Current and Future Medical Costs of Childhood Obesity in Alaska

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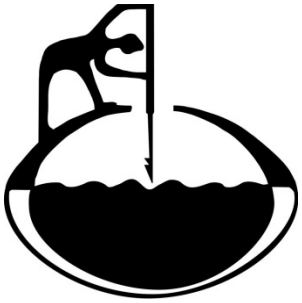

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Executive Summary

This study examines the medical costs of childhood obesity in Alaska, today and in the future. We estimate that 15.2% of those ages 2 to 19 in Alaska are obese. Using parameters from published reports and studies, we estimate that the total excess medical costs due to obesity for both adults and children in Alaska in 2012 were $226 million, with medical costs of obese children and adolescents accounting for about $7 million of that total.

And those medical costs will get much higher over time, as today's children transition into adulthood. Aside from the 15.2% currently obese, another estimated 20% of children who aren't currently obese will become obese as adults, if current national patterns continue. We estimate that the 20-year medical costs—discounted to present value—of obesity among the current cohort of Alaska children and adolescents will be $624 million in today's dollars.

But those future costs could be decreased if Alaskans found ways to reduce obesity. We consider how reducing obesity in several ways could reduce future medical costs: reducing current rates of childhood obesity, rates of obese children who become obese adults, or rates of non-obese children and adolescents who become obese adults. We undertake modest reductions to showcase the potential cost savings associated with each of these channels. Clearly the financial savings are a direct function of the obesity reductions and therefore the magnitude of the realized savings will vary accordingly.

Also keep in mind that these figures are only for the current cohort of children and adolescents; over time more generations of Alaskans will grow from children into adults, repeating the same cycle unless rates of obesity decline. And finally, remember that medical costs are only part of the broader range of social and economic costs obesity creates.

Introduction and Methods

The Centers for Disease Control and Prevention (CDC) estimates that 25.7% of Alaskan adults were obese in 2012.[1] This is an adjusted estimate; the BRFSS defines adulthood as 18 years of age and older, while this study defines adults as 20 years of age and older. The CDC doesn't estimate obesity among Alaska children and adolescents by age and sex. By using national rates from the National Center for Health Statistics to create Alaska-specific age and sex specific obesity rates,[2] we estimate that 15.2% percent of Alaskans ages 2 through 19—around 28,000 in 2012—are obese.

Weight status is assessed using the Body Mass Index (BMI). The CDC defines obese adults as having a BMI $\geq$ 30, and overweight adults as having a BMI between 25 and 29.9.[3] For children and adolescents, obesity is defined as having a BMI at or above their age and sex specific 95th percentile cutoff point.[4]

This paper provides the first estimates of the medical costs associated with obesity among children in Alaska today and in the future, as they become adults. Nationwide almost all those who are obese at ages 15 to 17—86% of obese boys and 90% of obese girls—remain obese as adults, and that 20.29% of boys and 20.97% of girls who were not obese as children become obese as they age.[5] We don't have the data to develop comparable parameters specifically for Alaska, so we use these nationwide parameters to estimate the additional costs attributable to obesity as children transition into adolescence and then adulthood. We also use the estimate developed by Finkelstein et al[6] of the difference in annual medical costs between obese and non-obese people nationwide—$1,429—as a basis for our estimates. We use the Bureau of Labor Statistics medical care CPI to adjust this figure for inflation.[7]

Specifically, we estimate the aggregate medical costs associated with obese Alaska children and adolescents in 2012, and then look at costs over 20 years—discounted to today's dollars—as those obese children age, and as additional Alaskans who were not obese as children become obese adults. We allow for cost increases in health care over time (i.e., medical care inflation) and discount future values at a rate of 7.0 percent per year. Discounting is used by economists

when costs are to be incurred in the future. It is applied to make future costs comparable to current costs

because consumers have a preference for current consumption compared to future consumption. Because health-related costs limit the funds available for consumption, a consumer would prefer to postpone payment of a given cost and the resulting reduction in consumption into the future. The current value of a given dollar amount to a consumer is therefore less if it has to be paid in the future than if it is incurred today. For this specific case, discounting means that costs incurred near the end (e.g., 15 to 20 years) of analysis are not as influential as ones incurred near the present in generating our cost estimate. In effect, it allows us to measure the savings in today's dollars, so we have an accurate picture of their relative importance. There is no consensus regarding a fixed discount rate value but it typically ranges from 3-5%. We choose to use 7% as a conservative estimate given that most obesity related costs are incurred later in life, while the oldest people in our simulation are aged 39 by the end of our window of analysis.

Finally, we look at how reducing rates of obesity—either by reducing the percentage of children who are obese or reducing how many remain or become obese as adults—could reduce future medical costs.

Given the persistence of childhood and adolescent obesity into adulthood, and the low success rate in transitioning out of obesity in adulthood, [8] it is imperative to investigate earlier interventions. Before describing our findings, we first put this problem in context, by discussing why widespread obesity among children—in the U.S. and elsewhere—is so alarming.

