2020

HIIT-ing the Books: University Student Time Allocation and Exercise

Teigan Nicole Avery
University of Montana, Missoula, ta107316@umconnect.umt.edu

HIIT-ing the Books: University Student Time Allocation and Exercise

Teigan Avery

Abstract

A growing body of economic literature examines irrational human behavior in many contexts including exercise habits (Duckworth and Milkman 2019). Informed by economic research, interventions known as nudges have been introduced, sometimes significantly altering how individuals behave. This study marries behavioral economics and wellness by examining university students' exercise habits. Physical exercise is associated with a slew of benefits, such as 40-50% reduction in all-cause mortality (Morris et al. 1953). Despite the benefits, only half of the university students surveyed in this study met the U.S. Health and Human Services suggested exercise requirement of 3-5 hours per week, with 5% reporting no exercise at all. Physical inactivity not only has costs to the individual student, but also to society, which are estimated at $117 billion per year in the United States alone (Carlson et al. 2015). This study investigates how students frame the tradeoffs between exercise and academics and the implications for behavioral nudges. Understanding how students frame their time consumption can enlighten nudges that promote physical activity.

This study uses data from a survey sent via email to the ~9,000 student members of the University of Montana Recreation Center which generated ~440 observations analyzed using ordinary least squares and ordered logit. Preliminary results align with national data and indicate a majority of students at the University of Montana do not engage in sufficient exercise. Students are least likely to give up studying time in order to exercise, but answered that they could be motivated to exercise if they received a payment or fine, academic credit, or if they went with a friend. These responses suggest novel behavioral interventions, or nudges, that could induce students to exercise more often and could be replicated in society at large.

Motivation

Recently, a movement towards wellness has taken the United States by storm. Various media outlets have dedicated coverage to the importance of physical activity and former First Lady Michelle Obama made it a priority (Freakonomics, Becoming, NYT). But despite all this attention, people don't exercise enough. All physically capable individuals should be getting at least three hours per week of moderate physical activity, ideally five hours per CDC guidelines—but they don't (Carlson et al). This paper investigates a specific population, university students, to understand if the problem of inactivity exists among this group and if so what it is that gets in the way of physical exercise. Understanding the habits and time prioritization among this group informs nuanced, effective potential policy responses that go above and beyond mere education programs to encourage sufficient exercise.

Literature Review

A growing body of research has accumulated a heap of benefits individuals stand to gain from physical exercise of all forms. The most obvious and immediate benefits from exercise are the physical benefits. Exercise has been shown to improve cardiovascular health for individuals that engage in activity, regardless of intensity or duration (Maessen et al. 2016). The improvements in cardiovascular health from exercise are subsequently linked to a longer life expectancy and a reduction in all-cause mortality—all-causes includes death from cancers, bacterial diseases, heart disease, and so on (Reimers et al. 2012; Shephard 2010). These benefits to physical health from exercise are found to induce superior health even for individuals with significant risk factors in their health history (Penedo and Dahn 2005). The benefits from exercise to individuals not only include physical health but are found to extend to mental wellbeing as well.

Physical exercise is associated with improvements in numerous mental wellbeing indicators. Physical activity is linked to lower likelihood of depression, boosts in mood, greater self-esteem, and a more positive outlook (Sleiman et al. 2016; Penedo and Dahn 2005). Physical exercise is also linked to psychological wellbeing and life satisfaction, suggesting an association between exercise and life satisfaction (Zayed et al. 2018). Not only does exercise make individuals feel better about themselves, but it has shown to improve cognitive capabilities for individuals also (Hogervorst et al. 1996). The link between physical exercise and mental performance is a new and developing realm of research.

The benefits of exercise have been demonstrated for students in academic settings as well. Multiple studies of student populations have indicated that those that exercise more frequently have higher GPAs (Keating et al 2013, Carnagio 2016). The connection between exercise and student wellness and success is a relationship that has more potential for study to understand the full interplay. Studies have also shown that engaging in moderate aerobic exercise while studying can improve retention and understanding of subjects such as foreign languages (Schmidt-Kassow 2013). The benefits of exercise to mental wellbeing and performance arise from actual changes to the body induced by exercise.

