Review article
doi:10.5633/amm.2026.0415

OBESITY IN SERBIA: EPIDEMIOLOGY, CARE GAPS, AND THE PATH FORWARD

Jovana Zlatković[1]

[1]University Clinical Center Niš, Clinic for Endocrinology, Diabetes and Metabolic Disorders, Niš, Serbia

Contact: Jovana Zlatković

48 Dr. Zorana Djindića Blvd., 18000 Niš, Serbia

E-mail: jovana.zlatkovic@outlook.com

Obesity is classified by the World Health Organization as a chronic, relapsing, multifactorial disease. In Serbia, it has become one of the most pressing public health challenges the country has yet to formally confront. Prevalence rates are among the highest in Europe, with over half of adults classified as overweight or obese, and the numbers in children and adolescents are rising. There is no nationally coordinated, multidisciplinary framework for managing it. This narrative review traces the epidemiological burden across the country, with particular focus on the south and on younger age groups, and examines what the current care structure actually looks like in practice: primary care physicians with limited obesity training, pharmacotherapy used without structured clinical support, and a largely unregulated nutrition sector filling the gap. Against this backdrop, the review draws on international models of structured obesity care and evidence from digitally supported behavioral interventions to argue that the treatment gap is not inevitable. It reflects a lack of system-level investment, and it can be reduced through physician-led, evidence-based approaches that are realistic within the Serbian context. The paper ends with a concrete call for structured obesity care aligned with current clinical knowledge and adapted to local realities.

Keywords: obesity; Serbia; multidisciplinary intervention; public health; care infrastructure

Pregledni rad

doi:10.5633/amm.2026.0415

GOJAZNOST U SRBIJI: EPIDEMIOLOGIJA, SISTEMSKI NEDOSTACI I PUT NAPRED

Jovana Zlatković [1]*

1Univerzitetski Klinički centar Niš, Klinika za endokrinologiju, dijabetes i bolesti metabolizma, Niš, Srbija

Kontakt:

Jovana Zlatković, Bulevar dr Zorana Đinđića 48, 18 000 Niš, Srbija

E-mail: jovana.zlatkovic@outlook.com

Gojaznost je od strane Svetske zdravstvene organizacije klasifikovana kao hronična, relapsirajuća, multifaktorijalno uslovljena bolest. U Srbiji, ona predstavlja jedan od najozbiljnijih javnozdravstvenih izazova sa kojima se zemlja još uvek nije sistemski suočila. Prevalenca spada među najviše u Evropskom regionu SZO, više od polovine odraslog stanovništva je prekomerno uhranjeno ili gojazno, a brojevi među decom i adolescentima rastu. Nacionalno koordinisan, multidisciplinaran okvir za lečenje gojaznosti ne postoji. Ovaj narativni pregled prati epidemiološki teret gojaznosti u Srbiji, sa posebnim fokusom na južni deo zemlje i na mlađe starosne grupe, i ispituje kako postojeća infrastruktura zdravstvene zaštite u praksi zaista funkcioniše: lekari primarne zdravstvene zaštite sa ograničenom edukacijom o gojaznosti kao hroničnoj bolesti, farmakoterapija koja se primenjuje bez strukturirane nutritivne i bihejvioralne podrške, i neregulisani sektor nutricionizma koji popunjava nastalu sistemsku prazninu. Na osnovu međunarodnih modela strukturirane brige o gojaznosti i dokaza o digitalno podržanim bihejvioralnim intervencijama, pregled argumentuje da postojeći jaz u lečenju nije neizbežan. On odražava izostanak sistemskog ulaganja i može se premostiti pristupima zasnovanim na dokazima koji su izvodljivi u srpskom kontekstu. Rad identifikuje konkretne oblasti u kojima su promene u obrazovanju, kliničkoj organizaciji i regulatornom okviru klinički opravdane i ostvarive.

Ključne reči: gojaznost; Srbija; multidisciplinarna intervencija; javno zdravlje; sistem zdravstvene zaštite

INTRODUCTION

Obesity is no longer regarded as a risk factor or a matter of individual lifestyle. The World Health Organization (WHO), the European Association for the Study of Obesity (EASO), and other major clinical bodies now define it as a chronic, relapsing, multifactorial disease shaped by biological, genetic, neurological, and environmental influences (1–3). This shift has clear clinical implications: it reframes obesity as a condition requiring structured medical care and places its management within the scope of the healthcare system.

Across Central, Eastern, and Southeastern Europe, healthcare systems are still adapting to this evolving framework. The gap between the scale of obesity and the availability of consistent, evidence-based care reflects how care is organized, how physicians are trained, and how obesity is perceived within both medical and social contexts.

The burden of obesity-related comorbidities continues to rise, with type 2 diabetes and cardiovascular disease foremost among them. Serbia illustrates this gap particularly clearly: with one of the highest obesity prevalence rates in the WHO European Region (4), no nationally defined framework for structured obesity care, and limited formal training in obesity medicine at the primary care level, the current response remains fragmented. This review examines that gap: its epidemiological scope, contributing factors, and the international evidence that can inform a more coordinated and context-sensitive approach.

LITERATURE SEARCH

A narrative literature search was conducted using PubMed/MEDLINE, Google Scholar, and the Cochrane Library, combining terms including *obesity*, *overweight*, *BMI*, *Serbia*, *Southeastern Europe*, *GLP-1 receptor agonist*, *digital health*, *behavioral intervention*, and *weight stigma*. National epidemiological data were sourced from the Serbian National Health Survey (2019), the WHO European Regional Obesity Report (2022), EUROSTAT (SDG_02_10), and the World Obesity Atlas (2022). No date restriction was applied for mechanistic studies; for pharmacotherapy and structured programs, publications from 2015 onward were prioritized. Articles in English and Serbian were included. Studies were excluded if they lacked peer review, consisted solely of opinion pieces without empirical basis, or reported data not applicable to the European context. Preference was given to original research, systematic reviews, meta-analyses, and official public health documents.

