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Adult obesity treatment and prevention: A trans-agency commentary on the research landscape, gaps, and future opportunities

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Summary

Given the high and growing prevalence of obesity among adults in the United States, obesity treatment and prevention are important topics in biomedical and public health research. Although researchers recognize the significance of this problem, much remains unknown about safe and effective prevention and treatment of obesity in adults. In response to the worsening obesity epidemic and the many unknowns regarding the disease, a group of key scientific and program staff members of the National Institutes of Health (NIH) and other federal and non-government agencies gathered virtually in September 2021 to discuss the current state of obesity research, research gaps, and opportunities for future research in adult obesity prevention and treatment. The current article synthesizes presentations given by attendees and shares their organizations' current initiatives and identified gaps and opportunities. By integrating the information discussed in the meeting and current initiatives, we identify potential targets and overlapping priorities for future research, including health equity and disparities in obesity, the heterogeneity of obesity, and the use of technological and innovative approaches in interventions.

Keywords

adult obesity; gaps and opportunities; prevention; treatment

1 | INTRODUCTION

Prevalence of obesity in the United States has been rising rapidly since the mid-1970s, and currently, about 42% of U.S. adults are classified as having obesity.[1] Obesity contributes to serious chronic diseases, such as type 2 diabetes, heart disease, and many types of cancer.[2] Obesity and overweight frequently co-occur with depression and anxiety,[3] suggesting that obesity is associated with both negative physical and mental health outcomes. Further, stigmatization associated with having obesity puts this population at increased risk for poor health outcomes and lower levels of treatment seeking.[4,5] Thus, obesity poses a significant financial burden associated with chronic disease comorbidities in the United States, resulting in estimated annual medical costs of at least $147 billion.[6] For these reasons, obesity has been identified as a crucial target for treatment and prevention research by public health agencies and research institutions.

Many obesity-related interventions focus on known lifestyle factors, such as caloric imbalance, diet quality, and physical activity. However, a large body of research

demonstrates that obesity is a complex, multi-determined condition. Obesity is influenced by factors such as sleep quality and insufficiency and genetic, environmental, and psychosocial factors. Social determinants of health (SDoH), for example, economic stability, education access and quality, heath care access and quality, neighborhood and built environment, and social and community context, have been identified as important contributors to obesity.[7] Simultaneously, health disparities in different social and racial groups have been documented, particularly among disadvantaged individuals and populations of color in the United States, who are at higher risk of developing obesity and its associated chronic diseases. For example, non-Hispanic Black and Hispanic adults in the United States have a higher prevalence of obesity compared to their non-Hispanic White and Asian counterparts,[1] and Black adults have the highest prevalence of obesity among all ethnic/racial groups, with estimates around 50%.[1] Structural racism and inequitable policies and distribution of resources are root causes of unequal SDoH that perpetuate racial health disparities.[8] Other demographic variables, such as age, gender, socioeconomic status (SES), and geographical location, also affect risk for obesity,[9] which may further contribute to individuals' responses to different types of treatment and preventive measures.[10-12] Clearly, disparities in obesity must be addressed by taking into account the full range of multilevel factors contributing to obesity.

In September 2021, in the context of the ever-increasing obesity epidemic and the many unknowns regarding the disease, a group of key scientific and program staff members of the National Institutes of Health (NIH), other federal agencies, and non-governmental organizations (NGOs) gathered virtually for the *Trans-Agency Meeting on Adult Obesity Treatment and Prevention: State of the Science, Research Gaps, and Opportunities for Future Research*. Representatives from nine NIH institutes, centers, and offices (ICOs), the Centers for Disease Control and Prevention (CDC), the Department of Veterans Affairs (VA), the Health Resources and Services Administration (HRSA), the American Heart Association (AHA), and the Patient-Centered Outcomes Research Institute (PCORI) presented information on their organizations' current initiatives regarding adult obesity treatment and prevention, including currently funded projects. Additionally, each identified gaps and opportunities for future research on adult obesity treatment and prevention within each agency's portfolio as well as for the field in general. In early 2024, organizations were given the opportunity to update their research endeavors and priorities to ensure that they were current at the time of this article's publication. Current research projects and resources selected by NIH ICOs and other agencies can be seen in Table 1.

2 | AGENCIES' INITIATIVES ON ADULT OBESITY TREATMENT AND PREVENTION AND IDENTIFIED GAPS AND OPPORTUNITIES FOR FUTURE RESEARCH

2.1 | NIH ICOs

2.1.1 | National Heart, Lung, and Blood Institute (NHLBI)

Current research: Because obesity is a well-established risk factor for several heart, lung, and sleep disorders, such as cardiovascular disease (CVD),[2] asthma,[13] and sleep apnea,[2]

understanding the mechanisms and moderators of these risks and possible interventions is of significant interest to NHLBI. In a recent portfolio analysis of NIH-funded obesity research conducted by the NIH Office of Portfolio Analysis (OPA), NHLBI was the Administrative Institute and Center (IC) for 364 independent awards on obesity from fiscal years 2016–2023. NIH obesity awards were grouped into 10 distinct topics based on semantic similarity using the deep-learning word2vec$_{OPA}$ model (Figure 1).[14] The scientific topic areas where NHLBI supported 20 or more awards were pro-inflammatory state, obesity prevention, cardiovascular risk, healthy diet, and lipid metabolism. Of these 364 grants, NHLBI was the Administrative IC on 85 awards in the portfolio that were linked to clinical trials. The majority of these trials were intervention studies of lifestyle, dietary, exercise, or combination interventions in various populations. A shared focus among several of the mechanistic clinical trials was the effects of sleep or sleep restriction on weight and metabolic outcomes.

NHLBI funds observational and mechanistic studies of obesity, as well as clinical trials of obesity treatment or prevention interventions and trials to test elements or mechanisms of such interventions. NHLBI's obesity portfolio contains a wide variety of intervention types, such as behavioral and lifestyle interventions promoting physical activity and dietary changes, some of which are family-, community-, or worksite-based. One such worksite cluster randomized trial established the effectiveness of a multicomponent and remotely administered Safety and Health Involvement For Truckers (SHIFT) weight control intervention for producing significant weight loss among 452 commercial truck drivers.[15] Many intervention trials also utilize mobile or digital health techniques, such as the Social Mobile Approaches to Reducing Weight (SMART) 2.0 randomized controlled trial for young adults in university settings with overweight or obesity.[16] However, at the time of the 2021 meeting, there were no medication trials, although a multi-site trial investigating the long-term efficacy and safety of phentermine (the LEAP trial) is currently underway. There was only one study on bariatric treatment, which compared the effectiveness of vertical sleeve gastrectomy (VSG) and Roux-en-Y gastric bypass (RYGB) operations on reduction of predicted 10-year atherosclerotic cardiovascular disease (ASCVD) risk and found that, 5 years after surgery, patients remained with relatively low risk levels (3.0% for VSG and 3.3% for RYGB), with no significant differences in predicted 10-year ASCVD risk between VSG and RYGB at any time.[17] NHLBI-funded interventions also target specific, medically underserved populations, including women, older adults, individuals with lower SES, and racial and ethnic minorities, specifically African Americans and Hispanic or Latino participants. At the time of the meeting, only one study explicitly targeted men (Hispanic fathers with overweight or obesity) and demonstrated the feasibility of a randomized controlled clinical trial to evaluate the efficacy of a father-targeted lifestyle program for low-income Hispanic men and their children.[18] Since then, an efficacy trial of this intervention (Healthy Dads, Healthy Kids) has been funded and is currently underway.

