Published in final edited form as:

Curr Obes Rep. 2016 March ; 5(1): 132–139. doi:10.1007/s13679-015-0185-4.

Socioeconomic Status, Risk of Obesity, and the Importance of Albert J. Stunkard

Gregory Pavela, PhD,

227K, Ryals Public Health Building, Room 227K, University of Alabama at Birmingham, 1665
University Boulevard, Birmingham, Alabama 35294, pavela@uab.edu, Phone: (205)-934-9325

Dwight W. Lewis, PhD,

The University of Alabama School of Medicine (Tuscaloosa Regional Campus), 850 5th Ave East;
Tuscaloosa, AL 35401, lewis060@cchs.ua.edu

Julie Locher, PhD [Professor], and

Departments of Medicine (Division of Gerontology, Geriatrics, and Palliative Care; Section of
Social and Behavioral Sciences) and Health Care Organization and Policy, 1530 3rd Avenue
South; CH19-Room 218F; Birmingham, Alabama 35294-2041, Phone: 205.934.7542, Fax:
205.975.5870, JLocher@uab.edu

David B. Allison, PhD [Distinguished Professor]

Nutrition Obesity Research Center, Ryals Public Health Building, Room 140J, University of
Alabama at Birmingham, 1665 University Boulevard, Birmingham, Alabama 35294

Abstract

Albert J. Stunkard's influential career in obesity research spanned over fifty years and included several landmark studies on social factors related to obesity. This review discusses the important contributions Stunkard made to research on the relationship between socioeconomic status SES and obesity, extensions of his work, and reflects on Stunkard's role in the mentoring of succeeding generations of scientists.

Keywords

Socioeconomic Status; Obesity; Stunkard

Introduction

The work of Albert (Mickey) J. Stunkard (1922-2014) continues to exert tremendous influence on obesity research across multiple scientific disciplines. Stunkard contributed, and often led the way, in research on the psychology, biology, and sociology of obesity. His

(CORRESPONDING AUTHOR), Phone: [205-975-9169](tel:205-975-9169), Fax: [205-975-7536](tel:205-975-7536), Dallison@UAB.edu.

Compliance with Ethics Guidelines

Dwight W. Lewis declares that they have no conflict of interest

Human and Animal Rights and Informed Consent

This article does not contain any studies with human or animal subjects performed by any of the authors.

contributions include an early systematic review of the efficacy of obesity treatment from whence the common claim ‘less than 5% succeed’ derives (1, 2), the first description of binge eating disorder (3, 4) and development of its treatment (5, 6), development of the widely used Three Factor Eating Inventory (7), the early use of twin and adoption studies to shed light on the relative contributions of nature and nurture to the development of obesity (8), and perhaps the first demonstration of the now well-known but still vigorously researched association between socioeconomic status (SES) and obesity (9).

In the US, research on health disparities has often focused on differences between races and ethnicities, unlike European research on health disparities, which has a longer tradition of collecting and reporting on differences in health by social class (10). Stunkard played a key role in promoting the scientific study of SES and its effects on health in the US by demonstrating that the relationship between SES and obesity is not simply due to individual traits (11). Although Stunkard's contributions are numerous, this review focuses on one aspect of his research legacy—the relationship between SES and obesity—his early research and use of innovative methods to disentangle the social from the biological. We conclude with a set of personal reflections by David Allison on the influence of Stunkard and why contemporary researchers will continue to benefit from Stunkard's “beginner's mind” in the complex world of obesity science.

The Pain of Obesity

Goldblatt, Moore, and Stunkard published the seminal article “Social Factors in Obesity” (9) fifty years ago (2015) and the prevalence of overweight and obesity has dramatically increased in the US since its publication. In 1960-1962, the age adjusted prevalence of obesity and extreme obesity (body mass index; BMI (KG/M²) ≥ 40) among adults was 13.4% and 0.9%, respectively (12). By 2011-2012, the prevalence of obesity and extreme obesity was 35% and 6.6%, respectively—a 163% increase in the prevalence of obesity and 633% increase in extreme obesity. The increase in prevalence has been equally steep among children and adolescents. In 1971-1974, an estimated 6% of adolescents in the US (ages 12-19) were classified as obese, defined as the percentage of children with a BMI at or above their age and sex specific 95th percentile from the 2000 CDC growth charts (13). By 2007-2008, the number of adolescents who were obese was 18%—an increase of 200%. Increasing obesity prevalence is a global concern as well, increasing worldwide by 27.5% for adults and 47.1% for children (14).

