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Heterogeneous Effects of Obesity on Life Expectancy: A Global Perspective

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Abstract

Based on an extensive literature review and publicly available data, this article provides insights into the differences in prevalence, sociodemographics, contributing factors, socioeconomic consequences, health effects, and public policies related to obesity between developed and developing countries. Most importantly, it explores the relationship between obesity and life expectancy and identifies potential mechanisms through which obesity affects mortality, highlighting the differences between developed and developing countries and by gender. It also examines how the associations between obesity and life expectancy differ at the population level compared with the individual level. The evidence shows a negative association between obesity and longevity, as well as an increased risk of various diseases with the rising rates of obesity. The findings contribute to a better understanding of the heterogeneous effects of obesity on life expectancy between developed and developing countries and by gender. The article also discusses the effectiveness of various policies adopted to address obesity and provides suggestions to address obesity problems and improve health and well-being in these countries.

1. INTRODUCTION

The global prevalence of overweight and obesity has increased dramatically in the past four decades, from 3.2% in 1975 to 11% in 2016 for adult men and from 6.4% to 13% for adult women (WHO 2021b). The trend is not limited to adults, as the number of overweight and obese children and adolescents has also risen from 4% in 1975 to 18% in 2016. In 2016, the number of overweight and obese people exceeded the number of undernourished people worldwide, with 1.9 billion overweight adults (of which 650 million were obese) compared with 462 million underweight adults (WHO 2021a).

The increase in obesity prevalence has led to public health concerns and significant socioeconomic consequences including a rise in medical costs, avoidable deaths, reduced quality of life, shortened life expectancies, and decreased labor productivity. Coinciding with increasing prevalence of chronic, noncommunicable diseases at an alarming rate, the obesity upsurge has become one of the most important population health risks, contributing to morbidity, mortality, and disability-adjusted life years (DALYs) for both developed and developing countries[1] (GBD Causes of Death Collab. 2017, Jaacks et al. 2019). The World Health Organization (WHO) states that overweight and obesity kills more people than undernutrition for most of the world's population (WHO 2021b).

Once associated with high-income countries (HICs), obesity is on the rise in low- and middle-income countries (WHO 2021b). In 2016, obesity prevalence was 5.8%, 7.3%, 14.3%, and 25.9% in low-income countries (LICs), lower-middle-income countries, upper-middle-income countries, and HICs, respectively. LICs have experienced a rapid rise of obesity, increasing from less than 1% of the population in 1975 to 5.8% by 2016. The shift from undernutrition to overnutrition has occurred rapidly in both LICs and middle-income countries (MICs), and obesity has emerged as a more significant health threat than hunger (Popkin 2007). **Figure 1** depicts the trends in adult obesity disaggregated by gender for LICs, MICs, and HICs during 1975–2016. It clearly shows that obesity prevalence was rising for both women (**Figure 1*a***) and men (**Figure 1*b***) across all income groups. The growth rate of obesity was higher in LICs. Obesity was higher for women than for men in LICs and MICs, but the gender gap disappears in HICs.

The sociodemographics of the obesity upsurge vary across subpopulations within a country and vastly differ between developing and developed countries (Ameye & Swinnen 2019). For example, in HICs, obesity prevalence is highest among the poor and minorities (Drewnowski & Darmon 2005). This has been attributed to the affordability and accessibility of calorie-dense foods over nutritious ones, as well as inadequate health awareness among the poor. The literature investigates various factors that contribute to obesity, including food prices (Schmidhuber & Shetty 2005), rapid urbanization (Popkin 1999), fast food chains and restaurants (Currie et al. 2010), food deserts (Chen et al. 2016), environmental factors (Fan & Jin 2014a), agricultural support policies (Alston et al. 2006, 2008; Rickard et al. 2013), and the excess availability of calories (Barrera & Shively 2022).

In contrast, obesity prevalence in LICs is higher among the upper class and women (Jones-Smith et al. 2012) as well as in urban settings (WHO 2021b). The upsurge of obesity in developing countries with a large undernourished population has led to the double burden of malnutrition, characterized by the coexistence of undernutrition and obesity/overweight (Wells et al. 2020). This phenomenon has become a significant public health problem for many developing countries (Abarca-Gómez et al. 2017, Delisle & Batal 2016, Popkin et al. 2020), including those in Latin

[1]We switch classification for countries between developed and developing countries, and HICs, MICs, and LICs, based on the World Bank classifications. Throughout the article, developing countries refer to LICs.

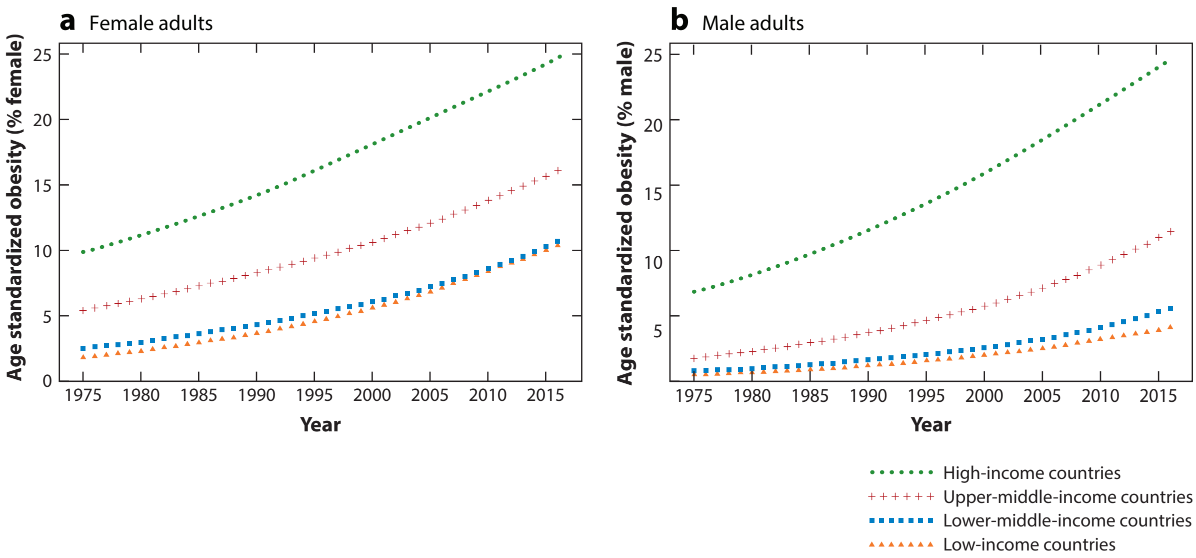

Figure 1

Trends in obesity prevalence across income groups. (*a*) Percentage of obesity in female adults. (*b*) Percentage of obesity in male adults. Figure by the authors from compiled World Bank data (1975–2016). The low-, lower-middle-, upper-middle-, and high-income country groups are based on the definitions from the World Bank.

