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HEALTHCARE COSTS ACROSS THE BODY MASS INDEX SPECTRUM: THE ROLE OF AGE AND MULTIMORBIDITY — A SYSTEMATIC REVIEW

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ABSTRACT

Background: Body mass index (BMI) is widely used to classify nutritional status and assess health risk at the population level. Both low and high BMI values are associated with adverse health outcomes; however, the economic consequences of abnormal BMI across the full BMI spectrum have not been comprehensively synthesized in recent literature.
Objective: To systematically review evidence published since 2015 on healthcare costs associated with BMI categories ranging from underweight to severe obesity, with particular attention to the modifying roles of age and multimorbidity.
Methods: A systematic literature search was conducted in PubMed to identify studies published between January 2015 and March 2025 reporting healthcare costs stratified by BMI. Observational studies, cohort studies, registry-based analyses, and cost-of-illness studies were included. Due to substantial methodological heterogeneity, a narrative synthesis was performed.
Results: Across healthcare systems, a consistent non-linear association between BMI and healthcare costs was observed. Normal BMI was associated with the lowest expenditures, while both underweight and obesity were linked to increased costs. Severe obesity generated the highest costs, largely driven by chronic disease burden and hospitalization. Age and multimorbidity substantially modified the BMI–cost relationship, with underweight particularly associated with prolonged hospitalization among older adults.
Conclusions: Healthcare costs vary significantly across the BMI spectrum. Both extremes of BMI are associated with increased economic burden, underscoring the importance of age-sensitive and multimorbidity-informed prevention and care strategies.

KEYWORDS

Body Mass Index, Healthcare Costs, Obesity, Underweight, Multimorbidity, Hospitalization

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1. Introduction

Abnormal body weight constitutes a major public health challenge and imposes a growing burden on healthcare systems worldwide. Both excess body weight and low body weight are associated with increased morbidity, mortality, and healthcare utilization, resulting in substantial economic consequences. In recent years, rising healthcare expenditures have been driven by demographic ageing, increasing prevalence of chronic diseases, and expanding use of medical technologies. Within this context, body mass index (BMI) has emerged as an important population-level indicator associated not only with health outcomes but also with patterns of healthcare resource utilization and costs.

BMI remains the most commonly used anthropometric measure in epidemiological research and clinical practice. Despite well-recognized limitations, including its inability to distinguish between fat mass and lean mass or capture body fat distribution, BMI demonstrates robust associations with adverse health outcomes at the population level. Standard BMI categories include underweight, normal weight, overweight, and obesity, with obesity further classified by severity. These categories continue to underpin public health surveillance and economic evaluations across diverse healthcare systems.

A growing body of literature published since 2015 has consistently demonstrated that obesity is associated with increased healthcare expenditures. Large cohort and registry-based studies have shown that individuals with obesity incur significantly higher medical costs than those with normal BMI, primarily due to increased prevalence of cardiometabolic diseases, musculoskeletal disorders, and mental health conditions (Biener & Decker, 2018; Kent et al., 2017; Rudisill et al., 2016). These conditions often require long-term pharmacotherapy, frequent outpatient visits, and recurrent hospital admissions, thereby contributing to sustained increases in healthcare spending.

Economic analyses further indicate that healthcare costs associated with obesity increase progressively with BMI severity. Individuals with class II and class III obesity consistently generate the highest healthcare expenditures, reflecting both greater disease burden and more intensive healthcare utilization. Hospitalization-related costs, in particular, represent a major component of obesity-associated expenditures, driven by higher admission rates, longer cumulative length of stay, and increased risk of complications during inpatient care (Kent et al., 2017; Tremmel et al., 2017).

In addition to direct medical costs, obesity imposes substantial indirect costs on society. Studies focusing on working-age populations have documented increased productivity losses due to sickness absence, reduced work capacity, disability, and early retirement among individuals with obesity (Biener & Decker, 2018; Tremmel et al., 2017). These indirect costs often constitute a significant proportion of the total economic burden associated with excess body weight and highlight the broader societal implications of obesity beyond healthcare systems alone.

In contrast to the extensive literature on obesity, the economic implications of underweight have received comparatively limited attention. Nevertheless, emerging evidence suggests that low BMI is also associated with increased healthcare utilization and costs, particularly among older adults. Underweight is frequently linked to frailty, sarcopenia, malnutrition, and advanced chronic disease, all of which contribute to increased vulnerability to acute illness and adverse hospitalization outcomes (Forman et al., 2018; Ho et al., 2021).

