



# Mapping the use of virtual reality in health promotion and weight management among overweight and obese individuals – a scoping review

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## ABSTRACT

**Introduction and aim.** Obesity and overweight, defined by excess body fat, are major global public health challenges. Virtual reality (VR) is emerging as a novel tool for health promotion and weight management. This scoping review aimed to map existing research on VR applications in overweight and obese populations.

**Material and methods.** Following PRISMA-ScR guidelines, systematic searches were conducted in PubMed, SCOPUS, EBSCO, Pedro, Embase, Web of Science, and Google Scholar up to March 2025. Keywords included 'obese', 'overweight' and "virtual reality." Eligible studies were cross-sectional, experimental or randomized controlled trials involving overweight or obese individuals exposed to VR-based interventions targeting physical health, behavior change, or weight control. Two reviewers independently screened and extracted the data.

**Results.** Ten studies published between 2012 and 2025 were included. Most involved adolescents and women, with limited representation of men and older adults. VR interventions varied in immersion, platform, and focus, targeting physical activity, behavioral change, and nutrition. Outcomes commonly included body composition, physical activity, emotional well-being, and diet. Heterogeneity prevented meta-analysis.

**Conclusion.** VR holds promise as a multidimensional tool for the management of obesity. However, more inclusive, culturally adapted, and long-term studies are needed to validate its effectiveness and applicability in diverse populations.

**Keywords.** adiposity, obesity, overweight, virtual reality, weight loss

## Introduction

Obesity is defined as 'abnormal or excessive fat accumulation that presents a health risk'.<sup>1</sup> Overweight refers to a condition in which an individual carries excess body fat that can affect health, whereas obesity indicates a more severe degree of fat accumulation with a greater risk of adverse health outcomes. Both conditions arise from an imbalance between energy intake (diet) and energy expenditure (physical activity), leading to fat deposition at subcutaneous and ectopic sites. Although recent data suggest a plateau in the prevalence of overweight

and obesity among children and adults in several countries, these conditions remain significant public health concerns.<sup>2</sup> They are strongly associated with chronic diseases such as hypertension, coronary heart disease, type 2 diabetes, stroke, gallbladder disease, certain cancers, osteoarthritis, and sleep apnea.<sup>3</sup> In light of the rising global burden, there is an urgent need for advanced treatment strategies that enable early intervention and prevent obesity-related complications. Early identification of overweight individuals within the community and the provision of timely targeted interventions are

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essential steps toward mitigating the long-term health risks associated with excess weight.

VR is an emerging transformative technology with significant potential in the medical field. By creating a controlled artificial environment, virtual reality bypasses the complexities of physical settings, thereby accommodating a wide range of therapeutic needs. Its applications include the treatment of neurological and psychiatric disorders, such as pain, anxiety, and depression, as well as the rehabilitation of neurodegenerative conditions such as Parkinson's disease and stroke. A key advantage of VR lies in its ability to generate a convincing illusion of reality, providing users with a heightened sense of presence and immersion.<sup>3</sup> Furthermore, VR has been shown to improve cognitive function and concentration, while its interactive nature encourages greater user participation.<sup>4</sup> Unlike traditional forms of physical activity, VR-based exercise has been found to elevate mood, increase enjoyment, and reduce the risk of burnout.<sup>5,7</sup> The recreational aspects of VR support deep immersion, boost motivation, and enhance learning outcomes.<sup>5</sup> By offering simulated experiential learning, VR holds promise in addressing the limitations of existing online weight management programs.<sup>8</sup> When combined with physical activity, immersive virtual reality (IVR) has been shown to increase physiological and metabolic demands without raising, and sometimes even reducing, perceived exertion.<sup>9</sup>

This scoping review maps and synthesizes the existing literature on VR-based interventions for overweight and obesity. Instead of evaluating the clinical effectiveness of these interventions, the review focuses on exploring the breadth, scope, and characteristics of current research. The key themes explored include aspects such as user engagement, adherence, psychological and behavioral outcomes, and the integration of VR into long-term health practices.