OBESITY AS A CHRONIC, RELAPSING DISEASE: BIOLOGICAL MECHANISMS

The reclassification of obesity as a chronic, relapsing disease reflects advances in mechanistic research rather than a change in terminology. Body weight is regulated through coordinated neuroendocrine systems, including leptin-melanocortin signaling and incretin-mediated effects on satiety (5–7). These systems adapt actively in the setting of sustained weight gain: regulatory set points shift, energy conservation mechanisms activate, and orexigenic drive intensifies, producing a biological state that resists weight loss and promotes regain (8,9). Adipose tissue functions as an active endocrine organ; in obesity, its signaling becomes dysregulated, driving leptin resistance, chronic low-grade inflammation, and a systemic environment that biologically favors weight regain (10–12). What is often attributed to poor adherence may, at least partly, reflect the predictable outcome of these physiological adaptations. Lifestyle interventions, while foundational, are frequently insufficient as standalone treatment because they do not specifically address the neuroendocrine mechanisms driving weight regain (13,14).

PHARMACOTHERAPY IN CURRENT OBESITY CARE

Contemporary obesity care has shifted toward structured, long-term management integrating medical, nutritional, and behavioral components. Pharmacotherapy now plays a central role, particularly with incretin-based therapies acting on appetite regulation and energy balance (15).

The STEP trial program established the efficacy of once-weekly semaglutide 2.4 mg, a glucagon-like peptide-1 (GLP-1) receptor agonist, with mean weight reductions of 14.9--16.0% over 68 weeks significantly exceeding placebo (16,17). The SURMOUNT program demonstrated greater weight loss with tirzepatide, a dual GLP-1 and glucose-dependent insulinotropic polypeptide (GIP) receptor agonist, with outcomes approaching those seen in some surgical cohorts (18,19). These therapies represent a substantial advance. Their availability has also made the limitations of medication-centered care more apparent: real-world data point to considerable dropout driven by cost, tolerability, and access, and weight regain following discontinuation is common. Follow-up data from the STEP 1 extension indicate that participants regained approximately two-thirds of their prior weight loss within one year of stopping semaglutide (20).

The pharmacological pipeline continues to expand, with oral formulations removing the barrier of injectable administration and triple receptor agonists such as retatrutide pushing efficacy further (21). Parallel interest has developed in agents targeting lean mass preservation, given consistent findings of muscle loss during GLP-1-based treatment (22). What this pipeline does not resolve is the question each new agent re-encounters: outcomes are shaped by behavior, nutritional status,

and continuity of care. Current evidence supports a model in which pharmacological treatment is integrated into a broader clinical framework, with ongoing supervision, nutritional guidance, and behavioral support (23–25).

EPIDEMIOLOGICAL BURDEN OF OBESITY IN SERBIA

The most comprehensive nationally representative dataset for Serbia remains the National Health Survey conducted in 2019 by the Institute of Public Health of Serbia (26). According to these data, 57.1% of individuals aged 15 and older are classified as overweight, including 20.8% meeting criteria for obesity based on measured BMI, placing Serbia among the highest-burden countries in Europe. Prevalence rises sharply after midlife, exceeding one third of the population between 45 and 64 years. Early signals are visible in younger groups, though updated granular national data on pediatric obesity are lacking, limiting trend monitoring in what is increasingly recognized as a critical entry point for long-term cardiometabolic risk (26). The comorbidity profile reflects this burden directly. Arterial hypertension is reported in 29.6% of adults, rising to 46.2% when measured or treated cases are included. Dyslipidemia and diabetes are also common, affecting 10.8% and 7.8% of the population, respectively, while 8.9% report coronary heart disease or angina (26). Nearly half the adult population (48.8%) lives with at least one chronic condition, with clustering of obesity-related comorbidities more prevalent among older and lower socioeconomic groups (26,27). Eurostat estimates indicate overweight prevalence rose from 49.5% in 2017 to 53.6% in 2019, with the most recent value at 52.4% in 2022, above the EU average (28). These figures rely on self-reported data and likely underestimate true prevalence. A regional policy dialogue conducted by the WHO Regional Office for Europe in 2022 identified persistent implementation gaps in Serbia: absent referral pathways for obesity care, limited food environment regulation, and fragmented preventive strategies (29). No equally comprehensive national health survey has been conducted since 2019, a limitation in itself given the dynamic trajectory of obesity and its comorbidities.

REGIONAL DISPARITIES: THE CASE OF SOUTHERN SERBIA

The Southern and Eastern Serbia statistical region, including Niš and surrounding districts, carries a disproportionately high obesity burden compared with northern Serbia and the Belgrade metropolitan area. Data from the 2019 National Health Survey and the World Obesity Federation country report indicate higher rates of overweight and obesity among children and adolescents aged 5--14 in this region (26,30), reflecting early exposure to obesogenic environments that tend to persist into adulthood (31,32). Several overlapping structural and cultural factors shape this risk profile. Dietary patterns are strongly rooted in traditional, energy-dense foods spanning grilled meats, bakery

products, burek, homemade pastries, that are part of everyday social life rather than occasional choices, reinforced by a high density of bakeries and fast-food outlets. The traditional Serbian restaurant known as the „kafana“ is typically associated with prolonged sitting, frequent alcohol consumption, and late meals, creating a setting where excess caloric intake and low energy expenditure coexist as routine. Opportunities for physical activity are further constrained by infrastructure: cycling in Niš is largely confined to a single arterial corridor, placing the city among the lowest-bikability environments in the regional context (33), while pedestrian accessibility is systematically limited by a street hierarchy built around motorized transport (34). A substantial proportion of households still rely on wood or coal for heating, contributing to high air pollution levels and a hostile outdoor environment during winter months (35).

