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Adolescent Smoking: The Relationship between Cigarette Consumption and BMI

Jacobs M*

College of Allied Health Science, Department of Health Sciences Information and Management, East Carolina University, USA

***Corresponding author:** Jacobs M, College of Allied Health Science, Department of Health Sciences Information and Management, East Carolina University, 600 Moye Blvd. Mail Stop 668, Health Sciences Building 4340E Greenville, NC 27834, USA, Tel: 252-744-6182, E-mail: Jacobsm17@ecu.edu

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Abstract

Background: Studies relating cigarette smoking and body weight yield conflicting results. Weight-lowering effects in women and men have been associated with smoking; however, no effects on weight have been proven. This study examined the association between cigarette smoking and relative weight in adolescent males and females as they age into young adults.

Methods: Data from the National Longitudinal Survey of Youth—a nationally representative survey conducted annually—was used for this analysis. The sample consists of 4,225 males and females observed annually from 1997 at age 12 to 17 through 2011 at age 27 to 31. Hierarchical generalized models (HGM) assess the impact of smoking on the likelihood of having higher BMI controlling for demographic, household and environmental impacts. The second estimation considers the possibility that smoking is endogenous and utilizes a multinomial instrument (IV) for smoking level.

Results: HGM models reveal a negative association between cigarette smoking and BMI for both males and females. Individuals who smoke more have lower BMI compared to infrequent or non-smokers. General health rating, region of residence and income were used instrument for smoking in a linear two-stage IV specification. The instrument is highly correlated with BMI and results mirror the HGM. Finally, models run on early, middle and advanced adolescents show that the relationship diminishes over time. The relationship between BMI and smoking decreases as female age, but increases for males.

Conclusion: Empirical models confirm an association cigarette consumption and BMI in both males and females. This negative relationship varies with age. It is important to identify health risks—obesity—and modifiable risk factors—smoking—that contribute to health disparities among adolescents. However, the increase in one risky behavior leading to the decrease in the prevalence of the other; complicates the issue. The higher prevalence of frequent cigarette uses among both adolescents and young adults of lower BMI suggest that smoking could be used curb or suppress appetite.

Keywords: Obesity; Adolescence; BMI; Mother

Introduction

Obesity rates have risen rapidly in the US since the 1990s and currently exceed 30% in most age groups [1,2]. Overweight and obesity, especially in children and young adults, are now regarded as one of the main public health challenges [3-5]. At the same time over 4.7 million middle and high school students currently use tobacco [6]. While adolescent tobacco use has declined substantially over the last 40 years, nearly one in 20 high school seniors smoke daily [7]. Substantial racial, ethnic and regional differences exist in smoking rates. White teens are more likely to smoke than are black or Hispanics [8]. Smoking is more typically in nonmetropolitan areas, and in the South and Midwest [9].

Despite efforts, physicians and policy makers have not succeeded in reversing the trend of adolescent smoking or obesity [10,11]. The awareness of overweight, smoking and other lifestyle choices in public health campaigns, commercial retail industries, and the media have been more prevalent since the early 2000s. Research indicates that public perception of overweight and obesity has been influenced by this focus, but public disfavor for smoking persists [12].

While the negative health impacts benefits of smoking are unquestionable, the strong probability of subsequent weight gain has raised concerns about an unintended effect of anti-smoking policies on obesity rates. Chou, Grossman, and Saffer (2009) proport that this resulting weight gain is simply "the price that must be paid to achieve goals that are in general favored by society [13]." Indeed, the association between smoking and body weight has become a central issue in the obesity literature, but the accumulating evidence present conflicting results.

Some, but not all, previous studies found that cigarette smokers weigh less than nonsmokers and former smokers are no heavier than nonsmokers [14]. Others find a direct link between smoking and substantial weight gain [15-25]. Others find that a substantial decrease in cigarette smoking has only a small effect on the prevalence of obesity [26,27]. Fang, Ali, and Rizzo (1999) reveal a moderately negative relationship between cigarette smoking and body mass index (BMI) [28], but the negative relationship could be attributable to simultaneity and should be interpreted with caution [29].

Much of the trouble in previous analyses involves lack of an identification strategy or appropriate instrument for endogenous factors. The motivation of initiating and maintaining smoking among adolescent females is quite different than males [30-32]. Weight concerns among adolescent females—who are more concerned with weight than males—may be one such factor [33,34]. More females consider themselves overweight than males and believe that smoking helps control weight leading them to use smoking as a method of weight control [21,34-40].