## **Aim**

In contrast to previous systematic reviews and meta-analyses that emphasize quantifiable outcomes such as weight loss or reduction in body mass index (BMI), this review provides a broader descriptive overview of how VR is currently being utilized in weight management contexts. It also examines the use of VR in both community and clinical settings, highlighting reported aspects of feasibility, usability, and cost. By identifying knowledge gaps and summarizing the existing landscape, this review aims to inform future research, technological development, and policy in the field of VR-based obesity interventions.

## **Material and methods**

### *Study design*

This scoping review was conducted with the primary objective of mapping and synthesizing the existing lit-

erature on the application of VR interventions for the management of overweight and obesity. The methodological approach was guided by the extension of preferred reporting items for systematic reviews and Meta-Analyses extension for scoping reviews (PRISMA-ScR), which provided a structured and transparent framework to ensure methodological rigor and reproducibility throughout the review process. This study constitutes a scoping review and was not registered in PROSPERO, as PROSPERO does not accept scoping review protocols. The protocol was drafted a priori to guide the methodological approach, in accordance with the PRISMA-ScR recommendations.

### *Search strategy*

A systematic search of the literature was performed on six major electronic databases: PubMed, SCOPUS, EBS-CO, PEDro, Embase, Web of Science, and Google Scholar during April and May 2024. The search was restricted to full-text articles published in English between January 2012 and April 2025. To enhance the completeness of the search, a combination of relevant keywords and Boolean operators was used, such as: (“virtual reality” OR “VR”) AND (“obesity” OR “obesity” OR “overweight”) AND (“intervention” OR “treatment” OR “therapy”). In addition to database searches, reference lists of all eligible studies were manually screened to identify any relevant articles that may not have been retrieved by electronic searches. Although the agreement was not formally quantified using statistical measures such as Cohen's kappa, the review process maintained a high level of consistency and transparency.

### *Eligibility criteria*

Studies were considered eligible for inclusion if they involved overweight or obese individuals, regardless of age or gender, and employed a VR-based intervention aimed at improving physical health, facilitating behavior change or promoting weight reduction. Only empirical studies adopting randomized controlled trials or quasi-experimental designs were included to ensure the reliability and applicability of the findings. Studies were excluded if they involved participants with serious comorbid conditions unrelated to obesity, lacked an interactive VR component, or were non-empirical in nature such as reviews, editorials, protocols, or conference abstracts.

### *Study selection process*

The initial database search yielded a total of 1,172 records. After the removal of 653 duplicates and 21 records excluded by automated filtering tools, 498 unique articles remained for title and abstract screening. Based on relevance to the research objectives, 36 articles were retrieved for full-text evaluation. Following a thorough

review using the predefined inclusion and exclusion criteria, 10 studies were deemed eligible and included in the final synthesis. The entire selection and selection process was independently by two reviewers. Disagreements at any stage were resolved by discussion and consensus. A third reviewer was available for arbitration, but was not required, as consensus was consistently achieved. The study identification and selection process are visually presented in the updated PRISMA-ScR flow diagram (Fig. 1).

