Obesity's Impact on Ohio's Workforce

By Rea S. Hederman Jr. and Logan Kolas

ECONOMIC RESEARCH CENTER
at THE BUCKEYE INSTITUTE

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March 30, 2023

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EXECUTIVE SUMMARY

Ohio, like much of the country, suffers from an obesity problem. Obesity plagues one-third of Ohioans and more than 40 percent of the U.S. adult population,[1] presenting a host of other health concerns and comorbidities to those suffering the disease. More broadly, because obesity too often keeps working age adults from maintaining full employment, it exacerbates labor shortages and contributes to Ohio's labor participation rate remaining below the national average and below the state's pre-pandemic level. A healthy, productive workforce is key to sustaining a strong economy. Workers in ill-health—including those with obesity—are more likely to miss work, work fewer hours, and be less productive while on the job. Those employee concerns can lead employers to reduce hours or close their doors, which affects the healthy and unhealthy workers alike. Working-age adults not participating fully in the labor market will suffer economically as they forego short-term income, employment benefits, and lifetime earnings often exceeding $100,000. And losing workers to obesity and ill-health contributes to higher public health bills while simultaneously reducing state and local tax bases.

Our economic analysis of Ohio data reveals that obesity keeps more than 32,000 Ohioans unemployed, which reduces potential state income tax revenues by nearly $20 million annually. Treating obesity and its associated illnesses also costs Ohio Medicaid hundreds of millions of dollars a year. With no single cure for obesity, policymakers should take several pragmatic steps to make Ohio healthier and more employed. Regulations that make it harder to access mental and physical obesity health care, prevention, and treatments—such as outmoded licensing requirements—should be repealed or more suitably tailored. Various obesity treatments should be rigorously studied, and obesity data should be tracked across state agencies and programs. And policymakers should form a study committee to analyze which obesity treatments have worked in other states and implement those treatments in Ohio. These studies and analyses should be broadly shared with the public so that private sector employers, medical groups, and health insurers can craft better obesity care plans for employees, patients, and clients.

[1] **Obesity Rate by State 2022**, World Population Review, 2022 (Last visited February 13, 2023).

OHIO'S OBESITY PROBLEM

Obesity in humans is defined as having a body mass index (BMI) greater than 30. It is a disease that causes significant adverse health outcomes, which, in turn, can cause significant social and economic problems. Those suffering obesity are more likely to develop heart disease, diabetes, osteoarthritis, and other chronic diseases.[2] They are at greater risk for acute injuries and contracting infectious diseases.[3] And obesity sufferers have a significantly greater risk of depression and other mental health side-effects.[4] Such serious health concerns make it more difficult for those with obesity to remain fully employed and productive in the workforce. Many with obesity simply stop working or work less hours than they might prefer due to the disease and its chronic side-effects. Absenteeism (missing days of work), presenteeism (reduced productivity at work), and early retirement are all higher among those with obesity.[5] The National Institutes of Health (NIH) reported, for example, that workers with obesity were 1.7 times more likely to miss work than workers without obesity.[6] Missing work means less work experience, which means lower earnings.[7] Wage penalties can reach 12 percent for women with obesity and 0.7 percent for men,[8] with some estimated to forfeit $114,626 over their lifetime due to lost productivity.[9]

Unfortunately, one-third of Ohioans suffer obesity and its adverse side-effects, well above the national average.[10] Such a significant percentage means that the adverse

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[2] **Heath Effects of Overweight and Obesity**, Centers for Disease Control and Prevention, September 24, 2022. See also, Jay Bhattacharya and Neeraj Sood, **Health Insurance, Obesity, and Its Economic Costs**, *Economics of Obesity*, January 1, 2004.

[3] Eric A Finkelstein, Hong Chen, Malavika Prabhu, Justin G, Trogdon and Phaedra S. Corso, **The relationship between obesity and injuries among U. S. adults**, *The American Journal of Health Promotion*, Volume 21, Issue 5 (May-June 2007) p. 460-468.

[4] Floriana S. Luppino, Leonore M. De Wit, and Paul F. Bouvy, **Overweight Obesity and Depression A Systematic Review and Meta-Analysis of Longitudinal Studies**, *Archives of General Psychiatry*, Volume 67, Issue 3 (March 2010) p. 220-229.