America (Gubert et al. 2017), Asia (Gao et al. 2020), and Africa (Onyango et al. 2019, Reardon et al. 2021). The double burden of malnutrition has been observed at the country, household, and even individual levels (Delisle & Batal 2016, WHO 2021a). In the context of developing countries, the literature identifies contributing factors such as relative prices of food (Conklin et al. 2019), urbanization, globalization and agricultural trade liberalization (Mary & Stoler 2021, Popkin 2006), changes in food outlets and emerging supermarkets (Reardon & Berdegué 2002), and a positive attitude toward large body size (Jones-Smith et al. 2012).

Figure 2 presents the time trend of the median life expectancy at birth for LICs, MICs, and HICs during 1960–2020. It shows that life expectancy was the highest for HICs and the lowest for LICs. While life expectancy has been increasing for LICs and MICs throughout the period, it leveled off for HICs after 2010. Developing countries have experienced a faster increase in life expectancy as compared with developed countries. The question arises as to the role played by obesity in the leveling off (or slight decline) of life expectancy in developed countries, and the implications the obesity surge in developing countries may have on their life expectancy growth.

Epidemiological research has provided rich evidence of a positive association between obesity and mortality (Calle et al. 2005). Obesity is found to be associated with higher mortality, and the body mass index– (BMI–) mortality relationship resembles a J- or U-shaped curve in the general adult population in developed countries (Ward et al. 2022) and developing countries (Wanjau et al. 2022), where mortality increases at both lower and higher BMI levels. However, there is limited understanding on how the relationship between obesity and life expectancy varies between developed and developing countries. This article aims to fill in this gap.

The relationship between obesity and life expectancy may differ between developing and developed countries due to various factors. First, the double burden of malnutrition in developing countries poses challenges for designing an effective nutritional policy (Bansal & Zilberman 2020). Second, genetic factors play a role in obesity. Scientists have long hypothesized that Latin

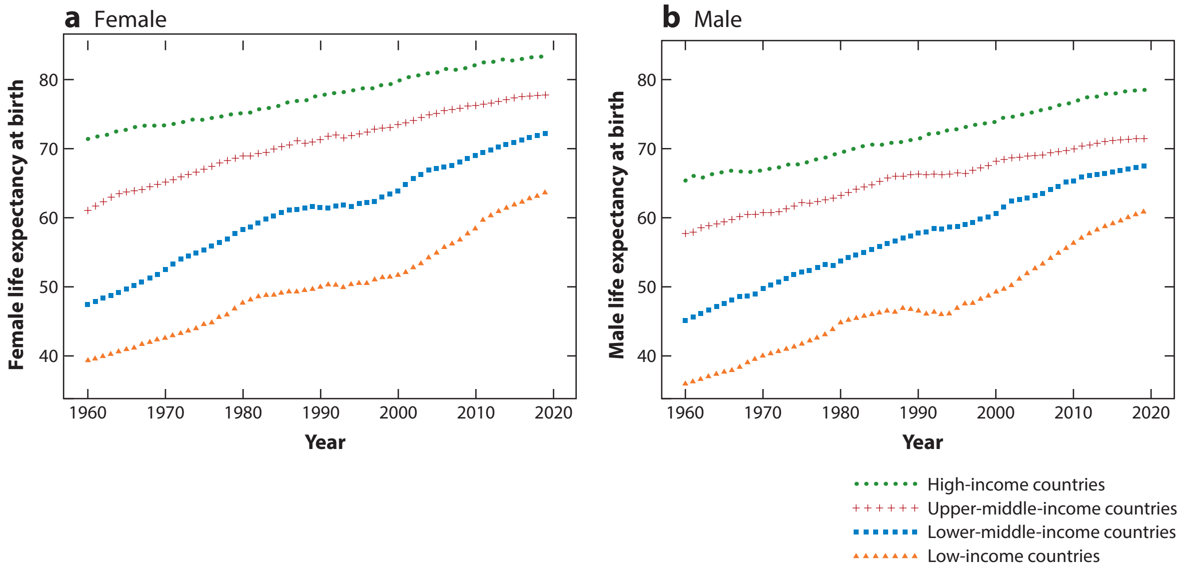

Figure 2

Median life expectancy across income groups. (*a*) Female. (*b*) Male. Compiled by the authors based on World Bank Life Expectancy data, available at **https://data.worldbank.org/indicator/SP.DYN.LE00.MA.IN**.

American, African, and South Asian populations may carry a disproportionately higher number of "thrifty genes" that evolved to help them survive in times of starvation or famine by enabling them to store fat more efficiently. When a person with these genes becomes overweight or obese, body fat tends to accumulate around heart and liver, increasing the risk of diabetes and cardiovascular diseases (Neel 1962). Finally, compared with developed countries, developing countries often have inadequate medical care and limited access to health services, and households may lack the financial resources to invest in their health (Leach et al. 2020).

While obesity has been shown to have a negative impact on life expectancy at the individual level, this relationship may not hold at the population level. Bansal & Zilberman (2020) distinguish between the effect of obesity on life expectancy at the individual and population levels, highlighting that aggregate obesity has both direct and indirect effects on average life expectancy. The indirect effect is driven by a reduction in underweight population, which may have a positive impact on average life expectancy. Bansal & Zilberman (2021) find that the relationship between aggregate obesity and life expectancy differs between developed and developing countries.

