# FEMALE EMPOWERMENT AS A SOCIAL DETERMINANT OF FEMALE OBESITY: A COMPARATIVE ANALYSIS OF NIGERIAN AND CANADIAN WOMEN

by

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# ABSTRACT

This study examined the effect of women's empowerment as a social determinant of female obesity in Nigeria and Canada. The study consists of descriptive analysis and a multinomial logistic regression of the women empowerment metrics and its relationship with female obesity in Canada and Nigeria. The prevalence rates of the various obesity categories underweight (UW), normal weight (NW), overweight (OW) and obese (O) based on the CCHS and NDHS, were approximated as Canada (UW (≈3%), NW (≈52%), OW (≈25%) and O (≈20%)) and Nigeria (UW (≈12%), NW (≈61%), OW (≈18%) and O (≈9%)) respectively. Odds ratios (OR) reveals that the women empowerment indicators have effect on female obesity at all significance levels ($p < 1\%, 5\%$ and $10\%$). In Canada obesity is a modifiable risk factor for empowered women while in Nigeria obesity is a thing of wealth, attention should be focused on mitigating strategies that are non pharmacologically centric.

# DEDICATION

I dedicate this work to Yeshua Hamashiach whose profound teaching is my primary source of existence, also to my family especially Julia Ejeh –Dickson and Prisca Ejeh (Big Sis), the entire community of the city of Fredericton, Hope City, Judy Robinson, Larry Robinson, and Sharon Lougheed just to mention a few –Thank You!

My sincere gratitude goes to my interim supervisors: Prof. Mary Mckenna and Prof. Neeru Gupta, more importantly I am forever grateful to my primary supervisors Prof. Richard Audas and Prof. Lisa Keeping – Burke, they both ensured that I am not left in the middle of the ocean by providing the necessary tools and guidance to guarantee that I get to the end of this work and the program in general.

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## Chapter 1: Introduction

Researchers have constantly emphasized that female empowerment is critical for sustainable development in countries all over the world. The disparity, discrimination, and limited access to opportunity for women tends to impact a given population and human development as a whole (De Soysa & Lewin, 2019; Gupta & Yesudian, 2006). Obesity is identified as a condition that limits quality of life of an individual and continues to be more prevalent amongst women than men (Fox et al., 2019; Neupane et al., 2015). Reports and research have constantly linked women empowerment as an influence to health conditions (Alsop et al., 2005; Dickson, 2021; Garces-Ozanne et al., 2016; Gupta & Yesudian, 2006; Mosedale, 2005; Samanta, 2020).

To better understand the indicators that best describe female empowerment and its influence on body size, this study considers a low and middle income country, Nigeria, and a high income country, Canada. These two countries were selected for comparison for the following reasons. First, studies including women from Nigeria and Canada have similar obesity measurement but differ in the prevalence of obesity. Second, both countries belong to two separate economic classes, with Canada being considered a high income country and Nigeria being a low and middle income country. This consideration will help facilitate the process for elucidating how the identified factors of empowerment can affect women across economic lines. Finally, for the sake of specificity, limiting the comparison between these two countries of interest will provide a clearer picture of how such factors influence obesity at an individual level

between both countries; this is because most studies focus on groups of multiple countries with risks factors examined at a national, rather than individual, level.

This section seeks to introduce and elucidate female empowerment as a social determinant of obesity. The preamble of the study includes background information centered on the key indicator of female empowerment that is linked directly to socioeconomic position of women and its influence on obesity. There are several metrics of empowerment which include, but are not limited to, agency (political rights and civil liberties), but the salient metrics relevant for this research include education, employment, income and environment. Age, marital status and other socio demographic factors are used as control variables and the measure of female obesity is the body mass index (BMI).

## 1.1 Background

There have been tremendous investments in factors that help to empower women. For example, there have been significant efforts to increase girls' education over the past decades as reflected on the millennium development goals that ended in 2015 (de Jong & Vijge, 2021). Although not all targets were met it became of necessity to translate some of the unmet goals to the sustainable development goals (SDGs) scheduled to meet the 2030 target. However, the achievements of the current goals of the SDGs are limited due to several factors, one of which is related to women's access to opportunities of empowerment. Most studies have identified cultural norms as a key limitation hindering access to opportunities. In most cases this is difficult to measure and mostly occurs because of limited or scarce resources. Unfortunately access to such

resources in some countries does not favor women. This kind of limitation has its consequence on the overall development of a given society and the general overall health of women (Deneulin, 2009; Duflo, 2012; Nussbaum, & Glover, 1995).

Obesity as a disease is becoming more prevalent globally and at an alarming rate. There are more obese women globally each year, hence the need to understand empowerment as a social determinant of obesity is a step towards mitigating the obesity epidemic (Kanter & Caballero, 2012). Researchers have continually identified female obesity to have an association or relationship with women's access to education, employment, income and environment (Andersen, 1999; Carbonnier, 2014; Frank & Engelke, 2001; Kpelitse et al., 2014; Martín et al., 2008; Morris, 2007), and these variables will be elaborated upon later in the literature review chapter.

The Gender Empowerment Measure (Klasen, 2006) and Human Development Index (Klasen, 2006) are both examples of measures for assessing empowerment at a national level with very few studies considering empowerment at an individual level. The Grossman model (2009) in this regard is different and is a framework for helping explain variations in individual health and medical care in terms of variations in supply and demand curves for health capital. A change in the supply curve signifies a change in the rate of depreciation on the stock of health with age, and significant change in the wage rate and education (Grossman, 1999). The Grossman Model considers an individual's investment of time as a form of empowerment into producing better health, whereby health itself is considered a home good (home goods are things acquired for the purpose of enjoyment or "fun" things). The time invested refers to engaging in activities such as acquiring education, working, income to buy things or carrying out

exercise to produce better health (like maintaining healthy body weight)(Grossman, 1972, 1999). In addition, when considering female empowerment as a social determinant of obesity, education, income, employment and environment are key indicators in estimating women empowerment as well as socioeconomic determinants of women obesity in similar studies (De Soysa & Lewin, 2019; Gupta & Yesudian, 2006; Maruf & Udoji, 2015; NCD Risk Factor Collaboration (NCD-RisC) – Africa Working Group et al., 2017; Siddiqi et al., 2015).

To elaborate on the above point, as an example, globally there has been a steady increase in the mean body mass index of women for decades (NCD Risk Factor Collaboration (NCD-RisC) – Africa Working Group et al., 2017; World Health Organization, 2000; World Obesity Federation, 2020). Obesity, defined on the basis of excessive fat accumulation detrimental to an individual's health and BMI above $30kgm^{-2}$, is considered a measure of being obese for most countries in studies based on the World Health Organization's (WHO) recommendations, although certain biases do exist. However, there are differences on how women's empowerment and obesity interact across countries and this is influenced by many factors including beliefs and norms, complexities in classifying countries as well as the difficulty in getting an accurate measure of empowerment. To mitigate this challenge, it is important to be able to control the variables and use a binary classification for the countries of interest (i.e. use of only two distinct countries for comparison) to better understand the dynamics of female obesity as a challenge and how empowerment influences this. The research for this study hopes to address some of these challenges by focusing exclusively on Canada and Nigeria for comparison purposes.

## 1.2 Statement of problem

Ideally, researchers should be able to understand the complexities associated with current global obesity prevalence to aid administering interventions and limit the prevalence of unhealthy and excessive weight gain (WHO, 2000; World Obesity Federation, 2020) . Although various factors of empowerment have been identified to influence obesity distribution among females across the globe, the research to date does not identify if variation in obesity distribution is due to limited studies capturing these indicators by context (i.e. a factor of empowerment in a particular country may not be considered as such in another country). As a result of this, and considering how countries are categorized based on income levels, it is difficult to segregate or re-categorize countries in order to consider these factors by context for analysis at an individual level. Thus recommendations from such studies are mostly vague and generalized and may lack the capacity to explain obesity and our understanding of the epidemic in general.

## 1.3 Objective of Study

The primary objective of this study is to explore women's empowerment as a social determinant of female obesity by conducting a comparative analysis of Canada and Nigeria. The study consists of descriptive analyses of the common measures of women empowerment including environment, income, employment and education and its relationship with the distribution of female obesity in Canada and Nigeria to determine the effect of women's empowerment measures on female obesity. Specifically it will be determined whether a significant increase or decrease in women

empowerment is associated with a positive or negative distribution of female obesity. The analyses will examine education, income, employment and environment as factors of women empowerment as identified in the background information, while controlling for age and marital status as confounders of the examined relationships. The relationships between female obesity and the identified factors of women empowerment will be examined and explored.

## 1.4 Research Question

The following research question guides the study:

- What is the effect of women's empowerment as a social determinant of female obesity in Nigeria and Canada?

## 1.5 Significance of this Study

This study aims to add to the scholarly literature on women empowerment as a social determinant of female obesity. Previous research has focused on a general or global view, of social determinants to help explain obesity, with little focus on female empowerment as a specific determinant of obesity. While control variables such as age, and marital status will be used to control factors of female empowerment on obesity, other risk factors such as education, income, employment and environment, that might influence obesity will also be explored.

## 1.6 Outline of the Research Study

By understanding empowerment as a social determinant of female obesity, then obesity as a public health crisis can be better understood. Policy oriented interventions

to improve the health of affected individuals can be introduced, and the effect of the obesity epidemic consequently better managed. Chapter two of this thesis explores the literature related to common measures of women empowerment, social determinants of health (SDoH), and female obesity. Chapter three describes the research methods along with analytical models as the secondary data for analyses. Chapter four outlines the results, and chapter five provides a discussion of the results. Implications for the study findings and suggestions for future initiatives are offered in chapter six.

# Chapter 2: Literature Review

## 2.0 Sources of Literature

The aim of this literature review is to examine the complex relationships between female empowerment and female obesity for this reason relevant article topics, abstracts and online articles in health-related journals were analyzed and included in the review. A search was conducted July 22, 2022 using MEDLINE (via PubMed: https://www.ncbi.nlm.nih.gov), University of New Brunswick Libraries: https://lib-unb-ca.proxy.hil.unb.ca/, and Proquest: https://www.proquest.com/advanced for gray literatures using the search query (see appendix 1 for Pub Med search). The search yielded 100 publications, with 15 being included in the final review. Extractional indicators were categorized into the domains of obesity, education, environment, income, and physical activity. The vast majority of the studies were observational and most of them utilized cross sectional study design. Figure 1 outlines the search results and study selection process for the articles included in this literature review.

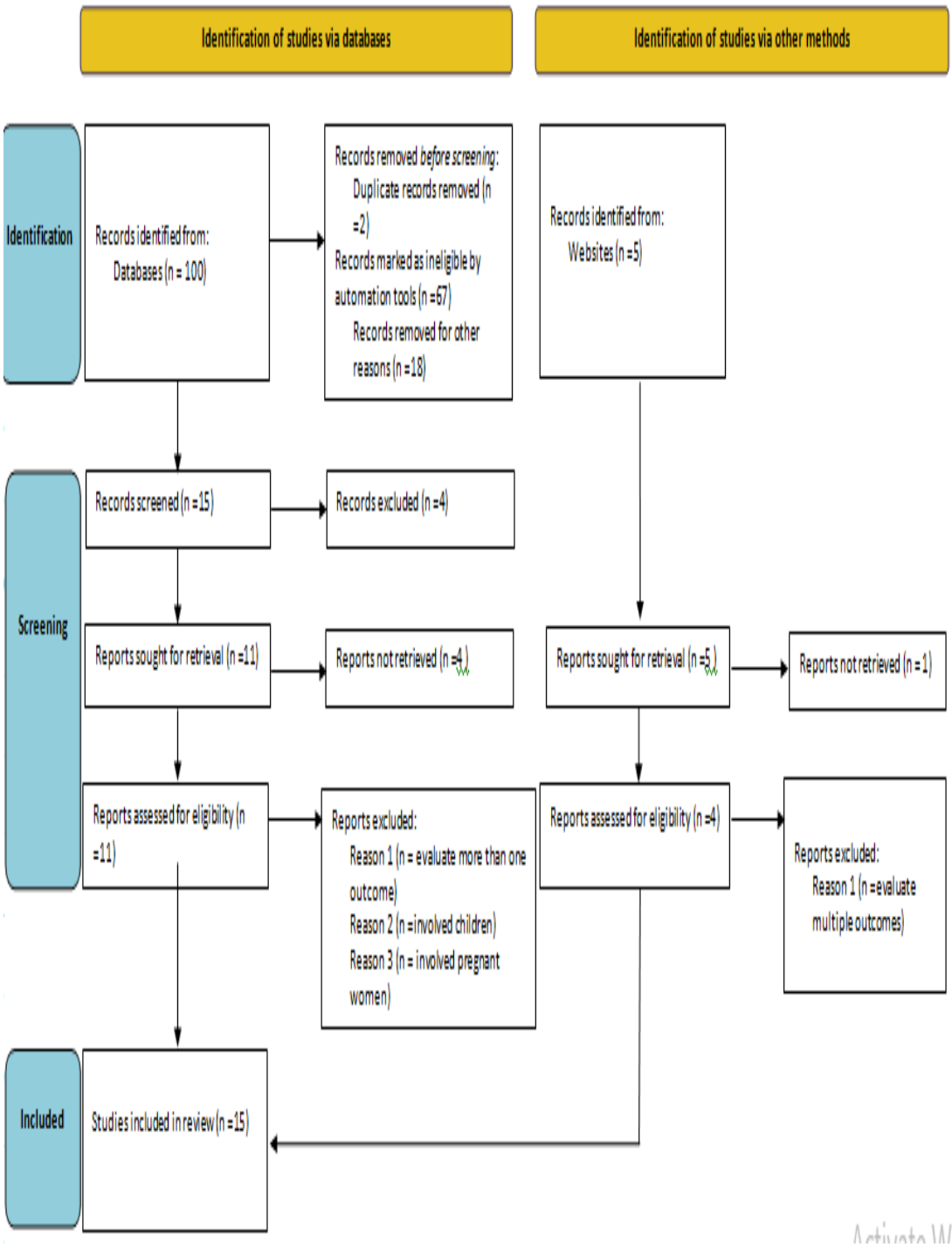


**Figure 1: Search results and study selection and inclusion process**

The scope of this review focused on literature relevant to female empowerment, female obesity, and social determinants of health. Information from bibliographies from the included articles were searched for additional relevant articles. An extensive literature review was conducted, and the determinants of health (including environment, income, employment and education) literature were chosen due to direct connections with women empowerment measures.

Further to this, in a search of gray literature, a series of internet sources of government and non- government agency publications on global trends in weight gain and body mass index measurement were also reviewed. Because each of the major concepts in this thesis is associated with an extensive body of literature to better understand the social drivers of differences in individuals' risk of unhealthy weight gain on population outcomes, there was no limitation placed on publication date, except for a few studies that were included for the proportional meta – analysis of the women empowerment as a social determinate of obesity. Websites of the UNESCO, WHO, World Obesity Federation, World Bank and United Nations Development Program (UNDP) were assessed for relevant information to be included such as recent statistics on obesity prevalence.

Based on the inclusion criteria for this study, four things were considered: (1) the search considered studies that excluded pregnant, lactating and women above aged 15 years; (2) the search, considered studies that evaluated female education, income, employment and built environment in association to female obesity or obesity. Studies that utilized body mass index as the obesity measure were considered; (3) the search

considered outcomes that included women with a BMI greater than 30 kg/$m^2$ and (4) all quantitative research studies, including observational studies, were considered.

## 2.1 Methods and Theoretical Framework

This section provides an analytical literature review grounded within the theory of investment in health capital using the Grossman Model (Grossman, 1999; Kpelitse et al., 2014). The Grossman Model explains how individuals behave when health is an important outcome of the choices to be made. Grossman (1972) defined health capital as a person's stock of knowledge and stock of health and how those affect an individual's market and nonmarket productivity, and the total amount of time an individual can spend producing money earnings and commodities. This model focuses on health and how personal choices affect health. The variables in this model include 'how much health capital (investments that are necessary for maintaining an individual's health and capacity) an individual has. This can be acquired by spending time (T) to get healthy or time earning to be able to buy things (M). Health in this model is a capital good. It is given by the equation:

$$H_t = H((1 - \gamma) H_{t-1}, T^H_t, M_t)$$

Where:

$H_t$ =how much health capital an individual has

$T^H_t$ = time an individual spends in acquiring health capital

$\gamma$ = fraction of health capital that wears out

$M_t$ = Medicine or things bought to stay healthy

There are three underlying assumptions in this model. First, it is assumed that all individuals have a minimum health capital to stay alive and that any investment in health capital from the minimum health investment should yield a return or benefit. For example, if a woman has a healthy BMI, any amount of time she spends to maintain that healthy BMI will yield a high benefit in that regard. Secondly, it is assumed that an individual's health investment changes when a person becomes a more efficient producer of health. For example, if an individual becomes more educated then he/she can better use the resources around them to acquire more health capital. Lastly, the healthier a person is, the more time that is available to do other productive activities such as working or making more health investment choices. It is thought that the human body functions at its best if the best experience mentally (education) and physically (income or the ability to cater for our daily needs, and work) exists. The Grossman model draws a relationship with home goods (those that give enjoyment) and health capital (Grossman, 1999; Kpelitse et al., 2014).

The Grossman model (2019) also operates in a similar pattern with the Human Development Index (HDI) (Klasen, 2006) (although the HDI is used at the population level to examine empowerment) in the sense that it examines health, income, and education. While the Grossman model examines these variables at an individual level, at a population level the HDI has been identified as a framework that best explains empowerment since its launch in 1990. Human development in this instance is defined as the process of enlarging people's choices by expanding human capabilities and functioning. At all levels of development, the three essential capabilities for human development are for people to live long and healthy lives, to be knowledgeable and, to

have access to the resources needed for a decent standard of living. If these basic capabilities are not achieved, many choices such as a decision to be educated or have a healthy environment to live in are simply not available, and many opportunities such as better paying jobs remain inaccessible (Alkire & Foster, 2010; UNDP, 2019).

## 2.2 Female Obesity, Measurement and Trends

Female obesity just like obesity in general can be defined as a state of excessive fat accumulation to the extent that health and wellbeing are affected or can be compromised (World Health Organization, 2000). The prevalence of obesity among women has steadily increased in both developing and developed countries. For example in Nigeria (a developing country), the female obesity rate increased from 5% in 2003 to approximately 10% in 2018, and for a developed country like Canada female obesity rates increased from 23.3% in 2004 to 27% in 2017 (World Obesity Federation, 2020).

The increase in female obesity is a concern because it is associated with increased hospitalizations, impaired productivity, incidence of several chronic disease (e.g. diabetes, cardiovascular disease, liver disease and certain cancers, needing more extensive and costly interventions) and early death (Andersen, 1999; Gupta & Yesudian, 2006; Łuczyński et al., 2016). With over 390 million obese woman globally (women with BMI >30kgm$^{-2}$), the staggering financial implication of BMI to health services use globally is estimated to be US$990 billion per year, i.e., 13 % of the global healthcare expenditure (Kpelitse et al., 2014; World Health Organization., 2019; World Obesity Federation, 2020). Hence, understanding how empowerment as a social determinant influences for obesity is important. One factor which has received a lot of

attention in the literature, but whose impact on obesity requires careful thought, are the various indicators of empowerment (income, education, occupation, and environment).

The WHO (2000) has attributed the causes of obesity among women to be multi - factorial including such factors as biological, social, dietary and nutritional, endocrine and psychological. Pregnancy, menopause and some socio demographic factors like age and parity are some of the recognized biological causes of obesity among females. Other studies have found that obesity can also be hereditary, with additional reports indicating that women gain more weight at 45 to 49 years of age (NCD Risk Factor Collaboration (NCD-RisC) – Africa Working Group et al., 2017; World Obesity Federation, 2020).Socio-economic status has further been found to have significant links to obesity. Poor women in developed countries have higher prevalence of obesity while in developing countries obesity is more prevalent among women in urban areas (Abarca-Gómez et al., 2017; Gupta & Yesudian, 2006). Dietary fat with high energy density and palatability with poor appetite control signals tends to increase energy intake and body fat. Stay at home mothers tend to eat between meals and which is a potential cause for obesity with some over-eating to avoid food wastage (i.e. leftover foods being thrown out) (WHO, 2000). Lastly, hormonal imbalances can also contribute to obesity. For example, hyperthyroidism (its activity decreases thyroxin level which causes obesity) and hypocartisolism (its metabolic activities lead to Hyperinsulinism which causes obesity due to genetic defects) are both known contributors to the issue (Pérusse & Bouchard, 1999).

### 2.2.1 Measuring Obesity

Body fat can be measured in several ways, with each body fat assessment method having benefits and limitations. Due to the ease and cost of performance, common measurements used in studies include, but are not limited to: Body Mass Index (BMI), Waist Circumference, Waist-to-Hip Ratio and Skin Fold Thickness. Other measures include the Bioelectric Impedance (BIA), Underwater Weighing (Densitometry), Bioelectric Impedance (BIA), Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI), Air-Displacement Plethysmography and Dual Energy X-ray Absorptiometry (DEXA) (Hu, 2008).

In population studies like this one, to measure obesity the WHO (2000) defines cut-off values for obesity based on the BMI: weight/height squared ($kg/m^2$). For male and female adults, if the BMI exceeds 25 $kg/m^2$, an individual is considered overweight, and if the BMI exceeds the value of 30 $kg/m^2$ (WHO, 2019) an individual is considered obese. Today, the Quetelet's Index or Obesity Index of Body Mass Index (weight (kg)/ Height in meters squared) has been found to be appropriate for this study because most reviewed literature utilized this ratio (squared height and weight) to measure obesity. BMI is calculated by taking the ratio of the mass (kilograms) and square height (meters) of an individual, typically expressed either in BMI = Kilogram/$meters^2$ or Lb 703/$in^2$ depending on the standard unit chosen. The most widely used definitions, established by the WHO ended the classification of obesity at class III while other experts further categorized class III obesity as morbidly obese and super obese and as summarized in the following table (Katzmarzyk, 2006; McKee, 2010).