[5] **The Global Economic Impacts of Obesity: Present Costs and Future Estimates,** RTI International (Last visited February 13, 2023).

[6] Paul A. Schulte, Gregory R. Wagner, Aleck Ostry, Laura A. Blanciforti, Robert G. Cutlip, Kristine M. Krajnak, Michael Luster, Albert E. Munson, James P. O'Callaghan, Christine G. Parks, Petia P. Simeonova, and Diane B. Miller, **Work, Obesity, and Occupational Safety and Health**, *American Journal of Public Health*, March 2007.

[7] Shari L. Barkin, William J. Heerman, Michael D. Warren, and Christina Rennhoff, **Millennials and the World of Work: The Impact of Obesity on Health and Productivity**, *Journal of Business and Psychology* Volume 25, Number 2 (2010) p. 239–245.

[8] *Ibid*.

[9] *Ibid*.

[10] **Obesity Rate by State 2022**, World Population Review, 2022 (Last visited February 13, 2023).

health effects suffered by those with obesity negatively affect Ohio's tax base, its workers' compensation system, the price of its Medicaid program, and the state's declining labor participation rate.

Obesity in Ohio, which is most prevalent among those between 45-64 years old,[11] costs the state tax revenue, higher workers' compensation expenses, and elevated Medicaid payments. Workers become more valuable to employers as they gain new skills, abilities, and job experience. The more skilled and valuable the worker, the more he or she earns.[12] Conversely, workers with less time and experience on the job will be paid less. Therefore, insofar as obesity reduces worker productivity and its side-effects keep workers sidelined, those suffering obesity tend to earn less over their lifetimes, with one estimate showing a national cost of $1.24 trillion due to lost productivity.[13] Ohio raises nearly one-third of its tax revenue through the personal income tax, and lower earnings due to obesity reduce the income tax that the state can collect. Earnings and their associated income taxes can and sometimes do fall to zero when obesity and its complications remove a worker from the workforce entirely. Obesity has removed over 32,000 workers from Ohio's labor market. Assuming an average $35,100 annual wage that pays $610 in state income tax, those lost workers cost the state nearly $20 million per year in forfeited tax revenue.[14] (See Figure 1.)

Workers with obesity also burden Ohio's state-run workers' compensation program. Those suffering obesity file twice as many workers' compensation claims, impose medical costs seven times higher, and missed 13 times more workdays due to injury or illness.[15] A more recent study found that average costs for disability, worker's compensation claims, and sick day expenses were over twice that for workers with obesity compared to those without obesity.[16] Under Ohio law, employers must self-insure or buy worker's compensation insurance through the state. But employers and their employees split the true cost of worker's

[11] **Explore Obesity in Ohio: 2021 Annual Report**, America's Health Rankings, 2021 (Last visited February 13, 2023).
[12] Susanna Loeb and Mary Corcoran, **Welfare, Work Experience, and Economic Self-Sufficiency**, *Journal of Policy Analysis and Management*, Volume 20, Number 1 (Winter 2001) p. 1-20.
[13] Claude Lopez, Joseph Bendix and Ken Sagynbekov, ***Weighing Down America: A 2020 Update***, The Milken Institute, December 1, 2020.
[14] Author's calculations assuming workers earn between $30,000 to $40,000 and pay average state income tax for that bracket.
[15] **Obesity Increases Workers' Compensation Costs**, Duke Health News, April 23, 2007.
[16] Karen Van Nuys, Denise Globe, Daisy Ng-Mak, Hoiwan Cheung, Jeff Sullivan and Dana Goldman, **The association between employee obesity and employer costs: evidence from a panel of U. S. Employers**, *American Journal of Health Promotion, Volume 28,Number 5 (May-June 2014) p. 277-85.*

compensation insurance, with employees bearing most of the burden in the form of lower wages, reduced pension benefits, and higher health insurance premiums. For their part, employers pay higher workers' compensation premiums at the expense of hiring, capital investment, expansion, and profit.

