IOSR Journal Of Pharmacy And Biological Sciences (IOSR-JPBS)
e-ISSN:2278-3008, p-ISSN:2319-7676. Volume 14, Issue 4 Ser. IV (Jul – Aug 2019), PP 54-65
www.Iosrjournals.Org

Female Obesity and the Skewed Economics

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Abstract: *The continuous rise in the prevalence of obesity around the world has been linked to dietary behaviours. But there are also views on how female labour participation and their income levels affect the prevalence of obesity among women, which vary across countries. The relationship between female labour force participation and income level against the prevalence of obesity among female is not straight forward in Nigeria, like many developing countries, especially as economic frameworks are neither the same nor consistent. This research examines the role of income level, female labour participation rate and female-male labour ratio on the prevalence of female obesity in Nigeria, utilising historical data (1990-2016) analysed using the ordinary least squares (OLS) method. While the result obtained indicates that income level has no significant influence on the prevalence of female obesity, female labour participation rate and female-male labour ratio do impact significantly, and further hinged that income level may only not have a direct influence but indeed has indirect impact on the prevalence of obesity through the earning power of women by which they access better quality food and healthcare. The study thus suggests the need for more educational opportunities and greater job prospects for the women to enhance both their physical quality and economic prospect.*

Keywords: *economics, female labour participation, female obesity, income level, Nigeria*

Date of Submission: 23-08-2019 Date of Acceptance: 07-09-2019

I. Introduction

1.1 Background

Being fat is a normal African disposition, as it is seen as a sign of good wellbeing. Even though overweight and obesity have traditionally been associated with developed countries, their prevalence in developing countries have been on the rise in recent time as low- and middle-income countries now experience accelerating rates of the obesity epidemic, with as much as 25% of all overweight children living in Africa, and almost half residing in Asia with Egypt having the highest prevalence of obesity in Africa, and South Africa ranking among highest in Africa, mirroring overall high rates of malnutrition (Hamel & Black, 2018). Indeed, developing countries have undergone dietary changes as custom diets have been swapped for western ones, coupled with reduced levels of physical activities and increased stress, the result which is a startling increase in obesity (Martorell et al., 2000). Neovius et al. (2008)'s submission is that unhealthy behaviours such as physical inactivity and poor diet also have a link with obesity.

Obesity is a growing global problem which doubled between the year 1980 and 2008, with prevalence of adult obesity at 35% (Hattingh, 2009). It is a headliner with lead focus by health professionals, media and other stakeholders. The numbers of overweight and obese persons keep on stunning with overweight figures estimated at 2 billion adults, and unfortunately, no country has been able to reverse the epidemic (Hamel & Black, 2018).

Concerns about the increased prevalence of obesity are premised on the effect it has in terms of adverse health outcomes and the economic externality to the extent of work disability, social (and economic) stigma, low productivity and output, increased health expenditures and at the end, a low income, whether at the macro- or micro-level. In terms of risk, obesity is linked to an increased risk of numerous comorbidities, including high blood pressure, high blood cholesterol, type 2 diabetes mellitus, coronary heart disease, osteoarthritis, asthma, and gallbladder disease, besides lowering adult life expectancy, mostly caused by poor diet and sedentary lifestyle (Must & McKeown, 2012).

There have been growing awareness over the years that the concerns around obesity have not appreciated a gender-specific strategy. Contrary to assumptions that both male and female are evenly

disadvantaged in the advent of obesity, women in reality are the worse affected.[1] And indeed, it has become obvious that (household) economics is female sensitive. In their view of female obesity, Crosnoe (2007), Morris (2007), van Duijvenbode et al. (2009) and Neovius et al. (2008) noted that high female obesity is associated with various educational and labour market outcomes, such as lower education, higher rates of unemployment and work disability. These are the same across a number of countries without the distinction of income levels: low, middle and high. The problem of obesity in relation to the economy is because it creates a burden on the macro- (creates pressure on the healthcare system, while also instigates a fiscal challenge) and micro- (impacts the individual) economic levels.

Our study is driven around the gender economics of labour in Nigeria, in relation with economics of lifestyle and nutrition. Given that Nigeria's labour force participation rate dropped to 55.21% in December 2018 compared with 55.22% the previous year, and the average participation rate is estimated to be 55.1%, with an all-time high of 55.9% in December 1990 and a record low of 54.7% in December 2004, the drop is traceable to the sparse involvement of women in the country's formal economic activities.[2] In the light of this, our research investigates the prevalence of obesity among women in Nigeria. We expected to discover inconsistent findings in obesity and economic activities related to income like female labour participation rate and female-male labour ratio. We assumed that women would have a higher prevalence of obesity compared with men, particularly with regards these economic activities. We also hypothesized that women with higher income would have a lower risk of obesity prevalence; this is tested as part of our investigation.