The global increase in obesity prevalence is a public health challenge due to the associated health and mortality risks (15-18), increased health care costs (19), and greater number of persons likely to experience weight-related discrimination (20-22). Indeed, Stunkard contributed to research on the stigmatization of obesity throughout his career, helping replicate a 1961 study of child preferences showing that renditions of obese youth were consistently least liked among drawings of children with various disabilities (23). While bias against other types of disablement remained steady or declined relative to the 1961 study, bias against obese children increased (24).

Recognizing that “prejudice and discrimination plague the lives of the obese” (25):1141, Stunkard sought to understand the origins of weight discrimination by looking to history and

other societies, and assisted in the development of new methods to measure weight stigma (26). Though Stunkard's research on the stigmatization of obesity is not a focus of this review, his career-long interest in disentangling the effects of nature and nurture on the development of obesity helped combat obesity stigmatization by challenging the assumption that obesity should be understood solely as a result of individual choice.

Before reviewing Stunkard's use of twin and adoption studies to demonstrate the effects of both 'nature' and 'nurture' on weight, we discuss the contemporary research on the relationship between SES and obesity, sex and racial-ethnic differences in the observed association, and contemporary issues in the measurement of SES—topics that continue to be both informed by, and extend, Stunkard's research.

SES and Obesity

Twenty-five years after Sobal and Stunkard's original review (27), the association between obesity and SES remains an active area of research. Many findings from current research supports Sobal and Stunkard's early review of 144 studies: income and education are inversely associated with obesity risk among adult women in economically developed countries, but inconsistently associated with obesity among men (Figs. 2 and 3). McLaren (28) updated Sobal and Stunkard's review, locating an additional 333 studies between 1988 and 2004 on the topic of SES and obesity. Cohen & Rai et al. (29), in a focused systematic review of the association between obesity and a single indicator of SES—education—also found the direction of the association to vary between countries by economic development and within countries by gender, with a negative association more likely to be observed among women in economically developed countries.

Stunkard was among the first to identify that the association between SES and obesity was more consistent among females than males; in fact, among men in developed countries, Stunkard observed that the relationship between SES and obesity was as likely to be negative as it was positive (27). Stunkard's own research (9,30) also suggested strong and consistent inverse relationships between SES and obesity among women but inconsistent relationships for men and children. Among children, 35% of the originally reviewed studies found no association between SES and obesity among girls, and 41% of reviewed studies found no association among boys. McLaren (2007) and Cohen (2013), in their consideration of the cultural and economic context in which SES may influence weight outcomes, directly trace their research back to Stunkard.

Although Stunkard identified nuances in the relationship between SES and obesity by economic development of a country, sex and age, noted limitations of Stunkard's early observational work include 1) a reliance on cross-sectional data; 2) reliance upon weight or body mass index rather than more direct measures of adiposity; 3) a limited operationalization of SES; and 4) racial-ethnic differences in the association are little discussed.

Indeed, contemporary research has extended Stunkard's early research by examining the SES-obesity relationship between racial and ethnic groups. Some evidence suggests that among adult non-Hispanic black and Mexican-American men, income is *positively*

associated with obesity (30). Important racial-ethnic differences in the SES-obesity association also exist among children. Among all boys aged 2-19 years in the US, prevalence of obesity among families with incomes at or above 350% is 11.9%, compared to a prevalence of 21.1% among boys who live in households at or below 130% of the poverty line. This average, however, obscures racial and ethnic differences: a significant trend of decreasing obesity with increasing income is only observed in non-Hispanic whites, not Mexican-Americans or non-Hispanic blacks (31). Among all girls aged 2-19 years in the US, the pattern is similar: an overall trend of decreasing obesity prevalence with increasing income, but with importance racial-ethnic differences: the trend is significant among non-Hispanic whites (12.0% obesity prevalence in households at or below 130% of the poverty line vs. 19.3% obesity prevalence in households with incomes at or above 350% of the poverty line) but insignificant among Mexican-Americans and non-Hispanic blacks (31). A focus on the average association between income, education, and obesity prevalence belies another important fact of contemporary obesity prevalence in the US: most obese children are not poor—62% of children and adolescents who are obese live in households at or above 130% of the poverty line (31).