OBESITY IN CHILDREN AND ADOLESCENTS

Data from the WHO Childhood Obesity Surveillance Initiative (COSI), Round 5 (2018--2020), indicate that approximately 35% of boys and 27% of girls aged 7-9 years in Serbia are affected by overweight or obesity, with prevalence among boys exceeding the European average of 31%. Obesity alone affects roughly 14% of boys and 10% of girls, placing Serbia among higher-burden countries in the region (36).

Physical inactivity compounds this picture. Serbian adolescent boys rank highest in the WHO European Region for insufficient physical activity, with girls ranking third (29,37). This is not solely a matter of individual behavior. Physical education is often structured around performance rather than inclusion, and students with excess body weight are among the least likely to engage with available opportunities (38). Furthermore, smoking remains common among Serbian adolescents and is documented as an active weight control strategy in this population (39), adding a further layer of complexity to any intervention targeting body weight and eating behavior.

PROBLEMS WITH THE EXISTING CARE INFRASTRUCTURE

Primary care in Serbia operates under increasing structural pressure from population ageing and a rising burden of noncommunicable diseases (40). Time constraints and workload pressures limit opportunities for guideline use and preventive care (41), and although chronic disease data are systematically collected at the population level (42), implementation of structured obesity management remains limited. Clinical interactions are often reduced to brief lifestyle advice, without comprehensive assessment of underlying drivers or initiation of evidence-based treatment.

Specialist care: limited availability and regional gaps

Structured obesity care at the tertiary level exists but remains geographically concentrated. EASO-accredited services exist in Belgrade (43), but in Southern Serbia, including Niš, no equivalent is available. Patients referred for specialist evaluation are commonly assessed to exclude secondary endocrine causes; when these are ruled out, structured treatment planning is not consistently implemented. The practical endpoint for many patients is a recommendation to follow general hygienic-dietary measures, without follow-up or integration into a broader care pathway.

GLP-1 pharmacotherapy without clinical scaffolding

The effectiveness of GLP-1 receptor agonists demonstrated in clinical trials was not achieved through pharmacotherapy in isolation. Participants were prescribed hypocaloric diets, increased physical activity, and structured follow-up. In Serbia, this context is largely absent. Semaglutide is reimbursed for selected patients with type 2 diabetes, but structured nutritional counseling and longitudinal follow-up are not consistently implemented. Obesity-specific agents such as Wegovy and Mounjaro are available at significant out-of-pocket cost, often without supervision. Many patients initiate treatment without dietary guidance, metabolic assessment, or monitoring, and without structured follow-up are less likely to be counseled on the side effect profile during titration, increasing the risk of early discontinuation before therapeutic benefit is established. Real-world outcomes are more variable and less durable when pharmacotherapy is used without structured support (23,44–46). Recent analyses consistently report reductions in lean body mass during GLP-1-based treatment, plausibly related to insufficient protein intake and lack of resistance training rather than a direct drug effect (22). Nutritional deficiencies, including inadequate protein, iron, vitamin B12, vitamin D, and calcium, have been described in patients undergoing rapid weight loss without dietary guidance (47–49).

The unregulated nutrition and fitness sector

In the absence of structured medical care, many individuals turn to personal trainers, nutrition advisors, and online coaching platforms. While lifestyle professionals can play a beneficial role in supporting behavior change, the rapid growth of digital platforms has enabled individuals without formal training to provide health-related advice at scale. Social media has become a primary source of nutrition information, where non-professional content predominate (50), a substantial proportion of which is inaccurate (51), and where users struggle to distinguish qualified from unqualified sources (51,52). Short online certification programs have further lowered the barrier to entry. Several countries have responded with stricter regulations on the use of professional titles in health communication. The challenge is not the presence of non-medical support but the absence of defined

boundaries and clinical integration, without which this landscape risks delaying appropriate diagnosis and management (53).

EVIDENCE FOR STRUCTURED MULTIDISCIPLINARY OBESITY PROGRAMS

Structured, multidisciplinary obesity programs consistently produce superior outcomes compared to pharmacotherapy or lifestyle intervention alone. Real-world data from the WeGoTogether digital support program, embedded alongside semaglutide 2.4 mg in over 8,000 patients, showed mean weight reductions of 17.6% at 12 months and 20.4% at 24 months, with approximately half achieving at least 20% weight loss (54), substantially exceeding estimates for pharmacotherapy without structured support. Data from a UK cohort indicate that patients actively engaging with digital coaching achieve significantly greater weight loss than non-users (11.5% vs 8.0% at 5 months, $p<0.001$) (55) with SMS and messaging-based formats showing the highest engagement where app-based models face adoption barriers. Group-based behavioral components contribute independently to outcomes. A systematic review of randomized controlled trials found group-based interventions more effective than individual treatment in psychologist-led programs, with lower dropout rates (56,57). Long-term maintenance is consistently better in programs combining behavioral, dietary, and structured follow-up components compared to single-component approaches (13,45,57).

WEIGHT STIGMA AS A STRUCTURAL BARRIER TO CARE

Attitudes framing excess body weight as a matter of personal responsibility remain common in both the general population and healthcare settings, with documented impact on quality of care (58,59). Weight stigma shapes how care is delivered and received: consultations may remain brief and focused on generalized advice, and patients who perceive judgment are more likely to disengage, delay follow-up, and show lower treatment adherence, contributing over time to worse metabolic outcomes (59–61).