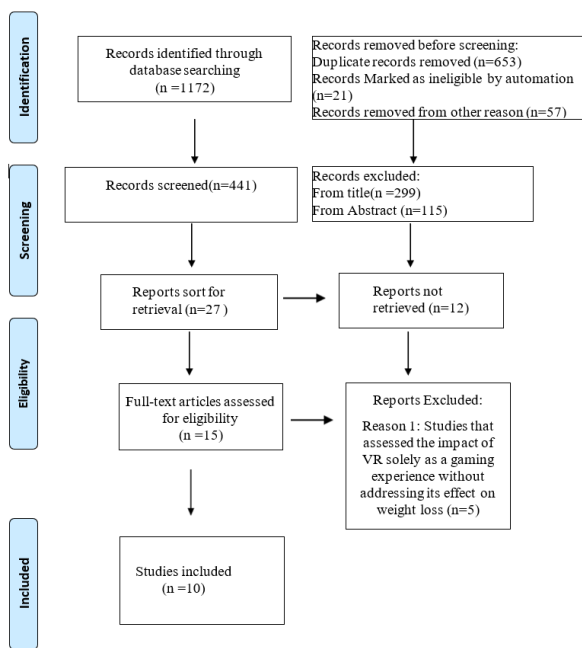


Fig. 1. PRISMA-ScR flow diagram

#### Data extraction and verification

A structured data chart form was developed and used to extract key information from each included study. Extracted variables included the author and year of publication, geographic location, study design, sample size and demographic characteristics, nature and duration of the VR intervention, outcome measures and principal findings. All data were independently verified by a second reviewer to ensure accuracy, completeness, and consistency between sources.

#### Quality appraisal

Although a formal risk of bias assessment is not a mandatory component of scoping reviews, a basic methodological assessment was conducted to provide contextual insights into the strength of the evidence. The Cochrane Risk of Bias tool was descriptively applied to the randomized controlled trials included in the review. This evaluation did not influence study selection or synthesis, but served to offer an additional layer of interpretive context regarding study quality.

#### Data synthesis

Given the variability in study designs, intervention protocols, and reported results, a meta-analysis was deemed inappropriate. Instead, a qualitative narrative and thematic synthesis was undertaken. The extracted data was thematically analyzed to identify recurring patterns and conceptual domains. An open coding approach was used to manually code relevant findings from each study, and similar codes were grouped into descriptive themes. The coding was performed iteratively and reviewed by the research team to ensure consistency and alignment with the study objectives. The synthesis focused on key themes such as physical health outcomes associated with VR interventions, psychological impacts on participants, levels of user engagement and adherence, feasibility of implementation in various settings, and the sustainability of the intervention effects over time.

#### Results

This scoping review included ten full-text articles, encompassing a cumulative sample of 960 participants. The findings were thematically organized according to the stated objectives, which focused on physiological outcomes, emotional responses, compliance, and sustainability. A tabulated summary of the studies is presented in Table 1, providing a structured overview of the literature on VR interventions in overweight and obese populations.

#### Physical health outcomes

Several studies reported improvements in physiological parameters following VR interventions. In particular, a Korean study demonstrated significant reductions in body mass index (BMI) among overweight middle-aged women, attributed to VR-facilitated physical activity.<sup>10</sup> Navarro et al. similarly reported reductions in BMI and body weight through the use of VR-enhanced exercise protocols. Most studies employed standard anthropometric tools such as calibrated stadiometers and digital weighing scales, although detailed measures of body composition (eg, fat mass or lean body mass) were rarely reported.<sup>11</sup> Furthermore, the brevity of intervention periods in many studies presents limitations in assessing long-term physiological efficacy. The study by Mologne et al. further demonstrated improvements in cardiometabolic parameters using an immersive VR exergame in a 12-week trial.<sup>12</sup>

#### Psychological outcomes

VR interventions were consistently associated with positive emotional changes. Several studies documented reductions in depressive symptoms and anxiety levels, as well as improvements in the affective states.<sup>10,11</sup> Na-