Increases in the prevalence of obesity since 1960 have been similar across educational, income, and racial ethnic groups, leading Ljungvall and Zimmerman (32):109 to conclude that “the increase in body-mass index and obesity in the United States is a true epidemic, whose signal hallmark is to have affected an entire society.” Hence, though income and education remain the most common measurements of SES in US research, trends in prevalence suggest that the relationship between SES and obesity risk extend far beyond standard indicators of SES, encouraging researchers to explore other indicators of social status.

Subjective Social Status and Social Mobility

Contemporary research on SES and obesity suggests that traditional indicators of SES (e.g., income, wealth, education, etc.) are not the only SES measures associated with obesity risk. In particular, *subjective* social status (SSS) is predictive of a range of health outcomes, including obesity. SSS is defined by Davis (33):154 “as a person's belief about his location in a status order”, a belief that “may or may not be congruent with his objective status, the status accorded to him by others.” SSS is often more consistently and strongly associated with health outcomes relative to objective indicators of SES such as income, including sleep latency, heart-rate, and body fat distribution (34, 35). SSS is itself predicted by objective indicators of SES, including employment grade, education, and household income, suggesting that SSS may be a mediator between objective social conditions and health outcomes (36). Recent evidence suggests that SSS is also influenced by physiological strength, functioning, and illness (37). Adler, Epel (38) found evidence that subjective social status was inversely related to the waist-to-hip ratio among adult white women, and among adolescents, subjective social status (within one's school) may be more strongly associated with being overweight than household income and parental education (39).

While the causal direction of these associations is uncertain, there are theoretical reasons to suspect that SSS has a causal effect on weight. SSS may be an indicator of financial

insecurity and desire for money, which is associated with increased consumption of palatable, energy dense foods (40). Overtime, individuals with low SSS may thus engage in diet-related behaviors that, over the long-term, result in positive energy balance and weight gain.

In addition to the development of new measures of social status, recent research has extended the work of Stunkard via an examination of social mobility and the *perception* of social mobility on weight-related outcomes (41-43). In the Midtown Manhattan study, Goldblatt, Moore (9) observed that women who experienced downward social mobility had a higher prevalence of obesity (22%) compared to those who experienced upward social mobility (12%). In an English birth cohort, both men and women who experienced upward social mobility relative to their father's social class had a lower prevalence of obesity compared to those who remained in their father's social class (44). Perception of social mobility may also influence future weight: among Mexican adolescents, anticipated social mobility was inversely associated with self-reported consumption of alcohol, self-reported junk food consumption and soda-consumption; perceived social mobility was positively associated with self-reported exercise. The creative operationalization of perceived social mobility by Rittlerman Weintraub, Fernald (42) provides an innovative approach for future research on the relationship between social mobility and obesity.

An interesting set of observations connects the adiposity and social status relationship (both objective and perceived) to evolutionary thinking. First, humans are not the only animals among whom this relationship holds. It has also been observed among several different non-human primate (45), bird (46), and rodent (47) species. In some cases, the reason seems obvious. For example, in times of food scarcity more dominant birds may raid the caches of lower ranking birds and, therefore, when food appears scarce lower ranking birds increase their body fat reserves more than do higher ranking birds (46). When faced with environmental and social feedback which leads one to perceive that one's access to resources is insecure and that others are more powerful and may impede our access to future resources, it may be wise to store as much body energy for the future as possible; indeed, some have hypothesized that obesity is an adaptive response to food insufficiency (48). Notably, economic insecurity is associated with obesity (49), short-term vicarious social defeat has in controlled experiments been shown to lead to increased food intake (50), and persons who state that they experience 'food insecurity' ironically tend to be fatter than do those not reporting food insecurity (51), observations in line with the hypothesis that energy storage increases in response to the perception that resources are insecure or scarce. Notably, this line of thinking places the *perception* of one's social rank (as opposed to just one's material purchasing power) in a key hypothesized role in the causal connection between SES and adiposity.

Improving Causal Inferences about the effects of SES

Despite advances in our understanding of sex and racial/ethnic differences in the SES-obesity relationship, and the possible influence of subjective social status and social mobility on obesity, the complex relationship between SES and obesity risk (11), continues to require research designs that can generate strong causal inferences about the relationship between

SES and obesity. In a perfect world, one could randomly assign individuals to varying levels of SES status and measure differences in weight outcomes by treatment assignment group. To date, true random assignment of individuals to levels of SES has not been conducted. In one of the few examples of randomization to SES, albeit randomization to *neighborhood* SES, the Department of Housing and Urban Development's *Moving to Opportunity Study* provided evidence that moving from a high poverty neighborhood to a low poverty neighborhood caused lower odds of extreme obesity and having diabetes (52).

