Adult obesity in the Baltics vs Nordics, 1990–2022: Ecological trends from WHO data

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Received: 22 November 2025

Accepted: 15 April 2026

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DOI 10.5001/omj.2026.67

Abstract

Objectives: To compare trends in adult obesity prevalence (BMI ≥30 kg/m²) between the Baltic (Latvia, Lithuania, Estonia) and Nordic (Denmark, Finland, Iceland, Norway, Sweden) regions from 1990 to 2022, and to assess whether the rate of increase in obesity prevalence differs between the two regions.

Methods: This ecological time-series study utilized age-standardized estimates of adult obesity prevalence from the World Health Organization (WHO) Global Health Observatory. Annual prevalence data from 1990 to 2022 were extracted for each country, and regional mean prevalence for the Baltic and Nordic regions was calculated. Temporal trends were analyzed using linear regression with a Year × Region interaction term to assess whether obesity trajectories differed between regions. Segmented regression was applied to identify inflection points, and the optimal model was selected by minimizing the sum of squared residuals. Segment-specific slopes and the Average Annual Percent Change (AAPC) were calculated.

Results: Over the 32-year period, obesity prevalence increased in both regions (Baltics: 16.3% in 1990 to 23.9% in 2022; Nordics: 9.6% in 1990 to 18.1% in 2022). The Year × Region interaction term was not statistically significant ($p = 0.903$), indicating parallel trajectories of obesity prevalence in both regions. The rate of increase was similar in both regions, with the Baltic region showing an average annual increment of 0.24 percentage points per year and the Nordic region showing 0.27 percentage points per year. Despite earlier adoption of preventive policies in the Nordic countries, their obesity trajectory did not diverge from that of the Baltic states.

Conclusions: Both the Baltic and Nordic regions experienced significant increases in adult obesity prevalence from 1990 to 2022, with nearly parallel trends. The findings suggest that policy maturity alone may not be sufficient to alter long-term obesity trends and highlight the need for more coordinated, multi-level interventions. These results underscore the importance of adopting comprehensive, system-level strategies to address the obesity epidemic across Northern Europe.

Keywords: Obesity; Epidemiology; Public health; Baltic region; Nordic countries; WHO

Introduction

Overweight and obesity remain among the most urgent global public-health challenges. In 2022, approximately 43% of adults aged 18 years and older were classified as overweight, and 16% were living with obesity (BMI ≥ 30 kg/m²).[1] Obesity substantially increases the risk of cardiovascular disease, type 2 diabetes, metabolic complications such as fatty liver disease, certain cancers, and musculoskeletal disorders, contributing significantly to global morbidity and mortality.[2–4]

Across the WHO European Region, nearly 60% of adults are affected by overweight or obesity, and prevalence continues to rise.[5] In 2022, within the European Union, considerable inter-country variation exists in the proportion of adults with overweight (BMI ≥ 25). The share of overweight women ranged from 31.3% in Italy to

56.7% in Latvia, while for men, the range was from 51.5% in France to 69.4% in Croatia, Malta, and Slovakia.[6] The differences in obesity rates across Europe reflect the influence of diverse socioeconomic, behavioral, and policy contexts. These factors impact nutrition, physical activity, and body weight, with stronger public health policies and higher socioeconomic status typically associated with lower obesity rates.[7,8] Understanding how long-term obesity trajectories differ across contrasting policy environments is essential to evaluating whether preventive strategies meaningfully alter population-level trends. Following their independence from the Soviet Union in the early 1990s, the Baltic states (Latvia, Lithuania, Estonia) underwent significant socioeconomic transformations and dietary shifts towards Western patterns.

Meanwhile, Nordic countries (Denmark, Finland, Iceland, Norway, Sweden) have maintained robust welfare systems and were early adopters of public health policies, including food-labeling reforms, physical-activity promotion, and taxes on sugar-sweetened beverages. Cross-sectional analyses have examined obesity variation across European countries,[9] but no prior study has directly compared 32-year adult obesity trajectories between the Baltic and Nordic regions using standardized WHO data. Understanding how obesity prevalence has evolved in these two geographically proximate, yet socioeconomically divergent regions may provide insight into how national policy, cultural factors, and lifestyle transitions shape long-term health outcomes.

Obesity also comprises heterogenous phenotypes that differ in total adiposity and body fat distribution. While BMI is widely used for population surveillance and enables standardized comparisons, it does not directly capture central (abdominal/visceral) adiposity.[10] Complementary anthropometric measures such as waist circumference (WC), waist-to-hip ratio (WHR; using hip/pelvic circumference), and waist-to-height ratio (WHtR)—are commonly used to characterize body fat distribution phenotypes and refine cardiometabolic risk stratification beyond BMI alone.[10,11]

Therefore, this study aimed to compare the prevalence of adults living with obesity (BMI ≥ 30 kg/m²) between Baltic and Nordic countries from 1990 to 2022 using publicly available World Health Organization (WHO) Global Health Observatory estimates, and to assess how regional contexts may have influenced obesity trajectories.

