THE GEORGE WASHINGTON UNIVERSITY
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Global Trends and Disparities in Obesity Prevalence: A Temporal Analysis Across Region, Age and Sex from 1990-2024

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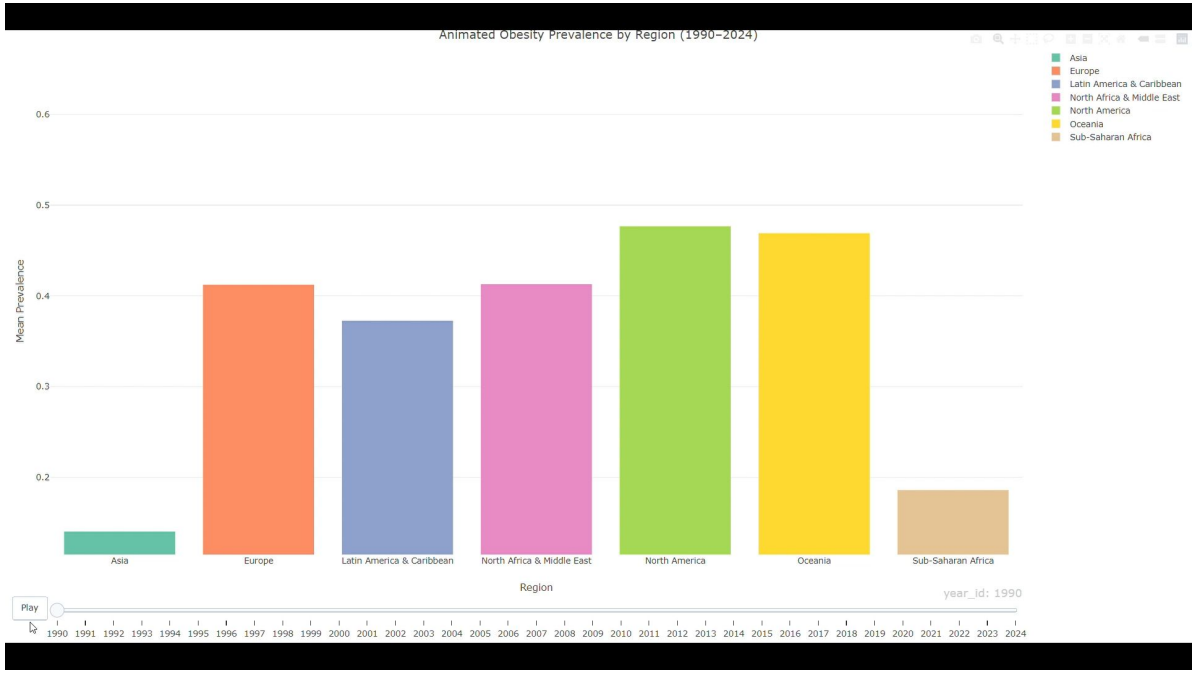
Introduction

- Obesity is a major contributor to the global burden of disease.
- Its prevalence has doubled since 1980, increasing risks for diabetes, cardiovascular conditions, and cancer.
- Despite known risks, many global datasets lack comparative analyses across age groups and regions.
- This study uses robust global data to explore demographic and geographic trends over three decades.



Background

- Few studies assess how obesity trends differ between adolescents and adults globally.
- Most prior analyses aggregate all age groups or focus only on high-income countries.
- There is a critical need to disaggregate by age, sex, decade, and region to inform targeted interventions.
- Our study addresses this gap using harmonized, modeled data from the Global Burden of Disease (GBD) 2021.

Dataset Overview

- Data Source: Global Burden of Disease (GBD 2021), Institute for Health Metrics and Evaluation
  - Includes estimates for 204 countries grouped into 7 Regions - Asia, Europe, Oceania, North America, Sub-Saharan Africa, North Africa & Middle East, Latin America & Caribbean
  - Two datasets Adolescents: 5–24 years and Adults: 25+ years have been merged
  - Obesity defined using WHO threshold: BMI ≥30 kg/m²

Aims and Hypotheses

- **Aim 1:** Assess association of age group, sex, region, and decade with mean obesity prevalence (1990–2024).

  Hypothesis: Mean obesity prevalence varies significantly by these predictors.

- **Aim 2:** Compare percent change in obesity prevalence (1990–2024) between adolescents and adults.

  Hypothesis: Percent change differs significantly across age categories.