Research gaps: Through this portfolio analysis as well as a literature review of obesity interventions, five major gaps and opportunities were identified: (1) research is needed on safe and effective ways to prevent initial (or continued) weight gain in adults, especially during developmental transitions such as young and older adulthood and reproductive

transitions of pregnancy, postpartum, and menopause, as well as ways to prevent regain of weight previously lost. (2) There is limited research on obesity-related health disparities, including obesity-related morbidity and mortality those during pregnancy and postpartum. Research is needed on safe and effective, real-world implementation of multi-level interventions of evidence-based approaches to address SDoH and excessive gestational weight gain and pre-pregnancy obesity, specifically in racial and ethnic minorities and rural populations. (3) More research is needed on bariatric surgery and anti-obesity medications. As both of these treatments may produce greater weight loss than non-medical interventions and are underutilized in clinical practice, additional research is needed on their long-term safety and efficacy. Recent studies have demonstrated efficacy of medications such as semaglutide and other glucagon-like peptide-1 (GLP-1) receptor agonists for obesity treatment, thus opening the door for future effectiveness trials.[19] (4) More studies utilizing precision prevention or treatment strategies are needed, to develop and test tailored interventions based on genetics, phenotyping, real-time data, artificial intelligence (AI) or machine learning, electronic health records (EHRs), and other technologies. (5) Although various dietary patterns have been studied, such as the Mediterranean Diet,[20] the DASH (Dietary Approaches to Stop Hypertension) diet,[21] and time-restricted eating or intermittent fasting,[22] further research is needed on the long-term sustainability, feasibility, and accessibility of these dietary patterns and other dietary approaches. Cultural adaptations of such diets may be needed to improve acceptance and address disparities in cardiovascular health and other health outcomes.

2.1.2 | National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK)

Current research: NIDDK continues to support a significant and robust investment in obesity prevention and treatment research across the lifespan. Funding goes to a wide variety of research topics including behavioral studies to prevent and treat obesity and its co-morbidities (e.g., diabetes and non-alcoholic fatty liver disease), bariatric surgery's impact on behavioral and metabolic outcomes, and natural experiments to inform obesity policy (e.g., changes in minimum wage, food access, and built environments), among others.

Investigator-initiated research projects funded by NIDDK on behavioral lifestyle interventions have shown some success in achieving clinically meaningful weight loss in many participants, although long-term maintenance of reduced weight is challenging. Heterogeneity in both short-term weight loss outcomes and longer-term maintenance of lost weight can be masked by analyses that focus on average response, rather than exploring individual and subgroup differences in intervention response.

Research gaps: These limitations point to the need to confront the challenges in both achieving and maintaining change in behavior and the need to apply knowledge of basic behavioral and social sciences to improve outcomes. Obesity is a chronic disease that requires lifelong management. The multiple factors opposing weight loss and maintenance in persons with obesity, and the limitations of behavioral weight loss treatment alone to help people achieve and maintain a healthy weight, point to the need for the development of additional therapeutic modalities. For research testing novel interventions, pilot studies

may be necessary to obtain preliminary data for adequately powered clinical trials. Better understanding of factors underlying risk and resilience to obesity development may improve primary prevention efforts. Research to refine behavioral and metabolic phenotyping and to integrate social and environmental inputs can be used to better understand the mechanisms underlying heterogeneity in response and ultimately to develop precision prevention and treatment approaches.

In addition to individual approaches, research to enhance prevention of and treatment for obesity should also consider multi-level, multi-component, and multi-disciplinary approaches, including at the family and community levels. Future research could target SDoH and upstream risk factors to prevent obesity and improve treatment outcomes, including intervening in mediators not directly obesity-related (e.g., housing, food insecurity, and recreational areas). It could also make use of adaptive and developing modalities for clinical trial designs (e.g., just-in-time adaptive interventions [JITAI], Multi-Phase Optimization Strategy [MOST], and Sequential Multiple Assignment Randomized Trial [SMART]).

2.1.3 | National Cancer Institute (NCI)

Current research: Obesity increases the risk of 13 types of cancer and affects every aspect of the cancer control continuum, from prevention through diagnosis, treatment, and survivorship.[23] In addition to being linked to multiple cancers, obesity can affect the quality of diagnostic imaging, uptake of cancer drugs, effectiveness of cancer surgery, quality of life, and, potentially, recurrence in cancer survivors.[24] As such, NCI has considerable interest and investment in basic and applied research in obesity and cancer, with a large portfolio of active grants spanning basic, translational, clinical, population and implementation science research. Coordination of activities in this important area is conducted through the Trans-NCI Obesity and Cancer Work Group,[25] which promotes information exchange and cross-cutting Institute interests in obesity and cancer research. Summaries of NCI's obesity-related resources and recent notices of funding opportunities (NOFOs) can also be found on the work group website.

NCI's focus on obesity has included large scale, transdisciplinary research on energetics and cancer as exemplified by the Transdisciplinary Research on Energetics and Cancer (TREC) RFA[26] and training programs.[27] Notable studies include a large Phase III trial, the Breast Cancer Weight Loss (BWEL) Trial, which is testing the impact of a weight loss intervention on invasive disease-free survival in women with overweight and obesity with Stage II-III HER2-negative breast cancer.[28,29] In 2022, NCI also funded two large Center grant initiatives (U01/U24) in obesity and related behaviors: one examining Metabolic Dysregulation and Cancer Risk[30] and a second testing Exercise and Nutrition Interventions to Improve Cancer Treatment-related Outcomes.[31]

NCI is committed to reducing obesity-related cancer health disparities through support for studies such as the Adapting MultiPLe behavior Interventions that eFfectively Improve (AMPLIFI) Cancer Survivor Health, which is testing a web-based diet and exercise intervention in older, rural, and minority cancer survivors,[32] and the Mi Vida Saludable trial of diet and physical activity interventions in Latina breast cancer survivors.[33] NCI

also supports research on the role of heterogeneity of obesity in cancer incidence and outcomes. Examples include the Trans-NIH Consortium: Randomized Controlled Trials of Lifestyle Weight Loss Interventions for Genome-Wide Association Studies, which seeks to understand the contribution of genetic variation in obesity treatment responses,[34] and the Accumulating Data to Optimally Predict Obesity Treatment (ADOPT) Core Measures project, which aims to assess biological, behavioral, psychosocial, and environmental factors that predict successful weight loss and maintenance.[35,36] NCI's interest also includes a molecular focus on cancer risk with use of incretin mimetics as well as epidemiological research designed to understand the impact of long-term incretin mimetic use on cancer risk and outcomes among individuals with and without comorbid conditions. NCI further supports funding of time-sensitive research to evaluate new policies or programs that can influence obesity-related behaviors.[37]