The theory behind the link between physical exercise and academic performance is that physical exercise causes physiological changes and responses in the body that differentiate how an active individual's body works in comparison to a sedentary individual. These changes improve mental wellbeing and intellectual capability. Researchers have investigated why exercise improves health outcomes across multiple metrics and found that exercise causes physiological changes that improve the body's ability to demand energy, direct blood flow, change hormone responses, and improve metabolic rates (Carlson et al. 2015). Other studies have found that physical exercise boosts the brains performance by enabling increased blood supply and improving the brains ability to demand energy, meaning exercise is good for the brain, not just quads.

So, given all the benefits of activity it would seem a given that individuals would engage in regular exercise, but this is not the case. In general, Americans are insufficiently active, 20% of the population is not active at all, which comes at a real economic cost (Carlson et al. 2015). Americans spend an estimated $117 billion per year in direct healthcare costs from inactivity (Carlson et al. 2015). The indirect costs from lost productivity are known to be significant as well, but more difficult to extrapolate, usually estimated at a proportion of

one-third of the direct costs (Ding et al 2016). Targeting the costs and foregone benefits of sedentary lifestyles through behavioral interventions has become the subject of a new revolution informed by behavioral economics and psychology for the benefit of individuals and society.

New organizations across the globe have been investigating the ways governments and institutions can induce individuals to make better decisions for themselves to reduce the cost to both individuals and society from poor decision making. The United Kingdom initiated an organization called the Behavior Insights Team with the express purpose of generating behavioral insights to inform policy and enlighten decision-making aimed at influencing individual behavior (Matjasko et al. 2016). The United States has similar groups, such as the Behavior Change for Good Initiative run through the University of Pennsylvania. These organizations are aimed at understanding individual behavior to formulate effective interventions known as nudges, popularized by Cass Sunstein and Richard Thaler (Sunstein and Thaler 2009). This research project is informed by the work of these such "nudge" units. The goal of these interventions is to induce individuals to behave in their self-interest.

There are numerous factors at play when individuals act against their best interest. As Nobel Laureate Richard Thaler put it, "It's not that we think people are dumb, it's that we think the world is really hard" (Dubner 2018). Individuals have a barrage of decisions to make for themselves every day that they may not even recognize as having implications for their long-term interests. Further, some individuals may know what their best interest is, but find it hard to make the decision that will benefit them (Pignatiello 2018). The origins of this line of thought come from Kurt Lewin and his concept of "restraining" and "driving" forces (Lewin 1943). Lewin's idea is that behavior is an equilibrium between restraining and driving forces; it's not that individuals don't want to act in their best interest, but there are certain external forces inducing them to act as they are presently.

Behavioral economists try to harness these psychological insights and make the world easier for individuals by changing the external forces acting upon them. Said another way, behavioral economists use a laissez-faire paternalism to help individuals make better choices for themselves. Interventions have been used to encourage exercise to understand what nudges make exercise programs stick (Milkman et al. 2013). This paper applies knowledge behavioral economics and physical exercise studies to investigate a specific populations physical exercise habits and the external forces surrounding their decision to exercise.

From this previous research, three potential links between student academic performance and physical exercise rates emerge. One theoretical link is that academics and exercise are complements and that engaging in sufficient exercise leads to physiological and mental changes that boosts student performance leading to higher GPAs. Another theoretical link is that academics and exercise are substitutes for the other and that time allocated to one activity comes at the expense of the other. Following this link, more time spent exercising would lead to decreased GPAs as students substitute away from studying. A final theory is that academics and exercise are linked but not causal and that what is more important is the individual characteristics of the student. It may be that the type of student that will exercise enough is also the type of student that is motivated to do well academically so that sufficient exercise and high GPA is linked but not because of any physiological explanation.

Method and Data

To investigate the link between physical exercise and GPA and understand student's time preferences, a survey was sent to the student membership of the University of Montana Campus Recreation Center which is 9,000 students, generating 449 responses—a 4.9% response rate—of which 440 were usable. The survey asked a variety of questions centered on respondent demographics, actual time use, and time prioritization aimed at understanding how students frame time dedicated to exercise and to academics respectively.

Demographic information included age, gender, year in school, and whether the student was a varsity athlete or not. Year in school was asked as there are qualitative differences between freshman and seniors in regard to time allocation from the variation of constraints and institutional knowledge the respective grades hold. Respondents were asked to identify whether they are varsity athletes or not, as the time spent exercising by this subpopulation is likely to have significant upward pressure on the average hours of exercise.

