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Association between socioeconomic status (SES) and Obesity among Adults: A Systematic Literature Review

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DECLARATION

I, Mayuri Jayantibhai Patel, declare that this dissertation has been composed by myself, that the work contained herein is entirely my own except where explicitly stated otherwise in the text, and that this work has not been submitted for any other degree or qualification, in whole or in part, except as specified.

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ABSTRACT

Obesity has emerged as a critical global public health challenge, contributing significantly to morbidity, mortality, and economic costs. Its development is shaped by a complex interplay of biological, behavioural, and environmental factors, yet socioeconomic status (SES) remains a central determinant of obesity risk. SES, encompassing education, income, occupation, and area-based deprivation, influences exposure to health risks, access to resources, and the adoption of health-promoting behaviours. Despite extensive research, findings on the SES–obesity relationship remain fragmented due to methodological inconsistencies, varied definitions of SES, and limited representation of diverse populations, particularly in low- and middle-income countries. This systematic literature review (SLR) synthesises global evidence on the relationship between SES and obesity among adults. A structured search strategy was employed across multiple databases, including PubMed, Scopus, and EBSCOhost, with studies screened and evaluated using predefined inclusion and exclusion criteria. The PRISMA framework guided the review process, resulting in the inclusion of 15 studies published between 2015 and 2025. Findings reveal that lower SES is consistently associated with higher obesity prevalence in high-income settings, while in some low- and middle-income contexts, higher SES groups show greater obesity risk, reflecting transitional nutrition environments. Mediating factors such as gender, ethnicity, age, cultural norms, and environmental conditions further shape these associations. The review also highlights gaps in longitudinal evidence, limited integration of behavioural and environmental mediators, and an overrepresentation of studies from high-income regions. This synthesis underscores the need for more comprehensive and globally inclusive research to inform equitable public health strategies. Addressing obesity requires not only biomedical interventions but also policies that tackle structural inequalities and environmental drivers, ensuring targeted and sustainable solutions across diverse adult populations.

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LIST OF ABBREVIATIONS

BAI – Body Adiposity Index

BMC – BioMed Central

BMI – Body Mass Index

BMJ – British Medical Journal

CASP – Critical Appraisal Skills Programme

COVID – Coronavirus Disease

DALY – Disability-Adjusted Life Year

EBSCO – Elton B. Stephens Company (academic database provider)

ESRC – Economic and Social Research Council

GDP – Gross Domestic Product

INCA – Income, Nutrition, and Child Analysis

ISCO – International Standard Classification of Occupations

NHS – National Health Service

OECD – Organisation for Economic Co-operation and Development

PEO – Population, Exposure, and Outcome

PLOS – Public Library of Science

PRISMA – Preferred Reporting Items for Systematic Reviews and Meta-Analyses

SBSI – Surface-Based Body Shape Index

SEBS – Socioeconomic Burden Score

SES – Socioeconomic Status SESI – Socioeconomic Status Indicator

SLR – Systematic Literature Review

WHO – World Health Organization

WHR – Waist-to-Hip Ratio

CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction to the Topic

Obesity, the excess body fat characterised a health hazard by WHO (2025), has turned into a worldwide health crisis on a national scale (Boutari and Mantzoros, 2022). Depending on biological motivations (Loos *et al*., 2021), behavioural patterns (Leitzmann, 2017), and the environment, its emergence is affected. The socioeconomic status (SES) is a highly important factor that decides the risks of obesity by including education, income, occupation, and area-based deprivation (Eum and Jung, 2020; Feuillet *et al*., 2020). The following systematic literature review intends to investigate the connexion between SES and obesity among the adults globally (Stiebahl, 2025). Although reduced SES is universally associated with increased obesity rates and concepts of the research limitation exist on the magnitude and direction of the relationship in the context of varied adolescent groups, there are relational along the socioeconomic gradient in diverse adult populations and the changing socioeconomic nature (Van der Heyden *et al*., 2023). The conceptualization of the role of the SES in the development of obesity is critical to successful community intervention against health disparities. The study aims to replicate the findings of existing evidence explaining the influence of the SES dimensions on the risk of obesity among adults.

1.2 Background and Current Context

1.2.1 Socioeconomic status (SES): Definition and development history

Socioeconomic status (SES), is a complex phenomenon, denoting the social and economic position of a person, or a group of people, in relation to other people, depending on how they are characterised in terms of education, occupation, income, and residential neighbourhood. The initial understandings of SES developed during the mid-1900s as models emerged on social classes and they associated the occupational prestige with health results (Adler et al., 1999). With time the construct has grown to embrace more widespread measures in the inclusion of material resources, educational attainment and measures of areas level deprivation. SES has now been universally acknowledged as the essential determinant of health, with a role in exposing to risks, access to healthcare and the uptake of health-promoting behaviours (Antonoplis, S., 2022).

1.2.2 Measurement of SES

The weight of SES is complicated in the sense that no one metric alone particularly reflects the variety of social and economic determinants of health. A combination of individual and contextual measures is used by the researchers typically since each of them represents various aspects of socioeconomic position.

1.2.2.1 Educational level

The most common proxy of SES is education. It does not simply show cognitive and skills development, but also shows the access to knowledge, health literacy and employment opportunities. Education has fairly constant life cycle and can be thus applied widely in population-based studies (Broer, Bai and Fonseca, 2019).

1.2.2.2 Occupational class

Status at work accounts to social status and work conditions such as employment in professional and managerial jobs to elementary and manual jobs. It comprises material benefits, work security, intangible psychosocial stressors and workplace risk factors. Cross-national comparisons are often done with standard classification systems, including the International Standard Classification of Occupations (ISCO) (Adler et al., 1999).

1.2.2.3 Income

Material resistance can be explicitly counts by household or individual income with

implications on access to housing, diet, health, and lifestyle amenities. Although it is very relevant, income may change with time and inaccurate measurements of income may occur as a result of under-reporting or informal income (Benzeval, Judge and Shouls, 2001).

1.2.2.4 Area-based SES

The socioeconomic environment in which persons occupy is determined by area-level indicators, including the deprivation index or neighbourhood socioeconomic score. These scales include such indicators of access to local assets, such as green spaces, health facilities and shops, or a community indicator of disadvantage, such as; unemployment or housing vulnerability (Rollings et al., 2023).

1.2.3 SES measurement worldwide and across countries

In different countries, the measurement of SES is different based on availability of information and culture. The standardised national surveys tend to be used to determine SES in high-income countries using the measures of education, income, and occupation. They can be replaced by household asset indices, levels of literacy, or neighbourhood-based indicators in low- and middle-income societies. Regardless of the differences, SES has been at the centre of health studies in the world where inequalities have been examined based on SES (Fotso and Kuate-Defo, 2005).

These inequalities will require a paradigm shift in the approach to the treatment of public health, that is, shifting the focus on the individual responsibility to altering the structural determinants of health. The reason is that in terms of combating the connexions between poverty and obesity, there should be extensive measures that must be undertaken to enable healthier living conditions and interrupt the cycle of poverty (Antonoplis, S., 2022).

1.3 Rationale for Research

Through the increased socioeconomic gradient in obesity is a significant worldwide public health outcomes concern, as it is associated with higher human misery, earlier death, and huge economic liabilities to the healthcare system and societies (Bradshaw and Dace, 2023). The connexion between declined socioeconomic status (SES) and an increased risk of obesity is a well-researched fact; however, much of the current studies is based on disjointed, cross-sectional information, which in most cases does not entail a detailed analysis with a specific focus on adults (Fysekidis *et al*., 2016).

The current study is expected to provide a systematic literature review in order to measure the correlation between the major SES dimensions such as education, income, occupation and area deprivation and obesity prevalence among adults in developed countries with obesity. It will also take differences in terms of gender (Eum and Jung, 2020), age (Stiebahl, 2025), and ethnic differences into account, and major discrepancies in the environment and culture. In addition, such synthesis will also emphasise gaps in the existing research (Boutari and Mantzoros, 2022; Ng *et al*., 2025) to guide future research. Through the integration of evidence into various settings, this review aims at advancing the knowledge on the role of SES dimensions in yielding global obesity tendencies in adults.

1.4 Research Question

This study investigates the link between socio-economic status (SES) and obesity, focusing on the following questions:

I. What impact does SES have on obesity?
II. What is the relationship between SES and obesity in adult populations?
III. Through which pathways do SES dimensions (education, income, occupation, and area-based deprivation) influence obesity risk in adults?

1.5 Research Aim

This research aims to critically evaluate the predominant evidence available on the correlation between socioeconomic status and obesity in adults in the globally distributed population on a systematic review, synthesisation, and evaluation of prior studies.

1.6 Research Objectives

I. To determine the impact of socioeconomic status (SES) on the prevalence and distribution of obesity among adults.

II. To analyse the relationship between SES and obesity across different adult populations, considering variations by gender, geography, and population subgroup.

III. To identify and evaluate the pathways through which SES dimensions (education, income, occupation, and area-based deprivation) influence obesity risk, providing insights for public health strategies to reduce inequalities.

1.7 Chapter Summary

The chapter presents the research questions, research aim, objectives and knowledge gaps. It creates obesity as an increasing community health concern in the global and in the United Kingdom with a disproportionate representation of the socioeconomically disadvantaged adults. The chapter also describes the concept of socioeconomic status (SES) and its major dimensions; education, income, occupation and area deprivation, making the instance of SES an important risk factor of obesity. This background makes it clear that systematic review is necessary. The second chapter will give an informative summary about the epidemiology of obesity and critically analyse the evidence of the connexion between SES and obesity at the global levels.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Today, obesity is a contentious international health challenge predicting much of the international health burden as it is associated with chronic health conditions like type 2 diabetes, cardiovascular disease, as well as certain forms of cancer (Balasundaram and Daley, 2025). The chapter is the sociopolitical epidemiology of obesity, specifically the contribution of the socioeconomic status (SES) to its prevalence and clinical outcomes among populations. It begins with an explanation of the meaning behind obesity and the classifications of obesity that exist in this current world before examining how obesity prevalence affects the world today. The review next examines the risk factors which are pertinent and the health and economic costs of obesity, the role of SES in dietary practises and eating behaviours. It is this summation of available findings that underlie Chapter 3 which outlines the procedure that will be followed in order to conduct the systematic literature review. This synthesis of existing evidence forms the basis for Chapter 3, which describes the methodology used to undertake the systematic literature review.

2.2 The Epidemiology of Obesity

2.2.1 Definition of Obesity

Topical definitions Obesity as demonstrated by World Health Organisation (WHO) is primarily a Body Mass Index (BMI) which is calculated as a ratio between the weight of a person in kilogrammes to the square of the height in metres (kg/m2). The 30-plus BMI according to the recommendation of World Health Organisation can be considered obsessive, thus an easy, population category to define the status of weight and monitor population health trends on a global scale (World Health Organisation, 2025).

But BMI alone cannot be considered a perfect measurement. It does not distinguish between lean and fat mass, and it may put muscular individuals into the category of people deemed as being overweight or obese, and it does not identify a high degree of adiposity in individuals that have a normal BMI (Callahan, 2023). Moreover, the distribution of fat is not captured by BMI; fat is a critical risk factor to risk obesity-related disease particularly abdominal obesity, which is much more closely linked to cardiovascular and metabolic disease. Evidence in this favour was that BMI is

characterised to be weak in different populations and its reliability is differing according to age, sex and ethnic groups (Buss, 2014).

Other anthropometric measurements have been identified in order to offset these inadequacies. Waist-to-hip ratio (WHR), waist circumference and waist-to-height ratio (Ahmad *et al*., 2025) are frequently used cardiometabolic risk predictors of central adiposity. As an example, a waist to height and waist to hip ratio above 0.50 and 0.85 respectively of men and women respectively are deemed to be unhealthy. A more precise measure of adiposity is the body fat percentage that was calculated based on skinfold callipers or bio electrical impedance analysis (Savva, Lamnisos and Kafatos, 2013). More recently, as a way to resolve the shortcomings of BMI, other methods have emerged that include the Body Adiposity Index (BAI) and Surface-Based Body Shape Index (SBSI) that retrieve a sensitive measure of body composition and shape (Fedewa, Nickerson and Esco, 2018).

2.2.2 Types of Obesity

Obesity is multi laid down disease and is associated with a complicated interaction of genetic, behavioural and environmental influencing determinants. It is not only polygenic with several combining with a small effect size of genes of versions that affect weight control, but also has syndromic or monogenic forms, including melanocortin-4 receptor mutations or Prader-Willi syndrome (Loos and Yeo, 2021). Examples of poor dietary practises, lack of physical exercise or activities, and psychosocial stressors are all examples of behavioural factors that adds to the risk factors contributing to excess weight gain. These are coupled with the environmental stress conditioned by obesogenic food systems, socioeconomic constraints and cultural practises that is combined with genetic leanings to determine the level of risk of obesity of the population (Ahmad *et al*., 2025).