Studies examining the relationship between BMI and smoking in adults show that cigarette smokers had a lower BMI. Heavy smokers and never-smokers had similar BMI [41,42]. Nicotine has been found to have slight metabolic effects and suppress appetite [43,44]. In longitudinal analyses, continuing smokers had a smaller increase in BMI than those who gave up smoking [43]. In those who quit smoking, there was a significant, positive relationship between number of cigarettes smoked and the subsequent increase in BMI. The impact of smoking on body weight could dissipate over time. Long-term smokers (20+ years) are heavier than never or former smokers, and heavy smokers are more likely to be obese than both other smokers and nonsmokers [45,46].

While smoking is correlated with lower BMI for adults, this trend has not been observed in younger smokers (ages 16–24 years) [47]. The weight control effects of smoking may not be consistent among individuals in their developmental years or in the initial stages of use. Smoking has a reported antiestrogenic effect in youth, which may reduce fat deposition leading to weight loss [48,49]. One study finds a positive impact of smoking on youth BMI, but highlights gender differences with females being more likely to initiate smoking and sustaining weight effects thereafter [50].

In additional to the impact on body weight, the motivation for adolescent smoking is also unclear [51,52]. A variety of factors have been identified as possible explanatory factors in use of substances other than smoking [53,54]. Expectancy or trepidation for future events is among the most reliable correlates of substance experimentation, use, abuse, and dependence [53]. Identifying factors that may mediate or moderate the smoking behavior is crucial for guiding the development of enhanced tobacco-control interventions targeting adolescents.

While previous research provides varied results regarding the relationship between BMI and smoking at various ages, this study provides a comprehensive analysis of adolescent smoking at three stages of youth development. It incorporates longitudinal, nationally representative data and incorporates two different statistical methods to assert the robustness of the relationship. This study will examine how overweight varies by gender and demographic characteristic, the correlation between smoking frequency and BMI and discuss the relationship between smoking and BMI change between adolescence and young adulthood.

This analysis not only examines the relationship between cigarette smoking and BMI controlling for age, region of residence and other confounding variables, but also to test whether this relationship changes as adolescents age into young adults. This paper proceeds with an outline of the data and analytical methods employed in Methods Section.

Materials and Methods

BMI is highly correlated with body fat and can be used to classify individuals as using a nationally accepted rubric [14]. Among adults, BMI appears to be a satisfactory measure of body fat especially if comparing across race and ethnicity [55,56]. The Centers for Disease Control (CDC) specifies those BMI values used to classify individuals as underweight, healthy weight, overweight, or obese. While slightly different rubrics are used for individuals below and above age 18, this study utilizes only the adult standard for simplicity and ease of interpretation[1].

BMI was calculated from self-reported height and weight from the National Longitudinal Survey of Youth 1997 (NLSY97)—a longitudinal panel that follows a sample of 8,984 American youth from 1997 to 2011. After 2011, the survey became biennial. This study focuses on those consecutive survey years[2].

Analysis tests the relationship between BMI and cigarette smoking and is performed separately for men and women due to inherent biological differences and varying growth rates. BMI increases substantially over the panel with biological growth and

[1]Using BMI, BMI percentiles and a hybrid of the two systems was tried. However, the hybrid system created a large discontinuity and percentiles are largely inapplicable to most of the sample. Therefore, only BMI was used.

[2]While measurement and misspecification error is a concern in self-reported data, the data was cleaned to remove errant, inconsistent, and illogical values of height and weight. If BMI values were missing due to omitted height, height was imputed from nearby observations wherever possible. Full height is achieved relatively early in the panel; thus, imputations were unlikely to cause bias the sample—4,205 individuals. BMI and other means are listed in Table I. Minimum BMI minimum is 12.5—underweight—and maximum is 55—overweight or obese—with an average of 25 and 26 for men and women respectively. BMI increases with age due to biological growth and weight gain but rates vary by race and gender (Gallagher 1996) [59].

increases in body fatness (Figure 1). These data are consistent with other samples showing that BMI is comparatively higher among Hispanic males and black females. They also experience steeper growth trajectories [57]. The proportion of underweight decreased with age among all racial and ethnic groups and BMI levels remained high through adulthood.