GPA was used as a proxy for academic success and respondents were given ranges to stratify themselves into. The ranges are separated based on university standards of excellence and stratifications between GPAs. For analysis, the average of the range was taken to represent the response of the student for each range, which lost specificity but encouraged accurate and complete responses. Hours spent exercising per week was used as a measure of activity, students were asked to respond with a whole number nearest to their average time. Some respondents entered a range which was averaged for a single number.

Students were asked to rank various activities based on what they would be most to least likely to give up on order to exercise more often and to study more often. This was asked to inform potential nudge responses with an understanding of what students prioritize. The activities were: personal time, social time, sleep, job time, study time, and exercise time. Personal time is understood as time spent alone passively doing things such as browsing social media, reading for leisure, napping, getting dressed, etc. Social time is understood as passive time spent with friends and peers.

Finally, students were asked to respond to a variety of incentive programs that have been used in other studies designed to encourage exercise. They were given the options of: receiving payment, earning academic credit, going with a friend, if enrolled in a fitness program, if penalized for inactivity, or if it were a competition. These responses in addition with their time prioritization responses inform what an effective nudge program may look like.

The data was analyzed using ordinary least squares regression, ordered logit, and simple statistical analysis. Responses with missing information were dropped from analysis. One of the limitations of the study is that it is using survey response data. Respondents were asked to indicate their exact number of hours spent exercising and studying, which was likely inflated as most survey data is. Another limitation is that most respondents were contacted through the Campus Recreation Center email, which may have compelled more active individuals to respond as they would be more receptive to email from the center which would also skew hours of exercise up. Finally, the regression of

interest had weak a R^2, which means the independent variables identified were not strongly predictive of the dependent variable of interest: GPA.

Results

Several interesting results were generated by analysis. The average student was found to engage in just enough exercise, average 5.8 hours of moderate activity per week meeting the CDC guideline of 5 hours per week. However, there was significant variance among respondents. 12 students answered that they engage in more than 20 hours of exercise per week, 20 students responded that they engage in 0 hours of exercise per week. In total, 44% of respondents were insufficiently active which, when using Carlson et al's, estimates works out to $3.1 million in health care costs for UM students alone (Carlson et al. 2015). When regressed against GPA, an additional hour of exercise was negatively associated but not found to be statistically significant.

The average GPA was in the 3.5-3.7 range. Students averaged 14.7 hours of study per week, once again with significant variance. The impact of an additional hour of studying on GPA was found to be statistically significant at the .1% level, but was not meaningfully significant as it was only a .009 point increase in GPA. The impact of an additional hour of exercise on GPA was statistically insignificant and in some estimations was negatively associated with GPA. These results indicate that time spent studying is more important than time spent exercising which is logical as exercise is assumed to have a diluted effect on GPA whereas study time is assumed to have a direct effect on GPA.

Being female was associated with a meaningful increase in GPA of .08 points versus being a male and was a statistically significant result. Being a varsity athlete or further along in school were negatively associated with GPA but neither was statistically significant. It is unclear why being a female would have such a strong effect on GPA; further research into this result would be illuminating. Being a student-athlete may decrease GPAs from the time constraints associated with being an athlete and older students are likely to have lower GPAs has their upper-divisionclasses are typically more challenging than introductory courses.

Student's time priority responses were informative. When asked what they would give up in order to exercise more, students responded were least likely to give up study and job time, most likely to give up personal time and social time. When asked the same question but in order to study more, students again responded that they would give up personal and social time but not job time. These responses indicate what activities can be bundled effectively in a nudge to help students exercise more by reducing conflict in time prioritization.

Students were given a variety of nudges to choose from that they believed would compel them to exercise more. The most popular responses were: to receive payment, to earn academic credit, or if they went with a friend. These responses are consistent with their time prioritization responses as students would be interested in bundling exercise with income or academics which reduces the time conflict between the activities, framing them as complements rather than substitutes.