Study Design and Procedures

- Repeated cross-sectional ecological design
- Secondary analysis of modeled data using MR meta-regression
- Standardized annual obesity prevalence extracted for 1990–2024
- Merged adolescent and adult GBD datasets
- No new data collection; all estimates are publicly available and validated

Key Variables

Variable	Categories	Variable type	Notes
Mean Obesity Prevalence	Annual average obesity prevalence	Continuous	Based on IHME-modeled estimates from BMI ≥30 kg/m² Stratified by age, sex, and region
Percent Change	% change in prevalence (1990–2024)	Continuous	(Prevalence in 2024 – Prevalence in 1990) / Prevalence in 1990 × 100. Stratified by age and region
Year_id	1990-2050	Continuous	To maintain the authenticity and to show the current trends, years from 1990-2024 have been used.
Age Category	Adolescents (5–24 yrs), Adults (25+ yrs)	Categorical	Based on IHME standard age groupings
Sex	Male, Female	Categorical	Records with “Both” were excluded
Region	Asia, Europe, Oceania, etc. (7 total)	Categorical	Regions based on IHME region lookup
Decade	1990s, 2000s, 2010s, 2020s	Categorical	Created by collapsing year variable
Age Group	19 five-year age groups (5+)	Categorical	Standard IHME classifications used

Statistical Analysis – Aim 1

- Multivariable linear regression model with robust standard errors (ANCOVA structure)
  - Outcome: Mean obesity prevalence
  - Predictors: Age group, sex, region, and decade
- **Why robust SEs?** To adjust for heteroskedasticity due to varying precision and variability across countries and years

Statistical Analysis – Aim 2

- Computed percent change in prevalence from 1990 to 2024 by region and age category

  Shapiro-Wilk test to check normality

  Welch's two-sample t-test to compare adolescents vs. adults

Results – Regression (Aim 1)

- Age, sex, region, and decades were all statistically significant predictors ($p < 0.001$)
- This means that there was a statistically significant association of all these factors to the mean prevalence.
- Highest prevalence: Adults, females, North Africa and the lowest was found in Asia