Figure 1: Estimated Additional Tax Revenues and Wages

Additional Working Ohioans	32,156
Average Wage	$35,100 Annually
Average Additional Income Tax Per Worker	$610
Estimated Additional Tax Revenues	$19.62 million

In addition to reducing tax revenues and hiking workers' compensation costs, obesity saddles Ohio with higher Medicaid expenses. As a joint federal-state healthcare program, Ohio pays more than a third of the state's total Medicaid bill. That bill has risen as Medicaid rolls have expanded and treatments for the chronically ill and those suffering obesity have become more expensive. In 2015, researchers estimated that treatment for obesity-related healthcare cost the Ohio Department of Medicaid hundreds of millions of dollars.[17] A 2018 study reported that obesity-related illness accounted for almost 18 percent of Ohio's annual Medicaid expenses, a higher percentage than in many other states.[18]

Finally, would-be workers who remain out of the workforce due to obesity exacerbate Ohio's declining worker participation rate. That annual average rate has dropped from 63.44 percent in 1980 to 61.73 percent in 2022—the lowest mark in 40 years.[19] And since 1980, Ohio's labor participation rate has persistently stalled below average nationally. Currently ranked 30th in labor participation,[20] Ohio ranked 34th, 35th, 32nd, 22nd, 27th, and 31st in state labor participation in 1980, 1990, 2000, 2010, 2019, and 2020 respectively. Many factors, of course, influence labor participation, including age, education, marital status, and health. Ohio's

[17] Y. Claire Wang, John Pamplin, Michael W. Long, Zachary J. Ward, Steven L. Gortmaker, and Tatiana Andreyeva, **Severe Obesity in Adults Cost State Medicaid Programs Nearly $8 Billion in 2013**, *Health Affairs*, Volume 34, Number 11 (November 2015).
[18] Adam Biener and John Cawley, **The Impact of Obesity on Medical Care Costs and Labor Market Outcomes in the US**, *Clinical Chemistry*, Volume 64, Issue 1 (January 2018) p. 108-117.
[19] **Labor Force Participation Rate for Ohio**, fred.stlouisfed.org (Last visited December 1, 2022).
[20] **Labor Force Participation Rate by State 2022**, World Population Review (Last visited December 1, 2022).

population is aging, with just 26.23 percent of its population 50 and older in 1980, compared to 37.44 percent in 2020.[21] As the state population ages and reaches retirement, labor participation declines. Similarly, research confirms that poor and declining health limit labor market participation,[22] with poor health or disability given as the number reason that males were not employed in a 2019 survey.[23]

Obesity may not be the primary cause of declining labor force participation, but it does worsen the state and national trends. A fuller economic analysis of obesity's impact on Ohio's labor market and working-age employment rate follows.

[21] **Our Changing Population: Ohio**, USA Facts (Last visited December 1, 2022).
[22] Alan B. Kreuger, "**Where Have All the Workers Gone? An Inquiry Into the Decline of the U.S. Labor Force Participation Rate**," Brookings Papers on Economic Activity, The Brookings Institute, Fall 2017.
[23] Jonathan Rothwell, **Scarred Boys, Idle Men: Family Adversity, Poor Health, and Male Labor Force Participation,** Institute for Family Studies, January 17, 2023.

ANALYZING OBESITY'S IMPACT ON OHIO'S LABOR MARKET

An economy's working age employment rate measures how many working age individuals are employed as a percentage of an economy's working age population. To estimate obesity's impact on employment in Ohio, we use a pooled logit model specification. After controlling for education, age, race, and other unhealthy behaviors, we find that eliminating obesity in Ohio would increase the number of employed Ohioans by more than 32,000 people. Although there is no single cure for obesity, policymakers can take steps to make Ohio healthier and more employed. First, regulations that impede access to mental and physical obesity health care, prevention, and treatments—such as burdensome licensing requirements—should be removed or more effectively tailored. Second, the effectiveness of various obesity treatments should be rigorously studied, and obesity data should be more closely tracked across state agencies and programs. Finally, policymakers should form a study committee to analyze which obesity treatments have worked in other states and implement those treatments in Ohio.