**Table 1.** Characteristics of key references

Sr no	Location	Author	Study design	Duration	subjects	Outcome assessed	Results	Limitations
1	Korea	Eun-young Seon (2023)	Randomized controlled trial	8 weeks	75 overweight middle-aged women (45-65year old)	BMI (extensometer, weight scale); Depression (PHQ-9); Exercise enjoyment (NRS); Immersion (sports immersion scale)	In middle-aged overweight women, virtual reality had a positive impact on BMI, depression scores, enjoyment of exercise, and immersion in exercise	Repeated studies are required for verification of the effect of VR as an intervention in middle aged women
2	China	Qian Wu (2023)	Randomized controlled trial	8 weeks	220 overweight adolescents	Primary outcome: bioelectrical impedance, secondary outcome: physical and brain related parameters	Virtual reality improved quality of life and encouraged overweight adolescents to participate in sports	Blinding not possible due to the nature of intervention
3	USA	Suzanne Phelan (2021)	Randomized controlled trial	4 weeks	15 overweight/obese adults	Demographic data, calibrated standard digital weight scale and Harpenden stadiometer	While both the treatment and control groups experienced weight loss, the virtual reality approach was more liked by the participants than the conventional approach	Future research is required to test the feasibility of the VR approach in other weight control skills in a larger sample size and a longer evaluation period to determine behavioral weight loss using different outcomes
4	USA	John Graham Thomas (2020)	Randomized controlled trial	6 months	146 Overweight/Obese adults	Weight (digital BWB-800 scale), Weight Control Strategies Scale	All groups lost weight; experienced Weight Watchers had better results	More research is needed to improve the outcomes of experience success by identifying the behavioral mechanisms
5	Spain	Jessica Navarro (2020)	Randomized controlled trial	2 weeks	42 overweight and obese women	Anthropometric and sociodemographic data. Questionnaires: Body shape questionnaire, International Physical activity, PACES, PASAS, Behavioral regulation in exercise questionnaire, Avatar identification modified questionnaire	Online VR intervention improved PA and self-efficacy; ideal avatar reduced anxiety	No follow-up; more outcomes are needed for long-term effects
6	United Kingdom	Leighton Jones (2019)	Experimental design	Single session of exercise	21 Overweight adults	Questionnaire: Attention scale, Feeling scale, PACES, Immersive experience questionnaire, PRETIE-Q Near infrared device to calculate hemoglobin difference	BMI decreased considerably in both groups. The waist-hip ratio did not differ between the pre- and post-test findings. The results imply that VR improved the emotional experience during exercise	Further studies are required to see the long-term sustainability of VR on Affective experience. Studies are required on the obese population and an equal distribution of genders
7	Spain	Rosa M. Banos (2016)	Counterbalanced design	Single session was taken	A total of 109 students among them 33 were overweight	Anthropometric Data: Height-calibrated stadiometer, weight-standard beam balance scale, BMI calculated Heart rate: NUUBO TIPS Attentional strategies tool, Feeling scale, Eston-Parfit scale, Enjoyment and preference scale	The findings showed that overweight children experienced a higher level of attention distraction when using virtual reality	Future studies are needed to intrinsically motivate overweight and obese children to be more physically active using VR.
8	USA	D.K. Sullivan (2016)	Randomized controlled trial	18 months	202 overweight and obese individuals	Primary outcome: weight maintenance, levels of physical activity, energy intake, macronutrient composition, consumption of fruits and diet, problem solving skills and experiential lessons	The VR group had better weight maintenance; Face-to-face clinic achieved greater weight loss	Barriers to long-term weight loss maintenance need study
9	USA	Elizabeth Behm-Morwitz (2016)	Randomized controlled trial	4-week program	92 overweight adults	Body measurements and surveys were taken	VR group showed increased motivation and achieved weight loss goals	Long-term sustainability needs evaluation in broader populations
10	USA	Jeanne D. Jhonston (2012)	Randomized control trial	12-Week program	38 overweight adults	Demographic data, BMI, Physical activity scale, Weight efficacy lifestyle questionnaire	Both groups lost weight; VR group showed better questionnaire outcomes	Larger studies with web-based VR needed

varro et al. noted increased self-efficacy and emotional engagement with exercise, suggesting that VR may foster psychological readiness for physical activity.<sup>11</sup> A UK-based study observed increased emotional variability during VR exercise, suggesting that immersive environments, while engaging, can also trigger unpredictable emotional responses in some individuals.<sup>13</sup> Another study involving overweight children used VR as a distraction during exercise, leading to more positive affective experiences.<sup>14</sup>

### *Compliance and motivation*

Motivational factors and adherence to exercise protocols were frequently enhanced through VR interventions. Studies indicated that the immersive and interactive nature of VR increased the enthusiasm of participants, which translated into improved compliance. Behm-Morawitz et al. observed that participants showed a greater willingness to engage in novel physical activities when guided by VR platforms.<sup>15</sup> Similarly, Wu et al. found that VR-based interventions encouraged consistent participation among overweight adolescents, largely driven by enhanced engagement and interest.<sup>16</sup> Thomas et al. showed that VR-based interventions helped participants develop behavioral skills related to physical activity, contributing to increased motivation.<sup>17</sup>