Background

Obesity, once a condition exclusive to mature adults, has now become commonplace among children. The World Health Organization (WHO) declared childhood obesity to be one of the most serious public health challenges of the 21st century.[9] In the U.S., 17% of children and adolescents between the age of 2 and 19 are obese.[10] Childhood obesity is associated with a host of chronic diseases, such as type II diabetes,[4] and can cause children serious psychological harm as a result of social stigmatization, depression, and poor body image.[11-13] Childhood obesity had been linked to excess weight in adulthood with long-term consequences in direct (medical

expenditure) and indirect (labor market) costs.[14-15] If current childhood obesity trends continue, we can expect even greater increases in disability, morbidity, and premature death, as well as more losses in productivity.[16]

The CDC reports that two in three Americans are overweight and one in three is obese;[17] in 2010, Colorado was the only state with an obesity rate below 20%. A recent Rand Institute report[18] based on previous research[19] finds that in 2020, up to one fifth of total health expenditures will be devoted to treating the consequences of obesity. The report also shows that obesity is linked to higher health-care costs than those related to smoking and drinking.[20]

The medical costs, however, present only a partial picture of the total costs related to obesity, as obesity is also associated with loss of work-days and incidents of disability.[21] Moreover, obese people may also be subject to social stigma and discrimination.[22]

Literature Review

To clarify the extent to which obesity influences health outcomes and personal and public expenditures, we provide a short literature review.

Field et al[23] used a ten-year follow up study of middle-aged women in The Nurses' Health Study (NHS) and men in the Health Professionals Follow-up Study (HPFS) and found that being obese made men 10 times, and women 11.2 times, more likely to develop diabetes relative to those of normal weight (BMI<25). They also found both obese men and women about 2.5 times more likely to develop gallstones, and between 1.5 and 2 times more likely to develop heart disease, among other diseases.

The illnesses mentioned above were among those with the highest out-of-pocket expenditures leading to bankruptcy driven by accumulation of medical costs for individuals who suffer from these diseases: on average $26,971 for diabetes, $23,380 for stroke and $21,955 for heart disease.[24] In addition, there were significant expenses for treating not just the diseases that resulted from obesity but obesity itself: in 2006 alone, there were approximately 113,000

bariatric surgeries performed in the United States, resulting in about $1.5 billion in medical expenses.[25]

At the individual level, the health care costs incurred by obese people also tended to be higher than those incurred by their non-obese counterparts. Sturm[19] showed that obesity was associated with a 36% increase in in-patient and out-patient spending and a 77% increase in medications. Finkelstein et al[6] concluded that the annual U.S. medical costs attributable to obesity expenditures were $78.5 billion in 1998, and estimated that obesity-related expenditures had increased to $86 billion by 2008, based on estimates from the Medical Expenditure Panel Survey, or as much as $147 billion, based on the National Health Expenditure Data.

Focusing on total payments, obese people cost $1,429 more than their non-obese counterpart across payers.[6]The fractions of expenditures attributable to obesity were 8.5% for Medicare spending, 11.8% for Medicaid spending, and 12.9% for private payer spending.[6] The attributable fractions were calculated as the amount, or percent, by which medical costs per payer would decrease if all obese individuals became non-obese. Across all payers, the results from the Finkelstein study indicated that obesity was associated with a 9.1% increase in annual medical spending in 2006, compared with 6.5% in 1998. As we discuss later in the text, we use the $1,429 figure from MEPS to account for adult obesity costs in this study and adjust it for inflation, because we do not have information on the number of obese Alaskans across payers. An even more thorough review of the range of factors and or outcomes influenced by obesity, and the costs associated with each, was estimated by Hammond and Levine, [26] and is presented in appendix 1.

Apart from the health costs, obesity is associated with a host of other indirect economic costs which we briefly discuss below. Our study makes no attempt to account for the indirect costs we enumerate, however. Therefore, it is best to think about our estimates as lower bound numbers. The economic costs of obesity-related morbidity have been documented in a number of studies.

In an epidemiologic study of 10,825 employees, Tucker et al[27] found that obese employees were 1.74 and 1.61 times more likely to experience high and moderate levels of absenteeism,

respectively, than were lean individuals. Burton et al[28] found that employees at risk for an obesity-level BMI were more likely to have other health risks compared to those not at risk for an obesity-level BMI, and had twice as many sick days (8.45) as compared to those not at risk (3.73). Thompson et al[29] found that the cost of obesity to U.S. businesses in 1994 was estimated at a total of $12.7 billion, including $2.6 billion as a result of mild obesity (BMI = 25-28.9) and $10.1 billion due to moderate to severe obesity (BMI ≥ 29). Using the 1994 National Health Interview Survey data, Wolf[30] find that the indirect costs of obesity were 39.2 million excess work days lost, 239 million excess restricted activity days and 89.5 million excess bed days.

Last but not least, obesity is also associated with social stigma, and obese people may suffer from discrimination; Carr et al[22 (p250)] used data from the Midlife Development in the United States (MIDUS) study, a national survey of more than 3,000 adults ages 25 to 74 in 1995, and found that compared to normal-weight people, people with a BMI of 35 or higher were more likely to report institutional and day-to-day interpersonal discrimination. Some of these issues resulted in non-economic costs that are difficult to quantify. For instance, obese non-professional workers were less likely than obese professional workers to report employment discrimination and interpersonal mistreatment.

