
RESEARCH ARTICLE

Income Gradients and Body Mass Index Among Community Adults in Northeast Pennsylvania: A Cross-Sectional Study

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ABSTRACT

Obesity contributes substantially to cardiometabolic disease and is socially patterned by income and socioeconomic status. Appalachian communities experience persistent economic disadvantage and elevated chronic disease burden. This study examines the association between household income and body mass index (BMI) among community-dwelling adults in northeast Pennsylvania. Cross-sectional data were collected from 254 adults between 2017 and 2021. Height and weight were directly measured. Household income was categorized into six ordinal levels. Linear regression estimated associations between income and BMI, adjusting for age and sex. Mean age was 51.7 ± 11.9 years and mean BMI was 28.7 ± 6.0 kg/m². Income was inversely associated with BMI in unadjusted models ($\beta = -0.56, p = 0.053$) and remained consistent after adjustment ($\beta = -0.56, 95\% \text{ CI } -1.13 \text{ to } 0.01, p = 0.053$). Findings suggest a graded socioeconomic pattern in BMI within this Appalachian community. Addressing structural economic inequities may help reduce obesity-related disparities in the region.

KEYWORDS

Body Mass Index; Obesity; Socioeconomic Status; Health Disparities; Social Determinants of Health; Rural Health

ARTICLE INFORMATION

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1. Introduction

The socioeconomic gradient in health is one of the most consistently observed findings in epidemiology (Adler & Ostrove, 1999; Adler et al., 1994). Incremental increases in socioeconomic position correspond to improved health outcomes across cardiovascular disease, diabetes, cancer, and mortality (Marmot, 2004; Braveman et al., 2005; Stringhini et al., 2010). Obesity is strongly patterned by socioeconomic status and mediates downstream cardiometabolic risk (Flegal et al., 2012; Ogden et al., 2020; Wang & Beydoun, 2007; McLaren, 2007; Drewnowski & Specter, 2004; Sobal & Stunkard, 1989; Robert & Reither, 2004; Pickett & Wilkinson, 2015).

Income influences access to nutritious food, preventive health care, neighborhood infrastructure, and psychosocial stress exposure (Diez Roux, 2001; Marmot & Wilkinson, 2006; Appalachian Regional Commission, 2017; Centers for Disease Control and Prevention [CDC], 2022; Cohen et al., 2007; Chandola et al., 2006; Seeman et al., 1997; Halverson et al., 2004). Appalachian regions experience economic restructuring, transportation barriers, and health workforce shortages that may intensify these structural determinants (Appalachian Regional Commission, 2017; Meit et al., 2017; Singh & Siahpush, 2014; Befort et al., 2012). This study evaluates whether a graded association between income and BMI exists among adults in northeast Pennsylvania.

2. Literature Review

The intersection of socioeconomic status and metabolic health has been extensively examined across public health literature. Seminal works by Adler and Ostrove (1999) and Marmot (2004) establish that social hierarchy exerts a profound biological toll, with lower socioeconomic standing reliably predicting elevated disease morbidity and mortality. In the specific context of body weight regulation, researchers such as Drewnowski and Specter (2004) and McLaren (2007) have highlighted how economic constraints dictate dietary patterns, demonstrating that energy-dense, ultra-processed foods are frequently more economically accessible than nutrient-dense options.

Furthermore, regional investigations focusing on rural and economically transitioning populations—such as those by Halverson et al. (2004) and Befort et al. (2012)—underscore that geographic isolation and post-industrial restructuring in regions like Appalachia

compound these nutritional and lifestyle challenges. Despite national consensus regarding socioeconomic gradients in obesity, granular, directly measured regional studies remain necessary to capture local realities and inform targeted policy interventions.

3. Methodology

This cross-sectional study included 254 adults aged 21–74 years residing in Luzerne County, Pennsylvania between 2017 and 2021. Height and weight were measured using standardized procedures by trained research personnel, and BMI was calculated as kg/m^2 . Household income was self-reported and categorized into six ordinal levels ($< \$14,000$ to $\geq \$100,000$ annually). Age and sex were included as covariates.

Ordinary least squares regression estimated associations between income and BMI. Model 1 was unadjusted; Model 2 adjusted for age and sex. Statistical significance was defined as $p < 0.05$. Research involving human subjects was performed in accordance with the Declaration of Helsinki. Ethical approval was obtained from the Institutional Review Board of King's College (Approval Reference: [Insert Reference Number]). Informed consent to participate was obtained from all participants prior to data collection, and participant identities were fully anonymized.