The objective of this article is to examine the effects of obesity on health, mortality, and life expectancy.[2] We begin by conducting a systematic literature search of peer-reviewed papers published in the past 50 years, using text-mining machine learning methods. Our findings indicate that most of the published papers focus on developed countries, while few studies are on developing countries. The literature on obesity-related issues in developing countries emerged only after 2010. This is not surprising as obesity is a relatively recent phenomenon for developing countries. We then review extant literature on obesity and health, examining the following specific questions: How do the associations between obesity and life expectancy vary between

[2]We note that the imbalance between food/energy intake and energy expense explains variations in body weight and obesity status. This article focuses on one side of the equation—food and energy intake.

developed and developing countries, and by sociodemographic factors such as gender and age? What are the different mechanisms that drive associations between obesity and life expectancy in these two sets of countries? Which policies have contributed to obesity and which have been successful in addressing it, especially for developing countries where the double burden of malnutrition is predominant? The answers to these questions require not only a better understanding of the prevalence, causes, and effects of obesity among different populations, but also evaluation of public policies.

The rest of the article unfolds as follows. The next section provides an overview of obesity. Section 3 provides a brief text-mining analysis on the obesity literature. Section 4 delves into empirical evidence and investigates various channels through which obesity affects life expectancy. Section 5 reviews how policies affect obesity and its relationship with life expectancy. Section 6 concludes.

2. BACKGROUND ON DEMOGRAPHIC TRANSITION AND OBESITY TRANSITION

2.1. Measure of Obesity

Obesity is defined as abnormal or excessive fat accumulation that may impede health. Various measures have been proposed to capture excessive fat accumulation, including assessment of the distribution of fat in the body, measures of central obesity, and indices of weight to height. These measures differ in accuracy, convenience, costs, predictive power of different health risks, and variability. While dual energy X-Ray absorptiometry, an imaging test that measures body fat and muscle mass, provides an accurate measure of fat accumulation and its distribution in the body, it is not considered suitable for large populations due to its high cost and potential risk of radiation exposure. Measures of central obesity include waist circumferences, waist to hip ratio, waist to height ratio, and waist to hip to height ratio. These measures provide a reasonable approximation of overall fat accumulation and its distribution. BMI, which is calculated as a ratio of weight in kilograms to height squared in meters, provides a measure of overall obesity.

BMI is the most used measure of obesity, particularly in social science research. It is considered a reliable proxy for total body fat, has been shown to be a predictor for several chronic diseases, and is widely used for large samples and population-level studies. However, BMI has been criticized on some grounds. First, BMI does not directly measure body fat level or its distribution and cannot differentiate between lean and fat mass. Second, the cutoffs of BMI for obesity are the same for adults of all genders and ages, which may not accurately reflect the diverse health risks of obesity by gender. Furthermore, BMI is a less reliable marker of adiposity in the elderly, as the prevalence of chronic diseases increases with age, and there is a loss of muscle mass due to the aging process (Manson et al. 2007). Supplementing BMI with other alternative measures of fatness would enrich social science research on obesity (Burkhauser & Cawley 2008).

2.2. Trends in Obesity Prevalence

Obesity prevalence has been associated with economic development and income growth, significant gender disparities, and variations within and between countries (Ameye & Swinnen 2019, Jaacks et al. 2019). In LICs and MICs, obesity levels increase with income, with higher levels among the upper class and women (Jones-Smith et al. 2012). In HICs, there is a negative association between income and obesity, and the prevalence of obesity is highest among the poor and minorities (Drewnowski & Darmon 2005).

The rural–urban gap in obesity differs with income. In LICs, urban areas have a much higher prevalence of obesity as compared with rural areas, with respective rates of 18% and 7% (Jaacks et al. 2019). In MICs, the difference between rural and urban obesity is smaller (29% versus 26%).

In HICs, the pattern reverses, with higher obesity prevalence in rural as compared with urban areas (19% versus 15%). In recent decades, obesity in rural areas of developing countries has been increasing rapidly, with more than 55% of the global increase in BMI from 1985 to 2017 coming from rural areas; the corresponding percentage for LICs and MICs reached more than 80% (NCD-RisC 2019). These figures indicate a closing and even reversal in the rural–urban obesity gap, which could be partially explained by the transformation of rural areas to resemble urban areas (Popkin & Reardon 2018, Aiyar et al. 2021).

2.3. Causes of Obesity

Focusing on America, Alston et al. (2016) discuss various factors related to food consumption choices and physical activity that could potentially contribute to obesity, including changes in income, relative prices, technology, preferences and lifestyle, availability and opportunity cost of time, work opportunities for women, and the built environment. The authors note that occurrence of obesity is complex and it is difficult to make definitive statements about the causes of the increase in obesity prevalence. We attempt to examine how the factors causing obesity in developing countries differ from those of developed countries.

Developing countries are experiencing nutritional transition, where food preferences and eating behaviors are influenced by economic, biological, and psychological factors. With economic development and globalization, dietary habits in developing countries have shifted toward a more Westernized diet, characterized by disproportionately higher consumption of overprocessed and energy-intensive foods (Pingali & Khwaja 2004). Urbanization has also contributed to the rise in obesity by promoting sedentary lifestyles and unhealthy diets, and shifting employment opportunities from the labor-intensive agrarian sector to less physically demanding jobs.

The observed link between obesity and socioeconomic status in HICs can be attributed to the affordability and accessibility of energy-dense foods. Refined grains, added sugars, and added fats are some of the cheapest sources of dietary energy, while lean meats, fish, fresh vegetables, and fruit, which are more nutrient-dense, tend to be more expensive.

The food supply chain has responded to these changes in dietary preferences. In LICs and MICs, food shops and supermarkets tend to offer mostly processed and ready-made meals, while in HICs, supermarkets increasingly offer a wide variety of fresh fruits and vegetables, low-calorie foods, and so-called superfoods (Popkin 2014). On average, people in HICs have greater resources to spend on healthy diets, including fresh fruit and vegetables, high-quality meat, and fish. However, in low-socioeconomic-status areas of countries such as the United States (Walker et al. 2010) and the United Kingdom (Cummins & Macintyre 2002), access to healthy foods is limited. In addition, access to health care, education, and recreational activities promoting weight management is also more widely available in HICs (Malik et al. 2013). These factors contribute to differences in the relationship between obesity, urbanization, and income between developed and developing countries. Some policies may have contributed to or curbed obesity prevalence, which is discussed in Section 5.