Methods

This was an ecological time-series study using publicly available secondary data. The analysis compared the prevalence of adults living with obesity in the Baltic region (Latvia, Lithuania, Estonia) and the Nordic region (Denmark, Finland, Iceland, Norway, Sweden). The observation period covered 1990–2022, spanning more than three decades of comparable national estimates.

Data source: Data were obtained from the World Health Organization (WHO) Global Health Observatory (GHO) indicator "Prevalence of obesity among adults (BMI ≥30 kg/m², age-standardized estimate, % of population aged ≥18 years)".[12] The dataset was downloaded in March 2024 and initially contained global obesity prevalence estimates. For this study, only values for Baltic and Nordic countries were retained. All processed data used in the analysis are included in S1_File. Source data were obtained from publicly available databases (WHO Global Health Observatory; Our World in Data).

Variables and definitions: The main outcome was the prevalence of adults living with obesity, defined as the proportion of individuals aged ≥18 years with BMI ≥30 kg/m², consistent with WHO standards. No transformations or re-classification of BMI categories were performed. Countries were grouped a priori into Baltic or Nordic regions to enable regional comparison.

Data processing: Data were reviewed for completeness and internal consistency. All data points were complete and numeric; no exclusions were necessary. Annual prevalence values for each country were retained for 1990–2022, and country values were averaged to generate regional mean prevalence (Baltic vs Nordic) for each year. Data cleaning and figure generation were performed in Microsoft Excel 2021 and Python 3.11.

Statistical analysis: Descriptive statistics summarized annual adult obesity prevalence over the time series. Relative change (%) and the average annual increment (percentage-points per year) were calculated as:
Relative change (%) = [(Value2022 – Value1990) / Value1990] × 100
Average annual increment (pp/year) = (Value2022 – Value1990) / (2022 – 1990)

Line graphs were used to illustrate the trends in country-specific prevalence over time. Additionally, regional mean prevalence for the Baltic and Nordic regions was calculated.

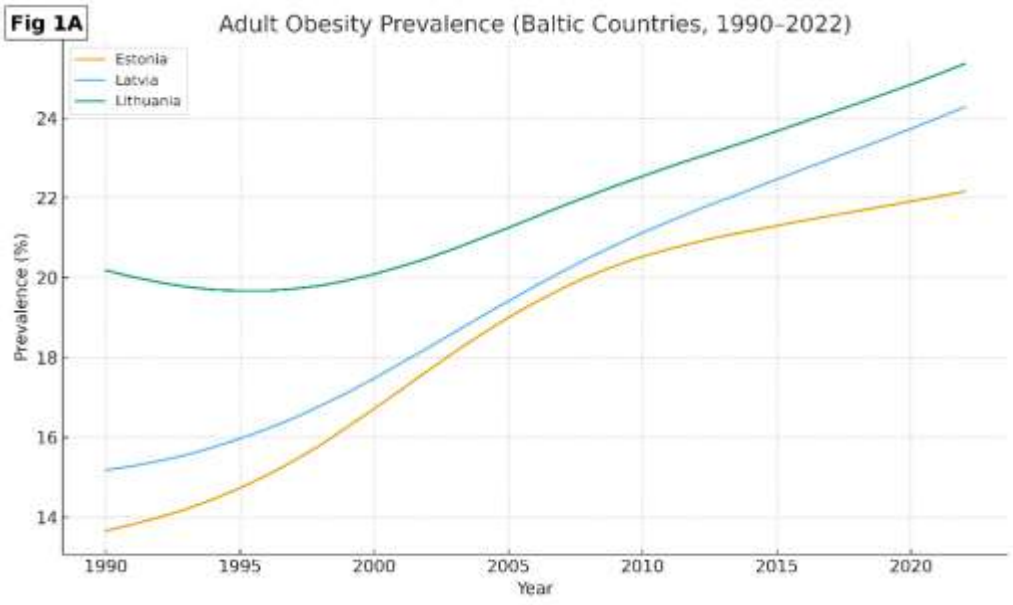
To compare long-term temporal trajectories between regions, while accounting for repeated annual observations within countries, we fitted a linear mixed-effects model with a country-level random intercept. Year was centered at 2006 (year_c = year − 2006), and a Year×Region interaction tested whether trends differed between the Baltic and Nordic regions. Sensitivity analyses included (i) ordinary linear regression, (ii) a mixed model with an AR(1) within-country correlation structure, and (iii) a quadratic year term (year_c²) to assess non-linearity.