Methodology

The model specification employs a pooled logit regression of the form:

$$\text{Prob}\,(\text{Employment}_{i2014\text{-}2021}) = B_0 + B_1\text{Obese}_{i2014\text{-}2021} + B_2X_{i2014\text{-}2021} + \text{Year}_t + \varepsilon_{it}$$

The binary dependent variable, *Employment*, takes on the value of 1 if a given Ohioan is employed for a wage or is self-employed and takes on the value of 0 otherwise. The main variable of interest, *Obesity*, is also a binary variable that takes on the value of 1 if an Ohioan has a body mass index between 30 and 99.99, and takes on the value of 0 otherwise. Consistent with the underlying data ranges from the Behavioral Risk Factor Surveillance System (BRFSS), any body mass index between 30 and 99.99 is considered "obesity" and "not obesity" otherwise.[24] Similar to Zhang, Lamichhane, and Wang (2014), vector X is a series of control

[24] BRFSS makes a distinction between obesity and overweight. Of course, this categorization is not perfect, as individuals can be overweight but not classified as having obesity. An obesity classification is assigned to any individual with a BMI between 30 and 99.99. Meanwhile, a BMI between 25 and 30 would be an overweight classification according to the BRFSS survey design. Data from the BRFSS are recorded with two implied decimal places; i.e., a 30 BMI is recorded as a BMI of 3,000. This has no effect on the classification of obesity in our sample and we remove the implied decimal places in our methodology.

variables denoting race classifications, education levels, the age group classifications of respondents, and an indicator variable for current smoking status to control for generally unhealthy behavior (see Figure 3 for descriptive statistics of these variables).[25] By controlling for smoking, we control for the possibility that those who have obesity engage in such unhealthy behaviors that themselves may affect employment status. Retired adults are removed from the population as they are no longer associated with labor market outcomes.[26] Finally, year fixed effects are included to control for factors that are constant between respondents, but change over time, such as recessions.

The Impact of Obesity on Ohio's Workers

Ohioans with obesity are significantly less likely to be employed. The preferred model shows that obesity is associated with a 2.94 percent lower likelihood of being employed. (See Figure 2.) Switching from a model specification that controls for common factors that change on a yearly basis to factors that change monthly, in order to control for seasonal effects on employment, yields similar results. In the monthly specification, obesity is associated with a 2.90 percent lower likelihood of employment. Similarly, according to our preferred model of year fixed effects, an Ohioan with obesity is 2.94 percent less likely than one without obesity to have a job. Extending these findings to Ohio's recent labor market data, we find that eliminating obesity would add 32,156 more Ohioans to the employment rolls. Ohio's employment-to-population ratio of 58.76 percent lags the national average of 59.84 percent by 1.08 percent. Employing an additional 32,156 Ohioans would close a quarter of that gap, boost Ohio's ratio to 59.14 percent, and push Ohio past Georgia and Oklahoma in the national employment rankings.[27] And, excluding the 2020 pandemic job market, an increase of 32,156 jobs would be the most monthly jobs added in a non-covid month this century. (See Figure 3.)

[25] Qi Zhang, Rajan Lamichhane, and Youfa Wang, **Association Between U.S. Adult Obesity and State and County Economic Conditions in the Recession**, *Journal of Clinical Medicine*, Volume 3, Issue 1 (March 2014) p. 153-166.

[26] *Ibid.*

[27] The number of employed Ohioans is calculated as the product of the average marginal effect in the logit model with year fixed effects, the percentage of the sample size represented by Ohioans with obesity without a job, and the raw Ohio working age population as of December 2022. Ohio Department of Jobs and Family Services, **Employment Situation Indicators for Ohio**, December 2022; and Bureau of Labor Statistics, **Local Area Unemployment Statistics** (Last visited March 20, 2023).

Figure 2: Association Between Obesity and Employment in Ohio[28]

	Regression Results	
	Employment (logit, year)	Employment (logit, month)
Obesity	-.0294***	-.0290***
	(0.0066)	(0.0066)
Controls	Yes	Yes
Year Fixed Effects	Yes	No
Month Fixed Effects	No	Yes
Sample Size	40,038	40,038

With Ohio employers struggling to find workers across the state, any factor driving down the willingness or ability of Ohioans to work needs immediate examination. A 2020 report on Ohio manufacturing found that over half of Ohio manufacturing companies reported that labor shortages were slowing business growth.[29] Today, job opening rates remain high in Ohio even as unemployment rates fall—indicating that persistent labor shortage issues have not been resolved.[30] Even statewide corporate champions like Intel have struggled to find the construction workers needed to facilitate the largest economic development project in Ohio history.[31] Obesity is likely compounding the labor shortage woes.