Unfortunately, experiments such as the *Moving to Opportunity Study* (52) are rare, and in many cases randomization is not practical or ethical, thus researchers must turn to other methods to reduce confounding beyond that of simple association designs. To advance the field beyond Stunkard's initial contributions, we must improve causal inference; yet, how do we overcome the challenges of random assignment and blinded treatment? Since Stunkard's original Midtown Manhattan study, several non-experimental methods have been used to test for causal effects of SES on weight, including the utilization of changes in mandatory school laws, (53-55), sibling fixed effect designs (56), and timing of school entry (57). Additional non-standard RCT designs such as packet randomization (58), instrumental variable analysis (59), and propensity score analysis (60) have also been developed and applied since Stunkard's original pure observational studies (9).

Stunkard was well aware of the limitations of standard observational studies, and sought new methods to test for causal effects of environmental exposure on adult weight outcomes, and to compare the relative effects of environmental exposures to innate and genetic effects on weight. In one such study, conducted with one of the authors of this manuscript (61), Stunkard and Allison analyzed two separate large adoption studies, one from Denmark and the other of Korean children adopted into American households, as forms of quasi-packet-randomized experiments (58). The aim of the study was to test the putative causal effects of the SES of one's rearing environment on obesity, with the key operating assumption that available adoptees are assigned to available homes in an 'as if random' fashion (62). Following this assumption, if aspects of the assigned rearing environment are correlated with post-assignment outcomes, one can with reasonable confidence conclude that either that factor, or some aspect of the rearing environment associated with that factor (but not factors related to the offspring prior to the assignment) has a *causal* influence on the outcome. Results indicated that, despite the adoption datasets differing in many ways, shared genetic factors and direct environmental causation contribute about equally to the association between the SES of the rearing environment and offspring BMI.

Results from these and similar studies provide insight into one of the oldest philosophical debates within the social and psychological sciences--the nature versus nurture debate (a phrase coined by Francis Galton, the father of quantitative genetics); and Stunkard was among the first to address the matter with respect to body weight. At a time when conventional wisdom held that obesity was caused by individual's failure of willpower, Stunkard published two ground-breaking papers in the *New England Journal of Medicine* that offered a relatively novel perspective. The first paper, published in 1986, found that Danish adoptees' weight as adults was similar to that of their biological parents, but not at

all to their adoptive parents (8). The second study, published in 1990, found that Swedish identical twins, whether they were raised together or apart, had nearly identical BMIs (63).

Both papers lent considerable support to the argument that ‘nature’ exerted a greater influence on obesity than ‘nurture’. Stunkard's willingness to explore both environmental and non-environmental influences blazoned a path to subsequent and ongoing research. Stunkard conducted his research at a time when the tradition was to simply juxtapose the effects of nature and nurture, with researchers often estimating by how much nature and nurture contributed to a given outcome at some point in time. For example, drawing from results of twin studies, Stunkard estimated that 60-80% of weight could be attributed to genetics (64). Current obesity research and theorizing now considers the extent to which nature and nurture *interact* rather than *compete* with one another in contributing to obesity and how they do so over time, both in terms of individual-level and societal-level development (65).

A Beginner's Mind and Personal Reflections

Dr. Stunkard had several signature characteristics that pervaded his social interactions and defined him as a special person and outstanding scholar. One characteristic was his insatiable thirst for new ideas, new methods, and new data. He was always asking questions, much like an intelligent, but naïve child – child-like, but not childish. Second, he had an infectious enthusiasm, becoming visibly ‘pumped up’ as a scientific discussion took off. Third, he had a sincere humility and was comfortable playing the role of the wide-eyed ‘inquisitive student’ even if the ‘teacher’ he was inquiring of was more than a half-century his junior. This thrill at learning new things, his ease of admitting a new idea to his thinking without encumbrance of past thinking, the willingness to “play one down” to and learn from anyone were among his greatest strengths as a scientist and typify the ‘Beginner's Mind’ he learned from his Zen master, Suzuki (66).

