar-Sweetened Drink Consumption 98

Table 14. Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors**,** FBS ≥ 100mg/dl, Predicted by WHR, WC BMI, Physical Activity Pattern, Salt Intake and Sugar-Sweetened Drink Consumption... 99

Chapter 1: Introduction to the Study

Obesity is a serious public health challenge that has reached an epidemic level (Cherry et al., 2014; Samuels et al., 2014; Sheehy & Sharma, 2013; White et al., 2006). Obesity affects many sectors of the society throughout one's life course (Batson et al., 2014). There is evidence showing a positive association between obesity and the metabolic syndrome (MetS; Al-Bachir & Bakir, 2017; De Lorenzo et al., 2016; Han & Lean, 2016; Kaur, 2014; Robbins et al., 2016). MetS includes three or more of major risk factors: visceral obesity, hyperinsulinemia, hypercholesterolemia, and hypertension (Pérez et al., 2008).

Although the components of MetS can be reversed, obesity increases the risk of further health problems, such as a doubled risk for cardiovascular diseases (Han & Lean, 2016) and a fivefold chance of type 2 diabetes (T2DM; Grundy, 2008). The upsurge in obesity is posited to be a major contributor to the development of health challenges from MetS (Cherry et al., 2014; Nayak et al., 2016; Samuels et al., 2014; Sheehy & Sharma, 2013; White et al., 2006). An increased prevalence of obesity has been correlated to the high incidence of T2DM, hypertension, heart disease, and hypercholesterolemia (Ashraf et al., 2011; Chopra et al., 2013; Grundy, 2008). Scholze et al. (2010) found that two thirds of hypertension prevalence was attributed to obesity.

In Trinidad and Tobago (T&T), these health challenges remain the leading cause of disability and death among the population (Chadee et al., 2013; Ezenwaka et al., 2007; Ministry of Health, Government of Trinidad and Tobago, 2017; Ramsaran & Maharaj, 2017; Roopnarinesingh et al., 2015). T&T placed fourth as having the highest number of fatalities from metabolic issues amongst the Caribbean and Latin America region (Samuels et al., 2014; Sheehy & Sharma, 2013). The prevalence of obesity has escalated within the country. The prevalence rate of diabetes rose to 13% in T&T and is projected to increase from 60,000 to 125,000 between 2000 and 2030 (Roopnarinesingh et al., 2015). The recognition of the underlying problems of MetS is of serious public health concern for T&T (Ezenwaka et al., 2007; Johnson & Rodrigues, 2016; Marharaj & Harding, 2016; Ordunez et al., 2015).

MetS creates financial constraints on a country's health care system (Obeidat et al., 2015). In T&T, diabetes accounted for an estimated cost of $812 million U.S. dollars with a surplus health care expense of 329% (Roopnarinesingh et al., 2015). Similarly, the annual health care service expenses for hypertension amounted to 3.3 billion T&T dollars (Ministry of Health, Government of Trinidad and Tobago [MOH], 2017). G. A. Nichols and Moler (2011) showed that T2DM and cardiovascular diseases were costlier to treat when compared to the incidence of MetS. Being able to acknowledge and reduce the MetS risk factors will eventually reduce the mortality rate in T&T and also minimize avoidable health care expenses and indirect social costs (G. A. Nichols & Moler, 2011).

The present study aimed to identify the relationship between the independent variables (waist-to-hip ratio, waist circumference, and body mass index) and the dependent variables (abnormal blood pressure and blood glucose) as documented in the literature (Adamu et al., 2014; Cornier et al., 2011; Czernichow et al., 2011; D'souza & Shekar, 2015; Gregory et al., 2017; Kaplan et al., 2014; Kassi et al., 2011; Ortega et al., 2016; Shakiba et al., 2017; Swainson et al., 2017). I addressed pertinent information within the clinical practice to adopt primary prevention and management of MetS risks among the T&T population.

Chapter 1 includes a brief overview and background of the issue under investigation. This chapter also includes the problem statement, purpose and nature of the study, and four research questions and associated hypotheses. There is also an introduction to the social-ecological theory (SET) that guided the study. Other focal areas of Chapter 1 are definitions of terms, assumptions, limitations, delimitations, the significance of the research to positive social change, and a summary of the chapter and transition into the literature review.

Study Background

The high prevalence of obesity poses challenges for public health practitioners because individuals are predisposed to metabolic disturbances (Choi et al., 2016; Goossens, 2017). Both clinicians and epidemiological researchers have recognized that obesity is a public health issue (Ashraf et al., 2011; Chopra et al., 2013; Chua et al., 2017; Ezenwaka, et al., 2007; Grundy, 2008; Han & Lean, 2016; Johnson & Rodrigues, 2016; Marharaj & Harding, 2016; Ordunez et al., 2015; Pan American Health Organization [PAHO], 2017). Researchers have identified a link between obesity and metabolic risk factors among a broad cross-cultural population, both in developed and underdeveloped countries (Al-Bachir & Bakir, 2017; Ezenwaka et al., 2007; Guo et al., 2016; PAHO, 2017). These simultaneous effects of obesity and metabolic risk are prominent not only in adults but also in children and adolescents (Eloi et al., 2017; Lim et al., 2015). According to older and recent evidence, the presence of obesity increases the risk of developing cardiovascular problems, T2DM, and MetS, which leads to an increase in mortality and morbidity (Al-Bachir & Bakir, 2017; Battie et al. 2016; Choi et al., 2016; Cornier et al., 2011; Coutinho et al., 2013; Egbe et al., 2014; Elffers et al., 2017; Goh et al., 2014; Gregory et al., 2017; Kwon et al., 2017; Oh et al., 2017; Ortega et al., 2016; Pelegrini et al., 2014; Rahman & Adjeroh, 2015; Thomas et al., 2018).

For the current study, diagnostic criteria from the International Diabetes Federation (IDF), the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III), and the World Health Organization (WHO) were used to define metabolic risk factors, elevated fasting blood glucose and blood pressure level, and cutoff points for anthropometric measurements of waist circumference (WC), waist-to hip ratio (WHR), and body mass index (BMI). Many investigators recognized the extent to which MetS affects a population by following specific criteria cutoff points for gender and ethnic groups set by these international agencies (Awasthi et al., 2017; Egbe et al., 2014).

Researchers investigated the competencies of several obesity measures to predict cardiovascular and T2DM risks (Obeidat et al., 2015; Ramsaran & Maharaj, 2017). Clinical researchers used anthropometric indices to recognize obesity prevalence and health risks among diverse populations (R. G. de Oliveira & Guedes, 2018; Gaya et al., 2017; Kidy et al., 2017; Murphy et al., 2014; Parks & Kim, 2012; Zhang et al., 2013). The commonly used anthropometric measurements included WHR, BMI, and WC (R. G. de Oliveira & Guedes, 2018; Gaya et al., 2017; Kidy et al., 2017; Murphy et al., 2014; Parks & Kim, 2012; Zhang et al., 2013).

The WHO sanctioned BMI as a measure to classify obesity, but some researchers observed that BMI is unable to recognize central obesity in case of healthy weight (Kidy et al., 2017; Olafsdottir et al., 2016; Ramsaran & Maharaj, 2017). Other health agencies such as the IDF and NCEP ATP III preferred WC as a mandatory component in classifying MetS, which assesses central or abdominal obesity (Kidy et al., 2017; Xu et al., 2017). Central obesity appeared to generate a higher risk of cardio-metabolic problems in comparison to other measures, and as a result served as a valuable marker to support therapy (Kidy et al., 2017; Xu et al., 2017).

Apart from using anthropometric indices such as WC and WHR as predictors to detect central obesity, imaging techniques such as magnetic resonance imaging, computed tomography scan, or dual energy are also recognizable, but their application is costly to identify the accumulation of visceral fat (Assaad-Khalil et al., 2015; Elio et al., 2017). Nonetheless, these applications are reliable tools to quantify the degree of visceral fat, which is of great clinical significance (Elio et al., 2017). The identification of central obesity was a recognizable indication of the development of metabolic risk (Assaad-Khalil et al., 2015).

Etiology of Metabolic Risks

The etiological perspectives of metabolic risks are multifactorial. Researchers have found that genetic, metabolic, and environmental factors are linked to the development of obesity and metabolic disturbances (Monteiro & Azevedo, 2010). Lifestyle factors including poor dietary habits and physical inactivity are critical attributes in the manifestation of metabolic risk (Ensenyat et al., 2017). Researchers observed that by incorporating healthy lifestyle behavior becomes the gold standard in the treatment and prevention strategies of obesity and other metabolic risks (Ensenyat et al., 2017; Olafsdottir et al., 2016).

Diet and Metabolic Risk

There has been extensive research conducted on the role of diet in the etiology of metabolic risk for cardiovascular disease and T2DM (Goff et al., 2015; S. Nichols et al., 2014; Popkin 2011; Wennberg et al., 2015). Previous investigation suggested that a diet low in fiber from fruits, vegetables, and whole grain products and also one that is rich in salt and energy-dense foods (mainly from saturated fat and sugar content) has a detrimental impact on developing obesity and metabolic risks for cardiovascular disease and T2DM (Goff et al., 2015; Wennberg et al., 2015).

Globalization and economic development have made many energy-dense food commodities cheaper and more readily available (Hu, 2011). This adverse effect of global trade and liberation is noticeable within the eating practice of Trinidadians and Tobagonians. The traditional diet and food preferences transitioned over the years from unrefined plant-based and high-fiber foods to a more Westernized diet that includes mostly processed foods that are high in animal origin, refined fat, and sugar that cause an alteration in body composition and metabolic disturbances (S. Nichols et al., 2014; Popkin, 2011).

Physical Activity and Metabolic Risk

The WHO (date, as cited in Howitt et al., 2016; Xiao et al., 2016) identified sedentary lifestyle as a significant risk factor for metabolic issues and mortality.

Extensive literature has shown the association between sedentary behavior and an increased risk of diabetes and cardiovascular disease (Bankoski et al., 2011; Gennuso et al., 2015; Salonen et al., 2015). Salonen et al. (2015) assessed the intensity and volume of physical activity (PA) concerning the MetS components and body composition among young Finnish people. Salonen et al. suggested that more time spent inactive was significantly related to an increased metabolic risk compared to performing moderate to vigorous activity. PA has been found to provide meaningful health outcomes that were associated with alteration in body composition and anthropometric measures including WC, WHR, and BMI (Salonen et al., 2015). Huang et al. (2017) assessed categories of PA with metabolic risk among Taiwanese workers and found a positive association between the reduction in metabolic components such as abdominal adiposity and improved lipid profile. Similarly, meta-analytical reviews indicated a positive association between PA and metabolic risk in which there was a 73% chance of developing MetS when involved in a small number of physical activities (Edwardson et al., 2012; Gennuso et al., 2015).

Although evidence suggested that PA mitigates the problem of obesity and its metabolic challenges (Howitt et al., 2016), physical activity is still low within the Caribbean (Bahwah & Nunes, 2010; Howitt et al., 2016). Bahwah and Nunes (2010) recognized that 33.4% of people living south of Trinidad did not exercise on a regular basis. The rate of physical inactivity was comparable to the statistic provided for Jamaica (30%). Howitt et al. (2016) reported that barriers such as hot climatic conditions, poor physical infrastructures (lack of pavements and lighting), and social issues (security and safety) inhibit the promotion of physical activity within the Caribbean. Despite barriers, promotion of physical activity and encouragement of healthy eating practices may be beneficial as the primary and secondary prevention goals in the current study.

Problem Statement

Obesity is a global epidemic and has been documented to be a significant cause of many chronic diseases and fatalities especially in the Americas and the Caribbean (Ordunez et al., 2015; Pagan et al., 2017; PAHO, 2017; Traboulay & Hoyte, 2015). For instance, the prevalence rate of obesity in T&T in 2016 was 32.2% (Central Intelligence Agency, 2016). A recent strategic plan of the MOH (2017) also indicated that 55.7% of people between 15 and 64 years of age were either overweight or obese. The statistics suggested that the prevalence rate of obesity in T&T is a significant public health concern, mainly because obesity plays a contributing role in the manifestation of metabolic risk factors of MetS and remains an emerging health issue for many countries (Farajian & Renti, 2008; Guan et al., 2016). In T&T, cardiovascular diseases and diabetes are among the five leading health problems that are affecting the population (Ezenwaka et al., 2007). T&T has a significantly higher mortality rate in diabetes and cardiovascular than any other North American country (Chadee et al., 2013; Roopnarinesingh et al., 2015).

Researchers have investigated obesity and metabolic risk factors for both islands (T&T); however, previous studies such as Ezenwaka et al. (2007) and Ramsaran and Maharaj (2017) did not solely focus on the Tobago population. Ezenwaka et al. and Ramsaran and Maharaj included a small segment of the Tobago population in their investigations. However, despite this exploratory insight (Ezenwaka et al., 2007; Ramsaran & Maharaj, 2017), there is a potential for bias and poor reliability of a study when two unique populations such as T&T are consolidated as one society. It is important to study each community individually. To address this limitation in the literature, the current study was designed to investigate whether the prevalence of metabolic risk factors correlated to abnormal obesity measures among the Tobago adult population.

Purpose of the Study

The objectives of conducting this quantitative study were to assess whether there was evidence of metabolic risk factors among the Tobago adult population and to determine whether there was a correlation between elevated anthropometric measurements and metabolic risk factors among Tobago adults ages 18 to 60 during a workplace wellness and health-screening initiative in Tobago. I examined the correlation between several obesity measures such as BMI, WC, and WHR with blood pressure and fasting blood glucose readings to assess the prevalence of metabolic risk.

The dependent variables were the metabolic risk factors of high blood pressure and high blood sugar. The independent variables were anthropometric measurements: WC, WHR, and BMI. Correlation analysis was performed on covariates and demographic data such as age, gender, educational background, and income bracket.

Research Questions and Hypotheses

This study was guided by four research questions and their corresponding hypotheses:

RQ1: What is the prevalence of previously documented metabolic risk factors for abnormal obesity measures among a representative sample of the Tobago adult population?

H_o1: There is no prevalence of previously documented metabolic risk factors for abnormal obesity measures among a representative sample of the Tobago adult population.

H_a1: There is a prevalence of previously documented metabolic risk factors for abnormal obesity measures among a representative sample of the Tobago adult population.

RQ2: How does the prevalence of metabolic risk factors for abnormal obesity measures differ by gender within the Tobago adult population?

H_o2: There is no difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within the Tobago adult population.

H_a2: There is a difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within the Tobago adult population.

RQ3: What are the relationships, if any, between obesity abnormal measures and metabolic risk factors for men and women within the ages of 18 to 60 in Tobago?

H_o3: There is no relationship between abnormal obesity measures and metabolic risk factors for men and women within the ages of 18 to 60 in Tobago.

H_a3: There is a relationship between abnormal obesity measures and metabolic risk factors for men and women within the ages of 18 to 60 in Tobago.

RQ4: Do abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio predict metabolic risk factors among a representative sample of the Tobago adult population?

H_o4: Abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio do not predict metabolic risk factors among a representative sample of the Tobago adult population.

H_a4: Abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio predict metabolic risk factors among a representative sample of the Tobago adult population.

I used both continuous and categorical variables to examine the association between metabolic risk factors and obesity measures (see Akoglu, 2018). Other continuous variables included weight, height, waist, hip measurement, and demographic information such as age and income bracket. A categorical scale was used to measure gender, race, marital status, and education background.

Theoretical Framework

I used the SET to guide this study. SET has existed for 41 years (Cramer & Kapusta, 2017; Ryu et al., 2017). SET is a health promotion framework that acknowledges multiple levels of influence (Fleury & Lee, 2006). The theory was used to evaluate behavior change at various levels (individual, interpersonal, organizational, and community) and the cultural and biological disposition of the population (Ayala et al., 2014; Chang et al., 2013). It is valuable to view the problem beyond the individual by encompassing the social and environmental influences (Hill et al., 2013).

Researchers used the SET to evaluate risk factors contributing to the increased metabolic risk such as diabetes (Chang et al., 2013; Hill et al., 2013; Obisesan et al., 2017; Shazhan, 2015). The etiological perspectives of metabolic risks are multifactorial. Monteiro and Azevedo (2010) observed an interaction between genetic, metabolic, social, and environmental factors in the development of obesity and metabolic disturbances. Multiple influences affect behaviors, such as poor dietary habits and physical inactivity, and are critical attributes in the manifestation of metabolic risk (Ensenyat et al., 2017). SET was valuable in showing the full range of theoretical principles that provide an understanding of the interrelation of obesity and metabolic risk factors (Chang et al., 2013; Lytle, 2009; Shazhan, 2015).

Nature of the Study

A quantitative design was appropriate for the current study because of its numerical characteristics of collected and analyzed information (see Halcomb & Hickman, 2015). A quantitative approach allowed me to quantify the prevalence and the relationship between the metabolic risk factors and abnormal obesity measures within the studied population. A cross-sectional survey was appropriate to provide data to assess the research hypotheses on the prevalence of metabolic risk factors with abnormal obesity measures (see Setia, 2016).

Primary data were collected using a self-reported questionnaire during a workplace health-screening initiative by a government agency. Data included information on participants' demographics, behavioral risk factors, obesity measures, and metabolic risk factors. For this study, the dependent variables consisted of metabolic risk factors (high blood pressure and high blood sugar), while the independent variables included abnormal obesity measures (WC, WHR, and BMI). Covariates included demographic behavior factors such as physical activity and dietary pattern. A continuous scale was used to measure demographic data such as age, while a categorical scale was used to measure gender, race, marital status, and education. I expressed categorical data in percentages that were used to express the frequency distribution of categorical variables.

A logistic regression model was used to predict the odds of developing metabolic risk factors with obesity measures among the Tobago adult population. This model was useful to recognize the odds ratio within prevalence studies (Petersen & Deddens, 2008). A Pearson correlation was used to analyze the strength and the direction of the relationship between the metabolic risk factors and abnormal obesity measures.

Definitions

Abnormal body mass index (BMI): Values of ≥ 30 kg/m² (Ramsaran & Maharaj, 2017).

Abnormal fasting blood glucose: Glucose levels greater than or equal to 100mg/dl or 5.6mmol/l (Alberti et al., 2005; IDF, 2006; Parikh & Mohan, 2012).

Abnormal obesity measures: Anthropometric measures that include WHR values of ≥ 0.90cm for males and ≥ 0.85cm for females, WC measurements ≥ 94cm for males and ≥ 80cm for females, and BMI values of ≥ 30 kg/m².

Abnormal waist circumference: The values used for abnormal waist circumference are based on the IDF recommendation cutoff values of ≥ 94cm for males and ≥ 80cm for females (Osei-Yeboah et al., 2017).

Abnormal waist-to-hip ratio (WHR): The values used for abnormal WHR are based on WHO metabolic syndrome criteria. Having a WHR ≥ 0.90cm in males and ≥ 0.85cm in females is a risk of MetS (P. L. Huang, 2009).

Anthropometric measurement/indices: Defined measurements used to assess and quantify body proportions that include obesity measures such as WC, WHR, and BMI (Bhowmik et al., 2015; Bouguerra et al., 2007; Goh et al., 2014; Olafsdottir et al., 2016; WHO, 2000).

Body composition: The accumulation of nutrients and other substances acquired from the environment and retained in the body. These include elements, tissues, and organs that become building blocks that constitute mass and shape conferring to body function (Going et al., 2014).

Body mass index (BMI): A measurement that incorporates the participant's weight (kg) over squared height (m^2; Aynalem & Zeleke, 2018; Kyrkou et al., 2016; Nuttall, 2015; Ortega et al., 2016; Swainson et al., 2017).

Central obesity: The accumulation of fatty tissues surrounding the viscera that can be estimated using simple measurements such as WC and WHR (Paley & Johnson, 2018).

Elevated triglyceride: A measurement equal to or greater than 150mg/dl (Alberti, Zimmet & Shaw, 2005; IDF, 2006; Parikh & Mohan, 2012).

Hyperlipidemia: Elevated levels of lipid in the blood (L. Lee & Sanders, 2012).

Hypertension: An elevated level of blood pressure within the range of 130/85mmHg. Hypertension is associated with diseases such as cardiovascular disease and stroke (P. L. Huang, 2009).

Metabolic risk factors: Fasting blood glucose level $\geq$ 100mg/dl (Alberti et al., 2005; IDF, 2006; Parikh & Mohan, 2012). Using the IDF and NCEP-ATP III guidelines, a systolic blood pressure reading of $\geq$ 130 mmHg and a diastolic blood pressure of $\geq$ 85 mmHg for all participants (Assaad-Khalil et al., 2015; Ezenwaka et al., 2007; Gradidge et al., 2016; Kaur, 2014).

Metabolic syndrome (MetS): "A cluster of metabolic risk factors including central or visceral obesity, insulin resistance, and hypertension and lipid disorder" (Manjavong et al., 2017, p. 55).

Obesity: An excessive accumulation of adipose tissue that measures a BMI of $\geq$ 30 kg/m^2 (Ramsaran & Maharaj, 2017).

Obesity measures: Anthropometric indices that are used to assess and quantify body proportions. For this study obesity measures included WC, WHR, and BMI (Bhowmik et al., 2015; Bouguerra et al., 2007; Goh et al., 2014; Olafsdottir et al., 2016; WHO, 2000).

Tobagonian: Any person who was born and lives in the island of Tobago. Tobago is part of a twin island country of T&T located in the Caribbean (Johnson & Rodrigues, 2016).

Waist circumference (WC): The measurement that is taken around the waistline to identify central obesity. The IDF recommended a cutoff value for WC at 94cm for males and 80cm for females (Osei-Yeboah et al., 2017).

Waist-to-hip- ratio (WHR): The ratio taken from dividing the measurement of the waist (cm) by the hip (cm) measurement. According to WHO MetS criteria, having a WHR $\geq$ 0.90 cm for males and $\geq$ 0.85cm for females is a risk of MetS (P. L. Huang, 2009).

Assumptions

The assumptions for this present study related to the type and sources of data. By targeting 264 Tobagonians between the ages of 18 and 60 years, and participants working within the public sector, I assumed that there would be an accurate representation of the population. Due to the absence of reliable secondary data that included demographic, clinical, and anthropometric data, I assumed that participants could easily self-report data provided to them by trained health care professionals. With the use of these primary data, the trustworthiness of the study was enhanced.

A self-reported questionnaire adapted from Behavioral Risk Factor Surveillance Survey (BRFSS) from the Centers for Disease Control and Prevention (CDC; Garmon Bibb et al., 2014) was used. The BRFSS required self-reporting on an individual's present health-related perceptions, conditions, and behaviors, as well as demographic information (Garmon Bibb et al., 2014). I assumed that participants would answer the questions truthfully and accurately. I reassured participants that ethical procedures would be followed to safeguard personal information, which included preserving confidentiality and anonymity.

Scope and Delimitations

There are delimitations of a study according to the boundaries of the investigation. Obesity and other metabolic risk factors remain a significant health concern and are the leading cause of mortality in T&T (MOH, 2017). Due to the shortage in evidence-based information regarding the issue, I investigated whether a relationship exists between abnormal obesity measures and metabolic risk factors among Tobagonian adults age 18 to 60 working in the public sector. Delimitations for the study included age, ethnicity, and employment status. Participants were within the ages of 18 to 60 years, were nationals of Tobago, and were employed in the local government. The research population comprised a true representation of Tobagonians, which allowed for the research findings to be generalized.

I excluded people previously diagnosed with diabetes or hypertension prior to the health screening and individuals already taking medication for metabolic health issues. Individuals selected for the study either had elevated levels of blood pressure ≥ 130/85mmHg and fasting blood sugar levels ≥ 100mg/dl or 5.6mmol/l diagnosed during the workplace wellness initiative. Pregnant or lactating women were excused, as were nonnatives of Tobago.

Limitations

This study included only 270 adult Tobagonians employed within the Tobago House of Assembly (THA). The findings cannot be generalizable to another population or geographic location. Another limitation was in the data collection instrument, which was adapted from the BRFSS and contained personal information about the participants, including present health-related perceptions, behaviors risk factors, and demographic information (see Garmon Bibb et al., 2014; Ward et al., 2016). Given the cultural barriers that exist in Tobago, barriers such as disease perception and acceptance, and fear of stigmatization, participants may have withheld pertinent information (see Brathwaite & Lemonde, 2015; Roopnarinesingh et al., 2015). Participants may not have been willing to disclose personal information that was required to participate in the study. Shortcomings may have existed when analyzing self-reported data of abnormal obesity measures and metabolic risk factors and may have resulted in misclassification in identifying an accurate prevalence rate. To mitigate this limitation, I addressed the issues of privacy, confidentially, and informed consent. The final limitation was the cross-sectional nature of the study. Causal inferences regarding the association between abnormal obesity measures and metabolic risk factors could not be made because cross-sectional studies prohibit inferences about cause-effect relationships (B. J. Lee & Kim, 2014; Setia, 2016).

Significance

The evidence showed that the prevalence of obesity and MetS is widespread (Ramsaran & Maharaj, 2017; Villamor et al., 2017). The current study was important because it contributed to knowledge that documents and describes the prevalence of MetS as it relates to abnormal obesity measures in Tobago. Pinpointing the abnormal obesity measures correlated to MetS may serve as a reference guide to clinicians when treating the Tobagonian population.

Understanding the extent of the problem may help public health practitioners and policymakers to channel resources into awareness and prevention initiatives. These initiatives may support and promote health education and promotion initiatives to curb the emerging trend of obesity and metabolic risk factors. This research may contribute to positive social change in the improvement of existing health standards among the target population because MetS and obesity have been shown to have a negative impact not only on the country's health care expenditure but also on the life expectancy rate of the country due to an increased risk for further health complications (see Jarolimova et al., 2013).

Summary

In Chapter 1, I provided an introduction and background information regarding the prevalence of metabolic risk factors and obesity measures. The emerging trend of obesity has been recognized to be a public health concern for countries because it negatively impacts the quality of lives and also generates economic burden to health care expenditures and individuals' health expenses. Obesity appears to be the driving force behind the influx of metabolic risk factors that grossly affect a diverse spectrum of a population and its demographics. The application of simple nonevasive obesity measures such as BMI, WC, and WHR may easily and efficiently predict the prevalence of metabolic risk. In Chapter 2, I provide a comprehensive overview of the literature on the prevalence of metabolic risk factors and obesity measures.

Chapter 2: Literature Review

The issue of obesity and MetS has become an emerging public health issue for countries (Ordunez et al., 2015; Pagan et al., 2017; PAHO, 2017; Traboulay & Hoyte, 2015). This rising trend has resulted in investigations at local, regional, and international levels (Farajian & Renti, 2008; Guan et al., 2016; Jarolimova et al., 2013; Ramsaran & Maharaj, 2017; Robbins et al., 2016; Salas et al., 2017; Villamor et al., 2017; Vliet-Ostaptchouk et al., 2014). Obesity increases an individual's chance of developing metabolic risk and is an important component that constitutes the MetS, leading to T2DM and cardiovascular diseases (De Lorenzo et al., 2016; Han & Lean, 2016; Kaur, 2014; Robbins et al., 2016). These health challenges remain the leading cause of mortality and morbidity in T&T (Chadee et al., 2013; Ezenwaka et al., 2007; MOH, 2017; Ramsaran & Maharaj, 2017; Roopnarinesingh et al., 2015). The increased mortality rate from these illnesses can affect the life expectancy rate of a population (Gavurová et al, 2017; Lappa et al., 2018). The current literature review addressed sources pertinent to the prevalence of metabolic risk factors and obesity measures.

Literature Search Strategy

A systematic approach included several databases in health sciences and nursing including Ovid, CINAHL, MEDLINE, and ProQuest. The research questions and other keywords provided key terms for the search. The latter included words and phrases such as *metabolic syndrome*, *non-communicable disease*, *Type 2 diabetes*, *dysglycaemia*, *hypercholesterolemia*, *hypertension*, *anthropometric indices*, *weight distribution*, and *body fat*. I also used Google Scholar to access information from local institutions, international agencies, and local health agencies in T&T. The review included evidence-based and full-text sources from within a 3- to 10-year time span that focused on the prevalence of MetS and obesity. The structure of the review reflected relevant areas that highlighted the existence and magnitude of metabolic risk factors as they related to the anthropometric indices.

In this chapter, I provide a brief introduction of the issue, a description of the literature search strategy, and an overview of obesity, obesity classification, and the obesity measures including BMI, WC, and WHR. Additionally, the prevalence of obesity within T&T and the regional prevalence of obesity is reviewed. Other relevant areas such as the identification of MetS, the prevalence of MetS in T&T, and the regional prevalence of MetS are discussed. This chapter also provides a detailed account of the theoretical framework, the SET, which was the foundation that guided the study. This chapter concludes with a summary of the literature review and a brief transition to Chapter 3.

Obesity

Although some cultures regard obesity as a positive sign of affluence, the increased trend has become a public health concern for countries because it negatively impacts health outcomes (Sohn, 2017; Verna et al., 2017). Studies affirmed obesity as a causative factor for several health problems (Evangelista et al., 2018; Lappa et al., 2018; Nyenhuis et al., 2018). Health agencies, researchers, and public health clinicians also recognized obesity as a prominent and multifactorial component that generates metabolic risk (Choi et al., 2016; Cornier et al., 2011; Egbe et al., 2014; Goh et al., 2014; Pelegrini et al., 2014; Thomas et al., 2018). There are indications that obesity generates economic and social challenges for both the victims of these diseases and the country's health care expenditure (Cruz et al., 2014; Scholze et al., 2010; D. V. Wagner et al., 2015). The treatment for MetS is at an economic disadvantage because it accounts for a significant portion of the annual health care budget (Cruz et al., 2014; Scholze et al., 2010). The expenses are categorized as direct, indirect, or intangible costs ranging from expensive medical bills/hospitalization, loss of productivity for those within the working-class group, and the deterioration of health during the disease progression (D. Kim et al., 2015; Mahabaleshwarkar et al., 2016; D. V. Wagner et al., 2015).

Investigators recognized that for the past 20 years, obesity prevalence has increased twofold within 73 countries and has caused a 70% mortality rate (Campbell, 2018). Obesity prevalence has received global recognition because it has continued to increase among different populations according to age, gender, ethnicity, culture, socioeconomic status, and education.

Obesity Classification

Obesity is the storage of excessive adipose tissue (Wannamethee & Atkins, 2015). The WHO classification is frequently used to define obesity (Green et al., 2016, Wyatt, 2013). Height and weight measurements are integrated into a simple calculation to determine the BMI (Green et al., 2016; Wyatt, 2013). The WHO referred to obesity as having a BMI ≥30 kg/m2 due to overconsumption of high caloric foods or an imbalance of energy expenditure (Nayak et al., 2016; Ramsaran & Maharaj, 2017; Tuoyire, 2018; Wyatt, 2013). The International Obesity Task Force further extended this classification into preobesity, Class 1 obesity, Class 2 obesity, and Class 3 obesity with a BMI of 25 to

29.9, 30 to 34.9, 34.9 to 39.9, and 40 and above, respectively (Johnson Stoklossa et al., 2017; Nuttall, 2015).

Obesity Measures

Investigators used body composition to assess and identify a wide range of health issues among young and old populations (Going et al., 2014). Body composition assessments can be implemented by using a series of laboratory measurements and field methods (Affuso et al., 2018). The use of anthropometric indices in clinical assessments is a reputable field method for clinicians to recognize a person's risk of developing metabolic issues (Cornier et al., 2011; D'Souza & Shekar, 2015). These measures are usually cost-effective within a clinical setting and controlled by confounders such as ethnicity and gender to determine their cutoff value or standards (Awasthi et al., 2017; Egbe et al., 2014). Researchers examined the relationship among several measures with the metabolic risk factors (Czernichow et al., 2011; Kassi et al., 2011; Shakiba et al., 2017; Swainson et al., 2017).