One perspective that can be of relevance in studying or defining obesity is the distribution of body fats since this will imply different health implications. In reality, central obesity (accumulation of fat in the abdomen and trunk or more precisely the apple shape) strongly correlates with central obesity in Android obesity and correlates with cardiovascular disorder, insulin resistance, and metabolic imbalance (Ma *et al*., 2023). On the other hand, gynoid obesity (fat centring in the hips, thighs and buttocks, or a pear-shape), has fewer deleterious effects on metabolism, and even been

evolutionarily adapted because fat deposits are used in energy to reproduce. Such local patterns of adiposity not only indicate disease predisposition, but also offer a clue to even more narrowly targeted prevention and clinical control (Boutari and Mantzoros, 2022).

Obesity severity has been categorised clinically according to BMI as Class I (30-34.9), Class II (35-39.9), and Class III (≥40) with the Class III (morbid obesity- Class being the riskiest with the possibility of surgical treatment) having the highest physical risk (Weir and Jan, 2023). These BMI subdivisions are further explained in the presence of obesity conditions/implements like diabetes, cardiovascular disease or even functional disability. Although BMI categories do play an effective role in terms of population-wide monitoring and in clinical decisions-making, they tend to overlook individual differences in metabolic well-being and fat distribution. This is a case in favour of the necessity of more advanced clinical models that consider both adiposity phenotypes and comorbidity, to capture the reality of complex obesity (Nuttall, 2015).

This definition is further classified should there be such complications as diabetes, cardiovascular disease or functional impairment. Nevertheless, they are ill-suited to population monitoring and clinical decision-making since the latter only might not consider the differences between individuals in terms of health risk, being instead based on adiposity plus MetS, and as such, requiring a higher level of clinical groupings, considering adiposity and its comorbidities (Nuttall, 2015).

2.2.3 Prevalence and Incidence

The global obesity cases have increased drastically in the past four decades to the criticism of the world health organisation (WHO) of a significant public health crisis. The prevalence rate of obesity has almost tripled globally since 1975, primarily because of the radical transformations in lifestyles, among which have been the growing number of sedentary lifestyles, urbanisation, and growing access to increasingly energy-dense and nutrient-sparse foods (Boutari and Mantzoros, 2022). The data provided on obesity in the adult population of the globe show a consistent high increase: in 1980, the prevalence rate of obesity among adults all over the globe was 4.6 and, in 2019, it increased immensely to 14.0. Overweight and especially obesity is preponderant among women, with the highest rates being recorded among the age brackets of 50-65 years of age, with an older increase in the older groups

(Boutari and Mantzoros, 2022). In 2022, the prevalence of obesity in the world had risen to 16.02 percent nearly twice the sport of the year, 2000 when the figure of the prevalence stood at 8.03 percent. Moreover, two-thirds of adults in the world were overweight (BMI ≥25) and two-thirds thirds were obese (BMI ≥30) in 2016 (Ritchie and Roser, 2022).

There is not such even distribution of obesity geographically. To illustrate the point, the latest statistics by Ng *et al*. (2025) suggest that prevalence of overweight and obesity have grown exponentially in all countries, regardless of income, in the range 1990-2021. The world had approximately one billion men and 1.11 billion women on the year 2021 alone. They were mainly popular in Oceania, North Africa and the Middle East in which over 80 percent of the adult population is reported to be overweight or obese. China (402 million), India (180 million) and the United States (172 million) recorded the highest population in absolute numbers with obesity case. They were notably sharp in North Africa and the Middle East, a tensile thirty years between under- and overnutrition of soaring rates of obesity three times in men and two times in women (Weir and Jan, 2023).

Such epidemic is caused not only by individual behaviour but also has roots that lie in multifaceted structural and socioeconomic elements. Globalisation has changed food systems which has brought in more access to highly processed energy-dense foods- many at the cost of traditional diets- over and above making them available to most people. These ecological alterations together with rapid urbanisation and a reduction in physical activity, have brought about, as they are now commonly referred to, the so-called obesogenic environment. Simultaneously, rising purchasing power in middle-income nations has led to increased demand of fast food and sweet beverages, including inequalities in health across nations characterised by chronic low and high-income groups has put disadvantaged people at the risk of unhealthy affordable food (Loos and Yeo, 2021). The scale, systemic and universal relationships are proved between the socioeconomic status, lifestyle and the environment as it shows the scope of the obesity crisis in many settings (Ritchie and Roser, 2022).

The effects accompany the severity of the problem. In the absence of actions serious interventions projects 3.8 billion adults (more than half the total world adult population) of the world will be overweight or obese by the year 2050. Part of the slow past history, Sub Saharan Africa is expected to experience the highest growth with the number of

affected people in the adult category increasing by 254.8%. The country is expected to occupy fourth position in terms of the biggest causes of obesity prevalence in the whole world with Nigeria alone having 141 million overweight or obese adults by the year 2050 (Ng *et al*., 2025). These rates indicate a shifting world-wide burden with the historic area of undernutrition shifting to the quickly growing proportions of overweight and obesity and onset of a non-communicable disease in the areas (Boutari and Mantzoros, 2022).

The impact of this epidemic is wide-spreading. The obesity is closely associated with type 2 diabetes, heart disease, certain types of malignancies and premature mortality, factors that substantially add to the worldwide issue of non-communicable diseases (NCDs). Besides the health-related expenses, obesity poses a big burden on the economy in terms of elevating costs in inventive care and reduced workforce participation as well as diminished productivity. Otherwise, the health inequity pressure of the untamed burden of undernutrition and overnutrition in most nations would increase, impact the development goal and point pressures on health systems that are already stretched by infectious diseases and ageing.

Such disturbing trends create an indication of the necessity of interim and multi-sectoral approaches to public health. Obesity is a condition compromised by the COVID-19 pandemic, as Boutari and Mantzoros (2022) remark, social mobilisation of science, policy and community involvement in the Global South has been instrumental in this endeavour. The obesity requires medical attention and food production, urban policy, health promotion, and socioeconomic policy reforms. The alternative of such holistic strategies is the world in which the diseases associated with obesity factors will be competing or surpassing other major health issues on a global scale.

2.2.4 Risk Factors for Obesity

Obesity is a complicated disease, which is caused by several biological, behavioural, psychological and socioeconomic factors. It centres around biology, genetics and epigenetics. It is established that 40-75 percent of individuals with obesity can be explained by the factors (Ritchie and Roser, 2022). There are also epigenetic changes that prenatal and postnatal exposures appertaining to obesity and predisposing individuals to become obese also affect how genes are expressed. Metabolic functioning is another significant determinant as obesity is present when the energy

intake chronically surpasses the expenditure. The human metabolism is not uniform, and despite the fact that a person can effectively increase metabolism by exercising, there are other causes or influences that impact this process in the opposite way like sedentary lifestyle and high energy diet (Leitzmann, 2017).

Obesity may also be predisposed to by psychological and behavioural reasons. The most prevalent risk behaviour factor is also physical inactivity and many health-conscious individuals can be prone to gain their weight in case the levels of activity are low (Leitzmann, 2017). Poor eating habits like a high rate of intake of fried foods, fast foods and sweetened beverages are very much indicative of being obese (Mohammadbeigi *et al*., 2018). Although these adaptations, as a general principle, are also a good thing, it was reported that some behavioural and genetic mechanisms may lead to the temporary gains in weight with increased appetite and lowering metabolism after quitting smoking (Driva *et al*., 2022). Another large one is caused by psychological stress: chronic stress raises the level of cortisol, which spurred the gain of fats and desires to eat foods rich in calories (Ghosh *et al*, 2023). Likewise, obesity risk behaviours (e.g., inactivity, poor diet, and high smoking rate) have been demonstrated to be associated with mental health conditions, including depression and schizophrenia (Firth *et al*. 2020).

The other determinant that has an equal role in establishing exposure to risk and responding to health-promoting behaviours is the socioeconomic status (SES). Education level is identified as being negatively and significantly correlated with the prevalence of obesity, where less education level (in particular, the level of parental education) correlates with low health literacy and low health lifestyle behaviours (Ahmad *et al*., 2018; Van der Heyden *et al*., 2023). The income is also an additional factor related to risk since lower-income families also have fewer options in accessing affordable, nutritious food, and physical exercise, as well as safe locations (Rehman *et al*., 2024; Fysekidis *et al*., 2016) especially in major cities. Occupational status is also linked to prevalence; manual/lower occupation was identified to have a higher prevalence of overweight, and this correlates even more in women (Eum and Jung, 2020). Another vulnerability dimension is deprivation. The inhabitants of deprived neighbourhoods are subjected to obesogenic environments that can be described as neighbourhoods that lack access to nutritious foods, access to green space, and social stressors (Chung *et al*., 2018; Feuillet *et al*., 2020). Such disparities can be

perpetuated through culture, which discourages physical exercise or good nutrition (Masood, 2015).

The combination of these three biologicals, behavioural, psychological and socio-economic factors has interacted to act in motivating the risk of obesity within the population. This complexity shows that far-reaching interventions beyond individual-level responsibility consider both structural inequities and barriers operating in the environment as well as favouring behaviour change (Firth *et al*. 2020).

2.3 Outcomes and Costs

The causes of mortality and morbidity in most parts of the world are obesity. The price of excess weight in the form of death rates from high body mass index (BMI) dropped by 34-percent, and the cost of disability-adjusted life years (DALYs) has grown by 48 percent between 1990 and 2019 with an indication of a decreasing burden of disease earlier and a rising burden of a disease later and decreasing quality of life (Song *et al*., 2024). Despite this reduction in the death rates of both the sexes, death rates were still higher among the females. After 1999 however, Dalay rates among the males have been higher than among the females, a result of the increased morbidity associated with obesity-related conditions among the male population (Heyden *et al*., 2023). Regional disparities captured the starkness as it is high-income Asia Pacific that does the most improvement in cutting down the death rates and East Asia that has the quickest improvements in DALYs. Globally the percentage of burden of disease due to obesity in women, too, has been associated with age, putting more emphasis on age- and sex-related risks (Rehman *et al*., 2024).

Regarding mortality, the percentage of deaths caused by obesity in the world rose in 2000 (4.2) to 2019 (6) and a bit later, to the present (5.6) in 2021. The death rate of obesity due to obesity in the global population is currently 44.2 per 100,000, which means that obesity is currently the sixth largest cause of death in the global population (Ritchie & Roser, 2022). Such findings not only expose the scale of the health problem, but also the persistence of obesity as the key reason behind the early death.

The price of obesity is equally significant in terms of economy on the world level. Indirect healthcare costs, abated productivity, and collateral outcome of the situation on various social problems are estimated to cost the world economy about 3 out of the global GDP under obesity (Bradshaw and Dace, 2023). Costs are multi-dimensional

and encompass direct health care expenditures on morbidity due to obesity, quality-adjusted life years (QALY) wasted, and indirect costs incurred in absenteeism, presenteeism in relation to unmeasured long-term economic inactivity, and long-term, relating to both the absence and the presence of local matters. An informal and formal care contributes additional costs to the money of the families as well as affecting health systems of the countries (Firth et al. 2020). In summary, these figures not only highlight the immense human burden that lies at the heart of the obesity issue but also show its increasingly huge economic burden, and therefore, obesity is one of the most urgent social health issues at the beginning of the 21st century.

2.4 Effect of socioeconomic status on obesity

The risk and prevalence of obesity are strongly associated with socioeconomic status (SES), as assessed by income, education, occupation and area deprivation. The lack of access to preventive health care, safe recreational areas, and healthy food intake has always been associated with obesity among the lower SES groups (Ahmad et al., 2018; Rehman et al., 2024; Fysekidis et al., 2016). Food deserts, unsafe living conditions, and psychosocial stressors are some of the obesogenic conditions that characterise disadvantaged neighbourhoods and contribute to weight gain (Chung et al., 2018; Feuillet et al., 2020).

Education influences the risk of obesity due to health literacy and diet consciousness and income limits the choices of food forcing low-income groups to the calorie-dense low-cost diets. The occupational status is also important: poor eating habits, stress, and disruption of metabolism, specifically among women, are linked with sedentary or inconsistent shift work and reduced job autonomy (Eum and Jung, 2020; Van der Heyden et al., 2023).

SES also interacts with psychological and biological determinants of obesity-chronic stress, high cortisol, and emotional eating-all of which enhance disparities in obesity (Ghosh et al., 2023; Masood, 2015). They are particularly apparent in low- and middle-income nations that are quickly urbanising, as the burden of obesity and malnutrition becomes twice as large (Loos and Yeo, 2021). The ability to understand the impacts of SES is thus important in developing equitable, multi-sectoral-based interventions to mitigate obesity and its health disparities (Firth et al., 2020).