Research gaps: Despite NCI's extensive portfolio of research on obesity and cancer, much needs to be learned. NCI has identified obesity-related behaviors such as physical activity and dietary behaviors as a particular focus of attention as part of the Division of Cancer Control and Population Sciences' Modifiable Risk Factors Scientific Priority Workgroup.[38] Needs in this area include research on multilevel and social determinants of obesity as well as community-engaged and policy-focused interventions to complement individual-level obesity-prevention and reduction strategies. An American Association for Cancer Research (AACR) Panel on Cancer Prevention identified three key areas in obesity research needed to advance cancer prevention and control[39]: (1) identify the measures most predictive of obesity-related cancer risk; (2) enhance mechanistic insights into the link between obesity and cancer; and (3) conduct clinical trials to identify the most effective interventions and optimal combinations of energy balance-related behaviors and physiological traits to minimize risk of cancer. Progress on all these topics is needed and ideally should involve multiple disciplines, approaches, and comprehensive efforts to address the multilevel determinants of obesity, identify its mechanistic links to cancer, and develop and test safe and effective interventions to decrease its cancer-related risks and improve outcomes in cancer survivors.

2.1.4 | National Institute on Minority Health and Health Disparities (NIMHD)

Current research: Racial and ethnic minorities and underserved populations experience health disparities and inequalities that put them at risk for poor health outcomes.[40] Black versus White adults in the United States have a higher prevalence of obesity, as well as lower quality of life, increased risk of other comorbidities, and shortened lifespan resulting from the disease.[41-43] A history of systemic racism in the United States impacts current-day health inequities and obesity disparities. Historical racialized segregation policies have left inequitable food access, neighborhood safety, and green space for outdoor activities, and other resources needed to live a healthy, active lifestyle.[44] Additionally, populations that experience health disparities have lower access to treatment options (e.g., health insurance, telehealth, and racial discrimination experienced from the medical community).[45] With health disparities in mind, NIMHD has been committed to supporting research on obesity treatment and prevention. From 2015 to 2020, NIMHD funded 149 obesity-related grants. An example of an NIMHD-funded study that has the potential to significantly

inform the field aims to examine the influence of the social, cultural, and environmental context on gestational weight gain BeFAB (Be Fabulous After Baby/Be Fit After Baby).[46] Another study that explored the relationship between stress and adherence to food group recommendations among Black women with obesity (mean body mass index [BMI] = 36.5 kg/m^2) in the Deep South[47] reported a relationship between higher stress and higher BMI. NIMHD has also funded a community-based participatory research (CBPR) study to qualitatively understand the factors that affect weight and interventions that may diminish obesity in urban African Americans with serious mental illness.[48] The study reported that participants articulated structural barriers common to low-income communities including a lack of safe places to exercise, poor access to supermarkets and health food environments, and cultural aspects of food and cooking practices. Additionally, participants viewed church participation as a positive influence on weight.

Research gaps: NIMHD has identified several gaps and opportunities in adult obesity treatment and prevention. There is a pressing need to understand the complex interactions of the environment, structural systems, and inequities—including access to good nutrition—as food insecurity continues to plague minority and underserved populations and, consequently, obesity and its co-morbidities.[49] Research needs to focus on the importance of culturally appropriate approaches to prevention and treatments. Culture-specific interventions are needed, as is the use of implementation research to inform practitioners on those culturally appropriate interventions. There is a lack of research on population-specific perceptions of obesity as “normative” or as a health risk and their association with treatment success. Assessment of stigma and body size acceptance in different cultures will help to better understand culture-specific expectations of obesity as an indicator of health risk, self-esteem, and self-stigma. There are significant between-population differences in these psychological factors that need further research to inform successful culturally specific intervention strategies. Finally, there are opportunities for research that targets policies of segregation and structural racism and their impact on obesity in underserved populations. For example, research that explores the association between food environments and dietary behaviors, food insecurity, chronic disease, and health disparities in segregated communities is needed.

2.1.5 | National Center for Complementary and Integrative Health (NCCIH)

Current research: NCCIH supports research related to obesity as part of our strategic priorities to foster research on health promotion and restoration, resilience, disease prevention, and symptom management (see the NCCIH strategic plan).[50] Obesity-related projects fall into two main categories: mechanistic research on natural products, dietary supplements, probiotics and microbiome, and intervention development research involving physical and psychological approaches, often termed mind and body approaches (e.g., mindful eating, yoga) for obesity and/or related outcomes. Funded studies have the potential to have a significant impact on the field of obesity research.

In a recent portfolio analysis, NCCIH funded 51 independent awards on obesity-related research between fiscal years 2013 and 2022. Research on natural products represented most awards (61%). Notably, NCCIH has supported two large center grant awards related

to obesity research, one on natural products and the other on mindfulness research. The "Botanicals and Metabolic Syndrome" center grant (P50AT002776) investigated functional aspects and mechanisms by which botanicals promote metabolic resilience and general health when exposed to an obesogenic environment. This Center produced over 220 publications that significantly advanced our understanding of how various botanicals modulate metabolic health. Additional translational research is needed to investigate the clinical utility of these products to prevent or treat obesity. NCCIH continues to support mechanistic research on a variety of natural products and dietary supplements for weight loss and metabolic health.

Research on mind and body interventions has focused mostly on intervention development and testing and has considered the utility of adding these approaches to standard diet and exercise interventions. A large center grant "Metabolic and Immunologic Effects of Meditation" (P01AT005013-01) tested effects of adding mindfulness to a diet and exercise intervention for 5.5 months versus diet and exercise alone on weight loss, fat distribution, and immune function at 18 months and examined the mechanisms through which mindfulness influenced metabolic and immunologic pathways in 194 adults with obesity (NCT00960414). Results showed that participants receiving mindfulness training had a 1.7-kg greater weight loss on average compared with the control intervention at 18 months, but this was not statistically significant. Mindfulness was associated with significant improvements in fasting glucose and triglyceride/HDL ratio at 18 months.[51] Additional studies are needed to evaluate whether mindfulness and/or other mind body interventions may promote metabolic health and help to prevent or treat obesity when combined with diet and exercise. NCCIH is currently supporting several projects testing feasibility and acceptability of different mindfulness approaches, such as mindful eating and yoga interventions, for improving obesity-related health behaviors and health outcomes in a variety of populations and settings.

Research gaps: NCCIH has identified several gaps that need to be addressed in relation to complementary and integrative health approaches for obesity-related outcomes. Overall, there is a need for research on complementary and integrative health approaches to address minority health and health disparities in obesity research. In addition, mHealth approaches have become increasingly popular, and well-designed research is needed to test the impact of providing complementary and integrative health approaches remotely as part of weight loss treatments.

