

Integrating Obesity and Diabetes Management: A Narrative Review of Multilevel Strategies

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ABSTRACT

Background: Obesity and type 2 diabetes mellitus (T2DM) are global public health challenges that frequently coexist due to overlapping metabolic and inflammatory pathways. This narrative review examines the bidirectional relationship between these conditions and evaluates multidisciplinary strategies for integrated prevention and management. Using literature from Scopus and ScienceDirect (2014–2024), the review includes studies that explore pathophysiological connections, lifestyle-based and pharmacological interventions, and public health policy innovations. The findings highlight the central role of visceral adiposity in insulin resistance and beta-cell failure, necessitating integrated treatment approaches. Multidisciplinary programs that combine dietary, behavioral, and technological interventions show promising outcomes in both weight and glycemic control. Policy interventions such as sugar-sweetened beverage taxation and front-of-pack labeling have contributed to improved population-level health behavior. Furthermore, community-based strategies, particularly in low- and middle-income countries (LMICs), offer culturally relevant and scalable solutions. Despite these successes, challenges remain in achieving sustainability, ensuring equitable access, and adapting interventions to local contexts. This review underscores the need for harmonized clinical, behavioral, and policy approaches, and calls for further research into long-term outcomes, scalability, and cost-effectiveness of integrated strategies for addressing the dual burden of obesity and diabetes.

INTRODUCTION

Diabetes mellitus (DM) and obesity represent two interrelated global epidemics that significantly contribute to the burden of noncommunicable diseases (NCDs) worldwide. As reported by the International Diabetes Federation, approximately 537 million adults aged 20 to 79 years were living with diabetes globally in 2021, a figure that is expected to increase to 783 million by 2045 (1). Similarly, the World Health Organization has identified obesity as a major global health threat, with over 650 million adults classified as obese in 2016 a threefold increase since 1975 (2). These chronic conditions not only heighten the risk of morbidity and premature mortality but also impose immense pressure on healthcare systems, particularly in low- and middle-income countries (LMICs) undergoing rapid epidemiological transitions.

In Indonesia, the burden of these dual conditions has intensified over the past decade. According to the 2018 Basic Health Research (Riskesdas) survey, the prevalence of obesity among adults increased from 14.8% in 2013 to 21.8% in 2018, while diabetes prevalence among individuals aged 15 and above reached 10.9% (3). The relationship between obesity especially visceral or abdominal adiposity and type 2 diabetes mellitus (T2DM) has been well documented in biomedical literature. Obesity is known to promote insulin resistance and chronic inflammation, which are central mechanisms in the pathogenesis of T2DM (4). Visceral fat, in particular, is metabolically active and secretes pro-inflammatory cytokines such as TNF- α and IL-6, which interfere with insulin signaling pathways. Despite extensive research efforts, current management strategies often fail to address the complex and bidirectional relationship between obesity and diabetes. Most interventions remain siloed, targeting either glycemic control or weight reduction without considering the integrated physiological and behavioral underpinnings of these co-occurring conditions (5). As a result, there is an urgent need for comprehensive approaches that can simultaneously manage both conditions through personalized, multidisciplinary, and culturally sensitive interventions. These approaches should not only focus on clinical outcomes but also incorporate psychosocial, lifestyle, and environmental determinants of health. The predominant reliance on monodisciplinary or pharmacological treatments has shown limitations in sustainability and scalability, especially in resource-constrained settings. While pharmacotherapies such as metformin and GLP-1 receptor agonists have shown efficacy in controlling glycemia and promoting modest weight loss, they do not address the root behavioral and

socio-environmental drivers of obesity and T2DM (6). Moreover, patient adherence to medication regimens is often suboptimal in LMIC contexts, where health literacy and access to care are limited. These barriers necessitate more integrative frameworks that encompass behavioral counseling, dietary interventions, physical activity promotion, and community engagement, in addition to pharmacological treatment.