2.5 Research Gaps and Limitations

Although there is immense literature to establish a relationship between socioeconomic status (SES) and obesity, certain results remain in dispensable pieces and do lack consistency across populations, regions and methods. A lot of literature is built on cross-sectional data, and this hinders the opportunity to infer reasons to explain the relationship between SES and obesity in the long run. Besides, the concept of SES is in itself operationalised variably across the literature, with its focus on either income some studies or education, occupation or composite indices, which yields heterogeneous results and complicates comparisons (Barakat and Konstantinidis, 2023).

The comparatively low level of the integration of intersectional considerations is one of the problems. SES-obesity relationship is moderated and/or confounded by gender, ethnicity, cultural norms and age, but they are usually investigated separately. Longitudinal designs that examine SES and obesity changes over time are few and those few that have used such designs have not borne behavioural (e.g. diet, physical activity) or environmental (e.g. food environment, urban design) mediators in their analyses (Eum and Jung, 2020).

These constraints are augmented by the geographic imbalance. Most research so far is concentrated toward high income countries, leaving low- and middle-income countries - where rates of obesity are rising most rapidly and where the social dynamics may be divergent - underrepresented. Such bias limits the generalisability of findings and could lead to a lack of context-specific risk factors of obesity in other populations (Chung et al., 2018; Feuillet et al., 2020).

Such inconsistencies indicate a necessity of a systematic literature review synthesising and critically evaluating the evidence and identifying the pattern of similarities and differences and explaining methodological and contextual variations. Through this, this chapter will attempt to give a clearer insight into the relation between global SES and obesity and a solid foundation on the basis of information that can be passed onto the policy of creating equitable and targeted policy changes in response to break injustice in health policies towards effective presentation of policies addressing obesity (Firth et al. 2020).

2.6 Chapter Summary

The chapter has critically analysed the epidemiology, prevalence and risk factors of obesity with special emphasis on the role of socioeconomic status (SES) in determining the outcomes of obesity. It has emphasised the interaction of education, income, occupation and neighbourhood deprivation with behavioural and environmental determinants to influence the risk of obesity across the world. Key research gaps were also revealed in the chapter such as the necessity of longitudinal designs, improved measurement of SES, and studies in low- and middle-income countries. This understanding provides the background of the following chapter. Chapter 3 presents the methodology chosen in the systematic review, the search strategy, inclusion criteria and analytical framework.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents the approach followed when conducting a systematic literature review (SLR) investigating the impact of socioeconomic status (exposure) on obesity (outcome) in adults (population). It can give us a detailed rundown of the process used to collect, analyse and synthesise the existing body of evidence on this subject. This chapter also contains the SLR approach, search strategy, search terms, inclusion/exclusion criteria, database choice, and ethical considerations. Also, it emphasises the significance of following a systematic structure in the search process, i.e., PEO. Last but not least, a conclusion of the chapter will summarise the search findings.

3.2 Systematic Literature Review (SLR)

A Systematic Literature Review (SLR) is an authoritative research approach to analyse literature written about a certain area to present the overview of what is known related to the subject (Carrera-Rivera *et al*., 2022). It is a process of identification, selection and critical assessment of relevant findings (Kitchenham, 2004). Crafting a clear research question, specifying inclusion and exclusion criteria, conducting an exhaustive database search, screening of search results, evaluation of study quality, and synthesising search results are the major components of a SLR (Moher *et al*., 2015). Mainly a SLR aims to create a strong evidence base to inform decision-making processes by synthesising the superior research available to date, areas warranting research, and future research (Liberati *et al*., 2009). SLRs will reduce bias and the unreliability of the results by relying on a clear and reproducible method.

3.3 Search Strategy

In research, a search strategy is a systematic and procedural method of searching the related studies using multiple data sources and databases (MacFarlane, Russell-Rose and Shokraneh, 2022). It includes identifying particular keywords, search words, and Boolean operators to cover the literature as broadly as possible (Gough, Oliver, and Thomas, 2017). This study utilized the PEO framework (Population, Exposure and Outcome) as the search strategy (Hosseini *et al*., 2024). This systematic review framework is applicable most frequently to qualitative and observational researches and serves to specify the important elements of the research question (Crowe, 2015).

In this review, the population was adults, the exposure was socioeconomic status and the outcome was obesity. It has searched in several databases, but preferred the studies that have been published within the past 10-25 years in order to get the most up-to-date and relevant studies on the subject. The PEO model helped make the search systematic, comprehensive, and targeted towards research studying the topic directly.

3.4 Search terms

Search terms describe particular words, phrases, or keywords that are typed in the process of literature search to find useful research studies and articles in databases (Chigbu, Atiku and Du Plessis, 2023). They are important as they determine the area of search so that only the useful studies are retrieved with minimum irrelevant search results (Chigbu, Atiku and Du Plessis, 2023). Defining search terms will be used to help accomplish an efficient and complete search, which would help achieve a comprehensive literature review of all studies that are related to the research question (Gough, Oliver, and Thomas, 2017).

Januszczak and Milek (2020) state that the implementation of synonyms is necessary when searching because it will be possible to consider both the differences between the terms used in different works, different fields of knowledge, and various sources. Terms can be defined in different ways by different authors relative to the similar concepts, and adding synonyms help guarantee that all potentially relevant studies are retrieved (Higgins *et al*., 2019). As an example, the words used in the context of obesity, such as obese, overweight, body mass index (BMI), excessive weight, etc may be all used interchangeably and adding such variations to the search would make it stronger. Synonyms can also be used to minimize the risk of excluding potentially relevant studies that might employ slightly different terminology but still deal with the same issue (Gusenbauer and Gauster, 2024).

This review used the PEO framework, or Population, Exposure, and Outcome to inform the search process. This framework can be especially applied to a qualitative and observational study as it allows dividing into basic constituents the research question and organising and performing the search (Crowe, 2015). In this research, the following were determined:

Table 1: PEO Framework

PEO Framework	Description
Population	Adults (individuals aged 18 and older, both male and female)
Exposure	Socioeconomic status (e.g., income, education level, occupation)
Outcome	Obesity (e.g., body mass index (BMI), excessive weight, overweight)

Based on the PEO framework, the research question was framed as: What is the association between socioeconomic status (income, education level, occupation) (E) and obesity (O) in adults (P)?

A combination of specific keywords and synonyms of the plethora of components of the PEO framework were used in a database search to find and obtain the result. The terms were efficiently combined using the term Boolean operator (AND, OR, and “NOT). E.g.in the case of Population/Problem (adults), the Boolean operator OR was used with such synonyms as: adults, individuals, men and women. On the same note, with Exposure, the relationship between terms such as socioeconomic status, income, education level and occupation were stored by use of OR. Finally, when considering Outcome, the following terms were used with the OR: obesity, BMI, overweight, excessive weight.

- Search 1(P): ("Adults" OR "Individuals" OR "Men and Women")
- Search 2 (E):("Socioeconomic status" OR "Income" OR "Education level" OR "Occupation")
- Search 3 (O): ("Obesity" OR "BMI" OR "Excessive weight" OR "Overweight")
- Search 4: Search 1 AND Search 2 AND Search 3

This was repeated in other databases in order to carry out a comprehensive search. By expanding the potential results with the help of synonyms and Boolean operators, it was possible to focus on a wider range of studies, reducing the possibility of missing studies of interest and improving the quality of the review.

3.5 Key Words

Normative keywords refer to keywords or expressions to be incorporated in the search process to aid in finding studies of interest in search databases (Chigbu, Atiku and Du Plessis, 2023). They are needed to transform the search results and guarantee the ability to find the relevant studies on the research topic (MacFarlane, Russell-Rose and Shokraneh, 2022). Explicit key words allow to simplify the search process and minimise misleading results (Higgins *et al*, 2019). Some key words were "adults," "socioeconomic status," "obesity," "BMI," and "overweight."

3.6 Databases

It is a key factor to do the right research work by searching in the right and numerous databases in order to receive various opinions about study subjects. Specialised information is offered in different databases and in this way the user might persevere through an immense volume of literature. This serves the purpose of avoiding ignorance of significant sources, and minimising biases (Rumsey, 2008). Numerous opinions, languages, and topics are addressed, and it contributes to a better understanding and better elimination of publication bias (Dawn *et al*., 2008). The advantage of interdisciplinary subjects is that they have integrated the information of other human areas. Several sources support the research rigour by reducing the risk of missing some systematic review results (Johnson *et al*., 2020). This method has had some evidence within it, in that the relevancy has risen with multiple database queries (Fearon *et al*., 2005). In general, the availability of databases allows getting access to numerous databases, which contributes to the completeness and impartiality of research works in all fields.

The relevant databases searched to reveal relevant articles to answer the questions put forth in the research project were PubMed, Scopus and EBSCO Host. This type of databases has been selected due to the extensive coverage of literature related to health, medicine, psychology and behavioural sciences that strike a chord with the multidimensional approach of this study.

3.7 Inclusion/Exclusion Criteria

The systematic review must have inclusion and exclusion criteria to determine its scope. Inclusion criterion assures exact selection of the studies to review which are characterised in some way that is relevant to the research question (Liberati et al., 2009). Consequently, exclusion criteria are useful in eliminating studies that are irrelevant to the study or do not meet the standards demanded. Such criteria have served to narrow down the review to something useful, relevant, and good (Liberati et al., 2009). The following inclusion-exclusion criteria has been implemented.

Criteria	**Inclusion**	**Exclusion**
Population	Adults aged ≥18 years	Children, adolescents, or non-adult populations
Exposure	Studies examining socioeconomic status (SES) in relation to obesity	Studies not addressing SES or economic/social factors in relation to obesity
Outcome	Research focusing on obesity incidence, prevalence, or related measures	Studies not concerned with obesity outcomes
Study Type	Secondary sources such as peer-reviewed journals, academic publications, governmental/health organisation reports	Non-peer-reviewed sources, blogs, unverified web content
Geographical Scope	Studies from all parts of the world to provide a comprehensive global perspective	None explicitly excluded based on geography
Publication Quality	Publications from reputable and trustworthy sources	Outdated, irrelevant, or low-quality studies

Language *(if needed)*	English (if language restriction applied)	Non-English (if translation not feasible)

3.8 Search Result

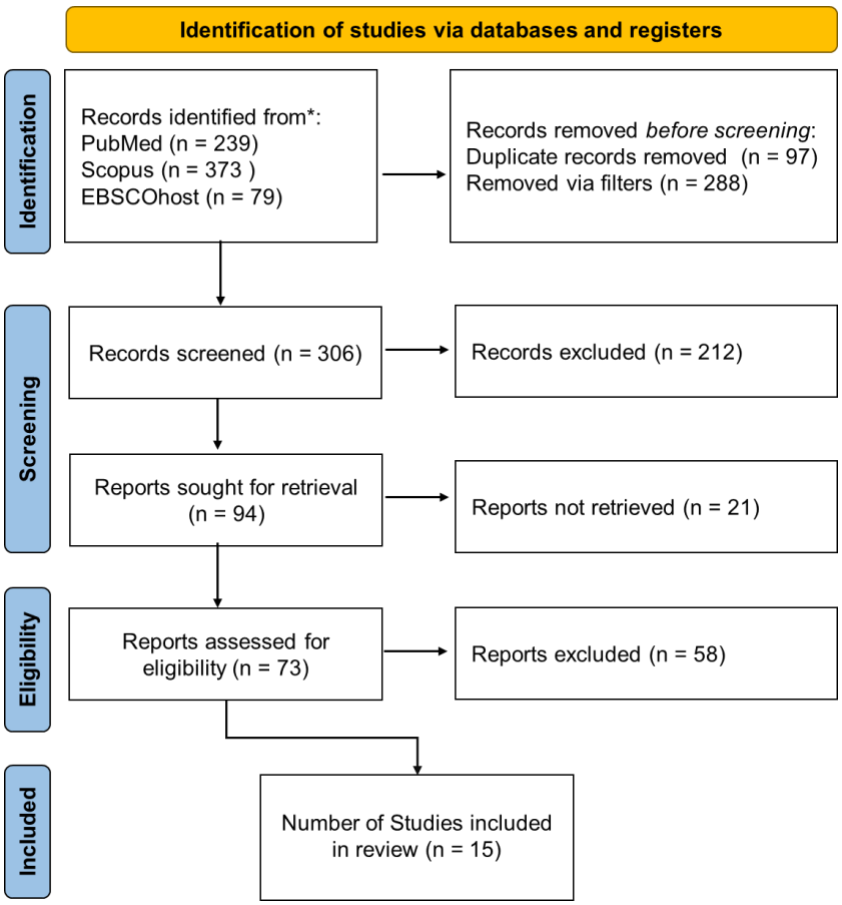

Figure 1: PRISMA flow chart (Adapted by the Author)

The steps that have been used when choosing the studies to include in this review can be seen in the PRISMA flow diagram. The screening and selection process followed the PRISMA framework. A total of 691 records were initially identified across PubMed, Scopus, and EBSCOhost. After removing 97 duplicates and 288 records through filtering, 306 records remained for screening. Of these, 212 were excluded based on titles and abstracts, leaving 94 reports sought for retrieval. Twenty-one could not be retrieved, resulting in 73 reports assessed for eligibility. Following full-text review, 58 reports were excluded for not meeting the inclusion criteria, and ultimately 15 studies were included in the systematic review.