When asked why students do not use the Campus Recreation Center if they do not, they frequently responded that they prefer exercising outdoors instead. This is an important reality to recognize and to overcome if trying to encourage sufficient exercise as the University of Montana has harsh winters and hazardous fire seasons that create challenges for or even prohibit adequate exercise outdoors. Other reasons that students gave for not using the center is that they feel uncomfortable or do not know what they are doing, which indicates that the center could help encourage students with orientation sessions or better signage for novice gym users. The number one reason students gave for not exercising was that they feel too busy. This response again illuminates the need to set up activities as complements rather than substitutes for students so that exercise does not come at the cost of other priorities like studying and working.

	e(mean)	e(Var)	e(sd)	e(min)	e(max)
HoursofExe~e	5.887387	20.4049	4.517178	0	28
HoursofStudy	14.71492	100.7779	10.03882	0	56
GPA_n	3.548786	.1326571	.3642212	2	3.95
YearinSchool	3.432127	3.366131	1.834702	1	6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
female	3.583786	.1273258	.3568274	2	3.95
VarsityGPA~e	3.548786	.0002905	.0170426	3.49359	3.554037

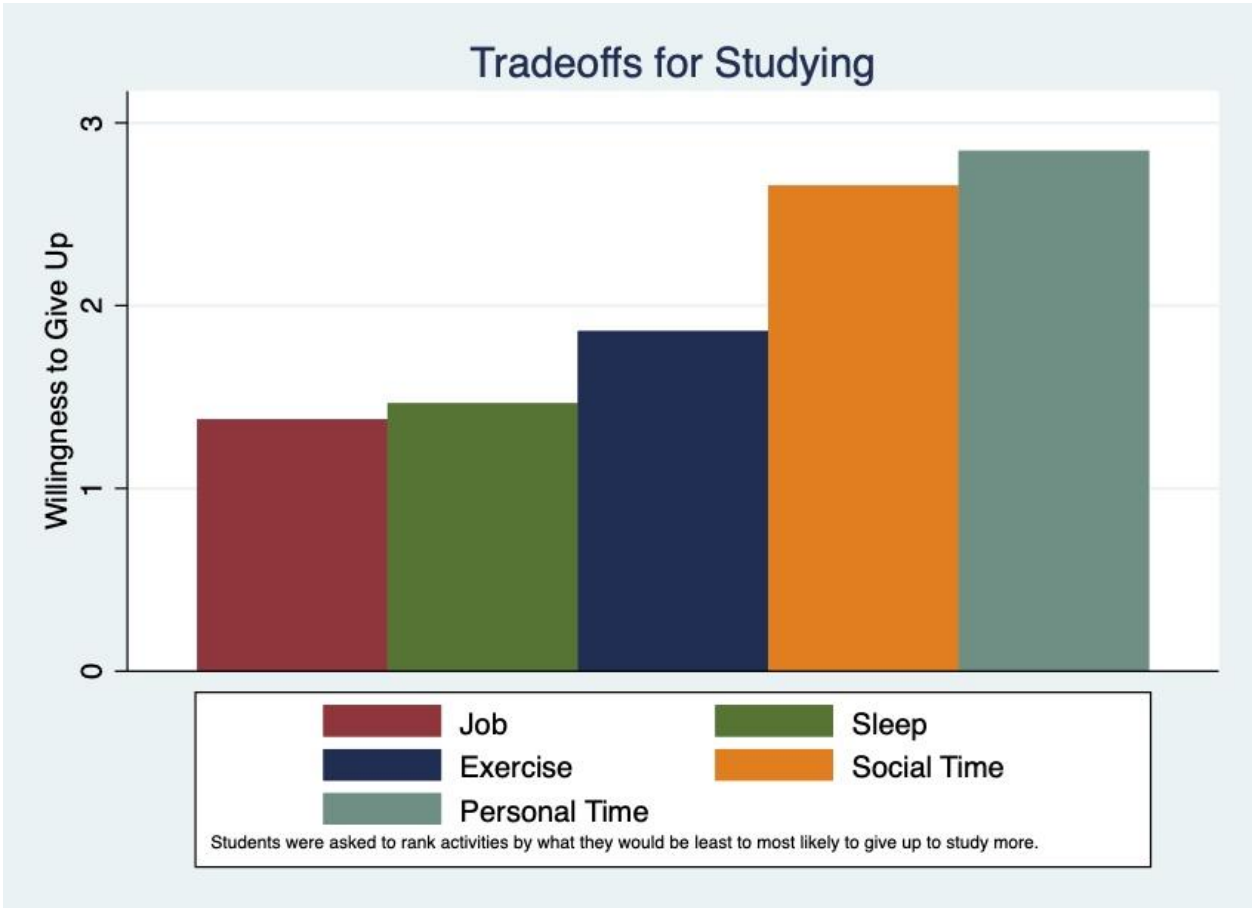
Summary statistics of variables of interest. The average hours of exercise were 5.8 hours per week, with significant variance.