In summary, the study focusses on the impact of income level and female participation in the labour market on the prevalence of obesity in Nigeria, that is, we study the relationship between female obesity and their related economic context (female labour participation rate, female-male labour ratio and national income level defined in terms of per capita income). The investigation into the relationships between female participation in the labour force and the prevalence of obesity was further motivated by two growing concerns in Nigeria: the problem of growing overweight and obesity rates and the challenge of female obesity in relation to its economics.

1.2 The Feminisation of Obesity

Socioeconomically, obesity does not discriminate; it is prevalent among the affluent and poor families alike. Food insecurity, obesity and undernutrition actually co-exist within the same communities and households. This triple burden of malnutrition undermines the health and economic well-being of households across the globe, and the consequences of these three will not abate unless policymakers and private-sector leaders make concerted efforts to reform the country's food system to support healthier diets for all (Hamel & Black, 2018).

The literature suggests five main justifications for obesity to be gender-specific and focussed on women as part of the overweight/obesity concerns:

1. The provision of platform for equity – equal access to health benefits and economic opportunities.
2. The alleviation of poverty, since women make significant contribution to household income and are more represented among the vulnerable people.
3. The improvement of household general welfare through raising women's income.
4. The improvement of the effectiveness of health programmes.
5. To be able to take advantage of the economic potentials that exists around the women.

In the discussion by Ball and Mishra (2006), generally, obesity is strongly socioeconomically determined among women, whereby in developed countries, women of low socioeconomic status are at increased risk of weight gain and the development of overweight and obesity, as research has shown, that poor socioeconomic conditions in both childhood and adulthood increases the risk of obesity among adults (Ball & Crawford, 2005 and Parsons et al. 1999). Young women have been observed to be at a high obesity risk most because they are at high risk for weight gain and the development of obesity (Ball et al., 2002 and Ball et al., 2003).

Testing for the relative effect of income level on obesity in women, research suggests a strong negative correlation between the two, with women of household incomes less than US $15,000 per year at the prevalence of obesity of 36%, more than twice that of women with household incomes of more than US $75,000 per year at prevalence of obesity of 16%. Also, obesity has been shown to have a negative effect on personal and household incomes in women (Baum & Ford, 2004; Laaksonen et al., 2004).

[1] For the sake of clarity, the term females used in this study refer to women, which is defined by the age range 15+; thus both terms are used interchangeably to mean the same thing.

[2] Nigeria Labour Force Participation Rate: see https://www.ceicdata.com/en/indicator/nigeria/labour-force-participation-rate and https://www.theglobaleconomy.com/Nigeria/Labor_force_participation/

The prevailing take-away from the review so far is that all households and larger population are vulnerable to poverty, and income is a common measure here. For women, the prevalence of obesity directly increases with increasing levels of poverty (that is, with low income as the indicator), whereas for men, this is indirect, as obesity rates are mostly determined by occupation and qualification, which predate vulnerability to poverty. Though also, the prevalence of obesity for women in unskilled occupations is almost twice that of those in professional occupations. Here, household income is crucial, as obesity in women falls as household income rises, with research showing a significant difference in prevalence between the highest and lowest income groups, even though these differences are smaller for men and may be insignificant (Public Health England; PHE, 2014).

1.3 Obesity, Health and the Biological Context: Conceptual Explanations

1.3.1 The biology of obesity

Obesity, generally associated with excess body fat and classified by a body mass index (BMI) equal or greater than 30, is a complex disorder as its development is influenced by multiple factors both within and outside the body. The basic underlying cause of obesity is an imbalance between energy intake into the body (from food consumption) and energy expenditure (utilization). Increased energy availability compared to its utilization puts the body in a positive energy balance, while the excess energy is stored as fat. Energy balance is controlled by a network of mechanisms and signals arising from adipose (fat) tissues, the stomach, pancreas and other organs (Heymsfield & Wadden, 2017). Some predisposing factors to obesity include sedentary lifestyle, decrease in physical activities, consumption of foods with high calories (fats and sugars), stress, lack of adequate sleep, emotional disturbances and genetics (family history and ethnicity). Having a high income and socio-economic status but living in low income countries have also been reported to increase predisposition to obesity (NCD Risk Factor Collaboration, 2016). These factors interact with complex body systems regulating energy balance and physiological processes, resulting in weight gain.

The breakdown of triglycerides in adipocytes (fat cells) releases free fatty acids which is transported via blood circulation. Obese individuals often have high free fatty acid levels in blood, reflective of several sources including increase in adipose tissue mass. Excess lipids are distributed to many body compartments over time. The accumulation of fat over time increases the weight of body organs like the liver, heart and pancreas in variable proportions (Heymsfield & Wadden, 2017). An obese individual as compared with persons without overweight or obesity, therefore has larger fat mass, lean mass, higher resting energy expenditure, higher cardiac output and blood pressure and greater pancreatic β-cell mass (Tchkonia *et al.,* 2013). Accumulation of lipid intermediates in non-adipose tissues which leads to lipo-toxicity, cellular dysfunction and apoptosis. Obesity is also characterized by increases in macrophages and other immune cells in adipose tissues, occurring as a result of tissue remodelling in response to adipocyte apoptosis. These immune cells secret pro-inflammatory cytokines, which contribute to the development of insulin resistance (Grant & Dixit, 2015). Elevated levels of free fatty acids, inflammatory cytokines and lipid intermediates all contribute to the adverse health consequences of obesity.