2.3.1. Economic burden. Obesity poses both direct and indirect economic burdens. Direct costs of obesity include expenses associated with diagnosing and treating obesity and obesity-related chronic comorbid conditions. Indirect costs are attributed to lost income due to illness, premature death, elevated costs for disability and insurance claims, and decreased productivity.

In developed countries, about 2–7% of total health care costs are attributable to obesity. Health care expenditures attributable to obesity were estimated to be about 6% of total health care spending in the United States in 1995. The expected lifelong medical care costs for the top five diseases related to obesity, hypertension, hypercholesterolemia, type 2 diabetes mellitus, coronary heart disease, and stroke, increase by 20% for mildly obese, 50% for moderately obese, and double for severely obese individuals (Thompson et al. 1999). Obesity-related health care costs are lower for women than for men. Based on the 2001–2016 Medical Expenditure Panel Surveys, Cawley et al. (2021) estimate that the annual medical burden of obesity in 2016 amounted to $260.6 million. The total direct and indirect economic cost of obesity in the United States was estimated to be $422 billion in 2018, representing about 2% of the national gross domestic product (GDP) (Woods & Miljkovic 2022). For comparison, these costs were estimated to be $725 million (purchasing power parity) for Thailand, representing approximately 0.13% of Thailand's GDP (Pitayatienanan et al. 2014).

2.3.2. Effect on labor market outcomes. The literature recognizes discrimination against obese individuals in job markets as they receive lower wages (Brown & Routon 2018, Han et al. 2011) and have lower likelihood of employment (Busetta et al. 2020, Campos-Vazquez & Gonzalez 2020). Using the National Longitudinal Survey 1982 by the US Bureau of Labor Statistics, Register & Williams (1990) find that the wage penalty for obesity in the United States was as high as 12% for female workers, but no significant penalty was found for male workers. Using the European Community Household Panel data, Brunello & d'Hombres (2007) find that men and women pay a penalty for obesity in labor markets of nine European countries—a 10% increase in the BMI reduced the real earnings of males by 3.27% and of females by 1.86%. Other studies find discrimination against obesity in employment by examining the call-back ratio and employment offers using fictitious resumes in response to real job advertisements—Rooth (2009) for Sweden, Busetta et al. (2020) for Italy, and Campos-Vazquez & Gonzalez (2020) for Mexico.

3. ANALYSIS OF THE LITERATURE ON OBESITY STUDIES FOR DEVELOPING AND DEVELOPED COUNTRIES BASED ON A TEXT-MINING MACHINE LEARNING APPROACH

We conduct a systematic literature search of peer-reviewed, English language papers published from 1973 to 2022 using the Scopus database and the keywords "obesity" and "life expectancy." Our search yielded 1,423 papers, including 1,232 for developed countries and 191 for developing countries. We conduct three types of text-mining machine learning analyses.

Supplemental Material >

First, we examine the time trend of these articles. **Supplemental Figure 1** shows that studies on obesity and life expectancy for developed countries started to increase in the early 2000s, while studies for developing countries started almost a decade later, around 2010.

Second, we analyze the differences in subject areas over time and between developed and developing countries based on study area for the papers. **Supplemental Figure 2** shows that most of the papers were published in medicine journals for both developed and developing countries. In developed countries, social science ranked fourth (from the top) as a subject area for studies, while it did not make it to the top five subject areas for studies focusing on developing countries. Agricultural and biological sciences ranked fifth for studies in developing countries. Since the determinants for obesity include economic, behavioral, socioeconomic status, urbanization and development, and public policy, more social science studies are needed to address it.

Third, we analyze the ten most frequent words in the articles. **Supplemental Figure 3** reveals that the top ten words are similar for studies focusing on developing and developed countries, except "mortality" and "weight" are exclusively present in the top ten list for developed countries, while "diabetes" and "cancer" are only in the list for developing countries. Both "patient" and "disease" are among the top ten words for studies in both developed and developing countries, reflecting the prominence of the medical field. Moreover, "health" ranks higher than "patient" and "disease" for developed countries (third versus fourth and eighth), but it ranks lower than "patient" and "disease" for developing countries (sixth versus second and third). These findings suggest that studies on obesity and life expectancy in developed countries have expanded beyond physical health to include other aspects of well-being, such as mental health and social esteem.

4. OBESITY, MORTALITY, AND LIFE EXPECTANCY

Several potential mechanisms may explain the association between BMI and mortality risk. Obesity has negative impacts on both physical and mental health. Obese individuals have a higher risk for developing diseases such as hypertension, insulin resistance, abnormal blood lipids, cardiovascular diseases, coronary heart disease, type 2 diabetes, certain cancers, gallbladder disease, osteoarthritis, and sleep apnea. Additionally, social stigma, low self-esteem, and body image dissatisfaction may lead to depression or anxiety among obese individuals. Obesity can affect life expectancy and quality of life. It is important to note that the impact of obesity at the population level may differ from its impact at an individual level.

4.1. Effect of Obesity on Physical Health

Medical researchers have conducted large-scale epidemiological cohort studies to examine how obesity affects life expectancy. These studies pool individual data from prospective studies[3] to conduct an analysis of associations between obesity, health, and mortality. Several collaborative prospective studies provide robust evidence that obesity decreases life expectancy and is a major risk factor for various noncommunicable diseases and premature mortality. Obesity-related mortality has been computed in two broad ways. Some studies have computed potential life expectancy if the entire population were in the healthy BMI range, while others have computed the increased risk of mortality (and diseases) associated with an increase in BMI.