Methods

Current Costs Nationwide and in Alaska

Before tackling the Alaska questions, we first estimate nationwide costs related to obesity by first calculating the number of obese people (Table 1) by age group and gender using Ogden[31] as the basis for obesity rates and the census as the source of population data. Once we generate these figures, we quantify the aggregate excess costs associated with obesity (Table 2) by multiplying the number of obese individuals by the average excess cost for each of these groups. The data on the excess medical costs are obtained from Finkelstein et al[6] for adults, Trasande and Chatterjee[32], and Trasande et al. [33] for children and adolescents.

The aggregate estimates of U.S obesity costs calculated in this study are **lower** than those found in the Finkelstein et al[6] study given that we use the average amount by which an obese person's expenditures exceed those of their non-obese counterpart and apply that to the overall number of

obese individuals[1]. Their approach in estimating the aggregates expenditures we can attribute to obesity is a function of the overall dollars devoted to medical expenditures. Our estimates are a combination of number of obese people and the average cost between an obese and a normal weight individual. Additionally, aggregate estimates in their study are different because the cost differential varies by source of payment (provider) and type of service. They are able to generate increases in medical spending attributable to obesity by each type of service. Both this cost differential heterogeneity, along with the distribution of obese individuals across payment type - which we do not have, influence the results**.** Furthermore, they impose attributable fractions generated from Medical expenditure panel survey, which only analyze the non-institutionalized population, onto the spending from the NHEA which include the people in institutions.
We follow the same procedure as the one laid out above in determining the costs associated with obesity in Alaska (see Tables3 and 4).The procedure we reference simply indicates that we multiply the number of obese individuals for each of the age brackets by the average amount an obese person's expenditures exceed those of their non-obese counterpart. Table 3 presents obesity statistics by age and gender for Alaska for the year of 2012. Alaska adjusted obesity rates are derived using national age and gender specific statistics and then adjusting them by the ratio of Alaska overall obesity rates relative to national overall obesity rates, allowing us to obtain specific age and gender rates for Alaska. Population figures are obtained from the US census, and based on these two data sources, we approximate that 162,829 Alaskans are obese. The obesity rates for Alaska children and adolescents are derived in a similar manner. The obesity rate for adults is 25.7% and for children and adolescents 15.2%.

We draw on some of the more recent literature that has looked at medical costs attributable to obesity in childhood and adolescence for age specific cost differentials. For example, Trasande and Chatterjee[32] find that childhood obesity is associated with an estimated $14.1 billion in additional prescription drug, emergency room and outpatient medical service costs annually. We use this and other[33] estimates to calculate obesity costs by age group for children, shown in Table 4.

Future Costs for Alaska for a single cohort of Alaska children and adolescents

[1] See Appendix 2 for a summary of Finkelstein et al (2009) Trogdon (2011) cost derivation.

Our study draws from a number of the studies mentioned above and examines the medical costs of childhood obesity in Alaska**.** We first estimate the number of obese individuals and the aggregate excess medical costs associated with them in 2012. Then, we focus our attention on the cohort aged (2-19) by aging them for a twenty year period in order to see how these costs evolve as children transition into adolescence and adolescents into adulthood. This is important given that the obesity related costs vary by age. The twenty year window also allows for this entire cohort to transition into adulthood. The key parameters used in our simulation are the age specific current obesity rates, the gender specific probability an obese adolescent becomes an obese adult, and the gender specific probability a non-obese adolescent becomes an obese adult Essentially, we follow this cohort as it ages out and chronicle the expenses incurred each year given that a subset of them move into adolescence or adulthood, before discounting the costs them back to the present.

We analyze both the overall medical costs (for adults and children/adolescents) incurred in 2012 as well as the future ones (20-year medical discounted costs) as the current cohort of 2-19 year olds age and transition into adulthood.

Detail of Findings

Annual Medical Costs of Obesity

Table 1 presents obesity statistics by age and gender for the United States for 2009 through 2010. Obesity figures are obtained from Ogden et al[31] and population figures for 2012 are obtained from the US Census Bureau. Based on these two data sources, we approximate that 97 million Americans are obese.

Table 2 presents data on the annual medical costs related to obesity, [6, 32, and 33] which are combined with the figures from Table 1 to generate overall costs. Using the above costs, we find that the annual obesity related medical costs nationwide in 2012 were $122.73 billion. As noted above, this amount differs from the much higher estimate in Finkelstein et al (2009), because we relied on the average annual individual cost difference between obese people and their non-obese counterparts—$1,429 (we adjust for inflation using the medical CPI)—and applied it to the obese population(See Appendix 2 for a summary of cost derivation from Finkelstein).

Table *4* presents data on the annual medical costs, [6, 32, 33] which are combined with the figures from Table 3 to generate overall costs for Alaska. Using the excess medical costs for the obese by age listed in column 3 of Table 4, we find that total excess or avoidable medical costs of obesity among adults and children in Alaska for 2012 is $226.8 million dollars, with $7.17 million attributable to obese children and adolescents (ages 2 through 19).

Future Medical Costs of Obesity:

In addition to current obesity costs, there will be an accumulation of costs over time as obesity persists into adulthood. In an attempt to capture how childhood obesity can influence expenditures, we age the current cohort (ages 2-19) of Alaska children in order to examine how their costs accumulate as they gradually all move into adolescence and then adulthood.