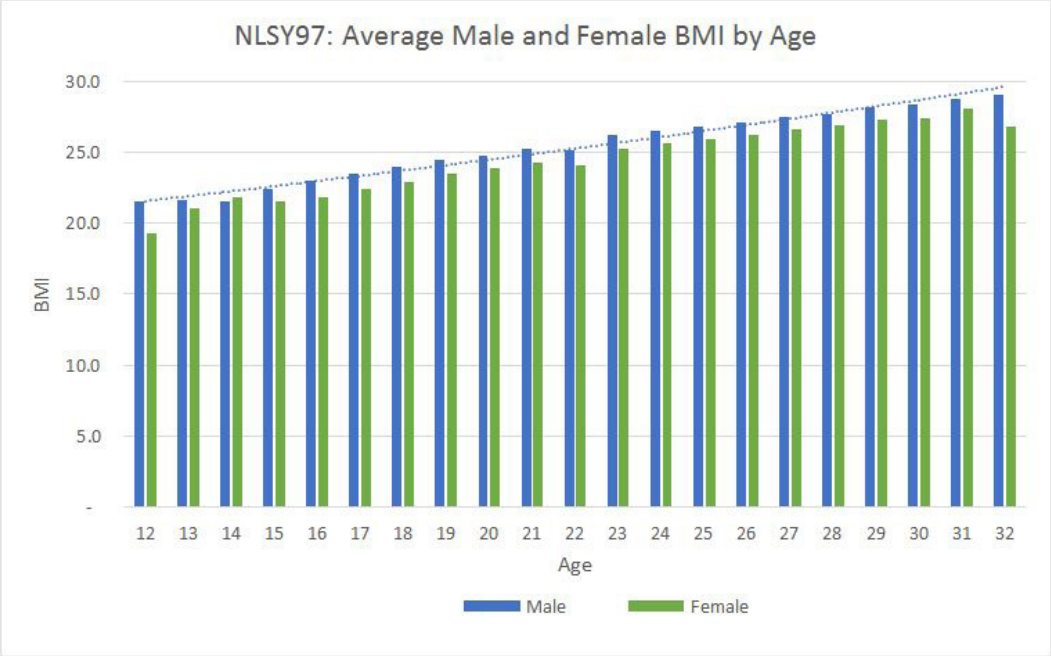

Figure 1: Average Male and Female BMI by Age

Table 1 provides simple statistics for the sample. Average household size is 3.5 persons but decreases with age. Seventy-five percent of the sample resides in an urban area, compared to 80 percent of the US population [58]. Dummy variables, northeast and south, represent regional residence, and the income/poverty ratio accounts for income level. Ratios below 1 indicate an income below poverty, while ratios of one or greater indicate income at least at the poverty level. The average ratio in the sample is between five and six—above poverty level.

General health score classifies overall health as 1= excellent, 2= very good, 3=good, 4=fair or 5=poor. The higher the rating, the lower the general level of health. On average, men and women rate their general health as 2 to 3 or "good". While the survey includes many questions about drinking, smoking, sleep and exercise, much of the data is incomplete or only specified in a handful of panel years. To obtain a valid indicator of adolescent smoking, number of days smoked was chosen. Response indicates whether they smoke zero or 1 to 5, 6 to 10, …, or 26 to 30 days a month. Most respondents indicate that they are non-smokers, smoking zero out of 30 days. Among those who report smoking, the average number of days smoked is between 20 and 21.

Data are first analyzed using a hierarchical generalized model (HGM). HGMs are appropriate only when the outcome of interest is not normally distributed, such as weight category, an appropriate error distribution needs to be incorporated into the model. Previously presented by Bell, Ene, Smiley and Schoeneberger (2013), HGM is a two-level organizational model with a polytomous outcome—the BMI category of youth drawn from a nationally representative longitudinal sample of American youth. HGMs accommodate categorical, non-normally distributed response variables. When dealing with this type of model, the assumptions of normally distributed, homoscedastic errors are violated [60]. Therefore, model employs a transformation of the BMI category using a cumulative logit link function and a multinomial distribution. These models are used to assess the relationship between hierarchical BMI categories, smoking and demographic controls.