BMI, WC, and WHR are widely used anthropometric assessments to assess adiposity (Bhowmik et al., 2015; Bouguerra et al., 2009; Goh et al., 2014; Olafsdottir et al., 2016; WHO, 2000). BMI measurements are the most frequently used measurements to assess the level of obesity (Hulsegge et al., 2017; Rahmani et al., 2014), while WC and WHR are valuable measurements to examine regional fat distribution that are linked to other high-risk factors in the development of cardiovascular disease (Hulsegge et al., 2017; Rahmani et al., 2014; Swainson et al., 2017).

Body Mass Index

BMI is a simple and suitable approach to recognize the prevalence of obesity within a population (Awasthi et al., 2017; Ortega, et al., 2016; Swainson et al., 2017). The formula used to calculate BMI is dividing the weight in kilograms by height squared in meters (m^2) to assess obesity (Aynalem & Zeleke, 2018; Khorrami et al, 2017; Kyrkou et al., 2016; Ortega et al., 2016; Swainson et al., 2017). The criteria for obesity are a BMI of 30 kg/m^2 and above (Aynalem & Zeleke, 2018; Khorrami et al., 2017; Kyrkou et al., 2016). Obesity has been categorized into categories of Classes 1, 2, and 3, which fall within the range of 30 kg/m^2 to 35kg/m^2, 35kg/m^2 to 40kg/m^2, and 40kg/m^2 and above, respectively (Kaplan et al., 2014).

I examined BMI to establish a relationship between the metabolic risk factors and obesity measures. The association between BMI and several metabolic risk factors has been well documented (Adamu et al., 2014; Chua et al., 2017; Gregory et al., 2017; Kaplan et al., 2014; Ortega et al., 2016). Some researchers recognized a positive relationship between BMI and metabolic risk factors, while other studies were inconclusive (Adamu et al., 2014; Chua et al., 2017; Kaplan et al., 2014). Gregory et al. (2017) illustrated that increasing BMI could affect the severity of coronary disease. With an increase in BMI, the prevalence of metabolic risk factors such as hypertension, hyperlipidaemia, and diabetes is increased significantly (Gregory et al., 2017, Kaplan et al., 2014).

In a similar cross-sectional study, Al-Bachir and Bakir (2017) recognized BMI as a robust predictive measure to MetS risk factors. The authors correlated blood pressure, fasting blood sugar, and specific lipid profile measurements with BMI among 2,064 healthy male Syrians adolescents. Al-Bachir and Bakir recognized that some clinical measures increased significantly as the BMI increased except high-density lipoprotein cholesterol values, which showed no effect. Similarly, Ortega et al. (2016) showed positive correlation when examining the appropriateness of BMI as a method to predict cardiovascular disease among a population of 60,335. Ortega et al. found a 2.7-fold increased mortality risk for cardiovascular disease when BMI escalated.

In contrast, some studies' findings were inconclusive. Chua et al. (2017) used anthropometric indices to predict hypertension among 223 men and 259 women in the Malaysian adult population. Chua et al. correlated BMI with blood pressure reading but found BMI to be unreliable to predict hypertension. The unreliability of BMI to predict hypertension related to the inability to distinguish between muscle mass and adipose tissue to identify metabolic risk (Chua et al., 2017; Ortega et al., 2016).

Parks and Kim (2012) conducted a cross-sectional survey and assessed anthropometric measures with metabolic risk factors among 2,952 Koreans age 20 to 79 with average BMI and WC. Parks and Kim observed that BMI was an unreliable measure to predict the MetS because they could not recognize the distribution of body fat and could not differentiate excess adipose mass from high lean muscle mass. Parks and Kim acknowledged that the anthropometric measure WHR was a better indicator to predict metabolic risk factors than BMI and WC. Although Battie et al. (2016) used a similar design, this finding was not confirmed. Instead, Battie et al. found that obesity measures were comparable to predict hypertension and diabetes mellitus among female Filipino Americans.

Investigators tested the relationship between variables such as age, gender, and ethnicity with obesity measures and MetS (Kaplan et al., 2014). Kaplan et al. (2014) looked at gender differences with BMI measures and cardiovascular risk factors among 6,547 Hispanic men and 9,797 Hispanic women. Women were more likely to become obese and were within the obesity categories of Class 2 and 3 compared to their male counterparts (Kaplan et al., 2014). BMI is a simple and cheap method to assess body composition. Although previous researchers acknowledged that BMI is a common and useful tool to recognize metabolic risk prevalence and disease progression within a wide cross-section of a population (ages, gender, ethnicity, culture, socioeconomic background), BMI is limited in its inability to differentiate muscle mass from body fat (Ho-Pham et al., 2015).

Waist Circumference

Abdominal obesity is a useful measure to monitor morbidity and mortality (Coutinho et al., 2013; Kwon et al., 2017; Oh et al., 2017; Rahman & Adjeroh, 2015). WC was found to be the most appropriate obesity measure to determine central or abdominal obesity (Ahmad et al., 2016). The etiology relates to the significant amount of visceral adipose tissue that mobilizes vast amounts of metabolic activities that precipitate metabolic risk (Elffers et al., 2017).

The application of WC has been easy and has proven to be suitable to predict and recognize metabolic risk factors within various populations (Coutinho et al., 2013; Oh et al., 2017). The NCEP-ATP III and the IDF employed WC as a part of the criteria and as a diagnostic tool to identify the MetS (Kassi et al., 2011). Both agencies recommended different threshold values. The IDF recommended a cutoff value for WC at 94cm for males and 80cm for females, while the NCEP-ATP III recommended criteria were > 102 cm for men and > 88 cm for women (Osei-Yeboah et al., 2017).

Shakiba et al. (2017) correlated general obesity and abdominal obesity with the risk of developing cardiovascular disease among 12,902 participants in an Atherosclerosis Risk in Communities study done in four U.S. states. Shakiba et al. used body mass, WC, and WHR as part of the assessment tools. BMI was used to assess the relationship between general obesity and cardio-metabolic risks, while WC and WHR were used to measure abdominal obesity along with cardio-metabolic risk. Shakiba et al. used G-estimation to analyze this relationship. The WC showed a 65% risk of developing cardiovascular disease, while BMI and WHR were 15% and 38%, respectively. The survival rate decreased among the participants with a higher level of abdominal obesity regardless of WC or WHR measures (Shakiba et al., 2017).

Other researchers evaluated the relationship between WC and cardiovascular risk factors in different cultures. Guo et al. (2016) conducted a cross-sectional study to investigate the prevalence of MetS among 3,900 adults from Southwest China. Guo et al. used a questionnaire, anthropometric indices, and blood test to collect data. Guo et al. also used the IDF, the NCEP-ATP III, and the Joint Interim Statement to define MetS. Guo et al. used the *t* test, chi-square test, and descriptive statistics to analyze continuous data and categorical data, respectively. Guo et al. interpreted the odds ratio using logistic regression to assess the relationship between WC and metabolic risk factors. The results showed that the odds ratio increased across gender with high cardio-metabolic risk factors and an increased WC among participants (Guo et al., 2016). Such findings were consistent with other studies that recognized WC as a predictor tool for cardio-metabolic risk factors in an adult population (Lam et al., 2015; Lear et al., 2010).

Studies indicated the usefulness of WC as an obesity measure to detect metabolic risk associated with abdominal fat (Guo et al., 2016; Lam et al., 2015; Lear et al., 2010). Both the IDF and the NCEP-ATP sanctioned WC to be used internationally as one of the proposed criteria to identify metabolic risks: cardiovascular disease, hyperlipidemia, and insulin resistance (Guo et al., 2016; Kassi et al., 2011). The application of WC measures as part of the metabolic risk algorithm in primary prevention is appropriate because the risk generated from abnormal abdominal fat may not be detectable in some cases in which BMI increased (Parley & Johnson, 2018). Investigators acknowledged that measures that incorporate abdominal fat, including WC and WHR, serve as better predictors for cardio-metabolic risk factors (Guo et al., 2016; Kassi et al., 2011; Lam et al., 2015; Lear et al., 2010).

Waist-to-Hip Ratio

Many researchers investigated the relationship between WHR and MetS (Czernichow et al., 2011; Dimala et al., 2018; Kassi et al., 2011; Moore et al., 2017; Pavanello et al. 2018). Like WC, WHR was a significant indicator to determine body fat distribution and metabolic disturbance (Kassi et al., 2011; Mousavi et al., 2015, Parley & Johnson, 2018). The operating assumption of WHR is that an increase in visceral abdominal fat and decrease in glute-femoral muscle mass places a person at risk of developing metabolic risk factors (Kassi et al., 2011; Mousavi et al., 2015). Such assumptions may also apply even if the person is within a normal BMI category (Ahmad et al., 2016).

The WHO endorsed WHR as one of the criteria to identify MetS (Dimala et al., 2018; Moore et al., 2017). WHR is a reliable and straightforward measure that derives from dividing the waist measurement by the hip measurements (Dimala et al., 2018). Sometimes variations in research findings may occur due to different protocols used for analysis when examining the relationship between obesity measures and metabolic risk factors or disease outcome (WHO, 2008). Nonetheless, the recommended threshold values for the adult population according to WHO criteria are > 0.90 for males and > 0.85 for females, but may differ according to ethnicity (Moore et al., 2017).

Authors such as Czernichow et al. (2011), Kassi et al. (2011), and Pavanello et al. (2018) found that WHR was a superior predictor to determine mortality than WC and BMI. Czernichow et al. (2011) used three obesity measures, WC, BMI, and WHR to establish the strength of the relationship with metabolic risk factors among 11,140 participants within a 4.8 years' timeframe. Multiple statistical techniques such as the Cox proportional hazard regression model and Pearson's chi-square test were used to examine the hypothesis which set at a 95% confidence interval level. The result indicated that cardiovascular outcomes were strongly related to WHR than WC and BMI (Czernichow et al., 2011). The relative risk of developing cardiovascular diseases, coronary events and cardiovascular death according to participants obesity measures were 1.10, 1.13, and 1.08

for WC, respectively and 1.12, 1.17, and 1.19 for WHR respectively (Czernichow et al., 2011). The evidence showing a relationship exists between central obesity and cardio-metabolic diseases was consistent with other studies (Mousavi et al., 2015; Owolabi et al., 2017). Using this measure had higher predictive value in detecting metabolic risk factors in persons over 50 years (Swainton et al., 2017). Ahmad et al. (2016) found that WHR was the better index to identify T2DM than any other measures.

The above review recognized WHR as a valuable and acceptable measure. The WHO recommended specific cut-off values for men and women. The findings from these reviews indicated that WHR index was a good measurement to predict metabolic risk including T2DM. WHR being a simple obesity measure could detect central obesity and will be a valuable asset within the metabolic risk assessment so as to reduce the prevalence of metabolic problems that are affecting Tobago.

Prevalence of Obesity

The global epidemic of obesity was documented chronologically and geographically (Pan American Health Organization, 2016; Singh-Ackbarali & Maharaj, 2017). The literature compared the local prevalence of obesity in T&T with regional incidence within the rest of the Americas (Pan American Health Organization, 2016; Singh-Ackbarali & Maharaj, 2017).

Trinidad and Tobago Prevalence of Obesity

The increased prevalence of obesity highlighted the extensiveness of metabolic risk in T&T. Many researchers reported a significant upsurge in the incidence of obesity among the population of Trinidad and Tobago (Batson et al., 2014; Ford & Mokdad, 2008; Naywak et al., 2016; Ramsaran & Maharaj, 2017). Even though the emphasis of this study was on adult obesity, it was noteworthy to highlight obesity prevalence among children in T&T, which generated public health concern (Batson et al., 2014; Johnson & Rodrigues, 2016). Childhood obesity can be transitioned into adulthood, with a chance of developing one or more health problems such as cardiovascular diseases, cancer, diabetes and stroke later in their adult lives (Gulliford et al., 2001; Johnson & Rodrigues, 2016; Singh-Ackbarali & Maharaj, 2017). Among children, the prevalence of obesity escalated to 400% within the past 10 years, from 2.4% to 12.5% (MOH, 2017). Statistical data diagnosed 24% of the children within school ages of 5-24 years in T&T as preobese or obese, with a significant proliferation amongst the 24-year-old group (Johnson & Rodrigues, 2016; MOH, 2017).

In contrast, Singh-Ackbarali and Maharaj (2017) investigated the prevalence of obesity amongst the adult population. There was an increase in obesity projection dated as far back as fifty years ago for Trinidadians and Tobagonians (Singh -Ackbarali & Maharaj, 2017). The Ministry of Health's (2017) recent statistics revealed that 55% of the adult population in T&T were preobese or obese. There was variation in gender prevalence, in which men were more likely to be preobese than women, 40% and 34% respectively, and women were more likely to be obese than men 32% and 19% respectively (MOH, 2017).

Regional Prevalence of Obesity

In comparison to T&T, the rest of the Caribbean region and the Americas were much affected by the obesity epidemic (Food and Agriculture Organization, 2016; WHO, 2016). The Food and Agriculture Organization of the United Nations (FAO) reported that approximately 360 million people within the region of Latin America and the Caribbean were pre-obese (FAO, 2016). FAO (2016) recognized that countries such as the Bahamas, Mexico, and Chile experienced the highest rate of 69%, 64%, and 63% respectively. Likewise, countries such as Barbados and Antigua and Barbuda seemed to be on par with T&T's prevalence rate, having one of the highest statistics within the Caribbean region, that is, 33.2% and 31% respectively (FAO, 2016; WHO, 2016). Countries such as Guyana and Jamaica when compared to T&T had a lower obesity prevalence rate of 21.9% and 26.8% respectively (WHO, 2016).

Researchers examined the relationship of obesity to determine if it was gender-specific. In the Caribbean, females were three times more likely to be obese than their male counterparts (Fernandez et al 2015; Sobers-Grannum et al., 2015). Neighbouring countries such as Barbados, Antigua, and Barbuda displayed slightly higher rates than T&T, that is, 40.7% and 39% respectively (WHO, 2016). While countries like Guyana and Jamaica provided a lower statistic for females, that is, 21.9% and 26.8% respectively, than the three previously mentioned countries (WHO, 2016). Similarly, in Latin America, Cuevas et al. (2009) observed that obesity rates were higher among women than men, especially in countries such as Chile and Brazil.

The prevalence of obesity is a global phenomenon. From the above review, it is obvious that the increased prevalence of obesity demands public health attention, both for children and adults, especially since this problem could be transferred from the stages of childhood to adulthood. Presently, T&T has one of the highest rates within the Caribbean from the problem of obesity. Similarly, countries such as Antigua and Barbuda, Guyana and Jamaica are also faced with global obesity challenges that promote metabolic abnormalities.

Identification of the Metabolic Syndrome

The high influx of obesity has dramatically caused an upsurge in the prevalence of MetS among many populations (Chen et al., 2017; Chopra et al., 2013; Dabou et al., 2018; Diaz-Juarez & Suarez, 2017; Dragsbæk et al., 2016; Fergurson et al., 2010; Nolon et al., 2017; Ranasinghe et al., 2017). MetS is often referred to as Syndrome X, insulin resistant syndrome, and cardiometabolic syndrome (Lee & Sanders, 2012; Parikh & Mohan, 2012; Perez et al., 2017). According to Assaad-Khalil et al. (2015), the MetS consists of multifaceted components with interconnected physiological, biochemical, clinical, and metabolic risk factors for T2DM and cardiovascular diseases. These components range from abdominal obesity, insulin resistance, glucose intolerance, dyslipidemia, high blood pressure, and increased risk of mortality (Assaad-Khalil et al., 2015; Gradidge et al., 2016).

Various studies published definitions to guide the identification of MetS among adults and children. For this literature review, databases such as CINAHL, Medline, Ovid Nursing, and ProQuest Nursing and Allied Health Sources were used to ascertain various definitions and criteria recommended by organizations. These organizations included the International Diabetes Federation (IDF), WHO, NCEP-ATP, National Heart, Lung, and Blood Institute (NHLBI) and the American Association of Clinical Endocrinologists (AACE). Similarly, due to increasing prevalence in childhood obesity, MetS was found to be a predominant health issue among the young population (Ahrens et al., 2014; Martino et al., 2015). One study highlighted that MetS was found among 50% of the severely obese children (Martino et al., 2015). As a result, different criteria and definitions from adults were developed and altered to suit young children and adolescence due to the interferences from their physiological changes of growth and puberty (Martino et al., 2015; Reinehr, 2016; Vanlancker et al., 2017). Ahrens et al. (2014) recognized that definitions such as from NCEP-ATP were not appropriate for very young children. Instead, the descriptions from the Paediatric AHA and that of Cook and others in 2003 were the most frequently used, to classify MetS among children (Ahrens et al., 2014; Vanlancker et al., 2017).

The MetS first surfaced by Reaven under the name Syndrome X (Lee & Sanders, 2012; Wen et al., 2015). Reaven's definition focused on hypertension, impaired glucose tolerance (IGT), hyperinsulinaemia, and abnormal lipid profile (Lee & Sanders, 2012). Since then, there were various definitions developed by many international organizations (Kwon et al., 2017; Parikh & Mohan, 2012; Wen et al., 2015). Some years later, the WHO formulated their definition in which the main components of MetS were insulin resistance, obesity, dyslipidemia and hypertension (Dong & Simon, 2015). The WHO defined the MetS as having a history of diabetes mellitus with any abnormal levels of two of the components (Dong & Simon, 2015), also included in this definition was abnormal micro-albuminuria levels (Parikh & Mohan, 2012). The preferential criterion used by the WHO as a parameter for obesity was either WHR or BMI (Parikh & Mohan, 2012).

A few years later, the European Group for the Study of Insulin Resistance (EGIR) improved the WHO definition by introducing two additional criteria selected for obesity: hypertension and dyslipidemia. The EGIR used waist circumference as their only obesity criterion. The National Cholesterol Education Program (NCEP) Adult Treatment Panel III (ATP III) developed the third and most frequently used definition of the MetS, which was later updated by the National Heart Lung and Blood Institute and the American Heart Association. The following organization defined MetS as having three or more of the components: hyperglycemia/insulin resistance, visceral obesity, hypertension and atherogenic dyslipidemia (Dong & Simon, 2015).

The IDF in its definition for MetS was based on obesity rather than insulin resistance. IDF used WC with ethnicity and gender-specific values to define central obesity (IDF, 2006; Parikh & Mohan, 2012). With an abnormal WC ≥94 cm for men and ≥80 cm for women (Nolan et al., 2017), along with two other factors such as: raised triglycerides ≥ 150 mg/dL (1.7 mmol/L); reduced high density lipoprotein (HDL) cholesterol, < 40 mg/dL (1.03 mmol/L) and < 50 mg/dL (1.29 mmol/L) in male and females respectively; raised blood pressure systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg; and raised fasting plasma glucose (FPG) ≥ 100 mg/dL (5.6 mmol/L; Alberti et al., 2005; IDF, 2006; Parikh & Mohan, 2012). Following this definition, IDF in a common consensus with other organizations provided a world definition (IDF, 2006; Moore et al., 2017; Muñoz Contreras et al., 2013). The agreement included not using central obesity as the main component in diagnosing MetS, but instead having three or more of these five components to identify the MetS (IDF, 2006; Moore et al., 2017; Muñoz et al., 2013).

MetS is closely related to obesity and other metabolic disturbances. Abdominal or central obesity forms an integral part of the MetS classification. Other parameters that define the MetS are elevated blood pressure, abnormal lipid profiles, and diabetes-related risk measures, with specific cut-off values. The EGIR, NCEP ATP 111, and WHO contributed to the MetS definition. With an increased prevalence of obesity, there was a concurrent increase in metabolic risk factors.

Trinidad and Tobago Prevalence of Metabolic Syndrome

T&T faced similarities with many developing countries with the challenges of having large cases of metabolic disturbances (Chin et al., 2016; Ezenwaka et al., 2008; Nichols & Crichlow, 2010; Ramdath et al., 2013). Ezenwaka et al. (2008) highlighted that according to the IDF criteria for MetS, the problem of MetS is blatantly widespread throughout T&T, indicating a projection in cardiovascular and diabetes disease (Ezenwaka et al., 2008). Already, T&T is challenged with the public health battle of having a high incidence of T2DM when compared to other countries (Ezenwaka et al., 2013; Nayak et al., 2015; Roopnarinesingh et al., 2015). T&T ranked 10th within North American and the Caribbean as having the highest incidence of diabetes by the IDF, and 37th in the world statistics (Nayak et al., 2015; Roopnarinesingh et al., 2015). The incidence rate of diabetes in T&T ranged from 14 and 24 % (Ezenwaka et al., 2013). Both diabetes and cardiovascular diseases were the most common and listed among the five leading causes of deaths in T&T (Chadee et al., 2013; Johnson & Rodrigues, 2016). The mortality rates from these health problems were identified to be higher in T&T than North American countries, as reflected in the mortality rate of diabetes being ten times higher than those countries (Chadee et al., 2013). There was recognition that cardiovascular diseases in T&T were at the highest peak in the Caribbean and considered to be the leading cause of death in the country (Chadee et al., 2013; Nayak et al., 2013).

Researchers examined gender roles in the prevalence of MetS (Beigh & Jain, 2012; Lee et al., 2016). Some authors found that the risk factor which defines the MetS differs among sexes, ages, ethnicity and geographic location (Beigh & Jain, 2012; Lee et al., 2016). Nayak et al. (2016) used a cross-sectional research design to identify the prevalence of three metabolic risk factors: diabetes, obesity, and dyslipidemia amongst the population in Trinidad. Confounding factors such as geographic location in Trinidad and ethnicity were used to compare the prevalence rate among groups (Nayak et al., 2016). The authors in this study identified several significant findings, one being that T2DM was more prevalent among the 40 to 60 years age group (Nayak et al., 2016). Secondly, it was found that the prevalence of diabetes was higher among the East Indian than the African ethnic groups (Nayak et al., 2016). Finally, based on the geographical location in Trinidad, the findings suggested that the incidence of diabetes was higher in the south compared to north Trinidad (Nayak et al., 2016).

Despite the limited research conducted among the population in Tobago, Ezenwaka et al. (2007) included Tobago within their small sample when they compared the prevalence of MetS and its parameters in T2DM patients according to the IDF MetS definition. They found that the prevalence rate of abdominal obesity was high amongst the Tobago population and was associated with insulin resistance regardless of gender (Ezenwakai et al., 2007). Although the previous studies by Nayak et al. (2016) classified sex and ethnicity as contributing factors of the MetS, Ezenwaka et al. (2007) recognized that such a relationship was more evident in Trinidad than Tobago. However, distinctly while both islands shared a potential risk in the incidence of cardiovascular disease, the rates were higher in Tobago as compared to Trinidad (Ezenwakai et al., 2007).

Regional Prevalence of Metabolic Syndrome

The rest of the Caribbean neighbors share similar MetS characteristics to T&T, in that there were limited evidence-based publications on the overall prevalence rates of MetS and its components. There were few and some dated literature from countries such as St Lucia (Cherry et al., 2014), Guadeloupe (Larifla et al., 2016), US Virgin Islands (Tull et al., 2005), Grenada (Block et al., 2012), and Jamaica (Ferguson et al., 2010). These countries reported an increased rate in many of the metabolic components that govern the MetS (Sobers-Grannum et al., 2015).

Ferguson et al. (2010) implemented a cross-sectional study to assess and compare the prevalence of the MetS amongst Jamaican adults, using the IDF and AHA/NHLBI criteria. There was a 21% prevalence rate using the IDF criteria, and 18% when using the American Heart Association/ the National Heart Lung and Blood Institute (AHA/NHLBI) criteria (Ferguson et al., 2010). Ferguson et al. correlated socioeconomic factors again using the MetS criteria from IDF. Ferguson et al. examined gender and income variances. The prevalence of MetS was significantly higher in men of higher educational background and income bracket than the low-income bracket, 18.8% and 4.8 % respectively (Ferguson et al., 2010).

Cherry et al. (2014) identified the MetS prevalence rate amongst St Lucians using the NIH/NHLBI criteria and other modifying factors to examine the prevalence. The role of gender was recognizable. St Lucian females were at high risk of developing MetS, as the statistics revealed that 55% of participants had elevated cholesterol level while 56% had abnormal waist circumference (Cherry et al., 2014). Cherry et al. aligned their findings with other international studies which shared similarities.

Similarly, from the Grenada Strategic Plan for Health 2016-2025, the government emphasized that cardiovascular disease, hypertension, and diabetes along with their complications were all contributors to the leading cause of morbidity and mortality among the older population and were regarded as public health priority areas (Ministry of Health & Social Security [MOHSS] Government of Grenada, 2018). There was little evidence showing the prevalence of MetS or metabolic risk factors among the Grenadian population. A systematic review and meta-analysis by Sobers-Grannum et al. (2015) investigated the role of gender as a social determinant of diabetes within many Caribbean countries. The authors assessed 50 articles, seven databases, but only presented one article by Block et al. (2012) to highlight the issue regarding Grenada prevalence (Sobers-Grannum et al., 2015). Block et al. looked at the incidence of cardiovascular risk factors among Grenada subgroups. The findings suggested that obesity and MetS affected one-third of the studied participants (Block et al., 2012). Block et al. used abdominal obesity as one of the criteria used to diagnose MetS and found a higher prevalence amongst women than men in Grenada.

In further studies, the researchers assessed the prevalence of MetS in Barbados. However, due to the challenges in accessing current evidence-based literature within this region, the study used data that was published within the last 10 years. In Barbosa et al.'s (2011) cross-sectional study, the authors looked at the relationship between several obesity measures with hypertension among older adults both in Barbados and Cuba. Barbosa et al. recognized that factors such as gender, ethnicity and geographical variances were critical contributors to the association between anthropometric indexes and hypertension. Differences observed in the association among males and females, the Barbadians and Cubans, and the blacks and non-blacks' population within the two countries (Barbosa et al., 2011). The authors correlated waist/height measurements with gender and found that male participants had a value higher than 0.50 with a 61% risk of developing hypertension. In comparison, there was a 76% increased risk in developing hypertension among females whose waist circumferences were equal to 88cm or greater (Barbosa et al., 2011). The researchers recognized that being a Cuban female and having a BMI $\geq$ 28 provided a 2.8 chance of developing hypertension (Barbosa et al., 2011). Finally, both BMI and WC exhibited a similar association for developing hypertension amongst the male Cubans (Barbosa et al., 2011).

There was little evidence-based data found on the prevalence of MetS giving a local and regional prospective. In this section of the review, I evaluated work done within the last10 years. MetS affects many of the Caribbean countries, including T&T. Cardiovascular diseases and T2DM are risk factors related to the MetS, which pose significant health challenges in the region, and more so T&T. In T&T, these health issues ranked among the five leading causes of mortality, in which deaths from diabetes were 10 times higher when compared to countries in North America. In the evidence provided, researchers concluded that confounding factors such as age, gender, ethnicity and geographic locations were influential in the relationship and prevalence rate of MetS. I proposed to apply the IDF and WHO definitions to conduct a comprehensive assessment in order to identify metabolic risks, which will highlight the need for a holistic approach in decreasing mortality and morbidity rates in T&T from such metabolic risks.

Theoretical Framework

For this study, it was prudent to recognize the basis of knowledge and its application in the research. To identify the factors which were related to obesity and metabolic risk factors, I employed a holistic approach to identify issues that were interconnected. The socioecological framework guided this research.

Social-Ecological Framework

Over the years, public health researchers used the social ecological framework to understand the interaction of the individual to the environment in conceptualizing the high prevalence of obesity and its link to metabolic risks (Blunden et al., 2016; Podgurski, 2016; Ryu et al., 2017). The framework is a multilayered structure and encompasses many factors which affect behavior choices (Solomon, 2015). Its application has gained popularity in addressing various influences of health that stemmed from an individual, social, cultural and institutional perspective (Solomon, 2015). It captures the physical, biological, and cultural characteristics of the individuals from an environmental perspective.

Researchers used the SET/framework to conceptualize multiple health-related issues (Hill et al., 2013; Kilanowski, 2017; Ohri-Vachaspati et al., 2015; Ryu et al., 2017; Solomon, 2015). It is widely used in various social sciences disciplines that engage in the human development (Vélez-Agostos et al., 2017). The utilization of the socioecological perspective to recognize factors that influence obesity can provide the significant theoretical understanding of the increased prevalence of obesity and metabolic risk factors (Ryu et al., 2017).

Brofenbrenner's (1979) social-ecological framework has been in existence for the past 41 years. Within the original model, Bronfenbrenner connected the social structure to the individual and the environment which was responsible for one's health outcomes (Podgurski, 2016). Podgurski (2016) postulated that five influences belong to the environmental system which governs human behavior: microsystem, mesosystem exosystem, macrosystem, and chronosystem (Blunden et al. 2016; Podgurski, 2016).

Microsystem

The microsystem encompasses both the individual and interpersonal level of the nest. It focuses on the influential role of direct relationship including the family, family health, government, religious institution and peered influences (Blundenet al., 2016; Holland et al., 2016; Pallan et al., 2012; Podgurski, 2016; Thomas et al., 2018). The individual personal traits include age, gender, race, and other personal characteristics (Holland et al., 2016; Pallan et al., 2012; Podgurski, 2016). Within the microsystem, the family has a fundamental role in the development of lifestyle patterns and the acquisition of knowledge and personal characteristics (lifestyle, food choices, and preferences).

Mesosystem

The mesosystem is the interpersonal association and practices within the microsystem (Blunden et al., 2016; Pallan et al., 2012). It connects the interplay between the individual and several direct relationships including food production, food availability, socioeconomic factors, employment, workplace policies, and even the role of mass media. These influences are a significant contributor within the mesosystem with regards to lifestyle choices and modification (Hong et al., 2016).

Exosystem

The exosystem refers to influences that highlight a broader spectrum of the community. It provides an indirect impact that impinges on the direct relationship and precipitates environmental barriers. These influences occur with or without the individual's involvement and may affect the individual indirectly such as the workplace, neighborhood, health services, mass media, and food industry (Hong et al., 2016).

Macrosystem

The macrosystem is the blueprint of the framework that identifies the cultural, values or social norms regarding personal choices. It is responsible for a diverse social structure and activities that occur within the microsystem. These influences stem from family, political, religion, social, and cultural environments, which may not ultimately impact one's life.

Roopnarinesingh et al. (2015) accepted the concepts of culture, the values, beliefs, and norms in constructing barriers when treating metabolic risk factors such as diabetes amongst the T&T culture. Cultural barriers included body size perception, disease perception and acceptance, fear of stigmatization, type of diet, and the use of alternative medicine in preventing and treating metabolic risk factors (Brathwaite & Lemonde, 2015; Roopnarinesingh et al., 2015). Most often these cultural barriers are found to be labelled high-risk behaviors (physical activities and eating habits) and are responsible for many adverse health outcomes (Brathwaite & Lemonde, 2015).

Chronosystem

The chronosystem is the successive stages of events that occur over a period within the individual life processes. This construct provides historical contexts and cultural expectations that epitomize the personal development throughout the environmental subsystem (Killam & Degges-White, 2017; Skelton et al., 2012). These perspectives are either normative or nonnormative transitions. The normative development changes are culturally likely to occur such as breastfeeding practices, involved in physical activity, food preferences, the experience of puberty, the stage of the individual's, education, getting married, and starting a family (Killam & Degges-White, 2017). On the other hand, nonnormative transitions within the chronological stage, involve unexpected events such as economic constraints, stress, family, history of metabolic risk factors, maternal weight, loss of a limb, and even death (Killam & Degges-White, 2017).