Studies focusing on older populations increasingly recognize underweight as a marker of reduced physiological reserve rather than a benign anthropometric characteristic. Low BMI in later life is often associated with prolonged hospital stays, higher readmission rates, and increased need for post-acute and long-term care services. As population ageing accelerates globally, the economic relevance of underweight is likely to increase, underscoring the need to consider the full BMI spectrum when evaluating healthcare costs.

Recent research suggests that the relationship between BMI and healthcare costs is non-linear. Several large-scale analyses have reported J-shaped or U-shaped associations, with the lowest costs observed among individuals with normal BMI and higher expenditures at both extremes of the BMI distribution (Kent et al., 2017; Tremmel et al., 2017). However, many economic evaluations focus primarily on obesity or dichotomize BMI into obese versus non-obese categories. Such approaches may underestimate the costs associated with underweight and overweight and obscure important differences across BMI categories.

Age represents a critical modifier of the relationship between BMI and healthcare costs. In working-age populations, obesity-related costs are driven by both direct medical expenditures and indirect costs related to productivity loss. In contrast, among older adults, low BMI and underweight appear to be more strongly associated with increased hospitalization-related costs, prolonged length of stay, and transitions to long-term care. These age-dependent patterns suggest that BMI-related economic consequences vary substantially across the life course and cannot be fully captured by analyses that do not stratify by age.

Multimorbidity further complicates the association between BMI and healthcare costs. Obesity substantially increases the risk of developing multiple chronic conditions, which act synergistically to increase healthcare utilization and expenditures (Rudisill et al., 2016).

Conversely, in older populations, underweight frequently coexists with multimorbidity and frailty, contributing to complex clinical trajectories characterized by recurrent hospitalizations and high resource use (Forman et al., 2018; Ho et al., 2021). Economic analyses that fail to adequately account for comorbidity burden may therefore underestimate the true impact of BMI on healthcare systems.

Another challenge in synthesizing evidence on BMI-related healthcare costs lies in the heterogeneity of healthcare systems and cost accounting frameworks. Studies conducted in publicly funded healthcare systems often emphasize inpatient and hospital-related expenditures, whereas analyses based on insurance claims data may capture a broader range of outpatient and pharmaceutical costs. Differences in costing perspectives, price years, and analytical methods complicate direct comparison of absolute cost estimates across studies. Consequently, narrative synthesis focused on relative cost patterns across BMI categories may provide more meaningful insights than direct comparison of monetary values.

Given these complexities, there is a clear need for an up-to-date synthesis of evidence that examines healthcare costs associated with BMI across its full spectrum, while explicitly accounting for age and multimorbidity. Previous reviews have often focused narrowly on obesity or have included studies published before 2015, limiting their relevance to contemporary healthcare systems. An updated synthesis restricted to recent PubMed-indexed literature may provide more actionable insights for clinicians, policymakers, and healthcare planners.

The aim of this systematic review is therefore to synthesize evidence published since 2015 on healthcare costs associated with BMI across its full spectrum, from underweight to severe obesity. Specifically, this review seeks to: (1) describe patterns of healthcare expenditures across BMI categories; (2) examine the modifying roles of age and multimorbidity in the BMI–cost relationship; and (3) summarize evidence on hospitalization-related outcomes, including length of stay and readmission. By providing a comprehensive and contemporary overview based exclusively on PubMed-indexed studies, this review aims to inform clinical practice, health policy, and future research on the economic consequences of abnormal body weight.

2. Methods

2.1 Study Design and Reporting Standards

This study was conducted as a systematic review following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A protocol defining eligibility criteria, search strategy, and data synthesis methods was developed a priori.

2.2 Data Sources and Search Strategy

A comprehensive search of PubMed was performed to identify relevant studies published between January 2015 and March 2025. Search terms included combinations of “body mass index,” “BMI,” “underweight,” “obesity,” “healthcare costs,” “medical expenditures,” and “economic burden.” Reference lists of included studies were also screened.

2.3 Eligibility Criteria

Studies were eligible if they:

1. Reported healthcare costs stratified by BMI or BMI categories
2. Included adult populations
3. Used observational or cost-of-illness designs
4. Were published in English from 2015 onward

Cost-effectiveness analyses and studies without BMI-specific cost data were excluded.