Previous research examining this topic have several weaknesses; most notably, the failure to account for unobserved personal characteristics that could motivate the decision to smoke [18,20,29,61,62]. To control for this possible endogeneity, this analysis utilizes instrumental variables. Smoking behavior is instrumented using region, income, age and general health status [63]. The logic of the instrumentation equation is simple—higher smoking rates in the south, excessive cost of cigarettes and related taxes, and the negative health impacts of cigarette use.

Other researchers have used instruments to control for smoking decision—Vietnam war draft [64], infant neurodevelopment and schooling and earnings [65,66]. This study, however, utilizes respondents' own characteristics to derive a highly correlated measure.

NLSY97: Mean Statistics by Gender					
Male					
Variable	**N**	**Mean**	**Std Dev**	**Min**	**Max**
BMI	29,786	25.83	5.21	14.137	54.81
Age	29,786	22.76	4.55	11	32
Black	29,786	0.22	0.41	0	1
Hispanic	29,786	0.19	0.39	0	1
South	29,786	0.36	0.48	0	1
Northeast	29,786	0.16	0.37	0	1
Urban	29,786	0.75	0.44	0	1
Household Size	29,783	3.51	1.67	1	19
Income/Poverty	20,842	390.09	376.71	1	3,227
General Health Score	29,780	1.98	0.91	1	5
Body Perception	29,654	3.20	0.74	1	5
Days smoked in last 30	10,479	20.57	11.65	1	30
Smoking Category	29,786	0.81	1.20	0	3
Weight Category	29,786	1.65	0.80	0	3
Female					
Variable	**N**	**Mean**	**Std Dev**	**Min**	**Max**
BMI	27,830	24.86	5.72	12.53	54.87
Age	27,830	22.67	4.60	11	32
Black	27,830	0.25	0.43	0	1
Hispanic	27,830	0.19	0.39	0	1
South	27,830	0.38	0.49	0	1
Northeast	27,830	0.16	0.36	0	1
Urban	27,830	0.77	0.42	0	1
Household Size	27,829	3.64	1.72	1	15
Income/Poverty	19,597	354.29	359.84	1	3,227
General Health Score	27,827	2.17	0.93	1	5
Body Perception	27,776	3.48	0.78	1	5
Days smoked in last 30	8,701	21.04	11.58	1	30
Smoking Category	27,830	0.73	1.17	0	3
Weight Category	27,830	1.48	0.83	0	3

Table 1: Mean Statistics by Gender

Results

Table 2 lists estimation results from the HGM specification. Underweight serves as and estimates model the probability of having a lower BMI category. Coefficients show that as age increases, respondents have a lower likelihood of having a low BMI category. In other words, BMI increases with age. Regional and geographic controls show no impact and smoking has a significant impact among females, but not males, indicating that as females smoke more, their probability of having a low BMI.

NLSY97: HGM Results by Gender					
Male			**Female**		
Value	**BMI Category**	**Observations**	**Value**	**Smoking Category**	**Observations**
0	Underweight	115	0	Underweight	278
1	Normal Weight	3,605	1	Normal Weight	3,353
2	Overweight	2,602	2	Overweight	1,419
3	Obese	1,370	3	Obese	1,235

NLSY97: HGM Results by Gender					
Modeling the probability of having a lower BMI Category					
Fit Statistics			Fit Statistics		
-2 Log Likelihood	10011.78		-2 Log Likelihood	8600.51	
AIC	10,038		AIC	8,626.51	
Results			Results		
Effect	**Estimate**	**Std Dev**	**Effect**	**Estimate**	**Std Dev**
Intercept (Normal)	-1.8481***	0.4531	Intercept (Normal)	0.3189	0.4367
Intercept (Over)	8.1182***	0.4526	Intercept (Over	9.7646***	0.4825
Intercept (Obese)	12.1022***	0.4905	Intercept (Obese)	13.2557***	0.5149
Smoking	0.004543	0.00459	Smoking	0.008554*	0.005218
Age	-0.3586***	0.01255	Age	-0.3188***	0.01283
South	-0.042	0.2053	South	-0.1393	0.2116
Northeast	0.2858	0.3008	Northeast	0.2843	0.2865
Black	0.1025	0.3683	Black	-3.14***	0.4171
Hispanic	-1.3365***	0.3669	Hispanic	-0.8869**	0.408
Urban	0.1091	0.1122	Urban	-0.1711	0.1158
Household Size	0.01609	0.02822	Household Size	-0.08449**	0.03001
logIncome/Poverty	0.03824	0.04167	logIncome/Poverty	0.0382**	0.04456
Dependent Variabl: BMI Category 1=Underweight, 2 = Normal Weight, 3 = Overweight, 4 = Obese					

Table 2: HGM Regression Results by Gender

Racial and ethnic variables appear highly deterministic. Hispanic males and black females are significantly less likely to be low BMI compared to other races/ethnicities. Other studies have attributed these differences to specific body size preference [67]. Income and household size are negatively related to female BMI—these factors are also highly contribute to health disparities among adolescents and young adults [68,69].