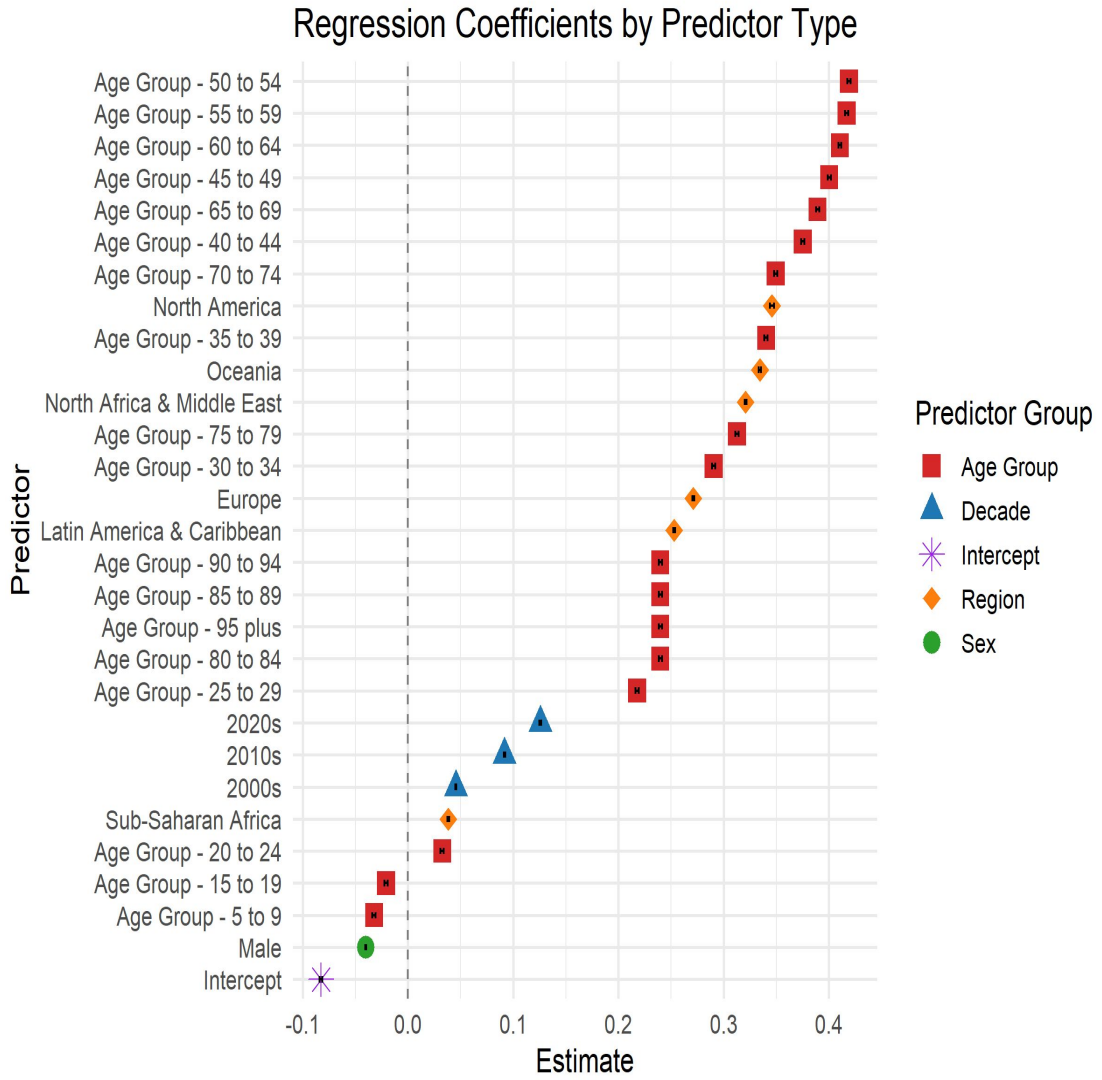


Table: Regression Estimates with Robust SEs and 95% Confidence Intervals

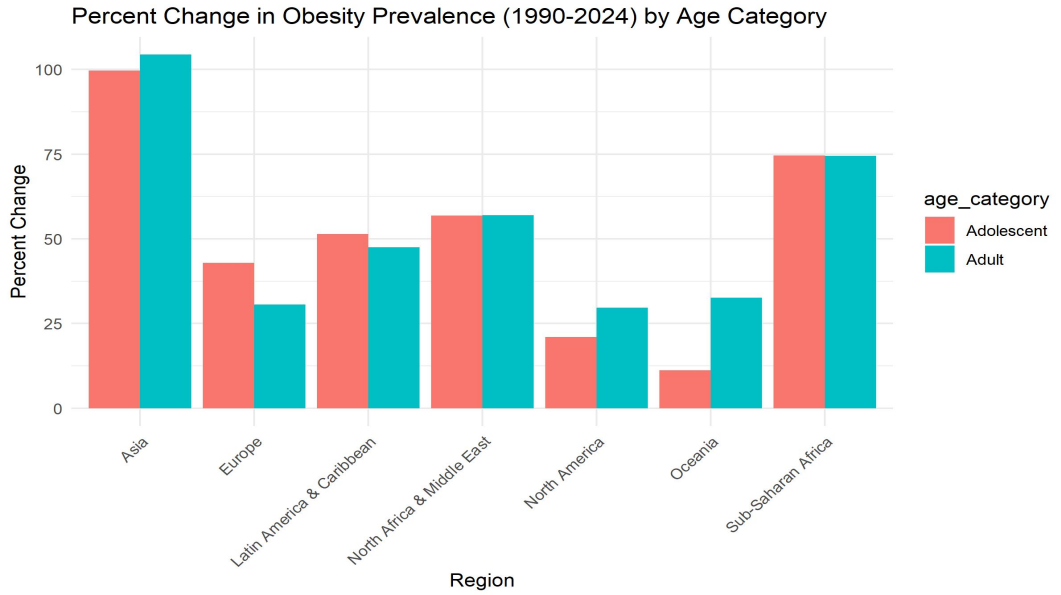
Term	Estimate	Std. Error	95% CI	p-value
(Intercept)	-0.0827	0.0013	[-0.0853, -0.08]	<0.001
decade2000s	0.0455	0.0006	[0.0442, 0.0467]	<0.001
decade2010s	0.0917	0.0006	[0.0904, 0.093]	<0.001
decade2020s	0.1257	0.0008	[0.1242, 0.1273]	<0.001
age_group_name15 to 19	-0.0208	0.0015	[-0.0237, -0.0178]	<0.001
age_group_name20 to 24	0.0325	0.0015	[0.0295, 0.0355]	<0.001
age_group_name25 to 29	0.2178	0.0015	[0.2148, 0.2207]	<0.001
age_group_name30 to 34	0.2905	0.0015	[0.2876, 0.2935]	<0.001
age_group_name35 to 39	0.3404	0.0015	[0.3374, 0.3433]	<0.001
age_group_name40 to 44	0.3752	0.0015	[0.3722, 0.3781]	<0.001
age_group_name45 to 49	0.4004	0.0015	[0.3974, 0.4034]	<0.001
age_group_name5 to 9	-0.0322	0.0015	[-0.0352, -0.0293]	<0.001
age_group_name50 to 54	0.4191	0.0015	[0.4161, 0.4221]	<0.001
age_group_name55 to 59	0.4171	0.0015	[0.4141, 0.42]	<0.001
age_group_name60 to 64	0.4106	0.0015	[0.4076, 0.4135]	<0.001
age_group_name65 to 69	0.3893	0.0015	[0.3863, 0.3923]	<0.001
age_group_name70 to 74	0.3496	0.0015	[0.3466, 0.3525]	<0.001
age_group_name75 to 79	0.3127	0.0015	[0.3097, 0.3157]	<0.001
age_group_name80 to 84	0.2398	0.0015	[0.2368, 0.2428]	<0.001
age_group_name85 to 89	0.2398	0.0015	[0.2368, 0.2428]	<0.001
age_group_name90 to 94	0.2398	0.0015	[0.2369, 0.2428]	<0.001
age_group_name95 plus	0.2398	0.0015	[0.2368, 0.2428]	<0.001
sexMale	-0.0400	0.0005	[-0.041, -0.039]	<0.001
regionEurope	0.2713	0.0009	[0.2696, 0.273]	<0.001
regionLatin America & Caribbean	0.2530	0.0009	[0.2511, 0.2548]	<0.001
regionNorth Africa & Middle East	0.3209	0.0011	[0.3188, 0.323]	<0.001
regionNorth America	0.3459	0.0019	[0.3422, 0.3496]	<0.001
regionOceania	0.3345	0.0011	[0.3324, 0.3366]	<0.001
regionSub-Saharan Africa	0.0384	0.0009	[0.0367, 0.0401]	<0.001