Table 5 presents information on the 20-year discounted medical costs associated with the current cohort of Alaska children and adolescents. A 20-year window allows the whole cohort to transition into adulthood. We conduct the analysis on a yearly basis but only report the 5-year increments. Given that the additional costs attributable to obesity are different for the 6-11 group than they are for the 12-19 group and eventually for adults, the overall costs increase as more children enter adulthood. The parameters used to simulate the model are listed below Table 5. Over the next 20 years, the present value (discounted medical costs) of excess obesity costs associated with this current cohort will be an estimated **624.3 million dollars**. This is found by aging the 2-19 year old cohort 20 years into the future, calculating the costs incurred due to obesity, and then discounting those costs to the present value.

How much savings can be generated from modest reductions?

The parameters displayed at the end of Table 5 in combination with the figures presented in Table 3 and Table 4 represent the starting points in estimating the 20-year discounted medical costs for this cohort of children and adolescents as explained above. Altering these parameters through interventions that decrease current childhood obesity rates, persistence, or likelihood of a non-obese adolescent becoming an obese adult can all be highly impactful.

We proceed by targeting each of these parameters separately and investigating how a one percentage point reduction affects the cost savings generated through these different mechanisms.

First, we simply estimate the 20-year discounted savings from reducing the rate of childhood obesity from 15.2 percent to 14.2 percent while holding everything else constant (Table 6). We find that such a cut in the obesity rate would decrease the present value of expenditures to 607.7 million dollars from the baseline of 624.37 million resulting in a 16.8 million dollar saving. This simulation stems from an across the board 1 percentage point decrease in the obesity rate for all three subgroups (2-5, 6-11, 12-19).

In an effort to shed some light regarding where most of the savings are coming from, we analyze the savings that can be generated by reducing the obesity rate for each group separately.

Table 7: Reducing the obesity rate of 2-5 year olds by 1 percentage point:

When we decrease the obesity rate from 10.64 to 9.64 percent for children between the ages of 2 and 5, the 20-year discounted medical savings are $380,000. This figure is small, but unsurprising. This is largely due to the fact that the additional medical costs attributable to obesity in childhood and adolescence are not as pronounced as the ones incurred in adulthood and that our time frame is only 20 years. Also, the number of children who are obese at that age is not very large. Having said that, lifestyle changes at an early stage have a much better chance of being lifelong ones; these simple simulations are restricted to a 20-year window and do not capture other dimensions some of these early-stage interventions may influence

Table 8: Reducing the obesity rate of 6-11 year olds by 1 percentage point:

When we decrease the obesity rate from 16.45 to 15.45 percent, the 20 -year discounted medical savings are 3.48 million dollars. Unsurprisingly, this figure is larger than the one we find for the younger children due to the additional years spent in adulthood (i.e., more costs) for this subgroup. These differences are pronounced due to the time frame we impose on the modeling.

Table 9: Reducing the obesity rate of 12-19 year olds by 1 percentage point:

When we decrease the obesity rate from 16.65 to 15.67 percent, the 20-year discounted medical savings are 11.49 million dollars. This figure is considerably larger than the potential savings achieved from reducing the obesity rate for the other subgroups. It is clear, as we explain above, that the older children at the beginning of our simulations are the ones spending the longest time incurring costs attributable to obesity as adults during our 20-year window, resulting in increased costs.

Now, we turn our attention to the other potential channels that can be targeted to generate financial savings.

Table 10: A 1 percentage point decrease in the transition of obese adolescents into obese adults

Here we examine the savings that can be achieved by reducing the probabilities that currently obese adolescents become obese adults. We simulate a one percentage point decrease in both male and female transition rates. We estimate that 20-year discounted costs would decrease by 2.9 million dollars if the probability of becoming an obese adult for male and female obese adolescents were to decrease from 86 to 85 percent and 90 to 89 percent respectively with the other parameters at their original values. An intervention such as the one described in this section is specifically targeting obese adolescents before entering adulthood and therefore attempts to alter behavior at a critical stage. We refer to this intervention age as critical given the evidence regarding the persistence of obesity past adolescence.

Table 11: A 1 percentage point decrease in the transition of non-obese adolescents into obese adults

We turn the focus to non-obese children and adolescents who become obese as they transition into adulthood and analyze the potential savings from a one percentage point reduction in the baseline transition rates. We find that that 20 -year discounted costs would decrease by 14.3 million dollars if the probability of becoming an obese adult for male and female adolescents were to decrease from 20.29 to 19.29 percent and 20.97 to 19.97 percent, respectively, with the other parameters at their original values. It is important to note the savings are large because the number of non-obese adolescents exceeds that of their obese counterpart which means that preventing a larger portion of them from becoming obese adults pays dividends.

Conclusion

When assessing the magnitude of the 20-year medical costs of obesity, it is critical to keep in mind that these costs are related to the *current* cohort of Alaska children and adolescents. Over the next twenty years, additional medical costs of obesity in adults will also be incurred. In other words, Alaska adults who are currently obese and those who become obese over the next twenty years will have obesity-related costs in addition to those estimated for children and adolescents. Additionally and perhaps more importantly from a policy standpoint, the 20-year medical cost figure is only for the current cohort of children and adolescents, but does not include the medical costs of obesity related to future cohorts of children. As a simple illustration, a new cohort of residents aged five and younger will emerge in five years, and this group of children (and the cohorts that follow) will have medical costs of obesity over the next twenty years that are not figured in our analysis. Therefore, this analysis provides a snapshot that will continue to repeat itself, absent interventions to break the pattern. The analysis above shows there are many potential channels of curbing the obesity trend, all of which can result in substantial savings even when the obesity reductions are modest.