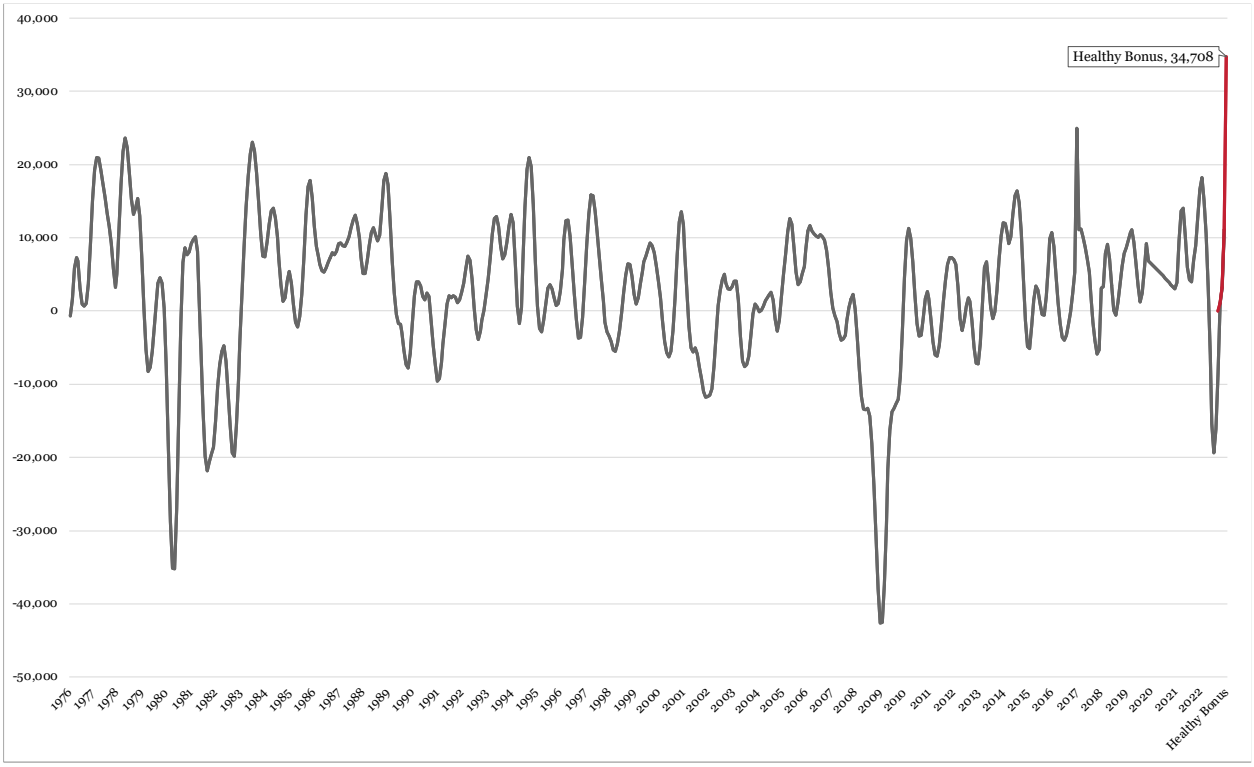
[28] Results show average marginal effects. Detailed results displayed in Figure 6 in the appendix. Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

[29] MAGNET and Ohio Manufacturing Extension Partnership, **2020 Ohio Manufacturing Report: Technology Talent and Transformation**, 2020.

[30] U.S. Bureau of Labor Statistics, **Job Openings and Labor Force Turnover Survey** (Last visited January 19, 2022); and U.S. Bureau of Labor Statistics, **Local Area Unemployment Statistics** (Last visited January 19, 2022).

[31] **7,000 Construction Workers are Needed for Ohio's Largest Economic Development Program**, Associated Press, August 22, 2022.