2.4 Study Selection and Data Extraction

Titles, abstracts, and full texts were independently screened by two reviewers. Extracted data included study characteristics, population demographics, BMI classification, cost components, and key findings. The synthesis was informed by 46 eligible studies; however, only selected representative publications are explicitly cited to illustrate consistent patterns across the overall evidence base.

2.5 Quality Assessment and Synthesis

Methodological quality was assessed using the Newcastle–Ottawa Scale. Given heterogeneity in costing methods and healthcare systems, a narrative synthesis was performed.

3. Results

3.1 Study selection

The systematic literature search conducted in PubMed identified 1,842 records published between January 2015 and March 2025. After removal of duplicate records, 1,530 unique articles were retained for title and abstract screening. During this initial screening stage, 1,437 records were excluded because they did not report healthcare cost outcomes stratified by body mass index, focused exclusively on cost-effectiveness of specific interventions without baseline BMI-related cost data, or did not meet predefined study design criteria.

Full-text articles were retrieved for 93 studies considered potentially eligible. Following detailed full-text assessment, 47 studies were excluded due to insufficient reporting of BMI- specific cost outcomes, lack of stratification by BMI categories, inclusion of pediatric populations without separate adult analyses, or inadequate description of cost methodology.

Ultimately, 46 studies met all eligibility criteria and were included in the final narrative synthesis. The study selection process is summarized in the PRISMA flow diagram (figure 1).

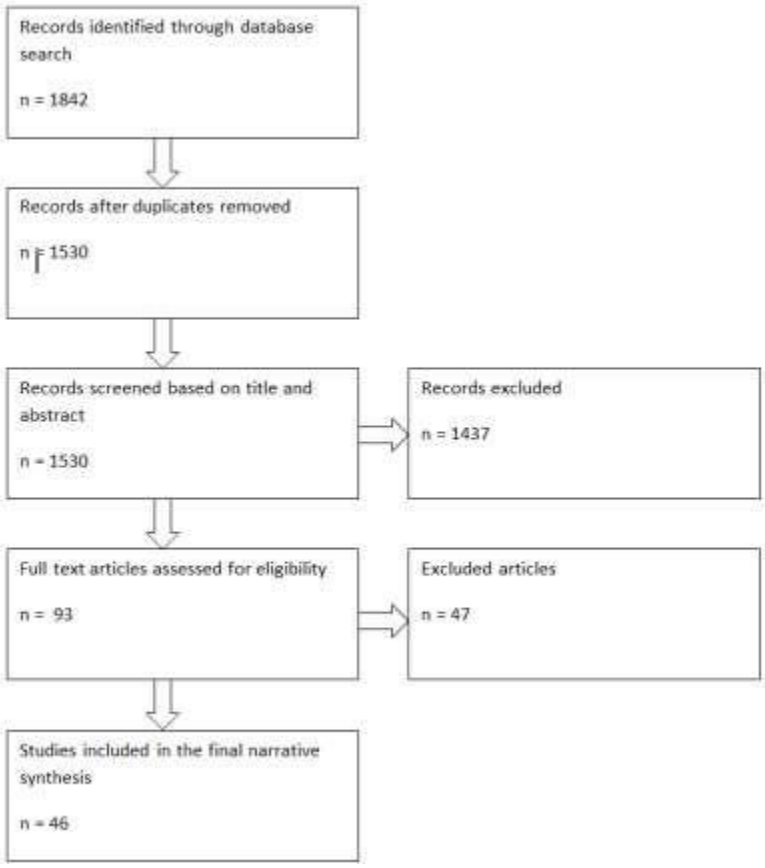

Fig. 1. *PRISMA flow diagram*

3.2 Characteristics of included studies

The 46 included studies represented a wide range of geographic regions, healthcare systems, and population characteristics. Most studies were conducted in high-income countries, including the United States, the United Kingdom, Germany, Sweden, Denmark, Italy, and Australia. A smaller number of studies originated from middle-income countries, primarily in Eastern Europe and East Asia. No studies from low-income countries met all inclusion criteria.