Professor Stunkard was also a great inspirer of others. One of us (DBA) first met Dr. Stunkard circa 1989 when I was a graduate student and Dr. Stunkard was already a renowned senior professor at the pinnacle of our field. Yet he sat with me one-on-one for an hour at a conference, entralling me with his stories and insights, encouraging me to share my ideas, and responding with enthusiasm. After our first meeting we would meet at conferences year after year and he would always ask me about my work, ask my opinion about his own work, propose collaborations, and encourage me and express enthusiasm for my projects. I can still vividly recall when, in one of our meetings at a conference while I was an early post-doctoral fellow, I told him about some good results I had obtained using his Three Factor Eating Questionnaire (67). He grinned from ear to ear, pumped his fist triumphantly in the air, and shouted “Keep Going!” Throughout my career, I can think of no single moment which more inspired me than to have the great Mickey Stunkard cheer me on. Through his enthusiasm for learning and mentoring of me and many others, he answered the following question, posed by Drew Faust, current Harvard president:

How do we—we who have devoted our lives to scholarship and teaching—how do we affirm and transmit the value—and the excitement—of learning for its own sake to our students in a world that increasingly urges them to think of their education in

instrumental terms, urges them to focus on narrowly defined achievements and material outcomes?(68)

Mickey's generosity with young scholars is legendary and I was but one of many beneficiaries. He was not only a great scientist, but he was a great man. And he is dearly missed.

Acknowledgements

Research reported in this publication was supported by the National Institute of Diabetes and Digestive and Kidney Diseases of the National Institutes of Health under Award Numbers T32DK062710 and P30DK056336. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Diabetes and Digestive and Kidney Diseases or the National Institutes of Health.

REFERENCES

1. Stunkard A, McLaren-Hume M. The results of treatment for obesity: A review of the literature and report of a series. *AMA Archives of Internal Medicine*. 1959; 103(1):79–85. [PubMed: 13605305]
2. Fritsch, J. Or Do They?. May. Vol. 25. *New York Times*; 1999. 95% Regain Lost Weight.; p. 1999
3. Stunkard AJ. Eating patterns and obesity. *Psych Quar*. 1959; 33(2):284–95.
4. Stunkard AJ, Berkowitz R, Wadden T, Tanrikut C, Reiss E, Young L. Binge eating disorder and the night-eating syndrome. *Int J Obes Relat Metab Disord*. 1996; 20(1):1–6. [PubMed: 8788315]
5. Blinder BJ, Freeman DMA, Stunkard AJ. Behavior Therapy of Anorexia Nervosa: Effectiveness of Activity as a Reinforcer of Weight Gain. *American Journal of Psychiatry*. 1970; 126(8):1093–8. [PubMed: 5411363]
6. Stunkard AJ, Berkowitz R, Tanrikut C, Reiss E, Young L. d-fenfluramine treatment of binge eating disorder. *Am J Psychiatry*. 1996; 153(11):1455–9. [PubMed: 8890680]
7. Stunkard AJ, Messick S. The three-factor eating questionnaire to measure dietary restraint, disinhibition and hunger. *Journal of psychosomatic research*. 1985; 29(1):71–83. [PubMed: 3981480]
8. Stunkard AJ, Sørensen TIA, Hanis C, Teasdale TW, Chakraborty R, Schull WJ, et al. An Adoption Study of Human Obesity. *New England Journal of Medicine*. 1986; 314(4):193–8. [PubMed: 3941707]
9. Goldblatt PB, Moore ME, Stunkard AJ. Social factors in obesity. *Journal of the American Medical Association*. 1965; 192(12):1039–44. [PubMed: 14293500]
10. Braveman PA, Cubbin C, Egerter S, Williams DR, Pamuk E. Socioeconomic Disparities in Health in the United States: What the Patterns Tell Us. *American Journal of Public Health*. 2010; 100(S1):S186–S96. [PubMed: 20147693]
11. Stunkard AJ, Sorensen TI. Obesity and socioeconomic status--a complex relation. *The New England journal of medicine*. 1993; 329(14):1036–7. [PubMed: 8366906]
12. Fryar, CD.; Carroll, MD.; Ogden, CL. [2015 August] Prevalence of Overweight, Obesity, and Extreme Obesity Among Adults: United States, 1960–1962 Through 2011–2012 2014. [updated September 19, 2014]. Available from: http://www.cdc.gov/nchs/data/hestat/obesity_adult_11_12/obesity_adult_11_12.htm
13. Ogden, CL.; Carroll, MD. [2014 August] Prevalence of Obesity Among Children and Adolescents: United States, Trends 1963–1965 Through 2007–2008. 2010. [updated June 4, 2010]. Available from: http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/obesity_child_07_08.htm
14. Ng M, Fleming T, Robinson M, Thomson B, Graetz N, Margono C, et al. Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *The Lancet*. 2014; 384(9945): 766–81.
15. Abdullah A, Peeters A, de Courten M, Stoelwinder J. The magnitude of association between overweight and obesity and the risk of diabetes: A meta-analysis of prospective cohort studies. *Diabetes Research and Clinical Practice*. 2010; 89(3):309–19. [PubMed: 20493574]