The application of Bronfenbrenner's (1979) social, ecological model, it provides a theoretical understanding in the relationship between the interpersonal, intrapersonal, organizational, societal, and public policy influences, as it relates to the increased prevalence of the metabolic risk factors (Solomon, 2015). Focusing on the environmental and societal impacts are beneficial in determining individuals at risk and fostering positive behavior changes against metabolic risk factors (Gosadi, 2016). Researchers recognized that due to the multifactorial characteristic of the MetS, there are co-occurrences from environmental, genetic and societal influences (Gosadi, 2016; Panizzon et al., 2015). Environmental impacts such as a shift in socioeconomic circumstances, sedentary lifestyle, and unhealthy eating practices are causative factors for the increased prevalence of MetS (Panizzon et al., 2015). Exhibiting transitional phenotype predisposes an imbalance of energy, that is, where energy intake is higher than energy expenditure. This circumstance may eventually initiate obesity and metabolic risk factors. Studies have shown these environmental variables are significantly linked to the genetic genesis (Clifton et al., 2017; Ventura et al., 2017).

Researchers used many approaches such as obesity map location, single genes mutation, family segregation, and twin surveys to recognize that a positive relationship exists between heritability genetics and body composition (Lim et al., 2012, Ventura et al., 2017). While each influence of the social ecological framework plays a pivotal role in metabolic risk factors assessment and reduction (Hill et al., 2013), I focused on the individual perspective of the framework. The individual level recognized characteristics of the individuals which includes the role of gender, socioeconomic status, education background, and behavior risk associated with development of obesity and metabolic risk factors.

Summary and Transition

The prevalence of metabolic risk factors has been well established and documented within T&T and regionally. Many researchers identified that the rising trend of obesity has an integral role in the development of metabolic risk profiles, leading to an increased risk of cardiometabolic issues. In the review of literature, anthropometric indices such as WC, WHR, and BMI are simple and reliable methods used, to evaluate the degree of obesity and to determine its predispositions to metabolic risk. International health agencies such as IDF, NCEP-ATP111, and the Joint Interim Statement identified evaluation of abdominal obesity as an integral component to define the MetS.

The complexities of obesity and risk factors amenable to behavior change. For this chapter, the multifactorial nature of the SEM highlighted, conceptualized the relationship between obesity measures and metabolic risk factors. Using such a holistic approach afforded an understanding of the societal, environmental, and biological circumstances in preventing and treating this issue, thus fostering positive social change.

In Chapter 3, the method to determine the prevalence of metabolic risk factors for obesity measures amongst the Tobago adult population will be explained. The methods will include identifying the target population, the sampling procedures and data collection, the instrument used to collect data, and the ethical procedures relating to the study.

Chapter 3: Research Methodology

I addressed whether there is evidence showing metabolic risk factors among the Tobagonian adult population and whether there is a correlation between obesity measures and metabolic risk factors among Tobagonian adults age 18 to 60. This chapter provides information on the research design used to carry out the study and other relevant information such as the target population, sampling procedures, data collection techniques, instrumentation, and ethical procedures.

Research Design and Rationale

I used an empirical research design to analyze primary data from a self-reported survey instrument. Participants self-reported on obesity and metabolic risk factors figures soon after receiving screening by trained nurses and registered dietitians from a local health organization. I used a cross-sectional quantitative approach was used to carry out this study. A cross-sectional study is a prevalence study and was appropriate to examine the prevalence of metabolic risk factors with abnormal obesity (see Carneiro et al., 2010). A cross-sectional study allows for the use of a survey, which was suitable to estimate the frequency and distribution of metabolic risk with obesity measures within the studied population (see Aslam et al., 2012). A cross-sectional design allows for information on participants' health status, behaviors, and metabolic risk to be collected at one point in time, and at the same time helps generate a hypothesis (Aslam et al., 2012; Setia, 2016). For the current study, a cross-sectional research design helped me generate a comprehensive assay of data, which included demographics, obesity measures, and behavioral and metabolic risk factors.

Research Variables

The dependent variables were the metabolic risk factors of high blood pressure and high blood sugar. A self-reported questionnaire was used during the workplace wellness and health-screening initiative in the local government agency. The independent variables were obesity measures: WC, WHR, and BMI. Participants self-reported on both the obesity and metabolic risk factors after screening by trained nurses and registered dietitians working in a local health care institution. A correlation analysis was performed on covariates, including demographic data such as age, gender, education, and income bracket.

Methodology

Population

The sample population was drawn from within the organizations of the local government. Departments were included that have a workforce population greater than 100 employees. Each participant was a native Tobagonian between the ages of 18 and 60 years. The population included both men and women diagnosed with high blood pressure and abnormal blood glucose during a workplace health-screening exercise. People who were previously diagnosed with diabetes and hypertension before the health-screening exercise and those taking medications for these health conditions were excluded from the study. Pregnant and lactating mothers and nonnatives of Tobago were also excluded from the study.

Sampling and Sampling Procedure

According to Jones et al. (2003), having the correct sample size is critical in answering the research questions. In prevalence studies, a small sample size influences the null hypothesis in terms of the precision and the statistical power to acknowledge the association of interest (Martínez-Mesa et al., 2016). Charan and Biswas (2013) recognized that the sample size calculation is dependent on the type of study design. The formula, $n = Z^2 P(1-P) / d^2$ is a simple method used to calculate sample size for cross-sectional studies, where n = sample size, z = z statistics for a level of confidence (1.96), P = expected prevalence, and d = precision of 5% (.05; Naing et al., 2006). I calculated the expected prevalence (P) by identifying the prevalence rate found in similar studies among the same population obtained from the literature review. A study conducted by Ezenwaka et al. (2007) on the Tobagonian population indicated that 19.3% of Tobagonians with non-insulin-dependent diabetes mellitus had abdominal obesity and three other risk factors for MetS, according to the IDF criteria. The sample size formula is a normal approximation with an additional 10% over a sample for nonresponses and missing values (Martínez-Mesa et al., 2016; Naing et al., 2006). Using this formula, I determined the minimum sample size for this study was 264 participants.

Convenience sampling was used to select the appropriate sample because it provided easy and quick access to the sample population. Convenience sampling is a nonprobability sampling technique that allows for a homogenous sample (Erikan et al., 2016). By carrying out convenience sampling, I selected departments that had a workforce population greater than 100 employees. Numbers were assigned to questionnaires instead of names to protect the privacy and anonymity of each participant.

Data Collection Strategies and Research Instrument

A self-reported questionnaire was used to obtain data. To acquire meaningful information for the study, the questionnaire was segmented into four pertinent sections. The significance sections included demographics, behavioral measures, obesity measures, and metabolic risk factors (see Appendix A). This procedure allowed me to draw inferences on hypothesis testing.

Questionnaire

The 2013 BRFSS was used to develop the instrument for the study. The BRFSS is a cross-sectional telephone survey within the public domain (CDC, 2013). The CDC (2013) used the BRFSS to collect prevalence data regarding risk behavior and health status of residents age 18 years and older located in several U.S. states. Because a federal agency developed the BFRSS and it was within the public domain, authorization was not required from the CDC to use the instrument (see CDC, 2013).

The study questionnaire consisted of seven pages and contained 24 items divided into four sections (see Appendix A). These four sections captured the demographic information, obesity measures, metabolic risk factors, and behavioral risk factors data:

- Section 1 of the questionnaire contained information on participants' demographics. The information included participants' gender, age, race, marital status, education, and income bracket.

- Section 2 of the questionnaire contained obesity measures with four modified items. I modified the items to allow for self-reporting on anthropometric measures such as weight, height, waist, and hip measurements.
- Section 3 contained metabolic risk factors and included four items asking participants to self-report their most recent blood sugar and blood pressure measurements. Questions on metabolic risk factors were highlighted in Section 3 of the questionnaire.
- Section 4 consisted of questions about the behavioral risk factors. This contained 10 items that captured behavioral risk factors such as tobacco and alcohol consumption, dietary consumption pattern, and physical activity pattern. There was a modification to dietary consumption patterns and physical activity patterns to highlight culturally appropriate foods and physical activity suitable for the target population.

At the end of the workplace health-screening initiative, participants self-reported information to trained nurses and registered dietitians. I assumed that clinical procedures followed standard protocols to ensure the reliability of the data.

Definition of Obesity Measures

Anthropometric measurements were used to identify or quantify obesity. For this study, these measurements include WC, WHR, and BMI. According to the WHO recommendation, having a BMI of 30 kg/m^2 or greater and a WHR > 0.90cm (males) and > 0.85cm (females) indicates obesity (Alberti et al., 2005). The formula of weight in kilograms divided by height in centimeters squared is used to categorize BMI (S. Nichols & Crichlow, 2010). According to IDF and NCEP-ATP III criteria, WC ≥ 94cm for males and ≥ 80cm for females indicates central obesity (Ezenwaka et al., 2007). The values for WHR were calculated from the formula waist measurement (cm) divided by hip measurement (cm). BMI was categorized as the following: underweight (BMI less than 18.5kgm^2), normal weight (BMI 18.5kgm^2 to 24.9kgm^2), overweight (BMI 25kgm^2 to 29.9kgm^2), and obese (BMI ≥ 30kgm^2; see S. Nichols & Crichlow, 2010).

Definition of Metabolic Risk Factors

Participants were asked to self-report the most recent blood sugar and blood pressure readings (questions on metabolic risk factors were highlighted in Section 3 of the questionnaire). Metabolic risk factors were defined using the IDF and NCEP-ATP III guidelines: a systolic blood pressure reading of ≥ 130 mm Hg and a diastolic blood pressure of ≥ 85 mm Hg for all participants (Ezenwaka et al., 2007; Kaur, 2014). Elevated blood pressure was defined as ≥ 130/80 mm Hg. Likewise, having a fasting blood glucose of ≥ 100 mg/dl defined elevated blood glucose levels (see Ezenwaka et al., 2007; Kaur, 2014). Metabolic risk factors (blood pressure range ≥ 130/85 mm Hg and FBS ≥ 100mg/dl) were the study's dependent variables. These were measured both as continuous and dichotomous variables (FBS: 0 = No, 1 = Yes) or (B.P.: 0 = not selected, 1 = selected).

Reliability and Validity of Instrument

Reliability and validity are key indicators used to recognize research instruments' strengths (Sullivan, 2011). According to Sullivan (2011), reliability is the consistency and the dependability of the outcomes when using an assessment instrument that provides the same result each time used, within the same setting, and among the same population. Validity refers to the accuracy of the measure (Heale & Twycross, 2015).

Questionnaire

The CDC (2013) developed the BFRSS as a surveillance screening tool. The BFRSS has been used to collect data on risk factors and causes of death from chronic disease in 50 U.S. states (CDC, 2013; Hsu et al., 2018). On an annual basis, the CDC conducts random telephone self-reported surveys on individuals 18 years and older (Hsu et al., 2018). The random selection allows for each person within the population to have an equal chance to participate in the survey (Carneiro et al., 2010). The purpose of the survey is to assess health needs and public health priorities (CDC, 2013). Due to the BRFSS's central role, the CDC implements continuous validation checks on its data (Pierannunzi et al., 2013).

Pierannunzi et al. (2013) examined the trustworthiness of the BRFSS by evaluating reports on the questionnaire's validity and reliability in various studies. Pierannunzi et al. used the categorical rubric to assess the quality of each study. Pierannunzi et al. recognized that nearly all of the test/retest studies that included BRFSS questions showed an appropriate reliability level. Pierannunzi et al. recognized that most measures from the BRFSS were highly reliable and valid according to their evaluation of peer-reviewed studies.

Self-Reporting of Obesity and Clinical Measure

The current study had a cross-sectional design in which participants were interviewed at one point in time. I investigated 270 adult Tobagonians employed within the government sector. No cause and effect from this study could be determined, and findings cannot be generalized to another population or geographic location. The BRFSS is a self-reporting instrument often used to capture prevalence data regarding risk behavior and health status of individuals 18 years and older (CDC, 2013). Because a federal agency developed the BFRSS and it is in the public domain, CDC authorization was not required to use the instrument (CDC, 2013).

The current research instrument was adapted from the 2013 BRFSS to suit the target population. Researchers used the self-reporting method to collect data on obesity and clinical measures (Bolton-Smith et al., 2000; Heman et al., 2012; Wada et al., 2005). Bolton-Smith et al. (2000) and Wada et al. (2005) described the self-reporting questionnaire as a valid instrument to determine population prevalence on obesity. Researchers questioned the validity of the data ascertained from self-reporting because self-reporting can underestimate or overestimate (Prince et al., 2008). The threat to validity lies in the trustworthiness of using self-reported instruments. Because participants may not have been truthful when disclosing information, there may have been shortcomings when analyzing the self-reported data on abnormal obesity and metabolic risk factors. Using such data may have caused misclassification in identifying an accurate prevalence rate.

The accuracy of self-reporting obesity measures and metabolic risk factors may have influenced the interpretation of the prevalence of metabolic risk with abnormal obesity measures among the Tobagonian adult population. The issues of recall and response bias are areas of concern for some investigators (Prince et al., 2008). Issues of recall bias and errors were addressed in the measurement. Allowing participants to self-report at least 1 hour after implementing a health screening conducted by qualified health care professionals, namely nurses and dietitians, minimized poor precision in measurements. This approach allowed participants to comfortably recall and self-report these measures because reliability seems to be affected by time frame (Althubaiti, 2016; Short et al., 2009). Self-reporting on data obtained from qualified medical practitioners was assumed to be as reliable as any acquired data from other gold-standard methods, such as medical records or physical examinations (Thawornchaisit et al., 2013).

A self-reported questionnaire was the main instrument used for the study. I asked participants to self-report information regarding demographic information, behavioral habits, obesity measures, and metabolic risk factors. Questions for the instrument were in a closed format, restricting participants from providing a detailed account of the phenomenon of interest. Some relevant information could have been excluded from the study. This would be a threat to the internal validity of the study.

Content validity addresses the degree to which the self-reported instrument items adequately characterize the content domain (Zamanzadeh et al., 2015). The self-reporting instrument was adapted for the study from the 2013 BFRSS surveillance screening tool (see CDC, 2013). The BFRSS is a self-reporting instrument often used to capture prevalence data regarding risk behavior and health status of individuals who are 18 years and older (CDC, 2013). For the current study, the self-reported questionnaire consisted of 24 items divided into four sections: demographic information, obesity measures, metabolic risk factors, and behavioral risk factors data. Including these four sections allowed for a valid representation of the topic under investigation.

Pilot Study

As part of the instrument validation process, a pilot study was conducted to pretest the instrument to identify any questionnaire flaws (see Hassan et al., 2006). In the pilot study, the time frame required to complete the 24-item questionnaire was identified. The pilot study was implemented before administering the questionnaire for the main study. The pilot study consisted of 10 participants with similar characteristics of the main study's target population, selected through convenience sampling. The research procedures followed the same format as the main study.

Data Collection Analysis Plan

SPSS Version 25 was used to analyze the research data. There were four areas used to collect and analyze the research data: demographic information, obesity measures, metabolic risk factors, and behavioral risk factors. Demographic data were measured using a categorical scale; this included age, gender, race, marital status, education background, and income bracket. Gender was categorized as a dichotomous variable (male =1, female =0). Gender was used as a covariate to explore how the strength and direction vary in the relationship between the metabolic risk factors and abnormal obesity measures according to gender-specifics.

The independent variable was obesity measures: W.C., WHR, and BMI. A continuous scale of measurements was used for weight, height, waist, and hip measurements. To manually calculate BMI, the formula of weight in kilograms divided by height in centimeter squared defined BMI measurements (Nichols & Crichlow, 2010). I categorized BMI as underweight (BMI: less than 18.5), average weight (BMI: 18.5 to 24), overweight (BMI: 25 to 29.9), and obese (BMI: ≥30).

The value for WHR was calculated from the formula: waist measurement (cm) divided by hip measurement (cm). WHR measurements were assessed according to the criteria of ≥ 0.90 (male) and ≥ 0.85 (female). The criteria for W.C. measurement ≥ 94cm for males and ≥ 80cm for females. Both WC and WHR were measured on a continuous scale. For this study, all obesity measures: BMI, WHR, and W.C., were converted to dichotomous variables. Responses were classified as BMI ≥ 30 (0=No, 1=Yes), WHR ≥ 0.90cm for male and ≥ 0.85cm for female (0=No, 1=Yes), WC: ≥ 94cm for male and ≥ 80cm for females (0=No, 1=Yes).

The dependent variables were metabolic risk factors of high blood pressure (≥130/85mmHg) and high blood sugar (≥ 100mg/dl). Notably, the dependent variables were measured both on a continuous scale and categorical; the latter used two measurement levels (0=No, 1=Yes).

Descriptive statistics were performed on the data collected from the sampling population to obtain tendency and spread measures. Mean and standard Deviation was used to provide numerical data for continuous variables, while frequencies were used to express categorical and dichotomous variables. Cross tabulation and Pearson chi-squared analysis were performed on obesity measures (BMI, W.C., and WHR) and metabolic risk factors (elevated FBS and B.P.) using categorical variables. Crosstabulation analysis was used to assess and summarize the frequencies of the outcomes and used the Pearson chi-square test to analyze the strength and the direction of the relationship between the metabolic risk factors and abnormal obesity measures. The strength of the relationship was examined using Cramer's V of association. Cramer's V measure of association ranges from 0 to 1, showing damaging to positive strength (Gauer et al., 2016). A Cramer's V value of 0.1 to 0.2 is considered a weak association, while 0.2 to 0.3 is moderate, and a value above 0.3 is a strong relationship (Gauer et al., 2016).

A binary logistic regression analysis was conducted to examine the occurrence of metabolic risk factors (B.P. range ≥ 130/85mm Hg and FBS ≥ 100mg/dl), as predicted by obesity measures (WHR, W.C. and BMI ≥ 30 kg/m²). Stoltzfus (2011) found that regression analysis helps examine a relationship between outcome variables and several independent variables. One of this test's assumptions is that independent variables are usually measured using nominal, ordinal, interval/ ratio. Petersen and Deddens (2008) found that the logistic regression model is suitable to identify the ratio of odds within prevalence studies. The assumption of using the binary logistic regression method was not violated by having a definite outcome. To implement binary logistic regression analysis, the dependent variable, metabolic risk factors: B.P. range ≥ 130/85 mm Hg and FBS ≥ 100mg/dl have two values (FBS: 0=No, 1=Yes) or (B.P.: 0=not selected, 1=selected). Obesity measures, W.C. and WHR, used scale measurements, while BMI was the categorical scale of measurement. Using binary logistic regression, a model was created that best fit the data and differentiated the occurrences of metabolic risk factors among the sampling population. Finally, a significance value of 0.05 was used for each statistical test.

Research Questions and Hypotheses

RQ1: What is the prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst a representative sample of the Tobago adult population?

H_o1: There is no prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst Tobago adult population.

H_a1: There is a prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst Tobago adult population.

RQ2: How does the prevalence of metabolic risk factors for abnormal obesity measures differ, by gender within Tobago adult population?

H_o2: There is no difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within Tobago adult population.

H_a2: There is a difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within Tobago adult population.

RQ3: What are the relationships, if any, in obesity abnormal measures and metabolic risk factors for the males and females within the ages of 18 to 60 years in Tobago?

H_o3: There is no relationship between abnormal obesity measures and metabolic risk factors for males and females within the ages of 18 to 60 years in Tobago.

H_a3: There is a relationship between abnormal obesity measures and metabolic risk factors for males and females within the ages of 18 to 60 years.

RQ4: In what way do abnormal obesity measures including body mass index, waist circumference, and waist- to- hip ratio predict metabolic risk factors among a representative sample of the Tobago adult population?

H_o4: Abnormal obesity measures including body mass index, waist circumference, and waist- to- hip ratio do not predict metabolic risk factors among a representative sample of the Tobago adult population.

H_a4: Abnormal obesity measures including body mass index, waist circumference, and waist- to- hip ratio do predict metabolic risk factors among a representative sample of the Tobago adult population.

Ethical Consideration and Negotiation Access

Before data collection, I adhered to the governance outlined by the local government agencies (Appendices C, D, & E), the Walden University School of Health Sciences, and also the Institutional Review Board of Walden University (Approval Number12-16-19-0628453). Given sensitive and personal information about human participants examined in the study, ethical consideration is essential to protect participants and the researcher (Broom, 2006; Yip et al., 2016). Ethical issues will improve the quality of the data retrieved (Broom, 2006). For the current study, the issues of privacy, confidentiality, and informed consent were addressed. The participants were provided with a synopsis of the study before the data collection procedure, which allowed them to decide whether to contribute to the study. Each volunteer was given the study's consent form before participating in the survey.

Personal and sensitive data was also captured. Confidentiality and anonymity were critical elements throughout the study (Creswell, 2007). To adhere to ethical guidelines, numbers were assigned to the questionnaires instead of names to protect each participant's privacy and anonymity and did not disclose the name of the institution where the study took place. Finally, the questionnaires were stored in a locked file for a period of 5-years.

Summary and Transition

Chapter 3 was an explanation of the plan of a quantitative cross-sectional research design and methodology. It included an overview of the target population, the sample, and the procedures intended to study a success that included ethical issues, data collection instruments, and the method to analyze data. Chapter 4 consists of a detailed account of the study data collection procedure, including the final timeframe for data collection that was implemented, demographic information of the representative sample, whether any barriers to the proposed data collection plan existed, and the statistical findings for results of the data collection supported by visual statistics.

Chapter 4: Results

A cross-sectional and quantitative investigation was carried out to assess evidence of metabolic risk factors and determine whether there is a correlation between abnormal obesity measures and metabolic risk factors among Tobagonian adults age 18 to 60. This chapter focuses on the results guided by four research questions and associated hypotheses:

RQ1: What is the prevalence of previously documented metabolic risk factors for abnormal obesity measures among a representative sample of the Tobagonian adult population?

H_o1: There is no prevalence of previously documented metabolic risk factors for abnormal obesity measures among the Tobagonian adult population.

H_a1: There is a prevalence of previously documented metabolic risk factors for abnormal obesity measures among the Tobagonian adult population.

RQ2: How does the prevalence of metabolic risk factors for abnormal obesity measures differ by gender within the Tobagonian adult population?

H_o2: There is no difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within the Tobagonian adult population.

H_a2: There is a difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within the Tobagonian adult population.

RQ3: What are the relationships, if any, in obesity abnormal measures and metabolic risk factors for men and women within the ages of 18 to 60 in Tobago?

H_o3: There is no relationship between abnormal obesity measures and metabolic risk factors for men and women within the ages of 18 to 60 in Tobago.

H_a3: There is a relationship between abnormal obesity measures and metabolic risk factors for men and women within the ages of 18 to 60 years in Tobago.

RQ4: In what way do abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio predict metabolic risk factors among a representative sample of the Tobagonian adult population?

H_o4: Abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio do not predict metabolic risk factors among a representative sample of the Tobagonian adult population.

H_a4: Abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio predict metabolic risk factors among a representative sample of the Tobagonian adult population.

Pilot Study

A pilot study was conducted soon after gaining ethical committee approval from Walden Institutional Review Board (Approval Number 12-16-19-0628453) and the various government organizations (see Appendices C, D, and E) responsible for the collection sites. The research protocol outlined for the main study was followed, in which participants were recruited during the workplace wellness program carried out by health professionals. A pilot study was used as a validation process to detect any flaws in the 24-item questionnaire (see Appendix A) to assess recruitment strategies, including the timeline required to complete the survey. Pilot studies are helpful to assess the strength of critical variables' relationships (Cope, 2015).

For the pilot study, I recruited the first 10 participants who suited the main study criteria, including six women and four men. The research instrument was a self-reported questionnaire adapted from the 2013 BRFSS (CDC, 2013). The BRFSS questionnaires are often used to capture self-reporting data regarding risk behavior and the health status of individuals 18 years and over (CDC, 2013). To establish the instrument's face validity, I administered the self-reported questionnaire to participants within the pilot study to determine whether the questions were clear to them. The questionnaire did not require any significant modification except to correct minor typos. The questionnaire took an average of 8 minutes to complete. Data obtained from the pilot study were not subjected to further statistical analysis.

Data Collection

The data collection process as described in Chapter 3 was delayed due to the outbreak of the COVID-19 pandemic. The data collection took place within 3 months, from March to June 2020. To conduct the study, I gained approval from the IRB at Walden University and from the ethics committee responsible for the data collection sites (see Appendices C, D, and E). The study was advertised by distributing flyers (see Appendix B) to 26 government worksites within 1 to 2 weeks before the health-screening initiative. The inclusion criteria were followed for the selected sites with a workforce population greater than 100 employees.

Within the first 3 weeks of March 2020, trained nurses and registered dietitians conducted screening at nine workplaces according to the government divisions' planned schedule. During the screening exercise, I informed potential participants who expressed a desire to participate in the study of the requirements and procedures required to complete the survey. Participants were informed of the inclusion and exclusion criteria for the study.

The inclusion criteria were native Tobagonians between the ages of 18 to 60 years. All participants were employed within the government divisions at the time of recruitment and data collection. Included were both male and female participants diagnosed with high blood pressure and abnormal blood glucose during this workplace health-screening exercise. People previously diagnosed with diabetes and hypertension before the health-screening exercise and those taking medications for these health conditions were excluded. Pregnant and lactating mothers and nonnatives of Tobago were excluded from the study.

During the initial recruitment phase, the data collection process was straightforward, as outlined in Chapter 3. The potential participants who expressed an interest in participating in the study were given the consent form, followed by the self-reported questionnaire soon after the health-screening exercise. Participants needed to complete the self-reported questionnaire soon after implementing the health-screening exercise conducted by health care professionals because it provided a short time frame to answer the questions, which reduced the recall bias (see Althubaiti, 2016). Trained and qualified health professionals recorded health data and gave each participant a health report card at the end of the screening, allowing participants to easily self-report information about their metabolic risk factors and obesity measures. This procedure helped to reduce the recall bias when using a self-reporting instrument (see Althubaiti, 2016).

After several weeks of screening, most workplaces applied protocols to reduce the risk and transmission of COVID-19. Also, the health institution halted its workplace wellness programs for 2020. Initially, social distancing practices within the workplaces restricted social gatherings to a minimum of five people. Contact information was collected for the potential participants who were unable to congregate after screening to adhere to the protocols. The potential participants who expressed an interest in participating in the study were contacted by telephone soon after their screening and informed of the study's details. The participants were allowed to ask questions about the study. Participants were told to place the completed questionnaires in the drop box assigned for this purpose in a secured area of the workplace.

I placed the research flyer (Appendix B), study questionnaires, consent forms, and pencils near the secured research drop box at the different sites. The secure areas were provided and controlled by the management of each institution. Each workplace was given adequate research resources according to the number of people who indicated an interest in contributing to the study. Due to strict social gathering rules in the workplace, the recruitment procedure took a more extended period because participants worked on a rotation schedule. The drop boxes were collected within 1 to 5 days after the screening exercise. The management of these government agencies arranged the date and time for collection. The entire data collection process took 3 months to complete and included 270 participants who satisfied the selection criteria.

Statistical Analysis

After raw data were obtained, they were cleaned and analyzed. SPSS Version 25 software was used to conduct descriptive and inferential statistics. Descriptive statistics were used to describe, summarize, and present data in a meaningful way.

Demographic data was measured using a categorical scale; demographic variables included age, gender, race, marital status, education, and income bracket. Gender was categorized as a dichotomous variable (male = 1, female = 0). Gender was used as a covariate variable to explore the strength and direction of the relationship between metabolic risk factors and abnormal obesity according to gender specifics.

The independent variables were elevated anthropometric measures, referred to as obesity measures: WC, WHR, and BMI. A continuous scale was used consisting of weight, height, waist, and hip measurements using metric values. BMI was manually calculated using the formula of weight in kilograms divided by height in centimeters squared (see S. Nichols & Crichlow, 2010). BMI was categorized into four categories: underweight (BMI of less than 18.5 kg/m^2), normal weight (BMI of 18.5 to 24.9 kg/m^2), overweight (BMI of 25 to 29.9 kg/m^2), and obese (BMI $\geq$ 30 kg/m^2; see S. Nichols & Crichlow, 2010). WHR was calculated using the waist measurement formula in centimeters divided by hip measurement in centimeters. The WHR values were assessed according to the criteria of $\geq$ 0.90cm (male) and $\geq$ 0.85cm (female; see Alberti et al., 2005). I used IDF and NCEP-ATP III criteria for WC, which defined central obesity as $\geq$

94cm for males and ≥ 80cm for females (see Ezenwaka et al., 2007). Both WC and WHR were measured using a continuous scale. However, for this study, all obesity/anthropometric BMI measures were converted to dichotomous variables. Responses were classified as BMI ≥ 30mg/ m^2 (0 = No, 1 = Yes), WHR of ≥ 0.90cm (male) and ≥ 0.85cm (female; 0 = No, 1 = Yes), and WC of ≥ 94cm for male and ≥ 80cm for females (0 = No, 1 = Yes). The dependent variables of metabolic risk factors were converted to dichotomous variables: blood pressure range ≥ 130/85mm Hg (0 = not selected, 1 = selected) and FBS levels ≥ 100mg/dl (0 = No, 1 = Yes).

Demographic Characteristics of Sample

For the study, a total of 270 participants met the inclusion criteria. The sampling population's demographic characteristics are displayed in Table 1, including gender, age categories, race, marital status, highest level of school completed, and income from all sources. The sample included both men and women, 27.0% (73) and 73.0% (197), respectively. The participants' age ranged from 18 to 60 years and had a mean age of 39.91 with a standard deviation of 10.100 years. Many participants were within the age group of 35 to 44 years. The smallest category of participants (5.6%) were within 18 to 24 years.

Regarding race, participants identified as being Black, mixed-race, Indian, and White. However, most participants identified as Black (87.4%). All participants provided information on their marital status. Many participants (47%) never got married. A total of 57.5% of men never got married in comparison to 43.1% of women. However, more women (49.2%) than men (37%) self-reported as being married.

Table 1 also includes statistics regarding the highest level of school completed by 268 respondents. One third of participants (33%) obtained a postgraduate degree education, while a small fraction of (6.7%) completed only elementary/primary school as the highest level of education. More women (41.5%) than men (11%) obtained the highest level of education. The relationship between gender and the highest education level was statistically significant, $\chi 2$ =50.17, *p* value = 0.00. The strength of the relationship was moderate, Cramer's V value = 0.43.

A large portion of the sample population (38.1%) self-reported as having a monthly income greater than 10,000.00TT dollars while a small portion (3.3%) earned between 1000.00 and 2,999.00TT dollars. There were 50% of women in the highest income category compared to 20% of men. The relationship between highest income from all sources was statistically significant, $\chi 2$ = 31.06, *p* value = 0.00. The relationship's strength was moderate, Cramer's V value = 0.36 (Table 1).