In addition, segmented (joinpoint) regression was applied to identify inflection points (changes in trend) within each region. Models allowing up to two joinpoints were evaluated, and the optimal model was selected based on the minimum sum of squared residuals. Segment-specific slopes (percentage-points per year) and the Average Annual Percent Change (AAPC) were calculated, consistent with the methodology used by the U.S. National Cancer Institute Joinpoint Regression Program.

No smoothing, transformation, or imputation was applied. All analyses used annual age-standardized estimates provided by the WHO Global Health Observatory. Data analysis and visualization were performed in Python (v3.11; Matplotlib v3.9) and IBM SPSS Statistics version 29 (IBM Corp., Armonk, NY).

Results

Between 1990 and 2022, the prevalence of adults living with obesity (BMI ≥30 kg/m²) rose substantially across all Baltic and Nordic countries.



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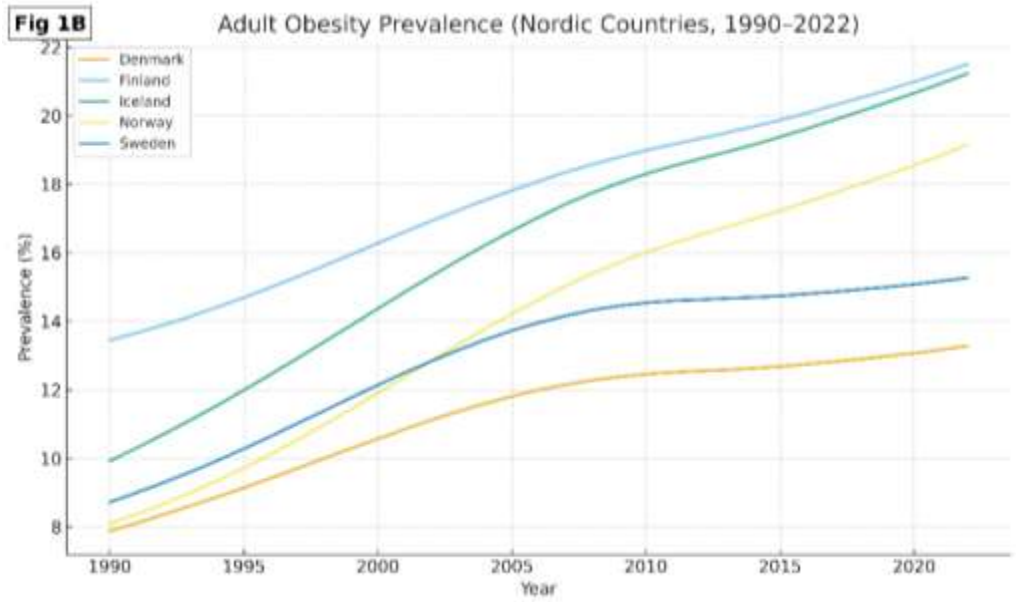

Figure 1. Age-standardized prevalence of adults living with obesity (BMI ≥ 30 kg/m²) in Baltic and Nordic countries, 1990–2022. Annual prevalence estimates (% of adults ≥18 years) from the World Health Organization Global Health Observatory (WHO GHO). **(1A)** Baltic countries: Latvia, Lithuania, Estonia. **(1B)** Nordic countries: Denmark, Finland, Iceland, Norway, Sweden. Each line represents one country's annual trend. No imputation or smoothing was applied; all values reflect WHO age-adjusted national prevalence estimates for each calendar year. Figure 1 illustrates individual country trends and Figure 2 presents regional averages.