Several studies have explored the benefits of multidisciplinary interventions, including those that integrate digital health tools, behavioral therapy, and structured lifestyle programs. For instance, the Diabetes Prevention Program (DPP) and Look AHEAD trials have demonstrated that lifestyle modifications can significantly reduce the incidence of T2DM and improve weight-related outcomes in high-risk individuals (7,8). In Indonesia, community-based interventions that utilize local health workers to deliver nutrition education and promote physical activity have also shown promise (9). These interventions are often more culturally appropriate and sustainable, particularly when supported by local governance and public health infrastructure. Digital health innovations, including mobile apps, telemedicine, and wearable fitness trackers, are emerging as cost-effective tools for managing obesity and T2DM in diverse populations. These tools can facilitate real-time monitoring, personalized feedback, and remote coaching, thus overcoming some of the barriers associated with traditional healthcare delivery (10). However, their implementation in LMICs remains limited by infrastructure challenges, digital literacy gaps, and regulatory concerns. Therefore, the potential of digital health must be contextualized within broader health system reforms and community-based support structures.

Although significant progress has been made, there remains a lack of integrative reviews that systematically synthesize the interplay between obesity and T2DM, especially in the context of LMICs like Indonesia. Most reviews tend to focus on either disease-specific outcomes or interventions without addressing the shared etiological pathways and the need for cross-sector collaboration (11). Furthermore, few studies have examined the effectiveness of policy-level interventions such as sugar taxes, food labeling regulations, and urban planning for active transport—in mitigating the dual burden of obesity and T2DM (12). These policy measures, when combined with community-based programs, have the potential to generate large-scale and sustained health improvements.

Given these gaps, this narrative review aims to provide a comprehensive synthesis of existing evidence on the pathophysiological connections, intervention strategies, and policy frameworks addressing obesity and T2DM. The review focuses on literature published in the last decade from high-impact journals indexed in Scopus and ScienceDirect, emphasizing studies that evaluate multidisciplinary and integrated approaches. By highlighting best practices and identifying challenges in implementation, this review seeks to inform future research, clinical guidelines, and national health strategies. The novelty of this study lies in its integrative perspective that transcends the conventional biomedical model to include sociocultural, economic, and systemic determinants of health. We hypothesize that integrated interventions, when tailored to local contexts and supported by multisectoral policies, are more effective than siloed approaches in managing the dual burden of obesity and diabetes. This review also draws on primary data extracted from recent Indonesian studies and databases to contextualize the findings within national health priorities. Ultimately, the goal is to propose a holistic framework that can guide future research and practice in addressing one of the most pressing public health challenges of our time.

METHODS

Review Approach

This study adopted a narrative literature review methodology to explore the multifaceted relationship between obesity and type 2 diabetes mellitus (T2DM), with a particular focus on multidisciplinary interventions and integrative health strategies. The narrative approach was chosen for its suitability in synthesizing heterogeneous evidence and providing a comprehensive understanding of conceptual, clinical, and policy-level insights. Unlike systematic reviews that follow rigid frameworks and meta-analytical protocols, narrative reviews allow for a more interpretive synthesis of diverse sources, including clinical trials, epidemiological data, public health evaluations, and policy analyses. This approach enabled the integration of findings from varied methodological traditions, offering a nuanced understanding of the interplay between physiological mechanisms, behavioral interventions, and socio-political determinants of health.

Search Strategy

A structured search strategy was developed to identify relevant articles from two prominent scientific databases: Scopus and ScienceDirect. These databases were selected due to their extensive indexing of high-impact,

peer-reviewed journals in medicine, public health, and interdisciplinary sciences. The search included studies published between January 2014 and January 2024 to ensure the inclusion of recent and relevant literature. Boolean operators were used to combine key terms, which were defined based on the research focus. The following query guided the search: ("Obesity" OR "Overweight") AND ("Type 2 Diabetes" OR "Insulin Resistance") AND ("Intervention" OR "Management" OR "Prevention"). All retrieved articles were initially screened by title and abstract for relevance to the research objectives. Subsequently, full-text articles were reviewed to ensure alignment with the inclusion criteria.

Inclusion and Exclusion Criteria

To maintain the quality and relevance of the review, a set of predefined inclusion and exclusion criteria was applied. Eligible studies were original research articles or systematic reviews published in English, accessible in full-text, and indexed in high-impact (Q1 or Q2) journals. Selected studies must have addressed the relationship between obesity and T2DM, or evaluated multidimensional interventions aimed at managing or preventing these conditions concurrently. Studies that focused exclusively on either obesity or T2DM without examining their interplay were excluded. Additional exclusion criteria included animal studies, in vitro experiments, editorials, commentaries, and letters to the editor. This selection process ensured that the final pool of literature reflected a comprehensive and high-quality body of knowledge suitable for narrative synthesis.