Study designs included retrospective cohort studies using administrative or insurance databases (n = 28), cross-sectional analyses (n = 12), prospective cohort studies (n = 5), and one large national registry-based analysis. Sample sizes ranged from approximately 1,200 individuals to more than 1.1 million participants. Follow-up duration varied substantially, ranging from one year in cross-sectional and short-term cohort studies to over ten years in longitudinal analyses.

The majority of studies included adult populations aged 18 years and older. Five studies explicitly stratified results by age groups, most commonly using a threshold of 65 years. Body mass index was classified according to World Health Organization categories in most studies, although several analyses further subdivided obesity into class I, class II, and class III. In a subset of studies, BMI was treated as a continuous variable in regression models in addition to categorical analyses.

Healthcare costs were reported from healthcare system, payer, or societal perspectives, depending on the structure of the national healthcare system and data availability. Most studies reported annual per-capita costs, while others focused on cumulative costs over the study period or costs associated with specific healthcare events, such as hospital admissions or outpatient episodes.

3.3 Types and components of healthcare costs

Across included studies, healthcare costs were categorized as direct medical costs, indirect costs, or a combination of both. Direct medical costs were reported in all studies and typically included inpatient hospital care, outpatient visits, pharmaceutical expenditures, diagnostic procedures, emergency department visits, and, in some analyses, long-term care services. Hospitalization-related costs constituted a substantial proportion of total healthcare expenditures in most studies.

Indirect costs were reported in 14 studies and primarily reflected productivity losses due to sickness absence, reduced work capacity, disability, early retirement, or premature mortality. These costs were predominantly assessed in working-age populations and were estimated using either the human capital approach or the friction cost method. Indirect costs were generally not reported for populations aged 65 years and older.

Due to heterogeneity in costing methodologies, currencies, and price years, absolute cost estimates varied widely across studies. As a result, synthesis focused on relative differences in costs across BMI categories within individual studies rather than direct comparison of absolute monetary values across settings.

3.4 Healthcare costs across the BMI spectrum

A consistent association between body mass index and healthcare costs was observed across healthcare systems and populations. In the majority of studies, individuals with normal BMI incurred the lowest healthcare expenditures and served as the reference category for cost comparisons. Both underweight and obesity were associated with increased healthcare costs, resulting in a non-linear, J-shaped relationship between BMI and expenditures.

Overweight was generally associated with modestly higher healthcare costs compared with normal BMI. These increases were primarily driven by greater utilization of outpatient services, increased use of preventive pharmacotherapy, and early management of cardiometabolic risk factors. However, the magnitude of cost differences between overweight and normal-weight individuals varied across studies and was influenced by healthcare system structure and study population characteristics.

In contrast, obesity was consistently associated with substantially higher healthcare costs. Individuals with obesity incurred higher annual medical expenditures, increased rates of hospitalization, and greater use of pharmaceutical and outpatient services compared with individuals with normal BMI. Several studies reported a stepwise increase in costs with increasing obesity severity, with the highest costs observed among individuals with class II and class III obesity.

3.5 Cost drivers among individuals with obesity

Among individuals with obesity, increased healthcare costs were largely attributable to higher prevalence of chronic diseases and greater healthcare utilization. Cardiometabolic conditions, including type 2 diabetes mellitus, hypertension, dyslipidemia, and cardiovascular disease, were identified as major contributors to increased medical expenditures across multiple studies.

Musculoskeletal disorders, particularly osteoarthritis and chronic back pain, were frequently reported as additional cost drivers. These conditions contributed to increased outpatient visits, imaging studies, pharmacological treatment, and surgical interventions, including joint replacement procedures. Mental health conditions, especially depression, were also more prevalent among individuals with obesity and were associated with increased healthcare utilization.

Hospitalization played a central role in driving obesity-related costs. Several studies reported higher rates of hospital admission, longer cumulative hospital stays, and increased use of intensive care services among individuals with obesity compared with those with normal BMI. Inpatient complications and comorbidity burden contributed substantially to increased resource use during hospital care.

3.6 Underweight and healthcare costs

Although fewer studies focused explicitly on underweight populations, available evidence indicated that low BMI was also associated with increased healthcare costs. Elevated costs among underweight individuals were particularly evident in older populations and among patients with chronic illness.