Figure 3: Monthly Job Growth Excluding Coronavirus[32]



Recommendations

There is no single cure or solution for obesity in Ohio. But modern medicine uses various combinations of education, counseling, medications, and surgery to combat obesity and alleviate its effects. Similarly, Ohio policymakers can and should pursue readily available policies to reduce obesity's spread and improve care for those who suffer from it. Doing so will not only benefit those with obesity, but will reduce government spending, increase state tax revenues, and help get people back on their feet and back to work.

[32] Source: Bureau of Labor Statistics, **Local Area Unemployment Statistics** (Last visited February 15, 2022).
Note: Chart for monthly job growth in Ohio excludes 2020. Since 2000, Ohio has added 876 jobs per non-2020 (i.e., non-COVID) month. The red line indicates what it would look like if the next month of data grew by Ohio's monthly average of 876 jobs since 2000 (excluding 2020) plus the 32,156 jobs from obesity elimination. 2020 is excluded because it is taken as a COVID anomaly that skews the data away typical monthly job growth. 2020, therefore, appears as a line connecting December 2019 to January 2021.

First, recognizing the seriousness of Ohio's obesity epidemic, policymakers and employers should expand access to obesity care in line with evidence-based medical standards. State policymakers should reform regulations to improve access to obesity care, prevention, and treatments. Many insurance plans and Medicaid cover nutrition and dietary counseling as an effort to manage obesity. But Ohio requires "nutritionists" or anyone offering specific nutrition advice to have a dietician's license. Fitness instructors who give specific advice on weight management must apply for an exemption to this requirement. Such requirements restrict access to care and prevention and should be repealed. And Ohio should explore ways to expand access to mental health treatment for people with obesity who need it. Good mental health is needed to effectively treat obesity and return to the workforce—and good mental health care can help.

Second, Ohio should track the performance of obesity treatments in its state employee health plan and Medicaid program. Ohio's state employee health plan recently began covering obesity care medications (with prior authorization) in July 2022,[33] and policymakers could study the effectiveness of those medications and implement a pilot a program to assess whether obesity medication for Medicaid enrollees offers a cost-effective treatment. The state should also improve its economic assessments of obesity and other health conditions by tracking information across the Ohio Department of Medicaid, the Bureau of Workers' Compensation, the Ohio Department of Jobs and Family Services, and other state agencies.

And finally, Ohio should form a study committee to analyze and recommend best practices proving successful in other states. Kentucky, Tennessee, and North Carolina, for example, offer health insurance coverage for a range of obesity treatments and medications, while other states use public health campaigns aimed at reducing obesity. Ohio should study the effectiveness of these insurance plans and health campaigns. And it should convene a taskforce of subject matter experts in across the health and economics fields to find ways to help workers return to the workforce. The taskforce should evaluate medical interventions in national programs and study programs tried in other states to keep Ohio policymakers updated with the latest research and best practices in treating obesity.

[33] **Important change to your prescription benefit program**, Ohio Department of Administrative Services health benefits release, 2022.

Conclusion

Reversing Ohio's obesity trend will help build a healthier, wealthier workforce. Obesity keeps more than 32,000 Ohioans from the labor rolls, adds to the state's Medicaid bill, and reduces state and local tax revenues by $20 million annually. Helping those suffering obesity get back to work will promote individual and socio-economic health and prosperity. State policymakers can take several pragmatic steps toward that end. Removing regulatory impediments to health care and obesity treatments and prevention would be a good place to start. State agencies can also review how other states are fighting the disease and emulate the best practices thus far. And Ohio can form a taskforce of experts to study and suggest medical interventions and programs for the state and its employers, insurance providers, and health officials to pursue. Private sector employers may then use the taskforce's recommendations to tailor their own obesity care and related health care initiatives. A healthier workforce is a stronger worker force, and the stronger the workforce the stronger the state and its people.

APPENDIX

All data in this report have been collected from the Behavioral Risk Factor Surveillance System (BRFSS) survey. The BRFSS is a voluntary response, state-based landline and cellular phone survey that collects responses on health-related behaviors, outcomes, and conditions on individuals across the country. Conducting more than 400,000 interviews each year, the BRFSS is the largest continuously-conducted health survey system in the world.[34] Data are restricted to Ohio and re-weighted according to Centers for Disease Control and Prevention (CDC) recommendations to reduce potential bias from selection probabilities and nonconvergence.[35] This analysis uses all BRFSS annual surveys from 2014 to 2021.[36] Missing response data is dropped prior to analysis to avoid bias.