Results from the two-stage regression are given in Table 3. Stage 1 results show that the instrument is highly correlated with smoking frequencies for females and most for males. Smoking frequencies increase with age, southern residence and general health. The residuals from Stage 1 are retained and used to approximate smoking frequency in Stage 2. The Stage 2 regression model is run as a categorical dependent variable model with the created instrument. The instrumented value appears to be a valid instrument and is highly correlated with BMI category.

NLSY97: 2SLS Results by Gender							
Male				Female			
Stage 1: Analysis of Variance				Stage 1: Analysis of Variance			
Source	**Sum of Squares**	**Mean Square**	**F Value**	**Source**	**Sum of Squares**	**Mean Square**	**F Value**
Model	32292	8072.9387	62.97***	Model	36333	9083.3424	74.41***
Error	985309	128.21202		Error	766511	122.07538	
Corrected Total	1017601			Corrected Total	802845		
Stage 1: Model Fit				Stage 1: Model Fit			
Root MSE	11.32307	R-Square	0.0317	Root MSE	11.04877	R-Square	0.0453
Dependent Mean	20.90468	Adj R-Sq	0.0312	Dependent Mean	21.65468	Adj R-Sq	0.0446
Coeff Var	54.16526			Coeff Var	51.02257		
Stage 1: Parameter Estimates				Stage 1: Parameter Estimates			
Variable	**Parameter**	**Standard**	**t Value**	**Variable**	**Parameter**	**Standard**	**t Value**
Intercept	13.59121***	1.12	12.09	Intercept	14.788***	1.17929	12.54
Age	0.15279***	0.04	4.12		0.20625***	0.03884	5.31
South	2.01406***	0.14	14.28	South	2.18845***	0.15085	14.51
General Health Rating	0.75664***	0.27	2.82	General Health Rating	0.57644**	0.28974	1.99
logIncome/Poverty	-0.19443	0.12	-1.57	logIncome/Poverty	-0.65774***	0.12707	-5.18
Dependent Variable: Smoking				Dependent Variable: Smoking			

NLSY97: 2SLS Results by Gender							
Stage 2: Response Category				**Stage 2: Response Category**			
Category	**Range**		**Frequency**		**Category**	**Range**	**Frequency**
Underweight	<=18.5		115		Underweight	<=18.5	278
Normal Weight	18.5<BMI<25		3604		Normal Weight	18.5<BMI<25	3353
Overweight	25<=BMI<30		2602		Overweight	25<=BMI<30	1418
Obese	>=30.0		1369		Obese	>=30.0	1235
Stage 2: Model Fit				**Stage 2: Model Fit**			
Criterion	**Intercept Only**		**Intercept and Covariates**	**Criterion**		**Intercept Only**	**Intercept and Covariates**
AIC	16800.02		16271.4	AIC		14192.721	13627.4
SC	16820.863		16820.9	SC		14212.959	13708.4
-2 Log L	16794.020		16247.4	-2 Log L		14186.721	13603.4
Stage 2: Parameter Estimates				**Stage 2: Parameter Estimates**			
Variable	**Parameter**	**Standard**	**Wald Chi Square**	**Variable**	**Parameter**	**Standard**	**Wald Chi Square**
Intercept_0	-0.6781***	0.2238	9.1798	Intercept_0	-0.2549	0.2211	1.3292
Intercept_1	3.5676***	0.211	286.0026	Intercept_1	3.2908***	0.221	221.8288
Intercept_2	5.2498***	0.2157	592.3094	Intercept_2	4.4713***	0.2243	397.4238
Smoking	0.0127***	0.00197	41.1761	Smoking	0.00408*	0.00226	3.2599
Age	-0.1223***	0.00645	359.4032	Age	-0.1123***	0.00696	260.5239
Black	0.0538	0.05	1.1561	Black	0.00575	0.0552	0.0109
Hispanic	-0.0339	0.0633	0.286	Hispanic	0.0997	0.0698	2.0381
Urban	-0.1945***	0.0618	9.9102	Urban	-1.0698***	0.0701	232.901
South	-0.4853***	0.0623	60.7172	South	-0.3454***	0.0714	23.4023
Northeast	0.000333	0.0513	0	Northeast	-0.0118	0.0582	0.0407
Household Size	-0.017	0.0138	1.5104	Household Size	-0.0575***	0.0151	14.5525
logIncome/Poverty	-0.1***	0.0216	21.3912	logIncome/Poverty	0.0241	0.0229	1.1074
Dependent Variable: BMI Category				Dependent Variable: BMI Category			
Significance: * = 10%, ** = 5%, *** = 1%				Significance: * = 10%, ** = 5%, *** = 1%			