Data Analysis Process

The review followed an inductive thematic analysis to identify key concepts, recurring themes, and significant gaps in the literature. After the full-text screening, data were extracted from each study using a structured matrix that captured relevant information such as study design, population characteristics, type of intervention, outcomes measured, and major findings. These data were then grouped into thematic domains that aligned with the review's objectives: (1) pathophysiological mechanisms linking obesity and T2DM; (2) effectiveness of multidisciplinary interventions in integrated care models; and (3) public health and policy-based approaches to dual-condition prevention and management. The synthesis involved comparing findings across contexts and methodologies, highlighting both consensus and divergence in the literature. Discrepancies were analyzed further to understand the role of setting, population characteristics, and intervention design in shaping outcomes. This process facilitated a coherent narrative that connected empirical findings to broader health system implications.

RESULT AND DISCUSSION

RESULT

Pathophysiological Mechanisms Linking Obesity and Type 2 Diabetes

The reviewed literature consistently identifies visceral adiposity as a central driver of the pathophysiological processes that link obesity to type 2 diabetes mellitus (T2DM). Excess visceral fat contributes to chronic low-grade inflammation and the dysregulation of adipokines, including leptin, adiponectin, and resistin, which impair insulin receptor function in hepatic, muscle, and adipose tissues (13). Concurrently, pro-inflammatory cytokines such as TNF-alpha and IL-6 activate stress kinases that inhibit insulin signaling pathways (14). Beta-cell dysfunction is also exacerbated through lipotoxicity and glucotoxicity induced by elevated free fatty acids and hyperglycemia (15). Moreover, ectopic fat deposition in the liver and pancreas further impairs metabolic homeostasis (16). These findings support the hypothesis that visceral obesity is not merely a comorbidity but a causative factor in the development of diabetes through its endocrine and inflammatory effects.

Effectiveness of Multidisciplinary Interventions Multidisciplinary

interventions demonstrate superior outcomes when compared to isolated clinical strategies. Structured lifestyle modification programs show significant reductions in body mass index (BMI) and glycated hemoglobin (HbA1c), integrating nutritional counseling, structured physical activity, and behavioral change strategies (17). One community-based intervention in Southeast Asia demonstrated weight reduction and improved glycemic control following a 12-month group education and home-activity program (18). The use of digital tools, including mobile health applications and wearable devices, is associated with improved adherence and self-regulation (19). Behavioral techniques such as motivational interviewing and cognitive behavioral therapy also enhance sustained outcomes in lifestyle programs (20).

Pharmacological therapies, including GLP-1 receptor agonists and SGLT2 inhibitors, further enhance outcomes when paired with lifestyle modification (21). Programs delivered by interdisciplinary teams consisting of endocrinologists, dietitians, exercise specialists, and psychologists show greater engagement and clinical success (22). However, many of these initiatives lack scalability and long-term sustainability in low-resource settings. Nevertheless, the current body of evidence affirms the need for personalized, integrated care models tailored to both individual and population needs (23).

Public Health Policies and Community-Based Strategies

Public health policies are essential in reducing population-level risks associated with obesity and diabetes. Sugar-sweetened beverage taxation has been shown to reduce purchase and consumption rates of high-calorie beverages in several countries, including Mexico and South Africa (24). Nutritional labeling on food products and restaurant menus encourages healthier consumer choices and increases awareness of calorie intake (25). National media campaigns promoting physical activity and balanced diets contribute to general knowledge and behavior change, particularly when culturally adapted (26). Community-level interventions are particularly effective in low- and middle-income countries (LMICs). Local health workers have been instrumental in conducting screening, education, and counseling initiatives, particularly in underserved urban and rural areas (27). In Indonesia, integrated NCD control posts (Posbindu PTM) and urban health centers have implemented preventive services addressing both diabetes and obesity, supported by local governance and community volunteers (28). Despite success in outreach and participation, many programs face barriers related to funding, workforce capacity, and evaluation infrastructure (29).