While a wide array of botanicals has been studied in detail, additional mechanistic research is needed on microbiome and probiotics in relationship to obesity risk. NCCIH is currently investing in research on popular dietary supplements, but more work is needed to systematically test the impact of various natural products, dietary supplements, probiotics, and the microbiome on digestion, absorption, and metabolism in relation to obesity outcomes. Furthermore, the field could benefit from translational research to move mechanistic work on natural products toward clinical studies to evaluate effects on disease prevention and treatment.

For mind and body approaches, it is important to investigate for whom and under what conditions the addition of these approaches may enhance the impact of standard diet and exercise interventions on weight loss and other obesity-related outcomes. For example, NCCIH-funded work has shown that adults with obesity who engage in compulsive eating may benefit more from the addition of mindfulness to diet and exercise.[52] Most of our mind and body obesity research portfolio has focused on mindfulness approaches. More work is needed to evaluate whether other mind and body approaches (e.g., yoga, hypnosis, guided imagery, and biofeedback) may prove beneficial for obesity-related outcomes. Furthermore, work on multi-component interventions and systems of care such as naturopathic medicine, traditional Chinese medicine, Ayurvedic medicine, and/or other integrative approaches for obesity is needed. Overall, much of the mind and body research is in the early feasibility testing phase, and there is a lack of adequately powered efficacy trials on promising mind and body approaches for obesity and related outcomes.

2.1.6 | National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)

Current research: Obesity is a major risk factor for many musculoskeletal (MSK), skin, and muscle disorders. It is associated with risk for osteoarthritis (OA) and a reduction of bone quality and increased fragility in bone (increased risk of fracture at some sites).[53] Obesity is also an established risk factor for skin infections and incident psoriasis. And as for muscle diseases, sarcopenic obesity, which is a combination of sarcopenia and obesity in elderly populations, has also been studied in relation to MSK outcomes.

A major initiative that NIAMS has undertaken is the funding of a serial group of randomized control trials (RCTs) on weight loss and nonpharmacological management of OA. Trials by investigators from Wake Forest University and other institutions were conducted to study the effectiveness of weight loss achieved via diet and exercise interventions for the management of knee OA. These trials have been supported by the NIAMS since 1992 with a total of over $20 million and have yielded about 40 publications, according to an analysis done with iCite, a tool developed by the NIH OPA. The trials started with the Arthritis Diet and Activity Promotion Trial (ADAPT) (5P60AG10484 and M01RR07122). The investigative team examined the effect of a 5% weight loss with and without exercise and found that exercise and diet together was superior to a treatment of just diet, a treatment just involving exercise, and a control group, with a 30% reduction in pain and 25% improvement in function and mobility.[54] Moreover, self-efficacy significantly mediated treatment effects on physical function and pain at 18 months.[55]

Following the ADAPT, the investigators conducted a single-blinded, 18-month Intensive Dietary Restriction with Exercise in Arthritis (IDEA) trial (R01AR052528). The IDEA trial was an efficacy trial that demonstrated the beneficial effect of an intensive diet and exercise intervention in older adults with knee OA under ideal, control circumstances. The results demonstrated a significant dose response effect of weight loss on OA.[56]

Most recently, in collaboration with investigators from the University of North Carolina, Chapel Hill, the investigators completed the Weight Loss and Exercise for Communities with Arthritis in North Carolina (WE-CAN) trial (U01AR068658) that examines whether

IDEA results can be generalized to less rigorously monitored patient cohorts.[57] The WE-CAN trial is a pragmatic community-based effectiveness trial designed to adapt the IDEA intervention for real-world clinical and community settings. The results have demonstrated that among patients with knee OA and overweight or obesity, diet and exercise compared with an attention control led to a small but statistically significant difference in knee pain over 18 months.[58]

Research gaps: We have identified several gaps within obesity research, as well as opportunities. First, there is a need for more accurate definitions and measurements of obesity subtypes, related biomarkers and heterogeneity, and a need for the development of personalized interventions based on research to better match the treatment to an individual patient. To address this gap, researchers could use novel approaches, such as quantitative imaging and omics technology for the development of biomarkers for accurate definitions of obesity subtypes to inform personalized interventions. There is also a need for research to improve the reach and effectiveness of remotely delivered behavioral interventions. The use of emerging technologies, such as mobile health (e.g., incorporate wearable sensor technology in data collection), could address this gap. A third identified gap is the lack of well-designed multi-level weight loss and maintenance interventions that can be widely disseminated, including community-level behavioral interventions, environment strategies, and public policy. And finally, we recognize the prevalence of disparities in obesity and the need to address inequitable risk factors and treatment. Given the complexity of obesity and its interaction with multiple organ systems, a center-based multidisciplinary approach, with private-academic and clinic-community partnerships, could be established to address these gaps.

2.1.7 | Office of Disease Prevention (ODP)

Current research: The ODP is the lead office at the NIH responsible for assessing, facilitating, and stimulating research in disease prevention and health promotion. In partnership with the NIH ICOs, the ODP strives to increase the scope, quality, dissemination, and impact of NIH-supported prevention research. The NIH Pathways to Prevention (P2P) workshop program is led by the ODP to identify research gaps in a scientific area of broad public health importance using an unbiased, evidence-based process.[59] P2P workshops are designed for topics that have limited or underdeveloped research and a need for a critical assessment of the evidence. The ODP collaborates with various NIH ICOs as well as other federal partners to sponsor the workshops. The ODP, NHLBI, NIDDK, and NCI co-sponsored a workshop on Methods for Evaluating Natural Experiments in Obesity in 2017. An independent panel considered evidence from the workshop and made recommendations for moving the field forward. The panel's report and accompanying systematic review has been published.[60-62]

The independent panel's research recommendations are categorized into four areas. (1) *Recommendations for Improving data systems*—specific recommendations include (a) maximizing use and sharing of existing surveillance and research databases and (b) enhancing the value of existing databases through data integration and linkages. (2) *Recommendations for improving methods for study design and analysis*, including (a)

develop reporting guidelines for critical study elements including selection or construction of the comparison population and the assessment and control of confounding, (b) develop reporting standards with guidance to fully describe the approaches taken to reduce the potential for bias in protocols and publications, and (c) develop tools specifically designed to assess risk of bias in natural experiments. (3) *Improving measurement of obesity-related outcomes* to (a) promote common standardized, valid, and reliable measures of obesity-related outcomes and exposures; (b) encourage measurement of co-benefits and unintended consequences of natural experiments that are important to community members and relevant stakeholders to inform decision-making and policymaking; and (c) develop and integrate new technologies for measuring obesity-related outcomes and exposures. Finally, (4) *Recommendations for cross cutting issues* include (a) develop NIH-sponsored training programs in modeling studies and causal inference relevant to obesity control and prevention and support collaborations to build capacity within the nation's prevention research community across disciplines and sectors; and (b) increase awareness, capacity for incorporating community engagement and context into natural experiment design and implementation.[59,60]