GPA Interactions

Variable	est1
HoursofExercise	.00166773
HoursofStudy	.00931382***
female	.08782632*
YearinSchool	-.00212482
VarsityAthlete	-.05691529
_cons	3.3586172***

legend: * p<0.05; ** p<0.01; *** p<0.001


Tradeoffs for Exercise
Willingness to Give Up
0
1
2
3
Study
Job
Sleep
Social Time
Personal Time
Students were asked to rank activies by what they would least to most likely give up to exercise more.


Tradeoffs for Studying
Willingness to Give Up
0
1
2
3
Job
Sleep
Exercise
Social Time
Personal Time
Students were asked to rank activities by what they would be least to most likely to give up to study more.

Conclusion

This research reveals the time preferences of university students to generate insights that can leverage time allocation. The average student at the University of Montana exercises enough, but there are multiple impediments to students that compete with their decision to exercise. To alleviate time stress, a few novel ways of exercising could be introduced informed by the time priorities of students. The first proposal is to bundle exercising and studying through investment in equipment that makes it easier to exercise and study, such as stationary bikes that are easy to read on or recorded lectures or recorded textbooks that can be listened to while being physically active. These investments could alleviate time pressure.

Another possibility is to pair academics with exercise through a general education requirement for activity, in line with the Greek tradition of education in which academics and gymnastics are equally important. An incentive program to bundle working and exercising could take the shape in some sort of payment program so that students do not feel they are losing income as they are physically active. In response to students' indication that going with a friend would encourage them to exercise, a program to pair students that commit to exercising together is another potential effective response. Future research would benefit from the introduction of one of these nudges in a field experiment and testing its efficacy.

The findings above contradict previous research as exercise was not found to be significantly or meaningfully associated with GPA as previous research has indicated. Further studies are necessary to investigate the existence or nonexistence of a link between exercise and academics. Regardless of the relationship, however, exercise is an important component of wellness for universities to address.

This study is important because it establishes a baseline for a specific population—university students—at a unique juncture in their lives. The decisions individuals in this group make now have intangible present benefits but real future effects. Some students said they would begin exercising if they became unhealthy which is counter to the point, exercise is meant to be preventative not curative. Student wellness and success is the essential mission of a university, encouraging good behaviors is a part of that mission which includes encouraging physical activity. Continued research into student wellness to produce evidence-based methods for supporting individual decision making is necessary for advising best practices among universities.

References

Carlson, Susan A., Janet E. Fulton, Michael Pratt, Zhou Yang, and E. Kathleen Adams. "Inadequate Physical Activity and Health Care Expenditures in the United States." Progress in Cardiovascular Diseases 57, no. 4 (2015): 315–23. https://doi.org/10.1016/j.pcad.2014.08.002.

Carnagio, Joseph, Nicholas Storm, Ryan Hunt, and Chris Haile. "IDEALS." IDEALS, December 2016. https://www.ideals.illinois.edu/handle/2142/97937.

Ding, Ding, Kenny D Lawson, Tracy L Kolbe-Alexander, Eric A Finkelstein, Peter T Katzmarzyk, Willem Van Mechelen, and Michael Pratt. "The Economic Burden of Physical Inactivity: a Global Analysis of Major Non-Communicable Diseases." *The Lancet* 388, no. 10051 (September 24, 2016): 1311–24. https://doi.org/10.1016/s0140-6736(16)30383-x.

Dubner, Stephen J. "Freakonomics Radio." Freakonomics Radio (podcast). Dubner Productions, June 26, 2019. http://freakonomics.com/podcast/exercise/.

Dubner, Stephen J. "Freakonomics Radio." *Freakonomics Radio* (podcast). WNYC, July 11, 2018. https://freakonomics.com/podcast/richard-thaler/.

Editorial Board. "Exercise and Academic Performance." *New York Times*, 24 May 2013, https://www.nytimes.com/2013/05/25/opinion/exercise-and-academic-performance.html.