1.3.2 Health consequences of female obesity

The prevalence of over-weight (BMI ≥25kg/m2) and obesity (BMI ≥30kg/m2) are increasing worldwide, especially in low- and middle-income countries (NCD Risk Factor Collaboration, 2016; Reynolds & Gordons, 2018). Obesity is associated with adverse effects on the individual, the family and the society at large, as high BMI was reported to contribute an estimated 4 million deaths globally in 2015 (GBD Obesity Collaborators, 2017). Obesity impairs glucose tolerance and lipid metabolism, leading to insulin resistance, type 2 diabetes mellitus, non-alcoholic liver disease, dyslipidaemia, metabolic syndrome, coronary heart disease and other cardiovascular disorders (Poston *et al.*, 2016; Reynolds & Gordon, 2018). Women represent a greater fraction of the general population with the highest incidence of obesity over the last decade (NCD Risk Factor Collaboration, 2016). The health of obese women especially during their reproductive age which constitute a chunk of their productive life has been reported to be most affected (Sebire *et al.,* 2001). Obesity impairs reproductive function in women as it is associated with anovulation, menstrual irregularity and impaired oocyte development (Talmon *et al.,* 2015).

Studies have also shown associations between maternal obesity and increased risk of long- and short-term pregnancy complications for the mother and the developing foetus. Obese women have an increased incidence of complications during pregnancy as well as an increased risk of developing gestational diabetes mellitus (Vambergue & Fajardy, 2011). Other health risks during pregnancy include preeclampsia, ante-natal depression and blood coagulation disorders (Reynolds & Gordon, 2018). Women with obesity are more likely to experience induction of labour and caesarean section, with up to 1 in 7 caesareans attributable to maternal obesity (Dodd *et al.,* 2011). An obesity severity–related relationship has also been established between maternal pre-pregnancy weight and maternal morbidity or mortality (Global BMI Mortality Collaboration, 2016).

Increased maternal morbidity and mortality have been reported to significantly increase the health burden and cost of antenatal services (Denison *et al.,* 2014).

Additionally, offspring born to obese mothers have an increased incidence of perinatal complications like birth trauma and macrosomia (increased birth weight). Obesity was reported to be the single largest predictor of large for gestational age (LGA) babies (Arendas *et al.,* 2008). Babies born LGA have a higher risk of childhood and adult obesity (Reynolds & Gordons, 2018). Maternal obesity has also been linked to glucose intolerance, insulin resistance, type 2 diabetes mellitus, dyslipidaemia, obesity, hypertension and other metabolic and cardiovascular disorders in the later life of the offspring (Yessoufou & Moutairou, 2011). These long-term consequences of maternal obesity, termed foetal programming, implies that maternal obesity impairs the intra-uterine environment, which consequently affects the developing foetus. This theory has been proven and widely accepted in the last few decades (Barker, 2006; Vambergue & Fajardy, 2011).

The psychological and mental health of obese women have also been reported to be impaired due to increased stress levels and reduction in sleep quality (Denison *et al.,* 2014; Rahman *et al.,* 2015). This leads to anxiety and depression-related disorders, which impacts the quality of life of obese women (Gilmore *et al.,* 2015; Reynolds & Gordon, 2018). Lifestyle interventions targeting diet, physical activity and behaviour change are recommended as effective steps in reducing the prevalence of overweight and obesity among women. The timing of intervention is however critical to its effectiveness. In women, the pre-conception period provides a good opportunity to modify lifestyle, since women are especially receptive to lifestyle advice during this time span (Best *et al.,* 2017). These interventions have the potential to decrease body weight, lower the risks of metabolic, cardiovascular and mental health disorders, consequently improve the quality of life. A reduction in the prevalence of maternal obesity will lower the incidence of foetal programming in the offspring, which will consequently reduce the vicious cycle of metabolic and cardiovascular disorders in the general population.

II. Literature Review

2.1 Insights from Previous Studies

Obesity has continued to be a major public health problem globally, especially because females are more impacted. Women are unduly affected by obesity: the prevalence of the condition is higher among women than men in most countries, and they are also exposed to the associated risks in forms of diseases, increased healthcare costs, and lower life expectancy than men, while as well undermining their upward social, economic, and political mobility, with a predisposition to low productivity, and a negative effect on their earnings potential and an overall significant economic loss, which in the end can reinforce intergenerational transmission of poverty (Hamel and Black, 2018). So, the burden of obesity among women is so great that the risk of diseases and their outcomes are transferrable to their children.