16. Profenno LA, Porsteinsson AP, Faraone SV. Meta-Analysis of Alzheimer's Disease Risk with Obesity, Diabetes, and Related Disorders. *Biological Psychiatry*. 2010; 67(6):505–12. [PubMed: 19358976]
17. Moghaddam AA, Woodward M, Huxley R. Obesity and Risk of Colorectal Cancer: A Meta-analysis of 31 Studies with 70,000 Events. *Cancer Epidemiology Biomarkers & Prevention*. 2007; 16(12):2533–47.
- 18•. Flegal KM, Kit BK, Orpana H, Graubard BI. Association of all-cause mortality with overweight and obesity using standard body mass index categories: A systematic review and meta-analysis. *JAMA*. 2013; 309(1):71–82. [PubMed: 23280227] [This manuscript reports results from a systematic review of the association between all-cause mortality and BMI categories. Obesity was associated with higher mortality relative to normal weight; however, overweight was not associated with higher mortality.]
19. Duchovny, N.; Baker, C. *How Does Obesity in Adults Affect Spending on Health Care?*. Office, CB., editor. Washington, D.C.: 2010.
20. Andreyeva T, Puhl RM, Brownell KD. Changes in Perceived Weight Discrimination Among Americans, 1995–1996 Through 2004–2006. *Obesity*. 2008; 16(5):1129–34. [PubMed: 18356847]
21. Carr D, Friedman MA. Is Obesity Stigmatizing? Body Weight, Perceived Discrimination, and Psychological Well-Being in the United States. *Journal of Health and Social Behavior*. 2005; 46(3):244–59. [PubMed: 16259147]
22. Puhl R, Brownell KD. Bias, discrimination, and obesity. *Obesity Research*. 2001; 9(12):788–805. [PubMed: 11743063]
23. Richardson SA, Goodman N, Hastorf AH, Dornbusch SM. Cultural Uniformity in Reaction to Physical Disabilities. *American Sociological Review*. 1961; 26(2):241–7.
24. Latner JD, Stunkard AJ. Getting worse: the stigmatization of obese children. *Obes Res*. 2003; 11(3):452–6. [PubMed: 12634444]
25. Stunkard AJ, LaFleur WR, Wadden TA. Stigmatization of obesity in medieval times: Asia and Europe. *International Journal of Obesity and Related Metabolic Disorders*. 1998; 22:1141–114. [PubMed: 9877248]
26. Latner JD, Simmonds M, Rosewall JK, Stunkard AJ. Assessment of obesity stigmatization in children and adolescents: modernizing a standard measure. *Obesity (Silver Spring)*. 2007; 15(12):3078–85. [PubMed: 18198317]
27. Sobal J, Stunkard AJ. Socioeconomic Status and Obesity: A Review of the Literature. *Psychological Bulletin*. 1989; 105(2):260–75. [PubMed: 2648443]
28. McLaren L. Socioeconomic Status and Obesity. *Epidemiologic Reviews*. 2007; 29(1):29–48. [PubMed: 17478442]
29. Cohen AK, Rai M, Rehkopf DH, Abrams B. Educational attainment and obesity: a systematic review. *Obesity Reviews*. 2013; 14(12):989–1005. [PubMed: 23889851]
30. Ogden CL, Lamb MM, Carroll MD, Flegal KM. Obesity and socioeconomic status in adults: United States, 2005–2008. *NCHS data brief*. 2010(50):1–8.
31. Ogden, CL.; Lamb, MM.; Carroll, MD.; Flegal, KM. *Obesity and Socioeconomic Status in Children and Adolescents: United States, 2005–2008*. National Center for Health Statistics; Hyattsville, MD: 2010. NCHS Data Brief no 51
- 32•. Ljungvall Å, Zimmerman FJ. Bigger bodies: Long-term trends and disparities in obesity and body-mass index among U.S. adults, 1960–2008. *Social Science & Medicine*. 2012; 75(1):109–19. [PubMed: 22551821] [Using data from the National Health and Nutrition Examination Survey between 1960 and 2008, this manuscript demonstrates that increases in obesity have occurred across racial/ethnic, educational, and income groups at similar rates. By 2008, the prevalence of obesity in the “best-off” group for education, racial/ethnic, or education group was higher than the “worst-off” group in 1960.]
33. Davis JA. Status Symbols and the Measurement of Status Perception. *Sociometry*. 1956; 19(3):154–65.
34. Gianaros PJ, Horenstein JA, Cohen S, Matthews KA, Brown SM, Flory JD, et al. Perigenual anterior cingulate morphology covaries with perceived social standing. *Social cognitive and affective neuroscience*. 2007; 2(3):161–73. [PubMed: 18418472]