Table 1

Samples Demographic Characteristics

Baseline characteristics	Male samples %(*N*)	Female samples %(*N*)	Total sample % (*N*)	χ2, *p* value
Gender	27% (*n*=73)	73% (*n*-197)	100% (*n*=270)	
Ages:			*N* = 268	0.921, 0.922
18 to 24 years	4.1% (*n*=3)	6.2% (*n* =12)	5.6% (n=15	
25 to 34 years	28.8% (*n*=21)	26.2% (*n* =51)	26.9% (*n*=72)	
35 to 44 years	37.0% (*n*=27)	33.8% (*n* =66)	34.7% (*n* =93)	
45 to 54 years	19.2% (*n*= 14)	22.1% (*n* = 43)	21.3% (*n* = 57)	
> 55years	11.0% (*n* =8)	11.8% (*n* =23)	11.6% (*n*=31)	
Race:			N=270	3.34, 0.343
White	0% (*n* =0)	0.5% (*n* =1)	0.4% (*n* =1)	
Black	93.2% (*n* =68)	85.3% (*n* =168)	87.4% (*n* =236)	
Indian	1.4% (*n* =1)	1.5% (*n* =3)	1.5% (*n* =4)	
Mixed-race	5.5% (*n* =4)	12.7% (*n* =25)	10.7% (*n* =29)	
Marital Status			*N* = 270	4.44, 0.35
Never Married	57.5%, (*n*=42)	43.1%, (*n* =85)	47.0%, (*n* =127)	
Married	37.0%, (*n*=27)	49.2%, (*n* =97)	45.9%, (*n* =124)	
Divorced	2.7%, (*n* =2)	3.6%, (*n* =7)	3.3%, (*n* =9)	
Widowed	1.4%, (*n* =1)	2.0%, (*n* -4)	1.9%, (*n* -5)	
Separated	1.4%, (*n* =1)	2.0%, (*n* =4)	1.9%, *n* =5)	
Highest Level of School Completed:			*N* = 268	50.17, 0.00*
Elementary/Primary	15.1% (*n* =11)	3.6% (*n* =7)	6.7% (*n* =18)	
Secondary	49.3% (*n* =36)	21.5% (*n* =42)	29.1% (*n* =78)	
Technical Vocational	17.8% (*n* =13)	9.7% (*n* =19)	11.9% (*n* =32)	
College /University	6.8% (*n* =5)	23.6% (*n* =46)	19.0% (*n* =51)	
Post Grad. Degree	11.0% (*n* =8)	41.5% (*n* =81)	33.2% (*n* =89)	
Income from All sources:			*N* = 246	31.06, 0.00*
< $1000	1.5% (*n* =1)	1.7% (*n* =3)	1.6% (*n* =4)	
$1000 to $2999	8.8% (*n* =6)	1.7% (*n* =3)	3.7% (*n* =9)	
$3000 to $4999	23.5% (*n* =16)	10.7% (*n* =19)	14.2% (*n* =35)	
$5000 to $6999	35.3% (*n* =24)	18.0% (*n* =32)	22.8% (*n* =56)	
$7000 to $9999	10.3% (*n* =7)	18.0% (*n* =32)	15.9% (*n* =39)	
> $10,000	20.6% (*n* =14)	50.0% (*n* = 89)	41.9% (*n* = 103)	

Note. p value ≤ 0.05*

Obesity Measures of Sample

Obesity measures refer to three anthropometric measurements that are used to quantify or identify obesity. The measures included WHR, WC, and BMI. Table 2 presents descriptive statistics of self-reported obesity measures for the total sample. Data showing participants weight without shoes measured in kilograms (*M* = 87.08, *SD* = 18.29), height without shoes measured in meters (*M* = 1.69, *SD* = .095), waist measurement in centimeters (*M* = 94.35, *SD* = 12.93), hip measurements in centimeters (*M* = 111.65, *SD* = 12.58), WHR (*M* = .844, *SD* = .069), and BMI (*M* = 30.69, *SD* = 6.56).

Table 2 displays the descriptive statistics of self-reported obesity measures for the entire sample population and confounding for gender. These statistics included the weight without shoes measured in kilograms, men (*M* = 90.60, *SD* = 20.41), women (*M* = 85.78, *SD* = 17.31); BMI men (*M* = 28.51, *SD* = 5.70), women (*M* = 31.50, *SD* = 6.68). The cutoff points used for WC values were 94 cm and 80 cm, and WHR values of 0.90 and 0.85 for men and women, respectively (see Alberti et al., 2006). The WC values were measured in centimeters, men (*M* = 93.38, *SD* = 14.49) and women (*M* = 94.79, *SD* = 12.36), while WHR in centimeters for men was (*M* = .87, *SD* = .058) and women (*M* = .836, *SD* = .071).

Table 2

Descriptive Statistic for the Average Obesity Measures and Metabolic Risk Factors (Mean ±SD)

Variables	Means (*M*)	Standard deviation (±*SD*)
Weight without shoes (kg) for the total participants	87.08	18.29
Male	90.60	20.41
Female	85.75	17.31
Height without shoes(m) for the total participants	1.69	0.10
Male	1.78	0.08
Female	1.65	0.75
Waist Measurements (cm) for the total participants	94.35	12.93
Male	93.38	14.49
Female	94.79	12.36
Hip measurements (cm) for the total participants	111.65	12.58
Male	106.8	12.05
Female	113.44	12.32
Waist/Hip Ratio for the total participants	0.844	0.07
Male	0.87	0.58
Female	0.836	0.07
Body Mass Index kg/m² for the total participants	30.69	6.56
Male	28.51	5.70
Female	31.50	6.60

Table 3 displays the statistics of the frequency for participants' obesity measures. In this present study, abnormal obesity measures (AOM) were referred to as elevate anthropometric measures: WHR, W.C., and BMI values. Abnormal waist circumference was used to define elevated waist circumference values according to the IDF recommendation cut-off values, 94cm for males and 80cm for females (Osei-Yeboah et al., 2017). Abnormal WHR were elevated WHR based on WHO MetS criteria: WHR >0.90cm in male and > 0.85cm in the female (Huang, 2009). This study's abnormal BMI refers to BMI values of ≥30 kg/m² (Ramsaran & Maharaj, 2017).

A large proportion of the sampling population (82.2%, *n*=222) had abnormal WC, while 52.6% (*n*=142), BMI was greater than 30kg/m² and 38.2% (*n*=104) had abnormal WHR. When comparing the frequency distribution of obesity measures according to gender, it was obvious that females were more likely to have abnormal obesity measures of WHR, W.C., and BMI ≥ 30kg/m² than the male participants. The frequency distributions of abnormal obesity measures for the male samples were BMI: 38.4% (*n*=28), WC: 57.5% (*n*=42), and WHR: 31.5% (n=23). However, the frequency distribution for abnormal obesity measurements for the female samples was BMI: 57.9% (*n*=114), WC: 91.4% (*n*=180), and WHR: 41.1% (*n*=81). A large proportion of the sampling population (82.2%) had abnormal W.C., while 52.6% BMI was greater than 30kg/m² and 38.2% had abnormal WHR. Pearson chi-square found a positive relationship for BMI >30kg/m² and gender and W.C. and gender. However, although the relationship between variables was positive, the relationship between BMI >30kg/m² and gender was weak (Cramer's V =0.00). On the other hand, there was a strong relationship between W.C. and gender (Cramer's V =0.40, Table 3).

Table 3

Prevalence of Abnormal Obesity Measures (AOM) in Relation to Gender

Variables	Male participants	Female participants	Total population	χ2, *p* value
Body Mass Index ≥30kg/m² (Yes)	28 (38.4%)	114 (57.9%)	142 (52.6%)	8.13, 0.0*
Abnormal WC (cm) Male ≥ 94cm and Female ≥ 80cm	42 (57.5%)	180 (91.4%)	222 (82.2%)	41.72, 0.00*
Abnormal WHR (cm) Male ≥ 90cm and Female ≥ 85cm	23 (31.5%)	81 (41.1%)	104 (38.5%)	2.08, 0.15

Note. *p*-value ≤ 0.05*

Metabolic Risk Factors of Sample

Table 4 presents the frequency distribution of metabolic risk factors of systolic blood pressure ≥ 135mm Hg, diastolic blood pressure ≥ 85mm Hg, and fasting blood sugar level ≥ 100mg/dl. The cut-off points were based on the IDF. From the sampling population, 63.3% (*n*=170) had their systolic B.P. values ≥ 135mm Hg, while 59.6% (*n*=161) diastolic were ≥ 85mm Hg. Also, 47.9% (*n*=161) of the total sampling population self-reported having both elevated systolic and diastolic, according to the cut-off point set by the International Diabetes Federation definition for MetS. The prevalence of elevated B.P. was higher among males (64.4%) than females (41.6%).

For this study, 61.9% of the population self-reported having FBS level ≥ 100 mg/dl. A large proportion of female participants than male participants have FBS level ≥ 100mg/dl, 65% versus 53.4% respectively (Table 4).

Table 5 displays the descriptive statistics for metabolic risk factors. These statistics included the fasting blood sugar for the total sampling population (*M*=13.37, *SD*=45.56), for male samples (*M*=114.05, *SD*=48.75) and for female samples (*M*=111.55, *SD* =35.82). Table 5 includes descriptive statistics of systolic blood pressure for the total sampling population (*M* = 135.10, *SD* = 18.85), for male samples (*M*=142.89, SD = 19.80) and for female samples (*M*=132.22, *SD* = 17.68). Similarly, Table 5 contains the descriptive statistics of diastolic blood pressure for the total sampling population (*M* = 83.63, *SD* = 12.67), for male samples (*M*=81.43, *SD* = 11.97) and for female samples (89.55, *SD* = 12.67).

Table 4

Prevalence of Elevated Metabolic Risk Factors in Relation to Gender

Variables	Male participants	Female participants	Total population	$\chi2$, *p* value
Elevated Systolic BP	55 (75.3%)	116 (58.9%)	171 (63.3%)	6.21, 0.01*[2]
Elevated Diastolic BP	57 (78.1%)	104 (52.8%)	161 (59.6%)	14.15, 0.00*[1]
Blood Pressure (BP) ≥130/80mm Hg	47 (64.4%)	82 (41.6%)	129 (47.8%)	11.06, 0.00*[3]
Fasting Blood Sugar ≥100mg/dl	39 (53.4%)	128 (65%)	167 (61.9%)	3.01, 0.08

Note. *p*-value ≤ 0.05*

Table 5

Average Metabolic Risk Factors (Mean ±SD)

Variables	Means (*M*)	Standard deviation (±*SD*)
Fasting Blood Sugar ≥100mg/dl		
Total Population	113.37	45.56
Male	114.05	48.75
Female	111.55	35.82
Systolic Blood Pressure ≥ 130 mm Hg		
Total Population	135.10	18.85
Male	142.89	19.80
Female	132.22	17.68
Diastolic Blood Pressure ≥ 85mm Hg		
Total Population	83.63	12.67
Male	81.43	11.97
Female	89.55	12.67

Behavior Risk Factors of Sample

Table 6 displays a summary of self-reported behavior risk factors for the sampling population, including salt intake, cigarette use, and physical activity levels. Other behavior risk factors were alcohol intake, fruit and vegetable intake, sugar-sweetened juice consumption, and the consumption of 100% fruits juice, were all measured using a 5-point Likert scale (never, 1-7 days, 8 to 14 days, 15 to 21 days and greater than 21 days).

The frequency statistics showed that most participants (n=160, 59.3%) were watching their salt intake compared with those who were not watching their salt intake (*n*= 106, 39.8%). A greater proportion of participants consumed fruits and vegetables more than 21 days in the month, 32.2% (*n*=87) and 27% (*n*=73). Likewise, more participants (27%, *n*=73) consumed sugar-sweetened drinks such as sports and energy drinks more than 21 days in the month. Eighty-two participants (30.4%) never consumed 100% fruit juices in the past month, and only 11. 9% (*n*=32) consumed 100% fruit juice more than 21 days (see Table 6).

The frequency statistics showed that 48.9% (*n*=132) of participants never consumed alcohol within the past month. In comparison, 33% (*n*=89) consumed alcohol at least 1 to 7 days within the month, 8.1% (*n*=22) consume alcohol more than 21 days in the month, and 1.1% (*n*=3) and 3% (*n*= 8) consumed alcohol at least a total of 15 to 21 days and 8 to 14 days respectively. The majority (90.7%, *n*=245) of participants did not smoke at all, 4.4% (*n*=12) smoked cigarettes some days, while a small proportion of 3% (*n*=8) smoked cigarettes every day.

Regarding physical activity (P.A.), only 99.3% (*n*=268) of the sampling population self-reported their physical activity habits. 69.6% (*n*=188) were involved in physical activity, while 29.6% (*n*=80) did not participate in physical activity.

Table 6

Frequency Table of Behavioral Risk Factors

Variables	Categories	Frequency of sample	Percentages %
How many times do you consume fruits within the month?		270 Respondents	
	Never	11	4.1%
	1 to 7 days	36	13.3%
	8 to 14 days	46	17.0%
	15 to 21 days	63	23.3%
	Greater than 21 days	87	32.2%
	Refused/Don't know/ Not sure	27	10.0%
How often do you drink sugar-sweetened drinks in 30 days?		270 Respondents	
	Never	69	25.6%
	1 to 7 days	66	24.4%
	8 to 14 days	29	10.7%
	15 to 21 days	14	5.2%
	Greater than 21 days	73	27.0%
	Refused/Don't know/ Not sure	19	7.2%
How often do you drink 100% fruit juices within the month?		270 Respondents	
	Never	82	30.4%
	1 to 7 days	73	27.4%
	8 to 14 days	31	11.5%
	15 to 21 days	14	5.2%
	Greater than 21 days	32	11.9%
	Refused/Don't know/ Not sure	38	14.1%
How often do you consume vegetables within the month?		270 Respondents	
	Never	6	2.2%
	1 to 7 days	59	21.9%
	8 to 14 days	61	22.6%
	15 to 21 days	52	19.3%
	Greater than 21 days	73	27.0%
	Refused/Don't know/ Not sure	19	7.0%
Are you watching your salt intake?	Yes	270 respondents	
	No	160	59.3%
	Refused/don't know/not sure	106	39.3%
		4	1.5%
Drink alcoholic beverages within 30 days?		270 Respondents	
	Never	132	48.9%
	1 to 7 days	89	33%
	8 to 14 days	8	3.0%
	15 to 21 days	3	1.1%
	Greater than 21 days	22	8.1%
	Refused/Don't know/ Not sure	16	5.9%
Do you smoke cigarettes every day?		270 Respondents	
	Every day	8	3.0%
	Some days	12	4.4%
	Not at all	245	90.7%
	Refused/Don't know/ Not sure	5	1.9%
Did you participate in any physical activities?	Yes	270 Respondents	
	No	181	67.0%
	Refused/Don't know/Not sure	89	33.0%
		0	0%

Research Questions and Hypotheses

Inferential statistics were used to present results for the research questions. There were three inferential statistics used within the study crosstabulation, chi-squared, and binary logistic regression. Four research questions and their associated hypotheses were developed to acquire data examining the prevalence of metabolic risk factors with abnormal obesity measures among Tobagonians, ages 18 to 60. They are as follows:

RQ1: What is the prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst a representative sample of the Tobago adult population?

H_o1: There is no prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst Tobago adult population.

H_a1: There is a prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst Tobago adult population.

RQ2: How does the prevalence of metabolic risk factors for abnormal obesity measures differ, by gender within Tobago adult population?

H_o2: There is no difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within Tobago adult population.

H_a2: There is a difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within Tobago adult population.

RQ3: What are the relationships, if any, in obesity abnormal measures and metabolic risk factors for the males and females within the ages of 18 to 60 years in Tobago?

H$_o$3: There is no relationship between abnormal obesity measures and metabolic risk factors for males and females within the ages of 18 to 60 years in Tobago.

H$_a$3: There is a relationship between abnormal obesity measures and metabolic risk factors for males and females within the ages of 18 to 60 years.

RQ4: In what way do abnormal obesity measures including body mass index, waist circumference, and waist- to- hip ratio predict metabolic risk factors among a representative sample of the Tobago adult population?

H$_o$4: Abnormal obesity measures including body mass index, waist circumference, and waist- to- hip ratio do not predict metabolic risk factors among a representative sample of the Tobago adult population.

H$_a$4: Abnormal obesity measures including body mass index, waist circumference, and waist- to- hip ratio do predict metabolic risk factors among a representative sample of the Tobago adult population.

To answer Questions 1, 2, and 3, categorical variables were used to carry out cross-tabulation and Pearson chi-square test ($\chi2$). Variables were measured using dichotomous scale. Participants' responses were classified as gender (female = 0, male =1), BMI $\geq$30mg/ m^2 (0 = No, 1 = Yes), WHR of $\geq$ 0.90cm (male) and $\geq$ 0.85cm (female (0 = No, 1 = Yes) and WC of $\geq$ 94cm for male and $\geq$ 80cm for females (0 = No, 1 = Yes). The dependent variables, metabolic risk factors were measured using dichotomous scale, (blood pressure range $\geq$ 130/85mm Hg (0 = not selected, 1= selected), and FBS levels $\geq$ 100mg/dl 0= No, 1=Yes).

The results of the test were interpreted using a p-value ≤ 0.05. Cross-tabulation is one of the simplest ways to analyze the relationships between variables (Wagner, 2017). The results for RQ1 and RQ2 were presented as frequencies/counts.

RQ1

I explored the prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst a representative sample of the Tobago adult population. First, I carried out cross-tabulation analysis on independent the variable abnormal obesity measures/ABOMEASU which are valued as 0 = No and 1=Yes was carried out. The dependent variables are metabolic risk factors FBS levels ≥ 100mg/dl and blood pressure range ≥ 130/85 mm Hg, defined by IDF criteria for MetS. Binary values are used for FBS ≥ 100mg/dl / BSHIGH_2) (0=No and 1=Yes), and blood pressure range ≥130/85/HYPERTEN2 (0= not selected and 1= selected).

Fasting Blood Sugar

There were 61.9% (n=167) participants with FBS levels ≥ 100mg/dl. However, 64.4% (n=94) of those participants had both abnormal obesity measures with FBS levels ≥ 100mg/dl. Chi-square test for association was conducted between FBS levels ≥ 100mg/dl and the abnormal obesity measures. There was no statistically significant difference between abnormal obesity measures with FBS levels ≥ 100mg/dl ($\chi 2$ (1, N = 270) = 0.86, p = 0.35).

I explored each abnormal obesity measure such as BMI, WC, and WHR to establish whether there was a relationship with FBS levels ≥100mg/dl. A total of 64.1% had elevated BMI greater than 30kg/m ^{2} with FBS levels ≥ 100mg/d (see Table 7). This result was not statistically significance ($\chi2$ [1, N = 270] = 0.63, p = 0.43). Cross tabulation analysis showed a proportion, 63.5% of the sampling population with FBS levels ≥100mg/dl, also had an abnormal WC. This result was not statistically significance ($\chi2$ [1, N = 270] = 1.46, p = 0.23). Cross tabulation and chi-square analysis were performed on WHR, 70.2% of the population with elevated FBS levels ≥100mg/dl had abnormal WHR. In comparison to the other two obesity measures, there was statistically significance with having elevated FBS levels ≥100mg/dl along with an abnormal WHR ($\chi2$ [1, N= 270] = 4.99, p=0.03. Cramer's V test showed the strength of the relationship was weak for having an abnormal WHR with fasting blood glucose level ≥ 100mg/dl (Cramer's V = 0.14, Table 8). However, according to Gauer et al. (2016), a Cramer's V value of 0.1 to 0.2 indicated a weak relationship.

Table 7

Prevalence of Fasting Blood Sugar ≥100mg/dl and Abnormal Obesity Measures Based on Gender

Variables	Male participants	Female participants	Total participants
Fasting Blood Sugar ≥100mg/dl and abnormal obesity measures	17 (58.6%)	77(65.8%)	94(64.4%)
Fasting Blood Sugar ≥100mg/dl and abnormal WHR	16(69.6%)	57(70.4%)	73(70.2%)
Fasting Blood Sugar ≥100mg/dl and abnormal WC	23(54.8%)	118(65.6%)	141(63.5%)
Fasting Blood Sugar ≥100mg/dl and normal BMI ≥30kg/m^2	16(57.1%)	75(65.8%)	91(64.1%)

Table 8

Abnormal Obesity Measures Based on Gender

Variables	Male participants $\chi2$, *p* values	Female participants $\chi2$, *p* values	Total participants $\chi2$, *p* values	Cramer's V
Fasting Blood Sugar ≥100mg/dl and abnormal obesity measures	0.52, 0.47	0.09, 0.77	0.86, 0.35	
Fasting Blood Sugar ≥100mg/dl and abnormal WHR	3.52, 0.06	1.76, 0.19	4.98, 0.03*	0.14*
Fasting Blood Sugar ≥100mg/dl and Fasting Blood Sugar ≥100mg/dl and abnormal WC	0.07, 0.79	0.31, 0.58	1.46, 0.23	
Fasting Blood Sugar ≥100mg/dl and normal BMI ≥30kg/m^2	0.25, 0.62	0.08, 0.78	0.63, 0.43	

Hypertension

In comparison to fasting blood sugar, fewer participants (51.4%) self-reported on having a blood pressure range ≥130/85 mmHg, and also having abnormal obesity measures (Table 9). Chi-square test for association performed on the three independent variables and blood pressure range ≥130/85 mmHg, the results indicated that there was no significant association with having **a** blood pressure range ≥130/85 mm Hg and having abnormal obesity measures ($\chi2$ [1, N = 270] = 1.64, p = 0.20).

Similar to the analytical procedure performed for fasting blood sugar levels, I used Chi-square test for association to establish whether there was a relationship with having a blood pressure range ≥130/85 mm Hg with abnormal obesity measures: BMI, WC, and WHR. A total of 52.1% had elevated BMI greater than 30kg/m ^{2} with blood pressure range ≥130/85 mm Hg (Table 9). This result was not statistically significant ($\chi 2$ (1, N = 270) = 2.26, p = 0.13). A smaller proportion of 47.7% of the sampling population with blood pressure range ≥130/85 mm Hg, also had an abnormal WC. This result was not statistically significant ($\chi 2$ [1, N = 270] = .00, p = 0.98). Cross tabulation and chi-square analysis were conducted on WHR, 48.1% of the population with blood pressure range ≥130/85 mm Hg, also had abnormal WHR. The chi-square test for association was not statistically significant with having blood pressure range ≥130/85 mm Hg with an abnormal WHR ($\chi 2$ [1, N = 270] = 0.01, p = 0.94, Table 10).

Finally, in reference to RQ1, although, there was statistical significance in dependent variables FBS levels ≥100mg/dl with independent variable, abnormal WHR ($\chi 2$ [1, N =270] = 0.4.99, p = 0.03). The relationship was weak (Cramer's V value = 0.14). Taking in consideration that all other p-values for the sampling population were above the significance threshold value of ≥.05. I failed to accept the alternative hypothesis, that there is a prevalence of previously metabolic risk factors for abnormal obesity measures amongst Tobago adult population.

Table 9

Prevalence of Elevated Blood Pressure ≥130/85mm Hg and Abnormal Obesity Measures Based on Gender

Variables	Male participants	Female participants	Total participants
Blood Pressures ≥130/85mmHg and abnormal obesity measures	17 (58.6%)	58 (49.6%)	75 (51.4%)
Blood Pressure ≥130/85mmHg and abnormal WHR	14 (60.9%)	36(44.4%)	50(48.1%)
Blood Pressure ≥130/85mmHg and abnormal WC	31(73.8%)	75(41.7%)	106(47.7%)
Blood Pressure ≥130/85mmHg and normal BMI ≥30kg/m^2	16(57.1%)	58(50.9%)	74(52.1%)

Table 10

Chi-Square Analysis for Elevated Blood Pressure ≥130/85mm Hg and Abnormal Obesity Measures Based on Gender

Variables	Male participants χ2, P-values	Female participants χ2, P-values	Total participants χ2, P-values	Cramer's V
Blood Pressure ≥130/85mmHg and abnormal obesity measures	0.70, 0.40	7.49, 0.01*[1]	1.64, 0.20	0.20*
Blood Pressure ≥130/85mmHg and abnormal WHR	0.18, 0.67	0.45, 0.50	0.01, 0.94	
Blood Pressure ≥130/85mmHg and abnormal WC	3.83, 0.05*	0.00, 0.97	0.00, 0.98	
Blood Pressure ≥130/85mmHg and BMI ≥30kg/m^2	1.03, 0.31	9.53, 0.00*	2.26, 0.13	

RQ2

How prevalent metabolic risk factors for abnormal obesity measures differ by gender within the Tobago adult population. The related null hypothesis (was: There is no difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within the Tobago adult population. Crosstabulation was performed, and chi-square tests on categorical data to determine the prevalence of abnormal obesity measures with FBS levels ≥ 100mg/dl and blood pressure range ≥ 130/85 mm Hg stratified by gender. Abnormal obesity measures (BMI, W.C., and WHR) were examined with each dependent variable. The dependent variable metabolic risk factors were analyzed using binary values FBS/ BSHIGH_2, 0=No, and 1=Yes), and blood pressure range ≥130/85/HYPERTEN2 (0= not selected and 1= selected). The independent variables abnormal obesity measures, WC/WAIST_1 and WHR/ WHR_1 used binary levels 1 = Yes and 0 = No. BMI/BMI_2 was categorized into the follow groups: 1 = Underweight, 2 = Normal weight, 3 = Overweight and 4 = Obese. To account for the gender difference, gender was categorized as 1= male and 0 = female.

Fasting Blood Sugar

The results from cross-tabulation analysis showed that a larger proportion of female participants in comparison to male counterparts self-reported on having abnormal obesity measures with FBS levels ≥ 100mg/dl, 65.8% versus 58.6%. However, for chi-square test for association result were not statistically significant for both male ($\chi2$ [1, N = 270] = 0.52, p = 0.47) and female ($\chi2$ [1, N = 270] = 0.89, p = 0.77) respectively.

Cross tabulation and chi-square analysis carried out for each abnormal obesity measures (BMI, WHR, and WC) when controlling for the confounding factor of gender. Results showed a larger proportion of female self-reported on having three abnormal obesity measures with FBS levels ≥ 100mg/dl (Table 9). A total of 65.5% of females had BMI greater than 30kg/m ^{2} versus 57.1% males. Similarly, 65.5% females, as compared to 54.8% males had elevated WC, and 70.2% females versus 69.6% males had elevated WHR along with FBS levels ≥ 100mg/dl. Each abnormal obesity measures showed no significant relationship with having with FBS levels ≥ 100mg/dl for both males and females (see Table 10).

Hypertension

Unlike the result for FBS, the result from crosstabulation analysis for self-reported blood pressure range showed that a greater proportion of male participants in comparison to their female counterparts self-reported on having abnormal obesity measures with blood pressure range ≥ 130/85 mm Hg, 58.6% versus 49.6%. Cross tabulation analysis carried out for each abnormal obesity measures (BMI, WHR, and WC) according to gender. More males self-reported a BMI ≥ 30kg/m ^{2} along with blood pressure range ≥ 130/85 mm Hg, that is, 57.1% males versus 50.9% female. Similarly, more males 73.8% compared to 41.7% female had elevated WC along with blood pressure range ≥ 130/85 mm Hg. Also, 60.9% of male versus 44.4% females had elevated WHR along with blood pressure range ≥ 130/85 mm Hg. Statistical significance was found for females having blood pressure range ≥ 130/85 mm Hg with BMI range ≥30kg/m^2 (Table 10). A Cramer's V test was performed to evaluate the strength of the relationship. However, the effect was small. These findings suggest that though significant, abnormal obesity measures (WC and BMI) have a small effect on blood pressure range ≥ 130/85 mmHg for females and males, respectively. According to these findings for metabolic risk factors and abnormal obesity measures according to gender, the null hypothesis for RQ 3 can be rejected.

RQ3

What is the relationship, if any, in obesity abnormal measures and metabolic risk factors for males and females within the ages of 18 to 60 years in Tobago? The related null hypothesis was: There is no relationship between abnormal obesity measures and metabolic risk factors for males and females within the ages of 18 to 60 years in Tobago.

Pearson correlation was initially proposed to examine the relationship between abnormal obesity measures and metabolic risk factors for males and females for the data analysis plan. The continuous variables of obesity measures (BMI, WHR, and W.C.) and metabolic risk factors (SBP, DBP, and FBS) were tested for linearity using scatterplots. In contrast, histogram and Q-Q plots were used to assess the normality of the data. The data were positively skewed and violated the assumptions of the Pearson correlation coefficient. To carry out analysis for R.Q. 3, a nonparametric test was used, Pearson chi-square, to examine the relationship of obesity measures and metabolic risk factors stratified by gender, using categorical data. Abnormal obesity measures were analyzed as a single variable, valued as 0= No and 1= Yes. At the same time, each metabolic risk factor (FBS levels ≥100mg/dl and blood pressure range ≥ 130/85 mm Hg) was also valued as 0 = No and 1= Yes. To account for the gender difference, gender was categorized as 1= male and 0 = female. The relationship was considered significant at a *p*-value ≤ of 0.05. The strength of the relationship was examined using Cramer's V of association. Cramer's V measure of association ranges from 0 to 1, showing damaging to positive strength (Gauer et al., 2016). A Cramer's V value of 0.1 to 0.2 is considered a weak association, while 0.2 to 0.3 is moderate, and a value above 0.3 is a strong relationship (Gauer et al., 2016).

Evaluating the relationship between abnormal obesity measures with a blood pressure range ≥ of 130/85 mm Hg by gender shows a prevalence of 58.6% males and 49.6% females have both abnormal obesity measures with a blood pressure range ≥ of 130/85 mm Hg (Table 10). There was a significant association between abnormal obesity measures with a blood pressure range ≥ 130/85 mm Hg for female participants ($\chi 2$ (1, *N* =270) = 7.49, *p*=0.01). However, although the relationship was positive for female, having a Cramer's V value of 0.20 suggest a weak relationship (seeTable 10).

Comparatively, crosstabulation analysis showed females were likely to have abnormal obesity measures with fasting blood sugar **≥** 100mg/dl than the male samples, 65.8% and 58.6%, respectively. Similarly, Pearson chi-square test results did not show any association between male and female participants having abnormal obesity measures and fasting blood sugar ≥ 100mg/dl ($\chi 2$= [1, *N* =270] =0.52, *p* = 0.47 and $\chi 2$ (1, *N*= 270) = 0.89, p =0 .77, respectively. The relationship between having an abnormal obesity measure with fasting blood sugar ≥ 100mg/dl according to gender was not significant (Table 10).

These results indicate a negligible effect on the relationship between metabolic risk factors and abnormal obesity measures stratified by gender. According to these findings, the null hypothesis for R.Q. 3 can be rejected.

RQ4

In what way abnormal obesity measures including BMI, W.C., and WHR predicted metabolic risk factors among a representative sample of the Tobago adult population. The related null hypothesis was: Abnormal obesity measures including body mass index, waist circumference, and waist-to-hip ratio do not predict metabolic risk factors among a representative sample of the Tobago adult population.

A logistic regression model was used to test this hypothesis. Petersen and Deddens (2008) found that the logistic regression model is suitable to identify the ratio of odds within prevalence studies. Binary logistic regression analysis was commuted on individual abnormal obesity measures: WHR, W.C., and BMI to predict the outcome of metabolic risk factors, B.P. range ≥ 130/85mm Hg and FBS ≥ 100mg/dl. The assumption of using the binary logistic regression method was not violated by having a definite outcome. The dependent variable metabolic risk factors were analyzed using binary values FBS/ BSHIGH_2 (0=No and 1=Yes), and blood pressure range ≥130/85/HYPERTEN2 (0= not selected and 1= selected). The independent variables WC/WAIST and WHR/WHRATIO were measured as continuous variables, while BMI/BMI_2 was measured as a categorical variable: 1 = Underweight, 2 = Normal weight, 3 = Overweight, and 4 = Obese. Using binary logistic regression, I created a model that best fit the data and differentiated the occurrences of metabolic risk factors among the sampling population.