### *Sustainability*

Although the short-term results were promising, evidence on the long-term sustainability of VR interventions remains insufficient. Most studies had limited follow-up durations, preventing conclusive assessments of weight maintenance or sustained behavior change. Sullivan et al. emphasized the practicality of web-based VR systems, which offer flexibility and accessibility, potentially supporting long-term adherence.<sup>18</sup> Phelan et al. demonstrated the feasibility of integrating VR into behavioral weight management programs, although their study was limited in scope.<sup>19</sup> The current evidence base is constrained by population homogeneity, primarily involving women and adolescent participants, and by geographic concentration in European and North American regions. Only a few studies originated in Asian settings, indicating a need for a larger demographic representation in future research.<sup>16</sup>

## **Discussion**

This scoping review aims to comprehensively map the existing literature on virtual VR interventions for weight management in overweight individuals. By consolidating diverse evidence, it identifies key themes, highlights research gaps, and informs future investigative priorities, rather than evaluating the effectiveness of the intervention. The findings suggest that VR serves as a promising adjunct to conventional therapies, support-

ing weight loss, promoting physical activity, and improving emotional well-being across varied populations. Despite heterogeneity in study designs, participant profiles, and outcome measures, all included studies reported at least one positive health outcome, underscoring VR's multifaceted therapeutic potential.

### *Therapeutic potential and mechanisms*

VR interventions improve outcomes by combining behavioral and cognitive strategies within immersive environments. These platforms support self-monitoring of dietary intake, exercise adherence, and weight control, often complementing traditional programs. They foster self-efficacy, body image satisfaction, and motivation, facilitating long-term habit formation and healthier lifestyle choices.<sup>20,21</sup> Real-time feedback and multisensory stimulation can promote neural plasticity associated with behavioral change and emotional regulation.

Additionally, VR enables customized exposure therapy that reduces anxiety surrounding eating and exercise by disrupting maladaptive memory patterns through simulated scenarios.<sup>23</sup> This controlled exposure aids emotional regulation, reduces avoidance behavior, and supports healthier routines. Avatar-based self-representation has also been linked to increased motivation and adherence, allowing users to embody healthier versions of themselves, thereby strengthening their commitment to weight-related goals.<sup>20,21</sup>

In addition, VR can simulate diverse real-world settings, overcoming environmental barriers such as poor weather or unsafe exercise conditions. This flexibility improves access and consistency in physical activity, particularly for people with limited resources or mobility. By embedding cognitive behavioral techniques into engaging, interactive experiences, VR addresses both physiological and psychological dimensions of overweight management, often beyond the scope of traditional interventions.<sup>20</sup>

### *Engagement and accessibility*

One of the key advantages lies in enhancing user engagement and enjoyment during physical activity, which supports the adherence to the intervention and long-term success. Interactive features, including personalized avatars, have been shown to increase motivation, although not all studies report statistically significant differences in outcomes compared to standard methods.<sup>22</sup> Notably, men remain underrepresented in VR-based weight loss research, reflecting broader trends in male participation in obesity trials and warranting targeted recruitment strategies.<sup>23,24</sup> Commercially available VR programs offer scalable, cost-effective alternatives to conventional behavioral interventions. However, their inconsistent incorporation of evidence-based components requires careful evaluation of design and efficacy.

### *Diversity of VR interventions*

The VR interventions in the included studies demonstrated substantial heterogeneity in type, level of immersion, and therapeutic intent. For example, Seo et al. employed a fully immersive VR cycling system, while Sullivan et al. used a non-immersive, avatar-based platform within Second Life. Others, such as Navarro et al., integrated VR with cognitive behavioral strategies targeting self-efficacy and body image.<sup>10,18,11</sup> This variability, ranging from game-based to therapeutic VR, poses challenges in comparing results and synthesizing findings. Additionally, inconsistent reporting of VR components limits cross-study comparability. Future research should classify VR modalities more clearly and analyze outcomes accordingly to enable more precise interpretation and application in obesity management.