In 2018, the World Health Organization (WHO) noted that since 1975, worldwide obesity has grown almost tripled with over 1.9 billion adults of at least 18 years were overweight as at 2016 (39% of adults aged 18 years and over were overweight in 2016, and 13% were obese), with more than 650 million of these obese.[3] The situation is not any palatable in Africa as prevalence of obesity in South Africa is among the highest while Egypt ranks the highest in the continent, reflecting the deplorable state of malnutrition on the continent (Hamel & Black, 2018).

In Nigeria, research data puts the prevalence of overweight persons at a range of 20.3% to 35.1%, and the prevalence of obesity at between 8.1% and 22.2%, which is of epidemic proportions as the figures are high to a great extent (Chukwuonye et al., 2013). Of these numbers, and as documented from WHO database by Akarolo-Anthony et al. (2014), the prevalence of overweight and obesity increased by approximate 20% between 2002 and 2010 in Nigeria noting that the prevalence of overweight was 26% and 37% in men and women respectively, and the prevalence of obesity was 3% and 8.1% in men and women respectively, and further data revealed that based on individuals aged 30 years and above, the prevalence of overweight and obesity together increased by 23% in men and 18% in women, while the prevalence of obesity alone increased by 47% in men and 39% in women between 2002 and 2010. As indicated by Okokon, et al. (2018), the higher prevalence of obesity is seen among females (that is, 6.82 % in females compared with 1.1% in males) which is similar to other research findings on female obesity in Nigeria, confirming the fact that gender is a predictor of obesity among Nigerians, with the fattening room culture for women in Calabar as one of the cultural cases by which overweight and obesity thrive in women.

The health implications of obesity are enormous for women with the consequences to include increased risk of exposure to several diseases like cardiovascular disease, diabetes and varied types of cancer, psychological and mental health, as well as infertility (Lim, et al. 2013). The demand and supply of health plays a big role here. On the demand for healthcare by the poor in particularly, this is limited by their incomes. Other demand factors in Nigeria as indicated in a paper by Binuomoyo and Ogunsola (2016) include burden of illness

[3] See https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight.

(these constitute competing needs and in themselves limit further income and related opportunities), population preferences and related healthcare consumption patterns as influencing the demand-side factors of healthcare services which affect the pattern of usage and the actual demand for the services. Poor diet and poverty by the women are often at the top of illnesses and other concerns, as they greatly influence household economics, noting that whether women work or not outside the homes, their input to household economy contribute to actual income or result in savings, directly or indirectly (see Singh & Singh, 2008).

2.2 Economic Framework of Obesity

2.2.1 Socioeconomics and obesity

Socioeconomic status is generally used to identify a person's status relative to others based on characteristics such as income, qualifications, type of occupation, and where they live (PHE, 2014). Prevalence of obesity is known to be associated with many indicators of socioeconomic status, with higher levels of obesity mostly found among the poor groups, and the association stronger for women than for men.

In low-income countries, overweight and obesity are usually more prevalent among higher socioeconomic groups, whereas the opposite is observed in most high-income countries, where lower socioeconomic individuals are more likely to be overweight or obese. Although considered a lower middle-income country, India has experienced considerable economic growth between 1998 and 2015, and how this has impacted the proportion classified as overweight or obese in different socioeconomic groups is unknown (Luhar et al., 2018).

Defining obesity in the context of socioeconomics, we build further understanding of the most important concepts and variables in the study as follows:

(i) Obesity and income level: The income level which is defined in this study by the per capital income in constant 2011 international dollars (adjusted for inflation and cross-country price differences), is a good indication of socioeconomic status, and is taken to also assume household income.[4] In this work, income level interacts with the prevalence of female obesity.

(ii) Obesity and female labour force participation rate: Female labour force participation corresponds to the proportion of the population ages 15 and older that is economically active. Occupational engagements are crucial for income and activity levels, which are both crucial as predictors of obesity level. Here, the social class is defined on educational and skill levels because in women, obesity prevalence falls by social class, in that women in unskilled manual occupations have over twice the prevalence of obesity of professional women (Ortiz-Ospina et al., 2018).

(iii) Obesity and female-male labour (force) ratio: Female-male labour ratio like female labour force participation rate, is also defined around the socioeconomic areas with related indicators like income, employment, health, disability and human capital (education, skills and training).[5] This ratio, which is defined as the number of females to males in the labour force, indeed has relationship with prevalence of obesity as more involvement in economic activities at greater levels relative to men, reduces the prevalence of obesity.

2.2.2 The economics of obesity: choices and the unsavoury outcomes

The Classical economic theory or rational choice theory states that assuming the availability of all possible choices, individuals will make a choice from available options, and given preferences and constraints, which could be what they eat and how much, type and place of work, and exercise, plus other excess weight control strategy (Wikipedia, 2019). It is assumed that while the individuals do not have perfect information about these choices, they nevertheless make them, whether they have most information or not. It could also be that their choices are influenced by advertisements, negligence, short-sightedness, addictions, and so on, or their decisions could be to deliberately become obese to be in vogue as is the African way, or in anticipation that they will use treatments to beat the weight back.