This snapshot we describe, while illustrative, only captures a partial picture of the overall costs society faces when it comes to dealing with obesity. Limitations of the current study stem from factors such as not accounting for indirect costs, having a relatively short 20 year follow up window, and the use average differences in expenditures between obese and their non-obese

counterparts, and using a rather conservative discount rate to account for the fact that most obesity related expenditures occur late in life.

References:

1. Centers for Disease Control and Prevention. Prevalence and Trends Data Alaska 2012 Overweight and Obesity. Behavioral Risk Factor Surveillance System. http://apps.nccd.cdc.gov/brfss/display.asp?cat=OB&yr=2012&qkey= 8261&state=AK. Updated December 24, 2013. Accessed January 19, 2014.
2. National Center for Health Statistics. Health, United States 2012. Obesity among Children and Adolescents Aged 2-19 Years. http://www.cdc.gov/nchs/data/hus/2012/069.pdf. Published May 2013. Accessed January 19, 2014.
3. Centers for Disease Control and Prevention. Defining Overweight and Obesity. Overweight and Obesity. http://www.cdc.gov/obesity/adult/defining.html. Updated April 27, 2012. Accessed January 19, 2014.
4. Centers for Disease Control and Prevention. Basics About Childhood Obesity. Overweight and Obesity. http://www.cdc.gov/obesity/childhood/basics.html. Updated April 27, 2012. Accessed January 19, 2014.
5. Freedman DS, Khan LK, Serdula MK, Dietz WH, Srinivasan SR, Berenson GS. The Relation of Childhood BMI to Adult Adiposity: The Bogalusa Heart Study. *Pediatrics.* 2005; 115(1):22–27. doi: 10.1542/peds.2004-0220.

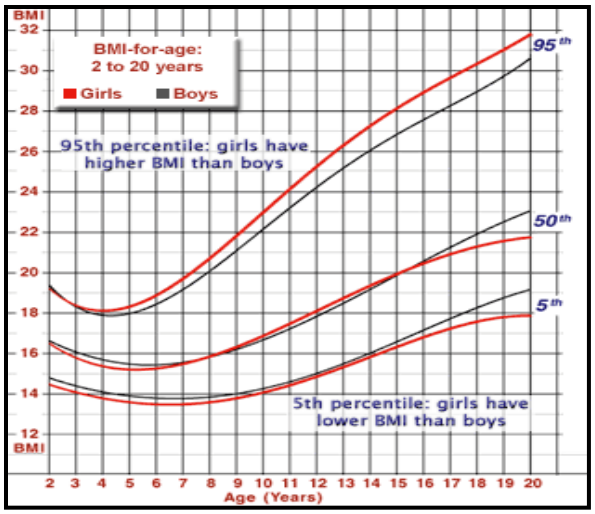
6. Finkelstein EA, Trogdon JG, Cohen JW, Dietz W. Annual Medical Spending Attributable to Obesity: Payer and Service Specific Estimates. *Health Affairs*. 2009; 28(5):w822-w831. doi: 10.1377/hlthaff.28.5.w822.
7. Bureau of Labor Statistics. Measuring Price Change for Medical Care in the CPI. Consumer Price Index. http://www.bls.gov/cpi/cpifact4.htm. Updated April 12, 2010. Accessed January 19, 2014.
8. Glassman T, Glassman J, Diehr AJ. Obesity: A Public Health Failure? *Am J of Health Stud.* 2013; 28(1):8-11. http://search.ebscohost.com/login.aspx?direct=true&db=cmh&AN=91512075&site=chc-live. Accessed January 18, 2014.
9. World Health Organization. Childhood Overweight and Obesity. Global Strategy on Diet, Physical Activity and Health. http://www.who.int/dietphysicalactivity/childhood/en. Published 2014. Accessed January 19, 2014.
10. Centers for Disease Control and Prevention. Data and Statistics. Overweight and Obesity. http://www.cdc.gov/obesity/data/childhood.html. Updated January 7, 2014. Accessed January 18, 2014.
11. Paxton HL. The Effects of Childhood Obesity on Self-Esteem. [thesis]. Theses, Dissertations and Capstones. Marshall University. 2005: Paper 140. ISBN 9780542145711, 0542145715. Accessed January 19, 2014.
12. Reeves GM, Postolache TT, Snitker S. Childhood Obesity and Depression: Connection Between these Growing Problems in Growing Children. *Int J Child Health Hum Dev*. 2008; 1(2):103–114. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2568994/. Accessed January 18, 2014.
13. Strauss RS. Childhood Obesity and Self-Esteem. *Pediatrics*. 2000; 105(1):e15. http://pediatrics.aappublications.org/content/105/1/e15.full.pdf+html. Accessed January 18, 2014.
14. Cawley J. The Economics of Childhood Obesity. *Health Affairs.* 2010; 29(3):364-371. doi: 10.1377/hlthaff.2009.0721.
15. Power, Chris, Julie K. Lake, and Tim J. Cole 1997. Measurement and Long-Term health risks of child and adolescent fatness. International Journal of Obesity 21, 507-526.
16. Wang YC, McPherson K, Marsh T, Gortmaker SL, Brown M. Health and Economic Burden of the Projected Obesity Trends in the USA and the UK. *Lancet.* 2011; 378:815-825. http://dx.doi.org/10.1016/S0140-6736(11)60814-3. Accessed January 19, 2014.