Evidence from Central and Eastern Europe indicates that stigmatizing attitudes, including perceptions of personal blame and shame, are present among both the general public and healthcare professionals (62,63). Serbia-specific data remain limited, but broader regional patterns and the sociocultural normalization of body weight commentary suggest this barrier is operative in the local context. Addressing obesity in a structured way therefore requires attention to how care is communicated, by explaining the biological basis of disease, using neutral and person-first language, and creating clinical environments designed to support engagement rather than avoidance (61,64).

IMPLICATIONS FOR POLICY AND CLINICAL PRACTICE IN SERBIA

Serbia has formally recognized obesity as a chronic disease. A National Programme for the Prevention of Obesity in Children and Adults was adopted in 2018 (65), national clinical treatment guidelines were published in 2022 (66), and a program for diabetes prevention and control covering 2025 to 2029 was adopted in 2025 (67). These steps represent meaningful acknowledgment at the policy level. The implementation gap, however, remains substantial: the 2018 program was enacted without an accompanying action plan with no published evidence of any implementation phase (68), no standardized referral pathways link primary to specialist care, and utilization of preventive services for noncommunicable diseases at the primary care level remains low (40). The structural elements currently absent are identifiable. Standardized BMI and waist-to-height ratio screening, alongside structured referral pathways in primary care, are needed. Training in obesity medicine for general practitioners and endocrinologists remains a separately documented gap, with providers across health systems consistently reporting lack of time, training, and multidisciplinary support as barriers to effective obesity care (69). At least one regional multidisciplinary center per region, including Southern Serbia, is required to close the geographic gap in specialist access. International guidelines consistently conclude that obesity should be managed by multiprofessional teams and that this model is achievable across different resource settings (23,25,70). Reimbursement of evidence-based pharmacotherapy for obesity as a primary indication, rather than only as a diabetes comorbidity, would align the public system with current clinical evidence.

Pediatric obesity warrants separate structural attention. Childhood overweight prevalence rose measurably between 2015 and 2019 (71), yet no nationally coordinated prevention program, consistent school nutrition standards, or referral pathways from pediatric primary care to specialist management currently exist. Given the strong tracking of pediatric obesity into adulthood, this represents the highest long-term leverage point for reducing future cardiometabolic burden.

Effective obesity care does not require sophisticated infrastructure: physician-led multidisciplinary programs combining dietary, behavioral, and follow-up components have demonstrated clinical efficacy in resource-constrained settings comparable to Serbia's (72).

CONCLUSION

Obesity in Serbia is a chronic disease epidemic of documented severity. Prevalence exceeds the EU-27 average, the trend is rising among children and adolescents, and the burden falls disproportionately on Southern Serbia, a region where socioeconomic disadvantage, an obesogenic built environment, and limited specialist access compound one another. The evidence reviewed here

situates this not as a problem of individual behavior, but as a consequence of biological disease processes unfolding within a healthcare and social system that has not yet developed the infrastructure to address them.

The picture of existing care that emerges from this review is one of structural fragmentation. Pharmacotherapy is becoming more accessible, but it is reaching patients without the nutritional guidance, metabolic monitoring, and behavioral follow-up that clinical evidence identifies as necessary for sustained outcomes. The absence of qualified dietitians and exercise specialists in both primary and tertiary care is a concrete gap, associated in current evidence with poorer pharmacological outcomes, greater muscle mass loss, and undetected nutritional deficiencies. Meanwhile, the space created by this absence has been occupied, at least in part, by an unregulated nutrition and lifestyle sector where the boundaries of professional competence are poorly defined and regulatory oversight is limited. This paper does not dismiss the potential role of non-medical practitioners in supporting behavior change; it points to the risks that arise when that role operates without professional standards, clinical integration, or mechanisms for appropriate referral.

Medical education is another gap this review surfaces. Obesity medicine has no formal curricular standing in Serbian undergraduate or postgraduate training. There are no nationally recognized obesity specialists produced through structured educational pathways, and primary care physicians consistently report inadequate training as a barrier to delivering guideline-consistent care. The field has changed substantially in the past decade, mechanistically, pharmacologically, and in terms of what structured care can realistically achieve, and the training infrastructure has not kept pace.

The policy instruments that exist, the 2018 prevention program and the 2022 national clinical guidelines, represent acknowledgment at the level of documentation. What is missing is an implementation framework connecting those documents to clinical practice: standardized referral pathways, regional multidisciplinary centers that include dietetic and exercise medicine expertise, training designed to produce physicians competent in obesity management, and regulatory clarity around who is qualified to provide clinical nutrition advice in a professional capacity.

This review maps the space where those changes could take place. It identifies what the evidence supports, where the clinical and structural gaps lie, and what international experience suggests is achievable within resource-constrained settings. The next step belongs to institutions, policymakers, and clinical communities in a position to move from documentation to organized practice.

LIMITATIONS

This review is subject to several limitations. As a narrative rather than systematic review, literature selection was guided by relevance, which may introduce selection bias and limits reproducibility. The synthesis remains inherently interpretative, even where priority was given to systematic reviews, meta-analyses, and official public health data. Serbia-specific and regionally granular data are limited across several areas covered here. National surveys and international datasets provide the epidemiological foundation, but data on regional variation, care pathways, and treatment outcomes are scarce, and some conclusions rely on extrapolation from broader European evidence. Patient-level data are also largely absent. How patients navigate the existing system, adhere to treatment, and experience weight stigma in clinical encounters remains poorly characterized in the Serbian context. These gaps point toward clear priorities for future research: prospective and survey-based studies on patient experiences and barriers to care, regionally stratified epidemiological data, and real-world clinical outcome studies that could provide a more precise foundation for designing targeted interventions.

ACKNOWLEDGEMENTS

The author declares no conflicts of interest.