**Table 1:** Obesity Classification

| **BMI** | <18.5 | 18.5-24.9 | 25.0-29.9 | 30.0-34.9 | 35.0-39.9 | > 40.0 | 40.0-49.9 | > 50 |
|---|---|---|---|---|---|---|---|---|
| **CLASS** | UW | NW | OW | Class I | Class II | Class III | morbid obesity | super obese |

**Where:** *UW* = Underweight *NW* = Normal weight *OW* = Overweight

Some limitations of using the BMI as a proxy for obesity includes, but is not limited to the fact that: indirect and imperfect measurement does not distinguish between body fat and lean body mass, it is not as accurate a predictor of body fat in the elderly as it is in younger and middle-aged adults and at the same BMI, women have, on average, more body fat than men, and Asians have more body fat than Caucasians (Hu, 2008).

However, it has been agreed (Ljungvall et al., 2015) that BMI is the most acceptable measure for adiposity in most studies with a common issue of misreporting (a measurement error that may introduce bias in estimating variables of interest) with self-reported BMI. Ljunvall et al. examined two common issues associated with the use of weight height indices to be misreporting and misclassification. They noted the consequences on estimating educational and income disparities in BMI and obesity and identified that this measurement is common among women's self-reported data. In the case of misreporting BMI, the indices lead to an underestimation of the education disparity when using self-report information (BMI); it is found that women with higher education misreport less than those with lower education while in the case of

misclassification (BMI) the probability of being misclassified decreases with income across gender.

Misreporting is more associated with BMI than misclassification (Gorber et al., n.d). BMI is more common in assessing obesity in the countries (Nigeria and Canada) of interest therefore, it is important to identify measures adopted to mitigate issues arising from misreporting in measuring BMI. The Nigerian Demographic Health Surveys (DHS) and Canadian Community Health Surveys (CCHS) both contain information on self-reported weight and height of individuals (Hajizadeh et al., 2014). In order to correct the measurement error on self-reported data with regards to BMI the adopted correction factors were applied to the self-reported BMI for females: $BMI_{corrected} = -0.12 + 1.05 \times BMI_{self—reported}$ (Gorber et al., n.d.). Formulated as the "correction factor" for BMI this method is now accepted by many researchers to significantly improve estimates based on self-reported data.

### 2.2.2 Obesity Trends in High Income Countries

In recent times occupations have tended to become more sedentary and less promoting of physical activity. In addition, dietary intake and related socio-cultural factors likely drive obesity among women in high income countries. For example, women are more likely to prefer and consume more foods high in added sugars than men, including energy-dense processed foods such as cookies, chocolate, and ice cream (Kanter & Caballero, 2012). The WHO global data reflects that the prevalence of overweight women was slightly higher than that of men in both 1975 and 2016. However, in high income countries such as Canada, the Canadian Health

Measures Survey (CHMS) 2017 estimated a 27% obesity prevalence among women and 26.9 % obesity prevalence among men and this pattern is similar for the United States and other high income countries according to the interactive map of the world global obesity observatory (https://data.worldobesity.org/#US|36|A|F). Similarly, cultural factors that emphasize preference to a thin body image among urban women in developed countries could likely be a contributory factor to the decrease in obesity among women in urban areas than in rural areas (Hruby & Hu, 2015).

Hajizadeh et al. (2014) examined trends in socioeconomic related inequalities in obesity risk among Canadians and suggested that obesity is more prevalent among poor women, more concentrated among poor women in rural areas, that obesity varies across provinces, and is more profound in the Atlantic Provinces. Hajizadeh et al. further posits that factors such as demographics, income, immigration, education, drinking habits, and physical activity are other key factors in obesity risk in Canada (Mason et al., 2007; McGlynn et al., 2015; Siddiqi et al., 2015). Although the decomposition analysis helps to identify the contribution of each factor of socio-economic inequalities to obesity risk adopted in her study was income based, it is still a relevant measure like the human development index in this comparative study. Hajizadeh et al. found that education makes a negative contribution to the inequality because this factor has a negative elasticity (indicating that an increase in educational attainment decreases the probability of being obese) and higher education attainments are mainly concentrated among the better off.

### 2.2.3 Obesity Trends in Low- And Middle-Income Countries

Similar patterns of global data on obesity prevalence among males and females exist for developing countries. For example, in Nigeria the WHO InfoBase estimates a 9.1% obesity prevalence among women and 6.5% obesity prevalence among men. This pattern is similar for other low and middle income countries according to the interactive map of the world global obesity observatory https://data.worldobesity.org/#US|36|A|F.

Templin et al., (2019) conducted a study on the overweight and obesity transition from the wealthy to the poor in low- and middle income countries using a survey of household data from 103 countries. The results of the study suggested that as countries develop economically, it was observed that, along with rising overweight rates across all income categories, a larger fraction of the global overweight and obese populations were among the poorest.

In contrast to developed countries cultural factors that emphasize a large body image among women in developing countries could be the increase of obesity among women in urban areas compared to those in rural. In addition, the emergence of nutrition transition in developing countries, diets tend to include a greater amount of fat, sugar, and refined carbohydrate, and an increasingly sedentary lifestyle. Increased obesogenic behavior is observed more in urban areas than rural areas where agricultural is the mainstay of the economy, hence requires an elevated level of physical activities (Kanter & Caballero, 2012; Wariri et al., 2021).

Some researchers have explored the prevalence of overweight and obesity and its associations with socio - demographic variables in the Nigerian population (Desalu et al., (2009); Maruf & Udoji, (2015)). Educated women in developing countries have

higher rates of obesity than in developed countries; although women's age, females in skilled occupation and females with tertiary educational attainment differ in the prevalence rate of obesity in all countries. The highest prevalence of excess weight gain were observed in participants who had only a primary education in developed countries, also, they were more obese and overweight women in urban areas than in rural areas in Nigeria. It is important to state that just as obesity distribution varies within developed countries, obesity distribution varies across the various states in Nigeria due to gender disparity in access to both asset and opportunity endowment within the country.

## 2.3 Women Empowerment, Barriers and Methodologies

Empowerment is defined as a multilevel process of gaining understanding and control over personal, social, economic and political forces in order to take steps to change one's situation (Garces-Ozanne et al., 2016). Garces-Ozanne et al. (2016) further identify individual and collective empowerment as two forms of empowerment.

Garces-Ozanne et al. (2016) explained the term "individual empowerment" as an individual having autonomy to make full decisions through access to education, poverty reduction and readily available and affordable information and communication technology. Furthermore, the concept of empowerment interventions was mentioned in their paper to mean programs planned to strengthen the capacity of people to solve their own problems, with the aim of improving their quality of life.

Empowerment therapy is a kind of individual empowerment intervention geared towards patients or individuals for developing a critical mindset to make autonomous and informed decisions (Łuczyński et al., 2016). Luczyniski et al. elaborated more on

empowerment therapy as a treatment administered to a patient if they are willing to change. It is centred on chronic conditions like diabetes and obesity and the effect of this kind of therapy is not just beneficial to the individuals, but entire communities or populations. In addition, Łuczyński et al. (2016) mentioned the Diabetes Empowerment Scale (DES) and Empowerment Motivation Medical Adherence (EMMA) as some of the methodologies used in empowerment therapy. Both therapies are administered by teams and are educational in nature, developed to accomplish certain goals among which are the ability of patients to provide 98% of their own care and make all decisions concerning their health and well-being. The overall objective of adopting these therapies is to reduce the Body Mass Index, stress levels, increase physical activity, improve diet and reduce the watching of television (in the case of children).

Furthermore, Alsop et al. (2005) defined empowerment as a group's or individual's capacity to make effective choices, that is, to make choices and then to transform those choices into desired actions and outcomes. They identified agency and opportunity structure as two inter - related factors that affect an individual's or a community's capacity to make effective choices.

Agency is described as the ability to define one's goals and act upon them (Kabeer, 1999). Agency in itself is not empowerment since it depends on an individual or group's ability to make purposeful choices, and, ultimately, they may lack the capacity to choose effectively. Assets equip individuals to use economic, social, and political opportunities, to be productive, and to protect themselves from shocks (Moser, 1998). Agency can be measured by asset endowment and indicators of asset include psychological, informational, organizational, material, social, financial, and human

assets. However, complexities exist in its measurement. For example, it may be easier to measure informational asset than social capital asset or psychological asset. The effect of education on asset is critical.

When the concept of empowerment is mentioned, we often think of those in the most unequal bargaining positions that is, those unable to make informed choices, are usually among the poorest and are more likely to be female. Hence, women's empowerment has transformed over time in definition depending on the context in which it is considered. Most literature identified it as a process and how it relates to personal development and development in general. Duflo (2012) opined that a relationship does exist between women's empowerment and economic development, that is development will bring about women's empowerment and women development will bring about economic development. Likewise, empowering women will bring about changes in decision making which will have a direct impact on development. The most comprehensive definition of women's empowerment is offered by Batliwala (1995), who define women empowerment as a process, and the outcome of the process, by which women gain greater control over material and intellectual resources and challenge the ideology of patriarchy and the gender-based discrimination against women in all the institutions and structures of society. Another study describes women's empowerment as a process by which women redefines gender roles in ways which extend their possibilities for being and doing (Mosedale, 2005).

Mosedale (2005) opined that those who are disadvantaged in choices, opportunities, and well-being need to be empowered. Her view did not capture the fact that some societies may empower women in some aspect e.g. material well – being, but

might deny access to other aspects of empowerment, like agency. However other researchers contend that the key aspect of empowerment is self - determination (i.e. people have the opportunity to take control over their lives and situations, on health) (Garces-Ozanne et al., 2016). Countries deliberately enact policies and implement programs to address women's issues with regards to empowerment as well as to enhance their status (social and health) and involve them in their developmental agenda.

### 2.3.1 Common Barriers of Women Empowerment

Customs and culture of a given population are important causes of women's lack of empowerment because when there is a scarcity of resource or opportunity in such a population, the culture and custom determines who gets access to such scarce benefits and opportunities. For example, in some countries, girls are not permitted to obtain formal education, with the ripple effect being that such girls will not qualify for better job opportunities or have meaningful political rights, if they are permitted to work or vote at all (Nussbaum, & Glover, 1995). In addition, the investigation of human capabilities identified cultural traditions as obstacles to women's health and well-being. They further stated that traditions perpetrate injustice against women in many fundamental ways, touching on some of the most central elements of a human being's quality of life—health, education, political liberty and participation, employment, self-respect, and life itself. In their paper further emphasis was placed on the implication of discrimination against women involvement in development strategies, considering the fact that women constitute a majority of the world's population and only receive a small proportion of its opportunities and benefits.

### 2.3.2 Cultural Influence on Female Obesity as an Empowerment Indicator

Custom and culture infiltrate every aspect of life, and this includes, but is not limited to views on obesity, eating patterns and behavior. It has been estimated by anthropologists that there are approximately 3800 cultures in the world in the year 2023 (https://web.archive.org/web/20170809073008id_/http://ttdinhduong.org/tailieudinhduong/22.pdf). With these many cultures, it is safe to presume that cultural values and norms surrounding body weight will vary greatly as an empowerment factor. What makes a culture unique is how a group of people define their acceptable ways of eating and appearance to others. For example, the average Nigerian translates being overweight and obese as a sign of wealth in finances, just as other regions of Africa have traditionally praised greater body shapes as attractive and prosperous. These cultural standards have a significant impact on obesity because they uphold the notion that larger figures are preferable (https://epubs.utah.edu/index.php/historia/article/view/1194). Recently, a study examined racial and ethnic differences in the relationship between weight perception and weight management behaviors among overweight and obese adults in North America (Canada inclusive). These researchers found that correct perception of body weight was positively associated with weight management behavior across all ethnic and racial groups, reflecting that it is deliberate for an individual to maintain a healthy BMI and that this can be sometimes an expensive habit to make. In addition, female family support may not be novel in Africa; breadwinning is the principal role of men in most African societies with Nigerian men being traditionally expected to financially provide for their families and households, and with most wives and women becoming

housewives and leading more sedentary lifestyles (Akanle & Nwaobiala, 2020). In 2006 Statistics Canada released a report that 4.7 million Canadian women are now main family breadwinners, because as more women get formal education and enter paid employment, and some men lose jobs, traditional breadwinning becomes inverted as growing numbers of women become family breadwinners; in such instances women may not be compelled to lead sedentary lifestyles (https://archives.nupge.ca/content/47-million-canadian-women-are-now-main-family-breadwinners), hence the influence on obesity.

### 2.3.3 Methodological Limitations of Measuring Female Empowerment

Alsop et al. (2005) in their book identified three measurement challenges of empowerment. Firstly, empowerment is multidimensional and different dimensions of empowerment require different metrics, making the task of high-quality statistical analysis difficult. Some researchers suggest that analysis should therefore focus on simple descriptive statistics and narrative reporting. For example, per capita income or consumption is an approach to indicate poverty when measuring and analyzing empowerment. However, data that describe the dynamic processes and relational changes in empowerment are difficult to quantify and analyze because they are less predictable, less tangible and more contextual (Takeko, 2019; Uphoff, 1992). Therefore to appropriately identify meaningful measurements of any dimension of poverty, researchers must neatly capture the essence of that aspect of poverty before concluding that there has been meaningful change.

Secondly, empowerment varies among individuals. Some individuals may experience a certain level of empowerment in a particular domain and may be denied access or choice in another domain. Such differences exist within and across countries. Hence, it poses a potential problem of endogeneity in conducting statistical analysis of empowerment (endogeneity in this case refers to some variables that can influence the empowerment unavoidably omitted).

Finally, there are the challenges of measuring and analysing empowerment to assume comparability across populations because the significance of context can vary across time as well as space. “Aggregation” describes whether the data generated can be aggregated across populations so that conclusions about impact and change can be inferred for larger population groups. Here the major problem is that empowerment often involves relative rather than absolute changes in states of being.

Furthermore, the Gender Empowerment Measure (GEM) is a measurement framework introduced by the United Nations Development Program (UNDP) to assess whether women and men are able to actively participate in economic and political life. It is used to measure relative empowerment; however, the GEM is agency focused because it is calculated based on women’s representation in parliaments, women’s share of positions classified as managerial and professional, women’s participation in the active labor force, and their share of the national income. GEM is valuable as a policy instrument (Cueva Beteta, 2006; Takeko, 2019). It is unclear if the above mentioned set of indicators under the GEM can accurately represent the dimensions of empowerment. (Cueva Beteta, 2006; Klasen, 2006; UNDP, 2019).

### 2.3.4 Methodological examples of women empowerment

The variable used to measure and define empowerment is largely dependent on the context of a study (Kabeer, 1999). For example, the four following studies that are elaborated upon measured empowerment in different contexts. First, Samanta (2020) investigated the association between women's empowerment as conceptualized through a framework of self-compassion and its antecedents using confirmatory factor analysis (CFA). The objective of confirmatory factor analysis is to test whether the data or construct of the measures used in a study fit the hypothesized measurement model or is consistent with the nature of the construct. This study utilized data from the India Human Development Survey-II (IHDS II) (2011–2012) to offer an empirical examination of the household level empowerment measure and to ensure a robust psychometric quality for this new measure (Samanta, 2020). This was accomplished through the theoretical construct of self-compassion and investigating its association with antenatal health. Given the conceptual ambiguities embedded in the multidimensional nature of women's empowerment, empowerment was described using some of the following indicators: "Who has the most say whether to buy an expensive item? Who has the most say about whether to buy land or property? Who has the most say about how much to spend on a social function? Can you go alone (or need permission) to the local health center? Can you go alone (or need permission) to go to the home of relatives/friends in the village/neighbourhood? Are you are a member of a credit/savings group?" (Samanta, 2020, p. 7).

Dickson (2021) used data from 2014 Ghanaian Demographic and Health Surveys, and examined the association between female empowerment and skilled birth

attendance among rural women. Women empowerment in this instance was the main explanatory variable and was described by the following indicators: decision-making ability power, knowledge level, labour force participation, acceptance of domestic violence, age, seeking medical attention for self, partner's educational level, antenatal care visit against skilled birth attendance as the principal outcome variable. He used descriptive and inferential analyses to build two statistical models; model one, looked at the relationship between women empowerment variables and skilled birth attendants while model II explored the relationship between skilled birth attendance and women empowerment plus the background characteristics. Binary logistic regression was performed on the variables of interest and the result indicated that efforts should be in place to increase the current skilled birth attendants and they should concentrate on the empowerment of women, male involvement in maternal health problems, women's education, and participation in the antenatal care (Dickson, 2021).

Castro Lopes et al., (2021) used the Mozambique Demographic and Health Survey (DHS) conducted in 2015 to examine the relationship of socio-economic, demographic, and behavioural determinants of women's empowerment in Mozambique. They used empowerment indicators related to decision-making within the household, justified beating and decisions about sexual intercourse, and coded into a 3-point scale against the independent variables of socioeconomic, demographic and behavioural indicators. The analysis is in three parts: descriptive statistics of all measures, a principal component analysis (PCA), which is a reduction method used to reduce the dimensionality of large data sets) and logistic regression. The results from the study affirmed the multi-dimensionality of empowerment as well as the importance of

considering the context- and community-specific characteristics (Castro Lopes et al., 2021).

Gupta and Yesudian (2006) further opined that development goals such as better health and increased income are evidence of empowerment. They identified with other studies that cultural norm as well as other factors such as age, wealth and class among others play a role in women empowerment and that this empowerment, for a western woman compared to third world woman is sparse in terms of education, wealth, and culture; this is to further emphasize that disparity in inequality is more rampant in developing countries compared to developed countries (Bayeh, 2016; Mosedale, 2005). They identified some important determinants for women's empowerment using multiple logistic regression analysis. They include: at the national level, household autonomy; freedom to move outside the home; gender preference attitude; and domestic violence. Women's educational levels and age emerged as important predictors for all the four dimensions of women empowerment (Gupta & Yesudian, 2006).

## 2.4 Women Empowerment Indicators as Social Determinants of Female Obesity

The effect of empowerment on obesity has not been examined by many studies and this could be due to the complexities in measuring empowerment. However, some studies have identified indicators that can describe empowerment (using individual and collective factors). This facilitates attempts in measuring the effects of empowerment. It is important to note that empowerment means different things to different people as individuals tend to make different choices, some of which are influenced by the social

determinants of health (SDoH). Some of the SDoH include but are not limited to: income and social status, employment and working conditions, education and literacy, physical environments, social supports and coping skills, healthy behaviours, access to health services, gender, culture and race / racism. Alsop et al. (2005) in an attempt to link some determinants of health to measure empowerment they suggested that empowerment can be measured using either asset endowments or opportunity structure, some of which include :  asset endowment - Financial assets (income) and Human assets (education) and opportunity structure - State (physical environment) and Market (employment)).

Krieger et al. (1997) in an attempt to conceptualize social determinants, linked social class as a key determinant of population health and introduced the concept of socioeconomic position by income, poverty, deprivation, wealth and education. Social class is defined as a social category referring to social groups forged by interdependent economic and legal relationships, premised upon people's structural location within the economy like employment, education credentials and skill assets. Socioeconomic position is an aggregate concept that includes both resource-based (such as income, wealth, educational credentials; terms used to describe inadequate resources include "poverty" and "deprivation") and prestige-based (such as people's access to and consumption of goods, services, and knowledge, as linked to their occupational prestige, income, and education level). O'Neill et al. (2020) in their work defined social gradient of health to be the steep inverse associations observed between socioeconomic position and mortality/morbidity.

O'Neill et al. (2019) used the SDoH framework to understand the health and longevity of females. Furthermore the SDoH approach suggests that health outcomes depend on the organization and distribution of socioeconomic resources across any given society. They also noted that some females have limited access to education which limits opportunities in those societies. They examined the socioeconomic position of various societies and concluded that people of lower socioeconomic position experience greater risk of non-communicable disease for which excess weight gain is a major factor. Education, wealth, income, occupation and neighborhood social class were identified to play an important role in shaping women's health especially in mid-life because at this age they are expected to have full autonomy in decision making (Krieger et al., 1997; O'Neill et al., 2019).

To determine the best indicators that define empowerment as it relates to obesity, for the sake of this study, a proportional meta-analysis of 11 studies (see appendix 1 & 2) was conducted using the Joanna Briggs Institute System for the Unified Management of the Assessment and Review of Information (JBI SUMARI) software on the indicators of women empowerment as a social determinant of excess weight gain. The criteria of this modified review and analysis included studies done within Nigeria and Canada that included non-pregnant women aged 15 and above (see Figure 2).

The figure below summarizes the meta-analysis that was performed. For this analysis, 11 studies were critically appraised and data extracted by graduate student EJ (see appendix 1 and 2). From the analysis, three of the eleven studies fell across the line of no effect. Since the focus of this thesis is on the effect of women empowerment on

female obesity, all studies on both sides of the line of no effect are significant to this work. It is important to note that all studies used at least three of the following indicators namely: physical environment, income, education, employment and age as a constant covariate variable.