The Prospective Studies Collaboration (2009) is one of the largest and most detailed studies on obesity and mortality. It includes about 900,000 participants from 57 prospective studies in the HICs of Europe, Israel, the United States, Australia, and Japan. This study shows that overweight and obesity are associated with increased all-cause mortality as demonstrated by the nonlinear J-shaped relationship between BMI and all-cause mortality. The risk of mortality is lowest at BMIs between 22.5 and 25 for both sexes and increases from a BMI of 25 but is not substantial until BMI exceeds 32–35. On average, each 5-unit increase in BMI was associated with about 30% higher risk of overall mortality. At BMIs of 30 to 35, median survival is reduced by 2–4 years. Similar findings are observed in a study that analyzes 1.46 million white adults from 19 prospective studies (Berrington de Gonzalez et al. 2010). The healthy BMI range was found to be lower when the study excluded smokers as smoking raises the BMI level at which mortality is minimized. Healthy women (i.e., those who reported no history of cancer or heart disease) who had never smoked and who were overweight were 13% more likely to die during the follow-up period compared with those in the healthy BMI range. Obese or severely obese women had a dramatically higher risk of death. The mortality risk increased nonlinearly with BMI and was significantly larger at higher BMI levels. Other studies found similar results using meta-analyses: those of Aune et al. (2016), based on 230 cohort studies, and Di Angelantonio et al. (2016), based on 239 prospective studies for Asia, Australia and New Zealand, Europe, and North America. Flegal et al. (2013) conduct a

[3] A prospective study, a longitudinal study where researchers follow and observe a group of subjects/cohorts over time, gathers information and records the development of outcomes to identify various health risk factors. These observational studies observe development of a disease and compare the risk factors among subjects. The researchers examine any factors that differed between the individuals who developed the condition and those who did not. They can then determine if an association exists between an exposure and an outcome, and even identify disease progress and relative risk.

meta-analysis of published studies of BMI and all-cause mortality that provide hazard ratios for standardized BMI categories. The study finds that relative to normal weight, obesity is associated with significantly higher all-cause mortality, with a hazard ratio of 1.18 for obese individuals.

Several studies have estimated years of life and active life lost due to obesity, presence of obesity-related diseases, and associated deaths. Peeters et al. (2003) report that obesity-related mortality can lead to up to 6 to 7 years of lost life expectancy in the United States. The adverse effect is stronger for black Americans compared with white and Latin Americans (Tilstra et al. 2022). Fontaine et al. (2003) calculate years of life lost for different BMI points and find significant gender differences, with a 40-year-old obese white man (with BMI of 38) losing an average of four years of life and a white woman of the same age and BMI losing three years. Finkelstein et al. (2009) compare life expectancy across different obesity classes and find a more pronounced reduction in life expectancy for high BMI categories. Similarly, Lung et al. (2018) find an 8.3-year decrease in life expectancy for obese men and 6.1-year decrease for obese women in Australia. In addition to reducing life expectancy, obesity also reduces active life expectancy, affecting overall quality of life[4] (Diehr et al. 2008, Jia & Lubetkin 2022, Leigh et al. 2016, Stenholm et al. 2017, Tareque et al. 2019, Walter et al. 2009, Zhang et al. 2019, Zheng et al. 2021).

Using panel data from 195 countries for 1990–2015, a study by the GBD Obesity Collaborators (2017) evaluates the presence of BMI-related diseases by age, sex, spatial, and socioeconomic characteristics. Following a similar methodology framework, Dai et al. (2020) analyze the above data further and find that the global deaths and DALYs attributable to high BMI (BMI $\geq$ 25) have more than doubled for both females and males. Age-standardized DALY rates increase in regions with the lowest sociodemographic index[5] but decline in regions with the highest sociodemographic index, with the exception of high-income North American countries. This observation is consistent with the argument that medical expenditure can reduce obesity-related health risks. The study also finds that high-BMI-related deaths and DALY rates are lower for women than for men in the age groups younger than 75 years. Severely obese individuals lose approximately eight disease-free years compared with their normal-weight peers, while mildly obese individuals lose about four disease-free years.

4.2. Effects of Obesity on the Incidence of Diseases

The risk of diabetes has been found to be closely linked to obesity. Based on 31 prospective cohort studies, Hartemink et al. (2006) find that the risk of type 2 diabetes increased by 15–20% per unit of BMI. Considering a representative sample from India, Gupta & Bansal (2020) examine the causal effect of a rise in BMI on the likelihood of being diabetic. They find that diabetes risk was twice as high or more for overweight and obese individuals compared with normal weight ones. A unit increase in BMI increased the probability of being diabetic by about 1.5% for overweight and obese individuals, compared with 0.5% for normal weight individuals. Evidence of increased risk of diabetes due to obesity is also reported for Brazil (Torquato et al. 2003).

Obese individuals are also at a considerably higher risk of cardiovascular diseases. Yusuf et al. (2004) analyze a large sample study of 29,972 individuals in 52 countries and find that the odds ratio for heart attack is 1.12 for individuals in the top BMI tertile compared with the bottom

[4]The healthy life expectancy concept considers both morbidity and mortality. Health expectancy is the number of remaining years, at a particular age, which an individual can expect to live in a healthy state (however health may be defined). It is useful in comparing the health of different populations and subpopulations. Disability is defined as restrictions in daily activities due to long-standing illnesses, conditions or handicaps.

[5]Sociodemographic index was computed based on fertility rate, educational attainment, and per capita income, and used as a composite indicator for development status of the location.

BMI tertile. Obesity also increases the probability of cancer, particularly in women. Using a meta-analysis of 89 epidemiological studies, Munsell et al. (2014) find that obesity is associated with an increased incidence of breast cancer in postmenopausal women, but no such evidence is found among premenopausal women.

A significant proportion of the global burden of disease is attributable to increases in BMI, including 58% for type 2 diabetes, 21% for ischemic heart disease, 39% for hypertensive disease, and 23% for ischemic stroke (James et al. 2004). This translated to the global burden of disease attributable to excess BMI in adults of more than 30 million DALYs in 2000, with ischemic heart disease and type 2 diabetes being the primary contributors.