3.9 Ethical Considerations

Research ethics could be defined as a collection of values and rules to guarantee that research studies adhere to specific ethical frameworks throughout such as getting the informed consent to conduct research, willing participation in the research, preventing harm, with confidentiality and SPR to report findings in a valuable and truthful manner (Resnik, 2020). Only peer-reviewed credible sources were used in this systematic literature review, and they included journal articles that were approved by institutional ethics review boards. All studies finalised in the articles displayed ethical rigour in the design and conduct of the studies. Since this review will not require the collection of any primary data, direct ethical risks related to the review are absent. However, much thought had to be given to the ethical uprightness of all incorporated literature.

3.10 Chapter Summary

This chapter outlined the process of having a systematic literature review (SLR) which was done relating to the influence of socioeconomic status (SES) and obesity in adults. It also covered the SLR procedure i.e. search strategy, inclusion/exclusion criteria, database selection and ethics. The mentioned PRISMA flow diagram shows that the search with the PEO framework identified 12 studies to be included. Analysis of the findings of the chosen studies will be the main topic of the next chapter, and some of the key trends will be outlined as well as the quality of the respective evidence.

CHAPTER 4: DATA EXTRACTION AND EVALUATION

4.1 Introduction to Chapter

The focus of the present chapter is the data-mining and appraisal procedure that is crucial to generalise the outcomes of the research included in this systematic literature study. The scope of data extraction aims at assessing the chosen papers in a methodical and a systematic manner in order to collect and only give out the most useful data as part of data analysis. In this chapter, the mechanism of data extracting, which variables and characteristics will be considered and the reason why were these variables selected, will be described. The chapter will also offer the importance of critical appraisal in research paper and determine tools to reach such judgement. The critical review will constrain the review with quality research dimension only, therefore improving the overall outcome.

4.2 Data Extraction

Data extraction is research means of amassing relevant data in research that includes a review. According to Liberati *et al*. (2009) data extraction is the operation of collecting data about studies based on pre-set protocols to minimise errors and bias that can affect the process of synthesis. The most significant information to elicit in this review can be the features of the studies such as authors of the work, year of the publication, study design, social size, population features, particulars of the interaction or exposure, and the outcomes. Data extraction form was prepared to establish a higher level of uniformity and standardisation of study. The specified type simplifies the process of collecting the relevant data and the review is capable of impounding key variables such as socioeconomic status (SES) measurements, the definition of obesity and the tools of analysing the correlation between SES and obesity. A structured form can be utilised to enhance data extraction process in regard to its transparency and reproducibility (Moher *et al*., 2015).

4.3 Critical Appraisal and Paper Quality Assessment

The process of systematised evaluation of research articles to determine whether they are reliable and relevant to the research question and evaluate quality and validity can be called critical appraisal (Greenhalgh, 2019). It also involves critique of the methodology, study design, data collection, data analysis and inferences in such a

way that one can say that findings can be real and to trust the findings as to make evidence-based judgments. Individual studies differ, and there might be methodological errors that could lead to wrong or incorrect conclusions in some studies (Higgins *et al*., 2019). By reviewing research, the researcher is able to establish the existing biases in research by identifying whether the findings are appropriate to the review, in addition to incorporation of most appropriate research. It is evident that critical appraisal

4.4 Critical Appraisal Tools

The outline tools provided by critical appraisal methods are utilised in evaluating qualities of research studies and allow the researcher to evaluate aspects of a research study that span design, methodology, sampling, and data collection and data analysis methods (Higgins *et al*., 2019). These tools are necessary because a systematic approach to evaluating the strengths and the weaknesses of studies is provided such that the researcher is able to make a reasonable draw about the reliability and the applicability of the study. One of the most popular critical appraisal tools is the Critical Appraisal Skills Programme (CASP) fulfilling checklists assessing the types of studies such as randomised controlled trials (RCTs), observational cohort studies, qualitative research, and so on (CASP, 2018). The CASP checklist evaluates such topics as study design, sample size, potential biases, and relevancy of the statistic methodology used in studies. The presentation of proper selection of a critical appraisal tool is also important since not all types of studies can be evaluated using the same type of evaluation tool. In this way, the investigators can remove the studies that are poorly performed and strong in such a manner that only good evidence produced when these studies are synthesised may be possible.

4.5 Evaluation of Quantitative Studies using an appropriate tool

To critically appraise the quantitative researches incorporated in this review, critical appraisal skills programme (CASP) Cohort Study Checklist was utilised. This tool has been chosen because it is often normally used to make quantitative assessments of the validity, reliability and relevancy of quantitative evidence (Higgins *et al*., 2019). CASP specifically adapts to analysing observational studies such as the cross-section study design and cohort studies, the most common forms of study designs encountered in this review (Liberati *et al*., 2009). It provides a framework of answering

whether the studies asked a well-close question, selected subjects appropriately, adequately measured exposures and findings, identified confounders and presented valid and practical findings. This approach ensured that already all studies were reviewed in a comparable way and it increased transparency and integrity. Appendix A has summarised the appraisal in details.

The selected fifteen quantitative studies evaluated the relationship between socioeconomic status and obesity and measured them in a quantitative way; that explained the inclusion of these in this specific study. The combination of these settings and populations provides substantial evidence base due to the semblance of the populations and settings.

Quantitative studies are intended to generate numerical data which can be analysed statistically to examine the associations, as well as, test hypotheses (Moher *et al*., 2015). The primary aim of all studies included was to examine the correlation between the socioeconomic status in education, income, occupation or composite measures and outcomes of overweight, obesity, or BMI. The modifiers of these relationships including the gender differences, age at migration, psychosocial factors, and physical activity were also analysed to be by some of the studies. Along with each other, the research works aimed to provide to the understanding of the social factors that define obesity and make policy and intervention action informative to bridge the existing health disparities.

Its approach to the studies was found to be suitable in all its works. They all entailed observational designs and none involved experimental studies; yet, all of them involved the survey type, cross-sectional, cohort or population surveys, which is suitable in the measurement of prevalence of obesity and its relation to its socioeconomic factors at the level of the population. The use of large and in one instance nationally representative samples, as is the case with Hasan *et al*. (2020), Sung *et al*. (2024) and Hwang *et al*. (2019) contributed to the higher generalisability of findings. More persuasive in elucidating temporal relationships were cohort studies such as the ones implemented by Dang *et al*. (2024) and Mayor (2017), since the process through which inequalities are created over time is simpler to obtain. Most studies used the estimates of odds ratios or beta coefficients of logistic/linear regressions employed some major confounding variables: age, sex, lifestyle behaviours and urban/rural homes. The confidence intervals and p-values were also

reported in a different manner that was not inconsistent and this was an indicator of the presence of a stringent rigour and accuracy of the results.

Among the eighty-one studies consulted, twelve studies were cross-sectional and three cross-sectional or cohort studies. The bulk of the evidence-base is consequently, of cross-sectional evidence, which in and of itself cannot prove causation, but nonetheless, is extremely helpful in support of patterns, trends and groups of populations at higher risk (Greenhalgh, 2019). The three longitudinal researches complement the evidence by showing how the repetitive or fresh social disparities in obesity take place over the years (Moher *et al*., 2015).

In the critical appraisal, it was evident that all studies utilised all the forms of the research questions where all of the derived SES and obesity associations. The recruitment mode was also appropriate and most of the studies used stratified or random sample in order to render them representative. Exposure and outcome were also generally strong, SES was measured through use of measures of education, income and occupation, obesity however was measured in a non-subjective manner through Body mass index (BMI), or waist circumference or other anthropometric measures. Internal validity was improved by the reality that the majority of the studies identified and ascribed the key confounders. The follow up time was sufficient to obtain the relevant results in the cohort studies and cross-sectional studies provided the snapshots of prevalence and correlation.

The way the presentation of the results was done was enlightened and understandable with elaborate tables summing up the results and statistically significant measures. Findings were credible and consistent with the existing literature of the plausibility of established relationships. Interestingly, most researches compared assorted outcomes of obesity such as overall and belly hence providing the study with the comprehensive understanding of the issue. Other studies such as Fillol *et al*. (2011) have gone to the extent of creating composite SES indices in an effort to capture socioeconomic position in a more multidimensional way.

All in all, these studies refer to the general image of education, income and occupation patterned socioeconomic disparities in obesity and mean that the risk of obesity is education based, and then education is a patterned environment-based disparity across countries and across different environments. These endorses the argument

that obesity involves more wide structural determinants, and does not solely act as a by-product of individual lifestyle. Whereas the advantage of cross-sectional studies is that it is mandatory to be cautious when drawing a causal conclusion, the measure of consistency and similarity of the observed relationships among the various populations lends certain credibility to the results. The longitudinal studies also add weight to these findings as they show what the trajectory of inequity might stay or become during lifetime.

The studies had common limitations, with risks of residual confounding by unmeasured factors (including dietary intake or cultural norms) and partly with underrepresentation of some subgroups in parts of the datasets (such as rural women, or lower-income households). Nevertheless, the evidence base in its entirety is strong and presents a very powerful case on which interventions to be done in particular populations of high risk such as high-income men, low-education women and high-income transitioning population. The insights may prove useful to shape policy and practise, as well as to design interventions to influence behavioural and structural reports on obesity.

4.6 Summary

The chapter reviews critical reviews of fifteen quantitative researches on the connexion between socioeconomic status and obesity in different populations and circumstances. To evaluate quality and methodological rigour and relevance of individual studies, systematic evaluation of quality, methodological rigour and relevance of each study was conducted with CASP (Critical Appraisal Skills Programme)- Quantitative Checklist, to enable that a strong evidence base supports the review. The appraisal recognised that most of the studies adhered to the appropriate designs including cross-sectional and longitudinal designs and their research procedures were justified to answer their research purpose. Generally, the findings have indicated recurrence of social economic disparities in the rates of obesity and the disparities were also based on gender and geometric position and stage of life. In chapter 5 starts analysis and synthesis of the data whereby the outcome of the studies was laced together to ascertain any existing trends/ patterns, similarities, and lapses.

CHAPTER 5: DATA ANALYSIS AND SYNTHESIS

5.1 Introduction

The current chapter is devoted to data analysis and synthesis process applicable to assessing the studies incorporated in this systematic literature review (SLR). It also describes the procedure that will be adopted to examine the data collected which is to synthesise qualitative and quantitative data to make meaningful conclusions. In this chapter, the application of thematic analysis will be described as the main tool that will be used to synthesise the studies and, then, an explanation of the narrative synthesis framework will be presented. Analysis results would be classified into important themes and tendencies, which will allow a clearer account of how socioeconomic status affects obesity in adults. Moreover, in this chapter the weakness of the analysis will be touched upon and some commentary will be given on the overall contribution of the research.

5.2 Thematic Analysis

The qualitative research technique adopted to identify, analyse, and report patterns of data (themes) in a body of data is thematic analysis (Braun and Clarke, 2006). It is commonly applied to the analysis of the qualitative data but can be also applied to synthesise the secondary data when performing systematic literature reviews (SLRs), which point out the particular pattern visible in the number of studies. This method is frequently referred to as thematic synthesis when it is applied to SLRs. It can be applied to the quantitative research since it allows one to generalise the study findings by discovering similarities in the data, including different findings in connected themes (Higgins *et al*., 2019).

5.3 Data Analysis Tool

The thematic analysis approach adopted in the study is narrative synthesis, which is a very suitable technique of synthesising both qualitative and quantitative data in a systematic review (Popay *et al*., 2006). Narrative synthesis is the process of categorising the findings of a study into themes and categories that indicate the relationships contained in those results. It provides an adaptable method on how the heterogeneity of the study design, populations, and outcomes can be addressed. Using this framework, trends, patterns, and gaps in the literature can be identified and a broad synthesis of the evidence at hand is allowed. The reason why it matters is that

narrative synthesis underlies the synthesis of many different results and a narrative description of the role of socioeconomic factors on obesity and different studies.