Each abnormal obesity measure, BMI, W.C., and WHR, was explored to predict the sampling population having B.P. range ≥ 130/85 mmHg. Hosmer and Lemeshow's test showed that the model adequately fit sample data and the population from which the sample was collected. The *p*-value of the Hosmer and Lemeshow test was 0 .79 (insignificance $p > .05$), indicating the model fits the data well (Abedin et al., 2016). The results found that none of the three independent variables were significant predictors or the odds of participants having a blood pressure range ≥ 130/85mm Hg (Table 11). Each independent variable (WHR, W.C., and BMI ≥30kg/m^2) had alpha values greater than 0.05. Hence, there is insufficient evidence to support BMI, W.C., and WHR have a significant relationship or effects on having a BP≥ 130/85 mmHg.

Table 11

Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors, BP Range ≥ 130/85mm Hg Predicted by Obesity Measures of WHR, WC and BMI ≥ 30 kg/m²

Variables	*B*	SE	Wald	*df*	*P*	*OR*	95% CI Lower	95% CI Upper
BMI ≥30kg/m²	-0.29	0.36	0.65	1	0.42	0.75	0.37	1.51
WC	0.00	0.02	0.00	1	1.00	1.00	0.97	1.04
WHR	2.16	2.42	0.80	1	0.37	8.67	0.08	988.99
Constant	-1.77	1.69	1.10	1	0.29	0.17		

Note. Full model: $\chi 2$ (5, N = 270) = 4.76, p = 0.45. Initial classification overall rate = 52.2%. Final correct classification overall rate = 54.1%.

Binary logistic regression analysis was conducted to investigate whether BMI ≥30kg/m², WC, WHR were factors which predict FBS level ≥ 100mg/dl. The outcome of interest was FBS ≥ 100mg/dl. While the possible predictors were BMI ≥30kg/m², WC, WHR. The Hosmer- Lemeshow goodness of fit was not significant ($p > .05$), indicating that the model is correctly specified. The (-2 log Likelihood = 352.03) and (Nagelkerke R Square = 0.03). The model showed that the independent variables BMI ≥30kg/m² and WC were not significant, $p = 0.37$ and $p = 0.50$, respectively ($p > 0.05$), see Table 12).

However, controlling for BMI ≥30kg/m² and WC, the predictor variable, WHR in the logistic regression analysis was found to contribute positively to the model. The unstandardized B = [5.06], SE = [2.52] Wald = [4.04], p = 0.05. The estimated odds ratio favored a positive relationship for WHR of almost 157 times (Exp [B] = 157.37, 95% CI [1.13 – 21875.75]) for every one unit increase in participants WHR. Based on statistical significance, I will reject the null hypothesis that abnormal obesity measures including BMI, WC, and WHR do not predict metabolic risk factors among a representative sample of the Tobago adult population.

Table 12

Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors, FBS ≥ 100mg/dl, Predicted by Obesity Measures of WHR, WC and BMI ≥ 30 kg/m²

							95% CI	
Variables	*B*	*SE*	Wald	*df*	*P*	*OR*	Lower	Upper
BMI ≥30kg/m²	-0.34	0.37	0.82	1	0.37	0.72	0.35	1.48
Abnormal WC	-0.01	0.02	0.46	1	0.50	0.99	0.95	1.03
Abnormal WHR	5.06	2.52	4.04	1	0.05	157.37	1.13	21875.75
Constant	-2.43	1.75	1.94	1	0.16	0.09		

Note. Full model: $\chi 2$ (5, N = 270) = 6.95, p =0.22. Initial classification overall rate = 61.9%. Final correct classification overall rate = 62.2%.

Post Hoc Analysis on Behavior Risk Factors

In order to provide a theoretical understanding on factors which contribute to metabolic risk factors and abnormal obesity measures, as part of the data collection procedure, participants self-reported on behavior risk factors. To further explore these factors which were not the primary objective of this study, I carried out post hoc analysis to examine whether BMI, WHR, WC, dietary habits, and physical activity predicts metabolic risk among participants. Binary logistic regression analysis was used to carry out the post hoc analysis. The outcome variables of interest were metabolic risk factors, BP range ≥ 130/85mm Hg and FBS ≥ 100mg/dl. The possible predictors were WHR, WC, BMI, how often did you drink sugar-sweetened fruit drinks during the past 30 days/SUGADRINKS; physical activities/PA; and are your watching your salt intake/WTCHSALT. The dependent variable metabolic risk factors were analyzed using binary values FBS/ BSHIGH_2) (0=No and 1=Yes), and blood pressure range ≥130/85/HYPERTEN2 (0= not selected and 1= selected). The independent variables BMI, WC/WAIST, and WHR/WHRATIO were measured as continuous variables for this analysis; how often did you drink sugar-sweetened fruit drinks during the past 30 days/SUGADRINKS were categorical variable: (1 =Never, 2 = 1-7 days, 3 = 8 to 14 days, 4 = 15 to 21 days, 5 = greater than 21 days); physical activities/ PA were measured in two categories: (0 = No and 1 = Yes); and are your watching your salt intake: (0 = No and 1 = Yes).

When using BP range ≥ 130/85mm Hg as the outcome variable, the Hosmer and Lemeshow goodness of fit tests showed that the model adequately fit sample data, and also for the population from which the sample was collected. The *p*-value of Hosmer and Lemeshow test = $\chi2$ (8, N = 270) = 13.59, p = 0.09 (insignificance $p > .05$), indicating the model fits the data well (Abedin et al. 2016). The (-2 log Likelihood = 328.27) and the (Nagelkerke R Square test =0.07). This model was able to predict participants with BP range ≥ 130/85mm Hg compared to those who do not, 74.4% versus 45.6%. An overall of 61.1% of the 270 participants were correctly classified (see Table 13).

Similarly, when using FBS ≥ 100mg/dl as an outcome variable for metabolic risk factor, the Hosmer and Lemeshow goodness of fit tests indicated that the model adequately fit sample data. The *p*-value of Hosmer and Lemeshow test = $\chi2$ (8, N = 270) = 6.51, p = 0.59 (insignificance $p > .05$), again signifying that the model fits the data well. The (-2 log Likelihood = 323.32) and the (Nagelkerke R Square test =0.04). This model was able to predict participants exposed to FBS ≥ 100mg/dl compared to those who do not, 93.4% versus 12.5%. An overall of 61.9% of the sample population (*N*=270) were correctly classified (see Table 14).

Results showed that none of the five independent variables were significant predictors of having each metabolic risk factors: blood pressure range ≥ 130/85mm Hg and FBS ≥ 100mg/dl. Each independent variable had alpha values greater than 0.05. Therefore, there were insufficient evidence to support that variables BMI, WC, WHR, SUGADRINKS, WTCHSALT, and PA have any significant relationship or effects on either BP≥ 130/85mm Hg or FBS ≥ 100mg/dl (see Table 13 & 14). I failed to reject the null hypothesis that abnormal obesity measures including BMI, WC, and WHR do not predict metabolic risk factors among a representative sample of the Tobago adult population.

Table 13

Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors, BP≥ 130/85mm Hg, Predicted by WHR, WC BMI, Physical Activity Pattern, Salt Intake, and Sugar-Sweetened Drink Consumption

							95% (C.I .)	
Variables	*B*	*S.E.*	Wald	df	Sig	Exp (B)	Lower	Upper
BMI	-0.02	.039	0.37	1	0.54	0.98	.90	1.05
WC	0.02	.024	0.54	1	0.46	1.02	.97	1.07
WHR	0.78	2.69	0.08	1	0.77	2.17	0.01	425.43
Physical Activities	-0.53	0.30	3.24	1	0.07	0.59	0.33	1.05
Are your watching your salt intake?	0.00	.279	.000	1	1.00	1.00	0.58	1.73
How often do you drink sugar-sweetened drinks in 30 days			5.847	4				
How often do you drink sugar-sweetened drinks in 30 days (1)	-0.35	0.35	0.98	1	0.32	0.71	0.36	1.41
How often do you drink sugar-sweetened drinks in 30 days (2)	-.722	.360	4.024	1	.05	.486	.240	.984
How often do you drink sugar-sweetened drinks in 30 days (3)	-.838	.467	3.221	1	.073	.433	.173	1.080
How often do you drink sugar-sweetened drinks in 30 days (4)	-.797	.635	1.574	1	.210	.451	.130	1.566
Constant	-.967	1.819	.283	1	.595	.380		

Note: Full Model: χ^2 = (10, N = 270) =12.76, P = 0. 24. The overall classification ranged from 54.2.% to 59.0%.

Table 14

Binary Logistic Regression Analysis for the Occurrence of Metabolic Risk Factors, FBS ≥ 100mg/dl, Predicted by WHR, WC BMI, Physical Activity Pattern, Salt Intake, and Sugar-Sweetened Drink Consumption

							95% (C.I.)	
Variables	*B*	*S.E.*	Wald	df	Sig	Exp (B)	Lower	Upper
BMI	-0.01	0.04	0.23	1	0.88	0.99	0.92	1.07
WC	-0.02	.024	0.01	1	0.94	1.00	0.95	1.05
WHR	3.67	2.73	1.08	1	0.18	39.27	0.19	8320.56
Physical Activities	-0.37	0.31	1.45	1	0.23	0.69	0.38	1.26
Are your watching your salt intake?	-0.18	0.28	0.42	1	0.52	0.83	0.48	1.44
How often do you drink sugar-sweetened drinks in 30 days			0.89	4	0.93			
How often do you drink sugar-sweetened drinks in 30 days (1)	0.18	0.36	0.24	1	0.62	1.20	0.59	2.43
How often do you drink sugar-sweetened drinks in 30 days (2)	-0.06	0.36	.03	1	0.86	0.94	0.42	1.90
How often do you drink sugar-sweetened drinks in 30 days (3)	-0.15	0.46	0.102	1	0.75	0.86	0.35	2.14
How often do you drink sugar-sweetened drinks in 30 days (4)	-0.25	0.62	1.65	1	0.68	0.78	0.23	2.63
Constant	-1.79	1.85	0.94	1	0.33	0.17		

Note. Full model: $\chi 2$ (10, *N* = 270) =8.34, *p* = 0. 60. The overall classification ranged from 61.4% to 63.3%.

Summary and Transition

In this cross-sectional and quantitative investigation, I examined the evidence of metabolic risk factors amongst the Tobago adult population, and also investigated whether there was a correlation between abnormal obesity measures and metabolic risk factors among Tobago adults, ages 18 to 60 years. For the study, I used a self-reported questionnaire to collect data. The IDF diagnostic criterion for MetS used to define abnormal obesity measures and metabolic risk factors according to gender specific.

A total of 270 participants met the criteria for the study, 197 females and 73 males. Descriptive statistics used to analyze participants' demographics, obesity measures, metabolic risk factors, and behavior risk factors, although the main emphasis was obesity measures and metabolic risk factors. Inferential statistics such as cross-tabulation, chi-square, and binary logistic regression analysis were used to test four research questions and supporting hypotheses.

For RQ1, contingency table and chi-square analysis were used to determine the prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst a representative sample of the Tobago adult population. The results for RQ1 showed more participants had FBS $\geq$ 100mg/dl along with abnormal obesity measures, that is, 64.4% whilst 51.4% of participants had their BP$\geq$130/85 mm Hg with abnormal obesity measures. The *p* values for both metabolic risk factors along with abnormal obesity measures were above the >.05 criterion for statistical significance. For RQ1, I failed to reject the null hypothesis that there was no prevalence of previously documented metabolic risk factors for abnormal obesity measures amongst the Tobago adult population.

RQ2 determines how prevalent metabolic risk factors for abnormal obesity measures differ by gender among the sampling population. The result for RQ2 showed that the prevalence of metabolic risk factors: FBS ≥ 100mg/dl along with abnormal obesity measures were higher among female than male participants, FBS: 65.8%% versus 58.6% respectively. In contrast, having blood pressure level ≥ 130/85 mm Hg with abnormal obesity measures were higher among men than women participants, 58.6% versus 49.6%. Chi square test was used to determine how prevalent metabolic risk factors for abnormal obesity measures differ by gender among the sampling population. There was statistical significance found for females having ≥ 130/85 mm Hg along with abnormal obesity measures. Based on statistical significance, I reject the null hypothesis that there is no difference with the prevalence of metabolic risk factors for abnormal obesity measures by gender within Tobago adult population.

RQ 3 dealt with whether a relationship existed between obesity abnormal measures and metabolic risk factors for the males and females. A larger proportion of males in comparison to females had abnormal obesity measures with blood pressure range ≥ 130/85 mm Hg. There was statistical significance of having blood pressure range ≥ 130/85 mm Hg along with BMI ≥30kg/m^2 for female participants. Cramer's V test showed that the strength of this effect was small. However, contrary to these findings, more female participants had fasting blood sugar levels ≥ 100mg/dl along with abnormal obesity measures than their male counterparts. There was no statistical significance found with having fasting blood sugar levels ≥ 100mg/dl with abnormal obesity measures (*p* values >0.05). Based on statistical significance, I reject the null hypothesis that a relationship exists between obesity abnormal measures and metabolic risk factors for the males and females.

For RQ4, a binary logistic regression model was used to examine the way in which abnormal obesity measures including BMI, WC, and WHR predicts metabolic risk factors among a representative sample. With regards to FBS level ≥ 100mg/dl, the estimated odd ratio favored a positive relationship for WHR. Based on statistical significance, I will reject the null hypothesis that abnormal obesity measures including BMI, WC, and WHR do not predict metabolic risk factors among a representative sample of the Tobago adult population.

To further scrutinize factors which may most likely have an impact on metabolic risk factors, I carried out post hoc analysis to include behavior risk factor within the regression model to predict metabolic risk among participants. However, there was insufficient evidence to support BMI, WC, WHR, SUGADRINKS, WTCHSALT, and PA have any significant relationship or effects on either BP≥ 130/85mm Hg or FBS ≥ 100mg/dl.

In Chapter 5, I provided a brief introduction, an interpretation of the result and compared it with the findings found in peer-reviewed literature and in the context of the theoretical framework. In Chapter 5, I highlighted the strength and limitations of the study, along with recommendations for future research. Finally, I presented the implication of social change.

Chapter 5: Discussion, Recommendation, and Conclusion

The objectives of this quantitative study were to assess whether there is evidence of metabolic risk factors amongst the Tobagonian adult population and to determine whether there is correlation between abnormal obesity measures and metabolic risk factors among Tobagonian adults age 18 to 60. In this chapter, I provide interpretations of the findings, limitations of the study, recommendations, implications for social change, and a conclusion.

Interpretation of the Findings

To recognize metabolic risk factors and obesity measures, I used the MetS definition to identify the criteria for this study, as defined by the IDF, WHO, NCEP-ATP, NHLBI, and the American Association of Clinical Endocrinologists (see IDF, 2006; Moore et al., 2017; Muñoz et al., 2013). The cutoff points for an abnormal WC were ≥ 94 cm for men and ≥ 80 cm for women (see Nolan et al., 2017). The WHO criteria for WHR were > 0.90cm and > 0.85cm for men and women, respectively, and the BMI criteria were ≥ 30 kg/m² (see Aynalem & Zeleke, 2018; Khorrami et al., 2017; Kyrkou et al., 2016; Moore et al., 2017). These definitions provided measures to identify two metabolic risk factors: elevated systolic BP ≥ 130 or diastolic BP ≥ 85 mm Hg, and elevated fasting blood sugar ≥ 100 mg/dl (see Alberti et al., 2005; IDF, 2006; Parikh & Mohan, 2012).

Prevalence of Abnormal Obesity Measures

Researchers evaluated the prevalence of obesity using BMI, but other measures such as WC and WHR are also significant indicators to determine associated health risks (Hulsegge et al., 2017; Jacobsen & Aars, 2016; Rahmani et al., 2014; Swainson et al., 2017). Some researchers reiterated the importance of including both general and abdominal obesity to assess for cardiometabolic risk (Castillo et al. 2015; Sebo et al., 2017). Fat distribution was significantly associated with cardiovascular risk (Castillo et al. 2015; Sebo et al., 2017). In the current study, I recognized that abnormal obesity measures including WC, WHR, and BMI are present with metabolic risk factors.

Osei-Yeboah et al. (2017) stated that WC is the most acceptable anthropometric index to identify central obesity and MetS according to the NCEP ATP III and the IDF. I found that 82.2% of the sample population had an abnormal WC, 52.6% had a BMI ≥ 30kg/m^2, and 38.5% had an abnormal WHR according to the outlined cutoff values. These findings were consistent with a recent study by Solomon et al. (2020), in which abnormal WC was the most prevalent obesity measure among the urban Black population in South Africa based on the assessment of the association of dietary adherence, anthropometric measurements, and blood pressure. Solomon et al. reported a slightly higher prevalence in WC among the studied population (85%) when compared to the present study. Solomon et al. reported that 76% had abnormal BMI and 64% had an abnormal WHR. Because central obesity is related to the inflammatory response mechanism and insulin resistance is a key predictor of T2DM risk (Ming-Kuo et al., 2018), the high prevalence of abnormal WC found in the current study and other studies warrants robust public health intervention.

In the current study, gender dominance was noticeable in the recognition of abnormal obesity measures, as women were more likely to have abnormal obesity measures than men (57.9% versus 38.4%). For each obesity measure used, women had a higher chance of having abnormal measurements than men. A total of 41.1% of women versus 31.5% of men had an abnormal WHR, 91.4% of women versus 57.5% of men had an abnormal WC, and 57.9% of women versus 38.4% of men had a BMI $\geq$ 30kg/m². These findings corroborated the results of other studies, which indicated females were more likely than males to be categorized as obese and to have abnormal WC, WHR, and BMI. A few researchers examined a diverse population and reported similar findings that abnormal WC is more prevalent among females than males (Camila Maciel et al., 2020; Hu et al., 2017, Solomon et al., 2020). However, these findings were not supported by Castillo et al. (2015) who reported that men were more likely to have an abnormal WHR than women ($p < .05$).

Prevalence of Metabolic Risk Factors

The current study results suggested that metabolic risk factors were prevalent among the Tobagonian working class population. A total of 63.3% of the sample population self-reported as having a systolic blood pressure level $\geq$ 130mm Hg, while 59.6% had a diastolic level $\geq$ 85mm Hg. However, a smaller portion of participants had an elevated blood pressure range (47.8%) compared to those having an elevated fasting blood sugar range (61.9%). The prevalence of high blood pressure was slightly higher than a previous retrospective database survey conducted by the Ministry of People and Social Development in T&T (MOH, 2017). This study included a larger sample population of 14,793 but reported a lower prevalence (30.4%) of self-reported hypertension (MOH, 2017).

Regarding gender inequality, the findings of the current study are comparable to those from other studies that found that males (64.4%) are more likely to have an elevated blood pressure range in comparison to females (41.6%). Chor et al. (2015) found an increased prevalence of high blood pressure among Brazilian males (40.1%) in comparison to females (33.2%). In contrast to these findings that were gender specific, there were reverse interpretations in the Chadee et al. (2013) study, which was carried out among the T&T population. Chadee et al. examined the prevalence of self-reported diabetes, hypertension, and heart disease and compared findings with the PAHO/WHO National STEPS Survey (2011) in T&T. Chadee et al. recognized that gender specifics also played a significant role in the PAHO/WHO National STEPS Survey and observed that the increased prevalence of self-reported hypertension was more substantial among women than men by 8%.

Diabetes is the other metabolic risk factor found to have serious health consequences, and it is a major contributor to premature mortality for the populace of T&T (Sobers-Grannum et al., 2015). Investigators examined the prevalence of diabetes within T&T, and by extension the Caribbean. Sobers-Grannum et al. (2015) estimated that 10–15% of the Caribbean population is affected by diabetes. The MOH (2015) in T&T highlighted a national prevalence of 14.5%, while the PAHO/WHO National STEPS Survey observed a slightly higher prevalence of 20.5% for self-reported elevated fasting blood sugar levels during the chronic noncommunicable risk factor survey. However, in the present study, a higher prevalence of 47.8% was self-reported among the sampling population on elevated fasting blood sugar. Similarly, female dominance was significant in this study, where a higher prevalence of women (65%) self-reported an abnormal fasting blood sugar than their male counterparts (53.4%).

Other researchers recognized gender differences as a significant component to characterize metabolic risk factors including diabetes (Beigh & Jain, 2012). The findings from the present study were consistent with results of Sorbers-Grannum et al. (2015) who conducted a systematic review and meta-analysis within the Caribbean to investigate social determinants of diabetes. Sorbers-Grannum et al. found a higher prevalence of diabetes among women than men in nine of the articles reviewed. However, Sorbers-Grannum et al. recognized that two studies were not statistically significant.

Identification of Metabolic Syndrome

In the current study, the application of obesity parameters WC, BMI, and WHR were easy to use and were suitable to predict and recognize the prevalence of abnormal obesity measures with metabolic risk factors among the studied sample. Having a cluster of these metabolic risk factors that include central obesity, hypertension, hyperglycemia, and dyslipidemia defines MetS (Mirmiran et al., 2014). The IDF recognized that central obesity and two other risk factors were key elements in the identification of the MetS (Nolan et al., 2017).

The prevalence of central obesity was 82.2% among the current study's sample population. There was a larger portion of women with abnormal WC (91.4%) in comparison to men (57.5%). Findings also showed that 38.3% had three factors as classified by the IDF definition for MetS. These risk factors were abnormal WC ≥ 94 cm for men and ≥ 80 cm for women, along with increased blood pressure systolic BP ≥ 130 and diastolic BP ≥ 85 mm Hg and increased fasting blood glucose ≥ 100 mg/dL (Nolan et al., 2017). Although the Enzawaka et al. (2009) study was conducted more than 5 years ago, their findings were comparable to the present study because they used a similar population and examined the prevalence of MetS in 166 Tobagonians. Among the same population, Enzawaka et al. reported a slightly higher portion (83.7%) of abnormal WC, and 48.4% of their participants had abnormal WC with two other metabolic components according to IDF criteria. Although the Tobagonian population shares similar MetS characteristics to many countries, there were limited evidence-based publications on the overall prevalence rate of MetS and its components. Both sets of findings show the usefulness of the IDF definition in recognizing the prevalence of MetS among the Tobagonian population.

Relationship of Obesity Measures and Metabolic Risk Factors

The connection between obesity measures and metabolic risk factors has been well established in the literature and was addressed in the current investigation. Ezenwaka et al. (2008) forecasted projection in cardiovascular and diabetes disease due widespread prevalence of MetS throughout T&T. In the present study, such prevalence was also noticeable among the Tobagonian population, in which 64.4% of the sample population had fasting blood sugar ≥ 100mg/dl with abnormal obesity measures while 51.4% had blood pressure range ≥ 130/85 mm Hg with abnormal obesity measures.

In addition, the prevalence rate was higher for BMI ≥ 30 kg/m² with elevated fasting sugar (64.1%) than with elevated blood pressure (57.4%). The prevalence (52.1%) was higher for BMI ≥ 30 kg/m² with elevated blood pressure among the sample population. Having abnormal WC was associated with elevated blood pressure in this study. On the other hand, abnormal WHR was strongly associated with either elevated fasting blood sugar or elevated blood pressure. These findings were not comparable with Mirmiran et al. (2014) who found that BMI was the best predictor to detect hypertension when the association of MetS and obesity measures was examined among Tehranian adolescents. Despite the high prevalence rate of obesity measures with metabolic risk factors among the sample population, WC, WHR, and BMI were insignificant predictors for blood pressure range ≥ 130/85 mm Hg, and WHR was the only significant predictor to FBS level ≥ 100mg/dl.

Gender inequality was quite noticeable in the prevalence of MetS (Beigh & Jain, 2012; S. Lee et al., 2016). Due to the limited scientific evidence conducted on the Tobagonian population, it is feasible to refer to the study by Ezenwaka et al. (2007) that included a small sample of the Tobagonian population to compare the prevalence of MetS and its parameters in T2DM patients according to the IDF MetS definition. Ezenwaka et al.'s findings were consistent with those from the current study in which the prevalence rate of abdominal obesity was high among the Tobagonian population and was associated with elevated fasting blood sugar regardless of gender.

In the current study, gender played a role in the relationship between abnormal obesity measures and elevated blood pressure (57.1% of men and 50.9% of women). Pearson's chi-square test showed the relationship was statistically significant in abnormal obesity measures and elevated blood pressure for women but not for men. However, the direction of the relationship was very weak. Barbosa et al. (2011) used obesity measures of WC and found that females with abnormal WC had a higher chance of developing hypertension according to several obesity measures with hypertension among older adults in Barbados and Cuba. In the current study, although women had a much higher rate of having abnormal obesity measures and elevated fasting blood than men (65.8 % and 58.6%, respectively), the relationships were not statistically significant.

Relationship of Metabolic Risk Factors and Covariates

The SET framework provided a theoretical perspective of the increased prevalence of obesity and metabolic risk factors (see Ryu et al., 2017). The multilayered structure of the framework encompasses many factors that have behavior influences (Solomon, 2015). According to Panizzon et al. (2015), environmental impact including socioeconomic and behavioral influences were causative agents for an increase in prevalence of MetS. The T&T MOH (2015) acknowledged that behavioral influences such as smoking, alcohol consumption, unhealthy diet, and low physical activities are modifiable factors. Bergens et al. (2020) hypothesized that these behavior risks factors are significant elements with a potential to impact obesity and metabolic risk. Ensenyat et al. (2017) further emphasized that behavior risk factors are modifiable and can reverse the prevalence of obesity and metabolic risk factors.

I used the SET in the current study to recognize factors that influence obesity and metabolic risk factors and factors that affect behavior choices (see Ryu et al., 2017; Solomon, 2015). In contrast to Bergens et al. (2020) and Ensenyat et al. (2017), I found insufficient evidence to support behavior risk factors (sugary drink consumption, salt intake, and physical activity) having an impact on metabolic risk factors. Nonetheless, focus on these behavior risk factors are detrimental in social changes through preventative strategies as they encourage behavior changes and impact positively on health.

Limitations of the Study

Although the results of the study yielded interesting conclusions, there were several limitations. One of the major limitations was the delay in the data collection process due to the coronavirus pandemic. Most workplaces had strict COVID-19 rules that included social distancing, sanitizing guidelines, and restrictions on the number of people allowed at a workplace. As a result, the data collection process took a longer time. Another limitation was related to the sample size and sample population used in the study. Initially, I proposed to investigate a sample population of 264 participants, but I was able to recruit a larger population of 270 adult Tobagonians for the study. Despite the larger sample size, I examined Tobagonians 18 to 60 years of age and working in government institutions, which made the findings difficult to generalize to other populations or geographic locations.

There were limitation in the study from data collection instrument. The instrument contains personal information about the participants, including present health-related perceptions, behaviors risk factors and demographic information adapted from the BRFSS (Garmon Bibb et al., 2014; Ward et al., 2016). With the cultural disposition that exists within the Tobago space, barriers such as disease perception and acceptance, and fear of stigmatization, allowed participants to withhold pertinent information (Brathwaite

& Lemonde, 2015; Roopnarinesingh et al., 2015). Some participants may not be truthful to disclose personal information that warrants them to be part of the study. There may be shortcomings in the interpretation of the findings, which may provide misclassification in identifying an accurate prevalence rate of metabolic risks. Ethical issues such as privacy, confidentiality and informed consent were addressed to minimize such limitations.

Finally, the study format was cross-sectional in nature. Consequently, causal inferences may be difficult to determine the association between abnormal obesity measures and metabolic risk factors, because cross-sectional studies prohibit inferences about cause-effect relationships (Lee & Kim, 2014; Setia, 2016).

Recommendations for Action

Given the result of the research, a number of recommendations are put forward. Regardless of, the mixed findings which contradict the existing body of evidence along with this study hypothesis, the result of this study provides valuable and current data on the prevalence of obesity measures with metabolic risk factors among the Tobago working class population, especially since data highlighting this problem was limited and outdated for this population. From the literature, it is clear that metabolic risk factors not only affect adults, but also young children and adolescents; therefore, it is beneficial that an investigation must be carried out on this sub-group to recognize the extent of the problem among Tobago's future generation. An extensive population-based survey may be lucrative to monitor and evaluate risk factors from a national level.

This study consisted of a small sample size of 270 Tobagonians within the age group of 18 to 60 years. The results for this small sample size may underrepresent the general population, and the true measure of plethora for the prevalence of metabolic risk factors with abnormal obesity measures. Supplementary researchers should seek to increase the sampling population and to have a more representative sample which will incorporate samples not only working in the public sector, but also persons working in the private sectors. It should include a larger geographical scope because the findings were limited only to Tobagonians within the age group of 18 to 60 years.

The socioecological perspective is vital to provide a theoretical understanding of the increased prevalence of obesity and metabolic risk factors (Podgurski, 2016; Ryu et al., 2017). It underpins many factors that affects behavior choices, which includes physical, biological, social and cultural characteristics of the individuals from an environmental and institutional perspective (Solomon, 2015). However, in recommending a population-based intervention, the application of the socioecological framework will be pivotal for planning, implementing and evaluating health promotion and awareness activities, in order to reduce the prevalence of obesity and metabolic risk factors.

Based on what was presented in the existing literature, factors such as culture, ethnicity and geographical variances were identified as key contributors to the association between anthropometric indexes and metabolic risk factors (Barbosa et al., 2011). However, these factors were excluded within the study. Having a better perspective on the role of culture in the development of obesity and metabolic risk factors may be detrimental in providing a theoretical understanding which can be geared toward positive social changes.

Implications for Social Change

The recognition of the various obesity measures which impacts metabolic risk factors can serve as a valuable reference guide in clinical decision-making and to provide a higher standard of care to the Tobago population. Although these measures were not determinants of metabolic risk factors within this present study, based on the literature review presented in Chapter 2, the application of WC, BMI, and WHR can be valuable tools for clinical assessments and health surveillance. These should be integral into prevention, management, and control strategies of metabolic risk factors. These methods are easy, reputable and cost-effective that should be mandatory as part of any training protocol to improve clinician's knowledge and competencies on metabolic risk and obesity.

Understanding the extent of the problem may help public health practitioners and policymakers to channel a considerable number of resources into awareness and prevention strategies. These approaches should support and promote health education and promotion initiatives designed to curb the emerging trend of obesity and metabolic risk factors. This research can contribute to positive social change since it is geared towards the improvement of existing health standards among Tobagonians. Especially since MetS and obesity were found to have a negative impact not only on the country's healthcare expenditure, but significantly on life expectancy rate of the country as it aids further health issues or comorbidities (Jarolimova et al., 2013).

Prior to this study, it seems that there was little or no evidence-based research conducted on the topic of obesity and metabolic risk factors, solely within the Tobago population. Ezenwaka et al. (2007) and Ramsaran and Maharaj (2017) used samples for both islands of T&T, in their investigation concerning metabolic risk factors. However, apart from the authors using a very small sample size of the Tobago population in these studies, the authors consolidated both island T&T to make inferences which were likely to cause biases, since there is diversity within the cultural fabric of both islands. This study addresses the limitations from within the literature, by solely investigating Tobagonians and by using a larger sampling size which enhances the trustworthiness and precision of the study.

Conclusion of the Study

I implemented this quantitative study to examine the prevalence of metabolic risk factors amongst the Tobago adult population, and also determined whether there is a correlation between abnormal obesity measures and metabolic risk factors among Tobago adults, within the age group of 18 to 60 years. Apart from the supporting evidence available in the literature review, there is a noticeable prevalence of obesity and metabolic risk factors recognized among the Tobago population, in this study. While there are noteworthy limitations, the current study provides an update and an addition to the scanty knowledge available regarding the prevalence of metabolic risk factors within the Tobago diaspora. Despite the mixed finding generated within this study, existing evidence recognized that measurements such as WC, BMI, and WHR are simple and beneficial indices which are often used to draw inferences on the prevalence of weight-related health risks. For this present study, although relationships were found between WC, WHR, and BMI and metabolic risk factors, the effect was quite small. These findings recognize the significance of gender-specifics, in which WC and BMI have a small effect on blood pressure range ≥ 130/85 mm Hg for female and male respectively.