Recent research shows that obese individuals may be at a greater risk of severe complications of COVID-19. Cai et al. (2020) find that overweight patients in China were more likely to develop severe COVID-19. Other studies from developing countries, such as Brazil (Szente Fonseca et al. 2020) and Mexico (Carrillo-Vega et al. 2020), also find that obese people are more likely to be hospitalized and require intensive care after developing COVID-19. Bretschger et al. (2020) find that obesity increases the risk of infection and death in Organisation for Economic Co-operation and Development (OECD) economies.

Can the effects of obesity be reversed by losing excess weight? Dattilo & Kris-Etherton (1992) find that losing excess weight improves blood lipid profiles, with a fall in total serum cholesterol and triglyceride levels and an increase in high density lipoprotein concentrations. In a randomized control trial in Sweden, Sjöström et al. (2000) find that very obese diabetic adults who underwent gastric bypass surgery to induce marked weight loss became nondiabetic, and there was minimal incidence of new cases over an 8-year postsurgery follow-up period. Additionally, four prospective studies, including three randomly controlled interventional studies, have shown that modest loss of weight induced by changes in diet and exercise behavior in overweight or obese people with glucose intolerance can significantly reduce subsequent development of type 2 diabetes over periods of 3–6 years (Diabetes Prev. Program Res. Group. 2002, Eriksson & Lindgärde 1991, Tuomilehto et al. 2001). Weight-loss trials among obese patients with type 2 diabetes have also shown significant improvements in diabetic status or even a return to normal glucose tolerance. The evidence of reduction in risk factors due to intentional loss of excess weight suggests a causal link between obesity and risk factors.

4.3. The Effects of Obesity on Mental Well-Being

Obesity is found to be extensively associated with mental health impairments, leading to decreased quality of life and increased disability, morbidity, and mortality. The association between obesity and mental health impairments is well documented (Simon et al. 2006). Individuals with mental health issues are at a higher risk of developing physical illness (Halfon et al. 2013). Mental health is often associated with body image dissatisfaction (Harriger & Thompson 2012), low self-esteem (Gow et al. 2020), symptoms of anxiety and depression (Simon et al. 2006), eating disorders and dysfunctional eating (Golden et al. 2016), substance use (Farhat et al. 2010, Baingana et al. 2015), psychological distress (Puder & Munsch 2010), poor sleep (Zhang et al. 2017), poor academic performance (Agnafors et al. 2021), and suicidal tendencies (Mather et al. 2009).

The relationship between obesity and mental health has several important features. First, the associations can be bidirectional (Mühlig et al. 2016) as they may share a series of clinical, neurobiological, genetic, and environmental factors (Mansur et al. 2015), amplifying and exacerbating each other, ultimately resulting in increased mortality and shortened life expectancy. This poses significant challenges for LICs as they face increasing rates of both obesity and mental health issues while lagging behind in the quantity and quality of mental health services (Patel et al. 2018, Rathod et al. 2017). Second, moderating or mitigating socioeconomic factors such as sex, age, race/ethnicity, and income can have different impacts on the obesity–mental health association depending on the country. For example, people in LICs are more likely to experience economic stress and lack coping strategies to mitigate the adverse impact. Lastly, while there are some cross-country studies on the relationship between mental health and obesity (Scott et al. 2008), very few studies are specifically for LICs.

4.4. Association Between Obesity and Life Expectancy at the Population Levels

The studies reviewed above on the association between obesity and life expectancy are mainly conducted at the micro (individual) level. In contrast, macrolevel studies are concerned with population health and are interested in estimating average years of life lost by members of a population due to obesity (Olshansky et al. 2005, Preston & Stokes 2011, Bansal & Zilberman 2020, Case et al. 2020, Bansal & Zilberman 2021). These studies examine the effects of obesity on mortality rates and reduced longevity by combining the proportion of underweight and obese populations in a country with the risks of mortality in a particular BMI category. By taking a population-level perspective, these studies provide insights into the broader impact of obesity on society and public health.

According to Olshansky et al. (2005), eliminating obesity in the United States would have increased life expectancy at birth by 0.33–0.93 year for white males and 0.30–0.81 year for white females in 2000. Preston & Stokes (2011) examine the contribution of obesity to international differences in life expectancy across 16 countries and find that the high prevalence of obesity in the United States reduced life expectancy at age 50 years by 0.62–1.85 years for men and 0.88–1.54 years for women. Case et al. (2020) note that the fall in mortality rate has slowed down or even reversed in recent years for white Americans. Among factors such as drug overdoses, suicides, and alcohol-related death, rising BMI has also contributed to the trend.

Much of the literature cited above focuses on HICs. Bansal & Zilberman (2020) examine the macrolevel relationship between obesity and life expectancy using cross country national data of 184 developed and developing countries. They find a positive relationship between obesity and life expectancy at lower levels of obesity, but the relationship becomes negative once the prevalence of obesity exceeds a certain threshold level. Furthermore, health expenditure mitigated the adverse impact of obesity. Bansal & Zilberman (2021) find that the average BMI at which average longevity is maximized in a population is higher than the BMI range that maximizes longevity for an individual. They also find that the turning point of the average BMI level at which life expectancy starts declining is much higher in developed countries than in developing countries. One plausible explanation for this could be that higher medical expenditure and better health care systems in developed countries allow obese people to live longer. Developing countries face challenges due to fat tails at both ends of the BMI distribution and poor medical care systems, making policy design more challenging.

4.5. Associations Between Obesity and Life Expectancy Differ by Sociodemographic Factors

Empirical evidence at the microlevel demonstrates that the effect of BMI or obesity on life expectancy varies considerably by age, gender, race, and ethnicity. For example, the relationship between obesity and mortality risk in the elderly is more complex (Cetin & Nasr 2014). Some studies find that, for the elderly population, an overweight BMI is paradoxically associated with lower mortality risk and that obesity does not increase mortality risk (Diehr et al. 2008, Folsom et al. 2000). Others find that obesity is associated with lower mortality risk among elderly patients, such as those with chronic heart failure (Abdoul Carime et al. 2022). Several systematic reviews, including those of Bales & Buhr (2008) and Oreopoulos et al. (2009), examine the evidence on the obesity paradox for elderly populations and explore potential explanations. These include the survival effect, which suggests that overweight and obese individuals who survive to old age may have characteristics that protect them and make them more resistant to complications of obesity. Another explanation, based on time discrepancy of competing risk factors, suggests that individuals who become obese in old age are likely to die of other conditions before the adverse effects of obesity manifest. Yet another explanation is that a high BMI or obesity in later life offers potential benefit, such as improving energy reserves and antioxidant defenses, which are potentially more beneficial for individuals in developing countries who are experiencing the double burden of malnutrition. Moreover, in contrast with younger adults, obesity in advanced age is not found to be associated with depression and cognition decline.