The P2P workshop report described a set of prioritized research and programmatic strategies that could be advanced through collaborations across the federal government and with private-sector partners. Several trans-NIH and HHS activities have occurred since the workshop was completed, including (1) The National Collaborative on Childhood Obesity Research (NCCOR) efforts to promote evaluation of Natural Experiments and (2) Childhood Obesity Prevention Across Borders project (led by Fogarty International Center).[63] This 2-day workshop highlighted synergies between research conducted in Latin America and among Latino populations in the United States, focusing on six cross-cutting areas: social environment; built environment; migration; implementation science; measures; and capacity building. These areas served as the basis for a journal supplement published in Obesity Reviews in both Spanish and English[64] that articulates a shared research agenda to address childhood obesity prevention in Latin America and among Latino populations in the United States. In addition, the workshop led to the development of collaboration awards that catalyze the development of new research partnerships between US and Latin American investigators as well as among investigators across different Latin American countries to address childhood obesity prevention. Thirteen awards were selected and funded to develop collaborations across nine countries that expand research partnerships, build research, and identify research priorities. As these awards wrap up, there have been several positive outcomes, including successful research applications, formal institutional collaborations, and scientific publications. (3) Effective Programs to Improve Access to Trails paper and webinar,[65,66] (4) Renewal of the Time-Sensitive Obesity Policy and Program Evaluation PAR-21-305 and PAR-18-854,[37] and (5) Creation of the Health and Housing group with collaboration between NIH, the U.S. Department of Housing and Urban Development (HUD), and CDC and a recent portfolio review.[67,68] Some activities from this group include a portfolio analysis (to characterize the health and housing portfolios across NIH, HUD, and CDC), various webinars, seminars, and conference presentations. An additional NIH and federal agency activity includes the NIDDK led 2-day workshop in 2022 entitled Housing and Obesity: Gaps, Opportunities and Future Directions for Advancing Health Equity,

sponsored by the NIH, Centers for Disease Control and Prevention, and the U.S. Department of Housing and Urban Development. The purpose of the workshop was to identify the state of the housing, obesity, and health equity fields, particularly the role of housing insecurity in behaviors and other pathways that may increase the risk for obesity-related health disparities across the life span. A summary of the workshop is available.[69]

2.1.8 | Office of Behavioral and Social Sciences Research (OBSSR)

Current research: OBSSR co-funds basic to translational behavioral and social sciences research (BSSR) on prevention and treatment of obesity. Funding is intended to accelerate the use of novel BSSR data modeling, newly identified mechanisms of action, and trial design approaches to inform intervention development. This includes incorporation of basic and translational BSSR constructs to help explain biological and psychological outcomes and their interactions and promote rigorous data aggregation and clinical relevance of results. OBSSR prioritizes the incorporation of health behavior change principles to address SDoH and health disparities affecting health outcomes. OBSSR also supports training researchers in methods that can advance research on obesity prevention and treatment, such as supporting multi-disciplinary, multi-level research approaches to integrate data from complex and diverse factors affecting rates of obesity via an R25 mechanism (RFA-OD-23-003: Short Courses on Innovative Methodologies). Such factors include the interactions between biologic and behavioral processes that influence weight gain, the ability to sustain weight loss, risk of developing comorbidities, and healthy behavior maintenance.

Research gaps: OBSSR has identified the following gaps in obesity-related research: (1) increased understanding of how behavioral mechanisms operate in situ with specific intended populations and settings; (2) best approaches to natural experiments to explore ways to reduce health disparities, accounting for context, bio-behavioral risk, and resilience factors; OBSSR leads a “just in time” funding mechanism that may be used to test theses associations.[70] The NOFO allows for applications that target community settings, policy implementation, and multi-level multi-resourced initiatives and may follow implementation time course and effects on the adoption of desired health behaviors, resources, programs, and associated disease outcomes; (3) validation of AI and other forms of big data modeling to assess whether predictive models match those found in intended populations and settings; (4) improved understanding of the interaction between SDoH and health care delivery systems. Answering these questions will help our health systems and community-based efforts to better meet the needs of underserved and disadvantaged populations.

2.2 | Other federal agencies

2.2.1 | Division of Nutrition, Physical Activity and Obesity, Centers for Disease Control and Prevention (CDC)

Current research: Several factors, including weight bias and access to referrals, may impact optimal weight management and medical care.[71-73] The use of EHR data and other health services data can help understand screening patterns and healthcare utilization.[74] CDC utilizes EHR data to assess conditions associated with high BMI, such as non-alcoholic fatty liver disease. The use of algorithms, or electronic phenotypes, to identify

co-occurring conditions in adults could be utilized to better understand rare conditions or to assess, for example, post-COVID-19 conditions that may be more common in individuals with excess adiposity.[75]

The open-source software “growthcleanr” is a data cleaning solution used in large EHRs to detect errors in height and weight data using the entire longitudinal trajectory of the individual.[76] Growth-cleanr alerts the user to data quality issues such as swapping of height and weight measurements or the use of incorrect units. The cleaned data can be used to investigate health services topics, such as the prevalence of chronic conditions stratified by BMI. This tool can also be used to create local obesity burden data to help health systems and decision makers prioritize resources. In addition, growthViz is a companion visualization tool that allows the user to remove flagged data points to assess data quality.[77] Two pilot sites of CDC's Clinical Community Data Initiative (CODI) have been utilizing growthcleanr as part of their local data modernization initiatives.[78]

A number of studies related to timely, real-world BMI data during the COVID-19 pandemic highlight the potential of using EHR data. Two published studies used IQVIA commercial claims data and the growthcleanr tool to describe weight gain among children and adults during the COVID-19 pandemic.[79,80] Other studies used administrative discharge data (Premier Healthcare Dataset, Special COVID-19 Release) and found overweight and obesity to be underlying medical conditions associated with severe COVID-19 illness among adults with emergency department and hospital encounters with COVID-19.[80,81] An increase in obesity-attributable costs and acute complications among adults and children hospitalized with COVID-19 has also been described.[82]

The use of EHR and claims data supports estimation of the obesity-attributable cost and health care utilization among US adults and children. Ongoing efforts use unique EHR data linked with commercial claims data (IQVIA) to assess the expenditures by BMI status and expenditures attributable to sustained obesity among commercially insured children and adults.

Ongoing work on the use EHR data to address obesity burden and treatment could address methodological issues such as how to address missing race and ethnicity data and cohort representativeness. Tools developed as part of CDC's efforts have been made open source to facilitate the spread of public good solutions in the use of timely data to answer obesity-related questions.

2.2.2 | U.S. Department of Veterans Affairs (VA)

Current research: The mission of the Office of Research and Development (ORD) within the Veterans Health Administration (VHA) in the VA is to discover knowledge and create innovations that advance the health and care of veterans and the nation. A major priority area for the VHA is reducing the significant rates of obesity and overweight among Veterans compared with rates of nonveteran populations in the United States.[83] Of the six million patients who receive yearly care from the Veterans Health Administration, 80% have either overweight or obesity.[84,85] Obesity is associated with various health risks including heart disease, type 2 diabetes, strokes, certain types of cancer, and other weight related medical

conditions.[2] The VHA has been addressing obesity through a national, population-based approach since early 2000, utilizing different methods, with varying effectiveness.[86]

From 2016 to 2021, ORD funded 138 projects focused on obesity and/or weight management in veterans. Study populations are generally veterans with overweight or obesity who also have a chronic disease such as diabetes, CVD, mental illness, or traumatic brain injury. The majority of studies focus on treatment interventions (biomedical, pharmacotherapy, and behavioral) or prevention strategies. Some studies also focus on psychosocial predictors of weight loss. Intervention services are commonly distributed through health professionals in primary care or community clinics. Increasingly, however, remote services are being utilized, including mobile applications and web-based approaches.