17. Centers for Disease Control and Prevention. FastStats. Obesity and Overweight. http://www.cdc.gov/nchs/fastats/overwt.htm. Updated November 21, 2013. Accessed January 19, 2014.
18. RAND Corporation. Obesity and Disability. Research Highlights. http://www.rand.org/content/dam/rand/pubs/research_briefs/2007/RAND_RB9043-1.pdf. Published 2007. Accessed January 18, 2014.
19. Sturm R, Ringel J, Andreyeva T. Increasing Obesity Rates and Disability Trends. *Health Affairs.* 2004; 23(2):1-7. http://search.proquest.com/docview/204625190/abstract?accountid=14473. Accessed January 17, 2014.
20. Sturm R. The Effects of Obesity, Smoking, and Drinking on Medical Problems and Costs. *Health Affairs.* 2002; 21(2):245-253. http://search.proquest.com/docview/204497654#. Accessed January 18, 2014.
21. Finkelstein EA, DiBonaventura MD, Burgess SM, Hale BC. The Costs of Obesity in the Workplace. *J Occup Environ Med.* 2010; 52(10):971-976. doi:10.1097/JOM.0b013e3181f274d2.
22. Carr D, Friedman MA. Is Obesity Stigmatizing? Body Weight, Perceived Discrimination, and Psychological Well-Being in the United States. *J Health Soc Behav*. 2005; 46(3):244-259. http://www.jstor.org/stable/4147670. Accessed January 20, 2014.
23. Field AE, Coakley EH, Must A, Spadano JL, Laird N, Dietz WH, Rimm E, and Colditz GA. Impact of Overweight on the Risk of Developing Common Chronic Diseases During a 10-year Period. *Arch Intern Med*. 2001; 161(13):1581-1586. doi:10.1001/archinte.161.13.1581.
24. Himmelstein DU, Thorne D, Warren E, Woolhandler S. Medical Bankruptcy in the United States 2007: Results of a National Study. *Am J Med.* 2009; 122(8):741-746. doi:10.1016/j.amjmed.2009.04.012.
25. Livingston EH. The Incidence of Bariatric Surgery has Plateaued in the US. *Am J Surg.* 2010; 200(3):378-385. doi:10.1016/j.amjsurg.2009.11.007.
26. Hammond RA, and Levine R. The Economic Impact of Obesity in the United States. *Diabetes Metab Syndr Obes.* 2010; 3:285-295. doi: 10.2147/DMSOTT.S7384.
27. Tucker LA, Friedman GM. Obesity and Absenteeism: An Epidemiologic Study of 10,825 Employed Adults. *Am J Health Promot.* 1998; 12(3):202-207. doi: http://dx.doi.org/10.4278/0890-1171-12.3.202.

28. Burton WN, Chen C, Schultz AB, Edington DW. The Economic Costs Associated with Body Mass Index in a Workplace. *J Occup Environ Med.* 1998; 40(9):786-792. Accession: 00043764-199809000-00007.
29. Thompson D, Edelsberg J, Kinsey KL, Oster G. Estimated Economic Costs of Obesity to U.S. Business. *Am J Health Promot.* 1998; 13(2):120-127. doi: http://dx.doi.org/10.4278/0890-1171-13.2.120.
30. Wolf AM, Colditz GA. Current Estimates of the Economic Cost of Obesity in the United States. *Obes Res*. 1998; 6(2):97-106. doi: 10.1002/j.1550-8528.1998.tb00322.x.
31. Ogden CL, Carroll MD, Kit BK. Flegal KM. Prevalence of Obesity in the United States, 2009-2010. National Center for Health Statistics Data Brief, no 82. http://www.cdc.gov/nchs/data/databriefs/db82.pdf. Published January 2012. Accessed January 20, 2014.
32. Trasande L, Chatterjee S. The Impact of Obesity on Health Service Utilization and Costs in Childhood. *Obesity*. 2009; 17(9):1749:1754. DOI: 10.1038/oby.2009.67.
33. Trasande L, Liu Y, Fryer G, Weitzman M. Effects of Childhood Obesity on Hospital Care and Costs, 1999-2005. *Health Affairs*. 2009; 28(4):w751-w760. doi: 10.1377/hlthaff.28.4.w751.
34. Ogden, C.L., M.D. Carroll, L.R. Curtin, M.M Lamb, and K.M. Flegal. 2010. Prevalence of high body mass index in the U.S children and adolescents. Journal of the American Medical Association.303 (3):242-249