5.4 Characteristics of the identified studies

Among the 15 (quantitative studies) identified, 5 were Chinese (Pan *et al*., 2021; Wang *et al*., 2020; Wang *et al*., 2022; Xiao *et al*., 2013; Deng *et al*., 2014). The European research was three, involving Greece, Belgium, Finland, Spain, Bulgaria and Hungary (Diamantis *et al*., 2022), Germany (Chae *et al*., 2022) and France (Fillol *et al*., 2011). Two works were done in India (Sung *et al*., 2024; Dang *et al*., 2020), one in Bangladesh (Hasan *et al*., 2020), one in Korea (Hwang *et al*., 2019), one in Australia/UK (Spinosa *et al*., 2019), one in the United States (Wagner *et al*., 2021), and one in China regarding Yi migrants (Wang *et al*., 2020b). The collective of these studies comprises a comprehensive geographic coverage of Asia, Europe, and the Western territories; hence, one may obtain a universal picture of the relationship between socioeconomic status and obesity. All study-specific data extraction tables may be accessed in the Appendices.

5.5 Emerging Themes from included studies

Collectively, the fifteen studies under this review present a multifaceted analysis of a complex association between socioeconomic status (SES) and obesity-related studies of different populations, study environments, and life stages. These studies demonstrate that the role of SES is a potent contributor in obesity, but whose effects are very context-specific, intricate and mediated by a host of other factors such as gender, life-course exposure, migratory history, psychosocial factors, lifestyle behaviour, and economic circumstances. Notably, these studies emphasise the fact that although higher SES usually provides a safeguard against obesity it is not a universal finding and higher income/education is actually a risk factor of obesity especially in the case of men. These results highlight the importance of intersectional and stressing context approaches to research and health interventions focused on the amelioration of obesity disparities.

Table 5.2: Emerging Themes and Sub-Themes

Theme	**Sub-Theme**	**Supporting Articles**
Socioeconomic	Income-related	Zhang *et al*., 2017; Sung *et al*.,

Status and Obesity	inequalities	2024; Hwang *et al*., 2019; Wang *et al*., 2022; Xiao *et al*., 2013
	Education-related inequalities	Zhang *et al*., 2017; Sung *et al*., 2024; Hwang *et al*., 2019; Pan *et al*., 2021; Xiao *et al*., 2013
	Composite SES indices	Diamantis *et al*., 2022; Fillol *et al*., 2011; Wang *et al*., 2020; Hasan *et al*., 2020
Gender Differences in Obesity	Male-specific SES associations	Hwang *et al*., 2019; Wang *et al*., 2022; Xiao *et al*., 2013
	Female-specific SES associations	Zhang *et al*., 2017; Pan *et al*., 2021; Sung *et al*., 2024; Chae *et al*., 2022
Age-related SES Patterns	Childhood SES influence on adult BMI	Wagner *et al*., 2018; Mayor, 2017; Dang *et al*., 2024
	Age at migration/modifier effect	Wang *et al*., 2020; Sung *et al*., 2024
Psychological Factors	Emotional eating and distress as mediators	Spinosa *et al*., 2019
	Depression and comorbidities	Chae *et al*., 2022
Urban-Rural Differences	Physical activity and rural–urban SES effects	Pan *et al*., 2021; Wang *et al*., 2020
Regional Variations	Country-level economic context effects	Diamantis *et al*., 2022; Fillol *et al*., 2011; Sung *et al*., 2024

5.5.1 Theme 1: Socioeconomic Status and Obesity

5.5.1.1 Income-related inequalities

The fact that income was presented as a major factor affecting the risk of obesity in several studies showed that the effects of income were gender-specific in many instances. Zhang *et al*. (2017) established the fact that women with higher income had lower chances of getting obese in the abdomen but high-income levels correlated to high risk of getting general overweight and obesity among men. In much the same way, Wang *et al*. (2022) perpetrate that the increased per capita income correlated with a higher tendency to be overweight or obese in men but be fewer in women, which suggests that socioeconomic advantage and the interaction of gendered lifestyle behaviours and cultural norms yield opposite interacts. As seen by Sung *et al*., (2024), in India, overweight or obese individuals were found to occupy the highest SES groups, and those in the lower SES groups were mainly underweight. Such a phenomenon reflects the malnutrition twofold burden in the fast emerged economies, where both undernutrition and overnutrition co-exist yet unevenly different socioeconomic layers remain disproportionately hit. The study by Hwang *et al*. (2019) in Korea revealed there was a draw towards the phenomena of pro-poor obesity whereby the proportion of obesity was higher among lower income women, yet among men, it was higher in the upper age groups. All these findings together show that only income cannot help much account for the risk of obesity, and its impact is closely intermingled with gender, cultural traditions, and environmental circumstances.

5.5.1.2 Education-related inequalities

Another important SES determinant, education, was, again, often played a role in shaping the outcomes in obesity, again interacting with gender and other SES indicator. Choosing to utilise educational attainment as a way of obtaining health literacy, nutrition knowledge, and awareness of healthy behaviours as a risk factor minimization tool, Zhang *et al*. (2017) concluded that higher educational attainment was associated with a lower risk of obesity in women. On the other hand, mediated effects of education and obesity in men showed fluctuation; it is believed that not all forms of education lead to healthier body weight among male population. The same was emphasised by Pan *et al*. (2021), which observed that the low educational attainment level correlated with higher BMI and a larger measure of obesity in rural Chinese women, and the assessment of physical activity attenuated the impact of the

former, proving the role of lifestyle behaviours as modulators of the effect of a lower level of education. Sung *et al*. (2024) also confirmed the presence of the deterrent effect of the level of education on obesity and underweight among Indian women, concluding that there was a dual protective effect on the total nutrition situation. As Xiao *et al*. (2013) noticed, the inverse relationship between education and obesity was found in women but not in men in Zhejiang Province, which demonstrates perpetual gender disparities. Together, those results indicate that education is not only a hospital SES variable but also a factor that leads to health-promoting practises, especially in women.

5.5.1.3 Composite SES indices

One theme of the methods used by the studies is that several studies utilise composite indices of SES, a trait that shares various dimensions of socioeconomic benefit and costs. Diamantis *et al*. (2022) created the Socioeconomic Burden Score (SEBS) that encompasses education, employment, and financial insecurity, of which cumulative disadvantage enhances the probability of overweight and obesity in six countries in Europe. Composite SES indices such as that developed by Fillol *et al*. (2011) in France that combined education with occupation and measuring household wealth showed multidimensional indices participated better in explaining obesity disparities in comparison to individual indices. Using a socioeconomic status index (SESI) on rural-urban Yi migrants in China, Wang *et al*. (2020) found that the contribution of SES to obesity was negatively related to the age of migration among early migrants (lower link, age of migration, ≥20 years), but was positively related among older migrants (≥20 years) to obesity. In the study by Hasan *et al*. (2020), in the year 2020, preciseness index decomposition was used in Bangladesh, where majority women inequality as a result of riches was found, then education and lifestyle practises, respectively. These results support the rationale of biaxial measures of SES in describing the complex cumulative disadvantage and fine-grained effects of socioeconomic risk factors on obesity risk.

5.5.2 Theme 2: Gender Differences in Obesity

5.5.2.1 Male-specific SES associations

One of the common and imperative findings of the studies was gender differences. Men and women showed different reactions to SES indicators, and these are the interactions with socioeconomic factors, the cultural, behavioural, and biological

factors. Zhang et al. (2017), Pan et al. (2021), Hwang et al. (2019), and Xiao et al. (2013) found that, women only, higher SES was always protective whereas, in other cases, among men, it posed an increased risk of obesity. These gender patterns underscore the need to design public health interventions and policies to consider the relative vulnerabilities, such that high-risk men and low-SES women are targeted to receive interventions suitable to their sociocultural settings. Moreover, differences associated with gender are not only prevalence patterns, but also impact the mechanisms that mediate the effects of SES on obesity, such as lifestyle behaviour, occupational status, and psychosocial stress.

5.5.2.2 Female-specific SES associations

In women, the SES was always linked to protection against obesity (Zhang et al., 2017; Pan et al., 2021; Hwang et al., 2019; Xiao et al., 2013). On the other hand, low socioeconomic women were identified as the most susceptible to obesity, the risks were aggravated by the lack of resources and health literacy and increased exposure to psychosocial stressors. Such results suggest that the low-SES women need more specific interventions that would consider the material disadvantage, as well as the cultural and environmental obstacles, in general. Equity-based approaches to public health targeting women should thus be implemented with a structural support and behavioural resources to those at high risk.

5.5.3 Theme 3: Patterns in age related SES.

5.5.3.1 Childhood SES influence on adult BMI

Life-course viewpoints also explain the multitude of the relationships between SES and obesity. Wagner et al. (2018), Mayor (2017), and Dang et al. (2024) showed that childhood SES was low, which predicted higher BMI, waist circumference, and obesity risk in adulthood and highlighted the long-term effects of early-life disadvantage. Dang et al. (2024) also found out that a combination of change in the baseline BMI, parental BMI and socioeconomic factors contributed to increasing the disparity in obesity between childhood and adulthood.

5.5.3.2 Age at migration/modifier effect

Wang et al. (2020) emphasised the effect of age of migration in altering the associations between SES and obesity, showing that environmental exposure in early life has an impact on the trajectories of obesity in adulthood. Sung et al. (2024)

emphasised that childhood and adult SES should be taken into account to capture the full picture of obesity disparities that include the cumulative and possibly compounding effects of socioeconomic determinants across the life trajectory.

5.5.4 Theme 4: Psychological Factors.

5.5.4.1 Emotional eating and distress as mediators

Psychological and mental health were found to be important mediators between SES and obesity. Spinosa et al. (2019) established that psychological distress and emotional eating were a sequential process of transformation of lower SES into higher BMI, which suggested that psychosocial stress is an important mediator that mediates the transformation of the socioeconomic disadvantage into obesity.

5.5.4.2 Depression and comorbidities

In their study, Chae et al. (2022) discovered that poor social support and low SES contributed to the higher prevalence of comorbid depression and obesity in women, which implies that psychosocial vulnerability enhances the risk of SES-related obesity. These studies highlight the relevance of mental health-related considerations within the scope of the public health approach since treating socioeconomic disadvantage might not be effective without considering psychological and behavioural pathways.

5.5.5 Theme 5 Urban-Rural Differences.

5.5.5.1 Physical activity and rural–urban SES effects

The SES-obesity relationship is also further mediated by urban-rural disparities and context. Pan et al. (2021) and Wang et al. (2020) have shown that the low SES-induced obesity was especially vulnerable to rural women, but the intervention of physical activity alleviated this vulnerability. Occupational status and retirement were also found to affect the risk of obesity according to Zhang et al. (2017), meaning that employment type and transitions between life stages overlap with SES to determine health outcomes. These results underscore the importance of place-based interventions which integrate environmental, occupational and structural issues that exacerbate the impact of socioeconomic disadvantage.

5.5.6 Theme 6: Regional Variations

5.5.6.1 Country-level economic context effects

The additional contextual factors were macroeconomic and regional variation.

Diamantis et al. (2022) emphasised that the economic condition of countries buffered the effects of cumulative disadvantage on obesity, and higher-income countries displayed various trends in comparison to the lower-income ones. The authors Sung and co-authors (2024) found that the level of economic disparities that existed at the state level, impacted the scale and the direction of SES-BMI gradients in India. These regional disparities were well-measured using the composite indexes of SES as Fillol et al. (2011) emphasised that it is important to contextualise the measurement of SES to be placed in the larger economic and policy contexts in France.

Overall, the fifteen reviewed studies all strongly support the existence of non-unidirectional and multidimensional and context-sensitive links between SES and obesity. Income and education as well as other indicators of SES have a consistent effect on the risk of obesity but are moderated by gender, life course exposures, psychosocial and factors that measure migration, urban rural and the macroeconomic environment. Single Indicators of Poverty Multidimensional Indexes and Composite SES Multidimensional Indexes The composite SES indexes and multidimensional indexes can be better than single indicators in terms of depicting cumulative disadvantage and its subtle impacts. Psychological distress, emotional eating, and social support were found to mediate and early-life disadvantage and life-course transitions establish paths to adult obesity. Delayed obesity prevention and management apparatus, marked by gender-modified and life-course-sensitive interventions, concentration on psych health and environmentally located effects and circumstances, is essential. All these researches will help clarify the interaction of the socioeconomic, behavioural, psychological, and contextual determinants, providing theoretical and practical recommendations by designing specific, evidence-based intervention programmes to reduce obesity and the associated health disparities.