Underweight was frequently associated with frailty, sarcopenia, malnutrition, and impaired immune function. These factors contributed to increased vulnerability to acute illness, higher risk of complications during hospitalization, and delayed recovery. Several studies reported that underweight individuals experienced longer hospital stays and higher rates of rehospitalization compared with individuals with normal BMI.

In analyses focusing on hospitalization-related outcomes, underweight was associated with a disproportionate share of inpatient costs relative to its prevalence in the population. Prolonged length of stay emerged as a key contributor to increased healthcare expenditures among underweight patients.

3.7 Indirect costs associated with abnormal BMI

Indirect costs represented a substantial component of the economic burden associated with abnormal BMI in studies that included productivity-related outcomes. Among working-age populations, obesity was consistently associated with increased sickness absence, reduced work productivity, higher rates of disability, and early retirement.

In several studies, indirect costs accounted for 25% to 50% of total obesity-related costs, depending on the population and cost perspective adopted. These findings underscore the importance of including societal costs when assessing the overall economic impact of obesity.

Indirect costs related to underweight were reported less frequently. When assessed, they were primarily associated with reduced work capacity in individuals with chronic disease or recurrent hospitalizations. However, indirect costs among underweight individuals were generally smaller in magnitude than those observed among individuals with obesity.

3.8 Age-stratified analyses: working-age and older populations

A subset of included studies performed age-stratified analyses to examine differences in the association between BMI and healthcare costs across life stages. The most commonly applied age threshold was 65 years, corresponding to the transition from working age to retirement.

In working-age populations, higher healthcare costs were primarily associated with overweight and obesity. Increased expenditures were driven by chronic disease management, outpatient care utilization, pharmaceutical treatment, and productivity-related losses. Indirect costs constituted a substantial share of total costs in this age group.

In contrast, a distinct pattern was observed among older populations. In individuals aged 65 years and older, the strongest increase in healthcare costs was associated with low BMI and underweight. Underweight older adults incurred higher hospitalization-related costs, longer length of stay, and greater need for post-acute and long-term care services compared with those with normal BMI.

Obesity in older populations was also associated with increased healthcare costs; however, the magnitude of this association was often weaker than in working-age populations. Several studies reported comparable or lower costs among older adults with overweight or mild obesity compared with those with normal BMI.

3.9 Multimorbidity and hospitalization-related outcomes

Multimorbidity was frequently reported as a key factor associated with abnormal BMI and increased healthcare utilization. In studies focusing on obesity, multimorbidity was commonly treated as a mediating or adjusting variable, with inclusion of comorbidity burden substantially attenuating the association between BMI and healthcare costs.

The most commonly reported comorbidities among individuals with obesity included cardiometabolic diseases, chronic kidney disease, chronic respiratory conditions, musculoskeletal disorders, and depression. Higher comorbidity burden was consistently associated with increased hospitalization rates, higher inpatient costs, and longer length of stay.

In studies involving older populations, underweight was increasingly described in the context of multimorbidity and frailty. Underweight individuals frequently presented with multiple chronic conditions and incurred higher hospitalization-related costs, higher readmission rates, and longer hospital stays. Although adjustment for multimorbidity reduced the magnitude of the BMI–cost association, the relationship remained statistically significant in several studies, particularly for severe obesity and underweight in older adults.

4. Discussion

4.1 Principal findings

This systematic review synthesizes contemporary evidence published since 2015 on healthcare costs associated with body mass index across its full spectrum, from underweight to severe obesity. The findings demonstrate a consistent, non-linear relationship between BMI and healthcare expenditures, characterized by the lowest costs among individuals with normal BMI and substantially higher costs at both extremes of the BMI distribution. Similar J-shaped cost patterns have been reported in large population-based and cohort studies examining BMI- related healthcare expenditures across different healthcare systems (Kent et al., 2017; Tremmel et al., 2017).

A key contribution of this review lies in its explicit integration of age and multimorbidity as modifiers of BMI-related costs. Prior studies have emphasized that BMI does not act in isolation but interacts with chronic disease burden and demographic factors to influence healthcare utilization and expenditures (Rudisill et al., 2016; Ho et al., 2021). The present synthesis reinforces these observations by highlighting consistent patterns across diverse populations and healthcare settings.