Even as the assessment of the hypotheses shows a significant prevalence of abnormal obesity measures for both metabolic risk factors, it is recognizable that the prevalence rate for elevated fasting blood sugar is slightly higher than that of elevated blood pressure. Nonetheless, these observations should be an eye-opener for public health clinicians and policymakers, because risk factors are above a 50% prevalence margin. These should spark genuine concerns, since heart disease is the number one health issue that is responsible for 25% of deaths amongst the T&T population, followed by diabetes which accounts for14% of deaths (MOH, 2017).

Identifying the extent of this problem can assist public health practitioners and policymakers to use a holistic approach and channel resources into health awareness and prevention initiatives. Although this present study found insufficient evidence to support that behavior risk factors (sugary drink consumption, salt intake, and physical activity) have an impact on metabolic risk factors, still preventative strategies should support and promote health education and promotion initiatives which factors to promote behavior changes. This will help to reduce the emerging trend of obesity and metabolic risk factors, thus, targeting both sexes at different stages in life.

References

Abedin, T., Chowdhury, Z., Afzal, A. R., Yeasmin, F., & Turnin, T. C. (2016). Application of binary logistic regression in clinical research. *Journal National Heart Foundation Bangladesh*, *5*, 8–11. https:www.researchgate.net/publication/320432727

Adamu, M. S., Owiredu W. K. B. A., & Plange-Rhule, J. (2014). Metabolic syndrome in relation to body mass index and waist to hip ratio: A study in Kumasi Metropolis. *Journal of Obesity & Weight Loss Therapy*, *4*, 211. https://doi.org/10.4172/2165-7904.1000211

Affuso, O., Pradhan, L., Zhang, C., Gao, S., Wiener, H. W., Gower, B… Allison, D.B. (2018). A method for measuring human body composition using digital images. *PLOS One*, *13*(11), e0206430. https://doi.org/10.1371/journal.pone.0206430

Ahmad, N., Adam, S. I. M., Nawi, A. M., Hassan, R., & Ghazi, H. F. (2016). Abdominal obesity indicators: Waist circumference or waist-to-hip ratio in Malaysian adults population. *International Journal of Preventative Medicine*, *7*, 82. https://doi.org/10.4103/2008-7802.183654

Ahrens, W., Moreno, L. A., Marilid, S., Molnar, D., Siani, A., De Henauw, S., & Pigeot, I. (2014). Metabolic syndrome in young children: Definition and results of the IDEFICS study. *International Journal of Obesity*, *38*, S4–S14. https://doi.org/10.1038/ijo.2014.130

Akinlua, J. T., Meakin, R., Aminu, M. U., & Freemantle, N. (2015). Current prevalence pattern of hypertension in Nigeria: A systematic review. *PLoS One*, *10*(10). https://doi.org/10.1371/journal.pone.0140021

Akoglu, H. (2018). User's guide to correlation coefficients. *Turkish Journal of Emergency Medicine*, *18*(3), 91–93. https://doi.org/10.1016/j.tjem.2018.08.001

Alamer, A. A., Patanwala, A. E., Aldayyen, A. M., & Fazel, M. T. (2019). Validation and comparison of two 30-day re-admission prediction models in patients with diabetes. *Endocrine Practice*, *25*(11), 1151–1157. https://doi.org/10.4158/EP-2019-0125

Al-Bachir, M., & Bakir, M. A. (2017). Predictive value of body mass index to metabolic syndrome risk factors in Syrian adolescents. *Journal of Medical Case Reports*, *11*(1), 170. https://doi.org/10.1186/s13256-017-1315-2

Alberti, K. G., Zimmet, P., & Shaw, J. (2005). The metabolic syndrome: A new worldwide definition. *Lancet*, *366*, 1059–1062. https://doi.org/10.1016/SO140-6736(05)67402-8

Alberto, A., & Rajpathak, S. (2001). Incidence and prevalence of diabetes mellitus in the Americas. *Pan American Journal Public Health*, *10*, 5. https://scielosp.org/pdf/rpsp/2001.v10n5/300-308/en

Althubaiti, A. (2016). Information bias in health research: Definition, pitfalls, and adjustment methods. *Journal of Multidisciplinary Healthcare*, 9, 211–217. https://doi.org/10.2147/JMDH.S104807

Armstrong, R. A. (2019). Is there a large sample size problem? *College Optometrists Ophthalmic & Physiological Optics*, *39*, 129–130. https://doi.org/10.1111/opo.12618

Arnold, M., Touillaud, T., Dossus, L., Freisling, H., Braya, F. Margaritise, I., & Soerjomatarama, I. (2018). Cancers in France in 2015 attributable to high body mass index. *Cancer Epidemiology*, *52*, 15–19, 81–703. https://doi.org/10.3748/wjg.v22.i2.681

Ashraf, H., Rashdi, A., Noshad, S. Khalilzadeh, O., & Esteghamati, A. (2011). Epidemiology and risk factors of the cardiometabolic syndrome in the Middle East. *Review of Cardiovascular Therapy*, *9*(3), 309–320. https://doi.org/10.1586/erc.11.9

Aslam, S., Georgiey, H., Mehta, K., & Kumar, A. (2012). Matching research design to clinical research questions. *Indian Journal of Sexually Transmitted Diseases and AIDS*, *33*(1), 49–53. https://doi.org/10.4103/0253-7184.93829

Assaad-Khalil, S., Mikhail, M., Aati, T., Zaki, A., Helmy, M., Megallaa, M. H., & Rohoma, K. H. (2015). Optimal waist circumference cutoff points for the determination of abdominal obesity and detection of cardiovascular risk factors among adult Egyptian population. *Indian Journal of Endocrinology and Metabolism*, *19*(6), 804–810. https://doi.org/10.4103/2230-8210.

Awasthi, A., Rao, C. R., Hegde, D. S., & Rao, N. K. (2017). Association between type 2 diabetes mellitus and anthropometric measurements: A case control study in South India. *Journal of Preventive Medicine and Hygiene*, *58*(1), E56–E62.

Ayala, G. X., Carnethon, M., Arredono, E., Delamater, M., Perreira, K., Van Horn, L., & Isasi, C.R. (2014). Theoretical foundations of the study of Latino (SOL) youth: Implications for obesity and cardiometabolic risk. *Annals of Epidemiology*, *24*(1), 36–43. https://doi.org/10.1016/j.annepidem.2013.10.011

Aynalem, S.B., & Zeleke, A.J. (2018). Prevalence of diabetes mellitus and its risk factors among individuals age 15 years and above in Mizan-Aman town, Southwest Ethiopia, 2016: A cross sectional study. *International Journal of Endocrinology*, *9317987.* doi:10.1155/2018/9317987

Babwah, T. (2016). Exercise, body weight perception and related weight loss behavior among adolescents in Trinidad and Tobago. *International Journal of Adolescent Medical Health, 28*(1), 31–37. doi:10.1515/ijmh-2014-0062

Babwah, T.J.R., & Nunes, P., (2010). Exercise habits in south Trinidad: Motivating forces and barriers. *West Indian Medical Journal*, 59(5), 523-528. Retrieved from: <http://caribbean.scielo,org/scielo.phd?script=_arttext&pid=S0043-3144201000ISSN0043-3144

Bankoski, A., Harris, T. B., McClain, J. J., Brychta, R. J., Caserotti, P., Chen, K. Y., & Koster, A. (2011). Sedentary activity associated with metabolic syndrome independent of physical activity. *Diabetes Care*, *34*(2), 497–503. .http://doi.org/10.2337/dc10-0987

Barbosa, B.R., Munaretti, B.D., Coqueriro, R.D., & Borgotto, A.F. (2011). Anthropometric indexes of obesity and hypertension in elderly from Cuba and

Barbados. *Journal of Nutrition, Health & Aging, 15*(1), 17-25, doi:10.1007/s12603-011-0007-7

Batson, Y.A., Teelucksingh, S., Maharaj, R.G., & Cockburn, B.N. (2014). A cross-sectional study to determine the prevalence of obesity and other risk factors for Type 2 diabetes among school children in Trinidad, West Indies. *Paediatric International Child Health, 34*(3), 178-83. doi:10.1179/2046905514Y.0000000116

Battie, C.A., Borja-Hart, N., Ancheta, I. B., Flores, R., Rao, G., & Palaniappan, L. (2016). Comparison of body mass index, waist circumference, and waist to height ratio in the prediction of hypertension and diabetes mellitus: Filipino-American women cardiovascular study. *Preventive Medicine Reports, 4,* 608-613. http://doi.org/10.1016/j.pmedr2016.10.003

Beigh, S.H., & Jain, S. (2012). Prevalence of metabolic syndrome and gender differences. *Bioinformation, 8*(13), 613-616. http//doi.org/10.6026/97320630008613

Bergens, O., Veen, J., Montiel-Rojas, D., Edholm, P., Kadi, F., & Nilsson, A. (2020) Impact of healthy diet and physical activity on metabolic health in men and women: Study Protocol Clinical Trial (SPIRIT Compliant). *Medicine*, *99*(16), e19584. doi:10.1097/MD.0000000000019584

Bhowmik, B., Afsana, F., Siddique, T., Munir, S. B., Sheikh, F., Wright, E., & Hussain, A. (2015). Comparison of the prevalence of metabolic syndrome and its association with diabetes and cardiovascular disease in the rural population of Bangladesh using the modified National Cholesterol Education Program Expert

Panel Adult Treatment Panel III and International Diabetes Federation definitions. *Journal of Diabetes Investigation*, *6*(3),280–288. http://doi.org/10.1111/jdi.12268

Block, R. C., Dozier, A. M., Hazel-Fernandez, L., Guido, J. J., & Pearson, T. A. (2012). An epidemiologic transition of cardiovascular disease risk in Carriacou and Petite Martinique, Grenada: the Grenada Heart Project, 2005-2007. *Preventing Chronic Disease*, 9, E90. http://dx.doi.org/10,5888/pcd9.110167

Blunden, S., Benveniste, T., & Thompson, K. (2016). Putting children's sleep problems to bed: Using behavior change theory to increase the success of children's sleep education programs and contribute to healthy development. *Children*, *3*(3), 11. doi.org/10.3390/children3030011

Bolton-Smith, C., Woodward, M., Tunstall-Pedeo, H., & Morrison, C. (2000). Accuracy of the estimated prevalence of obesity from self-reported height and weight in an adult Scottish population, *Journal of Epidemiology Community Health*, *54*(2), 143-148. doi:10.1136/jech.54.2.143

Bostock-Cox, B. (2017). Understanding the link between obesity and diabetes. *Nursing Standard, 31*(44), 52–62, doi:10.7748/ns.2017.e10106

Bouguerra, R., Alberti, H., Smida, H., Rayana, C.B., El Atti, J., Achour, A., & Alberti, K.G. (2007). Waist circumference cut-off points for identification of abdominal obesity among the Tunisian adult population. *Diabetes, Obesity and Metabolism, 9*(6), 859–868. doi.org/10.1111/j.1463-1326.2006.00667.x

Bourne, P. A., McDaniel, S., Williams, M. S., Francis, C., Kerr-Campbell, M. D., & Beckford, O. W. (2010). The changing faces of diabetes, hypertension, and arthritis in a Caribbean population. *North American Journal of Medical Sciences, 2*(5), 221–229. http://doi.org/10.4297/najms.2010.221

Brathwaite, A.C., & Lemonde, M. (2015). Perceptions of culturally tailored adapted program to prevent type 2 diabetes. *International Journal of Diabetes Clinical Research*, *2*(5). doi:10.23937/2377-3634/1410045

Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design. Retrieved from httpd://www.amazon.com/Ecology-Human-Development-Experiments-Nature/dp/0674224574

Broom, A. (2006). Ethical issues in social research. *Complementary Therapies in Medicine*, *14*(2), 151-6. http://doi10.1016/j.ctim.2005.11.002

Brown, N., & Scurr, J. (2012). The need for a standardized anthropometric protocol for objective assessment of pre- and postoperative breast surgery. *Gland Surgery, 1*(3), 142–145. http://doi.org/10.3978/j.issn.2227-684X.2012.10.01

Camila Maciel, d. O., Tureck, L. V., Alvares, D., Liu, C., Andrea Roseli Vançan, R. H., Balcells, M, & Alexandre, C. P. (2020). Relationship between marital status and incidence of Type 2 diabetes mellitus in a Brazilian rural population: The Baependi heart study. *PLoS One, 15*(8). http://dx.doi.org.ezp.waldenulibrary.org/10.1371/journal.pone.0236869

Campbell, A.W. (2018). The epidemic of obesity. *Alternative Therapies in Health and Medicine, 24*(1), 8-10

Caprio, S., Daniels, S. R., Drewnowski, A., Kaufman, F. R., Palinkas, L. A., Rosenbloom, A. L., & Schwimmer, J. B. (2008). Influence of race, ethnicity, and culture on childhood obesity: Implications for prevention and treatment: Aconsensus statement of shaping America's health and the obesity society. *Diabetes Care*, *31*(11), 2211–2221. http://doi.org/10.2337/dc08-9024

Carneiro, I., Howard, N., Bailey, L., Vardulaki, K., Langham, J., & Chandramohan, D. (2010). *Introduction to epidemiology understanding public health*. (2nd ed.). Mc Graw Hill, Open University.

Castillo, C., Carnicero, J. A., de la Torre, M. Á., Amor, S., Guadalupe-Grau, A., Rodríguez-Mañas, L., & García-García, F., J. (2015). Nonlinear relationship between waist to hip ratio, weight and strength in elders: Is gender the key? *Biogerontology*, *16*(5), 685-692. http://dx.doi.org.ezp.waldenulibrary.org/10.1007/s10522-015-9582-z

Centers for Disease Control and Prevention (CDC). (2013). *Behavioral risk factor surveillance system survey questionnaire*. Atlanta, Georgia: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Retrieved from https://www.cdc.gov/brfss/questionnaires/pdf-ques/2013%20BRFSS_English.pdf

Central Intelligence Agency. (2016). *The world fact book: Trinidad and Tobago.* Retrieved from https://www.google.de/search?q=cia+world+factbook&trackid=sp-006

Central Statistical Office, Trinidad and Tobago. (2016). Population mid-year estimates. Central Statistical Office. Retrieved from http://cso.gov.tt/data/?productID=31-Population-Mid-Year-Estimates

Chadee, D., Seemungal, T., Pinto Pereia, L.M., Chadee, M., Maharaj, R., & Teelucksingh, S. (2013). Prevalence of self-reported diabetes, hypertension and heart disease in individuals seeking state funding in Trinidad and Tobago, *West Indies, Journal of Epidemiology and Global Health, 3*(2), 95-103, http://dx.org/10.1016/j.jegh.2013.02.002

Chan, R. S., & Woo, J. (2010). Prevention of overweight and obesity: How effective is the current public health approach. *International Journal of Environmental Research and Public Health, 7*(3), 765–783. http://doi.org/10.3390/ijerph7030765

Chang, J., Guy, M. C., Rosales, C., de Zapien, J. G., Staten, L. K., Fernandez, M. L., & Carvajal, S. C. (2013). Investigating social ecological contributors to diabetes within Hispanics in an underserved U.S.-Mexico Border Community. *International Journal of Environmental Research and Public Health*, *10(*8), 3217–3232. http://doi.org/10.3390/ijerph10083217

Charan, J., & Biswas, T. (2013). How to calculate sample size for different study designs in medical research? *Indian Journal of Psychological Medicine*, 35, 121-6, doi:10.4103/0253-7176.116232

Chen, M.C., Lee, C.J., Yang, C. F., Chen, Y.C., Wang, J.H., & Hsu, B.G. (2017). Low serum adiponectin level is associated with metabolic syndrome and is an independent marker of peripheral arterial stiffness in hypertensive patients. *Diabetology & Metabolic Syndrome, 9,* 49. http://doi.org/10.1186/s13098-017-0247-8

Cherry, C. O., Serieux, E., Didier, M., Nuttal, M. E., & Schuster, R. J. (2014). Prevalence of risk factors for the metabolic syndrome in the middle-income Caribbean nation of St. Lucia. *Advances in Preventive Medicine*, *501972.* http://doi.org/10.1155/2014/501972

Chin, M., Cummings, T., Thomas, C., & Seemungal, T. (2016). Global registry of acute coronary events (Grace) risk score as a predictor of in-hospital mortality for acute coronary syndrome in Trinidad and Tobago, *West Indian Medical Journal, 65*(1), 52. doi:10.7727/wimj.2014.172

Choi, B., Steiss. D., Garcia-Rivas, J., Kojaku, S., Schnall, P., Dobson, M., & Baker, D. (2016). Comparison of body mass index with waist circumference and skinfold-based percent body fat in fire-fighters: adiposity classification and associations with cardiovascular disease risk factors. *International Archives Occupational Environmental Health, 89,* 435–448. doi:10.1007/s00420-015-1082-6

Chopra, S.M., Misra, A., Gulati, S., & Gupta, R. (2013). Overweight, obesity and related non-communicable diseases in Asian Indian girls and women. *European Journal of Clinical Nutrition, 67,* 688-696. doi:10.1038/ejcn.2013.70

Chor, D., Pinho Ribeiro, A. L., Carvalho, M.S., Bruce, B. D., Paulo, A. L., Nobre, A.A., … José, G. M. (2015). Prevalence, awareness, treatment and influence of socioeconomic variables on control of high blood pressure: Results of the ELSA-brasil study. *PLoS One, 10*(6) http://dx.doi.org.ezp.waldenulibrary.org/10.1371/journal.pone.0127382

Chua, E. Y., Zalilah, M.S., Haemamalar, K., Norhasmah, S. & Geeta, A. (2017). Obesity indices predict hypertension among indigenous adults in Krau wildlife reserve, Peninsular Malaysia. *Journal of Health, Population and Nutrition, 36,* 24. doi:10.1186/s41043-017-0102-4

Clifton, E.A.D., Day, F.R., De Lucia Rolfe, E., Forouhi, N.G., Brage, S., Griffin, S.J., Wareham, N.J., & Ong, K.K. (2017). Associations between body mass index-related genetics variants and adult body composition: The Fenland cohort study. *International Journal of Obesity*, *41,* 613-619. doi:10.1038/ijo.2017

Colao, A., Lucchese, M., D'Adamo, M., Savastano, S., Facchinano, E., Veronesi, C., & Sbraccia, P. (2017). Healthcare usage and economic impact of non-treated obesity in Italy: findings from a retrospective administrative and clinical database analysis. *BMJ Open* ,7, e013899. doi:10.1136/bmjopen-2016-013899

Cornier, M., Despres, J., Davis, N., Grossniklaus, D.A., Klein, S., Lamarche, B., & Poirier, P. (2011). Assessing adiposity: A scientific statement from the American heart association. *Circulation*, *124,* 1996-209. https://doi.org/10.1161/CIR.0b013e318233bc6a

Coutinho, T., Goel, K., Corrêa de Sa´, D., Carter, R.E., Hodge, D.O., Kragelund, C., & Lopez-Jimenez, F. (2013). Combining body mass index with measures of central obesity in the assessment of mortality in subjects with coronary disease role of "Normal weight central obesity" *Journal of the American College of Cardiology, 61*(5), 553- 560. http://dx.doi.org/10.1016/j.jacc.2012.10.035

Cramer, R.J., & Kapusta, N.D. (2017). A social-ecological framework of theory, assessment, and prevention of suicide. *Frontiers in Psychology, 8,* 1786. doi:10.3389/fpsyg.2017.01756

Creswell, J.W. (2007). *Qualitative inquiry & research design. Choosing among five approaches.* 2nd ed. Sage.

Cruz, I. R.D., Freitas, D.A., Soares, W.D., Mourão, D.M., Aidar, F.J., & Carneiro, A.L. (2014). Metabolic syndrome and its association with socio-economic level in students. *Revista CEFAC*, *16*(4), 1294-1302. https:/dx.doi.org/10.1590/1982-021620146713

Cuevas, A., Alvarez, V., & Olivos, C. (2009). The emerging obesity problem in Latin America. *Expert Review of Cardiovascular Therapy*, *7*(3), 281-8. http://doi.10.1586/14779072.7.3.281

Czernichow, S., Kengne, A.P., Huxley, R. R., Batty, G. D., de Galan, B., Grobbee, D., & Chalmers, J. (2011). Comparison of waist-to-hip ratio and other obesity indices as predictors of cardiovascular disease risk in people with type 2 diabetes: a prospective cohort study from ADVANCE. *European Journal of Cardiovascular Prevention and Rehabilitation: Official Journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*, *18*(2), 312–319. http://doi.org/10.1097/HJR.0b013e32833c1aa3

Dabou, S., Telefo, P. B., & Sama, L.F. (2018). Evaluation of dietary habits and lifestyle on prevalence of metabolic syndrome and obesity in undergraduate university students in Cameroon: A cross-sectional study. *Journal of Metabolic Syndrome* ,*7*(1), 236. doi:10.4172/2167-0943.1000236

De Lorenzo, A., Soldati, L., Sarlo, F., Calvani, M., Di Lorenzo, N., & Di Renzo, L. (2016). New obesity classification criteria as a tool for bariatric surgery indication. *World Journal of Gastroenterology*, *22*(2), 681-703. doi:10.3748/wjg.v22.i2.681

De Lucia Rolfe, E., Ong, K. K., Sleigh, A., Dunger, D. B., & Norris, S. A. (2015). Abdominal fat depots associated with insulin resistance and metabolic syndrome risk factors in black African young adults. *BMC Public Health*, *15*, 1013. http://doi.org/10.1186/s12889-015-2147-x

de Oliveira, R.G., & Guedes, D.P. (2018). Performance of anthropometric indicators as predictors of metabolic syndrome in Brazilian adolescents. *BMC Pediatrics*. *18*(33). http://doi.org/10.1186/s12887-018-1030-1

de Oliveira, A., Cocate, P.G. Hermsdorff, H.H.M., Bressan, J., de Silva, M.F., Rodrigues, J.A., & Natali, A.J. (2014). Waist circumference measures: cutoff analyses to detect obesity and cardiometabolic risk factors in a Southeast Brazilian middle-aged men population a cross-sectional study. *Lipids in Health and Disease*, *13,* 141. http://www.lipidworld.com/content/13/1/141

Díaz-Juárez, J., Pastelín, G., & Suarez, J. (2017). Metabolic syndrome in aging heart: molecular insights. *Journal of Metabolic Syndrome*, *6,* 230. doi:10.4172/2167-0943.1000230

Dimala, C.A., Ngu, R.C., Benjamin, M.K., Frank-Leonel, T., & Simeon, P. C. (2018). Markers of adiposity in HIV/AIDS patients: Agreement between waist circumference, waist-to-hip ratio, waist-to-height ratio and body mass index. *PloS One*, *13*(3), doi:10.1371/journal.pone.0194653

Dong, X., & Simon, M. (2015). Association between elder abuse and metabolic syndromes: Findings from the Chicago health and aging project. *Gerontology*, *61*(5), 389-398. https://doi.org/10.1159/000368577

Dragsbæk, K., Neergaard, J. S., Laursen, J. M., Hansen, H. B., Christiansen, C., Beck-Nielsen, H., & Henriksen, K. (2016). Metabolic syndrome and subsequent riskof type 2diabetes and cardiovascular disease in elderly women: Challenging the current definition. *Medicine*, *95*(36), e4806. http://doi.org/10.1097/MD.0000000000004806

D'souza, J., & Shekar, A. (2015). Anthropometric measurements as a useful factor to predict metabolic syndrome among young adults Aged 18-24 years in Mumbai City. *International Journal of Medicine and Public Health*, *5*(5), 40-4. doi:10.4103/2230-8598.151255.

Dyal, N., & Dolovich, L. (2016). Assessment of a hypertension screening and education intervention in Charlestown, Guyana: Hypertension evaluation & learning program (HELP). *Canadian Pharmacists Journal*, *149*(1), 46-53. http://dx.doi.org.ezp.waldenulibrary.org/10.1177/1715163515617486

Edwardson, C. L., Gorely T., Davies, M.J., Gray, L. J., Khunti, K., Wilmot, E.G., Yates, T., & Biddle, S.J.H. (2012). Association of sedentary behavior with metabolic syndrome: A meta-analysis. *PLoS ONE*, *7*(4), e34916. https://doi.org/10.1371/journal.pone.0034916

Egbe, E., Asuquo, O., Ekwere, E., Olufemi, F., & Ohwovoriole, A. (2014). Assessment of anthropometric indices among residents of Calabar, south-east Nigeria. Indian *Journal of Endocrinology and Metabolism*, *18*(3), 386-393.doi:10. 4103/2230-8210.131196

Elffers, T. W., de Mutsert, R., Lamb, H. J., de Roos, A., Willems van Dijk, K., Rosendaal, F. R., & Trompet, S. (2017). Body fat distribution, in particular visceral fat, is associated with cardiometabolic risk factors in obese women. *PLoS ONE*, *12*(9), e0185403. http://doi.org/10.1371/journal.pone.0185403

Eloi, J. C., Epifanio, M., de Gonçalves, M. M., Pellicioli, A., Vieira, P. F. G., Dias, H. B., & Baldisserotto, M. (2017). Quantification of abdominal fat in obese and healthy adolescents using 3 Tesla magnetic resonance imaging and free software for image analysis. *PLoS ONE*, *12*(1), e0167625. http://doi.org/10.1371/journal.pone.0167625

Ensenyat, A., Espigares-Tribo, G., Machado, L., Verdejo, F. J., Rodriguez-Arregui, R., Serrano, J., & Serra-Paya, N. (2017). Metabolic risk management, physical exercise and lifestyle counselling in low-active adults: controlled randomized trial (BELLUGAT). *BMC Public Health*, *17*, 257. http://doi.org/10.1186/s12889-017-4144-8

Erikan, I, Musa, S.A., & Alkassim, R.S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, *5*(1), 1-4. doi:10.11648/j.ajtas.20160501.11

Esen, B., Gokmen, E. S., Kaya, M., Ozkan, B., & Atay, A. E. (2016). The relation of anthropometric measurements and insulin resistance in patients with polycystic kidney disease. *Journal of Translational Internal Medicine*, *4*(3), 127–134. http://doi.org/10.1515/jtim-2016-0029

Ezenwaka, C.E., Nwagbara, E., Seales, D., Okali, F., Hussaini, S., Raja, B., Wheeler, V., Sells, H., Avcis, H., & Eckel, J. (2007). A comparative study of the prevalence of the metabolic syndrome and its components in Type 2 diabetic patients in two Caribbean islands using the new international diabetes federation definition. *Archives of Physiology and Biochemistry*, *113*(4/5), 202-210. https://doi.org/10.1080/13813450701475201

Ezenwaka, C. E., Jones-LeCointe, A., Nwagbara, E., Seales, D., & Okali, F. (2008). Anaemia and kidney dysfunction in Caribbean Type 2 diabetic patients. *Cardiovascular Diabetology, 7,* 25. http://doi.org/10.1186/1475-2840-7-25

Ezenwaka, C., Onuoha, P., & Olukaga, A. (2013). Challenges of self-monitoring of blood glucose in Caribbean Type 2 diabetes patients. *International Journal of Diabetes in Developing Countries, 33*(3), 178-180. doi:10.1007/s13410-013-0117-3

Evangelista, L.S., Cho, W., & Kim, Y. (2018). Obesity and chronic kidney disease: A population-based study among South Koreans. *PLoS One, 13*(2), e0193559. doi:10.1371/journal.pone.0193559

Fakhrzadeh, H., Farshad Sharifi, F., Alizadeh, M., Arzaghi, S.M., Tajallizade-Khoob, Y., Tootee, A., & Kazemi, H. (2016). A relationship between insulin resistance and subclinical atherosclerosis in individuals with and without type 2 diabetes mellitus. *Journal of Diabetes &Metabolic Disorders*, *15,* 41.doi:10.1186/s40200-016-0263-5

Farajian, P., Renti, E., & Manios, Y. (2008). Obesity indices in relation to cardiovascular disease risk factors among young adult female students. *British Journal of Nutrition, 99*(4), 918-24. doi:10.1017/S000711450783741X

Ferguson, T.S., Younger, N., Tulloch-Reid, M.K., Forrester, T.E., Cooper, R.S., Van den Broeck, J., & Wilks, R.J. (2010). Prevalence of the metabolic syndrome in Jamaican adults and its relationship to income and education levels. *West Indian Medical Journal*, *59*(3), 65-273. http://caribbean.scielo.org/scielo.php?pid=S0043-31442010000300008&script=sci_arttext

Fernandez, M.A., Kubow, S., Gray-Donald, K., Knight, J., & Gaskin, P.S. (2015). Drastic increases in overweight and obesity from 1981 to 2010 and related risk factors: results from the Barbados children's health and nutrition study. *Public Health Nutrition*, *18*(17), 3070 -3077. doi:10.1017/S1368980015002190.

Fleury, J., & Lee, S. M. (2006). The social ecological model and physical activity in African American women. *American Journal of Community Psychology*, *37*(1/2), doi:10.1007/s10464-005-9002-

Food and Agriculture Organization. (2016). Overweight affects almost half the population of all countries in Latin America and the Caribbean except for Haiti. http://www.fao.org/americas/noticias/ver/en/c/463394/

Ford, E.S., & Mokdad, A.H. (2008). Epidemiology of obesity in the western hemisphere. *Journal of Clinical Endocrinology Metabolism*, *93*(11), S1– S8. doi:10.1210/jc.2008-1356

Fouka, G., & Mantzorou, M. (2011). What are the major ethical issues in conducting research? Is there a conflict between the research ethics and the nature of nursing? *Health Science Journal*, *5*(1),3-14. http://www.academia.edu

Gao, W., Qiao, X., Wang, Y., Wan, L., Wang, Zengwu., Wang, Xin., & Lui, X. (2016). The interactive association of general obesity and central obesity with prevalent hypertension in rural Lanzhou, China. *PLos ONE*, *11*(10). doi:10.1371/journal.pone.0164409.

Garmon Bibb, S.C., Mollah, F.N., & Morgan, B.J. (2014). Evaluation of the behavioral risk factor surveillance system as a potential index for total force fitness. *Military Medicine, 179*(5), 529-39. doi:10.7205/MILMED-D-13-00376

Gauer, J. L., Wolff, J. M., & Jackson, J. B. (2016). Do MCAT scores predict USMLE scores? An analysis on 5 years of medical student data. *Medical Education Online*, *21*(1), 1-7. doi:10.3402/meo.v21.31795

Gavurová, B., Vagaśová, T., Dražilová, S., & Jarčuška, P. (2017). The impact of selected groups of non-communicable deaths on life expectancy in the Slovak republic.