The growth of obesity has been occasioned by several factors, chiefs of which are new economics (economic innovation) and new technologies which have reduced the prices of calorie-dense foods and drinks relative to fruits and vegetables, while also enhancing globalization to the fact that trade is made easier (see Finkelstein et al., 2005). Increase in the prices of fast-foods results in positive obesity outcomes, while same increase in the prices of fruit and vegetables results in increased obesity (Grossman, 2015).

So, the world of professional work which has reduced the burning of more calories from manual labour which burns much calories, and eat more in sedentary work due to technological change has also contributed to the rise of obesity (Lakdawalla & Philipson, 2009). And indeed, being overweight or obese can adversely affect labour market outcomes where (i) employers discriminate against overweight or obese persons, (ii) being overweight or obese lowers productivity through poor health and/or motivation due to the lower life expectancy

[4] See OurWorldinData.org/Female-Labour-force-participation-key-facts, in Ortiz-Ospina et al. (2018).
[5] See PHE (2014).

of these people, (iii) there exists social discrimination or non-acceptance in the society, and (iv) negative costs in form of poor body image and low self-esteem, which possibly lead to depression (Roberts et al., 2003).

Economics more than not, has been accused of being the devil in the obesity equation while medical advances have appeared angelic. Since economic forces have made it easier and cheaper to consume high-energy, tasty, affordable foods and have allowed people to be increasingly sedentary, the rise in obesity rates is traced to a direct result of changes in relative prices (or costs) that promote excess food consumption and inactivity and that decreases the motivation to engage in health-seeking behaviours. Hence, food consumption (including liquids like beers and sugared drinks) are the primary source of obesity (Finkelstein & Strombotne, 2010).

Food consumption is the major undoing of obesity. While lifestyle economics here studies the price-quantity demanded in an inverse relation, food prices have dropped over the years with subsidies in agricultural produces, reduced monetary costs and technology which have enhanced availability and convenience of food preparation in the context of globalisation. Indeed, food consumption increases consistently with falling food costs, as evidence from the United States indicates that since the late 1970s, men increased their daily food intake by 80 calories, and women increased theirs by 360 calories (Finkelstein & Strombotne, 2010). The increases in these calorie consumption have occurred mostly between meals, when the time costs were historically too high to prepare a high-calorie snack.

Economic growth, which is a fundamental macro-economic objective, is a systemic driver of obesity because the quest for sustained and higher levels of economic growth is reinforced by increased consumption of goods and services including food, beverages and energy saving devices (Finkelstein & Strombotne, 2010). The authors deduced that while though economic growth lifts low income countries out of poverty and is positively correlated with improved population health, a country's gross domestic product (GDP) ultimately appears to increase beyond the optimal level and produces diminishing marginal returns on health.

Economics as a (social) science and management tool has become a platform for consumers' advocacy, emphasising the 'consumer sovereignty' and 'normal' role of the markets, whereby the individuals are able to make decisions on the food they eat and physical activities engaged in, even though the 'appealing' cheap, tasty, energy-dense food, together with improved food distribution and highly pervasive and persuasive marketing obesogenic environment makes it difficult to decide in the interest of the larger society rather than self, leading to an externality concern (Ananthapavan et al., 2014). But then, the additional opportunity cost associated with physical activity during scarce leisure time contributes to sedentary lifestyles. With reference to both food choices and physical activities, it is not likely that the obesity epidemic is due to informed individual preference (Ananthapavan et al., 2014). Following from these, there is need for changes to the obesogenic environment, which may require government intervention (leading to the provision of such merit goods like education and healthcare which could be positive or negative) as applicable in the United States and Denmark which is as a result of market failure in the form of externalities, imperfect information and irrational individual behaviour monopoly power (Ananthapavan et al., 2014; Congdon et al., 2011).

2.2.3 The U-Shaped Hypothesis

Verick (2018) made a stylized argument that the U-shaped relationship between economic development and women's participation in the labour force in that when a country is poor, women work out of necessity, mainly in subsistence businesses like agriculture, but as a country develops, economic activities shift from agriculture to industry, which benefit men more than women. At higher stages of economic development, education levels rise, fertility rates fall, and social stigmas weaken, enabling women to take advantage of new jobs emerging in the service sector that are more family-friendly and accessible. At a household level, these structural shifts can be described in the context of the neoclassical labour supply model such that as a spouse's wage rises, there is a negative income effect on the supply of women's labour. Once wages for women start to increase, however, the substitution effect will induce them to increase their labour supply. This in essence explains not only the need to deepen female-male labour ratio, but also to make them able to access higher income economic opportunities.