FUNDING: This research received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

REFERENCES

1. Obesity and overweight [Internet]. [cited 2026 Apr 12]. Available from: https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

2. Bray GA, Kim KK, Wilding JPH, World Obesity Federation. Obesity: a chronic relapsing progressive disease process. A position statement of the World Obesity Federation. Obes Rev Off J Int Assoc Study Obes. 2017 Jul;18(7):715–23. doi:10.1111/obr.12551 PubMed PMID: 28489290.

3. Frühbeck G, Busetto L, Dicker D, Yumuk V, Goossens GH, Hebebrand J, et al. The ABCD of Obesity: An EASO Position Statement on a Diagnostic Term with Clinical and Scientific Implications. Obes Facts. 2019;12(2):131–6. doi:10.1159/000497124 PubMed PMID: 30844811; PubMed Central PMCID: PMC6547280.

4. WHO European Regional Obesity Report 2022 [Internet]. [cited 2026 Apr 8]. Available from: https://www.who.int/europe/publications/i/item/9789289057738

5. Grill HJ, Hayes MR. Hindbrain neurons as an essential hub in the neuroanatomically distributed control of energy balance. Cell Metab. 2012 Sep 5;16(3):296–309. doi:10.1016/j.cmet.2012.06.015 PubMed PMID: 22902836; PubMed Central PMCID: PMC4862653.

6. Affinati AH, Myers MG. Neuroendocrine Control of Body Energy Homeostasis. In: Feingold KR, Adler RA, Ahmed SF, Anawalt B, Blackman MR, Chrousos G, et al., editors. Endotext [Internet]. South Dartmouth (MA): MDText.com, Inc.; 2000 [cited 2026 Apr 12]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK570658/ PubMed PMID: 34033309.

7. Gut-Brain Cross-Talk in Metabolic Control: Cell [Internet]. [cited 2026 Apr 12]. Available from: https://www.cell.com/cell/fulltext/S0092-8674(17)30110-1?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS0092867417301101%3Fshowall%3Dtrue

8. Speakman JR, Levitsky DA, Allison DB, Bray MS, de Castro JM, Clegg DJ, et al. Set points, settling points and some alternative models: theoretical options to understand how genes and environments combine to regulate body adiposity. Dis Model Mech. 2011 Nov;4(6):733–45. doi:10.1242/dmm.008698 PubMed PMID: 22065844; PubMed Central PMCID: PMC3209643.

9. Sumithran P, Prendergast LA, Delbridge E, Purcell K, Shulkes A, Kriketos A, et al. Long-Term Persistence of Hormonal Adaptations to Weight Loss. N Engl J Med. 2011 Oct 27;365(17):1597–604. doi:10.1056/NEJMoa1105816

10. Blüher M. Adipose tissue dysfunction in obesity. Exp Clin Endocrinol Diabetes Off J Ger Soc Endocrinol Ger Diabetes Assoc. 2009 Jun;117(6):241–50. doi:10.1055/s-0029-1192044 PubMed PMID: 19358089.

11. Leptin and the endocrine control of energy balance | Nature Metabolism [Internet]. [cited 2026 Apr 12]. Available from: https://www.nature.com/articles/s42255-019-0095-y

12. Challenges and Opportunities of Defining Clinical Leptin Resistance: Cell Metabolism [Internet]. [cited 2026 Apr 12]. Available from: https://www.cell.com/cell-metabolism/fulltext/S1550-4131(12)00006-X?_returnURL=https%3A%2F%2Flinkinghub.elsevier.com%2Fretrieve%2Fpii%2FS155041311200006X%3Fshowall%3Dtrue

13. Wadden TA, Tronieri JS, Butryn ML. Lifestyle modification approaches for the treatment of obesity in adults. Am Psychol. 2020;75(2):235–51. doi:10.1037/amp0000517

14. Schwartz MW, Seeley RJ, Zeltser LM, Drewnowski A, Ravussin E, Redman LM, et al. Obesity Pathogenesis: An Endocrine Society Scientific Statement. Endocr Rev. 2017 Jun 26;38(4):267–96. doi:10.1210/er.2017-00111 PubMed PMID: 28898979; PubMed Central PMCID: PMC5546881.

15. Fredrick TW, Camilleri M, Acosta A. Pharmacotherapy for Obesity: Recent Updates. Clin Pharmacol Adv Appl. 2025 Sep 19;17:305–27. doi:10.2147/CPAA.S497904 PubMed PMID: 40995421; PubMed Central PMCID: PMC12456317.

16. Once-Weekly Semaglutide in Adults with Overweight or Obesity | New England Journal of Medicine [Internet]. [cited 2026 Apr 12]. Available from: https://www.nejm.org/doi/full/10.1056/NEJMoa2032183

17. Wadden TA, Bailey TS, Billings LK, Davies M, Frias JP, Koroleva A, et al. Effect of Subcutaneous Semaglutide vs Placebo as an Adjunct to Intensive Behavioral Therapy on Body Weight in Adults With Overweight or Obesity. JAMA. 2021 Apr 13;325(14):1–11. doi:10.1001/jama.2021.1831 PubMed PMID: 33625476; PubMed Central PMCID: PMC7905697.

18. Tirzepatide Once Weekly for the Treatment of Obesity | New England Journal of Medicine [Internet]. [cited 2026 Apr 8]. Available from: https://www.nejm.org/doi/full/10.1056/NEJMoa2206038

19. Effects of Bariatric Surgery on Mortality in Swedish Obese Subjects | New England Journal of Medicine [Internet]. [cited 2026 Apr 12]. Available from: https://www.nejm.org/doi/full/10.1056/NEJMoa066254

20. Wilding JPH, Batterham RL, Davies M, Van Gaal LF, Kandler K, Konakli K, et al. Weight regain and cardiometabolic effects after withdrawal of semaglutide: The STEP 1 trial extension. Diabetes Obes Metab. 2022;24(8):1553–64. doi:10.1111/dom.14725

21. Triple–Hormone-Receptor Agonist Retatrutide for Obesity — A Phase 2 Trial | New England Journal of Medicine [Internet]. [cited 2026 Apr 13]. Available from: https://www.nejm.org/doi/full/10.1056/NEJMoa2301972

22. Prado CM, Phillips SM, Gonzalez MC, Heymsfield SB. Muscle matters: the effects of medically induced weight loss on skeletal muscle. Lancet Diabetes Endocrinol. 2024 Nov 1;12(11):785–7. doi:10.1016/S2213-8587(24)00272-9 PubMed PMID: 39265590.