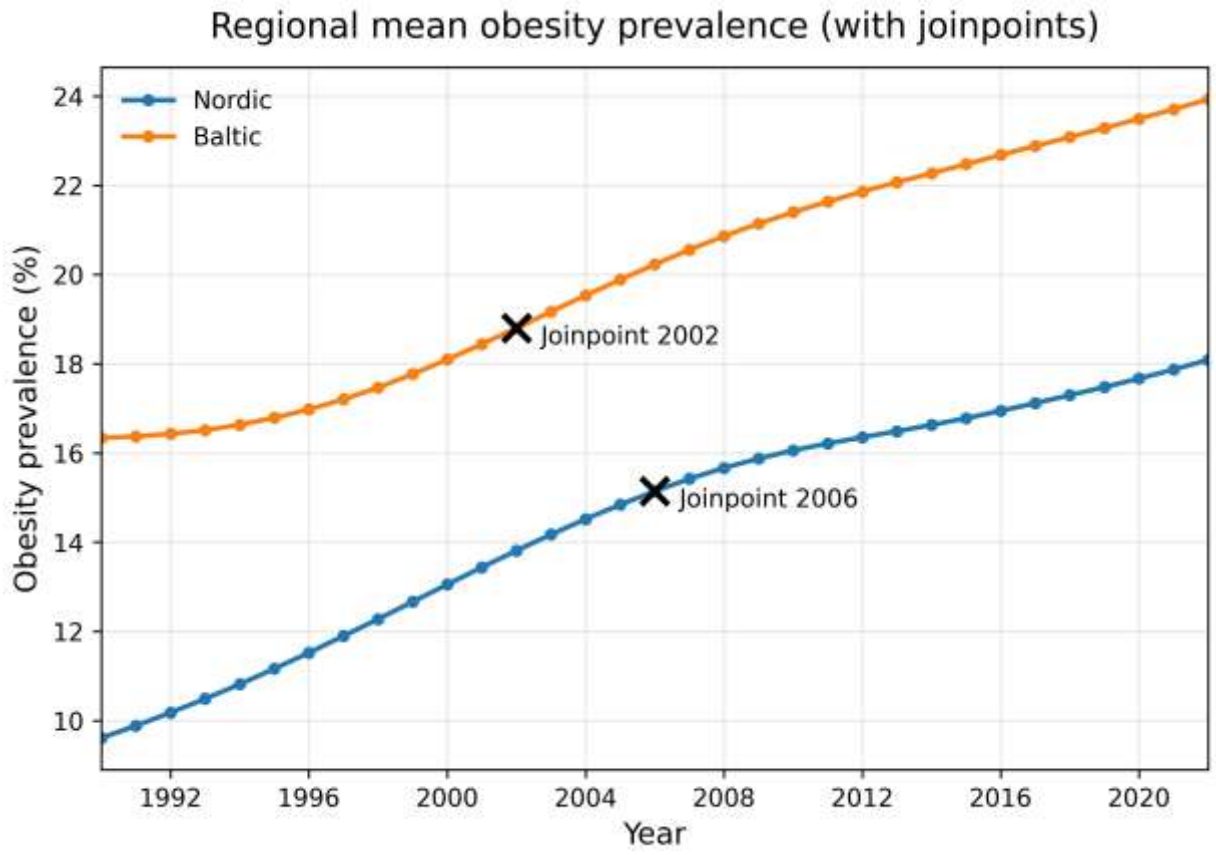

Figure 2. Regional mean prevalence of adults living with obesity (BMI ≥30 kg/m²) in Baltic vs. Nordic regions, 1990–2022, with joinpoints. Annual regional means were calculated as the average of all countries within each region for each calendar year. Data source: WHO Global Health Observatory age-standardized prevalence estimates (% of adults ≥18 years). A linear mixed-effects model with a country random intercept and a Year × Region interaction tested whether the change in prevalence over time differed between regions (no significant difference in slopes; $p = 0.903$). Segmented (joinpoint) regression identified one inflection point in each region (Baltics: 2002; Nordics: 2006), indicating a change in the rate of increase over time. No smoothing or imputation was performed.

Although annual data were analyzed, Table 1 displays only baseline (1990) and endpoint (2022) values to facilitate comparison.

Table 1. Age-standardized adult obesity prevalence (1990–2022): baseline vs. latest WHO estimates with calculated change.

Country	1990 (%)	2022 (%)	Relative change (%)	Annual increment (pp/year)
Denmark	7.88	13.28	68.5%	0.17
Estonia	13.66	22.16	62.2%	0.27
Finland	13.45	21.51	59.9%	0.25
Iceland	9.92	21.23	114.0%	0.35
Latvia	15.18	24.27	59.9%	0.28
Lithuania	20.18	25.36	25.7%	0.16
Norway	8.09	19.15	136.7%	0.35
Sweden	8.72	15.27	75.1%	0.20

Source: World Health Organization (WHO) Global Health Observatory, 2024.

Baltic countries: All three Baltic states—Latvia, Lithuania, and Estonia—showed a steady and nearly linear rise in the prevalence of adults living with obesity between 1990 and 2022 (Figure 1A). Latvia increased from 15.18% in 1990 to 24.27% in 2022 (+59.9%). Lithuania rose from 20.18% to 25.36% (+25.7%), a smaller relative increase because its baseline prevalence in 1990 was already high. Estonia from 13.66% to 22.16% (+62.2%). Although minor fluctuations appeared during the early 2000s, the overall trajectory remained consistently upward. By 2022, prevalence in all three countries converged near 22–25%, reflecting region-wide escalation accompanying ongoing socioeconomic development and lifestyle modernization.

Nordic countries: A similar upward trend was observed across the Nordic region (Denmark, Finland, Iceland, Norway, and Sweden) (Figure 1B). Denmark increased from 7.9% in 1990 to 13.3% in 2022 (+68.5%). Finland rose from 13.5% to 21.5% (+59.9%), and Sweden from 8.7% to 15.3% (+75.1%). Norway and Iceland demonstrated the steepest rises, from 8.1% to 19.2% (+136.7%) and 9.9% to 21.2% (+114.0%), respectively. Despite lower baseline levels in 1990, all Nordic countries exhibited a steady upward increase in obesity prevalence across the region.