Women generally are working at a lower rate than men, which may be as a result of the women's own decision or being denied, in favour of taking care of the family and other productive activities outside of the formal labour market, discriminatory laws and practices, and social and cultural norms that limit female employment opportunities (Council of Economic Advisers, 2019).

One way to explore the importance of women to economic growth is to consider the share of adult women who are participating in the labour market (and may be against the men). The labour force participation rate, which reflects the share of adults who are either working or looking for work, is a fundamental component of a country's total economic output. Where workers in two countries are equally productive but the countries have different fractions of their populations working, then the country in which a larger share of people are

working will produce more output per person. Hence, to the extent that countries increase the engagement of women in their workforce, there is the potential to increase economic output.

2.3 Structural Framework

2.3.1 Work and income

Income has a major impact on obesity as higher income could prevent weight gain by enabling consumers to access healthier but costlier foods over cheaper ones. Increased income allows people to consume more calories and spend more time in sedentary pursuits, though research has little or no evidence that income affects BMI or the likelihood of becoming overweight or obese (Schmeiser, 2009; Cawley et al., 2010). Income also positively affects healthcare access in that consumers are able to make demands for quality healthcare to address obesity-related issues they might have.

2.3.2 Maternal employment

Maternal employment may contribute to childhood obesity. It is estimated that the increase in a mother's average weekly work hours explains between 11.8% and 34.6% of the rise in childhood obesity in high socioeconomic status families between 1975 and 1994 (Anderson et al., 2003). There is an association between maternal employment and childhood obesity, which was not found positive for children whose mothers worked full time when the child was either pre-school age or age eleven, or for children whose mothers worked part time when the child was any of these ages (von Hinke, 2008). Children with working mothers are exposed to television, games, smart phones, and so on, than children whose mothers do not work outside the home, and as well, working mothers spend less time cooking and eating with their children than mothers who do not work outside the home, which increases the probability that the family will consume prepared foods (Cawley & Liu, 2007; Fertig et al., 2009).

Gwozdz (2016) affirms that maternal employment increases the likelihood of children being overweight or obese, driven by poor diets, increased sedentary behaviours, and lower quality sleep for children whose mothers work, with mixed outcomes from the findings that (i) maternal employment may reduce obesity through healthier lifestyles, including more quality diets and more physical activities; (ii) high-quality childcare, which has a positive effect on child development and may influence childhood obesity; (iii) by helping a family escape poverty, maternal employment could improve children's weight outcomes; (iv) having a mother working non-standard or long hours is associated with childhood obesity: (v) maternal employment might reduce time spent with children, which could in turn increase childhood obesity; (vi) maternal employment might lead to unhealthy diets and sedentary behaviour among children, thereby increasing childhood obesity; and (vii) maternal employment could increase childhood obesity if external care is of lower quality.

2.3.3 Female labour force participation rate

Female labour force participation is an important driver (and outcome) of economic growth and development. Women participate in the labour force in developing countries because of poverty and as a coping mechanism in response to socioeconomic shocks. The participation of women is the outcome of various economic and social factors. Access to quality education (beyond secondary) is critical to improve employment outcomes for women, so that they are able to acquire the capability to work on the white or blue collar level, and not the usual non-formal or manual work.

Female labour-force participation rates are among the highest in low-income countries where women are engaged in subsistence activities. But as GDP rises, some women who otherwise would have worked out of necessity, spending their time on activities outside of the labour market, will opt not to work. For example, some women will choose to engage in home production activities against pursuing formal work, while others attend school or stay longer in school to develop additional human capital that will enhance their productivity where they work. Most of these work done at home by women counts a lot in household income savings but are not captured in the national income, thereby undermining their economic importance at home. It may be high time therefore to start valuing the non-formal economic activities including women's work at home, in their stalls or the economic supports they offer their husbands or families.

Research has found that increased gender parity indeed has several potential positive outcomes. In a 2015 McKinsey report, Woetzel et al. (2015) noted gender inequality has varied implications not just for the lives and livelihoods of girls and women but also human development, labour markets, productivity, GDP growth, and inequality in the equation of inclusive growth. According to the report, reducing gender gap could double the contribution of women to global GDP growth between 2014 and 2025, that is, US $28 trillion of additional annual GDP in 2025. Women are half of the world's working age population, and even, not all are too economically active (fewer in numbers in terms of formal activity, fewer working hours, and in lower productivity sectors like agriculture) like men, yet they still generate about 37% of GDP.

III. Methods and Data

3.1 Data Description and Analysis

We analyzed data from WHO and OurWorldinData.org (a databank, which consists of data essentially sourced from a number of data holding platforms and organisations like the World Bank, WHO, etc.), over a 27-year period (between 1990 to 2016).[6]

The NCSS Data Analysis software (2019 version) was used for the preliminary statistical analyses. We examined both significant and non-significant variables, with a two-tailed p-value < 0.05, in our model analysis.