4.2 Obesity, chronic disease accumulation, and healthcare utilization

The strong association between obesity and increased healthcare costs observed in this review is consistent with previous analyses linking excess body weight to higher prevalence of cardiometabolic, musculoskeletal, and mental health conditions. Large administrative and cohort-based studies have demonstrated that these obesity-related conditions substantially increase healthcare utilization, including outpatient visits, pharmacotherapy, and hospital admissions (Biener & Decker, 2018; Kent et al., 2017).

Multimorbidity emerged as a central mechanism underlying obesity-related costs. Prior research has shown that adjustment for comorbidity burden significantly attenuates, but does not eliminate, the association between obesity and healthcare expenditures, suggesting both mediated and independent effects of BMI on costs (Rudisill et al., 2016). These findings are consistent with broader evidence indicating that severe obesity is associated with increased procedural complexity, higher complication rates, and prolonged recovery, all of which contribute to higher hospitalization-related costs.

4.3 Underweight, frailty, and economic burden in older populations

Although obesity has traditionally dominated discussions of BMI-related healthcare costs, the present review underscores the economic relevance of underweight, particularly in older adults. Previous studies have described low BMI in later life as a marker of frailty, sarcopenia, and advanced chronic disease, conditions that are strongly associated with adverse health outcomes and increased healthcare utilization (Forman et al., 2018; Wannamethee & Atkins, 2015).

Evidence from studies included in this review aligns with prior observations that underweight older adults experience longer hospital stays, higher readmission rates, and greater need for post-acute and long-term care services. These findings are consistent with research demonstrating that frailty and multimorbidity, rather than BMI alone, are key drivers of healthcare utilization and costs in ageing populations (Ho et al., 2021; Forman et al., 2018).

4.4 Age-dependent patterns of BMI-related costs

The findings of this review highlight pronounced age-dependent differences in the economic consequences of abnormal BMI. In working-age populations, obesity-related costs were driven by both direct medical expenditures and indirect costs related to productivity loss.

Prior studies have demonstrated that obesity is associated with increased sickness absence, reduced work capacity, and early exit from the labor market, substantially increasing the overall economic burden of excess body weight (Biener & Decker, 2018; Tremmel et al., 2017).

In contrast, among older adults, underweight emerged as a stronger predictor of increased healthcare costs than obesity. Previous analyses have reported that low BMI in older populations is associated with prolonged hospitalization and increased demand for long-term care, whereas overweight or mild obesity may be associated with comparable or lower costs, a phenomenon sometimes referred to as the “obesity paradox” (Kent et al., 2017; Forman et al., 2018). These age-specific patterns emphasize the importance of a life-course perspective in economic evaluations of BMI.

4.5 Multimorbidity as a central driver of hospitalization costs

Across BMI categories, multimorbidity consistently emerged as a major determinant of hospitalization-related costs and length of stay. Studies examining the relationship between BMI, comorbidity burden, and healthcare expenditures have shown that individuals with multiple chronic conditions incur disproportionately higher inpatient costs, regardless of BMI category (Rudisill et al., 2016; Ho et al., 2021).

In patients with obesity, multimorbidity contributes to increased procedural complexity and risk of complications, whereas in underweight older adults, it is closely linked to frailty- related hospital trajectories characterized by recurrent admissions and prolonged length of stay. These observations are consistent with prior research highlighting multimorbidity as a key driver of healthcare utilization and costs in both middle-aged and older populations (Forman et al., 2018).

4.6 Strengths and limitations

The strengths of this review include its exclusive focus on contemporary, PubMed-indexed evidence and its examination of the full BMI spectrum. By explicitly incorporating age and multimorbidity as modifiers, the present synthesis extends prior economic analyses that focused predominantly on obesity (Tremmel et al., 2017; Kent et al., 2017).

Several limitations should be acknowledged. Most included studies were observational, limiting causal inference, and BMI was self-reported in some analyses, introducing potential measurement error. Additionally, heterogeneity in healthcare systems, cost definitions, and analytical methods precluded quantitative meta-analysis, a limitation frequently noted in prior reviews of obesity-related healthcare costs (Tremmel et al., 2017).

4.7 Implications for clinical practice and health policy

The findings of this review have important implications for clinical practice and health policy. Previous studies have emphasized that interventions targeting obesity prevention in working- age populations may yield long-term economic benefits by reducing chronic disease burden and productivity losses (Biener & Decker, 2018; Tremmel et al., 2017). The present review supports these conclusions while also highlighting the need to address underweight and frailty in older adults.