The following explanation further supports the significance of the result of the analysis. The weighted mean difference is relevant since all studies measured the same outcome hence heterogeneity can be overlooked based on the JBI SUMARI guideline. From observing the forest plot (see figure 2 below), one would notice that studies with fewer samples have fairly normal data points except for 2 studies with weighted means of 61.51% and 28%. These could only signify the importance of using very large sample sizes for this kind of research. Only 3 studies fall exactly on the line of no effects,  The fixed effect model was used to make inference on the selected studies, that is the assumption that all included studies keep independent variables (income, education, physical environment, age, employment and marital status) constant and its effect on the various category of obesity with the caution that these studies are not representative of a population of studies and are not a random sample of studies (Barker et al., 2021).

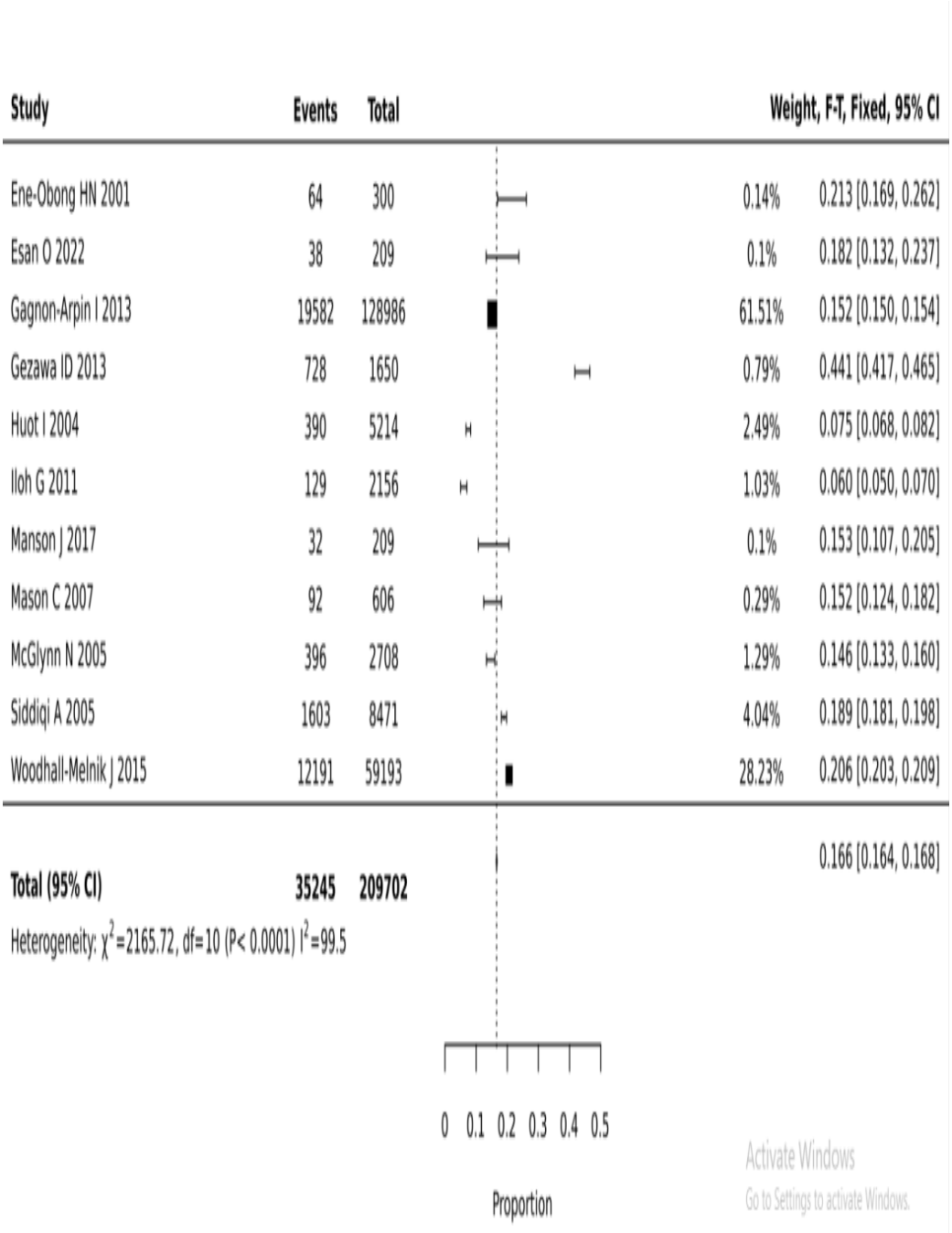


**Figure 2**: Proportional meta-analysis of indicators of women empowerment as a social determinant of excess weight gain

Alsop et al. (2005) opined that the interaction between agency ( described as the ability to define one's goals and act upon them) and opportunity structure (defined as

those aspects of the institutional context within which actors operate that influence their ability to transform agency into action.) must answer three questions to be considered for measurement of empowerment:

- Whether an opportunity to make a choice exists (existence of choice)?
- Whether a person or group actually uses the opportunity to choose (use of choice)?
- Whether the choice brings about the desired result (achievement of choice)?

The included studies were mostly cross sectional studies with one outcome variable that is the Body Mass Index (BMI) greater than 30 $kgm^{-2}$ against covariates and independent variables of age, gender, socioeconomic status and income, education, place of residence (rural/urban), occupation, and physical activity (Esan & Esan, 2022; Gagnon-Arpin et al., 2013; Huot et al., 2004; Id et al., 2013; Łuczyński et al., 2016; Mason et al., 2007, 2007; McGlynn et al., 2015; Siddiqi et al., 2015). These variables based on the definition of empowerment with regards to assets and opportunity endowments could be used as a measure of empowerment. Alsop et al. (2005) opined that an increase in agency, through the accumulation of assets such as education, information, psychological consciousness, and income or consumption wealth, have been shown to associate with changes in traditional informal institutions and gender-based inequalities in many countries.

### 2.4.1 Women Empowerment and Education

In an attempt to examine UNESCO's agenda of "Education for All", Ito (2013) emphasized the need of knowledge as a source of empowerment, equity, and

opportunity to participate in civil activities. They linked knowledge as a social entitlement which is a determinant of well-being and a goal of human development. Most research and educational development policy for example the UNESCO – "Education for All" did not address the need to tackle female access to education because some societies deliberately limit women involvement in opportunities, especially if opportunities are limited. After examining the distribution of foreign aid allocation over the years, although education has been a priority sector when considering foreign aid allocation since the 1970s, women have not benefited so much from it (Carbonnier, 2014; OECD, 2019). Interestingly, the goals set for education transitioning from Millennium Development Goals is still unmet, hence its reflection on the Sustainable Development Goals. Poverty and inequality have a dire impact on educational attainment (i.e. the number of years women spend in school) which remains much lower in Africa compared to other regions (Carbonnier, 2014).

Studies have continuously linked excess weight gain with the following determinants: education, physical environment, income, employment and age (Carbonnier, 2014; Gupta & Yesudian, 2006; Krieger et al., 1997; NCD Risk Factor Collaboration (NCD-RisC) – Africa Working Group et al., 2017; Neupane et al., 2015); In some regions of the world women are much less likely than men to be literate (Nussbaum, & Glover, 1995). Lower levels of literacy are associated with poor nutrition and higher fertility rates. Recall that the idea behind agency (autonomy in decision making) narrows down to the family level where women without access to education may never question her husband's authority over her, this conforms to the statement that "… education also has an instrumental process role in facilitating our capacity to

participate in decision-making processes at the household, community, or national level" ( Deneulin, 2009, p. 214).

To further buttress education as an indicator of women empowerment, UNESCO published a report on "empowerment in women's hand," highlighting access to education as a vital factor to overcome gender discrimination (Lamont, 2018), help to prevent and contain disease, and improve their children's health and chances of survival. It further elaborated how education increases women's voice and participation; increasing their opportunity to be employed (Belalczar et al., 2015).

### 2.4.2 Women Empowerment and Income

The definition of income and how it is measured depends on the context in which it is applied. Since our interest relates to individuals, income simply refers to money that a person receives in exchange for their labor. It could also be the total earnings of an individual in the form of salary and wages, return on investment or other monies received. For most studies, individual income is measured by household income and personal income from all sources.

Based on the Grossman framework income empowers women to be able to buy home goods to increase their health capital assuming that all other variables are at optimal levels. These home goods could be the capacity to seek professional advice, buy medicine and enroll in health classes. Kpelitse et al. (2014) found that increased income especially for women may lead to a reduction in the probability that a woman is obese. However, a woman with higher income may work more and have less time to invest in other healthy lifestyle to boost their health capital, this may be true for

developing countries because urban women are more likely to be obese than rural women due the sedentary lifestyle that the work culture promotes while this pattern differs for developed countries (Cawley, 2004; Kpelitse et al., 2014). The casual link for obesity and income is not clear for most studies.

### 2.4.3 Women's Empowerment and Employment

In the work environment sedentary lifestyles have contributed significantly to the obesity epidemic in our society. In addition, obesity is more prevalent in retired people and people that work from home, compared with occupations that require activity at work.

Based on Grossman framework, researchers have opined that some employers may examine the benefit of employing an individual with unhealthy weight because the opportunity cost associated with sick days for such an individual is higher compared with individual with healthy weight (Kpelitse et al., 2014; Martín et al., 2008). Morris (2007) found that obesity causes unemployment and obese persons are perceived to have systemic health conditions and to be less productive than normal weights and may not be considered for employment. There may be discrimination against the obese due to prejudice and stereotyping by employers due to a perceived inability to be productive. Also, unemployment contributes to obesity because unemployed individuals tend to patronize and consume cheaper, more fattening food.

### 2.4.4 Women Empowerment and Environment

Frank and Engelke, (2001) opined that the dynamic interaction between land development and transportation investments produces built environments which may

influence physical activity. Physical activity patterns are directly related to the levels of obesity or chronic disease in a given population. Andersen, (1999) also found that lack of exercise contributes to overweight and obesity or can have a positive effect on weight reduction and that moderate physical activities have the potential to be more effective and may provide long-term benefits for weight reduction than more structured, vigorous forms of exercise.

Individuals with a similar, class of income tend to live in the same neighborhood and so a decision to live in an environment that promotes healthy living depends on an individual's ability to afford such a lifestyle (Frank & Engelke, 2001; Kpelitse et al., 2014). This is important because the enabling environment that promotes walking and biking are common forms of moderate physical activities that lead to sustained health benefits including maintaining a healthy weight. However, street widening in urban areas in low and middle income countries without safe alternative plans for pedestrians unlike in high income countries discourages individuals from walking and biking. Barriers to physical activity can be classified into personal barriers and environmental barriers. While physical activity relies on the individual's motivation or ability to exercise and availability of time (forms of personal barriers), environmental barriers are real-world conditions that place restrictions on physical activity, such as a lack of bike lanes on roadways (Andersen, 1999; Frank & Engelke, 2001).

Urban and rural environments contribute to these aforementioned barriers. For example, most rural settings in developing countries promote walking and biking by default due to a lack of some basic amenities. Hence, physical activities are a major part of the daily lives while this may not be applicable for some urban areas in

developing countries. Urban settings in some developed countries may reconstruct and widen streets, and still make provision for sidewalks or walking – trails. For example, in the city of Fredericton there exists an intelligent network of walking trails that cut across all the corners of the city for people to bike and walk at their leisure. Individuals can effectively invest their time to become healthier in such an enabling environment.

In some developed countries equality and equity for women play a vital role in enabling women to invest their free time in producing health capital like going to the gym or earning some income to be able to afford a healthy body weight. This is not a common practice in some developing countries where married women are burdened with family responsibilities with little free time to invest in health capital. Also, in some countries married women are not permitted to go out alone, hence may never utilize the built environment for physical activities like walking or cycling which is critical in maintaining a healthy body weight. These reasons may be responsible for the patterned distribution of obesity in developed and developing countries (De Soysa & Lewin, 2019; Ferretti & Mariani, 2017).

### 2.4.5 Assessment of Women Empowerment and Female Obesity: Global View

Allen et al., (2017) identified wealth and education as common measures of socioeconomic status and tried to associate its impact on non-communicable disease and how it varies across high, middle, and low income countries. In their study, the population was drawn from urban and rural communities in 20 different countries with the conclusion drawn on the basis that low levels of education increase the risks of non-communicable diseases across all countries. Further, it was stated that a low level of

education is a stronger predictor of non-communicable disease compared to any other indicator like wealth. This resonates with the statement that "…If better education is what allows wealthier people to manage ideal body sizes while the poor are becoming obese, then systematic patterns of excluding women from gaining access to such 'public goods' as education might be the underlying problem, not a natural predisposition for gaining weight" (De Soysa & Lewin, 2019, p. 797).

The researchers demonstrated the difficulty associated with providing country specific recommendations on findings due to manner with which countries were grouped.

For example, De Soysa and Lewin (2019) elucidated female empowerment and its effect on female excess weight gain. They explored the Varieties of Democracy dataset (V-Dem is a database with global democracy rating) and utilized data that captured women's empowerment on variables measuring freedoms that allow women choice such as; freedom of movement, access to justice, access to property rights, and freedom from forced labor. Data was collected from 160 countries over a period of 24 years and it identified that female empowerment (in this sense was linked to gender inequality and gender discrimination) has more effect on the obesity of women compared to men. However, the aspect of female empowerment considered in this study was centered on rights and agency (both considered as poor predictors of obesity prevalence among females in general). They recommended that intervention among vulnerable groups promote healthier lifestyle and consumption of quality foods. Such interventions would be knowledge centric; however, the researchers did not explain how to identify this vulnerable group. Furthermore, it is observed from this study that females gain more

weight in general than males globally, citing gender-based inequalities as a contributor to the obesity epidemic among women. Their suggestion is rooted on women's empowerment, emphasizing that the more women are empowered; the prevalence of obesity among women decreases.

In addition, this study just like other reviewed studies agreed that health inequalities that exist between the rich and poor also lowers the incidence of obesity among females and further explains how lack of empowerment like denying education to girls disempowers them by limiting choice (De Soysa & Lewin, 2019). This can create obesogenic environments for women, hence influencing their choices which in turn increase the rate of female obesity.

Ferretti and Mariani (2017) identified the need to measure gender inequality in obesity and women's empowerment as it is essential to understand and monitor countries' progress in human development. The ratio of male and female prevalence of overweight and obesity was used to measure gender inequality in the broader sense as a 'proxy variable' to predict countries performance in achieving gender equality and human development. The frameworks adopted in this study were the HDI and Gender Inequality Index (GII). The former is more appropriate for this study because the HDI is considered the most appropriate measure for women's empowerment. The researchers computed the Spearman's rank-order correlation coefficients to test the strength of the association between the measures of gender discrimination (GII), the new Gender Development Index (GDI), the Global Gender Gap Index (GGGI), the Gender Equity Index (GEI), the Social Institutions and Gender Index (SIGI) and the Women's Economic Opportunities Index (WEOI) and the biometric measures of gender inequality

– gender obesity ratio (GOR). They found a significant impact of human development on BMI by focusing on obesity alone (i.e. countries with greater HDI scores are correlated with lower rates of obesity among females). The authors further add that as human development increases at the country level, obesity tends to decrease among women.

Kanter and Caballero (2012) point out that the global obesity epidemic is more prevalent in women than men and that it varies within and between countries. They also note that gender disparities in obesity are observed among urban and rural areas whereby urban areas have greater gender disparities in obesity than rural areas. They agreed with the investigations of other researchers that some SDoH factors are reasons why obesity is more prevalent among women in some societies, that include but are not limited to physical activity, cultural values, biological factors and urbanization (above mentioned are also some indicators of empowerment).

## 2.5 Research Gap

This literature review provided a pathway to elucidating education, income, environment and employment as various forms of women empowerment, female obesity and the relationship between the two, in terms of the social determinant factors influencing female obesity. Women's empowerment or empowerment in general, is difficult to measure because it is a broad concept as reviewed, however the identified factors of empowerment will help in explaining empowerment as a social determinant of female obesity. Female obesity has its own complexities in terms of measurement across diverse countries and populations. Clarity was provided on why education,

income, environment and employment are indicators of empowerment, and how researchers have used these variables to examine obesity at various levels across several countries in population studies.

Evidence has further shown that these factors of women empowerment have a particular role to play in this obesity epidemic. However, there are limitations to consider in population studies such as this one and include country categorization, measurement bias and differences in the context of how empowerment is defined in some countries.

Firstly, the manner with which countries are categorized in studies may be difficult to account for the differences that exist between those countries and within individual countries. This phenomenon may be likened to be referred to as inter and intra dimensional variation. These inter and intra dimensional variations refer to the difference(s) that exist within a country (intra – dimensional variation) and those differences that exist between countries (inter –dimensional variation). Considering these variations in terms of obesity prevalence, researchers ignore the complexities that exist in categorizing countries in studies. For example, in Canada, Hajizadeh et al. (2014) confirm that obesity is more prevalent among poor and uneducated females whereas differs in Alberta because obesity is more common among the affluent. This is a clear example of intra dimensional variation in the prevalence of obesity within Canada. While considering the obesity epidemic in Canada in comparison with the obesity prevalence in Nigeria, this kind of comparison will consider their inter - dimensional variations. Ideally, this inter-dimensional comparison will help improve understanding of the patterns of the obesity epidemic and facilitate precise

recommendations at the individual level for decision makers. However, studies seldom consider bi-national comparisons. Rather researchers compare multiple countries categorized in two or more groups and such studies accommodate several biases and their recommendations are not country specific.

Secondly, considering the measure of female obesity that is BMI, in the studies reviewed, the relationship or association of obesity were examined among several countries, for example Abarca-Gómez et al. (2017) used a Bayesian hierarchical model to examine trends from 1975 to 2016 in 200 countries for mean BMI and for prevalence of obesity. Due to the inter and intra dimensional variations that exist on participant body size and structure among countries, the various measure of adiposity includes a number of biases. Also, this will give room for misreporting and misclassification on self-reported data on BMI and waist circumference (WC) respectively, ultimately the relationship that exists between the estimated parameters will be affected. Considering Nigeria and Canada all reviewed studies used BMI as the measure of obesity in accordance with the standard measure from the WHO, hence these biases are not considered.

Thirdly, most reviewed studies used various indicators of empowerment or women's empowerment, socioeconomic status (SES) and female obesity; however, they tend to differ in context that is the choices of indicator a researcher adopts depends on the countries involved in the analysis and the availability of data. To mitigate this challenge, a proportional meta-analysis was carried out on 11 studies done within Nigeria and Canada to identify common indicators that best describe women empowerment as a social determinant of female obesity. The term 'proportional meta-

analysis', is a method of data synthesis that allows for calculation of a pooled, overall proportion from a number of individual proportions. This type of meta-analysis is most commonly used to quantify disease occurrence in populations and to answer questions related to both the prevalence and incidence of disease and are typically presented in systematic reviews dealing with prevalence and cumulative incidence data (Barker et al., 2021). However, the limitation due to static dataset to be used will still persist i.e. this study will utilize secondary data for analysis.

In conclusion, the research for this thesis employs the classic and determinant framework to disseminate findings. It is important for countries to enact policies that will empower women to stay healthy and maintain a healthy BMI. If a reward system can be in place for women who utilize their free time to invest in healthy activities (e.g. learning healthy tips, exercise) over time to produce more health capital (promote healthy body weight) will reduce the prevalence of obesity in females and their family as well. For example the ”cycle to work” policy is a scheme initiated by some European employers to diversify active transport to cycling as well to effect positive climate action, participants are actually being paid to cycle to work (Biernat et al., 2020; Jack et al., 2009). The ripple effect of such policy is that it will breed a healthier population if there is significant uptake. Studies also have shown that consistent but moderate exercise will reduce body weight rather than vigorous exercise; hence such policy will effectively promote healthy body weight among females over time.

# Chapter 3: Methodology

This chapter describes the study variables, how each was assessed, as well as the methods of analyses that were used. The focus of the analyses was on examining the relationships between female obesity and female empowerment. To operationalize each concept, reliable, publicly-available datasets at the individual level in Canada and Nigeria were used.

## 3.1 Participants

Survey samples were restricted to women 15-49 years of age because the Demographic Health Survey (DHS) dataset only captures this age range for women while the Canadian Community Health Survey (CCHS) captures women aged 15 years and above. In addition most women at this age range might have had a full-time education, and for whom the body mass index is a useful proxy for health risk.

## 3.2 Data Access

The analyses were reported based on individual-level national health surveys covering Canada and Nigeria. Data sources were the Canadian Community Health Surveys public use micro-data file (PUMF) from the Data Liberation Initiative (DLI) through the University of New Brunswick data and services SDA (https://sda-artsci-utoronto-ca.proxy.hil.unb.ca/index.html/sda.htm) and the Nigeria Demographic Health Surveys (NDHS) through the DHS program implemented by ICF and partners Avenir Health, Blue Raster, The Johns Hopkins Center for Communication Programs (JHCCP), EnCompass, PATH, and Vysnova (https://dhsprogram.com/data/dataset).

Instructions to access the CCHS dataset was issued through UNB data services (see appendix 4). The Variables of interest downloaded and converted to SPSS useable files from the SDA CCHS 2018 presented in the format (Variable, position, description) includes: (DHH_SEX, 0026-0026, Sex), (DHHGMS, 0027-0027,Marital status), (DHHGAGE,0035-0036,Age), ( EHG2DVR3, 0043-0043,Highest level of education - respondent), (HWTDGBMI 0069-0074 Body mass index), (PAA_005, 0439-0439, Active transportation) and (LBFDVWSS, 1310-1310, Working status last week).