Synthesis and Observed Patterns Several

patterns emerged across the reviewed literature. The consistent identification of inflammation, hormonal imbalance, and ectopic fat as common mechanisms reinforces the need for dual-condition management strategies (30). Lifestyle-based programs, particularly those that integrate digital tools, demonstrate efficacy in both short-term and intermediate health outcomes (31). Public health strategies, when supported by multisector collaboration and regulatory enforcement, can lead to systemic changes in population health behavior (32). Nonetheless, significant gaps persist. A large proportion of available studies originate from high-income countries, limiting generalizability to LMICs. Few studies examine combined clinical and policy-level interventions within a single analytical framework. Additionally, evidence on long-term adherence and relapse prevention remains limited (33).

Implications for Policy and Practice

The current findings highlight the importance of a systemic, multi-tiered approach to address the dual burden of obesity and diabetes. Integrative health models should align individualized care with environmental and policy supports. Investment in training health professionals, deploying digital infrastructure, and expanding community-based services are essential (34). Interventions must also be culturally tailored, context-sensitive, and designed for scalability. Regulatory measures, such as food subsidies and urban planning for active living, should be embedded into national prevention strategies (35). Overall, the evidence confirms that effective management of obesity and T2DM requires convergence of clinical, behavioral, and structural strategies. Future research should focus on evaluating integrative models in diverse settings and developing sustainable intervention pathways that are both equitable and scalable (36).

DISCUSSION

The findings of this narrative review reinforce the substantial and bidirectional link between obesity and type 2 diabetes mellitus (T2DM), a relationship underpinned by overlapping metabolic, inflammatory, and hormonal mechanisms. Visceral adiposity in particular has been shown to play a central role in promoting insulin resistance via increased secretion of pro-inflammatory cytokines such as TNF-alpha and IL-6, which impair insulin signaling pathways and contribute to beta-cell dysfunction (13,14). These mechanisms underscore the pathophysiological rationale for addressing obesity and T2DM through integrated approaches rather than treating them in isolation.

Our synthesis highlights that lifestyle interventions, when applied in a structured, multidisciplinary manner, yield superior clinical outcomes for individuals at risk or already diagnosed with T2DM. Programs incorporating

diet modification, physical activity, and behavioral counseling show consistent reductions in both body weight and glycemic indices, including HbA1c (17,18). These results echo the Diabetes Prevention Program and similar studies that report long-term benefits of lifestyle-based approaches to diabetes control (7,17). However, sustaining these effects remains a challenge. A number of interventions demonstrated diminishing returns over time, particularly in resource-constrained settings, raising concerns about long-term adherence and implementation capacity (23).

Digital health technologies have emerged as pivotal enablers in chronic disease management, particularly for facilitating lifestyle modification. Mobile applications, wearable devices, and remote coaching systems enhance user engagement and allow for individualized feedback, which is associated with improved outcomes in weight loss and glycemic control (19,31). Nevertheless, digital interventions require adaptation for LMIC contexts, where disparities in digital literacy and access to technology may limit their reach and effectiveness. Programs such as Health-e-call and mDiabetes provide valuable models of technology-enabled chronic disease support, but their translation to real-world settings in Indonesia remains limited by infrastructure and cost barriers (19,31).

Pharmacological strategies, particularly the use of GLP-1 receptor agonists and SGLT2 inhibitors, complement behavioral interventions by contributing to significant metabolic improvements and reduced cardiovascular risk (21). However, these therapies often come at high costs and require health system-level infrastructure for effective delivery and monitoring. In LMICs, inconsistent supply chains and limited insurance coverage reduce the feasibility of widespread pharmacological interventions, highlighting the importance of low-cost lifestyle strategies and community-based care models (22,34).

Policy-level interventions such as sugar taxes and nutritional labeling have proven successful in reducing risk factors at the population level. For instance, implementation of excise taxes on sugar-sweetened beverages in Mexico and South Africa has led to significant declines in consumption and sales, with corresponding reductions in obesity prevalence (24). Nutrition labeling in restaurants and supermarkets increases transparency and nudges consumers toward healthier choices (25). These regulatory approaches, while effective, often face resistance from industry stakeholders and require strong political commitment and sustained advocacy to maintain their impact (32).