A major initiative led by the VA is MOVE!, an individually tailored weight management, health promotion program designed to improve the lives of Veterans through healthy eating and increasing physical activity using a standardized format. The program was developed and supported by VA's National Center for Health Promotion and Disease Prevention, based on published evidence and clinical practice guidelines from VA and non-VA committees and organizations. From 2003 to 2004, pilot feasibility trials were conducted at 17 medical centers, and in 2005, the program was revised and launched nationally. The intervention is delivered by health professionals or peers in primary care or at community-based outpatient clinics, in-person, telehealth, or using mobile apps, and in group or individual sessions. More than 35 studies on the program's effectiveness have been completed, but evaluation has been challenging due to the large variability in implementation across medical sites. Overall, results showed modest, short-term weight-loss with an average of 0.28- to 7.3-pound weight-loss at 1-year, post-intervention follow-up. Weight-loss medications and bariatric surgery are also offered to veterans who have tried MOVE! but continue to struggle with weight-related issues.

Research gaps: The VA ORD has identified significant gaps in the field of obesity treatment and prevention: prevention-focused research should be prioritized, because obesity typically has been viewed as a disease or biomedical condition within VA medical system. There are also opportunities for improvement in interventional research. Obesity is a complex condition and, thus, should be viewed holistically, through a lens on whole health and long-term lifestyle changes. One way to do so is to invest in research on personalized medicine, as well as incorporate cultural, racial/ethnic, and gender differences in the causes and treatment of obesity. Individual, community, and social determinants of obesity need to be considered, as well as implementation strategies to scale evidence-based interventions within the existing VHA infrastructure.

2.2.3 | Health Resources and Services Administration (HRSA)

Current research: The Maternal and Child Health Bureau (MCHB) within HRSA supports research that can improve the health and well-being of maternal and child populations, including those with autism spectrum disorders and other developmental disabilities (ASDs/DDs). MCHB has unique research infrastructure funding to establish and maintain interdisciplinary, national, multi-site research platforms for scientific collaboration and

infrastructure building. Three research networks support obesity research within MCHB. Specifically, two research networks conduct research on obesity prevention and control and lifestyle interventions among children and adolescents with ASD/DD.[87,88] The third research network, Pregnancy-Related Care Research Network (PRCRN), researches a broad array of topics relevant to the health and well-being of pregnant women and their infants.[89] Related to obesity, the PRCRN focuses on whether guidelines affect physicians' confidence in impacting maternal overweight, obesity, and/or gestational weight gain.[90,91] In addition, a multi-institution Maternal Health Research Collaborative for Minority Serving Institutions (MH-RC-MSI) program was launched recently,[92,95,96] which was composed of and to support minority serving institutions to conduct research addressing maternal health disparities and find community-based solutions. Two of the research centers funded by this program focus on relationships between obesity and poor maternal health outcomes and interventions to control gestational weight gain and prevent postpartum weight retention among Black women.

Research gaps—Overall, MCHB has a small portfolio that conducts obesity research on children and adolescents with special healthcare needs and on weight management of pregnant women. Moving forward, MCHB encourages awardees to leverage the unique research network infrastructure to conduct multi-site intervention research on childhood and maternal obesity to test the heterogeneity and generalizability of the interventions. Future research should also address health equity and SDoH in obesity research, for example, recruiting participants of the interventions from underserved populations and engaging families, schools, and patients with lived experience, including autistic people[93] and pregnant people in the research design and implementation. We also want to emphasize the life-course approach to obesity prevention. Literature shows the close relationship between childhood obesity and obesity later in adulthood and between maternal obesity and the obesity of offspring.[94,95] Adult obesity prevention should start in childhood and consider a two-generational approach to how a mother's health would affect her offspring's future obesity status.

2.3 | NGOs

2.3.1 | AHA

Current research: The AHA is the largest non-governmental, nonprofit funder of cardiovascular and cerebrovascular research in the United States. AHA typically awards hundreds of new research awards each year, spanning from summer undergraduate research experiences to large, multi-million dollar programmatic initiatives focused on particular disease states.

As obesity is well known to increase the risk of CVD and mortality, understanding mediators of these risks and possible interventions has been of significant interest to the AHA. From 2016 to 2020, the AHA has funded nearly 390 obesity-related research grants totaling over $90M. Historically, the overwhelming majority of grants awarded by the AHA have been on investigator-initiated topics. More recently, AHA has allocated significant funding to large programmatic research initiatives focused on a specific topic of high interest to AHA, mainly through the Strategically Focused Research Network

(SFRN) mechanism. SFRNs are large ($15 M or more) multi-center (typically three to five centers) programs, with each center having multiple research projects focused on a particular theme. Centers must include at least two of the following research disciplines as part of their projects: basic research, clinical research, and population health research. Since the inception of SFRNs in 2014, AHA has funded one to two SFRNs each year. In 2017, in recognition of the clear adverse effects of obesity on cardiovascular health outcomes, the AHA funded an SFRN on obesity specifically. Four academic centers were funded to conduct multidisciplinary research projects addressing: (1) the role of time-restricted feeding on obesity and cardiometabolic health; (2) braking inflammation in obesity and metabolic dysfunction: translational and therapeutic opportunities; (3) intergenerational transmission of obesity; and (4) precision medicine approaches to treat obesity: promise of the GLP-1 receptor. A recent report[96] provides a summary of key findings from the SFRN on Obesity.

Research gaps: There remain important gaps and opportunities when considering the state of obesity research and its effects on CVD. In 2021, AHA published a Scientific Statement on obesity and CVD.[97] As part of this comprehensive review, the authors provided the following recommendations for future obesity research (reproduced from Table 3 of the referenced Scientific Statement, with permission): (1) evaluation of lifestyle interventions with RCTs to identify the role of intentional weight loss and decreased visceral adiposity for improving CVD outcomes in obesity; (2) development of dietary interventions with large RCTs to identify healthful dietary patterns or personalized diets for CVD risk reduction in obesity; (3) development of upstream interventions for primary prevention and better treatment of obesity as a chronic disease among young patients with severe obesity; (4) identification of best practices for use of (GLP-1) agonists and sodium-glucose cotransporter 2 inhibitors to reduce hospitalization for heart failure (HF) and cardiovascular death for patients with heart failure with reduced ejection fraction (HFrEF) and heart failure with preserved ejection fraction (HFpEF) with and without diabetes; and (5) development of effective strategies for weight maintenance and improved functional outcomes as opposed to weight loss interventions in elderly populations at risk for HF.