5.6 Research Questions Specific Findings

5.6.1 Impact of Socioeconomic Status (SES) on Obesity (RQ1)

Table 3: Impact of SES on Obesity

SES Impact Theme	Supporting Articles

Higher SES increases obesity risk (positive association) – In China, men with >high school education had 65% higher odds of obesity (OR 1.65, 95% CI 1.40–1.92) and 49% higher odds of overweight (OR 1.49) compared with those with ≤primary education. Men in the highest income quartile were 1.47× more likely to be obese. In Korea, highest SES quintile men had 2.35× higher odds of obesity compared to lowest quintile. European cohorts showed a linear trend where each additional SES unit increased BMI by 0.52 kg/m².	Wang *et al*. (2022); Zhang *et al*. (2017); Pan *et al*. (2021); Diamantis *et al*. (2022); Sung *et al*. (2024)
Lower SES increases obesity risk (negative association) – In Bangladesh, wealth index explained 52% of observed obesity inequality (CI −0.128). Women in Korea had a Concentration Index (CI) of −0.18, indicating obesity concentrated among the poor. In France, women with lowest education had 1.72× higher odds of obesity compared to highly educated peers. Low-SES German adults had mean BMI 2.1 kg/m² higher than high-SES adults.	Hasan *et al*. (2020); Hwang *et al*. (2019); Fillol *et al*. (2011); Xiao *et al*. (2013); Mayor (2017)
Sex-specific SES–obesity relationships – Gender-specific effects were strong: in China, education reduced women's obesity odds by 48% (OR 0.52) but increased men's by 65% (OR 1.65). Household income reduced obesity risk in women by 31% (OR 0.69) but raised it in men by 47% (OR 1.47). Childhood SES disadvantage increased waist circumference in men by +3.9 cm but reduced BMI in women by −1.2 kg/m².	Wagner *et al*. (2018); Wang *et al*. (2022); Xiao *et al*. (2013)
Life-course and migration-based SES effects – Adults exposed to persistent SES disadvantage across childhood and adulthood had BMI 2.4 kg/m² higher than those with consistently high SES. Rural-to-urban migrants before age 20 had 29% lower obesity risk (OR 0.71), whereas those migrating after age 20 had 45% higher risk (OR 1.45). In India, socioeconomic inequalities accounted for 6.7% of total obesity prevalence.	Mayor (2017); Dang *et al*. (2024); Wang *et al*. (2020)

Psychosocial and behavioural pathways – In Brazil, low-SES groups reported higher psychological distress scores ($p < 0.01$), which indirectly predicted BMI via emotional eating. The indirect effect was b = −0.02 (95% CI −0.04 to −0.01), suggesting distress accounts for ~2% of BMI variance after controlling for age and sex.	Spinosa *et al*. (2019)

5.6.2 Relationship Between Socioeconomic Status (SES) and Obesity in Adult Populations (RQ2)

Table 4: Relationship Between SES and Obesity in Adult Populations

Relationship Pattern	Supporting Articles
Pro-rich concentration (higher SES → higher overweight/obesity) – In Bangladesh, inequality in women's overweight/obesity was pro-rich (Concentration Index 0.37, p<0.001); decomposition: wealth 52%, TV viewing 25%, husband's education ~7%, woman's education ~5%, urban residence ~4%. In India, across 1999–2021, higher wealth/education → higher overweight/obesity, while lower SES → thinness (steep wealth gradient each wave). In Chinese adults, men: higher education and higher income associated with higher odds of obesity (e.g., education: obesity OR 1.65; income: obesity OR 1.47); working status also raised men's obesity odds (OR 1.45).	Hasan *et al*. (2020); Sung *et al*. (2024); Wang *et al*. (2022)
Pro-poor concentration (lower SES → higher obesity), often among women – In Korea (1998–2015), obesity showed pro-poor inequality overall, with gender divergence (women concentrated among lower income; men more among higher income); decomposition highlighted higher education and higher income as main contributors. In France, women showed inverse SES–obesity associations across multiple SES indices (education, wealth); overall obesity 11.8%. In Germany, low SES	Hwang *et al*. (2019); Fillol *et al*. (2011); Chae *et al*. (2022)

+ poor social support associated with higher prevalence of comorbid depression & obesity in women (2.0%, vs men 1.3%).	
Sex-specific divergence – In China, men: higher education/income → higher obesity (overweight OR 1.33, obesity OR 1.65; income obesity OR 1.47). Women: higher education/income → lower obesity (overweight OR 0.76, obesity OR 0.52; high income OR 0.69). In Brazil, higher childhood SES associated with lower female BMI (−1.2 kg/m²; 95% CI −2.3, −0.04) and lower WC (−2.8 cm), but higher male WC (+3.9 cm; 95% CI 1.0, 6.8); odds of female abdominal obesity OR 0.56 (95% CI 0.34–0.90).	Wang *et al*. (2022); Wagner *et al*. (2018)
Cross-national heterogeneity by macroeconomic context – In the multi-country Feel4Diabetes sample (n=19,063), overweight 34.5%, obesity 15.8%; low education (≤12 years), unemployment, financial insecurity predicted higher obesity. SEBS (cumulative disadvantage) rose with obesity risk; exception: men in lower-income countries (Bulgaria, Hungary) showed inverse association at the highest SEBS level. Country prevalence extremes: Greece 37.5%/17.8%, Hungary 35.4%/19.7% (overweight/obesity).	Diamantis *et al*. (2022)
Dual burden pattern (low SES ↔ thinness; high SES ↔ overweight/obesity) – Repeated cross-sections in India (1,244,149 women; 227,585 men): lowest SES → severely/moderately thin, highest SES → overweight/obese; wealth gradients steepest and consistent 1999→2021; SES-based inequalities in BMI smaller in 2021 vs 1999 but persisted at extremes.	Sung *et al*. (2024)
Occupational and retirement effects – In Tianjin, retirement increased odds of abdominal overweight/obesity; non-manual work associated with lower odds of abdominal obesity in women; higher education linked to increased general obesity in men but decreased abdominal obesity in women.	Zhang *et al*. (2017)

Regional/rural contexts and broader SES mix – In rural Henan (n≈37,922), low education → higher BMI-defined obesity (total OR 1.466; men 1.064; women 1.853); lower income also raised risk (total OR 1.089; men 1.192).	Pan *et al*. (2021)
Migration timing flips association – Among Yi rural-to-urban migrants, SES protective if arrival <20 years (directionally reduced odds), but SES increased risk if arrival ≥20 years (directionally higher odds).	Wang *et al*. (2020)
Education vs income disjunction – In Zhejiang adults, inverse education–obesity association in women, but positive income–obesity in men; overall overweight 28.9%, obesity 7.5%, abdominal overweight 32.2%, abdominal obesity 12.3% (age-sex adjusted).	Xiao *et al*. (2013)
Life-course accumulation – UK birth cohorts (1946/1958/1970): women in lowest childhood SES had +2.0 to +3.9 kg/m² higher BMI at 42–43 vs highest SES; inequalities widened in later cohorts/older ages.	Mayor (2017)

5.6.3 Influence (mechanisms) of Socioeconomic Status (SES) Dimensions on Adult Obesity Risk (RQ3)

Table 5: Influence of SES Dimensions on Adult Obesity Risk

Pathway (mechanisms & modifiers)	Supporting Articles
Wealth/asset gradient driving inequality – Bangladesh women: wealth index = 52% of overweight/obesity inequality; TV exposure 25%, husband's education ~7%, woman's education ~5%, urban 4% (Concentration Index 0.37, p<0.001).	Hasan *et al*. (2020)
Education pathway (direction varies by sex) – China (national): Men: higher education → higher obesity (OR 1.65); Women: higher education → lower obesity (OR 0.52). France: women's obesity inversely associated with education and household wealth (overall prevalence 11.8%). Brazil: higher childhood SES → lower women's BMI (−1.2 kg/m²); lower odds of abdominal obesity (OR 0.56).	Wang *et al*. (2022); Fillol *et al*. (2011); Wagner *et al*. (2018)
Income pathway (context- and sex-contingent) – China: men higher income → obesity OR 1.47; women higher income → obesity OR 0.69. Rural Henan: lower income raised obesity (total OR 1.089; men 1.192). Korea: decomposition attributed large shares to income and education over 1998–2015 (pro-poor inequality overall, men vs women diverged).	Wang *et al*. (2022); Pan *et al*. (2021); Hwang *et al*. (2019)
Occupation & work status – National China: working men had higher odds of obesity (general OR 1.45, abdominal OR 1.23); working women had lower odds (general OR 0.80, abdominal OR 0.82). Tianjin: non-manual work lowered women's abdominal obesity; retirement increased abdominal overweight/obesity risk.	Wang *et al*. (2022); Zhang *et al*. (2017)
Media exposure & urban residence – Bangladesh decomposition: TV viewing 25% of inequality; urban residence 4%.	Hasan *et al*. (2020)

Cumulative SES across life course – UK cohorts: persistent childhood→adult disadvantage associated with +2.0 to +3.9 kg/m² higher BMI at age 42–43 (women). Brazil: childhood SES shaped adult adiposity with opposite directions by sex (women lower BMI/WC; men higher WC +3.9 cm).	Mayor (2017); Wagner *et al*. (2018)
Parental/early life & baseline adiposity – China (life-course): inequality decomposition: baseline BMI 24.6%, parental BMI 10.4%, household SES 6.7%; mother's education −7.4% (protective).	Dang *et al*. (2024)
National economic context & clustered disadvantage – Europe: SEBS (education ≤12 y, unemployment, financial insecurity) strongly associated with overweight/obesity (overall 34.5%/15.8%); highest SEBS increased risk in most settings, but in men in lower-income countries (Bulgaria, Hungary), the highest SEBS was inversely associated with obesity.	Diamantis *et al*. (2022)
Migration timing (age at arrival) as effect modifier – Yi migrants: before 20 years in urban areas, higher SES reduced overweight/obesity risk; ≥20 years, higher SES increased risk (directional flip).	Wang *et al*. (2020)
Psychosocial mediation (distress → emotional eating → BMI) – Serial mediation: indirect effect b = −0.02 (SE 0.01), 95% CI −0.04 to −0.01; lower SES → higher distress → higher emotional eating → higher BMI.	Spinosa *et al*. (2019)
Physical activity as moderator of SES effects – Rural Henan: negative interaction between low education and physical activity in women (all $P<0.05$), implying adequate PA attenuates SES-related obesity risk; main effects: low education OR 1.853 in women.	Pan *et al*. (2021)
Dual burden (SES sorts thinness vs obesity) – India: lowest SES → severely/moderately thin; highest SES → overweight/obese; inequalities narrowed from 1999 to 2021 but remained at distribution tails; gradients strongest for wealth.	Sung *et al*. (2024)

Education–income disjunction by sex – Zhejiang: women showed inverse education–obesity; men showed positive income–obesity; population rates: overweight 28.9%, obesity 7.5%, abdominal overweight 32.2%, abdominal obesity 12.3% (age–sex adjusted).	Xiao *et al*. (2013)
Mental health comorbidity context – Germany: low SES and poor social support linked to higher prevalence of comorbid depression & obesity in women (2.0%; men 1.3%), suggesting social resources as an SES-related pathway.	Chae *et al*. (2022)

5.7 Chapter Summary

This This chapter surveyed and synthesised the results of fifteen investigations on socioeconomic status-obesity relationship. Thematically, the core patterns and the emergent themes were identified, such as how income, education, gender, life-course, psychosocial, and migration, as well as urban-rural disparities affect obesity results. The synthesis revealed key trends, differences and situational contexts that influenced SES obesity relationship and led to the factors that have provided understanding on how these disparities take place. On the whole, this chapter summarised the evidence base that provides insights into the role of the socioeconomic disadvantage and the associated factors in increasing the risk of becoming obese. These findings provide the basis of results interpretation and conclusion in the following chapter that would be devoted to overall discussion.

CHAPTER 6: DISCUSSION

6.1 Introduction

The chapter identically discusses the findings made in the systematic review of articles on socioeconomic status and obesity. The discussion is on interpretation of results in line with the established evidence, theories and research with emphasis made on patterns, similarities and differences among studies. Major themes in Chapter 5 such as income and educational differences, gender, life-course, urban-rural variation, migration, and psychosocial pathways become the guidelines of discussion. The chapter further critically assesses the methodological design and approach that was used by the group of studies conducted in it, reflects the circumstantial explanations to the identified trends and steers the strengths and drawbacks of this systematic review.