Permission to access the data was requested and issued through the DHS website and letter of approval was issued (see appendix 5) from ICF International. Nigeria (DHS-VII) Demographic and Health Survey executed by the Nigeria Population Commission in 2018. It is important to note that only the NGIR7BSV individual recode covered all women 15-49 and the following variable records of interest are presented in the format (variable id, description): (V102,Type of place of residence), ( V149, Educational attainment), (V190, Wealth index combined), (V445, Body Mass Index), (V447A, Women's age in years (from household questionnaire)), (V501, Current marital status) and (V714, Respondent currently working).

## 3.3 Measures

### 3.3.1 Dependent Variable

Body mass index (BMI) was calculated as weight in kilograms divided by square height in meters. Obesity and overweight status was derived as BMI greater than 30 $kg/m^2$ and 25 $kg/m^2$ respectively. BMI ($kg/m^2$) was extracted from the DHS and DLI datasets, based on self-reported height and weight information. An individual with a

BMI >30kg/$m^2$ is classified as obese (Purnell, n.d.). Individuals were categorized based on the BMI values as underweight if BMI < 18$kgm^{-2}$, normal weight if the BMI fell within the range (18-24.9) $kgm^{-2}$, overweight if BMI was (25-29.9) $kgm^{-2}$ and obese if BMI was >30$kgm^{-2}$.

### 3.3.2 Independent Variable

### 3.3.4 Indicators of Empowerment

Empowerment refers to the process of enhancing an individual's capacity to make effective choices, that is, as the ability to convert choices into desired actions and outcomes (Alsop et al., 2005). The presence of choice and its use are critical indicators of the degree of empowerment, measures of empowerment used in studies that demonstrated effectiveness in improving various aspect of health and well-being (Castro Lopes et al., 2021; Dickson, 2021; Garces-Ozanne et al., 2016; Kabeer, 1999; Naila, 2011; Samanta, 2020) differ by context. For example Garces Ozanne, et al (2016) used political rights and civil liberties as key measures for empowerment. The measures of empowerment in this study include female education, income, employment and physical environment, as explained below.

### 3.3.5 Female Education

Variable reflecting the numbers of years spent by everyone in full-time education including all the information available in each dataset on years of schooling and educational attainment was created. For consistency, individuals with no education and those with the lowest level of education were grouped together. Furthermore, the

highest level of education achieved was recorded into four categories: less than high school; high school graduate; some postsecondary; university degree or higher. These categories were created to be concurrent with the Nigerian school system and also reflect substantively meaningful educational attainment within the Canadian school system: primary, secondary, and post-secondary schooling (Gorber et al., n.d.).

### 3.3.6 Income

Income groups were categorized across the overall observations for both data sets because categorical income measure was reported in the datasets (NDHS and DLI - Statscan) to be used for this study (Kpelitse et al., 2014; Wang et al., 2002). A wealth index of 5 categories was reported in the DHS data set namely: poorest, poorer, middle rich and richest.

### 3.3.7 Employment

The employment variable was  a binary variable, that is, it indicated if an individual was unemployed or employed, the value one if the individual was in paid employment or self-employed and zero if the individual was unemployed or out of the labour force (Morris, 2007). The choice of this binary variable for employment was to ensure that both datasets corresponded.

### 3.3.8 Environment

The evidence also shows that environmental influences, which affect attitudes and behaviors to food intake and exercise, are key determinants of obesity (Morris, 2007).  Frank and Engelke (2001) opined that rurality explains an aspect of the nexus

between our activity patterns and the built environment. A domain adopted by this study is place of residence i.e. rural or urban for NDHS and Physical activity for the CCHS dataset.

### 3.4 Nigerian Demographic Health Surveys

The Nigerian Demographic Health Survey is conducted every four years and for this analysis, the latest NDHS dataset of 2018 (DHS-VII) was utilized. The variables were extracted and screened from the household file with 14 878 women as the primary respondents. The data extracted and utilized included: education attainment, current working status (employment), place of residence (environment) and income. These variables of interest were re-coded as shown in Table 2.

### 3.5 Canadian Community Health Surveys

The Canadian Community Health Surveys is conducted every two years and for this analysis, the latest CCHS dataset of 2018 was utilized. The variables were extracted and screened from the Micro-data Analysis and Sub-setting with SDA to 23 279 women as primary respondents. The data extracted and utilized included: education attainment, current working status (employment), place of residence and income. The variables of interest were re-coded as shown in Table 2.

**Table 2:** Summary of Variables and their respective properties

<table>
<tr><th>Dependent variable</th><th colspan="3">Independent variable</th></tr>
<tr><td rowspan="2">Body Mass Index (Kg/M$^2$)</td><td colspan="3">Empowerment indicators</td></tr>
<tr><td rowspan="7">Income</td><td>Domains/Range</td><td>Recode</td></tr>
<tr><td>Domains/Label</td><td>Poorest</td><td>0</td></tr>
<tr><td rowspan="11"><18.5 (underweight)<br>18.5-24.9 (normal weight)<br>25.0-29.9 (overweight)<br>>30 (Obese)</td><td>Poorer</td><td>1</td></tr>
<tr><td>Middle</td><td>2</td></tr>
<tr><td>Richer</td><td>3</td></tr>
<tr><td>Richest</td><td>4</td></tr>
<tr><td rowspan="2">Environment/Active Transport</td><td>Yes/Rural</td><td>0</td></tr>
<tr><td>No/Urban</td><td>1</td></tr>
<tr><td rowspan="2">Employment</td><td>Working</td><td>0</td></tr>
<tr><td>Not working</td><td>1</td></tr>
<tr><td rowspan="3">Education</td><td>Primary</td><td>1</td></tr>
<tr><td>Secondary</td><td>2</td></tr>
<tr><td>University or diploma</td><td>3</td></tr>
<tr><td colspan="3">NDHS have two extra recode or education</td></tr>
<tr><td colspan="3">Control variables</td></tr>
<tr><td colspan="3">Age</td></tr>
<tr><td colspan="3">Marital status</td></tr>
</table>

## 3.6 Data Preparation

For ease of analysis, both datasets, the CCHS and NDHS went through a data screening process. This helped ensure that all variables were as identical as possible across both datasets. For both variables, case ids with missing data for BMI were cleared off because for both datasets those cases were missing completely at random (MCAR). In addition, the CCHS 2018 dataset pulled from the SDA PUMF included both male and female respondents, the DHH_SEX variable was also recoded and male responses were completely cleared off. Other variables such as age and income from the CCHS 2018 were re - coded to conform to the corresponding variable in NDHS.

## 3.7 Steps for Data Analysis

Descriptive statistics were used to assess statistical significance of the comparison indicators between Nigeria and Canada. Descriptive measures of obesity and empowerment indicators by countries were calculated using cross tabulation of frequencies and percentages with compared proportion between the two countries.

In addition, multinomial logistic regression was performed on both datasets to identify odds ratios and draw comparisons across all obesity categories and relationships across all factors of empowerment.

# Chapter 4: Results

This research examined the effects of female empowerment indicators as a social determinant of female obesity. The results are based on data of 23,279 women 15 – 49 years of age from the Canadian Community Health Surveys (CCHS) collected in 2017/2018 and 14,878 women from the Nigerian Demographic Health Surveys collected in 2018. First, descriptive statistics were used to examine the distribution of obesity across various demographic and empowerment indicators across both countries. Secondly, multinomial logistic regression was used to provide a contextual analysis to help better understand the relationships between the empowerment indicators and female obesity, while controlling for other demographic and socio-economic factors. The dataset of both the NDHS and CCHS have very few missing data, hence the data adequately explains the indicators (see table 3).

**Table 3:** NDHS and CCHS Table of Missing Data

| | NIGERIA(DHS) | | | | | | CANADA (CCHS) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Valid** | | **Cases Missing** | | **Total** | | **Valid** | | **Cases Missing** | | **Total** | |
| | *N* | *%* | *N* | *%* | *N* | *%* | *N* | *%* | *N* | *%* | *N* | *%* |
| **Income** | 14878 | 100 | 14878 | 100 | 14878 | 100 | 21409 | 92.0 | 1870 | 8 | 23279 | 100 |
| **Work** | 14878 | 100 | 14878 | 100 | 14878 | 100 | 23148 | 99.5 | 131 | .6 | 23279 | 100 |
| **Age** | 14878 | 100 | 14878 | 100 | 14878 | 100 | 23279 | 100 | 0 | 0 | 23279 | 100 |
| **Edu.** | 14878 | 100 | 14878 | 100 | 14878 | 100 | 23091 | 99.2 | 108 | .8 | 23279 | 100 |
| **Marital Status** | 14878 | 100 | 14878 | 100 | 14878 | 100 | 23234 | 99.8 | 45 | .2 | 23279 | 100 |

## 4.1 Descriptive Statistics

### 4.1.1 Nigeria

This section provides insight to the prevalence of obesity among women in Nigeria. It describes how the rates of obesity vary across each of the descriptive variables. The results of the descriptive statistical analyses for the indicators are outlined in Table 4.

**Table 4:** Summary Table of Descriptive Statistics (NDHS).

| NIGERIA (*N = 14,878*) | | | | | | |
|---|---|---|---|---|---|---|
| **Variables** | **Domain(s)** | **UW (≈12%)** | **NW (≈61%)** | **OW (≈18%)** | **O (≈9%)** | **Total (%)** |
| **Income** | Poorest | 487 (19.05) | 1820 (71.18) | 208 (8.13) | 42 (1.64) | 100 |
| | Poorer | 369 (12.86) | 1989(69.33) | 391 (13.63) | 120 (4.18) | 100 |
| | Middle | 358 (10.86) | 2105 (63.87) | 592 (17.96) | 241 (7.31) | 100 |
| | Richer | 290 (8.80) | 1813 (55.51) | 772 (23.64) | 391 (11.97) | 100 |
| | Richest | 173 (5.99) | 1329 (45.99) | 782 (27.06) | 606 (20.97) | 100 |
| **Education** | No education | 785 (16.32) | 3247 (67.51) | 596 (12.39) | 182 (3.78) | 100 |
| | Incomplete primary | 66 (9.52) | 455 (65.66) | 119 (17.17) | 53 (7.65) | 100 |
| | Complete Primary | 136 (8.11) | 998 (59.55) | 346 (20.64) | 196 (11.69) | 100 |
| | Incomplete Secondary | 351 (12.96) | 1736 (64.11) | 417 (15.40) | 204 (7.53) | 100 |
| | Complete secondary | 268 (7.69) | 1931 (55.41) | 837 (24.02) | 449 (12.88) | 100 |
| | Higher | 71 (4.71) | 689 (45.75) | 430 (28.55) | 316 (20.98) | 100 |
| **Employment** | Yes | 850( 8.69) | 5761 (58.89) | 2039 (20.84) | 1133 (11.58) | 100 |
| | No | 827(16.23) | 3295 (64.67) | 706 (13.86) | 267 (5.24) | 100 |
| **(Urban/rural)** | Urban/not physically active | 564 (9.16) | 3344 (54.32) | 1376 (22.35) | 872 (14.17) | 100 |
| | Rural/physically active | 1113 (12.76) | 5712 (65.49) | 1369 (15.70) | 528 (6.05) | 100 |
| **Age** | 15-25 | 569(23.81) | 1627 (68.08) | 171 (7.15) | 23 (0.96) | 100 |
| | 26-35 | 350(12.79) | 1971 (72.04) | 364 (13.30) | 51 (1.86) | 100 |
| | 36-35 | 232 (8.63) | 1704 (63.37) | 538 (20.01) | 215 (8.00) | 100 |
| | Above 45 | 526 (7.53) | 3754 (53.76) | 1672 (23.94) | 1031 (14.76) | 100 |
| **Marital status** | Never in union | 641 (17.98) | 2378 (66.69) | 413 (11.58) | 134 (3.76) | 100 |
| | Married | 956 (9.41) | 6060 (59.63) | 2050 (20.17) | 1096 (10.79) | 100 |
| | Living with partner | 21 (4.93) | 265 (62.21) | 92 (21.60) | 48 (11.27) | 100 |
| | Widowed | 22 (5.33) | 228 (55.21) | 92 (22.27) | 71 (17.19) | 100 |
| | Divorced | 22 (11.76) | 114 (60.96) | 34 (18.18) | 17 (9.09) | 100 |
| | No longer living together | 15 (6.70) | 111 (49.55) | 64 (28.57) | 34 (15.18) | 100 |

Where: UW= Underweight; NW = Normal Weight; OW = Over weight; O = Obese

Considering the various obesity categories underweight (UW), normal weight (NW), overweight (OW) and obese (O), the overall rates of UW, NW, OW and Obese based on the NDHS, were approximated as UW (≈12%), NW (≈61%), OW (≈18%) and O (≈9%). The following insights were deduced from the analysis:

**Income:** The prevalence of obesity increases with more income for the obese and overweight women and the prevalence decreases with more income for the under weights and normal weights.

*Underweight*: 19.05% of females who are in the 'Poorest' category are underweight. This is compared to 5.99% of females in the 'richest' category who are underweight

*Normal weight*: 71.18% of females who are in the 'Poorest' category are normal weight. This is compared to 45.99% of females in the 'richest' category who are normal weight.

*Overweight:* 27.06% of females who are in the 'richest' category are overweight. This is compared to 8.13% of females in the 'poorest' category who are overweight

*Obese:* 20.97% of females who are in the 'richest' category are obese. This is compared to only 1.64% of females in the 'poorest' category who are obese.

**Education:**

The prevalence of obesity increases with more education for the obese and overweight women and decreases with more education for the under weights and normal weights.

*Underweight*: 16.32% of females who had no education are underweight. This is compared to 4.71% of females with higher education who are underweight.

*Normal weight*: 67.51% of females who had no education are normal weight. This is compared to 45.75% of females with higher education who are underweight.

*Overweight:* 28.55% of females with a higher education are overweight. This is compared to 12.39% of females with no education who are overweight.

*Obese:* 20.98% of females with a higher education are obese. This is compared to 3.78% of females with no education who are obese.

**Employment:** The prevalence of obesity increases as women participate in paid employment for overweight or obese and decreases for underweight and normal weight women who are not working.

*Underweight*: 8.69% of females who are in paid employment are underweight. This is compared to 16.23% of females who are not working are underweight.

*Normal weight*: 58.89% of females who are working are normal weight. This is compared to 64.67% of females who are not working, that are normal weight.

*Overweight:* 20.84% of females that are working are overweight. This is compared to 13.86% of females who are not working that are overweight.

*Obese:* 11.58% of females that are working are obese. This is compared to only 5.24% of females who are not working, that are obese.

**Urban/Rural:** The prevalence of obesity increase for overweight or obese women living in urban area and decreases for underweight and normal weight women who are living in urban area.

*Underweight*: 9.16% of females living in urban areas are underweight. This is compared to 12.76% of females who are living in rural areas, who are underweight.

*Normal weight*: 54.32% of females living in urban areas are normal weight. This is compared to 65.49% of females who are living in rural areas who are normal weight

*Overweight:* 22.35% of females living in urban areas are overweight. This is compared to 15.70% of females who are living in rural areas, who are overweight.

*Obese:* 6.05% of females living in rural areas are obese. This is compared to 14.17% of females who are living in urban areas, who are obese

**Age:** The Prevalence of obesity increases with age for overweight or obese and decreases with age for underweight, however the highest prevalence of normal weight women are aged 26 -35.

*Underweight*: 23.81% of females aged 15 - 25 years are underweight. This is compared to 7.53% of females aged 45 – 49 years that are underweight.

*Normal weight*: 72.04% of females aged 26 - 35 years are normal weight. This is compared to 53.76% of females aged 45 – 49 years that are normal weight.

*Overweight:* 23.94% of females aged 45-49 years are overweight. This is compared to 7.15% of females aged 15 – 25 years that are overweight.

*Obese:* 14.76% of females aged 45-49 years are obese. This is compared to 0.96% of females aged 15 – 25 years that are obese.

**Marital Status:** The Prevalence of obesity follows no specific pattern for marital status as it relates to all categories of obesity.

*Underweight*: 17.98% of single women are underweight. This is compared to 4.93% of women living with the partner.

*Normal weight*: 66.69% of single women are normal weight. This is compared to 49.55% of women not living with a partner.

*Overweight:* 11.58% of single women are overweight. This is compared to 28.57% of women no living with the partner who are overweight.

*Obese:* 3.76% of single women are obese. This is compared to 17.19% of widowed woman who are obese.

### 4.1.2 Canada

This section provides insight to the prevalence of obesity among women in Canada. It describes how the rates of obesity vary across each of the descriptive variables. The results of the descriptive statistical analyses for the indicators are outlined in Table 5.

Considering the various obesity categories underweight (UW), normal weight (NW), overweight (OW) and obese (O), the overall rates of UW, NW, OW and Obese based on the CCHS, are approximated as UW (≈3%), NW (≈52%), OW (≈25%) and O (≈20%). The following insights were deduced (please refer to the table 2 for values):

**Income:** The prevalence of obesity increases with more income for overweight and normal weight women and decreases with more income for the underweight and obese women.

*Underweight*: 5.18% of females who are in the 'poorest' category are underweight. This is compared to 2.58% of females in the 'richest' category who are underweight.

*Normal weight*: 48.24% of females who are in the 'poorer' category are normal weight. This is compared to 56.18% of females in the 'richest' category who are normal weight.

*Overweight:* 23.49% of females who are in the 'poorest' category are overweight. This is compared to 26.28% of females in the 'richest' category who are overweight.

*Obese:* 23.8% of females who are in the 'poorer' category are obese. This is compared to 15.59% of females in the 'richest' category who are obese.

**Education:** The prevalence of obesity and overweight increases with more education and decreases with more education for underweight and normal weight.

*Underweight*: 9.25% of females who have only primary education are underweight. This is compared to 3.25% of females with higher education who are underweight

*Normal weight*: 55.96% of females who have primary education are normal weight. This is compared to 50.58% of females with secondary education who are underweight

*Overweight:* 18.13% of females with only a primary education are overweight. This is compared to 25.14% of females with higher education who are overweight.

*Obese:* 18.88% of females with only a primary education are obese. This is compared to 19.91% of females with higher education who are obese.

**Employment:** The prevalence of obesity increase as women participate in paid employment for women who are overweight and normal weight and decreases for women who are underweight and obese.

*Underweight*: 3.67% of females who are in paid employment are underweight. This is compared to 6.49% of females who are not in paid are underweight.

*Normal weight*: 51.95% of females who are in paid employment are normal weight. This is compared to 51.81% of females who are not in paid employment working, that are normal weights.

*Overweight:* 24.56% of females who are in paid employment are overweight. This is compared to 21.25% of females who are not in paid employment, that are overweight.

*Obese:* 19.81% of females who are in paid employment are obese. This is compared to 20.44% of females who are not in paid employment working, that are obese.

**Urban/Rural:** The prevalence of obesity increase for overweight or obese women living in urban area and decreases for underweight and normal weight women who are living in urban area.

*Underweight*: 3.31% of females living in urban areas are underweight. This is compared to 4.0% of females who are living in rural areas, who are underweight.

*Normal weight*: 48.15% of females living in urban areas are normal weight. This is compared to 53.03% of females who are living in rural areas, who are normal weight

*Overweight:* 26.16% of females living in urban areas are overweight. This is compared to 23.24% of females who are living in rural areas, who are overweight

*Obese:* 22.39% of females living in urban areas are obese. This is compared to 19.73% of females who are living in rural areas, who are obese

**Age:** The prevalence of obesity increases with age for overweight or obese and decreases with age for underweight and normal weight women.

*Underweight*: 9.25% of females aged 15 -25 years are underweight. This is compared to 2.42% of females aged 45 – 49 years that are underweight.

*Normal weight*: 64.28% of females aged 15-25 years are normal weight. This is compared to 43.99% of females aged 45 – 49 years that are normal weight.

*Overweight:* 16.16% of females aged 15-25 years are overweight. This is compared to 28.60% of females aged 46-49 years that are overweight.

*Obese:* 10.31% of females aged 15-25 years are obese. This is compared to 24.99% of females aged 46-49 years that are obese.

**Marital Status:** The prevalence of obesity increases from being single to no longer living with partner for underweight and normal weight but decreases for overweight and obese women.

*Underweight*: 3.23% of women living with a partner are underweight. This is compared to 6.24 % of women not living with a partner.

*Normal weight*: 8.83% of single women are normal weight. This is compared to 56.18% of women not living with a partner.

*Overweight:* 48.33% of single women are overweight. This is compared to 7.9% of women not living with the partner.

*Obese:* 37.68% of single women are obese. This is compared to 17.7% of women no longer living with their partner.