2.3.2 | PCORI

Current research: PCORI is an independent, nonprofit research organization that seeks to empower patients and others with actionable information about their health and healthcare choices. PCORI funds comparative clinical effectiveness research (CER), which compares two or more medical treatments, services, or health practices to help patients and other stakeholders make better-informed decisions.

As part of PCORI's mission to help people make better-informed healthcare decisions, PCORI has funded 13 CER research projects on adult obesity treatment. These studies cover diverse populations, with the majority focusing on racial and ethnic minorities and low SES. There are a range of intervention strategies tested across the 13 CER studies, with most involving a clinical intervention (e.g., behavioral intervention for weight loss and bariatric surgery procedures) as well as different service delivery models. Many studies also include training and education interventions to help people maintain a healthy weight or lose weight

(e.g., teaching calorie counting, USDA's MyPlate plan, goal setting skills, and health coach support).

PCORI also issued a targeted funding announcement for pragmatic clinical trials to evaluate obesity treatment options set in primary care for adult underserved populations. Through this funding announcement, two studies on obesity treatment were awarded. Both trials incorporated a primary care component as well as strong links to community-based partners. These studies each implemented an evidence-based comprehensive lifestyle intervention including reduced-calorie diets, increased physical activity, and behavioral counseling to treat obesity in adults of certain racial and ethnic minorities, with low SES, or who reside in rural areas. In both studies, the interventions were tested against a standard fee-for-service obesity approach that included behavioral treatment delivered by a primary care team.

PCORI also made obesity the focus of a limited funding announcement for observational research using PCORnet, the National Patient-Centered Clinical Research Network. Through this funding announcement, one study was awarded that compared the health benefits and safety associated with the three main methods of bariatric surgery. The study examined records of 60,000 patients who had bariatric surgery in the past 10 years to compare patients' weight loss and regain, rates of diabetes improvement or relapse, and the frequency of complications or harms.

Research gaps: PCORI has identified evidence gaps and potential areas for future CER for obesity, including interventions addressing the intersection of SDoH, maternal health, and obesity, as well as bariatric surgery as a potential treatment for type 2 diabetes.

3 | CROSS-CUTTING THEMES AND FUTURE DIRECTIONS FOR ADULT OBESITY TREATMENT AND PREVENTION RESEARCH

The integration of ideas presented at the *Trans-Agency Meeting on Adult Obesity Treatment and Prevention: State of the Science, Research Gaps, and Opportunities for Future Research* by representatives from the NIH and other agencies allowed for the identification and prioritization of cross-cutting themes. This collaboration resulted in a comprehensive agenda of potential future directions for research on adult obesity treatment and prevention. Across meeting attendees, it was agreed that a **top priority for future research** is health equity and health disparities in obesity. Specific targets in research include the psychosocial determinants of health (e.g., stigma, neighborhood, and historical factors) that may be contributing to disparities related to obesity and especially to racial disparities in obesity. In this vein, the importance of simultaneously treating mental health and well-being should not be underestimated. NHLBI led a workshop in October 2022 on “Advancing Interventions for Adult Obesity to Promote Health Equity: State of the Science and Research Opportunities,” which explored more fully these issues identified in the September 2021 trans-agency meetings.

Another cross-cutting theme is understanding the heterogeneity of obesity: What biologic, social, and behavioral indicators can be identified to facilitate better prediction of related health outcomes of obesity and response to treatment? Studies are beginning to explore the

metabolic heterogeneity of obesity.[98] There may be differences in genetic, behavioral, and metabolic factors that protect some individuals with obesity from associated negative health outcomes. These mechanisms need to be better understood, with the goal of application to prevention and treatment. As a result, the NIH Obesity Research Task Force organized a virtual symposium in May 2022 on "Moving Beyond BMI: Exploring the Heterogeneity of Obesity."[99] Due to the heterogeneity and interplay of risk factors and disease processes underlying obesity, evidence suggests that development of interventions that view patients holistically, considering environmental, genetic, behavioral, social, and cultural factors in health, will be more effective. Eventually, precision prevention approaches may be used to develop precise, targeted interventions that act on multiple levels. In addition, multi-level, non-individually focused intervention strategies should be tested to assess their impact on factors beyond an individual's control, such as food availability and access to healthcare. To promote research in these areas, NHLBI released a Notice of Special Interest (NOSI): Advancing Research to Address the Heterogeneity of Obesity Risk, NOT-HL-23-090.

A future direction is research on the use of technological advances to develop innovative approaches to interventions. Technologies such as AI, EHRs, mHealth, and mobile apps have the potential to collect vast amounts of data and in real time with the use of ecological momentary assessment (EMA). The use of advanced technology also allows for Just In Time Adaptive Interventions (JITAIs), reaching participants in situations in which they are most at risk for health-damaging behaviors or providing the "nudge" to more healthful behavior. Such data could also be invaluable for evaluation of built environment, neighborhood, and policy interventions addressing obesity, using "natural experiment" research designs.[100]

In addition to these key opportunities, other important areas, such as maternal obesity and related morbidity and mortality, long-term maintenance of weight loss after treatment, and culturally appropriate approaches to obesity prevention and treatment, should be included in future research endeavors, such as NIH-sponsored workshops, initiatives, and investigator-initiated research projects. In conclusion, the above discussions and recommendations provide obesity research interests by various governmental and non-governmental agencies that could spur scientific investigations in adult obesity.

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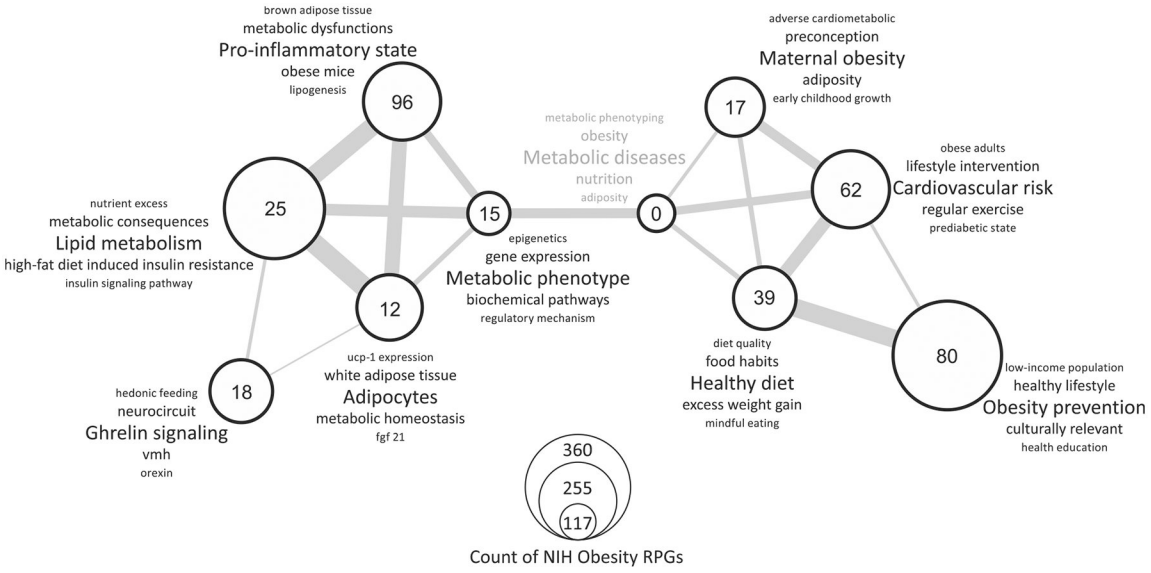

FIGURE 1.