Hogervorst, Eef, Wim Riedel, Asker Jeukendrup, and Jelle Jolles. "Cognitive Performance after Strenuous Physical Exercise." *Perceptual and Motor Skills* 83, no. 2 (October 1996): 479–88. doi:10.2466/pms.1996.83.2.479.

Keating, Xiaofen Deng, Darla Castelli, and Suzan F. Ayers. "Association of Weekly Strength Exercise Frequency and Academic Performance Among Students at a Large University in the United States." Journal of Strength and Conditioning Research 27, no. 7 (2013): 1988–93. https://doi.org/10.1519/jsc.0b013e318276bb4c.

Lewin K. (1943). Defining the "Field at a Given Time." *Psychological Review.* 50: 292-310. Republished in *Resolving Social Conflicts & Field Theory in Social Science,*Washington, D.C.: American Psychological Association, 1997.

Maessen, Martijn F.h., et al. "Lifelong Exercise Patterns and Cardiovascular Health." *Mayo Clinic Proceedings*, vol. 91, no. 6, 29 Apr. 2016, pp. 745–754., doi:10.1016/j.mayocp.2016.02.028.

Matjasko, J. L., Cawley, J. H., Baker-Goering, M. M., & Yokum, D. V. (2016). Applying Behavioral Economics to Public Health Policy: Illustrative Examples and Promising Directions. *American journal of preventive medicine*, *50*(5 Suppl 1), S13–S19. https://doi.org/10.1016/j.amepre.2016.02.007

Milkman, Katherine L., Julia A. Minson, and Kevin G. M. Volpp. 2014. "Holding the Hunger Games Hostage at the Gym: An Evaluation of Temptation Bundling." Management Science 60 (2) (02): 283-299. https://search-proquest-com.weblib.lib.umt.edu:2443/docview/1520330710?accountid=14593.

Parker-Pope, Tara. "Vigorous Exercise Linked With Better Grades." The New York Times, June 3, 2010. https://well.blogs.nytimes.com/2010/06/03/vigorous-exercise-linked-with-better-grades/.

Pignatiello, Grant A, Richard J Martin, and Ronald L Hickman. "Decision Fatigue: A Conceptual Analysis." *Journal of Health Psychology* 25, no. 1 (January 2020): 123–35. doi:10.1177/1359105318763510.

Reimers, C. D., et al. "Does Physical Activity Increase Life Expectancy? A Review of the Literature." *Journal of Aging Research*, vol. 2012, 1 July 2012, pp. 1–9., doi:10.1155/2012/243958.

Reynolds, Gretchen. "How Exercise Fuels the Brain." The New York Times, February 22, 2012. https://well.blogs.nytimes.com/2012/02/22/how-exercise-fuels-the-brain/.

Schmidt-Kassow M, Deusser M, Thiel C, Otterbein S, Montag C, Reuter M, et al. (2013) Physical Exercise during Encoding Improves Vocabulary Learning in Young Female Adults: A Neuroendocrinological Study. PLoS ONE 8(5): e64172. https://doi.org/10.1371/journal.pone.0064172

Shephard, R.j. "Physical Activity and All-Cause Mortality: An Updated Meta-Analysis with Different Intensity Categories." *Yearbook of Sports Medicine*, vol. 2010, 6 Feb. 2010, pp. 232–234., doi:10.1016/s0162-0908(09)79579-0.

Sleiman, Sama F, et al. "Exercise Promotes the Expression of Brain Derived Neurotrophic Factor (BDNF) through the Action of the Ketone Body β-Hydroxybutyrate." *ELife*, vol. 5, Feb. 2016, doi:10.7554/elife.15092.

Sunstein, Cass, and Richard Thaler. Nudge: Improving Decisions about Health, Wealth, and Happiness: Rev. and Exp. Ed. New York: Penguin, 2009.

Wood, Wendy, and David T. Neal. "Healthy through Habit: Interventions for Initiating & Maintaining Health Behavior Change." Behavioral Science & Policy 2, no. 1 (2016): 71–83. https://doi.org/10.1353/bsp.2016.0008.

Zayed, Kashef N., et al. "The Mediating Role of Exercise Behaviour on Satisfaction with Life, Mental Well-Being and BMI among University Employees." *Cogent Psychology*, vol. 5, no. 1, 2018, doi:10.1080/23311908.2018.1430716.