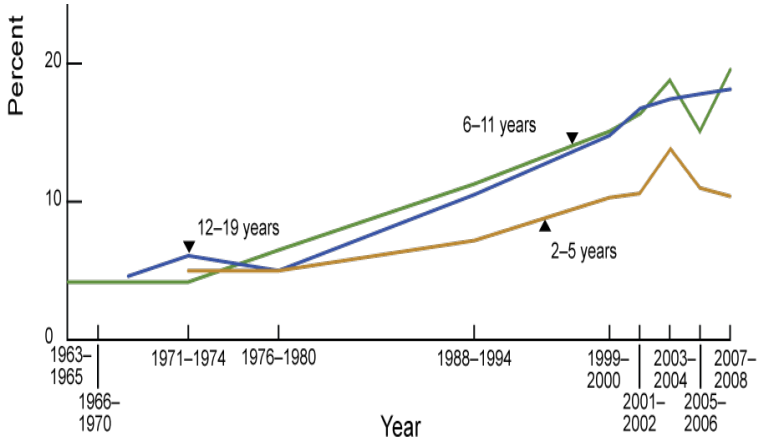
Figures

Figure 1: The CDC Growth Chart: BMI Criteria of Obesity for Children



Source: U.S. Department of Health and Human Services (http://depts.washington.edu/growth/module7/text/page3b.htm)

Figure 2: U.S. Trends in Obesity Among Children and Adolescents (1963-2008)



Source: *Centers for Disease Control and Prevention* (CDC),
http://www.cdc.gov/nchs/data/hestat/obesity_child_07_08/Figures1.png

Tables

Table 1: Incidence of Obesity in the United States using 2012 population data:

Age Cohort	2012 Population male	2012 Population female	% Obese Male	%Obese Female	Obese Population Male	Obese Population Female	Obese Population Total
Under 5	10,216,135	9,783,209	14.4	9.6	1,471,123	939,188	2,410,312
5 to 9	10,459,193	10,016,343	20.1	15.7	2,102,298	1,572,566	3,674,864
10 to 14	10,567,214	10,102,004	19.6	17.1	2,071,174	1,727,443	3,798,617
15 to 19	10,962,861	10,397,841	19.6	17.1	2,148,721	1,778,031	3,926,752
20 to 24	11,549,456	11,033,747	33.2	31.9	3,834,419	3,519,765	7,354,185
25 to 29	10,844,886	10,553,440	33.2	31.9	3,600,502	3,366,547	6,967,050
30 to 34	10,493,906	10,417,089	33.2	31.9	3,483,977	3,323,051	6,807,028
35 to 39	9,714,613	9,773,586	33.2	31.9	3,225,252	3,117,774	6,343,025
40 to 44	10,458,994	10,569,227	37.2	36	3,890,746	3,804,922	7,695,667
45 to 49	10,726,625	10,962,854	37.2	36	3,990,305	3,946,627	7,936,932
50 to 54	11,080,245	11,499,014	37.2	36	4,121,851	4,139,645	8,261,496
55 to 59	10,068,409	10,704,108	37.2	36	3,745,448	3,853,479	7,598,927
60 to 64	8,534,485	9,279,200	36.6	42.3	3,123,622	3,925,102	7,048,723
65 to 69	6,606,856	7,370,497	36.6	42.3	2,418,109	3,117,720	5,535,830
70 to 74	4,596,006	5,412,033	36.6	42.3	1,682,138	2,289,290	3,971,428
75 to 79	3,291,452	4,198,131	36.6	42.3	1,204,671	1,775,809	2,980,481
80 to 84	2,356,698	3,426,353	36.6	42.3	862,551	1,449,347	2,311,899
85 to 89	1,964,033	3,923,297	36.6	42.3	718,836	1,659,555	2,378,391
	154,492,067	159,421,973			47,695,743	49,305,862	97,001,605

Notes: Obesity statistics are from Ogden CL, Carroll MD, and Kit BK. Flegal KM. Prevalence of Obesity in the United States-2010, National Center for Health Statistics Data Brief, no 82. Figures are subject to rounding. The Census Bureau computes state population estimates using multiple data sets, the most important of which is the decennial census. These figures above include birth rates, death rates and estimates of residents migrating from one state to another.

Table 2: Estimated Annual Medical Costs of Obesity in the United States using 2012 population data:

Age Cohort	Obese Population Total	Medical cost (2012 dollars per obese individual	Estimated cost
Under 5	2,410,312	NA	
5 to 9	3,674,864	151	556,652,922
10 to 14	3,798,617	422	1,603,016,217
15 to 19	3,926,752	422	1,657,089,161
20 to 24	7,354,185	1,629	11,976,951,163
25 to 29	6,967,050	1,629	11,346,466,716
30 to 34	6,807,028	1,629	11,085,857,590
35 to 39	6,343,025	1,629	10,330,187,409
40 to 44	7,695,667	1,629	12,533,086,619
45 to 49	7,936,932	1,629	12,926,007,477
50 to 54	8,261,496	1,629	13,454,589,532
55 to 59	7,598,927	1,629	12,375,536,079
60 to 64	7,048,723	1,629	11,479,479,516
65 to 69	5,535,830	1,629	9,015,596,253
70 to 74	3,971,428	1,629	6,467,827,923
75 to 79	2,980,481	1,629	4,853,981,108
80 to 84	2,311,899	1,629	3,765,135,097
85 to 89	2,378,391	1,629	3,873,423,172
	97,001,605		**139,300,883,955**