Results – Percent Change (Aim 2)

- Adults showed greater percent increase in obesity prevalence
- Difference not statistically significant (p = 0.8659)
- Indicates meaningful increases in both groups

Table: Normality and Mean Comparison Results

Test	Statistic	df	p-value	95% CI	Group Means
Shapiro-Wilk (Adolescent)	0.9763		0.9398		
Shapiro-Wilk (Adult)	0.8700		0.1858		
Welch Two-Sample t-test	-0.1725	11.9	0.8659	[-36.5, 31.15]	Adol: 51.1; Adult: 53.77



Results – Descriptive

- Obesity prevalence rose significantly and consistently over 34 years
- Females consistently had higher prevalence than males (4%)
- Adults had higher mean obesity rates than adolescents
- North Africa showed the highest values across all decades (64%) while Asia (26%) had the lowest of all
- Highest Obesity prevalence was noted in age group 50-54 (56 %)

Limitations

- Ecological study design limits interpretation to population-level trends; individual-level inferences are not possible (ecological fallacy)
- Lack of population size data prevented weighting observations by country or region size
- Use of self-reported BMI data in some inputs may introduce misclassification
- Unmeasured contextual confounders, such as economic or policy-related variables, could influence associations but were not captured in this dataset

Addressing Limitations

- Applied robust standard errors to reduce the impact of heteroskedasticity from variable measurement precision
- Excluded modeled projections beyond 2024 to maintain data accuracy and show more current trends
- Stratified analysis by age, region, and sex to provide more granular insights
- Treated each region-age-sex-decade group as equal due to lack of population size, but used standardized mean estimates to ensure comparability

Summary and Conclusions

- Obesity prevalence increased globally from 1990 to 2024
- Significant demographic and regional disparities were observed
- Although adult trends are more pronounced, adolescent trends are also rising
- Public health strategies must be inclusive of age and region-specific needs

Recommendations

Invest in adolescent obesity prevention

Tailor interventions by region and sex

Use global datasets like GBD for continuous surveillance

Inform national and regional obesity policy using localized data

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