Word2vec$_{OPA}$ map of all National Institutes of Health (NIH) Investments in Obesity Research. Legend: The number inside each circle indicates the subset of NHLBI Research Project Grant (RPG) awards (FY2016-FY2023; a total of 364 awards) funding the topic indicated by the corresponding AI label (group of computationally extracted terms). Note that topics on the left side of the image are focused on fundamental areas of obesity research (e.g., signal transduction, molecular mechanisms, and physiology), whereas those on the right tend to be more clinically oriented (e.g., cardiovascular risk, diet, and prevention). The "Metabolic diseases" label is grayed out because there were no NHLBI awards on that topic. Thickness of the lines (edges) connecting the circles (nodes) is proportional to the degree of semantic similarity between the topics.

TABLE 1

Selected research projects and resources of NIH Institutes, Centers, and Offices (ICOs) and other agencies.

ICO/ agency	Current/recent obesity research
NHLBI	• Primary scientific topic areas recently funded: pro-inflammatory state, obesity prevention, cardiovascular risk, healthy diet, and lipid metabolism • Observational and mechanistic studies of obesity • Clinical trials of behavioral and lifestyle interventions promoting physical activity and dietary changes • Clinical trials utilizing pharmacological interventions • Target medically underserved populations (e.g., women, older adults, low SES, and racial/ethnic minorities) across various settings (e.g., family, worksite, and community) • Funding Opportunity: Heterogeneity of Obesity NOSI, NOT-HL-23-090
NIDDK	• Behavioral studies to prevent and treat obesity and its co-morbidities (e.g., diabetes and non-alcoholic fatty liver disease) • Investigating bariatric surgery's impact on behavioral and metabolic outcomes • Natural experiments to inform obesity policy (e.g., changes in minimum wage, food access, and built environments)
NCI	• Breast Cancer WEight Loss (BWEL) Trial • Metabolic Dysregulation and Cancer Risk • Exercise and Nutrition Interventions to Improve Cancer Treatment-related Outcomes • Adapting MultiPLe behavior Interventions that eFfectively Improve (AMPLIFI) Cancer Survivor Health • Mi Vida Saludable • Trans-NIH Consortium: Randomized Controlled Trials of Lifestyle Weight Loss Interventions for Genome-Wide Association Studies • Accumulating Data to Optimally Predict Obesity Treatment (ADOPT) Environmental Measures
NIMHD	• BeFAB (Be Fabulous After Baby/Be Fit After Baby) • Study on the relationship between stress and adherence to food group recommendations among Black women with obesity (mean BMI = 36.5 kg/m^2) in the Deep South • Community-based participatory research (CBPR) study to qualitatively understand the factors that affect weight and interventions that may diminish obesity in urban African Americans with serious mental illness
NCCIH	• Mechanistic research on natural products, e.g., The Botanicals and Metabolic Syndrome Center Grant • Mind and body approaches, e.g., The Metabolic and Immunologic Effects of Meditations Center Grant
NIAMS	Series of RCTs on OA: • Arthritis Diet and Activity Promotion Trial (ADAPT) • Intensive Dietary Restriction with Exercise in Arthritis (IDEA) • Weight Loss and Exercise for Communities with Arthritis in North Carolina (WE-CAN)

ICO/ agency	Current/recent obesity research
	• The Osteoarthritis Prevention Study (TOPS)
ODP	• The NIH Pathways to Prevention (P2P) workshop program
	• The National Collaborative on Childhood Obesity Research (NCCOR) efforts to promote evaluation of Natural Experiments
	• Childhood Obesity Prevention Across Borders
	• Effective Programs to Improve Access to Trails webinar
	• Renewal of the Time-Sensitive Obesity Policy and Program Evaluation
OBSSR	• Examination of bio-behavioral mechanisms of action and interaction effecting health behaviors to improve behavior maintenance (Improving Patient Adherence to Treatment and Prevention Regimens to Promote Health, NOT-OD-21-100; Notice of Interest in Long-term Maintenance of Behavior Change Research, NOT-OD-19-040)
	• Integration of multi-level determinants of health to enhance individual and population approaches to disease prevention and treatment (NOT-OD-21-100)
	• Importance of behavioral intervention development to address SDoH and health disparities (Notice of Special Interest: Development and Preliminary Testing of Health-related Behavioral Interventions, NOT-OD-22-203)
	• Infrastructure and policy impact on person level behavior, including of eating and activity patterns (NOT-OD-21-100)
	• Training researchers to advance multi-disciplinary research integrating bio-behavioral approaches
CDC	• Analysis of EHR data and other health services data to: – Understand and improve healthcare utilization – Assess conditions associated with obesity – Assess the expenditures by BMI status and expenditures attributable to sustained obesity among commercially insured children and adults
VA	• Treatment interventions targeting veterans with overweight or obesity who also have a chronic disease such as diabetes, cardiovascular disease, mental illness, or traumatic brain injury
	• MOVE! an individually tailored weight management, health promotion program designed to improve the lives of Veterans through healthy eating and increasing physical activity
HRSA	• Obesity prevention and control and lifestyle interventions among children and adolescents with ASD/DD
	• The Pregnancy-Related Care Research Network (PRCRN) researches whether guidelines affect physicians' confidence in impacting maternal overweight, obesity, and/or gestational weight gain
	• Maternal Health Research Collaborative for Minority Serving Institutions (MH-RC-MSI) program is testing interventions to control gestational weight gain and prevent postpartum weight retention among Black women
AHA	• Creation of a Strategically Focused Research Network (SFRN) researching: – Time-restricted feeding on obesity – Braking inflammation in obesity – Intergenerational obesity

ICO/ agency	Current/recent obesity research
	– Precision medicine and the use of GLP-1 RA
PCORI	• Clinical Effectiveness Research (CER) projects on adult obesity treatment, including:
	• Midwestern Collaborative for Treating Obesity in Rural Primary Care
	• The Louisiana Trial to Reduce Obesity in Primary Care
	• Comparing the Benefits and Harms of Three Types of Weight Loss Surgery -- The PCORnet® Bariatric Study

Abbreviations: ASD/DD = autism spectrum disorders and other developmental disabilities; EHR = electronic health records; GLP-1 RA, glucagon-like peptide-1 receptor agonists; OA, osteoarthritis; RCT, randomized control trial; SDoH, Social Determinants of Health; SES, socioeconomic status.