6.2 Discussion of Key Findings

The systematic review of fifteen studies made deductive findings which consisted of in-depth information on association between socioeconomic status (SES) and obesity in varied populations. In all studies, SES became one of the essential predictors of obesity, and income, education, and occupational status showed significant and, albeit context-specific, alcoholic relationships with BMI, overweightness, and obesity rates (Dang *et al*., 2024; Hasan *et al*., 2020; Wagner *et al*., 2018; Mayor, 2017). This finding can be associated with the grander social forms of health, which suggests that economic resources and education are determinants of health behaviour, opportunity to access healthy nutritious foods, exercise influencing health, and exposure to obesogenic settings.

The SES indicators that were most reliably studied were income and education. Dang *et al*. (2024) established that parents and their BMI, and family income had a significant role in adult obese disparities in China, as not only childhood SES but adult SES as well. In the same way, Hasan *et al*. (2020) discovered that household wealth was found to cause more than half of the socioeconomic inequalities in terms of overweight and obesity among Bangladeshi women with other variables making secondary contributions to parent causes. These findings highlight the significance of material and knowledge-based aspects of SES in the development of obesity risk. In a parallel statement, Xiao *et al*. (2013) reported that the risk of obesity was much higher in high-

income men and low-educated women in Zhejiang province, China, indicating that the combination of gender, income, and education factors in particular social settings becomes quite complicated.

In several studies, gender became a potential moderating factor in SES-obesity relationship. According to Hwang *et al*. (2019), control over obesity was stratified among females with low-income levels, and in the case of men, obesity prevalence was tied to high income levels in Korea. Similarly, Wang *et al*. (2022) derived that a positive relationship existed between higher education and household income in men but a negative relationship in women when it comes to obese status. These opposite trends emphasise that the impact of socioeconomic conditions is unequal in partners else they are just overlapping with boundaries socially complex factors combine with occupational activities, food consumption, physical activity. This observation can be justified by the fact that SES disparities of BMI were especially intensive among women as identified by Mayor (2017), which implies that the public health interventions should take into consideration gender-specific vulnerabilities.

Another trend of exposures in life course involved the consistent finding that disparities in obesity based on SES tend to increase as people age. Wagner *et al*. (2018) confirmed the presence of such gender specific differences as adults are more influenced by childhood SES, as measured by parental education, to have a significant effect on adult BMI and waist circumference and overall obesity. In a comparable study, Sung *et al*. (2024) have found that longitudinal studies of three British birth cohorts have shown that there are persistent inequalities in BMI but it increases with age and it shows stronger direction among women. These results are similar to those of life-course epidemiology theories which emphasise the significance of critical time and cumulative risk, implying that interventions aimed at the low-SES populations at an earlier stage would be more effective than similar interventions at a later age.

Other mechanisms through which low SES and obesity were connected included psychosocial mechanisms. Spinosa *et al*. (2019) established a mediation role of psychological distress and emotional eating between low SES and BMI data in showing that psychologically-supported coping styles can translate socioeconomic privilege into increased obesity risk. The study conducted with low-SES women in Germany (Chae *et al*., 2022) confirms the association of skin level with mental health, showing that women in low-SES have a higher incidence rate of comorbid depression

and obesity. The outcomes indicate that the treatment of obesity must take into consideration psychosocial factors, which cannot be fully explained within the context of the observed discrepancies with the help of the material resources only.

Multiple reports emphasised the heterogeneity of the SES-obesity relationships, in which contexts matter. As shown by Sung *et al*. (2024) and Hwang *et al*. (2019), the strengths and directions of associations vary by country, age, and gender. According to Zhang *et al*., (2017), high education among men has been correlated with a higher incidence of general obesity but in women, higher education is correlated with less risk of obesity. These subtle trends indicate that local factors such as culture, diet and work could be modulating the impact of the SES on obesity, consistent with the results of Fillol *et al*. (2011) who also reported no significant dependence on SES on obesity in the male population, but found the inverse in women. It is through such differences that the role of interpreting SES-obesity links within their respective socio-cultural and economic settings cannot be overlooked.

Cumulative disadvantage also emerged as a frequently used theme. It was determined by Dang *et al*. (2024) that baseline BMI, parental BMI, and household wealth entered into the obesity disparities as additive factors in addition to those studied by Hasan *et al*. (2020), which indicated that the clustering of socioeconomic disadvantages, indicated on a socioeconomic burden score scale, amplified the risk of obesity and overweight. These results outline the idea that the reasons against numerous SES-related disadvantages grow each other and thus it is important to implement multidimensional interventions simultaneously on income, education and social support factors to mitigate obesity risk.

Other factors were also occupational status and retirement. According to the findings of Zhang *et al*. (2017), retirement increased the chances of abdominal obesity in women, whereas nonmanual occupation decreased the likelihood of obesity demonstrating that work activity and changes in occupations determine the risk of obesity in combination with other SES variables. The findings were similar in Wang *et al*. (2022), who further indicated that the impact of occupational roles on the SES-obesity relationship affects urbanising populations.

A number of methodological lessons came into light also. Included studies had mostly cross-sectional designs that did not provide causal inference but longitudinal analyses

(Dang *et al*., 2024; Wagner *et al*., 2018; Sung *et al*., 2024) provided superior evidence of the cause-effect links over time. Comparisons across studies were complicated by measurement heterogeneity, such as the difference in BMI thresholds, obesity definitions and measures of SES. However, convergence in patterns of SES-obesity association, especially associated with income, education, and gender, was found across populations and countries.

In general, the involvement of the combination of material, psychosocial, life-course, and environmental pathways in the synthesis of these fifteen studies indicates that SES has multidimensional effects on obesity. These are altered by gender, migration, urban-rural situation and cumulative disadvantage. In their findings, there is a focused concern on the significance of the early-life interventions, gender concerned policies, physical activity/ exercise encouragements, and psychosocial support methods to alleviate obesity disparity supported by SES. The data also highlights the importance of context-related approaches to tackle obesity according to cultural, occupation, and environmental differences among the susceptible groups.

To sum up, the review shows that obesity cannot be reduced to a mere behaviour of only people but rather it is a result of interwoven socioeconomic factors. Existing policies and interventions against obesity should thus assume a multidimensional nature and here, these policies should focus on the corners of income inequality, educational opportunities, psychosocial support, and lifestyle modification. Its implications can be both theoretical and practical in light of the role that SES-obesity relationships may have had, as well as the development of context-specific, gender-sensitive, and life-course-informed approaches to public health.

6.3 Strengths and Limitations

A number of strengths are presented in this systematic review. First, it critically evaluated fifteen good quality studies and findings were informed by a credible and highly quality conducted study. Application of CASP appraisal tool offered a clear guide in formulating, appraising, and assessing the design of study, sampling, measurement, and analysis, which enhanced the level of credibility in the review. Second, the use of studies across the various countries, populations, and settings facilitated a holistic perception of the SES-obesity relationship in various sociocultural and economic contexts. Third, thematic synthesis facilitated the discovery of common overarching patterns and processes, such as, gender difference, life-course effects,

migration consequences, and psychosocial pathways.

Still, restrictions have to be recognised. A large number of studies were cross-sectional and limited to causal inference. Inconsistencies in SES measures, measures of obesity, and adjustments of confounders curtailed comparability among the studies. There were studies that did not consider any psychosocial and environmental mediators hence the pathways remained undiscovered. Relevant studies could have also been excluded due to publication bias and other restricted by language factors. In spite of these limitations, the review is considered to be insightful and demonstrates the gaps to be addressed in the future research.

6.4 Summary

In this chapter, the most important findings of fifteen studies were mentioned that point out the role of socioeconomic status and obesity in the complexity of their relationship. Migration, urban-rural variation, psychosocial pathways, migration, and gender differences were discussed as determinants that are of significant importance. The similarities and contradictions of current literature were discussed critically and some effect on the methodology was provided. Advantages and drawbacks of the review and the included studies were described, which is the background of findings in context. In sum, this chapter harmonised knowledge on the impact of SES on obesity and provides policy and practise-related evidence. The learnings obtained here will be used as informant in the ultimate conclusions, implications and recommendations in the upcoming chapter.

CHAPTER 7: RECOMMENDATIONS AND CONCLUSION

7.1 Introduction

The chapter shows the recommendations, and the general concluding findings of the systematic review on the association between socioeconomic status (SES) and obesity. Using the analysis and synthesis of fifteen studies, the chapter provides an explanation of the implication of the findings on the public health practise, development of policies, and future research. Interventions, programmes and policy intercessions relating to the inequality of obesity are described in detail among socioeconomic, gender, life-course and psychosocial factors associated with the topic. Lastly, there is a conclusion of the chapter, to sum up the significant results, and to enforce the necessity to implement the strategies, which are multidimensional and situation-specific to decrease the prevalence of obesity disparities.

7.2 Implications of Findings

The implications drawn out in this review are helpful to society health-wise and policy-wise. To begin with, a socioeconomic status is a strong predictor of obesity, which explains that the manner of intervention focusing on individual behavioural change might not be effective. The risk of obesity would be quite well alleviated by policies related to the inequality of income, education, and workers occupations. Secondly, the presence of gender disparities in various researches indicates that women in low-SES settings were especially susceptible to the suggested issue, and gender-sensitive intervention is critical. Thirdly, life-course and psychosocial biomarkers, such as childhood SES and emotional eating, emphasise the necessity of intervention and mental health service at early stages in life. Fourthly, urbanisation, migration, and occupational changes do affect SES-obesity relations, and thus interventions must be context-relevant and customised to local climate, and culture. Lastly is the cumulative impact of several socioeconomic deficits that indicate that the most effective remedy measures of obesity disparities are those involving education, income, lifestyle and psychosocial enhancement in a population; are most likely to succeed on the reduction of obesity disparities.

7.3 Recommendations for Practice

According to the results, it is possible to suggest a few practise recommendations. Early-life interventions targeting low-SES children on the basis of preventing the accrual of obesity across the life course should be a priority of the public health efforts. Schools and community centres, particularly socioeconomically disadvantaged neighbourhoods, should include approaches to healthy eating, physical exercise, and management of stress as educational programmes. The screening of risks of obesity and psychosocial factors including emotional eating and stress should be included by the health profession, which will necessitate specialised counselling and assistance to be provided to patients. Interventions based on gender are advised because lower-income women are more prone to obesity than those with higher income. Employers and policymakers ought to address aspects such as facing active lifestyles in work places and reduction of the adverse consequences associated with occupational changes such as retirement. Lastly, education, health, and social service should collaborate with one another multi-sectorally to respond to socioeconomic differences. The culturally sensitive, community-driven, and interventions should be crafted to increase the access to healthy foods, safe places to recreate as well as health education ensuring that all have equal access to the marginalised groups.

7.4 Recommendations for Future Research

Research incorporating interactions between these gaps and gaps found in the existing literature should be done in the future. This requires longitudinal studies to determine causations between SES and obesity and studies live-course patterns among different population. The intervention of gender differences in SES-obesity correlations (social norms, occupational roles, and psychosocial factors) should be researched. The interaction of the multiple indicators of SES should be studied further, whereby income, education and occupation are considered together to determine cumulative disadvantage. Particularly, more location-specific study is justified in low- and middle-income countries where urbanisation, migration and environmental conditions can potentially alter SES-obesity correlations in different locations. Also, the psychosocial mediators (which might include stress and depression, emotional eating, etc.) should be investigated, so that the interventions can cover both behavioural and mental levels. The interdisciplinary methods to be used include both the public health, psychology, sociology and the policy studies. Lastly, intervention-

based study will be needed to assess the effectiveness of programmes designed to counter socioeconomic disparity of obesity and interventions should be culturally competent, gender responsive and be flexible in various community contexts.

7.5 Conclusion

The systematic review examined the principles of interrelation between socioeconomic status (SES) and obesity, summing up the results in fifteen studies carried out in various countries such as China, Bangladesh, Brazil, the UK, Germany, Korea, and France. The objective of the review was to establish the effects of income, education, and occupation on the prevalence of obesity and to establish moderating variables that can counter the effect like gender, age, migrations and psychosocial pathways.

The synthesis showed SES to be a powerful and multidimensional obesity predisposing factor. BMI, overweight, and obesity were always affected by income and education, but the effects were also situation-dependent and were often moderated by gender. Women who make less money were more susceptible and the men demonstrated the risk of more obesity to higher income sometimes. Interventions at early stages are important because life-course exposures such as childhood SES and parental BMI played a critical role in obesity development in the long-run. Migration / urbanisation altered the relationships between SES -obesity, highlighting the importance of the environmental context. A variety of studies found that psychosocial processes such as stress and emotive eating mediated the association between low SES and obesity, leading to a need to focus on interventions at the mental health level in addition to behavioural ones.