Regional comparison: When aggregated by region, the mean prevalence of adults living with obesity increased from 16.3% to 23.9% in the Baltics and from 9.6% to 18.1% in the Nordics between 1990 and 2022. In the mixed-effects model, obesity prevalence increased over time (Baltics: $\beta=0.269$ percentage points/year, $p<0.001$), and Nordics had a lower mean prevalence than Baltics around 2006 ($\beta=-5.531$, $p<0.001$). The Year×Region interaction was not significant ($\beta=-0.004$, $p=0.903$; 95% CI −0.061 to 0.053), indicating parallel time trends (Nordics ≈0.265 vs Baltics ≈0.269 percentage points/year); results were consistent in ordinary regression, AR(1) mixed models, and a quadratic-year sensitivity model (year_c² $\beta=-0.004$, $p=0.032$; interaction $p=0.902$). Joinpoint (segmented) regression confirmed distinct inflection points in trend patterns. In the Baltic region, the annual increase accelerated after 2002 (from +0.21 to +0.24 pp/year). In the Nordic region, obesity increased more rapidly until 2006, followed by a slower but persistent rise (from +0.36 to +0.17 pp/year). Descriptively, the endpoint-based average annual increment from 1990 to 2022 was similar (Baltics ~0.24 vs Nordics ~0.27 percentage points/year).

Temporal and visual trends: As shown in Figures 1 and 2, the rate of increase accelerated after 2000 in both regions, coinciding with ongoing economic growth, urbanization, and westernization of dietary patterns in Northern Europe. The trend lines show smooth, monotonic increases with no evidence of plateau by 2022.

Discussion

To our knowledge, this is the first study to directly compare 32-year adult obesity trajectories between two contrasting European policy environments using standardized WHO estimates. By 2022, the Baltic region had largely converged toward Nordic levels, narrowing the inter-regional difference observed in 1990. Our findings suggest that to alter long-term obesity trends, more intensive, targeted, and multi-level interventions may be needed, moving beyond the initial adoption of policy measures. A formal statistical test ($p = 0.903$) confirmed that the rates of increase in obesity prevalence did not significantly differ between the Baltic and Nordic regions, suggesting that despite differing policy environments, the long-term trajectories of obesity prevalence followed similar patterns. Our ecological comparison shows steadily rising obesity prevalence in both regions over the 32-year period, with no indication of plateau by 2022. This trend mirrors global pooled analyses, which indicate continued increases in adult obesity through 2022,[13,14] with recent reviews discussing whether a future plateau might eventually emerge.[10] Our analysis confirms that although the Nordic region began with a lower baseline prevalence, the annual rate of increase was not significantly different from the Baltics.

Regional context matters: The Baltics underwent rapid socioeconomic transition and food-system "westernization" after the 1990s, while the Nordics maintained long-standing welfare systems and early preventive policies. Recent EU data show Latvia with one of the highest obesity rates in the EU, with Lithuania also reporting elevated levels; Finland and Denmark show comparably high prevalence among northern European countries, though the Eurostat report presents cross-sectional values rather than full trend trajectories.[6]

Policy implications: The Nordic countries — and Estonia — use the Nordic Nutrition Recommendations 2023 (NNR 2023) as a harmonized scientific basis for national nutrition policy and are implementing them.[15] In contrast, Latvia and Lithuania have not yet adopted a comparable unified framework; however, modeling shows that shifting current diets toward NNR-aligned patterns could yield meaningful gains in life expectancy.[16] and adherence to Nordic dietary patterns is consistently associated with improved cardiometabolic outcomes.[17–19]

Front-of-pack nutrition labeling (FOPL) systems such as Nutri-Score have demonstrated measurable effects on consumer food choices and, in some settings, have stimulated product reformulation. Adoption of a standardized FOPL system could support the Baltic region in improving diet quality.[20–22]

Fiscal policies also play a proven role: Implementation of sugar-sweetened beverage (SSB) taxes — such as the UK Soft Drinks Industry Levy — has been associated with significant reductions in sugar purchased from soft drinks,[23] and reductions in free-sugar intake in the population.[24] Evidence from multiple European countries further shows that SSB taxes reduce sugary-drink consumption at national level.[25] Microsimulation models in European settings indicate that interventions such as mandatory menu calorie labelling, when paired with SSB taxation, could reduce obesity prevalence,[26] while real-world evaluations of calorie labeling show beneficial changes in consumer behavior.[27] Still, the effect size of isolated interventions remains modest, reinforcing that multi-component strategies—marketing restrictions, school-nutrition standards, and urban-planning initiatives—are needed.[28–30] Younger cohorts are particularly relevant: in the WHO European Region, nearly one in three children (~ 29%) have overweight or obesity,[5] and global analyses confirm high adolescent obesity in Europe.[31] Lifestyle surveys in the Baltic countries reveal strong associations between diet quality, physical activity and mental health/subjective health outcomes.[32] Alongside these policies, a structured prevention education program targeting overweight/obese high-risk individuals improved risk awareness and highlights the value of sustained, population-oriented health education strategies.[33]