There is a considerable body of research documenting the differential effects of obesity by gender. Women are less adversely affected by obesity than men in terms of physical health (Bansal & Zilberman 2020, Berrington de Gonzalez et al. 2010, Dai et al. 2020, Lung et al. 2018, Olshansky et al. 2005, Preston & Stokes 2011). Gender differences also exist in the incidence and risks of specific diseases associated with obesity. For example, women with a higher BMI are at a higher risk for type 2 diabetes than men (Censin et al. 2019), and postmenopausal women with obesity have a higher incidence of breast cancer (Munsell et al. 2014). These differences in disease risk have important implications for health care costs, with the highest expected costs being for coronary heart diseases in men and diabetes in women. However, obese women face greater social and psychological pressures than men. For example, labor market discrimination against the obese is more pronounced for women (Busetta et al. 2020, Register & Williams 1990, Segal et al. 2020). The gender disparities in discrimination can also affect marriage prospects (Cawley & Danziger 2005). Moreover, women with obesity-related illnesses, such as hypertension and diabetes, are more likely to pass on a higher risk of obesity to their children (Armitage et al. 2008, Ordovas 2007).

The link between obesity and life expectancy, as established by epidemiological studies, is primarily based on observational research, which is subject to several confounding factors. Three types of biases have been identified in the literature. First, endogeneity of obesity can potentially lead to bias, as various factors can affect both obesity and life expectancy and some of them may not be necessarily observable to researchers. For example, smokers tend to have a lower body weight and shorter life expectancy as compared with nonsmokers. WHO (2022) finds that in 2020, about 22.3% of the global population (1.3 billion people) used tobacco, with over 80% living in LICs and MICs. Similarly, self-control capability may affect health-related behavior and therefore affect weight status (Fan & Jin 2014b) as well as life expectancy. The second source of bias is due to preexisting diseases that cause weight loss and affect mortality. Third, BMI calculated from self-reported weight and height may suffer from systematic measurement errors. The biases may lead to an underestimation of the impact of obesity on premature mortality. Differences in the estimated magnitudes across studies can be attributed to different sample sizes, regions, and durations of the follow-up period. For example, studies with shorter follow-up periods tend to have U-shaped associations, while those with longer follow-up periods tend to have J-shaped associations. The medical literature has a few randomized controlled studies that aim to estimate causal effects. The economics literature has employed advanced methods and appropriate instrumental variables to estimate causal effects of obesity on life expectancy.

5. POLICY ASPECTS

Public policies influence individual food choices, including what and how much to eat and how many calories to expend, by impacting the availability and affordability of various foods, their relative prices, and other environments. We focus on policies that affect food environments, food supply chains, and individual food choices. Specifically, we discuss the following policies: agricultural support policies, globalization and agricultural trade liberalization, economic incentives (e.g., taxes and subsidies on food items), and food assistance programs.

5.1. Agricultural Support Policies

Some studies have attributed the upsurge of obesity to farm subsidy policies (Ludwig & Pollack 2009, Tillotson 2004). These policies are widely employed globally and can alter relative food prices directly and indirectly by increased production. In developing countries, agricultural price supports for wheat and rice have similar effects. Additionally, the public distribution system in India has made fine cereals, such as wheat and rice, relatively cheaper, which has shifted consumption patterns away from nutritious foods, such as coarse cereals, dairy, fruits, nuts, and meats (Desai 2016, Khera 2011). However, other studies find small or null effects from farm subsidy policies (Alston et al. 2006, 2008).

5.2. Globalization and Trade Liberalization

Globalization has been attributed as a factor for the obesity surge in developing countries (Mary & Stoler 2021, Popkin 2006, Popkin & Reardon 2018), as it affects the quantity, variety, type, desirability, cost, and accessibility of foods for consumption as well as the incomes of and affordability for consumers. Globalization may affect obesity levels through several potential channels. First, food import and export not only impact food supply and consumption but also alter the availability and affordability of healthy and unhealthy foods (Baker et al. 2020, Friel et al. 2020). Vogli et al. (2014) show that increased agricultural trade openness has provided transnational food companies greater access to markets in developing countries for selling highly processed food and fast food. Baker et al. (2020) argue that globalization, along with industrialization of food systems and technological changes, has led to a substantial expansion of processed food sold worldwide, with rapid growth in Asia, the Middle East, and Africa, where nutrition policies are inadequate. Second, agricultural trade liberalization affects domestic food prices and the substitution between domestic and imported foods (Friel et al. 2020, Popkin & Reardon 2018), particularly with regard to processed foods and animal products as they become increasingly affordable. Third, agri-food trade liberalization creates awareness and increased acceptance of a Western diet, leading to changes in food preferences, possibly for obesogenic food products (An et al. 2019).

Agricultural protection policies, such as tariffs and subsidies, can significantly influence food prices, potentially impacting food consumption and health outcomes. Boysen et al. (2019) argue that trade liberalization by lowering import tariffs on highly processed foods would reduce underweight prevalence but exacerbate obesity in sub-Saharan Africa. Barrera & Shively (2022) point to potential unintended health consequences of agricultural and trade policies directed at increasing food supply as the availability of excess calories is positively and significantly associated with adult BMI for both men and women across countries. Furthermore, in recent years, individuals are becoming overweight or obese at an earlier age, resulting in a longer life span in an unhealthy state.

5.3. Economic Incentives Altering the Relative Prices of Healthy and Unhealthy Foods

The cost of energy-dense foods is typically lower than healthier, less-dense foods (Drewnowski & Darmon 2005). One policy suggestion is to change the relative price of healthy and unhealthy foods by using pricing policies such as tax and subsidy.