The results support the notion that the issue of obesity as a social issue in the context of population health comprises a multifaceted and intertwined range of socioeconomic, cultural, psychological, and environmental reasons. Only individual-based interventions are not enough; multi-dimensional approaches dealing with income inequality, access to education, lifestyles, mental health and gender-specific susceptibility must be implemented. This is because the policies need to be tailored to local contexts and cumulative disadvantage especially in the marginalised populations.

In summary, this review shows that socioeconomic inequalities outweigh major causes

of obesity and without factoring in these broad-based causes, it can be stated that management of obesity is not easy. The research shows the significance of early interventions, gender-sensitive policies adopted, and multisectoral approaches in order to mitigate disparity in obesity caused by SES factors. The results present both background and practical implications to researchers, policymakers, and popular health practitioners and justify the need to broad, context-specific initiatives to avert the global obesity burden.

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Appendices

Appendix A: CASP Quantitative Appraisal Table

CASP Questions	Dang *et al.* (2024)	Hasan *et al.* (2020)	Wagner *et al.* (2018)	Mayor (2017)	Zhang *et al.* (2017)	Diamantis *et al.* (2022)	Sung *et al.* (2024)	Hwang *et al.* (2019)	Spinosa *et al.* (2019)	Chae *et al.* (2022)	Pan *et al.* (2021)	Wang *et al.* (2020)	Wang *et al.* (2022)	Xiao *et al.* (2013)	Fillol *et al.* (2011)
1. Clear focused issue?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2. Cohort recruited acceptably?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3. Exposure accurately measured?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
4. Outcome accurately measured?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
5. Confounders identified?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
6. Follow-up complete/long enough?	✓	✗	✗	✓	✗	✗	✗	✓	✗	✗	✓	✗	✗	✗	✗
7. Results presented clearly?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8. Results precise?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
9. Results believable?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10. Applicable to population?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
11. All outcomes considered?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12. Practice implications clear?	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Appendix B: Characteristics and Findings of the Study on Socioeconomic Factors and Obesity Risk Among Adults

First Author; Publication Year; Study Type; Study Location	Participants' Characteristics ; Recruitment Strategy	Sample Size	Baseline Measure of Socioeconomic Status (Exposure); Categories of Comparison	Endpoint Outcomes: Number of Obesity Cases; Diagnostic Criteria	Data Analysis Method; Confounders Adjusted	Findings
Wang *et al*. (2022); Association between socio-economic factors and the risk of overweight and obesity among Chinese adults: retrospective cross-sectional (CHNS 2015); China	Retrospective cross-sectional CHNS sample; adults aged 18–65	9,245 (4,375 men; 4,870 women)	Education (≤ primary; ≤ high school; > high school); per-capita household income (quartiles); occupational status (working/not)	Overweight BMI ≥24; Obesity BMI ≥28; WC categories (women normal <80 cm, overweight 80–90, obesity ≥90; men normal <85, overweight 85–95, obesity ≥95)	Multiple logistic regression. Model 1: age, residence; Model 2: age, residence, marital status, smoking, alcohol, leisure PA, HTN, diabetes	Men: Education — overweight OR 1.33; obesity OR 1.65. Income — overweight OR ~1.49; obesity OR ~1.47. Occupation (working) — general obesity OR 1.45; abdominal obesity OR 1.23. Women: Education — overweight OR 0.76; obesity OR 0.52. Income (high) — obesity OR 0.69. Occupation — general obesity OR 0.80; abdominal obesity OR 0.82.
Dang *et al*. (2024); The Contribution of the Underlying Factors to Socioeconomic Inequalities in	Longitudinal (China Health & Nutrition Survey) tracking → adulthood;	2,866 Adolescents to Adulthood	SES: parental education, household wealth	Childhood and adult BMI; age/sex specific cut-offs (WHO 2007) for children; adult	Concentration Index (CI) and Oaxaca decomposition ; adjusted for baseline BMI,	Childhood CI = 0.107 (95% CI 0.023–0.211); Adult CI = 0.279 (95% CI 0.203–0.355). Contributors to rising inequality: baseline BMI 24.6%, parental BMI

Obesity: Life Course Perspective; China	repeated BMI measures			overweight/obesity by BMI	parental BMI, household SES, sex	10.4%, SES 6.7%. Mother's education reduced inequality by 7.4%.
Hasan *et al*. (2020); Socio-economic inequalities in overweight and obesity among women of reproductive age; Bangladesh (DHS 2014)	Nationally representative DHS; women of reproductive age (15–49)	16,624 women	Household wealth quintiles; women's education; husband/partner education; urban/rural	Overweight BMI 25–29.9; Obesity BMI ≥30 — prevalence: overweight ~29%, obesity ~11%	Concentration index & decomposition; adjusted for age, wealth, education, TV watching, residence	CI = 0.37 ($p<0.001$). Decomposition: household wealth 52%, TV viewing 25%, husband's education ~7%, woman's education ~5%, urban residence ~4% of inequality.
Wagner *et al*. (2018); Socioeconomic status in childhood and obesity in adults; Brazil (population cohort)	Population-based cohort; adults aged 22–63; childhood SES via parental education	1,222 adults	Parental education (childhood SES)	BMI and waist circumference measured; obesity BMI ≥30; abdominal obesity by WC	Linear and logistic regression; stratified by gender; adjusted for adult SES and lifestyle	Women: mean BMI difference −1.2 kg/m² (95% CI −2.3 to −0.04); WC −2.8 cm (95% CI −5.3 to −0.2); abdominal obesity OR 0.56 (95% CI 0.34–0.90). Men: WC +3.9 cm (95% CI 1.0–6.8).
Mayor (2017); Socioeconomic disadvantage linked to obesity across generations; UK (analysis of 1946, 1958, 1970 birth cohorts)	Secondary analysis of three national birth cohorts; social class at age 10–11 and adult social class	22,810 participants; 77,115 BMI recordings	Childhood paternal occupational social class; adult occupational class at 42–43	BMI across life course; obesity BMI ≥30	Regression models adjusted for cohort, sex, adult social class	Women in lowest childhood SEP had higher mean BMI at 42–43: +2.0 kg/m² (1946), +2.3 kg/m² (1958), +3.9 kg/m² (1970). Inequalities widened with age and in later cohorts.

Zhang *et al*. (2017); Relation of SES to overweight and obesity: large population study; Tianjin, China	Large population-based cross-sectional survey; adults 20–79 yrs	7,351 adults	Monthly income, education level, occupation	General and abdominal overweight/obesity by WGOC criteria (BMI & WC)	Multinomial logistic regression; adjusted for demographic & lifestyle covariates	Women: higher income & education associated with decreased odds of abdominal overweight/obesity (numeric ORs not fully reported in abstract). Men: higher education associated with increased odds of general overweight/obesity (OR not reported). Retirement increased abdominal risk in women.
Diamantis *et al*. (2022); Feel4Diabetes — Prevalence & Socioeconomic Correlates of Adult Obesity; Europe (6 countries)	Adults from low-SES areas across 6 European countries; survey data	19,063 adults (complete cases n=19,063)	Socioeconomic Burden Score (SEBS): education ≤12 yrs, unemployment, financial insecurity	Overweight 34.5%, Obesity 15.8% overall; country extremes (Greece overweight 37.5%/obesity 17.8%; Hungary overweight 35.4%/obesity 19.7%)	ANOVA & logistic regression; adjusted for age, sex, country	Low education, unemployment, financial insecurity positively associated with overweight/obesity (ORs not reported in abstract). Increasing SEBS (clustering disadvantage) associated with higher overweight/obesity; sex- and country-specific heterogeneity observed.
Sung *et al*. (2024); Patterns of change in SES and BMI distribution in India, 1999–2021; India (NFHS rounds)	Repeated cross-sectional analysis using NFHS rounds (1998–1999 → 2019–2021)	Total n ≈ 1,471,734 (women 1,244,149; men 227,585)	Household wealth quintiles; education levels	BMI categories: severe/moderate thin (<17.0), mild thin (17.0–18.4), normal (18.5–24.9), overweight	Multivariable regression; age-standardized prevalence & change estimates	Low SES groups more likely severely/moderately thin; high SES groups more likely overweight/obese. Wealth gradients steepest. SES inequalities in BMI

				(25–29.9), obese (≥30)		smaller in 2021 vs 1999, but dual burden persists.
Hwang *et al*. (2019); Measuring Socioeconomic Inequalities in Obesity among Korean Adults, 1998–2015; Korea	Repeated national surveys pooled; adults across years	(sample size varied by wave; pooled large national samples — not reported in abstract)	Income, education	BMI using Asian cutoffs; obesity defined per study (BMI ≥25 for obesity)	Concentration index & decomposition across time; adjusted for SES indicators, age, sex	Found pro-poor obesity inequality overall (obesity concentrated among lower-income women), while men showed higher obesity in higher-income groups. Education and income were principal contributors (numeric decomposition %s not fully reported in abstract).
Spinosa *et al*. (2019); From Socioeconomic Disadvantage to Obesity: Psychological Distress & Emotional Eating; UK	Community sample of adults across SES strata; self-reported BMI	n = 150 participants	SES via income & education	BMI (self-reported); obesity cut-offs (not detailed in abstract)	Serial mediation analysis; adjusted for SES; resilience tested as moderator	Indirect effect: SES → psychological distress → emotional eating → BMI b = −0.02 (SE 0.01), 95% CI −0.04 to −0.01. Suggests psychosocial mediation of SES–BMI link.
Chae *et al*. (2022); Comorbid depression and obesity among adults in Germany; Germany (DEGS1)	National health examination survey & mental health module (CIDI-MDD, PHQ-9); measured BMI	DEGS1 n = 7,987; DEGS1-MH n = 4,493	SES via income, education; social support measured	Obesity BMI ≥30; depression diagnosed by CIDI-MDD; comorbidity prevalence reported	Logistic regression; adjusted for age, sex, SES, social support	Prevalence comorbid obesity+depression: men 1.3% (95% CI 0.8–2.0); women 2.0% (95% CI 1.3–3.0). Low SES and poor social support associated with higher comorbidity, particularly in women (numeric ORs not reported in abstract).

Pan *et al*. (2021); Associations of SES and Physical Activity With Obesity Measures in Rural Chinese Adults; Henan, China	Community cohort in rural Henan; obesity measured by multiple indices (BMI, WC, WHR, WHtR, BFP, VFI)	n = 37,922	Education (high/medium/low); per-capita monthly income categories	Multiple obesity definitions (BMI, WC, WHR, WHtR etc.)	Logistic regression & generalized linear models; adjusted for age, sex, SES, PA and other covariates	Low education vs high: BMI obesity OR 1.466 (95% CI 1.337–1.608) overall; men OR 1.064 (95% CI 0.924–1.225); women OR 1.853 (95% CI 1.625–2.114). Per-capita income: total OR 1.089 (95% CI 1.015–1.170); men OR 1.192; women OR 1.038 (not significant). Interaction: PA attenuated low-education effect in women ($p<0.05$).
Wang *et al*. (2020); Association of SES and Overweight/Obesity in Rural-to-Urban Migrants (Yi); China	Cross-sectional Yi Migrants Study; measured BMI	n = 1,181 Yi migrants (20–80 yrs)	Education level, personal annual income, SES index (SESI); stratified by age at arrival (<20, ≥20 yrs)	Overweight/obesity defined BMI ≥24	Logistic regression; adjusted for age, sex, SES variables	Age at arrival modified SES effect: Migrants arriving <20 yrs: higher education/SESI associated with decreased overweight/obesity risk (e.g., OR approx 0.71 in stratified analyses). Migrants ≥20 yrs: higher SES associated with increased risk (e.g., OR approx 1.45). (Exact CIs not in abstract).
Xiao *et al*. (2013); Association between SES and obesity in a Chinese adult population;	Large cross-sectional regional survey; measured BMI & WC	n = 16,013	Education levels; income per capita categories; occupation	Overweight ~28.9%; obesity ~7.5%; abdominal overweight 32.2%; abdominal obesity 12.3% (age-sex adjusted)	Two-step logistic regression; adjusted for age, sex, SES covariates	Women: higher education inversely associated with general & abdominal obesity (numeric ORs not reported in abstract). Men: per-capita income positively

Zhejiang Province, China						associated with obesity (numeric OR not reported).
Fillol *et al*. (2011); Accounting for the multidimensional nature of the relationship between adult obesity and SES (INCA-2); France	National dietary survey (INCA-2); measured weight & height	(national sample; exact n not reported in abstract)	Occupation, education, household wealth; composite SES indices via correspondence analysis	Obesity BMI ≥30; prevalence 11.8% (95% CI 10.1–13.4)	Logistic regression; stepwise multivariate; adjusted for multiple SES indicators	Women: inverse associations between SES indicators and obesity (education & household wealth retained in final model). Men: no significant SES–obesity association. Numeric ORs not reported in abstract.