Table 3: 2SLS Regression Results by Gender

IV estimates are consistent with those from the HGM. Smoking frequency is negatively related to BMI and age and race/ ethnicity are positively related. Minority groups have a lower probability of being in a low weight category. As expected, the probability of low BMI decreases with age for men and women but increases with household size. Both have a negative relationship between BMI and income.

While the relationship between BMI and smoking is unquestionable, does it vary with age? To test the robustness of both models to age, analyses are repeated at three different points in the age distribution—age 12 to 17, 20 to 25 and 27 to 32. Results are listed in Appendix I. As males age, smoking increases in significance become more deterministic. For females, the opposite occurs—there is a strong relationship between BMI category and smoking for that age 12 to 17, but it decreases with age.

HGM Regression Results by Gender and Age

NLSY97: HGM Results by Gender and Age					
Male			Female		
Age 12-17					
Value	BMI Category	Observations	Value	Smoking Category	Observations
0	Underweight	28	0	Underweight	61
1	Normal Weight	501	1	Normal Weight	455
2	Overweight	175	2	Overweight	126
3	Obese	59	3	Obese	69
Modeling the probability of having a lower BMI Category					
Fit Statistics			Fit Statistics		
-2 Log Likelihood	1101.41		-2 Log Likelihood	1127.06	
AIC	1,127		AIC	1,153.06	
Results			Results		
Effect	Estimate	Std Dev	Effect	Estimate	Std Dev
Intercept (Normal Weight)	-4.0378	2.6348	Intercept (Normal Weight)	-5.7308	4.5183
Intercept	12.007***	2.7077	Intercept	9.9796**	4.3622
Intercept (Obese)	19.4281***	2.8045	Intercept (Obese)	16.4264***	3.8818
Smoking	-0.02014	0.02023	Smoking	-0.03231	0.02226
Age	-0.3747**	0.1307	Age	-0.2728	0.1966
South	1.6192**	0.6405	South	-0.02474	0.699
Northeast	0.2191	0.7926	Northeast	2.8537**	0.9309
Black	-0.9258	0.7729	Black	-4.1076**	1.2962
Hispanic	-2.9809***	1.0109	Hispanic	-5.9523**	1.9681
Urban	1.8871***	0.6158	Urban	0.614	0.5952
Household Size	0.04371	0.1614	Household Size	0.0198	0.1765
logIncome/Poverty	-0.00026	0.2194	logIncome/Poverty	0.4183*	0.2392
Age 20-25					
Value	BMI Category	Observations	Value	Smoking Category	Observations
0	Underweight	50	0	Underweight	122
1	Normal Weight	1,720	1	Normal Weight	1,577
2	Overweight	1,187	2	Overweight	649
3	Obese	605	3	Obese	519
Modeling the probability of having a lower BMI Category					
Fit Statistics			Fit Statistics		
-2 Log Likelihood	5,212.34		-2 Log Likelihood	4,245.53	
AIC	5,212.44		AIC	4,271.53	
Results			Results		
Effect	Estimate	Std Dev	Effect	Estimate	Std Dev
Intercept (Normal Weight)	-0.7993	1.0955	Intercept (Normal Weight)	0.6381	1.2337
Intercept	9.8061***	1.1263	Intercept	15.3828***	1.596
Intercept (Obese)	15.7323***	1.1998	Intercept (Obese)	20.3435***	1.7886
Smoking	0.01879**	0.008182	Smoking	0.01333	0.01056
Age	-0.4389***	0.04221	Age	-0.4276***	0.05117
South	0.004513	0.3257	South	-0.1617	0.3802
Northeast	-0.2792	0.4674	Northeast	-0.2587	0.4919
Black	-0.2936	0.5207	Black	-6.9422***	1.1584
Hispanic	-2.3266***	0.5183	Hispanic	-1.0463	0.7553
Urban	0.6573**	0.2051	Urban	-0.1091	0.2205
Household Size	0.01598	0.05067	Household Size	-0.1803**	0.05937
logIncome/Poverty	0.004038	0.07045	logIncome/Poverty	0.1664**	0.08663