23. Secretariat E. Framework for the Pharmacological Treatment of Obesity And its Complications from The European Association for the Study of Obesity. EASO [Internet]. 2025 Oct 2 [cited 2026 Apr 13]. Available from: https://easo.org/framework-for-the-pharmacological-treatment-of-obesity-and-its-complications-from-the-european-association-for-the-study-of-obesity/

24. WHO issues global guideline on the use of GLP-1 medicines in treating obesity [Internet]. [cited 2026 Apr 12]. Available from: https://www.who.int/news/item/01-12-2025-who-issues-global-guideline-on-the-use-of-glp-1-medicines-in-treating-obesity

25. Pedersen SD, Manjoo P, Dash S, Jain A, Pearce N, Poddar M. Pharmacotherapy for obesity management in adults: 2025 clinical practice guideline update. CMAJ Can Med Assoc J. 2025 Aug 11;197(27):E797–809. doi:10.1503/cmaj.250502 PubMed PMID: 40789597; PubMed Central PMCID: PMC12350384.

26. The 2019 Serbian National Health Survey | Statistical Office of the Republic of Serbia [Internet]. [cited 2026 Apr 13]. Available from: https://www.stat.gov.rs/en-us/vesti/20210429-istrazivanje-zdravlja-stan/

27. Dimitrijev I, Radovanovic S, Vesic Z, Colakovic G, Selakovic V, Lackovic A, et al. Demographic and Socioeconomic Predictors of Prehypertension and Hypertension in the Adult Population: Serbian National Health Survey. Medicina (Mex). 2024 May;60(5):824. doi:10.3390/medicina60050824

28. [sdg_02_10] Obesity rate by body mass index (BMI) [Internet]. [cited 2026 Apr 13]. Available from: https://ec.europa.eu/eurostat/databrowser/view/sdg_02_10/default/table?lang=en

29. Kluge HHP, Weltgesundheitsorganisation, editors. WHO European regional obesity report 2022. Copenhagen: World Health Organization; 2022. 1 p.

30. World Obesity Federation Global Obesity Observatory [Internet]. [cited 2026 Apr 13]. Serbia. Available from: https://data.worldobesity.org/country/serbia-188/

31. Singh AS, Mulder C, Twisk JWR, van Mechelen W, Chinapaw MJM. Tracking of childhood overweight into adulthood: a systematic review of the literature. Obes Rev Off J Int Assoc Study Obes. 2008 Sep;9(5):474–88. doi:10.1111/j.1467-789X.2008.00475.x PubMed PMID: 18331423.

32. Predicting adult obesity from childhood obesity: a systematic review and meta-analysis - Simmonds - 2016 - Obesity Reviews - Wiley Online Library [Internet]. [cited 2026 Apr 13]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/obr.12334

33. Piatkowski D, Lu C, Östh J. Urban Bikability: A Case-Comparison of Utrecht, the Netherlands and Nis, Serbia. In: Stanković JJ, Luè A, van der Laag C, editors. Regional and Urban Challenges and Opportunities for Data-Policy Interactions: The Western Balkans and Eastern European Countries [Internet]. Cham: Springer Nature Switzerland; 2026 [cited 2026 Apr 13]. p. 189–204. Available from: https://doi.org/10.1007/978-3-032-08592-4_10 doi:10.1007/978-3-032-08592-4_10

34. van der Laag C, Tan W, Garau C, Murgante B. On Foot Through Town? The Conundrum of Pedestrian Accessibility in Niš, Serbia. In: Stanković JJ, Luè A, van der Laag C, editors. Regional and Urban Challenges and Opportunities for Data-Policy Interactions: The Western Balkans and Eastern European Countries [Internet]. Cham: Springer Nature Switzerland; 2026 [cited 2026 Apr 13]. p. 173–87. Available from: https://doi.org/10.1007/978-3-032-08592-4_9 doi:10.1007/978-3-032-08592-4_9

35. Impact of Domestic Heating on Air Pollution—Extreme Pollution Events in Serbia [Internet]. [cited 2026 Apr 13]. Available from: https://www.mdpi.com/2071-1050/16/18/7920

36. Report on the fifth round of data collection, 2018–2020: WHO European Childhood Obesity Surveillance Initiative (COSI) [Internet]. [cited 2026 Apr 13]. Available from: https://www.who.int/europe/publications/i/item/WHO-EURO-2022-6594-46360-67071

37. Spotlight on adolescent health and well-being. Findings from the 2017/2018 Health Behaviour in School-aged Children (HBSC) survey in Europe and Canada. International report. Volume 1. Key findings [Internet]. [cited 2026 Apr 8]. Available from: https://www.who.int/europe/publications/i/item/9789289055000

38. Understanding body image in physical education - Charlotte Kerner, Leen Haerens, David Kirk, 2018 [Internet]. [cited 2026 Apr 12]. Available from: https://journals.sagepub.com/doi/10.1177/1356336X17692508?utm_source=researchgate.net&utm_medium=article

39. Kilibarda B, Gudelj Rakic J, Mitov Scekic S, Krstev S. Smoking as a weight control strategy of Serbian adolescents. Int J Public Health. 2020 Nov 1;65(8):1319–29. doi:10.1007/s00038-020-01469-1