Integrating nutritional assessment, frailty screening, and multimorbidity management into routine clinical care may help reduce prolonged hospitalizations and transitions to long-term care, as suggested by prior research on ageing populations and chronic disease management (Forman et al., 2018; Ho et al., 2021).

4.8 Directions for future research

Future research should prioritize longitudinal studies examining BMI trajectories, multimorbidity development, and healthcare costs over time. Prior reviews have highlighted the need for standardized cost definitions and improved reporting to enhance comparability across studies (Tremmel et al., 2017). Additional research focusing on underweight and frailty in ageing populations is particularly warranted, given their growing relevance to healthcare systems worldwide (Ho et al., 2021).

4.9 Implications for healthcare system planning (with citations)

Beyond individual-level clinical implications, the findings of this review have important relevance for healthcare system planning and resource allocation. The consistently observed J-shaped relationship between body mass index and healthcare costs suggests that both obesity prevention and early identification of underweight should be considered priorities in health system strategies. Large population-based studies have demonstrated that obesity is associated with substantially increased healthcare expenditures, particularly through hospitalizations and chronic disease management, highlighting the potential economic benefits of preventive interventions targeting excess body weight (Kent et al., 2017; Biener & Decker, 2018).

At the same time, the economic burden associated with underweight and frailty in older populations underscores the need for targeted strategies beyond traditional obesity-focused approaches. Prior research has shown that low BMI in later life is closely linked to multimorbidity, frailty, and prolonged hospital stays, all of which contribute to increased demand for inpatient and long-term care services (Forman et al., 2018; Ho et al., 2021). These findings suggest that healthcare systems facing demographic ageing may need to allocate greater resources toward nutritional support, rehabilitation, and integrated geriatric care pathways.

Healthcare systems experiencing increasing pressure from rising multimorbidity may benefit from incorporating BMI-based risk stratification into planning and budgeting processes.

Evidence indicates that both severe obesity and underweight are associated with disproportionately high healthcare utilization when accompanied by multiple chronic conditions, emphasizing the importance of integrated care models that address body weight, comorbidity burden, and functional status simultaneously (Rudisill et al., 2016; Ho et al., 2021).

Taken together, these findings support the development of age-sensitive and multimorbidity- informed health policies aimed at reducing hospitalization-related costs and optimizing resource allocation. Preventive strategies targeting obesity in working-age populations and interventions aimed at mitigating frailty and undernutrition in older adults may contribute to more efficient use of healthcare resources and improved system sustainability (Tremmel et al., 2017; Kent et al., 2017).

5. Conclusions

This systematic review demonstrates that healthcare costs vary substantially across the body mass index spectrum and that both low and high BMI values are associated with increased economic burden. While obesity—particularly severe obesity—remains a major driver of healthcare expenditures, underweight represents a significant and underappreciated contributor to costs, especially among older adults.

The findings highlight the critical roles of age and multimorbidity in shaping BMI-related healthcare costs. In working-age populations, obesity-related costs are driven by chronic disease management and productivity losses, whereas in older populations, underweight and frailty are associated with prolonged hospitalization and increased need for long-term care. Multimorbidity emerges as a central mechanism linking abnormal BMI to increased healthcare utilization and costs across the lifespan.

These results underscore the need for comprehensive, age-sensitive, and multimorbidity- informed strategies to address the economic consequences of abnormal body weight.

Preventive interventions, integrated care models, and targeted health policies aimed at maintaining healthy body weight and reducing chronic disease burden may contribute to improved health outcomes and more sustainable healthcare systems.

Author Contributions

Conceptualization: Author 1, Author 4

Methodology: Author 4, Author 7

Protocol development: Author 1, Author 4

Literature search: Author 1, Author 2, Author 3

Study selection and eligibility assessment: Author 1, Author 2, Author 3, Author 8

Data extraction: Author 1, Author 3, Author 5, Author 8 Data curation and organization: Author 5, Author 10

Data synthesis and interpretation: Author 1, Author 4, Author 6 Formal analysis: Author 6, Author 7

Writing – original draft: Author 1, Author 6

Writing – review and editing: Author 2, Author 3, Author 4, Author 5, Author 7, Author 8, Author 9

Visualization (PRISMA flow diagram): Author 10 Supervision: Author 4, Author 9

Project administration: Author 9

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