### *Population gaps and representation*

A consistent shortcoming in studies is the underrepresentation of specific subgroups, particularly men, older adults, and individuals from low and middle-income countries. The predominance of female and adolescent participants mirrors broader patterns in obesity and digital health research but limits the generalizability of the findings.<sup>25</sup> Tailored recruitment strategies are essential to ensure gender balance and age diversity in future trials. Furthermore, most of the studies were conducted in western settings and published in English, which could overlook the sociocultural factors influencing the acceptability and effectiveness of VR interventions in non-Western populations. Context-specific adaptation is critical, especially in regions with unique nutritional, behavioral, or infrastructure challenges.

### *Limitations and research gaps*

Several methodological limitations constrain the current evidence base. Variations in intervention duration, sample sizes, and study quality limit generalizability and comparability. The predominance of short-term follow-up restricts insights into long-term efficacy. The exclusive inclusion of English-language studies and underrepresentation of research in Asian populations further narrow geographic and cultural applicability. Older adults, despite facing a growing burden of overweight-related health concerns, remain significantly underrepresented. The heterogeneity of VR interventions and inconsistent reporting between studies limited the comparability of findings and hindered the ability to assess overall efficacy of the intervention. The technical challenges inherent to VR technology also warrant consideration. High costs, variable accessibility, potential usability issues, and adverse effects such as cyber sickness can limit widespread adoption. Furthermore, effective implementation requires user training and ongoing support, aspects often underexplored in existing research.

### *Future directions*

Future research should prioritize large, well-powered randomized controlled trials with standardized protocols, extended follow-up, and blinding of the evaluator to enhance methodological rigor. Regionally adapted VR interventions that account for sociocultural, demographic, and environmental factors are essential, particularly in densely populated or low-resource settings. Inclusion of underrepresented groups, especially males and older adults, will improve generalizability and offer insights throughout life. Given the involvement of minors in several studies, future investigations must also address ethical considerations such as cognitive safety, content appropriateness, and long-term exposure effects. The establishment of standardized guidelines for the safe and effective use of VR in pediatric populations is critical. Multidisciplinary collaboration among healthcare professionals, behavioral scientists, and technologists will further ensure the development of relevant, usable, and sustainable interventions.

### *Clinical implications*

VR offers a safe, practical, and user-friendly tool to support weight loss and improve psychological and physiological outcomes. It holds promise as a cost-effective alternative or complement to traditional care, particularly in settings with limited access to in-person services. Although the initial findings are encouraging, their long-term impact in diverse populations requires further validation through rigorous and inclusive research.

### *Review limitations*

This review is limited by the restriction to English-language publications and may have missed relevant studies in other languages or unpublished data. Database selection and search strategies, while comprehensive, could have introduced selection bias. These factors should be taken into account when interpreting the mapped evidence.

### **Conclusion**

This scoping review maps the evolving landscape of VR interventions for overweight management, highlighting therapeutic promise alongside critical research gaps. Addressing methodological weaknesses, diversifying study populations, and overcoming technical challenges are essential for translating VR potential into effective, equitable clinical practice.

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### Author contributions

Conceptualization, M.B. and R.J.; Methodology, M.B.; Software, M.B.; Validation, R.J. and M.B.; Formal Analysis, R.J.; Investigation, M.B.; Resources, M.B.; Data Curation, R.J.; Writing – Original Draft Preparation, M.B.; Writing – Review & Editing, M.B.; Visualization, R.J.; Supervision, R.J.; Project Administration, R.J.

### Conflicts of interest

The authors declare that they have no competing interests.

### Data availability

In this study, no new data was generated or analyzed in this study.

### Ethics approval

This study did not require ethical approval, as it is a scoping review of previously published literature.

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