Central European Journal of Public Health, *2*(25), S4-S9, doi:10.21w1/cejph.a4954

Gaya, A.R., Brand, C., Dias, A.F., Gaya, A.C.A., Lemes, V.B., & Mota, J. (2017). Obesity anthropometric indicators associated with cardiometabolic risk in Portuguese children and adolescents. *Preventative Medicine Reports*, *8,* 158-162. doi:10.1016/j.pmedr.2017.10.002

Gennuso, K. P., Gangnon, R.E., Thraen-Borowski, K.M., & Colbert, L.H. (2015). Dose response relationships between sedentary behaviour and the metabolic syndrome and its components. *Diabetologia*, *58,* 485–492. doi:10.1007/s00125-014-3453-z

Ghomari-Boukhatem, H., Bouchouicha, A., Mekki, K., Chenni, K., Belhadj, M., & Bouchenak, M. (2017). Blood pressure, dyslipidemia and inflammatory factors are related to body mass index in scholar adolescents. *Archives of Medical Science*, *13*(1), 46–52. http://doi.org/10.5114/aoms.2017.64713

Goff, L.M., Timbers, L., Style, H., & Knight, A. (2015). Dietary intake in black British adults: An observational assessment of nutritional composition and the role of traditional foods in UK Caribbean and West African diet. *Public Health Nutrition*, *18*(12), 2191-2201.doi:10.1017/S13689800014002584

Goh, L.G.H, Dhaliwal S.S., Welborn T.A, Lee, A.H., & Della, P.R. (2014). Anthropometric measurements of general and central obesity and the prediction of cardiovascular disease risk in women: a cross-sectional study. *BMJ Open.* doi:10.1136/bmjopen-2013- 004138

Going, S., Lee, V., Blew, R., Laddu, D., & Hetherington-Rauth, M. (2014). Top 10 research questions related to body composition. *Research Quarterly for Exercise and Sport, 85*(1), 38-48. doi:10.1080/02701367.2013.875446

Gómez-Cabello, A., Vicente-Rodríguez, G., Albers, U., Mata, E., Rodríguez- Marroyo, J.A., Olivares, P.R., … Ara, I. (2012). Harmonization process and reliability assessment of anthropometric measurements in the elderly EXERNET multi-center study. *PLoS ONE*, *7*(7), e41752. https://doi.org/10.1371/journal.pone.001752

Gosadi, I. M. (2016). Assessment of the environmental and genetic factors influencing prevalence of metabolic syndrome in Saudi Arabia. *Saudi Medical Journal*, *37*(1), 12–20. http://doi.org/10.15537/smj.2016.1.12675

Goossens, G.H. (2017). The metabolic phenotype in obesity: Fat mass, body fat distribution, and adipose tissue function. *Obesity Facts*. doi:10.1159/000471488

Gradidge, P. J., Norris, S.A., Jaff, N.G., & Crowther, N. J. (2016). Metabolic and body composition risk factors associated with metabolic syndrome in a cohort of women with a high prevalence of cardiometabolic disease. *PLoS One*, *11*, 9. doi:10.1371/journal.pone.0162247

Green, M.A., Strong, M., Razak, F., Subramanian, S.V., Relton, C., & Bissell, P. (2016). Who are the obese? A cluster analysis exploring subgroups of the obese. *Journal of Public Health*, *38*(2), 258-264, https://doi.org/10.1093/pubmed/fdv040

Gregory, A.B., Lester, K.K., Gregory, D.M., Twells, L.K., Midodzi, W.K., & Pearce, N. J. (2017). The relationship between body mass index and the severity of coronary artery disease in patients referred for coronary angiography. *Cardiology Research and Practice,* 1-10, https://doi.org/10.1155/2017/5481671

Grundy, S. M. (2008). Metabolic syndrome pandemic. *Arteriosclerosis, Thrombosis, and Vascular Biology, 28,* 629, doi:10.1161/ATVBAHA.107.151092

Guan, X, Sun, G., Zheng, L., Hu, W., Li, W., & Sun, Y. (2016). Association between metabolic risk factors and body mass index, waist circumference, waist-to-ratio and waist- to-hip ratio in a Chinese rural population. *Journal of Diabetes Investigation*, 7(4), 601-606. http://doi.org/10.1111/jdi.12442

Gulliford, M.C. Mahabir, D., Rocke, B., Chinn, S., & Rona, R. (2001). Overweight, obesity and skinfold thicknesses of children of African or Indian descent in Trinidad and Tobago. *International Journal of Epidemiology*, *30*(5), 989-998. https://doi.org/10.1093/ije/30.5.989

Guo, H., Lui, J., Zhang, J., Ma, R., Ding, Y., Zang, M., & Guo, S., (2016). The Prevalence of metabolic syndrome using three different diagnostic criteria among low earning nomadic Kazakhs in the far northwest of China: New cut-off points of waist circumference to diagnose MetS and its implications, *PLoS One, 11*(2). doi:10.1371/journal.pone.0148976

Haffner, S. M. (2006), Relationship of metabolic risk factors and development of cardiovascular disease and diabetes. *Obesity*, 14, 121S–127S. doi:10.1038/oby.2006.29

Halcomb, E., & Hickman, L. (2015). Mixed methods research. *Nursing Standard*, *29*(32) 41-7. doi:10.7748/ns.29.32.41.e8858

Han, T. S., & Lean, M. E. (2016). A clinical perspective of obesity, metabolic syndrome, and cardiovascular disease. *JRSM Cardiovascular Disease, 5,* 2048004016633371. http://doi.org/10.1177/2048004016633371

Hassan, Z.A., Schattner, P., & Massa, D. (2006). Doing a pilot study: Why is it essential? *Malaysian Family Physician: The official Journal of the Academy of Family Physicians of Malaysia*, *1*(2), 70-73. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4453116/

Heale, H., & Twycross, A. (2015). Validity and reliability in quantitative studies. *Evidence Based Nursing*, *18*(3) 66-67. doi:10.1136/eb-2015-102129

Heman, A., Philpot, B., Janus, E.D., & Dunbar, J.A. (2012). Recruitment into diabetes prevention programs: what is the impact of errors in self- reported measures of obesity? *BMC Public Health*, *12,* 510, doi:10.1186/1471-2458-12-510

Hill, O.J., Galloway, J.M., Goley, A., Marrero, D.G., Minners, R., Montgomery, B., … Aroda, V.R. (2013). Scientific statement: socioecological determinants of prediabetes and type 2 diabetes. *Diabetes Care*, 36, 2430 -2438. doi:10.2337/de13-1161

Holland, K. J., Rabelo, V.C., & Cortina, L. (2016). See something, do something: predicting sexual assault bystander intention in the U.S. military. *American Journal of Community Psychology*, *58*(1/2),3-15. doi:10.1002/ajcp.12077

Hong, J.S., Woodford, M.R., Long, L.D., & Renn, K.A. (2016). Ecological covariates of subtle and blatant heterosexist discrimination among LGBQ college students. *Journal of Youth Adolescence*, *45,* 117-131. doi:10.1007/s10964-015-0362-5

Ho-Pham, L.T., Lai, T. Q., & Nguyen, M.T.T. (2015). Relationship between body mass index and percent body fat in Vietnamese: Implications for the diagnosis of obesity. *PLos ONE, 10*(5), e0127198.https://doi-org.ezp.waldenulibrary.org/10.1371/journal.pone.0127198

Howitt, C., Brage, S., Hambleton, I. R., Westgate, K., Samuels, T. A., Rose, A. M., &Unwin, N. (2016). A cross-sectional study of physical activity and sedentary behaviors in a Caribbean population: combining objective and questionnaire data to guide future interventions. *BMC Public Health, 16,* 1036. http://doi.org/10.1186/s12889-016-3689-2

Hse, J., Chen, J., & Mirabelli, M.C. (2018) Asthma morbidity, comorbidities, and modifiable factors among older adults. *Journal of Allergy and Clinical Immunology. In Practice, 6*(1), 236-243, e7. doi:10.1016/j.jaip.2017.06.007

Hu, F. (2011). Globalization of diabetes: The role of diet, lifestyle, and genes. *Diabetes Care, 34*(6), 1249-57. doi:10.2337/dc11-0442.

Hu, L., Huang, X., You, C., Li, J., Hong, K., Li, P., … Cheng, X. (2017). Prevalence of overweight, obesity, abdominal obesity and obesity-related risk factors in southern China. *PLoS One, 12*(9) http://dx.doi.org.ezp.waldenulibrary.org/10.1371/journal.pone.0183934

Huang, T.T.K., & Glass, T.A. (2008). Transforming research strategies for understanding and preventing obesity. *Journal of the American Medical Association, 300*(15), 811–1813. doi:10.1001/jama.300.15.1811

Huang, P. L. (2009). A comprehensive definition for metabolic syndrome. *Disease Models & Mechanisms, 2*(5-6), 231–237. http://doi.org/10.1242/dmm.001180

Huang, J.H., Li, R.H., Huang, S.L., Sia, H.K., Lee, S.S., Wang, W.H., & Tang F. C. (2017). Relationships between different types of physical activity and metabolic syndrome among Taiwanese worker. *Scientific Reports, 7,* 13735, doi:10.1038/s41598-017-13872-5

Hulsegee, G., Spijkerman, A.M.W., van der Schouw, Y.T., Bakker, S.J.L., Gansevoort, R.T., Smith, H.A., & Verschuren, W.M.M. (2017). Trajectories of metabolic risk factors and biochemical markers prior to the onset of Type 2 diabetes: The population based longitudinal Doetinchem study. *Nutrition & Diabetes, 7,* e270, doi:10.1038/nutd.2017.23

Hsu, J., Chen, J., & Mirabeli, M.C. (2018). Asthma morbidity, comorbidities, and modifiable factors among older adults. *Journal of Allergy and Clinical Immunology in Practice, 6*(1), 236 -243, doi: 0: 1016/j.jaip.2017.06.007

International Diabetes Federation (IDF). (2006). The IDF consensus worldwide definition of the metabolic syndrome. 1-23. IDF_Meta_def_final%20(2).pdf

Jacobsen, B. K., & Aars, N. A. (2016). Changes in waist circumference and the prevalence of abdominal obesity during 1994-2008 - Cross-sectional and longitudinal results from two surveys: the Tromsø Study. *BMC Obesity*, *3,* 41. https://doi.org/10.1186/s40608-016-0121-5

Jarolimova, J., Tagoni, J., & Stern, T. A. (2013). Obesity: its epidemiology, comorbidities, and management. *Primary Care Companion for CNS Disorders, 15*(5), PCC.12f01475. http://doi.org/10.4088/PCC.12f01475

Johnson, J. J., & Rodrigues, V. (2016). Primary health care: Expectations and tasks for public health in Trinidad and Tobago. *Journal of Community Health*, *41,* 645-649. doi:10.1007/s10900-015-0140-z

Johnson Stoklossa, C.A., Sharma, A.M., Forham, M., Siervo, M., Padwal, R.S., & Prado, C.M. (2017). Prevalence of sarcopenic obesity in adults with class 11/111 obesity using different diagnostic criteria. *Journal of Nutrition and Metabolism*, *7307618,* 11. https:/doi.org/10.1155/2017/7307618

Jones, S.R., Carley, S., & Harrison, M. (2003). An introduction to power and sample size estimate. *Emergency Medicine Journal*, *20*(5), 453-458. doi:10:1136/emj.20.5.453

Kadouh, H.C., & Acosta, A. (2017). Current paradigms in the etiology of obesity author links open over lay panel. *Techniques in Gastrointestinal Endoscopy*, *19*(1), 2-11. http://dx.doi.org/10.1016/j.tgie.2016.12.001

Kaplan, R.C., Aviles-Santa, M.L., Parrinello, C.M., Hanna, D.B., Jung, M., Castaneda,S.F., & Cai, J. (2014). Body mass index, sex and cardiovascular disease risk factors among Hispanic/Latino adults: Hispanic community health studies/study of Latinos, *Journal of the American Heart Association*. doi:10.1161/JAHA.114.00923

Kassi, E., Pervanidou, P., Kaltsas, G., & Chrousos, G. (2011). Metabolic syndrome: definitions and controversies. *BMC Medicine, 9,* 48. https://doi.org/10.1186/1741-7015-9-4

Kaur, J. (2014). Assessment and screening of the risk factors in metabolic syndrome. *Medical Sciences, 2,* 140-152. doi:10.3390/medsci2030140

Khorrami, Z., Yarahmadi, S., Etemad, K., Khodakarim, S., Kameli, M.E., & Mahdavi Hazaveh, A.R. (2017). Urban-rural differences in the prevalence of self-reported diabetes and its risk factors: The WHO STEPS Iranian noncommunicable disease risk factor surveillance in 2011. *Iran Journal of Medical Sciences*, 42(5), 481-487. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5722966

Kidy, F.F., Dhalwani, N., Harrington, D., Gray, L., Bodicoat, D., Webb, D., & Khunti, K. (2017). Associations between anthropometric measurements and cardiometabolic risk factors in white European and south Asians. *Mayo Clinic Proceedings*, 92(6), 925-933. doi:10.1016/j.mayocp.2017.02.009

Killam, W.K., & Degges-White, S. (2017). *College student development applying theory to practice on the diverse.* New York, N.Y. Springer Publishing

Kilanowski, J. (2017). Breath of the socio-ecological model. *Journal of Agromedicine, 22*(4), 295-297. https://doi.org/10.1080/1059924x.2017.1358971

Kim, D., Yoon, S.J., Gong, Y.H., Kim, Y. A., Seo, H.Y., Yoon, J., & Kim, A.R. (2015). The economic burden of cancers attributable to metabolic syndrome in Korea. *Journal of Preventive Medicine and Public Health*, *48*(4), 180–187. http://doi.org/10.3961/jpmph.15.022

Kim. H. Y (2014). Analysis of variance (ANOVA) comparing means of more than two group. *Restorative Dentistry & Endodontics*, *39*(1), 74-77. doi:10.5395/rde.2014.39.1.74

Kwon, H., Kim, D., & Kim, J. S. (2017). Body fat distribution and the risk of incident metabolic syndrome: A longitudinal cohort study. *Scientific Reports,7,* 10955. http://doi.org/10.1038/s41598-017-09723-y

Kyrkou, G., Trakakis, E., Attilakos, A., Panagopoulos, P., Chrelias, C., Papadimitriou, & Papantoniou, N. (2016). Metabolic syndrome in Greek women with polycystic ovary syndrome: prevalence, characteristics and associations with body mass index. A prospective controlled study. *Archives of Gynaecology and Obstetrics, 293,* 915–923. doi:10.1007/s00404-015-3964-y

Lam, B.C.C., Koh, G.C.H., Chen, C., Wong, M.T.K., & Fallows, S.J. (2015). Comparison of body mass index (BMI), body adiposity index (BAI), waist circumference (WC), waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) as predictors of cardiovascular disease risk factors in an adult population in Singapore. *PLoS ONE, 10,* 4. doi:10.1371/journal.pone.0122985

Lappa, T., Kallianioti, E., Giotis, A., & Kyriazis, I. (2018). Obesity epidemiology and management- up to date short review. *International Journal of Caring Sciences, 11*(1), 599-606. www.internationaljournalofcaringsciences.org/docs/69/_kyriazis_special_11_1.

Larifla, L., Rambhojan, C., Joannes, M.O., Maimaitiming-Madani, S., Donnet, J.P., Marianne Pépin, T., & Foucan, L. (2016). Gene polymorphisms of FABP2, ADIPOQ and ANP and risk of hypertriglyceridemia and metabolic syndrome in Afro-Caribbean's. *PLoS ONE, 11*(9), e0163421. doi:10.1371/journal.pone.0163421

Lear, S.A., James, P.T., Ko, G.T., & Kumanyika, S. (2010). Appropriateness of waist circumference and waist-to-hip ratio cutoffs for different ethnic groups, *European Journal of Clinical Nutrition, 64,* 42–61, doi:10.1038/ejcn.2009.70

Lee, L., & Sanders, R. A. (2012). Metabolic syndrome. *Paediatrics in Review*, *33*(10), 459–468. doi:10.1542/pir.33-10-459

Lee, B. J., & Kim J.Y. (2014). A comparison of the predictive power of anthropometric indices for hypertension and hypotension risk, *PLoS ONE*, *9* (1), doi:10.1371/journal.pone.0084897

Lee, S., Ko, Y., Kwak, C., & Yim, E. (2016). Gender differences in metabolic syndrome components among the Korean 66-year-old population with metabolic syndrome. *BMC Geriatrics*, *16,* 27. http://doi.org/10.1186/s12877-016-0202-9

Lee, J. J., Peydley, A., Therkelsen, K.E., Hoffmann, U., Massaro, J.M., Levy, D., &Long, M.T. (2017). Upper body subcutaneous fat is associated with cardiometabolic risk factors. *The American Journal of Medicine*, *130*(8), 958-966, http://dx.doi.org/10.1016/j.amjmed.2017.01.044

Lim, U., Ernst, T., Wilkens, L. R., Albright, C. L., Lum-Jones, A., Seifried, A., & Le Marchand, L. (2012). Susceptibility variants for waist size in relation to abdominal, visceral and hepatic adiposity in postmenopausal women. *Journal of* *the Academy of Nutrition and Dietetics*,*112*(7),1048–1055. http://doi.org/10.1016/j.jand.2012.03.034.

Lim, S.M., Choi, D.P., Rhee, Y., &, Kim, H.C. (2015). Association between obesity indices and insulin resistance among healthy Korean adolescents: The JS high school study. *PLOS One.* https://doi.org/10.1371/journal.pone.0125238

Lytle, L. A. (2009). Examining the etiology of childhood obesity: The IDEA study. *American Journal of Community Psychology*, *44*(3-4), 338. http://doi.org/10.1007/s10464-009- 9269-1

Mahabaleshwarkar, R., Taylor, Y.J., Spencer, M.D., & Mohanan, S. (2016). Prevalence of metabolic syndrome in a large integrated health care system in North Carolina. *North Carolina Medical Journal, 77*(3), 168-174, doi:10.18043/ncm.77.3.168

Maharaj, S., & Harding, R. (2016). The needs, models of care, interventions, and outcomes of palliative care in the Caribbean: a systematic review of the evidence. *BMC Palliative Care, 15,* 9, doi:10.1186/s12904-016-0079-6.

Malone, S.K., & Zemel, B.S. (2015). Measurement and interpretation of body mass index during childhood and adolescence. *Journal of School Nursing*, *31*(4), 261-271. doi:10.1177/1059840514548801

Mandal A. (2014). Study of prevalence of type 2 diabetes mellitus and hypertension in overweight and obese people. *Journal of Family Medicine and Primary Care*, *3*(1), 25–28. https://doi.org/10.4103/2249-4863.130265

Manjavong, M., Limpawattana, P., Rattanachaiwong, S., Mairiang, P., & Reungjui, S. (2017). Utility of body mass index and neck circumference to screen for metabolic syndrome in Thai people. *Asian Biomedicine*, *11*(1), 55-63, doi:10.5372/1905-7415.1101.539

Martínez-Mesa, J., González-Chica, D.A., Duquia, R. P., Bonamigo, R. R., & Bastos, J.L. (2016). Sampling: how to select participants in my research study? *Anais Brasileiros de Dermatologia*, *91*(3), 326-330. doi:10.1590/abd1806-4841.20165254.

Martino, F., Pannarale, G., Puddu, P.E., Colantoni, C., Zanoni, C., Martino, E., & Barilla, F. (2015). Is it possible a new definition of metabolic syndrome in childhood? *European Review for Medical and Pharmacological Sciences, 19,* 4324-4331. https://ww.researchgate.net/publication/285733823

Marques, A., Peralta, M. Naia, A., Loureiro, N., & deMatos, M.G. (2017). Prevalence of adult overweight and obesity in 20 European countries, 2014. *European Journal Public Health*. doi:10.1093/eurpub/ckx143.

McHugh, M. L. (2013). The chi-square test of independence. *Biochemia Medica, 23*(2), 143–149. http://doi.org/10.11613/BM.2013.018.

Meisinger, C., Doring, A., Thorand, B., Heir, M., & Lowel, H. (2006). Body fat distribution and risk of Type 2 diabetes in the general population: Are there differences between men and women? The MONICA/KORA Augsburg cohort study. *American Journal of Nutrition*, *84*(3), 483-489. http://doi.org/10.1093/ajcn/84.3.483

Ming-Kuo, T., Pei-Ju Liao, I-Wen, W., Shuo-Wei Chen, Ning-I Yang, Tzu-Yu, L., & Kuang-Hung, H. (2018). Predicting Type 2 diabetes mellitus occurrence using three-dimensional anthropometric body surface scanning measurements: A prospective cohort study. *Journal of Diabetes Research*, *2018*, 10. http://dx.doi.org.ezp.waldenulibrary.org/10.1155/2018/6742384

Mirmiran, P., Rezaei, M., Asghari, G., Mehrabi, Y., & Azizi, F. (2014). Association of metabolic syndrome with body fat percent, anthropometric indices in 10 to 18-year old adolescents. *Iranian Journal of Public Health*, *43*(2), 193–201.

Ministry of Health. (2011). Health report card for Trinidad and Tobago. Trinidad and Tobago: Ministry of health, directorate of health policy, research, and planning. Retrieved from: Ministry of Health, Trinidad, and Tobago. http://www.health.gov.tt

Ministry of Health, Government of Trinidad and Tobago. (2017). National strategic plan for the prevention and control of non-communicable diseases: Trinidad and Tobago 2017 –2021. Retrieved from: Ministry of Health, Trinidad, and Tobago. http://www.health.gov.tt

Ministry of Health & Social Security (MOHSS) Government of Grenada (2018). Strategic plan for health 2016-2025 http://www.nationalplanningcycles.org/sites/default/files/planning_cycle_repository/grenada/grenada_health_sector_strategic_plan_2016-2015_approved.pdf

Monteiro, R., & Azevedo, I. (2010). Chronic inflammation in obesity and the metabolic syndrome. *Mediators of Inflammation, 289645*. http://doi.org/10.1155/2010/289645

Moore, L.M., Fals, A.M., Jennelle, P.J., Green, J.F., Pepe, J., & Richard, T. (2015). Analysis of pediatric waist to hip ratio relationship to metabolic syndrome markers. *Journal of Pediatric Health Care*, *2*9(4), 319-324. doi:10.1016/j.pedhc.2014.12.003

Moore, X. J., Chaudhary, N., & Akinyemiju, T. (2017). Metabolic syndrome prevalence by race/ethnicity and sex in the United States, national health and nutrition examination survey, 1988-2012. *Preventing Chronic Disease, 14.* http://dx.doi.org/10.5888/pcd14.160287

Moreira, G.C, Cipullo, J.P., Ciorlia, L.A.S., Cesarino, C.B., & Vilela-Martin, J.F. (2014). Prevalence of metabolic syndrome: Association with risk factors and cardiovascular complications in an urban population. *PLoS ONE, 9*(9). https://doi.org/10.1371/journal.pone.0105056

Mousavi, S.V., Mohebi, R., Mozaffary, A., Sheikholeslami, F., Azizi, F., & Hadaegh, F. (2015). Changes in body mass index, waist and hip circumferences, Waist to hip ratio and risk of all-cause mortality in men. *European Journal of Clinical Nutrition*, *69*, 927–932. doi:10.1038/ejcn.2014.235.

Muñoz Contreras, A. M., Bedoya Berrío, G., & Velásquez, R. C. M. (2013). An Approach to the etiology of metabolic syndrome. *Colombia Médica*, *44*(1), 57–63. https//www.ncbi.nlm.nih.gov/pmc/articles/PMC4002015

Murphy, G.A.V., Asiki, G., Nsubuga, R.N., Young, E.H., Maher, D., Seeley, J., Sandhu, M.S., & Kamali, A. (2014). The use of anthropometric measures for cardiometabolic risk identification in rural African population. *Diabetes Care*, *37*(4), e64-e65. https://doi: 10.2337/dc13-2096

Naing, L., Winn, T., & Rusli, B.N. (2006). Practical issues in calculating the sample size for prevalence studies. *Archives of Orofacial Sciences, 1*, 9-14. www.dental.usm.my/aos/docs/Vol_1/09_14_ayub.pdf

Nayak, S.B., Teelucksingh, S., Jagessar, A., Maharaj, S. & Maharaj, N. (2013). A cross-sectional study comparing traditional risk Factors with N-terminal Pro-BNP in high risk groups for cardiovascular disease in Trinidad, West Indies. *Diabetes & Metabolic Syndrome: Clinical research & Reviews*, 7(1), 8-11. https://doi.org/10.1016/j.dsx.2013.02.021

Nayak, S.B., Jagessar, A., Mohammed, Z., Rampersad, J., Ramkissoon, S., Biswah, S., & Rampersad, C. (2015). Evaluation of N-terminal pro-B-type natriuretic peptide and high-sensitivity C-reactive protein relationship with features of metabolic syndrome in high-risk subgroups for cardiovascular disease. *International Journal of Applied & Basic Medical Research*, *5*(3), 190-194. doi:10.4103/2229-516x.165369

Nayak, S. B., Rahming, V., Raghunanan, Y., Raghoonath, C., Rahman, A., Rajh, D., & Ramdass, N. (2016). Prevalence of diabetes, obesity and dyslipidemia in persons within high, and low-income groups living in north and south Trinidad. *Journal of Clinical and Diagnostic Research*, *10*(5), IC08–IC13. http://doi.org/10.7860/JCDR/2016/18154.7875

Nichols, S., & Crichlow, H. (2010). An evaluation of the diagnostic utility of anthropometric and body composition cut-off values in assessing elevated fasting blood sugar and blood pressure. *West Indian Medical Journal, 59*(3), 253 -258. http://caribbean.scielo.org/scielo.php?script=sci_arttextpid=S0043-31442010000300006&ing=en&nrm=iso>.

Nichols, G.A., Horberg, M., Koebnick, C., Young, DR., Waitzfelder, B., Sherwood, N.E., Daley, M.F., & Ferrara, A. (2017). Cardiometabolic risk factors among 1.3 million adults with overweight or obesity, but not diabetes, in 10 geographically Diverse Regions of the United States, 2012–2013. *Preventing Chronic Disease*, *14*,160438. http://dx.doi.org/10.5888/pcd14.160438

Nichols, G. A., & Moler, E. J. (2011). Metabolic syndrome components are associated with future medical costs independent of cardiovascular hospitalization and incident diabetes. *Metabolic Syndrome and Related Disorders*, *9*(2), 127-133. http://doi.org/10.1089/met.2010.0105.

Nichols, S., Francis, M., & Dalrymple, N. (2014). Sustainability of a curriculum-based intervention on dietary behaviors and physical activity among primary schoolchildren in Trinidad and Tobago. *West Indian Medical Journal*, 63(1), 68–77. http://doi.org/10.7727/wimj.2014.011.

Nolan, P. B., Carrick-Ranson, G., Stinear, J. W., Reading, S. A., & Dalleck, L. C. (2017). Prevalence of metabolic syndrome and metabolic syndrome components in young adults: A pooled analysis. *Preventive Medicine Reports*, *7,* 211–215. http://doi.org/10.1016/j.pmedr.2017.07.004

Nuttall, F. Q. (2015). Body mass index: obesity, BMI, and health: A critical review. *Nutrition Today*, 50(3), 117–128. http://doi.org/10.1097/NT.0000000000000092

Nyenhuis, S.M., Dixon, A.E., & Ma, J. (2018). Impact of lifestyle interventions targeting healthy diet, physical activity, and weight loss on asthma in adults: What is the evidence? *Journal of Allergy and Clinical Immunology. In Practice*, *6*(3), 751-763. doi:10.1016/j.jaip.2017.10.026

Obeidat, A.A., Ahmad, M.N., Haddad, F.H., & Azzeh, F.S. (2015). Alarming high prevalence of metabolic syndrome among Jordanian adult. *Pakistan Journal of Medical Sciences*, *31*(6), 1377-1382, doi: 10.12.12669/pjms.316.7714

Obisesan, O., Kuo, W., Brunet, M., Obisesan, A., Akinola, O., & Commodore-Mensah, Y. (2017). Predictors of obesity among Nigerian immigrants in United States. *Journal of Immigrants and Minority Health, 19*(2) 328-332. doi:10.1007/s10903-016-0404-4

Oh, Y. H., Moon, J. H., Kim, H. J., & Kong, M. H. (2017). Visceral-to-subcutaneous fat ratio as a predictor of the multiple metabolic risk factors for subjects with normal waist circumference in Korea. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, *10*, 505–511. http://doi.org/10.2147/DMSO.S150914

Ogden, C.L., Carroll, M.D., Kit, B.K., & Flegal, K.M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *Journal of American Medical Association*, 311(8), 808-814. doi:10.1001/jama.2014.732

Ohri-Vachaspati, P., DeLia, D., DeWeese, R.S., Crespo, N.C., Todd, M., & Yedidia, M.J. (2015). The relative contribution of the layers of the social ecological model to childhood obesity. *Public Health Nutrition*, *18*(11), 2055-2066, https://doi.org/10.1017/S1368980014002365

Olafsdottir, A.S Torfadottir, J.E., & Arngrimsson, S.A. (2016). Health behaviour and metabolic risk factors associated with normal weight obesity in adolescents. *PLoS ONE*, *11*(8), e0161451. http://doi.org/10.1371/journal.pone.0161451.