Beyond BMI: Because our analysis relies on standardized WHO BMI-based estimates, and BMI does not necessarily reflect body-fat proportion.[34] Our findings primarily reflect trends in general adiposity rather than changes in fat distribution. This matters because cardiometabolic risk may shift even when BMI-based prevalence changes modestly. Evidence suggests that waist-to-height ratio (WHtR) can outperform BMI (and waist circumference) for screening adult cardiometabolic risk factors.[11] Future surveillance would be strengthened by reporting waist-based indicators (e.g., WC, WHR, WHtR) alongside BMI to better capture central adiposity patterns. Also, tools such as bioelectrical impedance analysis (BIA) and digital anthropometry may further improve estimation of fat mass and distribution in clinical settings, together with assessment of weight-related complications to stage disease severity.[10,34]

Implications: Both Baltic and Nordic countries require coordinated, multi-level obesity-prevention strategies that integrate several key components. These include harmonized front-of-pack nutrition labeling (FOPL) systems and product reformulation targets to improve consumer food choices,[20,21] tiered sugar-sweetened beverage (SSB) taxes and healthy public-procurement policies to reduce sugary drink consumption and improve public diet quality,[24,35] and mandatory menu labeling accompanied by systematic evaluation to empower consumers with clearer nutrition information.[26,27] Additionally, promoting NNR-aligned diet patterns can lead to long-term improvements in diet quality and health outcomes across both regions.[15,18]

Strengths and limitations: This study used standardized World Health Organization (WHO) data spanning more than 30 years, ensuring regional comparability. Limitations include its ecological design and absence of individual-level confounder control. Findings should therefore be interpreted as descriptive, policy-oriented surveillance rather than causal inference.

What This Study Adds

- This is the first study to directly compare 32-year adult obesity trajectories between the Baltic and Nordic regions using standardized WHO data.
- Despite earlier adoption of preventive nutrition policies in the Nordic countries, both regions experienced nearly identical long-term obesity trends.
- These findings suggest that policy maturity alone may not be sufficient to reverse the obesity trajectory and that more system-level interventions are needed.

Conclusion

Adult obesity increased substantially across all Baltic and Nordic countries from 1990 to 2022, and the rate of increase did not significantly differ between regions. Despite starting from lower baseline levels, the Nordic countries did not achieve slower long-term growth of obesity prevalence, suggesting that policy maturity alone is not sufficient to bend the curve. These findings underscore the need for coordinated, system-level interventions that go beyond individual policy measures. Multi-level strategies—including fiscal measures (e.g., sugar-sweetened beverage taxation), mandatory front-of-pack labeling, and product reformulation targets—must be prioritized to meaningfully alter population-level obesity trajectories.

Author contributions

Abdulrahman Al-Dawoudi: Conceptualization; methodology; data collection and curation; formal analysis; visualization; writing – original draft; writing – review and editing; project administration. Daniil Varlamov: Literature search; reference management; writing – review and editing. Mujahed Dalain: Supervision; formal analysis; interpretation of results; writing – critical review and editing. All authors approved the final manuscript and agree to be accountable for all aspects of the work.

Data availability

All processed data are included in S1_File. The complete dataset of age-standardized adult obesity prevalence estimates (1990–2022) was extracted from the WHO Global Health Observatory and used for all analyses in this study. Source data were obtained from publicly available databases (WHO Global Health Observatory; Our World in Data). The S1_File contains the full dataset used in this analysis.

Ethics statement

This study used exclusively publicly available, aggregate, and de-identified data obtained from the World Health Organization (WHO) Global Health Observatory and Eurostat. In accordance with the institutional policies of the University of Latvia and research regulations, including the Declaration of Helsinki, studies using publicly available and fully anonymized secondary data are exempt from ethical approval and do not require informed consent. No

human participants were involved, and no individual-level or identifiable data were accessed at any stage of the research.

Disclosure

The authors declare no competing interests. The authors received no specific funding for this work.

References

1. World Health Organization. Obesity and overweight: Key facts [Internet]. World Health Organization; https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight

2. Boutari C, Mantzoros CS. A 2022 update on the epidemiology of obesity and a call to action: as its twin COVID-19 pandemic appears to be receding, the obesity and dysmetabolism pandemic continues to rage on. Metabolism. 2022; https://doi.org/10.1016/j.metabol.2022.155217

3. Mohamed1, AM, Isa HM, Ali MS, Dadi A, Kadhim Z. Prevalence of Non-alcoholic Fatty Liver Disease among Patients with Diabetes Mellitus Attending Primary Health Care Centers in Bahrain. Oman Med J. 2022;37:e350–e350. https://doi.org/10.5001/omj.2022.53

4. Al-Sayegh H, Al-Zadjali S, Al-Moundhri M. Hyperglycemia and obesity are the key drivers of increased colorectal cancer mortality in the North Africa and Middle East region. Oman Med J. 2025. doi:10.5001/omj.2025.92.