40. Milena N Ha Thi Hong,Djukic, Predrag,Zajeganovic Jakovljevic, Jelena,Misic, Ivana,Sormaz, Nemanja,Gajic Stevanovic. World Bank [Text/HTML] [Internet]. [cited 2026 Apr 13]. Serbia – Toward a More Effective, Efficient, Equitable and Resilient Health System. Available from: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099056102282317093

41. Santric Milicevic M, Tripkovic K, Bjelica N, Dinic M, Jeremic D, Van Poel E, et al. General Practitioners' Mental Well-Being During Crises: Results of the PRICOV-19 Study Pilot in Serbia. Healthcare. 2025 Jan;13(5):573. doi:10.3390/healthcare13050573

42. Institut za javno zdravlje Srbije „Dr Milan Jovanović Batut." Zdravstveno-statistički godišnjak Republike Srbije 2024. Beograd: IZJZS; 2025. [Internet]. Available from: https://www.batut.org.rs/download/publikacije/pub2024v1.pdf

43. Center for Obesity, Clinic of Endocrinology, Diabetes and Metabolic Disease, Clinical Center of Serbia. EASO [Internet]. [cited 2026 Apr 13]. Available from: https://easo.org/com/center-for-obesity-clinic-of-endocrinology-diabetes-and-metabolic-disease-clinical-center-of-serbia/

44. Rubino D, Abrahamsson N, Davies M, Hesse D, Greenway FL, Jensen C, et al. Effect of Continued Weekly Subcutaneous Semaglutide vs Placebo on Weight Loss Maintenance in Adults

With Overweight or Obesity: The STEP 4 Randomized Clinical Trial. JAMA. 2021 Apr 13;325(14):1414–25. doi:10.1001/jama.2021.3224

45. Wadden TA, Chao AM, Moore M, Tronieri JS, Gilden A, Amaro A, et al. The Role of Lifestyle Modification with Second-Generation Anti-obesity Medications: Comparisons, Questions, and Clinical Opportunities. Curr Obes Rep. 2023;12(4):453–73. doi:10.1007/s13679-023-00534-z PubMed PMID: 38041774; PubMed Central PMCID: PMC10748770.

46. Jensen SBK, Blond MB, Sandsdal RM, Olsen LM, Juhl CR, Lundgren JR, et al. Healthy weight loss maintenance with exercise, GLP-1 receptor agonist, or both combined followed by one year without treatment: a post-treatment analysis of a randomised placebo-controlled trial. eClinicalMedicine. 2024 Mar 1;69:102475. doi:10.1016/j.eclinm.2024.102475

47. Scott Butsch W, Sulo S, Chang AT, Kim JA, Kerr KW, Williams DR, et al. Nutritional deficiencies and muscle loss in adults with type 2 diabetes using GLP-1 receptor agonists: A retrospective observational study. Obes Pillars. 2025 Sep 1;15:100186. doi:10.1016/j.obpill.2025.100186

48. Urbina J, Salinas-Ruiz LE, Valenciano C, Clapp B. Micronutrient and Nutritional Deficiencies Associated With GLP-1 Receptor Agonist Therapy: A Narrative Review. Clin Obes. 2026 Feb;16(1):e70070. doi:10.1111/cob.70070 PubMed PMID: 41549912.

49. Johnson B, Milstead M, Thomas O, McGlasson T, Green L, Kreider R, et al. Investigating nutrient intake during use of glucagon-like peptide-1 receptor agonist: a cross-sectional study. Front Nutr. 2025 Apr 25;12. doi:10.3389/fnut.2025.1566498

50. Kaňková J, Binder A, Matthes J. Helpful or harmful? Navigating the impact of social media influencers' health advice: insights from health expert content creators. BMC Public Health. 2024 Dec 18;24:3511. doi:10.1186/s12889-024-21095-3 PubMed PMID: 39696170; PubMed Central PMCID: PMC11657387.

51. Evans S, Lambert K, Dinale A, Quinn M, Cosier D. Unqualified Advice and Product Promotions: Analysis of Health and Nutrition Content on Social Media Consumed by Young Adults. Nutrients. 2025 Dec 22;18(1):44. doi:10.3390/nu18010044 PubMed PMID: 41515162; PubMed Central PMCID: PMC12787465.

52. Lissens M, Harff D, Schmuck D. Responses to (Un)healthy advice: Processing and acceptance of health content creators' nutrition misinformation by youth. Appetite. 2025 Feb 1;206:107812. doi:10.1016/j.appet.2024.107812 PubMed PMID: 39643086.

53. Social media and the spread of misinformation: infectious and a threat to public health | Health Promotion International | Oxford Academic [Internet]. [cited 2026 Apr 13]. Available from: https://academic.oup.com/heapro/article/40/2/daaf023/8100645?utm_source=chatgpt.com

54. Toliver JC, Divino V, Ng CD, Wang J. Real-World Weight Loss Among Patients Initiating Semaglutide 2.4 mg and Enrolled in WeGoTogether, a Digital Self-Support Application. Adv Ther. 2025 Oct;42(10):5010–22. doi:10.1007/s12325-025-03325-1 PubMed PMID: 40768192; PubMed Central PMCID: PMC12474656.