4. Results/Findings

Mean participant age was 51.7 ± 11.9 years; mean BMI was $28.7 \pm 6.0 \text{ kg/m}^2$. Income demonstrated an inverse association with BMI. Each incremental increase in income category corresponded to a 0.56 kg/m^2 lower BMI in unadjusted models. After adjusting for age and sex, the magnitude of association remained stable ($\beta = -0.56, 95\% \text{ CI } -1.13 \text{ to } 0.01$). The adjusted model explained 4.0% of BMI variance.

Table 1. Sample Characteristics (N = 254)

Characteristic	Value
Age, mean (SD)	51.69 (11.91)
BMI, mean (SD)	28.72 (6.02)
Female, n (%)	146 (57.5%)
Income Level 1	1 (0.4%)
Income Level 2	15 (5.9%)
Income Level 3	41 (16.1%)
Income Level 4	50 (19.7%)
Income Level 5	47 (18.5%)
Income Level 6	100 (39.4%)

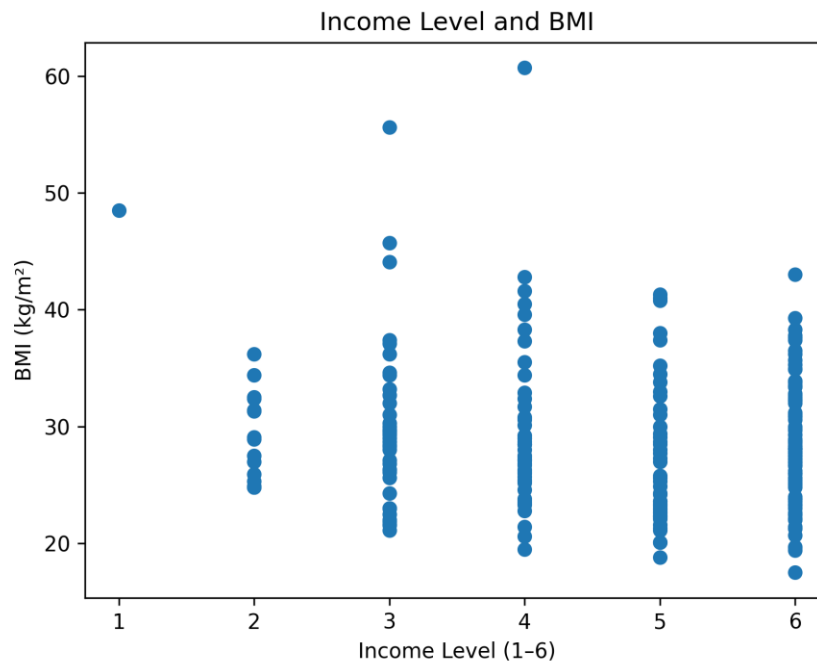
Table 2. BMI by Income Category

Income Level	N	Mean BMI	SD
1	1	48.50	nan
2	15	29.09	3.75
3	41	29.74	6.98
4	50	29.42	7.00
5	47	27.20	5.99
6	100	28.42	4.93

Table 3. Adjusted Linear Regression Model Predicting BMI

Predictor	β	95% CI	p-value
Income (ordinal)	-0.559	-1.124 to 0.007	0.053
Age	0.005	-0.057 to 0.068	0.870
Female	-1.914	-3.399 to -0.429	0.012

Model $R^2 = 0.040$

Figure 1. Income Level and Body Mass Index

Scatterplot illustrating the relationship between income category (1–6) and measured BMI (kg/m²) among adults in northeast Pennsylvania.

5. Conclusion

This study provides localized evidence of a socioeconomic gradient in BMI within an Appalachian community. Even modest shifts in population BMI are associated with meaningful reductions in cardiometabolic risk (Afshin et al., 2017). Income-related disparities may reflect structural inequities in food access, preventive care, and economic opportunity. Efforts to reduce obesity in Appalachian regions may benefit from multilevel interventions addressing economic mobility, food environments, and preventive health infrastructure. Future research should incorporate longitudinal designs and evaluate policy interventions targeting social determinants of health.

Statements and Declarations

Funding: This research received no external funding.

Conflicts of Interest: The authors declare no conflict of interest.

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