**Table 5:** Summary Table of Descriptive Statistics (CCHS).

| CANADA (N=23,279) | | | | | | |
|---|---|---|---|---|---|---|
| **Variables** | Domains | **NW (≈52%)** | **NW (≈52%)** | **OW (≈24%)** | **O (≈20%)** | **Total (%)** |
| **Income (Wealth index)** | Poorest | 413 (5.18) | 4009 (50.27) | 1873 (23.49) | 1680 (21.07) | 100 |
| | Poorer | 183 (3.04) | 2903 (48.24) | 1500 (24.93) | 1432 (23.80) | 100 |
| | Middle | 84 (2.49) | 1710 (50.71) | 871 (25.83) | 707 (20.97) | 100 |
| | Richer | 47 (2.51) | 979 (52.19) | 493 (26.28) | 357 (19.03) | 100 |
| | Richest | 56 (2.58) | 1218 (56.18) | 556 (25.65) | 338 (15.59) | 100 |
| **Education** | | | | | | |
| | Complete Primary | 270(9.25) | 1633(55.96) | 529(18.13) | 486(18.88) | 100 |
| | Complete secondary | 233(4.83) | 2438(50.58) | 1093(22.68) | 486(18.88) | 100 |
| | Higher | 499 (3.25) | 7938 (51.70) | 3859 (25.14) | 3057 (19.91) | 100 |
| | | | | | | |
| | | | | | | |
| **Employment** | Yes | 642 (3.67) | 9090 (51.95) | 4298 (24.56) | 3467 (19.81) | 100 |
| | No | 367 (6.49) | 2928 (51.81) | 1201 (21.25) | 1155 (20.44) | 100 |
| | | | | | | |
| **Built Environment (Urban/rural)** | Urban/not physically active | 360 (3.31) | 5237 (48.15) | 2845 (26.16) | 2435 (22.39) | 100 |
| | Rural/physically active | 424 (4.00) | 5617 (53.03) | 2461 (23.24) | 2090 (19.73) | 100 |
| | | | | | | |
| **Age** | 15-25 | 462 (9.25) | 3211 (64.28) | 807 (16.16) | 515 (10.31) | 100 |
| | 26-35 | 256 (3.52) | 3848 (52.84) | 1721 (23.63) | 1458 (20.02) | 100 |
| | 36-35 | 210 (2.76) | 3540 (46.48) | 2042 (26.82) | 1824 (23.95) | 100 |
| | Above 45 | 82 (2.42) | 1489 (43.99) | 968 (28.60) | 846 (24.99) | 100 |
| | | | | | | |
| **Marital status** | Never in union | 238 (5.15) | 408 (8.83) | 2233 (48.33) | 1741 (37.68) | 100 |
| | Married | 127 (3.48) | 1831 (50.21) | 907 (24.87) | 782 (21.44) | 100 |
| | Living with partner | 65 (3.23) | 940 (46.74) | 544 (27.05) | 462 (22.97) | 100 |
| | No longer living together | 579 (6.24) | 5215 (56.18) | 1846 (7.9) | 1643 (17.70) | 100 |

Where: UW= Underweight; NW = Normal Weight; OW = Over weight; O = Obese

## 4.2 Multinomial Logistics Regression

A multinomial logistic regression was used to analyze factors predicting obesity among women between 15-49 years of age. The weight class variable was categorical with four possible outcomes: obese, overweight, normal weight and underweight. The reference category for the outcome variable was normal weight and each of the other three categories was compared to the reference category. The main interest of the current analyses was focused on the relationships between the independent variables (environment, occupation, income, education) and BMI – dependent variable (4 categories), while controlling for age and marital status (Please see table 7 and 8 for values).

### 4.2.1 Nigeria

#### 4.2.1.1 Underweight

**Income:** Given that all other variables are held constant for each income group, the results suggest that:

*Poorest:* given the odds ratio of income from poorest to middle class (OR: 1.388-1=0.388), the poorest women are 38.8% more likely to be underweight as compared to women who are middle income earners at 1% significant level.

*Poorer:* given the odds ratio of income from poorer to middle class (OR: 1.017-1=0.017), the poorer women are 1.7% more likely to be underweight as compared to women who are middle income earners. However this category is not statistically significant.

*Richer:* given the odds ratio of income from richer to middle class (OR: 0.987-1=0.013), the richer women are 1.3% less likely to be underweight as compared to women who are middle income earners. However this category is not statistically significant.

*Richest:* given the odds ratio of income from richest to middle class (OR: 1-0.831=0.169), the richest women are 16.9% less likely to be underweight as compared to women who are middle income earners at 10% significant level.

**Rural/Urban :** Given the odds ratio of urban (OR:0.875-1=0.135), urban women are 13.5% less likely to be underweight as compared to women who are in rural areas at 5% level of significance.

**Employment:** Given the odds ratio for unemployed (OR:1-0.729=0.271), unemployed women are 27.1% less likely to be underweight as compared to women who are employed at 1% level of significance.

**Education:** Given that all other variables are held constant for each education category, the results suggest that:

*Incomplete primary school:* given the odds ratio of education from no education to incomplete primary (OR: 1-0.711=0.289), women with incomplete primary are 28.9% less likely to be underweight as compared to women with no education at 1% significance level.

*Complete primary:* given the odds ratio of education from no education to complete primary (OR: 1-0.786=0.214), women with complete primary are 21.4% less likely to be underweight as compared to women with no education at 1% significance level.

*Incomplete secondary school:* given the odds ratio of education from no education to incomplete secondary school (OR: 1-0.643=0.357), women with incomplete secondary education are 35.7% less likely to be underweight as compared to women with no education at 1% significance level.

*Complete secondary/Higher*: given the odds ratio of education from no education to complete secondary/Higher (OR: 1-0.534=0.466), women with complete secondary/higher education are 46.6% less likely to be underweight as compared to women with no education at 1% significance level.

**Age category:** Given that all other variables are held constant for each age group, the results suggest that:

*Age (15-25):* given the odds ratio of age from (15-25) to (26-35) years, (OR: 1.669-1=0.669), women aged 15-25 increases the probability of being underweight by 66.9% as compared to women aged 26-35 years at 1% significance level

*Age (36-44):* given the odds ratio of age from (36-44) to (26-35) years, (OR: 1-0.903=0.097), women aged 36-44 decreases the probability of being underweight by 9.7% as compared to women between the ages 26-35 years. However this category is not statistically significant.

*Age (45-49):* given the odds ratio of age from (45-49) to (26-35) years, (OR: 1-0.876=0.124), women aged 45-49 decreases the probability of being underweight by 12.4% as compared to women between the ages 26-35 years. However this category is not statistically significant.

**Marital status:** Given that all other variables are held constant for each marital status group, the results suggest that:

*Married*: given the odds ratio of marital status from single to married (OR: 1-0.525=0.475), being married decreases the probability of being underweight by 47.5% as compared to women who have never married (single) at 5% significance level.

*Living with partner:* given the odds ratio of marital status from single to living with partner (OR: 1-0.710=0.29), women living with a partner decreases the probability of being underweight by 29% as compared to women who have never married (single). However this category is not statistically significant.

*Widowed:* given the odds ratio of marital status from single to widowed (OR: 1-0.970=0.03), widowed women decreases the probability of being underweight by 3% as compared to women who have never married (single). However this category is not statistically significant.

*Divorced/separated:* given the odds ratio of marital status from single to divorced/separated (OR: 1-0.913=0.087), divorced/separated women increases the probability of being underweight by 8.7% as compared to women who have never married (single). However this category is not statistically significant.

#### 4.2.1.1 Overweight

**Income:** Given that all other variables are held constant for each income group, the results suggest that:

*Poorest*: given the odds ratio of income from poorest to middle class (OR: 1-0.458=0.542), the poorest women are 54.2% less likely to be overweight as compared to women who are middle income earners at 1% significant level.

*Poorer:* given the odds ratio of income from poorer to middle class (OR: 1-0.730=0.27), poorer women are 27% less likely to be overweight as compared to women who are middle income earners at 1% significant level.

*Richer:* given the odds ratio of income from richer to middle class (OR: 1.419-1=0.419), richer women are 41.9% more likely to be overweight as compared to women who are middle income earners at 1% significance level.

*Richest:* given the odds ratio of income from richest to middle class (OR: 1.725-1=0.725), the richest women are 72.5% more likely to be overweight as compared to women who are middle income earners at 1% significance level.

**Urban/rural:** Given the odds ratio of environment from rural to urban (OR: 1-0.968=0.032), urban women are 3.2% less likely to be overweight as compared to women who live in rural areas. However this category is not statistically significant.

**Employment:** Given the odds ratio of employment from unemployed to employed (OR:1.116-1=0.116), unemployed women are 11.6% more likely to be overweight as compared to women who are employed at 5% level of significance.

**Education:** Given that all other variables are held constant for each education category, the results suggest that:

*Incomplete primary school*: given the odds ratio of education from no education to incomplete primary (OR: 1.251-1=0.251), women with incomplete primary are 25.1% more likely to be overweight as compared to women with no education, at 1% significance level.

*Complete primary*: given the odds ratio of education from no education to complete primary (OR: : 1.208-1=0.208), women with complete primary are 20.8% more likely to be overweight as compared to women with no education at 5% significance level.

*Incomplete secondary school*: given the odds ratio of education from no education to incomplete secondary school (OR: 1.564-1=0.564), women with incomplete secondary education are 56.4% more likely to be overweight as compared to women with no education at 1% significance level.

*Complete secondary/Higher*: given the odds ratio of education from no education to complete secondary/Higher (OR: 1.702-1=0.702), women with complete secondary/higher education are 70.2% more likely to be overweight as compared to women with no education at 1% significance level.

**Age category**: Given that all other variables are held constant for each age group, the results suggest that:

*Age (15-25)*: given the odds ratio of age from (15 - 25) to (26 - 35) years, (OR: 1-0.43=0.57), women aged 15 - 25 are 57% less likely to be overweight compared to women aged 26-35 years at 1% significance level.

*Age (36-44)*: given the odds ratio of age from (36 - 44) to (26 - 35) years, (OR: 1.494-1=0.494), women being aged 36 - 44 increases the probability of being overweight by 49.4% as compared to women between the ages 26 - 35 years at 1% significance level.

*Age (45-49)*: given the odds ratio of age from (45 - 49) to (26 - 35) years, (OR: 1.875-1=0.875), women being aged 45-49 increases the probability of being overweight by 87.5% as compared to women between the ages 26-35 years at 1% significance level.

**Marital status:** Given that all other variables are held constant for each income group, the results suggest that:

*Married*: given the odds ratio of marital status from single to married (OR: 1-0.945=0.055), married women decreases the probability of being overweight by 5.5% as compared to women who have never married (single). However this category is not statistically significant.

*Living with partner:* given the odds ratio of marital status from single to living with partner (OR: 1-0.845=0.155), women living with a partner decreases the probability of being overweight by 15.5% as compared to women who have never married (single). However this category is not statistically significant.

*Widowed:* given the odds ratio of marital status from single to widowed (OR: 1.086-1=0.086), being widowed increases the probability of being overweight by 8.6% as compared to women who have never married (single). However this category is not statistically significant.

*Divorced/separated:* given the odds ratio of marital status from single to divorced/separated (OR: 1.539-1=0.539), divorced/separated women increases the probability of being underweight by 53.9% as compared to women who have never married (single) at 5% significance level.

#### 4.2.1.3 Obese

**Income:** Given that all other variables are held constant for each income group, the results suggest that:

*Poorest*: given the odds ratio of income from poorest to middle class (OR: 1-0.267=0.733), the poorest women are 73.3% less likely to be obese as compared to women who are middle income earners at 1% significance level.

*Poorer:* given the odds ratio of income from poorer to middle class ( OR: 1-0.616=0.384), the poorer women are 38.4% less likely to be obese as compared to women who are middle income earners at 1% significant level.

*Richer:* given the odds ratio of income from richer to middle class (OR: 1.616-1=0.616), the richer women are 61.6% more likely to be obese as compared to women who are middle income earners at 1% significance level

*Richest:* given the odds ratio of income from richest to middle class ( OR: 2.894-1=1.894), the richest women are 189.4% more likely to be obese as compared to women who are middle income earners at 1% significance level

**Urban/rural:** Given the odds ratio of urban (OR: 1-0.784=0.216), urban women are 21.6% less likely to be obese as compared to women who are in rural areas. However this category is not statistically significant.

**Employment (**employed = 1**):** Given the odds ratio of employment from unemployed compared to employed ( OR: 1.163-1=0.163), unemployed women are 16.3% more likely to be obese as compared to women who are employed at 5% level of significance.

**Education:** Given that all other variables are held constant for each education category, the results suggest that:

*Incomplete primary school*: given the odds ratio of education from no education compared to incomplete primary (OR: 1.639-1=0.639), women with incomplete primary

are 63.9% more likely to be obese as compared to women with no education at 1% significance level.

*Complete primary*: given the odds ratio of education from no education compared to complete primary (OR: 1.830-1=0.830), women with complete primary are 83% more likely to be obese as compared to women with no education at 1% significance level.

*Incomplete secondary school*: given the odds ratio of education from no education compared to incomplete secondary school (OR: 2.035-1=1.035), women with incomplete secondary education are 103.5% more likely to be obese as compared to women with no education at 1% significant level.

*Complete secondary/Higher*: given the odds ratio of education from no education compared to complete secondary/Higher (OR: 2.451-1=1.451), women with complete secondary/higher education are 145.1% more likely to be obese as compared to women with no education at 1% significant level.

**Age category:** Given that all other variables are held constant for each age group, the results suggest that:

*Age (15-25)*: given the odds ratio of age from (15-25) compared to (26-35) years, (OR: 1-0.184=0.816), women aged 15-25 decreases the probability of being obese by 81.6% as compared to women aged 26-35 years at 1% significance level.

*Age (36-44)*: given the odds ratio of age from (36-44) compared to (26-35) years, (OR: 2.095-1=1.095), women aged 36-44 increases the probability of being obese by 109.5% as compared to women between the ages 26-35 years at 1% significance level.

*Age (45-49)*: given the odds ratio of age from (45-49) compared to (26-35) years, (OR: 3.718-1=2.718), women aged 45-49 increases the probability of being obese by 271.8% as compared to women between the ages 26-35 years at 1% significance level.

**Marital status:** Given that all other variables are held constant for each income group, the results suggest that:

*Married*: given the odds ratio of marital status from single compared to married (OR: 1.003-1=0.003), being married increases the probability of being obese by 0.3% as compared to women who have never married (single). However this category is not statistically significant.

*Living with partner:* given the odds ratio of marital status from single compared to living with partner (OR: 1-0.943=0.057), women living with a partner decreases the probability of being obese by 5.7% as compared to women who have never married (single). However this category is not statistically significant.

*Widowed:* given the odds ratio of marital status from single compared to widowed (OR: 1-0.994=0.006), being widowed decreases the probability of being obese by 0.6% as compared to women who have never married (single). However this category is not statistically significant.

*Divorced/separated:* given the odds ratio of marital status from single compared to divorced/separated (OR: 1.363-1=0.363), being divorced/separate increases the probability of being obese by 36.3% as compared to women who have never married (single). However this category is not statistically significant.

**Table 6:** Estimate of Multinomial Logistics Regression on Obesity and Women Empowerment Indicators (NDHS)

| Variables | NIGERIA *(N=14,878)* | | | | | |
|---|---|---|---|---|---|---|
| | **Underweight** *(n=1319)* | | **Overweight** *(n=2745)* | | **Obese** *(n=4514)* | |
| | **OR (95% CI)** | **SE** | **OR (95% CI)** | **SE** | **OR (95% CI)** | **SE** |
| **Income** | | | | | | |
| **Poorest** | 1.388 (1.174,1.641)* | 0.085 | 0.458 (0.380, 0.551)* | 0.094 | 0.267 (0.188, 0.379)* | 0.179 |
| **Poorer** | 1.017 (0.862,1.199) | 0.084 | 0.730 (0.628, 0.849)* | 0.077 | 0.616 (0.485, 0.781)* | 0.122 |
| **Middle[d]** | 1 | | 1 | | 1 | |
| **Richer** | 0.987 (0.830,1.174) | 0.089 | 1.419 (1.244, 1.619)* | 0.067 | 1.616 (1.344, 1.943)* | 0.094 |
| **Richest** | 0.831 (0.671,1.029)*** | 0.109 | 1.725 (1.487, 2.001)* | 0.076 | 2.894 (2.382, 3.515)* | 0.099 |
| **Built Environment** | | | | | | |
| **Urban[d]** | 0.875 (0.769, 0.997)** | 0.066 | 0.968 (0.874, 1.073) | 0.052 | 0.784 (0.683, 0.899)* | 0.070 |
| **Rural[d]** | 1 | | 1 | | | |
| **Employment** | | | | | | |
| **Unemployed** | 0.729 (0.652, 0.815)* | 0.057 | 1.116 (1.004, 1.242)** | 0.054 | 1.163 (0.995, 1.359)*** | 0.080 |
| **Employed[d]** | 1 | | 1 | | 1 | |
| **Education** | | | | | | |
| **No education[d]** | 1 | | 1 | | 1 | |
| **Incomp. Primary** | 0.711 (0.581, 0.871)* | 0.103 | 1.251 (1.069, 1.465)* | 0.080 | 1.639 (1.316, 2.042)* | 0.112 |
| **Comp. Primary[d]** | 0.786 (0.670, 0.922)* | 0.082 | 1.208 (1.034, 1.410)** | 0.079 | 1.830 (1.462, 2.291)* | 0.115 |
| **Incomp. Sec** | 0.643 (0.538, 0.769)* | 0.091 | 1.564 (1.355, 1.806)* | 0.073 | 2.035 (1.655, 2.502)* | 0.105 |
| **Completed Sec/higher** | 0.534 (0.400, 0.712)* | 0.147 | 1.702 (1.423, 2.035)* | 0.091 | 2.451 (1.937, 3.101)* | 0.120 |
| **Age** | | | | | | |
| **15-24** | 1.669 (1.464,1.903)* | 0.067 | 0.43 (0.382, 0.551)* | 0.064 | 0.184 (0.146,0.231)* | 0.117 |
| **25-34[d]** | 1 | | 1 | | 1 | |
| **35-44** | 0.903 (0.762,1.071) | 0.087 | 1.494 (1.332, 1.674)* | 0.058 | 2.095 (1.810, 2.424)* | 0.074 |
| **45-49** | 0.876 (0.679,1.130) | 0.130 | 1.875 (1.594, 2.206)* | 0.083 | 3.718 (3.062, 4.514)* | 0.099 |
| **Marital Status** | | | | | | |
| **Never in union[d]** | 1 | | 1 | | 1 | |
| **Married** | 0.525 (0.335, 0.825)* | 0.230 | 0.945 (0.734, 1.216) | 0.129 | 1.003 (0.721, 1.396) | 0.169 |
| **Living with partner** | 0.710 (0.452, 1.116) | 0.230 | 0.845 (0.651, 1.097) | 0.133 | 0.943 (0.699, 1.270) | 0.152 |
| **Widowed** | 0.970 (0.608, 1.548) | 0.238 | 1.086 (0.727, 1.622) | 0.205 | 0.994 (0.572, 1.727) | 0.282 |
| **Divorced/Separated** | 0.913 (0.527,1.581) | 0.280 | 1.539 (1.111, 2.132)* | 0.166 | 1.363 (0.896, 2.075) | 0.214 |

4.2.2 Canada

#### 4.2.2.1 Underweight

**Income:** Given that all other variables are held constant for each income group, the results suggest that:

*Poorest*: given the odds ratio of income from poorest compared to middle class (OR: 1.045-1=0.045), the poorest women are 4.5% more likely to be underweight as compared to women who are middle income earners. However this category is not statistically significant.

*Poorer:* given the odd ratio of income from poorer compared to middle class (OR: 1-0.811=0.189), poorer women are 18.9% less likely to be underweight as compared to women who are middle income earners. However this category is not statistically significant.

*Richer:* given the odd ratio of income from richer compared to middle class (OR: 1-0.626=0.374), richer women are 37.4% less likely to be underweight as compared to women who are middle income earners at 10% significance level.

*Richest*: given the odd ratio of income from richest compared to middle class (OR: 1-0.666=0.334), the richest women are 33.4% less likely to be underweight as compared to women who are middle income earners at 10% significance level.

**Rural/urban:** Given the odds ratio of rural compared to urban (OR:1.428-1=0.428), rural women are 42.8% more likely to be underweight as compared to women who are in urban areas at 1% level of significance.

**Employment**: Given the odds ratio of unemployed compared to employed (OR:1-0.682=0.318), unemployed women are 31.8% less likely to be underweight as compared to women who are employed at 1% level of significance.

**Education:** Given that all other variables are held constant for each education category (highest level of education attained), the results suggest that:

*Completed secondary school*: given the odds ratio of education from primary to secondary (OR: 1-0.759=0.241), women who completed secondary school are 24.1% less likely to be underweight as compared to women who completed primary school at 5% significance level.

*Degree/Diploma:* given the odds ratio of education from primary compared to degree/diploma (OR: 1-0.641=0.359), women with a degree/diploma are 35.9% less likely to be underweight as compared to women who completed primary school at 1% significance level.

**Age category:** Given that all other variables are held constant for each age group, the results suggest that:

*Age (15-25):* given the odds ratio of age from (15-25) compared to (26-35) years, (OR: 1.532-1=0.532), women aged 15-25 increases the probability of being underweight by 53.2% as compared to women aged 26-35 years at 1% significance level.

*Age (36-44):* given the odds ratio of age from (36-44) compared to (26-35) years, (OR: 1-0.833=0.117), women aged 36-44 decreases the probability of being underweight by 11.7% as compared to women between the ages 26-35 years. However this category is not statistically significant.

*Age (45-49):* given the odds ratio of age from (45-49) compared to (26-35) years, (OR: 1-0.737=0.263), women aged 45-49 are 26.3% less likely to be underweight as compared to women between the ages 26-35 years. However this category is not statistically significant.

**Marital status:** Given that all other variables are held constant for each marital status, the results suggest that:

*Married:* given the odds ratio of marital status from single to married (OR: 1-0.847=0.153), being married decreases the probability of being underweight by 15.3% as compared to women who have never married (single). However this category is not statistically significant.

*Living with partner:* given the odds ratio of marital status from single to living with partner (OR: 1-0.868=0.132), women living with a partner decreases the probability of being underweight by 13.2% as compared to women who have never married (single). However this category is not statistically significant.

*No longer living with partner*: given the odds ratio of marital status from single to no longer living with partner (OR: 1.059-1=0.059), women who no longer live with a partner increases the probability of being underweight by 5.9% as compared to women who have never married (single). However this category is not statistically significant.