3.2 Model Estimation

We have previously discussed the theory for understanding the relationship between obesity and certain economic variables like income, female labour force participation and the interacting female-male labour ratio. The Obesity Kuznets curve[7] and the U-Shaped Hypothesis are clear bases of this understanding. With reference to the above, we specify the accompanying model which lays emphasis on the human capital-work output, and assume that, as income increases, female obesity reduces; and as more women participate in the labour market (relative to the men as well), female obesity drops. Taking cognisance of the U-Shaped Hypothesis and the McKinsey suggestion, we assume that the prevalence of female obesity (OP) is inversely impacted by income level (YC), and negatively influenced by both female labour force participation rate (WL) which to an extent represents the level of social and cultural disposition of the society towards women including norms and customs, education, etc., and the ratio of female to male in the labour force (FM), due to the activity level and resultant income that will come with these.

While taking note of income as the national (household) income defined by the country's per capital income, the underlying model for income level and female obesity could be linearly written as follows:

$$OP = f(YC, WL, FM) \quad (1)$$

The rise in female labour participation has been regarded as one of the most remarkable economic development path (Ortiz-Ospina et al., 2018), as women transition from being passive economic contributors to actively participate in not only global economic activities but also being key household income contributors.

Based on the above, we identify a regression model with a non-linear term for the national income level to underline the behaviour of income in the relationship (see Prasada, 2016), so that having taken the log of income, we have:

$$OP = \beta_0 + \beta_1 InYC + \beta_2 WL + \beta_3 FM + \mu \quad (2)$$

Where β_0 is the intercept, β_1, β_2 and β_3 are the estimation parameters associated with log of income level, female labour force participation rate and the ratio of female to male in the labour force respectively, with μ being the disturbance error term. Our a-priori expectations or expected behaviour of the independent variables (InYC, WL and FM) on the dependent variable (OP) are:

$$\delta OP / \delta InYC < 0; \ \delta OP / \delta WL < 0; \ \delta OP / \delta FM < 0,$$

with the implication that the higher the income level of household (associated with women), the lower their prevalence rate of obesity, and the greater the female labour force participation rate and female-male labour ratio, the lower the prevalence rate of obesity in female for both. The two variables, female labour force participation rate and the female-male labour ratio speak to two outcomes; income and activity levels, where both impact obesity in women.

3.3 Results

We present in Table 1 as follows the results of the regression analysis.

[6] See WHO (2018) and OurWorldinData.org for data employed.

[7] Simon Kuznets' (1955) hypothesis says that as a country develops, a natural cycle develops where inequality first increases, then decreases, has become known at the Kuznets curve. This pattern has also been applied to obesity, an 'Obesity Kuznets curve' where as incomes rise, resources become available to buy more food. As such, people consume more calories and obesity rates increase. However, as incomes continue to rise, personal health becomes a more valued asset and people decrease their obesity levels (increasing their health levels). See Grecu and Rotthoff (2013) for further discussion on this.

Table 1: Regression Results on Prevalence of Female Obesity, Income Level and Female Labour Participation in Nigeria

Variables	Coefficients and t-values in parentheses
Intercept (t)	-19.80 (-3.43)
InYC (t)	-0.83 (-1.04)
WL (t)	-0.95 (-4.83)
FM (t)	1.03 (13.34)
R^2 / Adjusted R^2	0.988 / 0.987
F	654.3
p-value	InYC: 0.3116 / WL: 0.0001 / FM: 0.0000

The model indicates a strong fit with a R-square of 98.8%. Since the computed F-statistic of 654.3 is greater than the tabulated F-statistic (3, 23) valued at 3.03 at 5 percent level of significance, the F-statistic hence shows that the model is useful in determining the influence of income level, female labour participation rate and female-male labour ratio on female prevalence of obesity. For the individual variables, the coefficients and the associated t-values (at 5% level of significance) indicated that income level and female labour force participation rate are negatively or inversely related to the prevalence of female obesity which is in line with our a-priori expectations of their negative influence on the prevalence of female obesity, while the coefficients and the associated t-values (at 5 percent level of significance) showed that female-male labour ratio is positively related to the prevalence of female obesity contradicting our a-priori expectations of a direct positive relationship with the prevalence of female obesity.

IV. Discussion of the Results

Our hypotheses are based on the economics of obesity in terms of income level and labour force participation by women, that is, the relationships between the prevalence of female obesity with each of income level, female labour force participation rate, and female-male labour ratio, which were negative for the first two instances but positive for the last case. The reasons for the negative results can be partly associated with the U-Shaped Hypothesis where income appears to positively impact behavioural disposition to diet and health at one point in time and negative at another point. In a way, economic growth could spur poor dietary behaviour in the first instance but with time, consumers pay attention to their diet and health with greater income level coming good. Also, the notion that non-formal working female are susceptible to overweight is upheld by the negative relationship between female labour force participation rate and the prevalence rate of obesity in female, whereas, the female-male labour force ratio did had positive relationship with the prevalence of female obesity and does not therefore influence the obesity level. This could make so much sense as there is no real theoretical theory behind the relationship.