The authors analyzed data on employment status, obesity status, race, education, age, and smoking status. Figure 4 lists the descriptive statistics of the selected variables. All variables have been recoded as binary variables to indicate whether individuals are part of the classification groups listed. For example, an employed Ohioan would be assigned a value of 1 if employed and 0 otherwise. Therefore, mean results in the descriptive statistics in Figure 4 display the percentage of Ohioans in the survey that fit into each classification.

[34] **Centers for Disease Control and Prevention**, BRFSS Frequently Asked Questions (Last visited January 18, 2022).
[35] **Complex Sampling Weights and Preparing 2021 BRFSS Module Data for Analysis**, Centers for Disease Control and Prevention, July 2022.
[36] Centers for Disease Control and Prevention, **Annual Survey Data** (Last visited January 18, 2022).

Figure 4: Descriptive Statistics of Variables[37]

	Mean	Standard Deviation	Minimum	Maximum	Sample Size (n)
Employment	0.72	0.45	0	1	40,038
Obesity	0.38	0.49	0	1	40,038
White	0.86	0.35	0	1	40,038
Black	0.07	0.25	0	1	40,038
Asian	0.01	0.12	0	1	40,038
Hispanic	0.03	0.16	0	1	40,038
American Indian	0.01	0.09	0	1	40,038
Other	0.03	0.16	0	1	40,038
Less than High School	0.05	0.21	0	1	40,038
High School	0.32	0.47	0	1	40,038
Some College	0.28	0.45	0	1	40,038
College Graduate	0.34	0.47	0	1	40,038
Smoke	0.23	0.42	0	1	40,038
Age 18-24	0.09	0.29	0	1	40,038
Age 25-34	0.16	0.36	0	1	40,038
Age 35-44	0.19	0.39	0	1	40,038
Age 45-54	0.26	0.43	0	1	40,038
Age 55-64	0.31	0.46	0	1	40,038

The Addition of Odds Ratios

When running a logistic regression to estimate the likelihood of employment, results are typically given as log-odds, but are expressed in-text as an odds ratio of the form: ln(Pr(Employment)/(1-Pr(Employment)).[38] We convert the log-odds into an odds ratios for both a logistic year and month fixed effect model and present the results in Figure 5. Once again, using the preferred specification of year

[37] Figures may not add due to rounding.

[38] John E. Anderson, Seth H. Giertz, and Shafiun N. Shimul, **Property Taxes for Agriculture: Use-Value Assessment and Urbanization Across the United States**, working paper, Mercatus Center at George Mason University, August 24, 2015.

fixed effects, obesity has 16.1 percent less odds of having employment compared to those without obesity.[39]

Figure 5: Odds Ratios of Logistic Regressions[40]

	Odds Ratios	
	Odds Ratio with Year Fixed Effects	Odds Ratio with Month Fixed Effects
Obesity	-0.161***	-0.159***
	(0.036)	(0.036)
White	0.470***	0.464***
	(0.101)	(0.101)
Black	0.132	0.130
	(0.113)	(0.113)
Asian	-0.205	-0.216
	(0.164)	(0.164)
Hispanic	0.282**	0.275**
	(0.137)	(0.137)
American Indian	0.163	0.161
	(0.310)	(0.309)
High School	0.859***	0.859***
	(0.069)	(0.069)
Some College	0.875***	0.874***
	(0.070)	(0.070)
College Graduate	1.625***	1.625***
	(0.073)	(0.073)
Smoke	-0.436***	-0.440***
	(0.041)	(0.041)
Age 25-34	1.119***	1.122***
	(0.065)	(0.065)
Age 35-44	1.134***	1.138***

[39] Beware, odds have precise statistical definition of P/(1-P) and should not be interpretated as relative probabilities. Instead, the authors present average marginal effects in Figure 3 and Figure 6.
[40] Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1).