Community-based strategies are indispensable, particularly in LMIC settings. In Indonesia, local health infrastructure such as Posbindu PTM and Puskesmas provide essential platforms for screening, education, and management of noncommunicable diseases, including diabetes and obesity (28). Programs utilizing cadres or community health volunteers have shown increased participation and greater reach into marginalized populations. However, ensuring the quality, consistency, and sustainability of such efforts remains an operational challenge. Training, supervision, and adequate compensation for community health workers are essential to sustaining these interventions (29).

A key theme across the reviewed literature is the fragmentation of intervention efforts. Many programs operate in silos either within clinical settings without linkage to community or policy strategies, or within public health programs without clinical integration (5,33). Bridging these divides is crucial to maximizing the impact of interventions. Multilevel frameworks that align policy, health service delivery, and community engagement are more likely to produce sustained behavioral and metabolic change. Integrated models of care such as the Chronic Care Model (CCM) and the WHO Package of Essential Noncommunicable Disease Interventions (WHO PEN) offer promising templates that have yet to be fully scaled in LMIC contexts.

Moreover, most studies continue to originate from high-income countries, with limited generalizability to LMIC populations. Cultural differences in diet, physical activity, and health beliefs necessitate the adaptation of intervention strategies to local contexts (26,27). For example, while calorie-count labeling may influence behavior in urban populations familiar with nutrition education, such interventions may be less impactful in rural communities where literacy or access to labeled foods is limited. Similarly, health promotion campaigns in LMICs must account for local language, media access, and socioeconomic realities to be effective (10,32).

Another critical gap is the under-evaluation of long-term sustainability and cost-effectiveness of interventions. While short-term results are promising, the ability to maintain weight loss and glycemic control over years remains poorly documented. Relapse rates post-intervention are rarely reported, and few studies include follow-up periods exceeding 24 months (33,36). Cost-benefit analyses are similarly lacking, which hampers policy makers' ability to prioritize among competing health programs, especially when resources are constrained.

The Indonesian context presents both challenges and opportunities for innovation in integrated diabetes-obesity care. With a growing prevalence of both conditions and a fragmented health system, Indonesia must develop scalable and culturally attuned interventions. Strengthening primary care, expanding insurance coverage through BPJS Kesehatan, and leveraging existing community health structures can serve as entry points for integrated programs. National strategies should also consider fiscal measures that address upstream determinants of health, such as agricultural subsidies for healthy foods and urban planning that facilitates physical activity (35).

In light of the evidence presented, it is clear that addressing the double burden of obesity and T2DM requires a systems-level approach. Clinical, behavioral, and policy dimensions must be harmonized through coordinated strategies involving stakeholders across the health sector, civil society, and government. Successful programs in other LMICs have demonstrated the value of multisector collaboration, transparent monitoring systems, and continuous stakeholder engagement in sustaining intervention outcomes. Indonesia and similar contexts can draw from these lessons to refine and scale integrated health strategies that respond to their specific population needs and resource capacities.

CONCLUSION

This narrative review emphasizes the profound and intertwined relationship between obesity and type 2 diabetes mellitus (T2DM), underpinned by shared inflammatory and metabolic pathways. It reveals that visceral adiposity serves as a major contributor to insulin resistance and beta-cell dysfunction, reinforcing the necessity for integrated approaches to prevention and treatment. Multidisciplinary lifestyle interventions, particularly those augmented by digital health tools and behavioral support, have demonstrated considerable success in reducing both body weight and glycemic levels. Public health policies such as sugar taxes and nutritional labeling further support these outcomes on a population scale. Additionally, community-based strategies offer cost-effective and scalable interventions, particularly in low- and middle-income countries (LMICs) like Indonesia. However, implementation challenges remain, especially in terms of sustainability, contextual adaptation, and bridging fragmented efforts across clinical and policy domains. This review contributes to the body of knowledge by synthesizing contemporary literature and proposing the alignment of clinical, behavioral, and structural strategies for dual-condition management. Future research should prioritize long-term evaluation of integrated programs, their cost-effectiveness, and cultural adaptability in diverse settings.

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