55. Journal of Medical Internet Research - Impact of Digital Engagement on Weight Loss Outcomes in Obesity Management Among Individuals Using GLP-1 and Dual GLP-1/GIP Receptor Agonist Therapy: Retrospective Cohort Service Evaluation Study [Internet]. [cited 2026 Apr 8]. Available from: https://www.jmir.org/2025/1/e69466

56. Renjilian DA, Perri MG, Nezu AM, McKelvey WF, Shermer RL, Anton SD. Individual versus group therapy for obesity: Effects of matching participants to their treatment preferences. J Consult Clin Psychol. 2001;69(4):717–21. doi:10.1037/0022-006X.69.4.717

57. Johns DJ, Hartmann-Boyce J, Jebb SA, Aveyard P, Behavioural Weight Management Review Group. Diet or exercise interventions vs combined behavioral weight management programs: a systematic review and meta-analysis of direct comparisons. J Acad Nutr Diet. 2014 Oct;114(10):1557–68. doi:10.1016/j.jand.2014.07.005 PubMed PMID: 25257365; PubMed Central PMCID: PMC4180002.

58. Puhl RM, Himmelstein MS, Pearl RL. Weight stigma as a psychosocial contributor to obesity. Am Psychol. 2020;75(2):274–89. doi:10.1037/amp0000538

59. Phelan SM, Burgess DJ, Yeazel MW, Hellerstedt WL, Griffin JM, Ryn M van. Impact of weight bias and stigma on quality of care and outcomes for patients with obesity [Internet]. doi:10.1111/obr.12266

60. Weight stigma experienced by patients with obesity in healthcare settings: A qualitative evidence synthesis - Ryan - 2023 - Obesity Reviews - Wiley Online Library [Internet]. [cited 2026 Apr 12]. Available from: https://onlinelibrary.wiley.com/doi/10.1111/obr.13606

61. Rubino F, Puhl RM, Cummings DE, Eckel RH, Ryan DH, Mechanick JI, et al. Joint international consensus statement for ending stigma of obesity. Nat Med. 2020 Apr;26(4):485–97. doi:10.1038/s41591-020-0803-x

62. Is Obesity a Cause for Shame? Weight Bias and Stigma among Physicians, Dietitians, and Other Healthcare Professionals in Poland—A Cross-Sectional Study [Internet]. [cited 2026 Apr 12]. Available from: https://www.mdpi.com/2072-6643/16/7/999

63. Frontiers | Weight stigma and fat phobia in Poland – attitudes towards people living with obesity and the level of knowledge about obesity among the social media internet respondents and medical professionals [Internet]. [cited 2026 Apr 13]. Available from: https://www.frontiersin.org/journals/nutrition/articles/10.3389/fnut.2023.1287783/full

64. Albury C, Strain WD, Brocq SL, Logue J, Lloyd C, Tahrani A. The importance of language in engagement between health-care professionals and people living with obesity: a joint consensus statement. Lancet Diabetes Endocrinol. 2020 May 1;8(5):447–55. doi:10.1016/S2213-8587(20)30102-9 PubMed PMID: 32333880.

65. Government of the Republic of Serbia. Uredba o Nacionalnom programu za prevenciju gojaznosti kod dece i odraslih [Regulation on the National Programme for the Prevention of Obesity in Children and Adults]. Official Gazette of the Republic of Serbia, No. 9/2018. Belgrade, 2018. [Internet]. Available from: https://zdravlje.gov.rs/view_file.php?file_id=2040&cache=sr

66. Ministry of Health of the Republic of Serbia. Nacionalni vodič dobre kliničke prakse: Lečenje gojaznosti [National Guideline of Good Clinical Practice: Treatment of Obesity]. Belgrade: Ministry of Health; 2022 [Internet]. Available from: https://www.gojaznost.org.rs/wp-content/uploads/2023/02/Nacionalnivodiczalecenjegojaznosti.pdf

67. Government of the Republic of Serbia. Zaključak o usvajanju Operativnog programa prevencije i kontrole dijabetesa u Srbiji za period od 2025. do 2029. godine [Conclusion on the Adoption of the Operative Programme for the Prevention and Control of Diabetes in Serbia for the Period 2025–2029, with an Action Plan for 2026–2027]. Adopted 24 July 2025. [Internet]. Available from: https://www.zdravlje.gov.rs/tekst/458614/operativni-program-prevencije-i-kontrole-dijabetesa-u-republici-srbiji-za-period-2025-2029-godine.php

68. An epidemic of inaction: national responses to obesity [Internet]. Available from: https://assets.ctfassets.net/9crgcb5vlu43/7gVU7zPR8jgUUiR2Es9SI/522561cf86f148043a9d0160b1347946/EI_x_Eli_Lilly_Global_Obesity_Response_Index_Executive_summary.pdf

69. Oshman L, Othman A, Furst W, Heisler M, Kraftson A, Zouani Y, et al. Primary care providers' perceived barriers to obesity treatment and opportunities for improvement: A mixed methods study. PLOS ONE. 2023 Apr 18;18(4):e0284474. doi:10.1371/journal.pone.0284474 PubMed PMID: 37071660; PubMed Central PMCID: PMC10112804.

70. Semlitsch T, Stigler FL, Jeitler K, Horvath K, Siebenhofer A. Management of overweight and obesity in primary care-A systematic overview of international evidence-based guidelines. Obes Rev Off J Int Assoc Study Obes. 2019 Sep;20(9):1218–30. doi:10.1111/obr.12889 PubMed PMID: 31286668; PubMed Central PMCID: PMC6852048.

71. Marković L, Đorđić V, Trajković N, Božić P, Halaši S, Cvejić D, et al. Childhood Obesity in Serbia on the Rise. Children. 2021 May 18;8(5):409. doi:10.3390/children8050409 PubMed PMID: 34070022; PubMed Central PMCID: PMC8157883.

72. Vázquez-Velázquez V, García García E. Feasibility and Effectiveness of a Comprehensive Care Program for People Living with Obesity: A Real-World Experience in a Public Hospital in Mexico.

Obes Facts. 2022 Sep 19;15(6):774–86. doi:10.1159/000527024 PubMed PMID: 36122569; PubMed Central PMCID: PMC9801369.