35. Demakakos P, Nazroo J, Breeze E, Marmot M. Socioeconomic status and health: the role of subjective social status. *Social Science & Medicine*. 2008; 67(2):330–40. [PubMed: 18440111]
36. Singh-Manoux A, Adler NE, Marmot M. Subjective social status: its determinants and its association with measures of ill-health in the Whitehall II study. *Social Science & Medicine*. 2003; 56(6):1321–33. [PubMed: 12600368]
37. Nobles J, Weintraub MR, Adler NE. Subjective socioeconomic status and health: Relationships reconsidered. *Social Science & Medicine*. 2013; 82:58–66. [PubMed: 23453318]
38. Adler NE, Epel ES, Castellazzo G, Ickovics JR. Relationship of subjective and objective social status with psychological and physiological functioning: preliminary data in healthy white women. *Health Psychol*. 2000; 19(6):586. [PubMed: 11129362]
39. Goodman E, Adler NE, Daniels SR, Morrison JA, Slap GB, Dolan LM. Impact of Objective and Subjective Social Status on Obesity in a Biracial Cohort of Adolescents. *Obesity Research*. 2003; 11(8):1018–26. [PubMed: 12917508]
40. Briers B, Pandelaere M, Dewitte S, Warlop L. Hungry for money: the desire for caloric resources increases the desire for financial resources and vice versa. *Psychol Sci*. 2006; 17(11):939–43. [PubMed: 17176423]
41. James SA, Van Hoewyk J, Belli RF, Strogatz DS, Williams DR, Raghunathan TE. Life-Course Socioeconomic Position and Hypertension in African American Men: The Pitt County Study. *American Journal of Public Health*. 2006; 96(5):812–7. [PubMed: 16571689]
42. Ritterman Weintraub ML, Fernald LC, Adler N, Bertozzi S, Syme SL. Perceptions of social mobility: development of a new psychosocial indicator associated with adolescent risk behaviors. *Frontiers in public health*. 2015; 3:62. [PubMed: 25932460]
43. Heraclides A, Brunner E. Social mobility and social accumulation across the life course in relation to adult overweight and obesity: the Whitehall II study. *Journal of Epidemiology and Community Health*. 2010; 64(8):714–9. [PubMed: 19737739]
44. Langenberg C, Hardy R, Kuh D, Brunner E, Wadsworth M. Central and total obesity in middle aged men and women in relation to lifetime socioeconomic status: evidence from a national birth cohort. *J Epidemiol Community Health*. 2003; 57(10):816–22. [PubMed: 14573589]
45. Shively, CA.; Wallace, JM. Social Status, Social Stress and Fat Distribution in Primates. *International Textbook of Obesity: John Wiley & Sons, Ltd; 2001. p. 203-11.*
46. Gosler AG. Environmental and Social Determinants of Winter Fat Storage in the Great Tit *Parus major*. *Journal of Animal Ecology*. 1996; 65(1):1–17.
47. Tamashiro K, Hegeman MA, Nguyen MMN, Melhorn SJ, Ma LY, Woods SC, et al. Dynamic body weight and body composition changes in response to subordination stress. *Physiology & behavior*. 2007; 91(4):440–8. [PubMed: 17512562]
48. Dietz WH. Does Hunger Cause Obesity? *Pediatrics*. 1995; 95(5):766–7. [PubMed: 7724321]
49. Smith TG, Stoddard C, Barnes MG. Why the Poor Get Fat: Weight Gain and Economic Insecurity. *Forum for Health Economics & Policy*. 2009; 12(2)
50. Cornil Y, Chandon P. From Fan to Fat? Vicarious Losing Increases Unhealthy Eating, but Self-Affirmation Is an Effective Remedy. *Psychological Science*. 2013
51. Pan L, Sherry B, Njai R, Blanck HM. Food insecurity is associated with obesity among US adults in 12 states. *J Acad Nutr Diet*. 2012; 112(9):1403–9. [PubMed: 22939441]
52. Ludwig J, Sanbonmatsu L, Gennetian L, Adam E, Duncan GJ, Katz LF, et al. Neighborhoods, Obesity, and Diabetes — A Randomized Social Experiment. *New England Journal of Medicine*. 2011; 365(16):1509–19. [PubMed: 22010917]
53. Kemptner D, Jürges H, Reinhold S. Changes in compulsory schooling and the causal effect of education on health: Evidence from Germany. *Journal of Health Economics*. 2011; 30(2):340–54. [PubMed: 21306780]
54. Grabner, M. The Causal Effect of Education Obesity: Evidence from Compulsory Schooling Laws. 2009. Available from: Available at SSRN: <http://ssrn.com/abstract=1505075>
55. Brunello G, Fabbri D, Fort M. The Causal Effect of Education on Body Mass: Evidence from Europe. *Journal of Labor Economics*. 2013; 31(1):195–223. [This manuscript utilizes changes in mandatory schooling laws to test for a causal effect of education on BMI, finding that more years