	(0.064)	(0.064)
Age 45-54	0.888***	0.886***
	(0.059)	(0.059)
Age 55-64	0.537***	0.537***
	(0.055)	(0.055)
Constant	-1.004***	-1.044***
	(0.132)	(0.140)
Observations	40,038	40,038

Robustness Check

By definition, a logistic regression on a binary dependent variable (known as logit) is a non-linear model. When dealing with binary (0 or 1) dependent variables (in this case, employment), it has become common practice to deploy non-linear model specifications such as logit or probit. But in some cases log odds (the results of a "logit" regression) are nearly a linear function of probability,[41] and as Hellevik (2007) finds, there are often compelling arguments to use a linear model specification.[42] Because this relationship is assumed to be non-linear, we prefer a logistic specification. Results for a linear probability model, however, are presented alongside our previous results as a robustness check on the previous logistic results in Figure 6. As before, the robustness check using a linear probability model shows a negative relationship between obesity and employment status, although this effect is marginally smaller in magnitude. In the linear model, obesity is associated with a 2.87 percent lower likelihood of employment compared to 2.94 percent lower likelihood in the logistic model. Similar results are displayed for month fixed effects as well. Given the similarity of magnitude and the statistically significant relationships, the results are consistent across varying time fixed effect decisions and model specifications.

[41] Von Hippel, **Linear vs. Logistic Probability Models: Which is Better, and When?**, Statistical Horizons, July 5, 2015.

[42] Ottar Hellevik, **Linear Versus Logistic Regression When the Dependent Variable is a Dichotomy**, *Quality and Quantity: International Journal of Methodology*, Volume 43 (February 16, 2007) p. 59-74.

Figure 6: Comparing Association Between Obesity and Employment Using Logit and Linear Probability[43]

	Regression Results			
	Employment (lpm, year)	Employment (lpm, month)	Employment (logit, year)	Employment (logit, month)
Obesity	-0.0287***	-0.0282***	-.0294***	-.0290***
	(0.007)	(0.007)	(0.0066)	(0.0066)
Controls	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	No	Yes	No
Month Fixed Effects	No	Yes	No	Yes
Sample Size	40,038	40,038	40,038	40,038

[43] Results show average marginal effects. Standard errors in parentheses (*** p<0.01, ** p<0.05, * p<0.1)

About the Authors

Rea S. Hederman Jr. is executive director of the Economic Research Center and vice president of policy at The Buckeye Institute. In this role, Hederman oversees Buckeye's research and policy output.

A nationally recognized expert in healthcare policy and tax policy, Hederman has **published numerous reports and papers** looking at returning healthcare power to the states, the impact of policy changes on a state's economy, labor markets, and how to reform tax systems to spur economic growth.

Prior to joining Buckeye, Hederman was director, and a founding member of the Center for Data Analysis (CDA) at the **Heritage Foundation**, where he served as the organization's top "number cruncher." Under Hederman's leadership, the CDA provided state-of-the-art economic modeling, database products, and original studies.

While at Heritage, Hederman also oversaw the organization's technical research on taxes, healthcare, income and poverty, entitlements, energy, education, and employment, among other policy and economic issues. He was also responsible for managing Heritage's legislative statistical analysis and econometric modeling.

Hederman's commentary has been published in *The Washington Post*, *The Washington Times*, *National Affairs*, *The Hill*, National Review Online, and FoxNews.com, among others. He is regularly quoted by major newspapers and wire services, and has appeared on Fox News Channel, CNN, CNBC, and MSNBC.

Logan Kolas is an economic policy analyst with the Economic Research Center at The Buckeye Institute where he researches and writes about state and local taxes, state-level budgets, technology and innovation policy, and labor market issues.

Kolas has conducted state-level tax modeling and budget research for states such as Iowa, Louisiana, New Hampshire, and North Carolina. He has authored policy papers, book chapters, blog posts, and op-eds on restoring Ohio's technology and innovation leadership, the effects of federal and state labor market policies on work, and on modernizing Ohio's outdated economic system to return the Buckeye State to economic prosperity and leadership. He is the author of The Buckeye Institute's three-part "Policies for More Innovation" series where he authored the reports ***A Policy Primer for Emerging Technology in Ohio*** and ***Modernizing Ohio's Policies to Seize New Economic Opportunities***. Kolas has also conducted **multiple analyses** estimating the number of state-level jobs lost to a $15 per hour minimum wage.

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Obesity's Impact on Ohio's Workforce

 The Buckeye Institute has received support from Eli Lilly and Company.

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