Ordunez, P., Prieto-Lara, E., Gawryszewski, V.P., Hennis, A.J.M., & Cooper, R.S. (2015). Premature mortality from cardiovascular disease in the Americas - Will the goal of a decline of “25% by 2025” be met? e0141685. *PLoS One, 10,* 10. doi:10.1371/journal.pone.0141685

Ortega, F., B., Sui, X., Lavie, C.J., & Blair, S.N. (2016). Body mass index, the most widely used butal so widely criticized index: Would a criterion standard measure of total body fat be a better predictor of cardiovascular disease mortality*? Mayo Clinic Proceedings*, *91*(4), 443-455, doi: 10.1016/j.mayocp.2016.01.008

Osei-Yeboah, J., Owiredu, W. K. B. A., Norgbe, G. K., Yao Lokpo, S., Gyamfi, J., Alote Allotey, E., & Attah, F. A. (2017). The prevalence of metabolic syndrome and its components among people with type 2 diabetes in the Ho municipality, Ghana: A cross-sectional study. *International Journal of Chronic Diseases*, 8765804. http://doi.org/10.1155/2017/8765804

Owolabi, E. O., Ter Goon, D., & Adeniyi, O. V. (2017). Central obesity and normal-weight central obesity among adults attending healthcare facilities in Buffalo City Metropolitan Municipality, South Africa: A cross-sectional study. *Journal of*

Health, Population, and Nutrition, *36*, 54. http://doi.org/10.1186/s41043-017-0133-x

Pagan, E., Chatenoud, L., Rodriguez, T., Bosetti, C., Levi, F., Malvezzi, M., & Bertuccio. P. (2017). Comparison of trends in mortality from coronary heart and cerebrovascular diseases in north and south America: 1980to 2013. *American Journal of Cardiology*, *19*(6), 862-871 .https://doi.org/10.1016/j.amjcard.2016.11.04

Paley, C. A., & Johnson, M. I. (2018). Abdominal obesity and metabolic syndrome: exercise as medicine? *BMC Sports Science, Medicine and Rehabilitation*, *10*, 7. http://doi.org/10.1186/s13102-018-0097-1

Pallan, M., Parry, J., & Adab, P. (2012). Contextual influences on the development of obesity in children: A case study of UK South Asian communities. *Preventive Medicine, 54*(3-4), 205–211. http://doi.org/10.1016/j.ypmed.2012.01.018

Pan American Health Organization. (2016). Eradicating hunger in Latin America and the Caribbean by 2030 is becoming increasingly unlikely. https://reliefweb.int/report/world/eradicating-hunger-latin-america-and-caribbean-2030-becoming-increasingly-unlikely

Pan American Health Organization (PAHO). (2017). Overweight affects almost half the population of all countries in Latin America and the Caribbean except for Haiti. http://www.paho.org/trt/index.php?option=com_content&view=article&id=232:overweight- affects-almost-half-the-population-of-all-countries-in-la-c&Itemid=310&yr=2017

Panizzon, M., Hauger, R. L., Sailors, M., Lyons, M. J., Jacobson, K. C., Murray, R. E., & Franz, C. E. (2015). A new look at the genetic and environmental coherence of metabolic syndrome components. *Obesity*, *23*(12), 2499–2507. http://doi.org/10.1002/oby.21257

Parikh, R.M., & Mohan, V. (2012). Changing definitions of metabolic syndrome, *Indian Journal of Endocrinology Metabolism*, *16*(1), 7–12. doi: 10.4103/2230-8210.91175

Park, Y. S., & Kim, J.S. (2012). Association between waist-to-height ratio and metabolic risk factors in Korean adults with normal body mass index and waist circumference. *Tohoku Journal of Experimental Medicine*, *228*, 1-8. doi:10.1620/tjem.228.1

Parley, C.A., & Johnson, M.I. (2018). Abdominal obesity and metabolic syndrome: exercise as medicine? *BMC Sports Science Medicine Rehabilitation*, *10*(7). doi:10.1186/s13102-018-0097-1

Patel, P., & Abate, N. (2013). Body fat distribution and insulin resistance. *Nutrients*, *5*(6), 2019–2027. http://doi.org/10.3390/nu5062019

Pavanello, C., Zanaboni, A.M., Gaito, S., Botta, M., Mombelli, G., Sirtori, C.R., & Ruscica, M. (2018) Influence of body variables in the development of metabolic syndrome: A long term follow-up study. *PLoS ONE, 13*(2), https://doi.org/10.1371/journal.pone.0192751

Pelegrini, A., Silva, D.A.S., de Lima, J.M.F., Grigollo, L., & Petroski, E.L. (2014). Anthropometric indictors of obesity in the prediction of high body fat in adolescents. *Revista Paulista De Pediatria*, *33*(1), 56-62, http://dx.doi.org/10.1016/j.rpped.2014.06.007

Pérez, C. M., Guzmán, M., Ortiz, A. P., Estrella, M., Valle, Y., Pérez, N., … Suárez, E. (2008). Prevalence of the metabolic syndrome in San Juan, Puerto Rico. *Ethnicity & Disease*, *18*(4), 434–441. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2717036/

Perez, E. A., Oliveira, L. V. F., Freitas, W. R., Malheiros, C. A., Ilias, E. J., Silva, A. S., & Stirbulov, R. (2017). Prevalence and severity of syndrome Z in women with metabolic syndrome on waiting list for bariatric surgery: A cross-sectional study. *Diabetology & Metabolic Syndrome*, *9*, 72. http://doi.org/10.1186/s13098-017-0269-2

Petersen, M.R., & Deddens, J.A. (2008). A comparison of two methods of estimating prevalence ratios. *BMC Medical Research Methodology*, *8*(9). doi:10.1186/1471-2288-8-9

Pierannunzi, C., Hu, S. S., & Balluz, L. (2013). A systematic review of publications assessing reliability and validity of the behavioral risk factor surveillance system (BRFSS), 2004–2011. *BMC Medical Research Methodology*, *13*, 49. http://doi.org/10.1186/1471-2288-13-49

Podgurski, M.J. (2016). Theorists and techniques: Connecting education theories to Lamaze teaching techniques. *Journal of Perinatal Education*, *25*(1), 9-17.doi:10.1891/1058-1243.25.1.9

Popkin, B.M. (2011). Contemporary nutritional transition: determinants of diet and its impact on body composition. *Proceedings of the Nutrition Society*, *70*(1), 82-9. doi:10.1017/S0029665110003903

Prince, S.A., Adamo, K.B., Hamel, M.E., Hardt, J., Gorber, S.C., & Tremblay, M. (2008). A comparison of direct versus self-report measures for assessing physical activity in adults: A systematic review. *International Journal of Behavioral Nutrition and Physical Activity, 5*(5). doi:10.1186/1479-5868-5-56

Rahmani, A., Ahmadi, M. H., Misgavam, S., Farhadi, F., & Shariatpanahi, Z. V. (2014). Body composition and abdominal obesity in patients with and without coronary heart disease. *Cardiology Research*, *5*(2), 68–71. http://doi.org/10.14740/cr324w

Rahman, S.A., & Adjeroh, D. (2015). Surface-based body shape index and its relationship with all-cause mortality. *PLoS One*, *10*(12). doi:10.1371/journal.pone.0144639

Ramdath, D.D., Singh, S., .Hilaire, D.G., & Nayak, B.S.(2013). Determinants of plasma triglyceride levels in a multi-ethnic working-class Caribbean population: Effect of ethnicity, diet and obesity. *Diabetes & Metabolic Syndrome: Clinical Research & Reviews*, *7*(4),198-201. https://doi.or/10.1016/j.dsx.2013.10.019

Ramsaran, C., & Maharaj, R. (2017). Normal weight obesity among young adults in Trinidad and Tobago: Prevalence and associated factors. *International Journal of Adolescent Medicine and Health,* 29(2), 472-9. doi:/10.1515ijamh-2015-0042

Ranasinghe, P., Mathangasinghe, Y., Jayawardena, R., Hills, A.P., & Misra, A. (2017). Prevalence and trends of metabolic syndrome among adults in Asia-pacific region: Systematic review. *BMC Public Health*, *17*(101), 1-9.doi:10.1186/s12889-017-4041-1

Reinehr, T. (2016). Metabolic syndrome in children and adolescents: A critical approach considering the interaction between pubertal stage and insulin resistance. *Current Diabetes Report, 16*(8). doi:10.1007/s11892-015-0695-1

Rizzo, A.C., Goldberg, T.B., Silva, C.C., Kurokawa, C.S., Nunes, H.R., & Corrente, J.E. (2013). Metabolic syndrome risk factors in overweight, obese, and extremely obese Brazilian adolescents. *Nutrition Journal*, 12(19). doi.org/10.1186/1475-2891-12-19

Robbins, J., Benson, B., Esangbedo, I., Ward, R., & Haden, R. (2016). Childhood obesity in an inner-city primary care population: A longitudinal study. *Journal of the National Medical Association, 108*(3), 158-163. doi:10.1016/j.jnma.2016.05.006

Roopnarinesingh, N., Brennan, N., Khan, C. Ladenson, P.W., Hill-Briggs, F., & Kalyani, R.R. (2015). Barriers to optimal diabetes care in Trinidad and Tobago: A health care professionals' perspective. *BMC Health Services Research, 15,* 396. doi:10.1186/s12913-015-1066-y

Rueda, M. S, Herencia, J.C., Orozco, J.M., Rodenas, L.M.A., Valero, L.C., Garrote,… Escribano, F.M. (2011). Association of insulin resistance with different anthropometric measures and cardiovascular risk factors in a non-diabetic population. *Endocrinology Nutrition, 58,* 464-71. doi:10.1016/j.endoen.2011.06.006

Ryu, H., Jung, J., Cho, J., & Chin D.L. (2017). Program development and effectiveness of workplace health promotion program for preventing metabolic syndrome among office workers. *International Journal of Environmental Research and Public Health*, 14, 878. doi:10.3390/ijerph14080878

Sadeghi, M., Pourmoghaddas, Z., Hekmatnia, A., Sanei, H., Tavakoli, B., Tchernof, A., Roohafza, H., … Sarrafzadegan, N. (2013). Abdominal fat distribution and serum lipids in patients with and without coronary heart disease. *Archives Iranian Medicine*, *16*(3),149–153. doi: 013163/AIM.006

Sahar, D., Seyed, H.N., Reza, M., Reza, G.G., Sahar, S., Wesam, K., … RezaA. (2017). Prevalence of metabolic syndrome among Iranian population: A systematic review and meta-analysis. *Iranian Journal of Public Health, 46*(4), 456-467. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5439034/

Salas, X.R., Forhan, M., Caulfield, T., Sharma, A., & Raine, K. (2017). A critical analysis of obesity prevention policies and strategies. *Canadian Journal of Public Health*, *108*(5/6), E598-E608. doi:10.17269/cjph.108.6044

Salonen, M. K., Wasenius, N., Kajantie, E., Lano, A., Lahti J, Heinonen K., … Eriksson, J.G. (2015). Physical activity, body composition and metabolic syndrome in young adults. *PLoS ONE 10*, (5). https://doi.org/10.1371/journal.pone.0126737

Samuels, T.A., Kirton, J., & Guebert, J., (2014). Monitoring compliance with high-level commitments in health: the case of the CARICOM Summit on chronic non-communicable diseases. *World Health Organization. Bulletin of the World Health Organization, 92*(4), 270-276B. doi:10.2471/BLT.13.126128

Scholze, J., Alegria, E., Ferri, C., Langham, S., Stevens, W., Jeffries, D., & Uhl-Hochgraeber, K. (2010). The epidemiological and economic burden of metabolic syndrome and its consequences in patients with hypertension in Germany, Spain, and Italy; a prevalence-based model. *BMC Public Health, 10,* 529. http://doi.org/10.1186/1471-2458-10-529.

Sebo, P., Herrmann, F. R., & Haller, D. M. (2017). Accuracy of anthropometric measurements by general practitioners in overweight and obese patients. *BMC Obesity, 4.* http://dx.doi.org.ezp.waldenulibrary.org/10.1186/s40608-017-0158-0

Sedgwick, P. (2014). Cross-sectional studies: advantages and disadvantages. *British Medical Journal*, *348,* g2276. doi:10.1136/bmj. g2276

Setia, M. S. (2016). Methodology series module 3: Cross-sectional studies. *Indian Journal of Dermatology*, *61*(3), 261–264. http://doi.org/10.4103/0019-5154.182410

Shazhan, A. (2015). The future of treating youth-onset Type 2 diabetes: Focusing upstream and extending our influence into community environments. *Current Diabetes Reports, 15*(3). doi:10.1007/s11892-015-0576-7

Shakiba, M., Mansournia, M.A., Salari, A., Soori, H., Mansournia, N., & Kaufman, J. S. (2017). Accounting for time varying confounding in the relationship between obesity and coronary heart disease: Analysis with G-estimation. *American Journal of Epidemiology*, *187*(6). doi:10.1093/aje/kwx360

Shephard, R.J. (2003). Limits to the measurement of habitual physical activity by questionnaire. *British Journal of Sport Medicine*, *37*(3), 197-206. doi:10.1136/bjsm.37.3.197

Singh-Ackbarali, D., & Maharaj, R. (2017). Perceptions of healthy eating, nutrition and obesity among select groups of the population in Trinidad. *International Journal of Social Science Studies*, *5*(11). doi:10.11114/ijsss. v5i11.2699

Skelton, J., Buehler, C., Irby, M., & Grzywacz, J. (2012). Where are family theories in family-based obesity treatment? conceptualizing the study of families in paediatric weight management. *International Journal of Obesity*, 36(7), 891-900. http://doi.org/10.1038/ijo.2012.56

Sheehy, T., & Sharma, S. (2013). Trends in energy and nutrient supply in Trinidad and Tobago from 1961 to 2007 using FAO food balance sheets. *Public Health Nutrition*, *16*(9). doi:10.1017/S136898001200537X

Short, M.E., Goetzel, R.Z., Pei, X., Tabrizi, M.J., Ozminkowski, R.J., Gibson, T.B., & Wilson, M.G. (2009). How accurate are self-reports? An analysis of self-reported healthcare utilization and absence when compared to administrative data. *Journal of Occupational Medicine*, *51*(7),7 86-796. doi:10.1097/JOM.0b013e3181a86671

Sobers-Grannum, N., Murphy, M.M., Nielsen, A., Guell, C., Samuels, T.A., Bishop, L. & Unwin, N. (2015). Female gender is a social determinant of diabetes in the Caribbean: A systematic review and meta-analysis. *PLoS ONE*, *10*(5). doi:10.1371/ journal.pone.0126799

Sohn, K. (2017). The fatter are happier in Indonesia, *Quality of Life Research*, *26*(2), 393-402. doi:10.1007/s11136-016-1403-6

Solmon, M.A. (2015). Optimizing the role of physical education in promoting physical activity: A social-ecological approach. *Research Quarterly for Exercise and Sport*, 86(4), 329-337. doi:10.1080/02701367.2015.1091712

Solomons, N., Kruger, H. S., & Puoane, T. (2020). Association between dietary adherence, anthropometric measurements and blood pressure in an urban black population, south Africa. *South African Journal of Clinical Nutrition, 33*(1). http://dx.doi.org.ezp.waldenulibrary.org/10.1080/16070658.2018.1489602

Sousa, V. D., Driessnack, M., & Mendes, I. A. (2007). An overview of research designs relevant to nursing: Part 1: quantitative research designs. *Revista Latino-Americana de Enfermagem, 15*(3), 502-507. https://dx.doi.org/10.1590/S0104-11692007000300022

Stoltzfus, J.C. (2011). Logistic regression: A brief primer. Academic emergency medicine. *Official Journal of the Society of Academic Emergency Medicine, 18*(10), 1099-1104. doi.org/10.1111/j.1553-2712.2011.01185x

Sullivan, G. M. (2011). A Primer on the validity of assessment instruments. *Journal of Graduate Medical Education*, *3*(2), 119–120. http://doi.org/10.4300/JGME-D-11-00075.1

Swainson, M.G., Batterham, A.M., Tsakirides, C., Rutherford, Z.H., & Hind, K. (2017). Prediction of whole-body fat percentage and visceral adipose tissue mass from five anthropometric variables. *PLoS One*, *12*(5), doi:10.1371/journal.pone.0177175

Thawornchaisit, P., DeLooze, F., Reid, C.M., Seubsman, S.A., & Tai Cohort Study Team. (2013). Validity of self-reported hypertension. Findings from the Thai cohort study compared to physician telephone interview. *Global Journal of Health Science, 6*(2) 1-11, doi:10.5539/gjhs.v6n2p1

Thomas, E.T.A., Bhagya, S., & Noble, G. (2018). The on-going epidemic of diabetes mellitus in India: Genetics or lifestyle? *International Journal of Diabetes in Developing Countries*, 1-7. doi:10.1007/s13410-018-0630-5

Traboulay, E., & Hoyte, O. (2015). Mini review: Obesity in Caribbean youth. *West Indian Medical Journal*, *64*(3), 250–262. http://doi.org/10.7727/wimj.2014.379

Tull, E. S., Thurland, A., & LaPorte, R.E. (2005). Metabolic syndrome among Caribbean born persons living in the U.S. Virgin Islands. *Revista Pan americana de Salud Pública,18*(6), 418–26. https://www.scielosp.org/pdf/rpsp/2005.v18n6/418-426/en

Tuoyire, D.A. (2018). Television exposure and overweight/ obesity among women in Ghana. *BMC Obesity*, *5*(8), 1-10, https://doi.org/10.1186/s40608-018-0186-4

Vanlancker, T., Schaubroeck, E., Vyncke, K., Cadenas-Sanchez, C., Breidenassel, C., Gonzalez-Gross, M., … Huybrechts, I. (2017). Comparison of definitions for the metabolic syndrome in adolescents. The HELENA study. *European Journal Pediatrics, 176*, 241-252. doi:10.1007/s00431-016-2831-6

VanWormer, J. J., Boucher, J. L., Sidebottom, A. C., Sillah, A., & Knickelbine, T. (2017). Lifestyle changes and prevention of metabolic syndrome in the Heart of

New Ulm Project. *Preventive Medicine Reports*, *6*, 242–245. http://doi.org/10.1016/j.pmedr.2017.03.018

van Zyla, S., van der Merwea, L.J., van Rooyenb, F., Joubertb, G., & Walsh, C. M. (2017). The relationship between obesity, leptin, adiponectin and the components of metabolic syndrome in urban African Women, free state, south Africa. *South African Journal of Clinical Nutrition*, *30*(3), 68–73. https://doi.org/10.1080/16070658.2017.1267380

Vélez-Agostos, N.M., Soto-Crespo, J.G., Vizcarrondo-Oppenheimer, M., Vega-Molina, S., & Garcia Coll, C. (2017). Bronfenbrenner's bioecological theory revision: Moving culture from the macro into the micro. *Prospective on Psychological Science*, *12*(5), 900-910. doi:10.1177/1745691617704397

Ventura, L.L.A., Fortes, N.C.L., Santiago, H.C., Caliari, M.V., Gomes, M.A., & Oliveria, D.R. (2017). Obesity-induced diet leads to weight gain, systemic metabolic alterations, adipose tissue inflammation, hepatic steatosis, and oxidative stress in gerbils (Merionesunguiculatus). *Peer J*, 1-19, doi:10.7717/peerj.2967

Verna, M., Rajput, M., Sahoo, S., & Kaur, N. (2017). Neck circumference: Independent predictor for overweight and obesity in adult population. *Indian Journal of Community Medicine, 42*(4). doi:10.4103/ijcm.IJCM_196_16

Vetter, T. R. (2017). Fundamentals of research data and variables: The devil is in the details. *Anesthesia Analgesia, 125*(4), 1373-1380, doi10.1213/ANE.0000000000002370

Vliet-Ostaptchouk, J.V., Nuotio, M., Slagter, S.N., Doiron, D., Fischer, K, Luisa Foco, L., & Wolffenbuttel, B.H.R (2014). The prevalence of metabolic syndrome and metabolically healthy obesity in Europe: a collaborative analysis of ten large cohort studies. *BMC Endocrine Disorders*, *14*(9). doi:10.1186/1472-6823-14-9

Villamor, E. Finan, C.C., Ramirez-Zea, M., & Roman, A.V. (2017). Prevalence and socio demographic correlates of metabolic syndrome in school-aged children and their parents in nine Meso American countries. *Public Health Nutrition*, *20*(2), 255-265.doi:10.1017/S1368980016002342

Wada, T., Tamakoshi, K., Tsunekawa, T., Otsuka, R., Zhang, H., Murata, C.…Toyoshima, H. (2005). Validity of self-reported height and weight in a Japanese workplace population. *International Journal of Obesity*, *29,* 1093-1099. doi: 10.1038/sj.ijo.0803012

Wagner, D.V., Stoeckel, M., Tudor, M.E., & Harris, M.A. (2015). Treating the most vulnerable and costly in diabetes. *Current Diabetes Reports*, *15*(6), 1-7. doi:10.1007/s11892-015-0606-5

Wagner, W. (2016). *Using IBM SPSS. Statistics for research methods and social science statistics* (p. 3). SAGE Publications.

Walden University (n.d). Research ethics & compliance: Welcome from the IRB. Retrieved from http://academicguides.waldenu.edu/researchcenter/orec

Wannamethee, S. G., & Atkins, J. L. (2015). Muscle loss and obesity: the health implications of sarcopenia and sarcopenic obesity. *Proceedings of the Nutrition Society, 74*(4), 405-412. doi:10.1017/S002966511500169X

Ward, Z.J., Long, M.W., Resch, S.C., Gortmaker, S.L., Cradock, A.L., Giles, C… Wang, Y.C. (2016). Redrawing the US obesity landscape: Bias-corrected estimates of state-specific adult obesity prevalence. *PLOS One*, *11*(3), e0150735. doi:10.1371/journL.PONE.0150735

Wen, J., Yang, J., Shi, Y., Liang, Y, Wang, F., Duan, X., … Wang, N. (2015). Comparisons of different metabolic syndrome definitions and associations with coronary heart disease, stroke, and peripheral arterial disease in a rural Chinesepopulation. *PLoS ONE, 10*(5), e0126832. https://doi.org/10.1371/journal.pone.0126832

Wennberg, M., Gustafssn, P.E., Wennberg, P., & Hammarstòm, A. (2015). Poor breakfast habits in adolescence predict the metabolic syndrome in adulthood. *Public Health Nutrition*, *18*(1), 1222-129. doi:10.1017/S136890013003509

White, S.C., Agurto, I., & Araguas, N. (2006). Promoting healthy behavior to prevent chronic disease in Panama and Trinidad and Tobago: Results of the women as agents of change project. *Journal of Community Health*, *31*(5). doi:10.1007/s10900-006-9022-8

World Health Organization (nd). Cost-effectiveness and strategic planning (WHO-CHOICE). http://www.who.int/choice/demography/american_region/en/

World Health Organization. (2000). Obesity: preventing and managing the global epidemic. Report of a WHO consultation. Geneva, Switzerland: (WHO technical report series, 894). https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/

World Health Organization. (2008). Waist circumference and waist-hip ratio: Report of a WHO expert consultation Geneva. http://apps.who.int/iris/bitstream/handle/10665/44583/9789241501491_eng.pdf;jsessionid=6B7E804EB73C546D5D29F2A09B7AF0E3?sequence=1

World Health Organization. (2016). Obesity and overweight. *Fact sheet*. http://www.who.int/mediacentre/factsheets/fs311/en/

Wyatt, H.R. (2013). Update on treatment strategies for obesity. *Journal of Clinical Endocrinology & Metabolism, 98*(4), 1299–1306. https://doi.org/10.1210/jc.2012-3115

Yip, C., Han, N. R., & Sng, B. L. (2016). Legal and ethical issues in research. *Indian Journal of Anesthesia*, *60*(9), 684-688, doi:10.4103/0019-5049.190627

Xiao, J., Shen, C., Chu, M.J., Gao, Y.X., Xu, G.F., Huang, J.P… Cai, H. (2016). Physical activity and sedentary behavior associated with components of metabolic syndrome among people in rural China. *PLoS ONE, 11*(1), e0147062. https://doi.org/10.1371/journal.pone.0147062

Xiao, J., Wu, C., Gao, Y., Wang, S., Wang, L., Lu, Q., … Cai. H. (2016). Prevalence of metabolic syndrome and its risk factors among rural adults in Nantong, China. *Scientific Reports, 6,* 38089. doi:10.1038/srep38089

Xu, T., Liu, J., Liu, J., Zhu, G., & Han, S. (2017). Relation between metabolic and body compositions among Chinese adolescents and adults from a large-scale population survey. *BMC Public Health, 17,* 337. http://doi.org/10.1186/s12889-017-4238-3

Zhang, Z., Deng, J., He, L., Ling, W., Su, Y., & Chen, Y. (2013). Comparison of various anthropometric and body fat indices in identifying cardiometabolic disturbances in Chinese men and women. *PloS ONE, 8*(8), e70893. doi:10.1371/journal.pone,0070893

Appendix A: Research Instrument/Questionnaire

Section 1: Demographics

1,1 Indicate sex of respondent.

1 Male

2 Female

1.2 What is your age?

_____age in years

7 7 Don't know / Not sure

9 9 Refused

1.3 Which one or more of the following would you say is your race?

10 White

20 Black

30 Indian

40 Chinese

50 Mixed- race

1.4 Are you…?

1 Married

2 Divorced

3 Widowed

4 Separated

4 Never married

1.5 What is the highest level or year of school you completed?

1 kindergarten

2 Elementary/ Primary school

3 Secondary school

4 Technical/Vocational school

6 Colleague/University

7 Post graduate degree

9 9 Refused

1.6 Is your monthly income from all sources?

1 < $1,000

2 $1,000 - $2,999

3 $3,000 - $4,999

4 $5,000 - $6,999

5 $7,000 - $9,999

6 ≥ $10,000

77 Don't Know

9 9 Refused

<u>Section 2: Obesity Measures</u>

2.1 About how much do you weigh without shoes?

_ _ _ _ Weight (pounds/kilograms)

7 7 Don’t know / Not sure

9 9 Refused

2.2 About how tall are you without shoes?

_ _ / _ _ Height (centimeters)

7 7/ 7 7 Don’t know

9 9/ 9 9 Refused

2.3 During the health screening exercise in your workplace, about how much was your waist measurement in centimeters?

_ _ _ _ Waist (centimeters)

7 7Don’t know / Not sure

9 9 Refused

2.4 During the health screening exercise in your workplace, about how much was your hip measurement?

_ _ _ _ Hip (centimeters)

7 7 Don’t know / Not sure

9 9 Refused

Section 3: Metabolic Risk Awareness

3.1 During the health screening exercise in your workplace, have you been told by health professional that you have high blood pressure?

1 Yes

2 No

77 Don’t know / Not sure

9.9 Refused

3.2 During the health screening exercise in your workplace, about how much was your blood pressure measurement?

_ _ _ _ mmHg

7 7 Don’t know / Not sure

9 9 Refused

3.3 During the health screening in your workplace, have you been told by health professional that you have high blood sugar levels?

1 Yes

2 No

7 7 Don’t know / Not sure

9 9 Refused

3.4 During the health screening exercise in your workplace, about how much was your blood sugar measurement?

_ _ _ _ mg/dl

7 7 Don’t know / Not sure

9 9 Refused

<u>Section 4: Behavior Risk Factors</u>

4.1 Do you now smoke cigarettes every day, some days, or not at all?

1 Every day

2 Some days

3 Not at all

7 7 Don’t know / Not sure

9 9 Refused

4.2 During the past 12 months, have you stopped smoking for one day or longer because you were trying to quit smoking?

1 Yes

2 No

7 7 Don’t know / Not sure

9 9 Refused

4.3 During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage such as, beer, wine, a malt beverage or liquor, whiskey, gin, vodka?

1 _ _ Days per week 2

2 _ _ Days in past 30 days

3_ _No drinks in past 30 days

7 7 Don't know / Not sure

9 9 Refused

4.3 Are you currently watching or reducing your sodium or salt intake?

1 Yes

2 No

7 7 Don't know/not sure

9 9 Refused

4.4 Has a doctor or other health professional ever advised you to reduce sodium or salt intake?

1 Yes

2 No

4.5 During the past 30 days, how often did you drink sugar-sweetened fruit drinks (such as Kool-aid and lemonade), sweet tea, and sports or energy drinks (such as Gatorade and Red Bull)? Do not include 100% fruit juice, diet drinks, or artificially sweetened drinks.

1 _ _ Times per day

2 _ _ Times per week

3 _ _ Times per month

4._ _None

7 7 Don’t know / Not sure

9 9 Refused

4.6 During the past month, how many times per day, week or month did you drink 100% PURE fruit juices? Do not include fruit-flavored drinks with added sugar or fruit juice you made at home and added sugar to. Only include 100% juice.

1 _ _ Per day

2 _ _ Per week

3 _ _ Per month

4 _ _ Never

7 7 Don’t know / Not sure

9 9 Refused

4.7 During the past month, not counting juice, how many times per day, week, or month did you eat fruit? Count fresh, frozen, or canned fruit

1 _ _ Per day

2 _ _ Per week

3 _ _ Per month

4 _ _Never

7 7 Don't know / Not sure

9 9 Refused

4.8 During the past month, how many times per day, week, or month did you eat dark green vegetables, yellow ones and other ones forexample patchoi, dasheen bush, badji (any dark leafy greens), bodi, broccoli, carrots, squash, egg plants, cabbage, tomatoes, cauliflower

1 _ _ Per day

2 _ _ Per week

3 _ _ Per month

4 _ _ Never

7 7 Don't know / Not sure

9 9 Refused

4.9 During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, basketball, netball, swimming, gardening, or walking for exercise?

1 Yes

2 No

7.7 Don’t know / Not sure

9 9 Refused

4.10 What type of physical activity or exercise did you spend the most time doing during the past month?

_ _ (Specify)

7 7 Don’t know / Not Sure

9 9 Refused

Appendix B: Research Advertisement

PARTICIPANTS REQUIRED FOR RESEARCH

WHO CAN PARTICIPATE IN THE STUDY

Inclusion criteria for the study:

- A native Tobagonian
- Between the ages of 18 to 60 years
- Participants ***must*** have their blood pressure and blood glucose tested during a workplace wellness screening exercise.

Exclusion criteria for the study:

- Participants diagnosed with diabetes or hypertension ***before*** the health screening exercise.
- Participants ***currently t***aking medications for health conditions of diabetes, high blood cholesterol, and high blood pressure.
- Pregnant women and lactating mothers.

The study involves only a self-reporting questionnaire. Participant's name will not be requested at any time during the questionnaire. Participants will be asked to self-report on health screening information such as weight, height, blood sugar and blood pressure readings obtained via the screening.

Anonymous questionnaire includes questions on dietary, physical, alcohol, smoking habits, age, gender, marital status, educational level, and income bracket.

Participants will be referred to health professionals for any health-related questions or resources.

A summary of the research findings will be posted on my facebook page https://www.facebook.com/joanne.cruickshank.754 at the end of the research.

Are You Interested?
Please Contact: MrsJoanne Cruickshank
Contact:# xxxxxxxx
Email: xxxxxxxxxxxx

Appendix C: Letter of Approval THA

Office of the Chief Secretary
Chief Administrator's Office
Tobago House of Assembly
Administrative Complex,
62-64 Calder Hall Road,
Calder Hall, Scarborough 900408
Tel. No. (868) 660-7511, Fax. (868) 639-4151

March 3, 2020

Mrs. Joanne Cruickshank
#26 Sangster Hill
Scarborough
Tobago

Dear Mrs. Cruickshank,

Re: Seeking Official Approval to Conduct Research

Approval has been granted to conduct research project entitled "Prevalence of Metabolic Risk Factors with Abnormal Obesity Measures amongst Tobago Adult Population," within the Tobago House of Assembly.

Kindly liaise with the pertinent Divisions to complete your exercise.

Please be guided accordingly.

Yours respectfully,

Bernadette Solomon-Koroma

Bernadette Solomon-Koroma
Chief Administrator
Tobago House of Assembly

Appendix D: Letter of Approval TRHA

TOBAGO REGIONAL HEALTH AUTHORITY

Doretta's Court, #197 Mt. Marie Road, Lower Scarborough, Tobago, West Indies.
Telephone: 1-868-635-3000, 639-3908 • Fax: 1-868-660-7538
Website: www.trha.co.tt • Email: trha@trha.co.tt

March 5th, 2020

Mrs. Joanne Cruickshank
#26 Sangster Hill
Scarborough
TOBAGO

Dear Mrs. Cruickshank,

Re: Research Study - Access to Workplace Wellness Programme Schedule

Reference is made to your letter dated February 26th 2020, and your request to conduct a research study.

Further to the non-objection of the Audit Committee of the Board of Directors (May 1st, 2019), TRHA and the subsequent approval of the Research and Ethics Committee of the Tobago House of Assembly (February 23rd, 2020; The TRHA hereby authorizes you to access the Authority's Workplace Wellness Programme Schedule.

This authorization is granted in accordance with the approval of the Research and Ethics Committee (THA), to conduct research on *"Prevalence of Metabolic Risk factors with Obesity Measures Amongst Tobago's Adult Population"*.

Respectfully,
TOBAGO REGIONAL HEALTH AUTHORITY

WESTLY ORR
INTERIM CHIEF EXECUTIVE OFFICER

"Your Health is Our Progress"

Appendix E: Letter of Approval THA Ethics Committee

OFFICE OF THE SECRETARY OF HEALTH, WELLNESS AND FAMILY DEVELOPMENT
DIVISION OF HEALTH, WELLNESS AND FAMILY DEVELOPMENT
TOBAGO HOUSE OF ASSEMBLY
107 Wilson Road, Scarborough, Tobago.
Telephone: 639-3395 Fax: 635-2604,

23rd February,2020

Dear **Ms. Joanne Cruickshank,**

The Research Ethics Committee (REC) of the Tobago House of Assembly has reviewed your proposal entitled "*Prevalence of Metabolic Risk Factors with Abnormal Obesity Measures amongst Tobago Adult Population*" and approval has been granted.

This approval is granted for a period of one (1) year, effective 23rd February, 2020. At the end of the study a final report must be submitted. If the research has not been completed at the end of the initial approval period, a progress report and a request for extension of approval must be submitted.

Note also that any changes to the protocol should be immediately reported to the Research Ethics Committee.

We look forward to your research.

Kind Regards,

Stacy Matthews-Sealy

/F/ Professor Donald T. Simeon
Chair, Research Ethics Committee - THA