5. World Health Organization Regional Office for Europe. WHO European Regional Obesity Report 2022 [Internet]. World Health Organization Regional Office for Europe; 2022 p. Copenhagen (Denmark). https://www.who.int/europe/publications/i/item/9789289057738. Accessed 15 Sept 2024

6. Eurostat. Overweight and obesity – BMI statistics [Internet]. European Commission; https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Overweight_and_obesity_-_BMI_statistics

7. Diamantis DV, Karatzi K, Kantaras P, Liatis S, Iotova V, Bazdraska Y, et al. Prevalence and Socioeconomic Correlates of Adult Obesity in Europe: The Feel4Diabetes Study. IJERPH. 2022;19:12572. https://doi.org/10.3390/ijerph191912572

8. Lam TM, Aarestrup J, Van Den Akker ELT, Baker JL, Banik A, Berntzen BJ, et al. Advancing knowledge, maps and tools to address obesity and related socio-economic disparities in Europe: the OBCT project. Global Health Action. 2025;18:2517492. https://doi.org/10.1080/16549716.2025.2517492

9. Stival C, Lugo A, Odone A, Van Den Brandt PA, Fernandez E, Tigova O, et al. Prevalence and Correlates of Overweight and Obesity in 12 European Countries in 2017–2018. Obes Facts. 2022;15:655–65. https://doi.org/10.1159/000525792

10. Sweatt K, Garvey WT, Martins C. Strengths and Limitations of BMI in the Diagnosis of Obesity: What is the Path Forward? Curr Obes Rep. 2024;13:584–95. https://doi.org/10.1007/s13679-024-00580-1

11. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obesity Reviews. 2012;13:275–86. https://doi.org/10.1111/j.1467-789X.2011.00952.x

12. World Health Organization. Prevalence of obesity among adults (BMI ≥ 30 kg/m^2, age-standardized estimate) (%) [Internet]. Geneva (Switzerland): World Health Organization, Global Health Observatory; 2024. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-obesity-among-adults-bmi-=-30-(age-standardized-estimate)-(-). Accessed 15 Sept 2024

13. NCD Risk Factor Collaboration. Worldwide trends in underweight and obesity from 1990 to 2022: a pooled analysis of 3663 population-representative studies with 222 million children, adolescents, and adults. Lancet. 2024;403:1027–50. https://doi.org/10.1016/S0140-6736(23)02750-2

14. Koliaki C, Dalamaga M, Liatis S. Update on the Obesity Epidemic: After the Sudden Rise, Is the Upward Trajectory Beginning to Flatten? Curr Obes Rep. 2023;12:514–27. https://doi.org/10.1007/s13679-023-00527-y

15. Erkkola M, Berg O, Brugård Konde Å, Gunnarsdottir S, Dahl Lassen A, Kaartinen NE, et al. From evidence to action: implementing the Nordic Nutrition Recommendations in national policy. Proc Nutr Soc. 2025;1–12. https://doi.org/10.1017/S0029665125100682

16. Javadi Arjmand E, Arnesen EK, Haaland ØA, Økland J-M, Livingstone KM, Mathers JC, et al. Life Expectancy Gain of Implementing the Nordic Nutrition Recommendations 2023: Modeling From 8 Nordic and Baltic Countries. Current Developments in Nutrition. 2025;9:104540. https://doi.org/10.1016/j.cdnut.2024.104540

17. Gunge VB, Andersen I, Kyrø C, Hansen CP, Dahm CC, Christensen J, et al. Adherence to a healthy Nordic food index and risk of myocardial infarction in middle-aged Danes: the diet, cancer and health cohort study. Eur J Clin Nutr. 2017;71:652–8. https://doi.org/10.1038/ejcn.2017.1

18. Strid A. Swedish Food Guidelines Adherence and Longevity: A Population Cohort. Public Health Nutrition. 2023;26:2333–42. https://doi.org/10.1017/S1368980023001295

19. Mørch AB, Ibsen DB, Wolk A, Dahm CC. Development of the Nordic Nutrition Recommendations 2023 Food-Based Diet Score and Its Association with All-Cause Mortality in Two Swedish Cohorts. The Journal of Nutrition. 2025;S0022316625004195. https://doi.org/10.1016/j.tjnut.2025.06.030

20. Julia C, Gokani N, Hercberg S, Garde A. Ten years of Nutri-Score front-of-pack nutrition labelling in Europe. Nat Food. 2025;6:239–43. https://doi.org/10.1038/s43016-025-01141-y