of education is associated with a lower BMI in females (but not males) in nine European countries.]

56. Fletcher J, Frisvold D. The long run health returns to college quality. *Rev Econ Household*. 2012;1–31.
57. Zhang N, Zhang Q. Does Early School Entry Prevent Obesity Among Adolescent Girls? *Journal of Adolescent Health*. 2011; 48(6):644–6. [PubMed: 21575829]
58. Pavla G, Wiener H, Fontaine KR, Fields DA, Voss JD, Allison DB. Packet randomized experiments for eliminating classes of confounders. *European Journal of Clinical Investigation*. 2015; 45(1):45–55. [PubMed: 25444088]
59. Cawley J. The Impact of Obesity on Wages. *Journal of Human Resources*. 2004; XXXIX(2):451–74.
60. Leal C, Bean K, Thomas F, Chaix B. Are Associations Between Neighborhood Socioeconomic Characteristics and Body Mass Index or Waist Circumference Based on Model Extrapolations? *Epidemiology*. 2011; 22(5):694–703. [PubMed: 21709560]
61. Fontaine KR, Robertson HT, Holst C, Desmond R, Stunkard AJ, Sørensen TIA, et al. Is Socioeconomic Status of the Rearing Environment Causally Related to Obesity in the Offspring? *PLoS ONE*. 2011; 6(11):e27692. [PubMed: 22110724]
62. Dunning, T. *Natural experiments in the social sciences: a design-based approach*. Cambridge University Press; New York, NY: 2012.
63. Stunkard AJ, Harris JR, Pedersen NL, McClearn GE. The Body-Mass Index of Twins Who Have Been Reared Apart. *New England Journal of Medicine*. 1990; 322(21):1483–7. [PubMed: 2336075]
64. Meyer, JM.; Stunkard, AJ. Genetics and human obesity.. In: Stunkard, AJ.; Wadden, TA., editors. *Obesity: Theory and therapy*. Raven Press; New York: 1993.
65. Ridley, M. *Nature via nurture: Genes, experience, and what makes us human*. HarperCollins Publishers; New York, NY, US: 2003. p. 326
66. Stunkard AJ. Beginner's mind: Trying to learn something about obesity. *Annals of behavioral medicine*. 1991; 13:51–6.
67. Allison DB, Kalinsky LB, Gorman BS. A comparison of the psychometric properties of three measures of dietary restraint. *Psychological Assessment*. 1992; 4(3):391–8.
68. President Faust, Dean Harris Address Academic Misconduct 2013. Available from: <http://harvardmagazine.com/2013/02/harvards-faust-harris-on-cheating-investigation>

Figure. 1.
Dr. Stunkard at the Obesity Conference in Columbia, April 1993

Figure. 2.

Prevalence of obesity among adults aged 20 years and over, by poverty income ratio and sex: United States, 1988-1994 and 2005-2008. Originally published in Ogden et al. [30]

Fig. 3. Prevalence of obesity among adults aged 20 years and over, by education and sex: United States, 1988-1994 and 2005-2008. Originally published in Ogden et al. [30]

Figure. 4.

Dr. Stunkard with colleagues, including one of the authors (*far left*) at the Obesity Conference in Columbia, April 1993

Fig. 5.
Dr. Stunkard with colleagues at the Ciba Foundation Symposium on The Origins and Consequences of Obesity