#### 4.2.2.2 Overweight

**Income:** Given that all other variables are held constant for each income group, the results suggest that:

*Poorest*: given the odds ratio of income from poorest to middle class (OR: 1.257-1=0.257), the poorest women are 25.7% more likely to be overweight as compared to women who are middle income earners at 1% level of significance.

*Poorer:* given the odds ratio of income from poorer to middle class (OR: 1.136-1=0.136), the poorer women are 13.6% more likely to be overweight as compared to women who are middle income earners at 5% level of significance

*Richer:* given the odds ratio of income from richer to middle class (OR: 1.056-1=0.056), the richer women are 5.6% more likely to be overweight as compared to women who are middle income earners. However this category is not statistically significant.

*Richest:* given the odds ratio of income from richest to middle class (OR: 1-0.918=0.092), the richest women are 9.2% less likely to be overweight as compared to women who are middle income earners. However this category is not statistically significant.

**Urban/rural:** The result suggests that, given the odds ratio (OR:1-0.769=0.231), rural women are 23.1% less likely to be overweight as compared to women who are in urban areas at 1% level of significance.

**Employment:** The result suggests that, given the odds ratio (OR:1.106-1=0.106), unemployed women are 10.6% more likely to be overweight as compared to women who are employed at 1% level of significance.

**Education**: Given that all other variables are held constant for each education category, the results suggest that:

*Completed secondary school:* given the odds ratio of education from primary to secondary (OR: 1.002-1=0.002), women who completed secondary school are 0.2% more likely to be overweight as compared to women who completed primary school. However this category is not statistically significant.

*Degree/Diploma:* given the odds ratio of education from primary to degree/diploma (OR: 1-0.915=0.085), women with a degree/diploma are 8.5% less likely to be overweight as compared to women who completed primary school. However this category is not statistically significant.

**Age category:** Given that all other variables are held constant for each age group, the results suggest that:

*Age (15-25):* given the odds ratio of age from (15 - 25) to (26 - 35) years, (OR: 1-0.637=0.463), women aged 15 - 25 are 46.3% less likely to be overweight as compared to women aged 26-35 years, at 1% significance level

*Age (36-44):* given the odds ratio of age from (36 - 44) to (26 - 35) years, (OR: 1.308-1=0.308), women aged 36-44 are 30.8% more likely to be overweight as compared to women aged 26 - 35 years at 1% significance level.

*Age (45-49):* given the odds ratio of age from (45 - 49) to (26 - 35) years, (OR: 1.481-1=0.481), being aged 45-49 increases the probability of being overweight by 48.1% as compared to women aged 26 - 35 years at 1% significance level

**Marital status**: Given that all other variables are held constant for each income group, the results suggest that:

*Married*: given the odds ratio of marital status from single compared to married (OR: 1.068-1=0.068), being married increases the probability of being overweight by 6.8% as

compared to women who have never married (single). However this category is not statistically significant.

*Living with partner:* given the odds ratio of marital status from single to living with partner (OR: 1.042-1=0.042), women living with a partner increases the probability of being overweight by 4.2% as compared to women who have never married (single). However this category is not statistically significant.

*No longer living with partner:* given the odds ratio of marital status from single to no longer living with partner (OR: 1.058-1=0.058), women who no longer live with a partner increases the probability of being overweight by 5.8% as compared to women who have never married (single). However this category is not statistically significant.

#### 4.2.2.3 Obese

**Income**: Given that all other variables are held constant for each income group, the results suggest that:

*Poorest:* given the odds ratio of income from poorest to middle class (OR: 1.433-1=0.433), the poorest women are 43.3% more likely to be obese as compared to women who are middle income earners at 1% level of significance.

*Poorer:* given the odds ratio of income from poorer to middle class (OR: 1.381-1=0.381), the poorer women are 38.1% more likely to be obese as compared to women who are middle income earners at 1% level of significance.

*Richer:* given the odds ratio of income from richer to middle class (OR: 1-0.991=0.009), the richer women are 0.9% less likely to be obese as compared to women who are middle income earners. However this category is not statistically significant.

*Richest:* given the odds ratio of income from richest to middle class (OR: 1-0.722=0.278), the richest women are 27.8% less likely to be obese as compared to women who are middle income earners. However this category is not statistically significant.

**Urban/rural:** The result suggests that, given the odds ratio (OR:1-0.617=0.383), rural women are 38.3% less likely to be obese as compared to women who are in urban areas at 1% level of significance.

**Employment:** The result suggests that, given the odds ratio of employment from unemployed to employed (OR: 1-0.957=0.043), unemployed women are 4.3% less likely to be obese as compared to women who are employed. However this category is not statistically significant.

**Education:** Given that all other variables are held constant for each education category, the results suggest that:

*Completed secondary school:* given the odds ratio of education from primary to secondary (OR: 1.030-1=0.030), women who completed secondary school are 3% more likely to be obese as compared to women who completed primary school. However this category is not statistically significant.

*Degree/Diploma:* given the odds ratio of education from primary to degree/diploma (OR: 1-0.781=0.219), women with a degree/diploma are 21.9% less likely to be obese as compared to women who completed primary school at 1% significance level.

**Age category**: Given that all other variables are held constant for each age group, the results suggest that:

*Age (15-25):* given the odds ratio of age from (15 - 25) to (26 - 35) years, (OR: 1-0.316=0.684), women aged 15 - 25 are 68.4% less likely to be obese as compared to women aged 26-35 years at 1% significance level.

*Age (36-44):* given the odds ratio of age from (36 - 44) to (26 - 35) years, (OR: 1.511-1=0.511), women aged 36 - 44 are 51.1% more likely to be obese as compared to women aged 26 - 35 years at 1% significance level

*Age (45-49):* given the odds ratio of age from (45 - 49) to (26 - 35) years, (OR: 1.701-1=0.701), women aged 45-49 are 70.1% more likely to be obese as compared to women aged 26-35 years at 1% significance level.

**Marital status:** Given that all other variables are held constant for each income group, the results suggest that:

*Married*: given the odds ratio of marital status from single to married (OR: 1-0.777=0.233), being married decreases the probability of being obese by 23.3% as compared to women who have never married (single) at 1% significance level.

*Living with partner:* given the odds ratio of marital status from single to living with partner (OR: 1-0.865=0.135), women living with a partner decreases the probability of being obese by 13.5% as compared to women who have never married (single) at 5% significance level.

*No longer living with partner:* given the odds ratio of marital status from single to no longer living with partner (OR: 1-0.822=0.178), women who no longer live with a partner decreases the probability of being obese by 17.8% as compared to women who have never married (single) at 5% significance level.

**Table 7:** Estimate of Multinomial Logistics Regression on Obesity and Women Empowerment Indicators**.**

| Variables | CANADA *(N=23,279)* | | | | | |
|---|---|---|---|---|---|---|
| | **Underweight** *(n=783)* | | **Overweight** *(n=5293)* | | **Obese** *(n=4514)* | |
| | **OR (95% CI)** | **SE** | **OR (95% CI)** | **SE** | **OR (95% CI)** | **SE** |
| **Income** | | | | | | |
| **Poorest** | 1.045(0.835, 1.309) | 0.115 | 1.257(1.142,1.384)* | 0.049 | 1.433(1.290, 1.593)* | 0.054 |
| **Poorer** | 0.811(0.611, 1.076) | 0.144 | 1.136(1.030,1.252)** | 0.050 | 1.381(1.244, 1.533)* | 0.053 |
| **Middle[d]** | 1 | | 1 | | 1 | |
| **Richer** | 0.626(0.390, 1.005)*** | 0.468 | 1.056(0.924,1.206) | 0.068 | 0.991(0.854, 1.150) | 0.076 |
| **Richest** | 0.666(0.431, 1.029)** | 0.222 | 0.918(0.808,1.403) | 0.065 | 0.722(0.622, 0.838)* | 0.076 |
| **Built Environment** | | | | | | |
| **Urban[d]** | 1 | | 1 | | 1 | |
| **Rural[d]** | 1.428(1.209, 1.688)* | 0.085 | 0.769(0.718,0.823)* | 0.035 | 0.617(0.572,0.665)* | 0.038 |
| **Employment** | | | | | | |
| **Unemployed** | 0.682(0.564, 0.825)* | 0.097 | 1.106 (1.012,1.208)* | 0.045 | 0.957 (0.872,1.050) | 0.048 |
| **Employed[d]** | 1 | | 1 | | 1 | |
| **Education** | | | | | | |
| **Comp. Primary[d]** | 1 | | 1 | | 1 | |
| **Completed Sec** | 0.759 (0.581,0.992)** | 0.137 | 1.002(0.882,1.139) | 0.065 | 1.030(0.902,1.176) | 0.068 |
| **Degree/Diploma** | 0.641(0.490, 0.837)* | 0.136 | 0.915(0.812,1.032) | 0.061 | 0.781(0.689,0.885)* | 0.064 |
| **Age** | | | | | | |
| **15-25** | 1.532(1.183, 1.983)* | 0.132* | 0.537 (0.479,0.601)* | 0.065 | 0.316 (0.278, 0.358)* | 0.079 |
| **26-35[d]** | 1 | | 1 | | 1 | |
| **36-44** | 0.883(0.683, 1.141) | 0.131 | 1.308(1.206,1.419)* | 0.044 | 1.571(1.387,1.647)* | 0.053 |
| **45-49** | 0.737(0.512, 1.062) | 0.186 | 1.481(1.336,1.641)* | 0.055 | 1.701(1.526,1.896)* | 0.055 |
| **Marital Status** | | | | | | |
| **Never in union[d]** | 1 | | 1 | | 1 | |
| **Married** | 0.847(0.654, 1.096) | 0.132 | 1.068(0.980,1.165) | 0.044 | 0.777(0.710,0.851)* | 0.046 |
| **Living with partner** | 0.868(0.650, 1.159) | 0.148 | 1.042(0.941,1.155) | 0.052 | 0.865(0.777,0.964)** | 0.055 |
| **No longer living together** | 1.059(0.712, 1.573) | 0.202 | 1.058(0.930,1.202) | 0.065 | 0.822(0.718,0.940)** | 0.69 |

***a.*** ***R****eference category: Normal weight (CCHS n=13,049, DHS n=6,300). ***p <0.1, **p<0.05 and *p<0.01.SE=Standard Error; OR=Odd Ratio. d. Omitted category for each category*

## Chapter 5: Discussion

This study utilized descriptive statistics and multinomial logistic regression to assess the effects of women empowerment as a social determinant of female obesity. The study identified income, education, living in urban/rural areas, and employment as indicators of empowerment and age and marital status as control variables, which could influence female obesity. These factors were analyzed and compared between Canada, a high-income country, and Nigeria, a low-medium income country, using four categories of obesity: underweight, normal weight, overweight and obese.

The findings of the descriptive statistics and multinomial logistic regression analysis demonstrated that in Canada increased empowerment in some metrics like income and education is associated with lower rates of overweight/obese except for living in urban areas. Similarly, Nigeria increased empowerment in some metrics like employment is associated with lower rates of overweight/obese except for income and education which are associated with higher rates of overweight and obesity. The next sections capture the similarity and differences for these indicators in greater detail.

While remaining cognizant of the fact that it takes an effective approach to challenge deeply ingrained beliefs, an approach that respects a diversity of ethnic origins is needed. The results of this study must therefore be considered in recognition of the significant influence of culture on body image views and encouraging healthier lives. It is also especially important to recognize the necessity to inculcate these values early during the formative years and in schools and colleges through sports and recreational activities

(https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2967448/#:~:text=Most%20of%20the%20participants%20reported,as%20a%20necessity%20in%20life).

## 5.1 Similarities between Canada and Nigeria

The tables below illustrate that empowering women in such areas as education, paid employment, increased income and living in healthy urban areas can help reduce the likelihood of being underweight among women and enable them to maintain a healthier body mass index (BMI) in both Nigeria and Canada.

**Table 8:** Similarities of income as an empowerment indicator of female obesity in Nigeria and Canada.

| **Nigeria** | **Canada** |
|---|---|
| ***Underweight***<br><br>*Richest (0.831 (0.671, 1.029)):* the richest women are 16.9% less likely to be underweight as compared to women who are middle income earners at 10% significant level. | ***Underweight***<br><br>*Richest 0.666(0.431,1.029))*: the richest women are 33.4% less likely to be underweight as compared to women who are middle income earners at 10% significance level. |

This suggests that the propensity of becoming underweight is lowest for the richest in Nigeria and Canada at 16.9% and 33.4% respectively.

**Table 9:** Similarities of rural/urban as an empowerment indicator of female obesity in Nigeria and Canada

| Nigeria | Canada |
|---|---|
| ***Underweight***<br><br>*(0.875 (0.769, 0.997):* urban women are 13.5% less likely to be underweight as compared to women who live in rural areas at 5% level of significance. | ***Underweight***<br><br>*(1.428(1.209,1.688)):* rural women are 42.8% more likely to be underweight as compared to women who live in urban areas at 1% level of significance. |

This suggests that the propensity of becoming underweight is lowest for women in urban area compared to women in rural area in Nigeria and Canada.

**Table 10:** Similarities of employment as an empowerment indicator of female obesity in Nigeria and Canada

| Nigeria | Canada |
|---|---|
| ***Underweight***<br><br>(0.729 (0.652, 0.815)): Unemployed women are 27.1% less likely to be underweight as compared to women who are employed at 1% level of | ***Underweight***<br><br>(0.682 (0.564, 0.825)): Unemployed women are 31.8% less likely to be underweight as compared to women who are employed at 1% level of |

| | |
|---|---|
| significance**.**<br><br>***Overweight***<br><br>**(**1.116 (1.004, 1.242)): Unemployed women are 11.6% more likely to be overweight as compared to women who are employed at 5% level of significance. | significance**.**<br><br>***Overweight***<br><br>(1.106 (1.012, 1.208)): Unemployed women are 10.6% more likely to be overweight as compared to women who are employed at 1% level of significance**.** |

The probability of being underweight is lowest for unemployed women compared to employed women. In addition, this propensity increases for unemployed women compared to employed overweight women in Nigeria and Canada by 11.6% and 10.6% respectively.

**Table 11:** Similarities of education as an empowerment indicator of female obesity in Nigeria and Canada

| **Nigeria** | **Canada** |
|---|---|
| ***Underweight***<br><br>Completed secondary/Higher (0.534 (0.400, 0.712)): women with complete secondary/higher education are 46.6% less likely to be | ***Underweight***<br><br>Completed secondary school (0.759 (0.581,0.992)): women who completed secondary school are 24.1% less likely to be underweight as compared to |

| | |
|---|---|
| underweight as compared to women with no education at 1% significance level. | women who completed primary school at 5% significance level.<br><br>*Degree/Diploma (0.641(0.490,0.837)):* women with a degree/diploma are 35.9% less likely to be underweight as compared to women who completed primary school at 1% significance level. |

This suggests that the propensity of becoming underweight is lowest for women who have completed secondary and higher education in Nigeria and Canada.

## 5.2 Differences between Canada and Nigeria

The tables below illustrate that empowering women aged 15-49 years of age in the areas of income, higher education attainment, employment and rural/urban suggests that in Nigeria income tends to make underweight women more likely to be normal weight, however differs for overweight and obese categories where increased income and education attainment tends to make women more likely to be obese and overweight. Employment tends to make women less likely to be obese and overweight. Urban/rural is not a statistically significant contributor to the probability of being in the overweight and obese category. These results suggest that some of these empowerment indicators have a positive effect while others have a negative effect on obesity for women in Nigeria. Employment tends to positively impact obesity in Nigeria, with income and urban/rural having a partial positive effect (positive for underweight women and

negative for obese/overweight) and urban/rural having a positive effect for those who are underweight only. Conversely in Canada, it appears that empowering women with more income, higher education attainment and living in urban areas yields greater positive effects. Women who live in rural areas are more likely to be overweight or obese. Employment is not a statistically significant predictor of obesity. Attaining higher education makes women less likely to be obese. These results suggest that increased income and higher educational attainment tend to benefit the poor primarily and Canadian women, respectively (income and education have a protective effect with higher education and income associated with a lower probability of obesity). Women in rural areas tend to benefit and employment has no statistical effect.

**Table 12:** Differences of income as an empowerment indicator of female obesity in Nigeria and Canada

| **Nigeria** | **Canada** |
|---|---|
| ***Underweight***<br><br>*Poorest:* the poorest women are 38.8% more likely to be underweight as compared to women who are middle income earners at 1% significant level. | ***Underweight***<br><br>*Poorest*: the poorest women are 4.5% more likely to be underweight as compared to women who are middle income earners. However, this category is not statistically significant.<br><br>*Poorer:* poorer women are 18.9% less likely to be underweight as compared |

| | |
|---|---|
| *Poorer:* The poorer women are 1.7% more likely to be underweight as compared to women who are middle income earners. However, this category is not statistically significant.<br><br>*Richer:* Richer women are 1.3% less likely to be underweight as compared to women who are middle income earners. However, this category is not statistically significant.<br><br>***Overweight***<br><br>*Poorest*: The poorest women are 54.2% less likely to be overweight as compared to women who are middle income earners at 1% significant level.<br><br>*Poorer:* Poorer women are 27% less likely to be overweight as compared to women who are middle income earners at 1% significant level.<br><br>*Richer:* given the odds ratio of | to women who are middle income earners. However, this category is not statistically significant.<br><br>*Richer:* Richer women are 37.4% less likely to be underweight as compared to women who are middle income earners at 10% significance level.<br><br>***Overweight.***<br><br>*Poorest*: The poorest women are 25.7% more likely to be overweight as compared to women who are middle income earners at 1% level of significance.<br><br>*Poorer:* The poorer women are 13.6% more likely to be overweight as compared to women who are middle income earners at 5% level of significance<br><br>*Richer:* The richer women are 5.6% more likely to be overweight as compared to women who are middle |

| | |
|---|---|
| income from richer to middle class (OR: 1.419-1=0.419), richer women are 41.9% more likely to be overweight as compared to women who are middle income earners at 1% significance level.<br><br>*Richest:* The richest women are 72.5% more likely to be overweight as compared to women who are middle income earners at 1% significance level.<br><br>***Obese***<br><br>*Poorest*: The poorest women are 73.3% less likely to be obese as compared to women who are middle income earners at 1% significance level.<br><br>*Poorer:* Poorer women are 38.4% less likely to be obese as compared to women who are middle income | income earners. However, this category is not statistically significant.<br><br>*Richest:* The richest women are 9.2% less likely to be overweight as compared to women who are middle income earners. However, this category is not statistically significant.<br><br>***Obese***<br><br>*Poorest:* The poorest women are 43.3% more likely to be obese as compared to women who are middle income earners at 1% level of significance.<br><br>*Poorer:* Poorer women are 38.1% more likely to be obese as compared to women who are middle income earners at 1% level of significance.<br><br>*Richer:* Given the odd ratio of income from richer to middle class (OR: 1- |

| | |
|---|---|
| earners at 1% significant level.<br><br>*Richer:* Given the odds ratio of income from richer to middle class (OR: 1.616-1=0.616), the richer women are 61.6% more likely to be obese as compared to women who are middle income earners at 1% significance level<br><br>*Richest:* Given the odds ratio of income from richest to middle class (OR: 2.894-1=1.894), the richest women are 189.4% more likely to be obese as compared to women who are middle income earners at 1% significance level | 0.991=0.009), the richer women are 0.9% less likely to be obese as compared to women who are middle income earners. However, this category is not statistically significant.<br><br>*Richest:* Given the odd ratio of income from richest to middle class (OR: 1-0.722=0.278), the richest women are 27.8% less likely to be obese as compared to women who are middle income earners at 1% significance level. |

The income trend in Nigeria suggests that poverty (poorest/poorer) is more likely to be associated with women being underweight than overweight or obese and wealth (richer/richest) is more likely to make such women overweight or obese than underweight while in Canada poverty is not a statistically significant predictor for being underweight; richer women are less likely to be underweight. Poverty (poorest/poorer) more likely makes women overweight or obese in Canada and wealth (richest) less likely to make women obese.

**Table 13:** Differences of urban/rural as an empowerment indicator of female obesity in Nigeria and Canada

| Nigeria | Canada |
|---|---|
| ***Overweight***<br><br>Urban women are 3.2% less likely to be overweight as compared to women who live in rural areas. However, this category is not statistically significant<br><br>***Obese***<br><br>Urban women are 21.6% less likely to be obese as compared to women who are in rural areas. However. this category is not statistically significant | ***Overweight***<br><br>Rural women are 23.1% less likely to be overweight as compared to women who are in urban areas at 1% level of significance<br><br>***Obese***<br><br>Rural women are 38.3% less likely to be obese as compared to women who are in urban areas at 1% level of significance |

The urban/ rural trend in Canada suggests that women are less likely to be overweight/obese while in Nigeria rural/urban is not statistically significant.

**Table 14:** Differences of employment urban/rural as an empowerment indicator of female obesity in Nigeria and Canada

| Nigeria | Canada |
|---|---|
| ***Obese***<br><br>Given the odds ratio of employment from unemployed compared to employed (OR: 1.163-1=0.163), unemployed women are 16.3% more likely to be obese as compared to women who are employed at 5% level of significance. | ***Obese***<br><br>The result suggests that, given the odd ratio of employment from unemployed to employed (OR: 1-0.957=0.043), unemployed women are 4.3% less likely to be obese as compared to women who are employed. However, this category is not statistically significant |

The employment trends in Nigeria suggest that unemployed women are more likely to be obese while in Canada employment for the obese is not statistically significant for overweight/obese women.