The results from the above show that the variables are interwoven; and help clarify the link-up between income level and female labour participation (as well as female-male labour ratio). For instance, the model estimates show that a 94.5% decrease in female labour force participation can lead to a 100% increase in prevalence of obesity in female, while at 100% increase in prevalence of obesity in female, there had been 103% increase in female-male labour ratio. This is another point of economic skewness aside the non-endogeneity of income level.

The above assertions conform with the observations of Finkelstein and Strombotne (2010), Kpelitse et al. (2014), Kim and von dem Knesebeck (2017), Luhar et al. (2019), PHE (2014) and other researchers who noted that the income group (or socioeconomic position) of women is important in determining their overweight prevalence which either increases to a smaller extent, remains the same or even declines without all certainty of the direction of income, while also stating that reduced prevalence of female obesity are surprisingly linked to increased female labour force participation rate indicating a skewness in the economic framework. This is contrasted with female-male labour force ratio, for as this ratio increases, it increases the income potential of women. Theoretically, the rise in female labour force participation is a key step toward gender equality including in the labour force, with positive impact on their social, economic, and cultural wellbeing (Cotter et al., 2004).

The complexities of the results are such that while income level is indeed inversely related to the prevalence of obesity in female, it is not significant in the model. Even though this is consistent with the work of Schmeiser (2009) and Cawley et al. (2010), it nevertheless appears to underline the fact that per capital income does not directly impact obesity but indirectly as demonstrated by female labour participation rate which is significant in the model (and could use two indicators, income and physical activity) to drive home the relationships as it affects female labour participation rate, income level and the prevalence of obesity in women.

On the other hand, the female-male labour ratio is though positive in relation with the prevalence of obesity as its increment spurs further increases in the prevalence of obesity, it does not appear consistent with the economics behind this study even though the variable is significant in the model. This could be attributed to the fact that even though women participate in the labour force, they are mostly employed in the non-formal

sector or the lower end of the economy that cannot really induce significant upward income level for them, and in many occasions, are not active to the point of being taken out of poverty and being able to make healthy dietary choices or demand better healthcare.

V. Conclusion and Recommendations

An empirical study on the influence of income level, female labour force participation rate, and female-male labour ratio on the prevalence of obesity in female in Nigeria was carried out using historical data from 1990 to 2016. The findings showed that income level is not significant, whereas female labour force participation rate and female-male labour ratio are significant on the prevalence of obesity in female. But these results yet appear incoherent because of certain economic inconsistencies which may be specific to the Nigerian environment or related population characteristics in other developing countries. It further underlines that the economics of obesity is indeed skewed as country-specific studies and remedies are the best fit in this kind of issue.

The results of the prevalence of female obesity in Nigeria are being interpreted in their economic context, and are clear indications of the direct impact of female labour participation on obesity, and as well their indirect role through income on obesity. Nigeria though ranks lower than most African countries in terms of the prevalence of obesity, it still stands at a great risk. The high rates of obesity among sub-Saharan African (SSA) countries is an indication of the economic, social and biological vulnerability of persons to obesity. While we have expected to find a positive relationship between income level and the prevalence of obesity based on the presumption and often-held belief that being fat in Africa is a sign of affluence and commands respect, the situation is often the difference as income though is an important factor but dietary pattern appears to be important (which of course is yet determined by income level). However, the poor female are the ones that are at a greater risk of obesity and have similar probabilities of being obese like those in active labour participation if their overall socioeconomic condition does not improve.

Even though there is hardly any study that has established a direct link between female labour force participation rate and obesity, as confirmed by our results as well, when female labour force participation rate and economic growth relationship are isolated, Appiah (2018) noted that increase in the latter may indeed encourage economic growth in developing countries, while the low rate of female labour force participation may lower economic growth. We find clear and consistent evidence that while income level is though insignificant in the relationship, the influence is but negative, confirming that female obesity can be intimately linked with the income level of the women. But then, as earlier noted, female labour participation rate is significant in this model, and policies that increase the capacity of women in form of empowerment like education and credits should be well promoted.

The results above cannot be used to predict a direct relationship between the prevalence of female obesity and income level, even though we have interest in income. Female labour force participation rate and female-male labour ratio can serve the purpose of income direction here. So the question, what will happen to the prevalence of female obesity as female labour force participation rate and female-male labour ratio grow? The study did found an impact in the relationships and thus, these findings strengthen the link between female labour force participation rate and income level, with the prevalence of female obesity.

Notwithstanding the above, the results reinforce the imperative of attention to the following: the urgent need to treat obesity as a public health discourse and focus for the government of Nigeria; to redefine social and cultural characteristics in Nigeria towards improving tolerance to women; and to enhance economic capabilities for women taking cognisance of the need to design labour force participation with women at a reasonable equal parity with men. These all provide reference points for other countries as well particularly the SSA.

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