21. Devaux M M Aldea A, Lerouge A, Vuik S, Cecchini M. Establishing an EU-wide front-of-pack nutrition label: Review of options and model-based evaluation. Obes Rev. 2024;25:e13719. https://doi.org/10.1111/obr.13719

22. Amberntsson A, Paulsen MM, Bianchi MA, Birgisdóttir BE, Biltøft-Jensen AP, Konglevoll DM, et al. Improvements to the Nutri-Score to address challenges identified in a Nordic setting. Food Nutr Res. 2025;69:10914. https://doi.org/10.29219/fnr.v69.10914

23. Rogers NT, Pell D, Mytton OT, Penney TL, Briggs A, Cummins S, et al. Changes in soft drinks purchased by British households associated with the UK soft drinks industry levy: a controlled interrupted time series analysis. BMJ Open. 2023;13:e077059. https://doi.org/10.1136/bmjopen-2023-077059

24. Rogers NT, Cummins S, Jones CP, Mytton O, Rayner M, Rutter H, et al. Estimated changes in free sugar consumption one year after the UK soft drinks industry levy came into force: controlled interrupted time series analysis of the National Diet and Nutrition Survey (2011–2019). J Epidemiol Community Health. 2024;78:578–84. https://doi.org/10.1136/jech-2023-221051

25. Semerád P, Hospodková P, Lamačová M, Rogalewicz V, Babuněk O, Dobranschi M. Sugar-sweetened beverages: taxation evidence from seven European countries and recommendations for implementation in other EU regions. Cent Eur J Public Health. 2024;32:279–87. https://doi.org/10.21101/cejph.a8210

26. Putra IGNE, O'Flaherty M, Emmert-Fees KMF, Vasquez MS, Evans R, Peters A, et al. Estimating the health impact of menu calorie labelling policy and sugar-sweetened beverage taxation in two European countries: a microsimulation study. European Journal of Preventive Cardiology. 2025;zwaf333. https://doi.org/10.1093/eurjpc/zwaf333

27. Essman M, Burgoine T, Jones A, Polden M, Robinson E, Sacks G, et al. Assessing the impact of a mandatory calorie labelling policy in out-of-home food outlets in England on consumer behaviour: a natural experimental study. BMC Public Health. 2025;25:955. https://doi.org/10.1186/s12889-025-22150-3

28. Hassapidou M, Vlassopoulos A, Kalliostra M, Govers E, Mulrooney H, Ells L, et al. European Association for the Study of Obesity Position Statement on Medical Nutrition Therapy for the Management of Overweight and Obesity in Adults Developed in Collaboration with the European Federation of the Associations of Dietitians. Obes Facts. 2023;16:11–28. https://doi.org/10.1159/000528083

29. Chrissini MK, Panagiotakos DB. Public health interventions tackling childhood obesity at European level: A literature review. Prev Med Rep. 2022;30:102068. https://doi.org/10.1016/j.pmedr.2022.102068

30. Von Philipsborn P, Bahlke M, Breidenassel C, Holzapfel C, Joisten C, Plachta-Danielzik S, et al. Prevention of Obesity among Adults: Evidence- and Consensus-based Guideline. Obes Facts. 2025;1–33. https://doi.org/10.1159/000546415

31. Zhang X, Liu J, Ni Y, Yi C, Fang Y, Ning Q, et al. Global Prevalence of Overweight and Obesity in Children and Adolescents: A Systematic Review and Meta-Analysis. JAMA Pediatr. 2024;178:800. https://doi.org/10.1001/jamapediatrics.2024.1576

32. Skurvydas A, Valanciene D, Lisinskiene A, Dadeliene R, Sarkauskiene A, Fernāte A, et al. Self-rated health habits, mental health, emotional intelligence, and impulsivity across the Baltic States. Front Public Health. 2025;13:1522918. https://doi.org/10.3389/fpubh.2025.1522918

33. Alkaabi JM, Al-Maskari F, Afandi B, Yousef S, Shah SM, Heideman WH, et al. Effects of Diabetes Prevention Education Program for Overweight and Obese Subjects with a Family History of Type 2 Diabetes Mellitus: A Pilot Study from the United Arab Emirates. Oman Med J. 2021;36:e268–e268. https://doi.org/10.5001/omj.2021.67

34. Hidrus A. Multipronged Approach to Assess Risk Factors for Non-alcoholic Fatty Liver Disease. Oman Med J. 2022;37:e425–e425. https://doi.org/10.5001/omj.2022.93

35. Cobiac LJ, Rogers NT, Adams J, Cummins S, Smith R, Mytton O, et al. Impact of the UK soft drinks industry levy on health and health inequalities in children and adolescents in England: An interrupted time series analysis and population health modelling study. PLoS Med. 2024;21:e1004371. https://doi.org/10.1371/journal.pmed.1004371