The “fat tax,” a tax on unhealthy foods, has been advocated by public health scholars and practitioners (Alston et al. 2016, Cash & Lacanilao 2007, Cawley et al. 2019). Chriqui et al. (2008) conduct a comprehensive investigation of food taxes at the state level in the United States and find that 40 states impose sales taxes on at least one soft drink, candy, or snack item. According to data from the World Cancer Research Fund International, taxes on sugar-sweetened beverages have been implemented in at least 36 countries, including the United Kingdom, Ireland, Mexico, France, Hungary, and Norway, as well as some cities in the United States (e.g., Berkeley, Philadelphia, Seattle, and San Francisco). The effectiveness of price policies is likely to depend on the price elasticity of demand. Some studies suggest that taxation, by increasing the relative prices of unhealthy foods, can be effective in promoting healthy food consumption (Falbe et al. 2020, Teng et al. 2019), particularly among low-socioeconomic-status groups with a high price elasticity (Colchero et al. 2017, Eyles et al. 2012). Research on economic incentive–based policies in developing countries is limited. Jumrani & Meenakshi (2023) investigate the effects of subsidies on cheaper palm oil in three states in India and find that they increased consumption of cheaper palm oil without significantly affecting overall edible oil consumption; the impacts were stronger for the poor.

While a fat tax has been proposed as a potential solution, it may face many practical challenges. For example, Denmark’s tax on saturated fat was abolished within 15 months due to lack of political acceptance and objections from industry (Eyles et al. 2012). Colchero et al. (2017) also find strong opposition to taxes on sugar-sweetened beverages from manufacturers. Furthermore, food taxes may not be economically effective as the effect may be too small and/or offset by increased consumption of other caloric drinks (Pell et al. 2021). Cawley et al. (2019) find that while taxes may lower consumption of taxed beverages, the reduction is partly offset by cross-border shopping outside the taxing jurisdictions. Additionally, food taxes are likely to be regressive, with low-income individuals paying a larger share of their income toward the tax than high-income individuals (Fearne et al. 2022, Hagenaars et al. 2017).

5.4. Food Assistance Programs

Food assistance programs are commonly used in both developing and developed countries (Aliyar et al. 2015, Oostindjer et al. 2017). In developed countries, the objective of food assistance programs has shifted from fighting hunger to improving nutritional outcomes and addressing the issue of rising obesity. Bitler & Seifoddini (2019) provide a review of the health and nutritional effects of food assistance programs in the United States. Several studies find that the Supplemental Nutrition Assistance Program, the largest food assistance program in the United States, does not contribute to obesity among adults (Nguyen et al. 2015) and children (Fan & Jin 2015). In developing countries, food assistance programs serve as a social safety net to alleviate hunger and increase school enrollment in the short run, while aiming to improve nutritional and educational outcomes in the long term (Jomaa et al. 2011).

While there is abundant literature on school feeding programs (SFPs) in developed countries such as the United States, research on SFPs in developing countries is rather limited. Jomaa et al. (2011) conduct a review of 18 studies in developing countries, including Kenya, Jamaica, India, Indonesia, and China, and document positive effects of SFPs on energy intake and micronutrient status. Quaye et al. (2010) find that the national SFP in China launched in 2012 did not have significant effects on anemia rates or BMI. Afridi (2010) finds that Nutritional Support for Primary Education, a mandatory program that offered free meals in all public primary school in India, reduced hunger at school and improved protein-energy malnutrition. Starting in late 2001, India implemented the Midday Meal program nationwide, and free school lunches in primary schools are now available in every state.

In developing countries where the double burden of malnutrition is a concern, SFPs need to address the rising obesity problem. Carrillo-Larco et al. (2016) find that participation in food assistance programs in Peru is associated with a lower risk of obesity in children but a higher risk of obesity in mothers. The quality of food provided by SFPs is important. For example, Anitha et al. (2019) find that replacing rice with millets in the Midday Meal program in a periurban region of Karnataka State, India, improved the nutritional outcomes of children (Anitha et al. 2019). Linking SFPs with community involvement and local support can promote local production and the economy (Quaye et al. 2010). Promoting nutritional education and creating school environments are also crucial for developing countries to encourage healthy eating habits.

6. CONCLUSIONS

This article presents robust evidence of the negative effects of obesity on life expectancy and quality of life at an individual level. However, the impact of the level of obesity on population-level health outcomes may differ between developed and developing countries due to the latter's large underweight populations and the double burden of malnutrition. We also document important gender differences. Developed countries may potentially mitigate the adverse health effects of obesity on life expectancy and quality of life by increasing their spending on medical care and health investment. However, developing countries and their populations often lack the financial means for the diagnosis and treatment of obesity-related diseases. The lack of economic and health care resources in developing countries exacerbates the social, economic, and health consequences of obesity. As such, developing countries face the challenge of addressing the concurrent issues of undernutrition and obesity in their policy design and implementation.

Pricing policies such as fat taxes implemented in many countries have not proven effective in bringing significant changes in behavior or reducing obesity levels. Alternative, nonpricing policies are needed to promote behavioral changes. This article also highlights the unintended effects of agricultural policies that aim to increase food production on the obesity surge in developing countries. This raises an important question for developing countries—should agricultural policies prioritize food production to ensure food security, or should they also focus on promoting nutritious food as a way to tackle obesity?

The current literature on obesity research predominantly consists of epidemiological studies from developed countries that conduct analyses at an individual level and capture associations rather than causation. To address obesity's impact on individual well-being and population health, more social science studies are needed. Population-level studies would be especially beneficial in providing a better understanding of these relationships and guiding policy development. Innovative studies that establish causal effects through emerging data (e.g., genetic data) and advanced estimation techniques would further enhance our understanding of the issue. Furthermore, the lack of empirical evidence from developing countries highlights the need for more obesity-related research in these countries. To achieve this, data at a disaggregated level are required from all parts of the world, with a particular emphasis on developing countries.

The global upsurge of obesity has given rise to the weight management industry, which encompasses weight-loss programs, weight-loss pills, surgeries, gyms, personal trainers, and so on. It would be intriguing to investigate how this expanding industry impacts economic and health outcomes.

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