**Table 15:** Differences of education as an empowerment indicator of female obesity in Nigeria and Canada

| Nigeria | Canada |
|---|---|
| ***Overweight*** | ***Overweight*** |

| | |
|---|---|
| *Incomplete primary school*: women with incomplete primary are 25.1% more likely to be overweight as compared to women with no education, at 1% significance level.<br><br>*Complete primary*: women with complete primary are 20.8% more likely to be overweight as compared to women with no education at 5% significance level.<br><br>*Incomplete secondary school*: women with incomplete secondary education are 56.4% more likely to be overweight as compared to women with no education at 1% significance level.<br><br>*Complete secondary/Higher*: women with complete secondary/higher education are 70.2% more likely to be | *Completed secondary school:* women who completed secondary school are 0.2% more likely to be overweight as compared to women who completed primary school. However, this category is not statistically significant.<br><br>*Degree/Diploma:* women with a degree/diploma are 8.5% less likely to be overweight as compared to women who completed primary school. However, this category is not statistically significant. |

| | |
|---|---|
| overweight as compared to women with no education at 1% significance level.<br><br>***Obese***<br><br>*Incomplete primary school*: women with incomplete primary are 63.9% more likely to be obese as compared to women with no education at 1% significance level.<br><br>*Complete primary*: women with complete primary are 83% more likely to be obese as compared to women with no education at 1% significance level.<br><br>*Incomplete secondary school*: women with incomplete secondary education are 103.5% more likely to be obese as compared to women with no education at 1% significant level.<br><br>*Complete secondary/Higher*: women with complete secondary/higher | ***Obese***<br><br>*Completed secondary school:* women who completed secondary school are 3% more likely to be obese as compared to women who completed primary school. However this category is not statistically significant.<br><br>*Degree/Diploma:* women with a degree/diploma are 21.9% less likely to be obese as compared to women who completed primary school at 1% significance level. |

| | |
|---|---|
| education are 145.1% more likely to be obese as compared to women with no education at 1% significant level. | |

The education trends in Nigeria suggest that as women attain more education the probability of becoming overweight and obese increases while in Canada Diploma and Degree holders are less likely to be obese. Although education is not statistically significant for overweight women, those who completed secondary school follow the same pattern but are not statistically significant for both overweight and obese women.

## 5.3 Summary

In accordance with the Grossman model (1999), every investment on health capital improves the life of an individual and such investment is only beneficial up to certain time or age limit and the current state of one's health. Therefore as women tend to increase investment overtime towards working to earn more money, building intellectual capital and living in a healthy environment that promotes physical activities in Canada, they are more likely to have a healthy body weight, with this is more likely to benefit those between the ages of 15 -35, who never married and those who are married and living with a partner. On the other hand, in Nigeria, although education and income tend to increase the probability of becoming obese, such investments would still have a positive impact on women between the ages of 15 – 49 in addition to living in a healthy environment. Investing in promoting female empowerment is associated with lower rates of obesity in both countries. Nigeria, being underweight is an indicator of poverty and low levels of empowerment. In Canada, it is the opposite: less empowered

women are more likely to be overweight or obese. In other words, being underweight is not a significant issue in Canada, at least not at a population health level. In Nigeria, however, there is significant risk of extreme poverty that is associated with chronic under-nourishment that leads to being underweight. People do not have enough resources to buy or grow enough food to eat. Whereas in Canada, individuals experiencing poverty do not have access to high quality food and facilities to participate in exercise, thus making them more likely to be overweight or obese.

**Income**

In Canada, higher income is associated with being normal weight. Women are more likely to be underweight than middle income earners. The poorest and poorer women are more likely to be overweight and obese than those who are middle income earners. These results are consistent with the findings of Hajizadeh et al. (2014) who examined trends in socioeconomic related inequalities in obesity risk among Canadians. Their result reflects that obesity is more prevalent among poor women, and more concentrated among poor women in rural areas.

In Nigeria income also helps women influence the tendency of becoming normal weight across all obesity categories (underweight overweight and obese). Being underweight is more likely among the poorest women in Nigeria as such women are more likely to be underweight than those who are middle income earners. Being overweight and obese occurs across all income categories in Nigeria. The poorest and poorer women are less likely to be overweight and obese than middle income earners. The richest and richer are more likely to be overweight and obese than middle income earners. These results are not consistent with the findings of Templin et al., (2019) who

conducted a study on the overweight and obesity transition from the wealthy to the poor in low- and middle-income countries using a survey of household data from 103 countries. They discovered that, a larger fraction of the overweight and obese populations were among the poorest. This could possibly be as a result of concentrating the findings among women aged 15-49.

**Urban/Rural**

In Canada the place of residence (urban/rural) influences weight outcomes across all categories (underweight, overweight and obese). Rural women are less likely to be underweight than women in urban Canada. Rural women are more likely to be overweight and obese than women in urban Canada. These results are consistent with the findings of Hruby and Hu (2015) who emphasized that the preference for a thin body image among urban women in developed countries could likely be a contributory factor to the decrease in obesity among women in urban versus rural areas.

In Nigeria, urban/rural status influences the tendency to become normal weight with rural women more likely to be underweight than women in urban Nigeria. Urban women are more likely to be overweight and obese than in rural Nigeria. This result is consistent with other studies (Akombi et al. 2017; Kanter & Caballero, 2012; Wariri et al., 2021). These researchers reviewed trends in SES and global gender disparities in obesity and found that in contrast to developed countries, cultural factors that emphasize a large body image among women in developing countries could explain the increase of obesity among women in urban areas compared to those in rural areas.

**Employment**

In both Canada and Nigeria, employed women are more likely to be normal weight. Unemployed women are less likely to be underweight than employed women and unemployed women are more likely to be overweight than employed women. These results suggest that sedentary lifestyles are prevalent among women who are unemployed in Nigeria and Canada and is consistent with the findings of other research (Morris,2007; Kanter & Caballero, 2012). Kanter and Caballero, (2012) found that as activities become more sedentary and less promoting of physical activity that these changes likely drive obesity among women. In addition, Morris (2007) examined the impact of obesity on employment and found Employment reduces the likelihood of obesity.

**Education**

In Canada education influences the tendency of becoming underweight and obese. Women who are more educated are less likely to be obese or overweight. Being underweight is more prevalent among women with completed secondary school education in Canada, with such women being more likely to be underweight than women with primary level education. Women with a degree or diploma are more likely to be underweight and obese than women with primary education in Canada. These results are consistent with the findings of Hajizadeh et al. (2014) who found that education makes a negative contribution to inequality because an increase in educational attainment decreases the probability of being obese and higher education attainments are mainly concentrated among the better off.

In Nigeria an increased education increases the tendency to become normal weight. Education increases the tendency to become overweight and obese. In Nigeria education helps women influence the tendency of becoming normal weight. Women who are more educated are more likely to be overweight or obese than women with little or no education. In addition, women with incomplete primary education, complete primary, incomplete secondary and complete secondary or higher education are less likely to be underweight than women with no education. Women with incomplete primary education, complete primary, incomplete secondary and complete secondary or higher education women are more likely to be overweight and obese than women with no education. These results are consistent with the findings of other researchers (Desalu et al., 2009; Maruf & Udoji, 2015) who explored the prevalence of overweight and obesity and its associations with socio - demographic variables in the Nigerian population and found that educated women have higher rates of obesity than in developed countries.

# Chapter 6: Implications, Limitations & Conclusions

## 6.1 Policy Implication for Nigeria and Canada

Unfortunately, only a few policy interventions have a solid evidence base to suggest they will have a significant impact in reducing population level obesity in the near future. According to the 2014 comprehensive systematic analysis they opined that no national success stories have been reported in the past 33 years (Ng et al., 2014). From previous findings, empowering women is the most effective way to boost a country's health, social and economic outcomes (Garces-Ozanne et al., 2016). However, the high rates of obesity from previous findings increases the risks of diseases such as high blood pressure and high cholesterol (both risk factors of heart disease), type 2 diabetes, breathing problems, osteoartrithis/musculoskeletal discomfort, gallstone and gallbladder problems. In addition, overweight and obese mothers tend to raise overweight or obese children, hence the possibility of transference of psychological problems such as anxiety and depression to such children exist (Reilly & Kelly, 2011). Therefore, the policy implications for the next decade from the current findings and considering previous findings for both countries should be considered:

**Canada**: As women become more empowered obesity becomes a modifiable risk factor (this is the true definition of empowerment) as suggested from the findings. This is because considering the empowerment metrics used in this study, for example, higher income is associated with healthier weights, most likely due to access to high quality, fresh foods and access to opportunities for active lifestyles, all which can be expensive.

This could also suggest that poverty alleviation strategies by the government and non-government actors (e.g. food banks) have significant effects on the poorest in Canada.

Some existing policies and programs to mitigate obesity prevalence in Canada includes but is not limited to: restricting marketing to children, taxing sugar-sweetened beverages and other products and the strategies to promote healthy food environments (e.g. commercial licensing and zoning powers to limit the location and number of fast food shops, e.g. near schools) and increase fresh food markets (Cohen, 2010; Browning et al, 2013; Ni Mhurchu et al, 2013).

The above mitigating strategies are geared towards non pharmacological approaches at a national level suggesting that this is the way forward. Because weight loss does not mean that the overweight and obese are cured, but need to make life-long smart choices to maintain healthier BMIs. Therefore inter-sectoral actions by government and the private sector can promote non pharmacological research to identify areas to influence people's choices to maintain healthy body weight. Such initiatives should facilitate the sharing of proportionate, lawful and necessary information with actors, while respecting the highest ethical standards to ensure freedom of information and respect for privacy. Such information could include periodic reports on prevalence rates of obesity risk diseases across health authorities.

Targeting women in their prime (15 - 49 years) with BMIs greater than 30 $kg/m^2$ requires strong regulation and supervision to monitor real time prevalence rates to detect and report regions with high cases of obesity linked conditions. Such commitments are effective only if regulations are uniform and compliance is enforced in all jurisdictions with the government setting a "level playing field". This will be even

more important in the future to implement interventions tailored to each region's specific needs based on information gathered and research done over time.

**Nigeria:** As women become more empowered, obesity becomes a thing of wealth as suggested from the findings. This is because as income increases and women engage in paid employment such individuals tend to become overweight and obese. The absence of the two empowerment indicators mentioned above makes the poorest and the poor women more likely to be underweight. In addition to the epidemic of being overweight and obese, being underweight is also a matter of concern especially for women between the ages 15 – 25 years based on the current findings.

Some existing policies and interventions to mitigate obesity prevalence in Nigeria includes but not limited to promoting breastfeeding, labelling pre-packaged food, food based dietary guidelines and tax on sugar sweetened beverages. Similar to Canada, these strategies are non-pharmacologically centric to address obesity at a country level. Public-private-partnership (PPP) may be challenging to implement especially in developing countries but at the same time can promote interventions/projects that will alleviate women from poverty through establishing capital projects that provide paid non-sedentary employment or new and reviving existing markets. For example, the Buenos Aires Declaration (World Trade Organization (WTO)) that featured the Trade Facilitation Agreement (TFA) of 2017, aiding Nigerian women to participate in global trade, which Nigeria committed itself to implement. Despite the benefit of US$170 billion in 20 years from new trade flows that can accrue to Nigeria from implementing the TFA, it is not surprising that not a lot has been done by government agencies, private organizations and stakeholders who should

be driving the process. Such initiatives should involve advocacies and training in skill development in the areas where the benefiting communities have comparative advantage and scaling up such endeavors to yield more benefits/profits.

The effectiveness of these kind of interventions depend on compliance being enforced in all states of the federation targeting underserved communities void of any form of biases (external or internal influence, e.g. political) and the sustainability of such interventions. Sustainability can be facilitated by periodic data gathering of such interventions for monitoring and evaluation purposes.

## 6.2 Special Recommendation for Nigeria

More broadly there is an economic development argument that suggests that empowering women is the most effective way to improve economic outcomes for countries (Garces-Ozanne et al., 2016). The challenge of obesity in Nigeria cuts across all obesity categories namely: underweight, overweight, and obese. Just like in Canada where poverty is almost nonexistent to influence the underweight. Similarly, among the rich you could liken the factor that wealthy women in Nigeria have available resources to make the choices they need to maintain a healthy body weight. However, the poorest of the poor women could only rely on the interventions of government to facilitate their empowerment and invariably maintain a healthy BMI.

One viable way to address poverty at the grass roots level is to identify goods or services women in certain areas or district have comparative advantage over other districts and to amplify their efforts to a commercial level. This can be achieved through trainings, provision of micro credit and creating new and reviving available markets for

their goods and services. Through collaborations like the contributions towards the Coalition Against COVID-19 relief fund in 2019 with both indigenous and multinational companies and the government participating, resources are needed such as: technical skills and expertise, available market and crowd funding (or tasking both government and private super rich institutions e.g. International Oil Companies (IOCs) and the National Oil Company (NOC), telecommunication companies and their regulator, commercial and development banks and port authorities as well as individuals as part of their corporate social responsibility) to an apparent "national fund" to manage the needs of such groups. A national body can be set up for accountability and sustainability purposes to manage the overall operations (monitoring and evaluation). Emanating projects or interventions should be partially managed by the benefiting communities as well. The common goal of this kind of intervention will be focused on underserved communities who are prone to being underweight due to poverty to become normal weight.

From findings, urban/rural places of residence, employment and education influence obesity among Nigerian women, through partnerships, government and private sector can collaborate to set up a system to monitor the BMI of women aged 15-49 years that have exceeded 30kg/$m^2$ so as to encourage them to participate in interventions that would make them maintain a healthy body mass index.

## 6.3 Study Limitations

One major advantage of this study is to facilitate precise findings at a specific country level. However, some limitations do exist for instance this study utilized survey

data (2017/2018) for both datasets, which is not current. Furthermore, some empowerment metrics that was available in the CCHS were not available in the NDHS, and this limits the number of metrics that were used to measure empowerment. Despite these limitations, the credibility of the study to adequately define women empowerment as a social determinant was consistent with the objective of the study. Also, there exists common metrics for both datasets collected in the same year for both countries.

## 6.4 Conclusion

This research was stimulated by the need to expand evidence regarding the role of empowerment as a social determinant of female obesity and the need to understand the relationships between the dynamics of empowerment and obesity. This research has made several contributions to what is known on the topic.

First, the study used the same metrics to assess the relationships between women empowerment and female obesity between Nigeria and Canada, i.e. a low and middle income country and high income country, respectively. Second, it was identified that high levels of empowerment showed less likelihood of obesity for the rich and vice verse for the poor in Canada, suggesting that it is greatly influenced by modifiable risk factors. Third, it found that high levels of empowerment showed an increased likelihood of obesity for the rich and vice verse for the poor in Nigeria, suggesting that obesity is greatly influenced by “poverty/wealth”.

The use of common metrics is a significant contribution of this research as prior to undertaking this study a literature search on the role of women empowerment on obesity identified very few studies that measured this at a national level (comparatively)

between a high income and low and middle income country. Likewise, inconsistencies existed in the few studies that were found; hence their evidence cannot be generalized. One of the main challenges was that each study compared different measures of empowerment with different health conditions. Even though there is evidence that empowerment influences obesity, the evidence was biased to the particular measure that was used. Additionally, the previous studies were conducted broadly by categorizing several countries, hence the existing evidence was more generalizable.

This study helps address these shortcomings by exploring the dynamics of empowerment on obesity at a specific country level. This study includes a high income country (Canada) and a low medium income country (Nigeria) with a sample size of approximately 23000 and 14000 respectively with different empowerment metrics (income, employment, urban/rural places of residence and education). In addition, the study identified that most aspects of empowerment were associated positively with the various obesity categories in Canada, especially obese/overweight and negatively to the various obesity categories (underweight, overweight and obese) in Nigeria.

A major contribution of this study is the precise evidence generated for each country against numerous countries clustered in two distinct groups of high income versus low and medium income countries.

This study did not capture all social determinants of health to define empowerment. Although this is possible, it needs to be conducted using primary data, as this will help answer some question on the types of employment and quality of education such women engaged in. In addition, an interventions component to such

research will help to measure how long it takes for an empowered woman to attain normal weight. This is currently beyond the scope of this work.

The use of current data from primary sources or recent surveys would serve as an appraisal of the progress made since the completion of this study as well as identify new concepts that may influence female obesity across countries categorized as high income or low and middle income countries.

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# Appendix 1: Search strategy

| No. | Search Query | Results |
|---|---|---|
| 1 | ((((((((((((((((‘‘Empowerment’’[Mesh]) OR Empower* [tw]) OR ‘‘women empowerment’’[Mesh]) OR ‘‘education’’[Mesh]) OR educate* [tw]) OR income [tw]) OR "social economic status"[tw]) OR "economic freedom"[tw]) OR liberty* [tw]) OR ‘‘Physical environment’’[Mesh]) OR urban* [tw]) OR employ* [tw]) OR occupation* [tw]) | 2,380,942 |
| 2 | (((((((((‘‘health’’[Mesh]) OR "educate*" [tw]) AND (((((((‘‘social determinant’’[Mesh]) OR obese* [tw]) OR "determinant of health" [tw]) OR income [tw]) OR "social determinant of health" [tw]) OR "physical environment" [tw]) OR "discrimination" [tw]) OR " inclusion" [tw]) | 338,493 |
| 1&2 | ((((((((((((((((‘‘Empowerment’’[Mesh]) OR Empower* [tw]) OR ‘‘women empowerment’’[Mesh]) OR ‘‘education’’[Mesh]) OR educate* [tw]) OR income [tw]) OR "social economic status"[tw]) OR "economic freedom"[tw]) OR liberty* [tw]) OR ‘‘Physical environment’’[Mesh]) OR urban* [tw]) OR employ* [tw]) OR occupation* [tw]) AND (((((((‘‘Obesity’’[Mesh]) OR "body mass index" [tw]) AND (((((((‘‘Canada’’[Mesh]) OR "Nigeria" [tw]) AND (((((((((‘‘women’’[Mesh]) OR female* [tw]) AND (((((((((‘‘health’’[Mesh]) OR "educate*" [tw]) AND (((((((‘‘social determinant’’[Mesh]) OR obese* [tw]) OR "determinant of health" [tw]) OR income [tw]) OR "social determinant of health" [tw]) OR "physical environment" [tw]) OR "discrimination" [tw]) OR " inclusion" [tw]) | 100 |

# Appendix 2: Critical Appraisal Results

## Table 16: Analytical Cross-Sectional Study

| Citation | Q1 | Q2 | Q3 | Q4 | Q5 | Q6 | Q7 | Q8 |
|---|---|---|---|---|---|---|---|---|
| Ene-Obong HN, Enugu GI, Uwaegbute AC. 2001. | N | Y | Y | Y | N | N | Y | Y |
| Esan O, Esan A. 2022. | Y | N | Y | Y | N | N | Y | Y |
| Gagnon-Arpin I, Makvandi E, Imbeault P, Batal M, Bouchard L. 2013. | Y | Y | Y | Y | N | N | Y | Y |
| Huot I, Paradis G, Receveur O, Ledoux M. 2004. | Y | Y | Y | Y | N | N | Y | Y |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| McGlynn N, Kirsh VA, Cotterchio M, Harris MA, Nadalin V, Kreiger N. 2005. | Y | Y | Y | Y | N | N | Y | Y |
| Mojisola OK SA. 2021. | Y | Y | Y | Y | Y | Y | Y | Y |
| Onuoha-Obilor. 2017. | Y | Y | Y | Y | Y | Y | Y | Y |
| Siddiqi A, Brown R, Nguyen QC, Loopstra R, Kawachi I. 2005. | Y | N | N | Y | Y | Y | Y | Y |
| Woodhall-Melnik J, Cooke M, Bigelow PL. 2015. | N | Y | Y | Y | N | N | Y | Y |
| % | 77.77 | 77.77 | 88.88 | 100.0 | 33.33 | 33.33 | 100.0 | 100.0 |

## Table 17: Cohort Study

| **Citation** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q6** | **Q7** | **Q8** | **Q9** | **Q10** | **Q11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Manson J, Rotondi M, Jamnik V, Ardern C, Tamim H. 2017. | N | Y | Y | N | N | Y | N | N | N | N | N |
| Mason C, Brien SE, Craig CL, Gauvin L, Katzmarzyk PT. 2007. | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| % | 50.0 | 100.0 | 100.0 | 50.0 | 50.0 | 100.0 | 50 | 50.0 | 50.0 | 50.0 | 50 |

## Table 18: Prevalence Study

| **Citation** | **Q1** | **Q2** | **Q3** | **Q4** | **Q5** | **Q6** | **Q7** | **Q** | **Q9** |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | 8 | |
|---|---|---|---|---|---|---|---|---|---|
| Gezawa ID, Puepet FH, Mubi BM, Uloko AE, Bakki B, Talle MA, et al. 2013. | Y | Y | Y | Y | Y | Y | Y | Y | Y |
| Iloh G, Amadi AN, Nwankwo BO, Ugwu VC. 2011. | Y | Y | Y | Y | Y | N | Y | N | Y |
| % | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 50.0 | 100 | 50 | 100.0 |

**Table 19: Systematic Review and Research Syntheses**

| **Citation** | **Q1** | **Q2** | **Q3** | **Q 4** | **Q 5** | **Q6** | **Q7** | **Q8** | **Q9** | **Q 10** | **Q11** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Clemmens D, Hayman LL. 2003. | Y | Y | Y | N | U | Y | Y | Y | N | N | Y |
| % | 100.0 | 100.0 | 100.0 | 0 | 0 | 100 | 100.0 | 100.0 | 0 | 0 | 100 |