NLSY97: HGM Results by Gender and Age					
Age 27-32					
Value	BMI Category	Observations	Value	Smoking Category	Observations
0	Underweight	21	0	Underweight	67
1	Normal Weight	993	1	Normal Weight	973
2	Overweight	1,068	2	Overweight	548
3	Obese	638	3	Obese	594
Modeling the probability of having a lower BMI Category					
Fit Statistics			Fit Statistics		
-2 Log Likelihood	3882.85		-2 Log Likelihood	3412.8	
AIC	3,909		AIC	3,438.80	
Results			Results		
Effect	Estimate	Std Dev	Effect	Estimate	Std Dev
Intercept (Normal Weight)	-8.9651***	2.2819	Intercept (Normal Weight)	-2.2284	1.5557
Intercept	3.0692	2.0477	Intercept	8.7085***	1.6764
Intercept (Obese)	13.4159***	1.7317	Intercept (Obese)	13.0841***	1.7451
Smoking	0.01566**	0.01157	Smoking	-0.02052	0.01203
Age	-0.3145***	0.05917	Age	-0.2136***	0.04834
South	0.5757	0.4572	South	-0.0625	0.4652
Northeast	1.8629**	0.7693	Northeast	0.6585	0.5953
Black	-0.568	0.7037	Black	-4.8432***	0.9315
Hispanic	-2.2747***	0.6956	Hispanic	-1.8334**	0.8562
Urban	0.1802	0.2885	Urban	-0.1441	0.2868
Household Size	0.009861	0.07968	Household Size	-0.1697**	0.07814
logIncome/Poverty	0.2214*	0.1134	logIncome/Poverty	0.04544	0.1091
Dependent Variabl: BMI Category 1=Underweight, 2 = Normal Weight, 3 = Overweight, 4 = Obese					

Discussion and Conclusion

This paper addresses the following research areas:

1. How prevalent is overweight among males and females during the adolescent years?
2. Does this prevalence vary across demographic/household/geographic characteristics?
3. What is the relationship between smoking frequency and BMI?
4. Does the relationship between smoking and BMI change between adolescence and young adulthood?

Analysis showed that males and females gain weight with age and obesity/overweight become more prevalent over time. Smoking rates remain low, but persist steadily throughout adolescence. Household and geographic patterns pay little role in BMI determination. Race, age and ethnicity are highly deterministic and positive—older and minority respondents have comparatively higher BMI. Household size plays a small role for females and income for males.

This study, like most, does face several limitations. First, BMI is calculated from self-reported height and weight data. All self-reported data suffers from reporting bias period Second, instrumental variables are less precise than utilizing actual smoking data. While IV alleviates endogeneity concerns, no instrument is perfectly correlated with its proxy. Finally, this data does not allow for observation of peer effects of influences. Adolescents are likely impacted by the actions, opinions and behaviors of the peers and schoolmates.

Finally, smoking and BMI are inversely related—lower BMI respondents smoke more. Higher BMI respondents tend to be light or non-smokers. When similar analysis were conducted with young, middle and older adolescents, males showed that the relationship between BMI and smoking frequency became stronger over time while women showed that smoking frequency became less deterministic. Causality falls outside the scope of the analysis, but reports show significantly higher smoking rates among men, but faster BMI increases among women. Therefore, both female smokers and non-smokers are likely to be increasing BMI more rapidly and the differential between the two groups could narrow. The disparity between male smokers and non-smokers could be growing as more males continue to smoke later in life or are unsuccessful quitters. This analysis shows a significant behavioral impact on BM, but the age-related relationship for men and women merits further analysis.

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Conflicts of Interest Disclosure

The author certifies that he/she has NO affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

Appendix

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