## Appendix 3: Characteristics of Included Studies

### Table 20: Characteristics of Included Studies - Analytical Cross-Sectional Study Form

| **Study** | **Country** | **Setting/context** | **Participant characteristics** | **Groups** | **Outcomes measured** | **Main description of results** |
|---|---|---|---|---|---|---|
| Ene-Obong | Nigeria | Nigeria | 300 women of childbearing age | Three hundred | The basic determinants | Most (88.5%) |

| | | | | | | |
|---|---|---|---|---|---|---|
| HN, Enugu GI, Uwaegbute AC. 2001. | | | in two rural farming communities | respondents were included in the cross-sectional survey. A stratified sampling technique was employed. Three different strata, farmers, traders/market women, and teachers, were considered. The method of selecting respondents in each stratum differed due to their special characteristi | of health and nutritional status of women are socioeconomic and cultural, education having a mediating or modifying influence on cultural practices | women in the study were aged 25-45 years. There were significantly ($p<0.05$) more younger women (18-24 years) among the farmers (16%) and traders (15%) than among the teachers (1.2%). evel of educatio |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | cs. In the villages where the study was conducted, there were no streets. Families clustered in different locations. For farmers, the researchers randomly picked one in every four households in each cluster for the survey. The farmers were usually visited in the morning hours as the research was | | n correlated positively with all the nutritional variables but was significant ($p<0.05$) for energy ($r=0.334$), niacin ($r=0.330$) and vitamin C ($r=0.348$) intake. There was a significant ($p<0.05$) positive associati |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | conducted during the pre-planting season. The traders/market women were located at the market places. The main market in each community was selected. One in every two market-stalls was randomly selected, and the traders were interviewed there. All the female teachers, identified in the two | | on between income and all the nutritional variables, except for vitamin C intake (r=0.175, p<0.05). Income was also strongly correlated to age-at-marriage (r=0.719; p<0.05), level of education (r=0.837; |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | communities, were included in the study to make up the number of respondents required | | p<0.05), and nutrition knowledge (r=0.601, p<0.05). However, it had a negative non-significant (p<0.05) association with workload (r=-0.078). The association between workload and most nutritional variables |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | was negative, except for energy, niacin and vitamin C intakes. However, workload was significantly ($p<0.05$) correlated with protein intake ($r=-0.346$). |
| Esan O, Esan A. 2022. | Nigeria | Nigerians with schizophrenia | A total of 207 people with schizophrenia met the inclusion criteria and were evaluated | The non-obese participants were made up of underweigh t 24 | obese people with schizophrenia | We found that age, educatio n and monthly income |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | for BMI. participants were required to be between the ages of 18 and 55 years, should be able to read and write and must have had at least 6 years of education, that is, primary school education in Nigeria. | (11.7%), normal weight 118 (57%) and overweight 38 (18.4%).The prevalence of obesity was 12.6% at 27 | | were all associated with obesity. It has been suggested that as affluence increases in low- and middle-income countries such as Nigeria, it is expected that poverty-obesity patterns would mirror those of high-income countries. |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | Education is expected to offset the negative effects of increasing purchasing power in emerging obesogenic environments [6]. However, the protective influence of education is yet to be seen in |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | Nigeria, as revealed in the current study where both more educatio n and monthly income were directly associate d with increase d likelihoo d of obesity |
| Siddiqi A, Brown R, Nguyen QC, Loopstr a R, | Canada and united states | Canada and United states | the target population included adults aged 18 or older residing in households with a landline telephone | The population in the US was stratified by four geographic regions.In | Our results suggest there is variation between U.S. and Canada in different dimensions of socioeconomi | In the U.S., every socioeco nomic group except the |

| | | | | | | |
|---|---|---|---|---|---|---|
| Kawachi I. 2005. | | | | the US, Computer-Assisted Telephone Interviews (CATI) were given in English and Spanish. Our final analytic sample was restricted to normal weight and obese individuals only and consisted of 3346 residentsThe population was stratified in Canada by province. In Canada, Computer- | c inequalities in obesity | college educated had significant excess prevalence of obesity. By contrast in Canada, only those with less than high school were worse off, suggesting that the shape of the socioeconomic gradient differs in |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | Assisted Telephone Interviews (CATI) were given in English and French. Our final analytic sample was restricted to normal weight and obese individuals only and consisted of 2221 | | the two countries . U.S. differentials between socioeconomic levels were also larger than in Canada (e.g., PR quintile 1 compared to quintile 5 was 1.82 in the U.S. [95 % CI: 1.52-2.19] but 1.45 in Canada [95 % CI: 1.10- |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | 1.91]). At the lower end of the socioeconomic gradient, obesity was more prevalent in the U.S. than in Canada. |
| Woodhall-Melnik J, Cooke M, Bigelow PL. 2015. | Canada | Canadian food service workers | The survey dataset we constructed two groups of 16 to 65 year olds. Those who were classified as food and beverage servers (G012), food counter attendants, kitchen helpers, and related | e National Occupational Classification System (NOC-S) codes provided on the survey dataset we constructed two groups of 16 to 65 year olds. | Food service workers in general were not at higher risk for high BMI, but those between the ages of 41 and 64 are at higher risk of having a BMI in the overweight or obese ranges. | Canadian food service workers are less likely to have BMIs in the overweight and obese ranges than the |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | occupations (G961), and food service supervisors (G012) formed the food service worker group (N= 921) in the analysis. We chose these three groups as they clearly indicated employment in the food service industry. All other respondents aged 16 to 65 used for comparison population (N= 58,272) | Those who were classi fied as food and beverage servers (G012), food counter attendants, kitchen helpers, and related occupations (G961), and food service supervisors (G012) formed the food service worker group (N= 921) in our analysis. We chose these three groups as they clearly indicated employmen | | general populati on. Stratifica tion by age demonstr ated that this decrease d risk can be attribute d to the fact that food service workers tend to be younger than the general populati on. As age increases among food service |

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|---|---|---|---|---|---|---|
| | | | | t in the food service industry. All other respondents aged 16 to 65 were used as our compar ison group, which we refer to as the general Canadian population (N= 58,272) | | workers, the odds of having a BMI in the overweig ht and obese ranges increases . |
| McGlyn n N, Kirsh VA, Cotterch io M, Harris MA, Nadalin V, Kreiger N. 2005. | Canada | Canadian Women | Self-administered questionnaire data were used from healthy, currently employed females in a population-based study, | The Ontario Women's Diet and Health case-control study (n = 1611 controls), and from a subset of a of university alumni | As these analyses found a positive association between high probability of shift work expo sure and obesity in a population-based sample, but not in an | In the populati on-based sample, high probabili ty of shift work was associate d with obesity |

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| | | | | from the Canadian Study of Diet, Lifestyle, and Health (n = 1097) cohort study.The alumni societies of the University of Toronto, Alberta, and Western University mailed study questionnaires to their alumni. The small subset collected in 1992 was recruited by contacting known individuals | alumni cohort, it is suggested that the relationship between shift work and obesity is complex, and may be particularly susceptible to occupational and education-related factors within a given populati | (reference = near nil probability of shift work, OR: 1.88, 95% CI: 1.01–3.51, p = 0.047). In the alumni cohort, no significant association was detected between shift work and overweight or obesity. |

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| | | | | of Canadian Cancer Society volunteers | | |
| Gagnon-Arpin I, Makvandi E, Imbeault P, Batal M, Bouchard L. 2013. | Canada | Canadians | Excess weight among Francophones and Anglophones in canada | Two multivariate logistic regression models, for men and for women, were used to test | The study reaffirms the role of social and behavioral determinants in the prevalence of excess weight. Although language does not directly influence excess weight, given the socioeconomic reality of the Francophone minority, represented in greater proportion in the strata of the population most vulnerable to | The prevalence of overweight is higher among Francophones than Anglophones in Ontario, although this difference is no longer significant when the model is adjusted for socioeconomic |

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| | | | | | excess weight, belonging to a minority group should challenge health planners. | and behavioral characteristics. Nevertheless, Francophones are older, less educated and live more in rural areas than their Anglophone counterparts, a context that makes them more vulnerable. |

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| Huot I, Paradis G, Receveur O, Ledoux M. 2004. | Canada | Quebec population | Data were analysed from a sample of 5214 participants (2227 males, 2987 females) | The urban region was one of high population density, low socio-economic status and multiethnic population in south central Montreal.The suburban region had a lower population density, was mostly middle-class and was located 20 km north of Montreal.The rural region was composed mostly of farming | Future health interventions in Quebec should target people with low education, smokers and those living in a rural environment. Obese men and sedentary women should have access to specific dietetic resources. | : In both genders, lower level of education, smoking status, French and English languages compared with other languages spoken at home, and a rural environment were associated with poor diet quality. Having no |

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| | | | | communities with low socio-economic status and low density population and was located 500 km east of Montreal | | intention to eat low-fat dairy products more often was associated with a high-fat diet. In men, obesity (body mass index $30 kg m22 ) and absence of reported health problems were correlates of a high-fat diet, |

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| | | | | | | while, in women, lower physical activity was a correlate . |

**Table 21: Characteristics of Included Studies - Prevalence Study Form**

| Study | Country | Year/timeframe for data collection | Participant characteristics | Conditions and measurement methods | Description of main results |
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| Gezawa ID, Puepet FH, Mubi BM, Uloko AE, Bakki B, Talle MA, et al. 2013. | Nigeria | The survey was conducted twice weekly (Saturdays and Sundays) between July 2008 and January 2009. | We selected a sample of 1650 men and women aged 15 years | The selection was done using simple balloting. In stage three, we carried out a household enumeration to identify eligible residents. In all, 1700 subjects from 340 households selected systematically (every second household based on calculated sampling fraction) were identified and were | The prevalence of overweight and obesity is high in Maiduguri metropolis particularly among women |

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| | | | | invited to participate in the study | |
| Iloh G, Amadi AN, Nwankwo BO, Ugwu VC. 2011. | Nigeria | A descriptive study was carried out from June 2008 to May 2009. | A total of 2156 consecutive new adult patients aged 18-90 years | A total of 2156 consecutive new adult patients aged 18-90 years were screened for obesity using the BMI criterion, and 129 patients had BMI ≥30kg/m2 and met the inclusion criteria. The data collected included age, sex, marital status, education, occupation, social class, weight, height and blood pressure, fasting blood sugar and lipid profile. | The prevalence of obesity was 6.0%, with class I obesity (86.1%) being the most common pattern. Hypertension (16.3%) was the most common primary co-morbidity; others included low high-density lipoprotein—cholesterol (21.7%), high low-density lipoprotein—cholesterol (9.3%), high total cholesterol |

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| | | | | | (7.8%), high triglyceridemia (4.7%) and diabetes mellitus (3.9%). |

**Table 22: Characteristics of Included Studies - Cohort Study Form**

| Study | Country | Setting/context | Participant characteristics | Groups | Outcomes measured | Description of main results |
|---|---|---|---|---|---|---|
| Manson J, Rotondi M, Jamnik V, Ardern C, Tamim H. 2017. | Canada | Canadian adults | Two hundred and nine ethnically diverse mid to older community dwelling Canadian adults residing in low income neighbourhoods | Two hundred and nine ethnically diverse mid to older community dwelling Canadian adults residing in low income neighbourhoods were enrolled in a 16 week | beneficial influence on musculoskeletal health-related fitness and self-reported physical health in a mid to older low socioeconomic, ethnically diverse sample. | Using paired sample t-tests significant improvements were found in both upper and lower body strength, low back flexibility, and the SF 36 physical health scores ($p < 0.05$). Based on multiple linear regression analyses, no common health determinants explained a |

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| | | | | Yang style TC program | | significant portion of the variation in percent changes of the musculoskeletal fitness and SF 36 measures. |
| Mason C, Brien SE, Craig CL, Gauvin L, Katzmarzyk PT. 2007. | Canada | Canadian adults | participants who were between the ages of 20 and 69 yr in 1981 | The sample used in the present analysis was limited to 606 PALS participants who were between the ages of 20 and 69 yr in 1981 and who completed both the questionnaire and | : The results indicate that MSF is a significant predictor of weight gain during a 20-yr period. Promoting participation in activities that enhance MSF may be beneficial in attenuating age-related weight gain and in preventing obesity among | During the 20-yr follow-up, the prevalence of obesity (BMI Q 30 kgImj2 ) increased from 3.1 to 15.2%, reflecting a mean weight gain of 7.4 kg (men: 6.7 kg; women: 8.1 kg). Further, independent of age, sex, baseline BMI, physical activity, cardiorespiratory fitness, smoking, alcohol |

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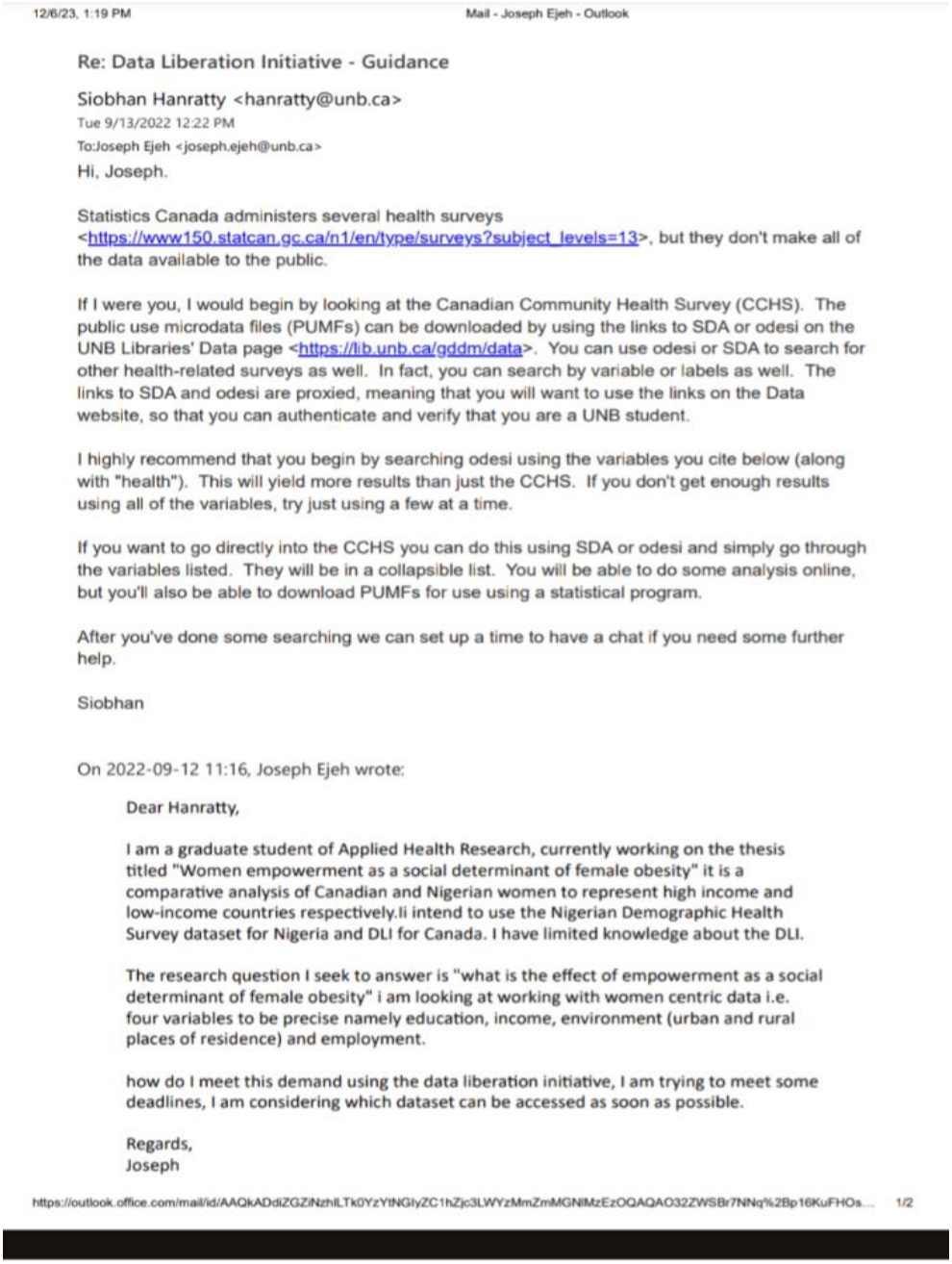
| | | | | physical measures components of the CFS | Canadians | consumption, and income, low MSF was associated with significantly higher odds of having gained at least 10 kg during follow-up (OR: 1.78, 95% CI: 1.14–2.79). |

## Appendix 4: Data Access and Permission (CCHS)



12/6/23, 1:19 PM Mail - Joseph Ejeh - Outlook

Re: Data Liberation Initiative - Guidance

Siobhan Hanratty <hanratty@unb.ca>
Tue 9/13/2022 12:22 PM
To:Joseph Ejeh <joseph.ejeh@unb.ca>

Hi, Joseph.

Statistics Canada administers several health surveys <https://www150.statcan.gc.ca/n1/en/type/surveys?subject_levels=13>, but they don't make all of the data available to the public.

If I were you, I would begin by looking at the Canadian Community Health Survey (CCHS). The public use microdata files (PUMFs) can be downloaded by using the links to SDA or odesi on the UNB Libraries' Data page <https://lib.unb.ca/gddm/data>. You can use odesi or SDA to search for other health-related surveys as well. In fact, you can search by variable or labels as well. The links to SDA and odesi are proxied, meaning that you will want to use the links on the Data website, so that you can authenticate and verify that you are a UNB student.

I highly recommend that you begin by searching odesi using the variables you cite below (along with "health"). This will yield more results than just the CCHS. If you don't get enough results using all of the variables, try just using a few at a time.

If you want to go directly into the CCHS you can do this using SDA or odesi and simply go through the variables listed. They will be in a collapsible list. You will be able to do some analysis online, but you'll also be able to download PUMFs for use using a statistical program.

After you've done some searching we can set up a time to have a chat if you need some further help.

Siobhan

On 2022-09-12 11:16, Joseph Ejeh wrote:

> Dear Hanratty,
>
> I am a graduate student of Applied Health Research, currently working on the thesis titled "Women empowerment as a social determinant of female obesity" it is a comparative analysis of Canadian and Nigerian women to represent high income and low-income countries respectively.Ii intend to use the Nigerian Demographic Health Survey dataset for Nigeria and DLI for Canada. I have limited knowledge about the DLI.
>
> The research question I seek to answer is "what is the effect of empowerment as a social determinant of female obesity" i am looking at working with women centric data i.e. four variables to be precise namely education, income, environment (urban and rural places of residence) and employment.
>
> how do I meet this demand using the data liberation initiative, I am trying to meet some deadlines, I am considering which dataset can be accessed as soon as possible.
>
> Regards,
> Joseph

https://outlook.office.com/mail/id/AAQkADdiZGZiNzhlLTk0YzYtNGIyZC1hZjc3LWYzMmZmMGNlMzEzOQAQAO32ZWSBr7NNq%2Bp16KuFHOs... 1/2

12/6/23, 1:19 PM Mail - Joseph Ejeh - Outlook

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Siobhan Hanratty
Head, Reference & Circulation Services • Data/GIS Librarian
Harriet Irving Library (317D)
T 506-451-6803 E hanratty@unb.ca

## Appendix 5: Data Access and Permission (DHS)

Sep 13, 2022

Joseph EJeh
University of New Brunswick
Canada
Request Date: 09/12/2022

Dear Joseph EJeh:

This is to confirm that you are approved to use the following Survey Datasets for your registered research paper titled: "Women Empowerment a social determinant of female obesity":

**Nigeria, Nigeria (Ondo State)**

To access the datasets, please login at: https://www.dhsprogram.com/data/dataset_admin/login_main.cfm. The user name is the registered email address, and the password is the one selected during registration.

The IRB-approved procedures for DHS public-use datasets do not in any way allow respondents, households, or sample communities to be identified. There are no names of individuals or household addresses in the data files. The geographic identifiers only go down to the regional level (where regions are typically very large geographical areas encompassing several states/provinces). Each enumeration area (Primary Sampling Unit) has a PSU number in the data file, but the PSU numbers do not have any labels to indicate their names or locations. In surveys that collect GIS coordinates in the field, the coordinates are only for the enumeration area (EA) as a whole, and not for individual households, and the measured coordinates are randomly displaced within a large geographic area so that specific enumeration areas cannot be identified.

The DHS Data may be used only for the purpose of statistical reporting and analysis, and only for your registered research. To use the data for another purpose, a new research project must be registered. All DHS data should be treated as confidential, and no effort should be made to identify any household or individual respondent interviewed in the survey. Also, be aware that re-distribution of any DHS micro-level data, either directly or within any tool/dashboard, is not permitted. Please reference the complete terms of use at: https://dhsprogram.com/Data/terms-of-use.cfm.

The data must not be passed on to other researchers without the written consent of DHS. However, if you have coresearchers registered in your account for this research paper, you are authorized to share the data with them. All data users are required to submit an electronic copy (pdf) of any reports/publications resulting from using the DHS data files to: references@dhsprogram.com.

Sincerely,

*Bridgette Wellington*

Bridgette Wellington
Data Archivist
The Demographic and Health Surveys (DHS) Program

530 Gaither Road, Suite 500, Rockville, MD 20850 USA +1.301.407.6500 +1.301.407.6501 fax icf.com

# Curriculum Vitae

| | |
|---|---|
| Candidate's full name: | Joseph Ejeh |
| Universities attended: | Modibbo Adama University, March 2010 to Sept 2015 (B.Tech. (Hons) Operations Research)<br>University of New Brunswick - Fredericton, NB - Sept 2020 to Present (Master of Applied Health Services Research) |
| Publications: | None |
| Conference Presentations: | None |