Notes. Data on the medical costs of obesity are from studies by Finkelstein et al. (2009), Trasande and Chatterjee (2009), and Trasande et al. (2009). Medical costs are adjusted for inflation and expressed in 2012 dollars using the medical care Consumer Price Index (2000 to 2012) of the U.S. Bureau of Labor Statistics. http://www.bls.gov/cpi/cpifact4.htm

Table 3: Incidence of Obesity in Alaska:

Age Cohort	2012 Population Male	2012 Female Population	Total	% Obese Male	% Obese Female	Obese Population Male	Obese Population Female	Obese Population Total
2 to 5	22,129	20,543	42,672	12.5	8.6	2,771	1,771	4,542
6 to 11	31,271	29,583	60,854	17.4	15.3	5,466	4,542	10,008
12 to 19	41,932	38,463	80,395	17.0	16.2	7,147	6,261	13,407
20 to 24	33,281	26,829	60,110	24.0	23.0	7,997	6,194	14,191
25 to 34	58,634	52,476	111,110	24.0	23.0	14,089	12,116	26,205

35to 39	23,325	21,758	45,083	24.0	23.0	5,605	5,023	10,628
40 to 49	50,642	46,689	97,331	26.9	26.0	13,635	12,165	25,800
50 to 59	56,370	52,076	108,446	26.9	26.0	15,177	13,569	28,746
60 to 64	21,340	18,875	40,215	26.4	30.6	5,653	5,779	11,432
65 plus	30,625	31,872	62,497	26.4	30.6	8,112	9,758	17,870
	369,549	339,164	708,713			85,651	77,177	162,829

Notes: The Census Bureau computes yearly state population estimates using multiple data sets, the most important of which is the decennial census. These figures above include birth rates, death rates and estimates of residents migrating from one state to another. Obesity statistics for children and adolescents are derived by first creating a ratio of obesity incidence in Alaska to that in the US from the 2011 Youth Risk Behavior Surveillance survey (10-17). We then apply that ratio to national figures of obesity from study by Ogden et al. (2012) Figures are subject to rounding. This method allows us to create adjusted Alaska obesity rates by age and gender. For adults (20 and above), we adjust the national age and gender obesity rates by the ratio of Alaska to U.S obesity rates.

Table 4: Estimated Annual Medical Costs of Obesity in the Alaska using 2012 population data:

Age Cohort	Obese Pop	Cost in 2012 Dollars	Estimated Medical Costs of Obesity
2 to 5	4,542	N.A	0.00
6 to 11	10,008	151.48	1,515,988.70
12 to 19	13,407	422.00	5,657,863.60
20 to 24	14,191	1,629	23,111,885.86
25 to 34	26,205	1,629	42,676,845.19
35to 39	10,628	1,629	17,309,037.38
40 to 49	25,800	1,629	42,017,393.43
50 to 59	28,746	1,629	46,814,912.39
60 to 64	11,432	1,629	18,617,246.43
65 plus	17,870	1,629	29,103,118.48
	162,829		**$ 226,824,291.46**

Notes. Data on the medical costs of obesity are from studies by Finkelstein et al. (2009), Trasande and Chatterjee (2009), and Trasande et al. (2009). Medical costs are adjusted for inflation and expressed in 2012 dollars using the (medical care) Consumer Price Index (2000 to 2012) of the U.S. Bureau of Labor Statistics.

Table 5: Estimated 20 year Medical Costs of Obesity for Current Cohort of Alaska Residents between the ages of 2 and 19

Years in Future	Age Range	Obese Population	Estimated Medical Costs	**Costs Related to Currently obese Children and Adolescents**
5	7 to 24	34,834	90,265,645	59,276,308.45
10	12 to 29	38,391	149,892,251	82,374,661.05
15	17 to 34	41,459	185,076,495	91,454,511.65
20	22 to 39	43,332	199,142,287	100,219,272.44
		Total	**$624,376,679.51**	**$333,324,753.59**

Key Model Parameters:

%Currently Obese Children and Adolescents	15.2%
% Obese Male Adolescents Who Become Obese Adults	86%
% Obese Female Adolescents Who Become Obese Adults	90%
% Non-Obese Male Adolescents Who Become Obese Adults	20.29%
% Non-Obese Female Adolescents Who Become Obese Adults	20.97%

Notes: Medical costs are adjusted for inflation using historical data (2000 to 2012) from the medical care Consumer Price Index of the U.S. Bureau of Labor Statistics. Future values are discounted at a rate of 7.0 percent per year. Parameters on the obesity/non-obesity transitions between adolescence and adulthood are from a study by Freedman et al. (2005).

Table 6: Reduce Obesity rate for children between 2-19 by 1 percentage point

	Years in Future	Age Range	Obese Population	Estimated Medical Costs
	5	7 to 24	33,080	86,773,201
	10	12 to 29	36,909	145,359,253
	15	17 to 34	40,315	180,355,703
	20	22 to 39	42,556	195,215,973
Total				**607,704,131**
Savings	**16,850,481**			

Key Model Parameters:

%Currently Obese Children and Adolescents	**14.2%** compared to 15.2%
% Obese Male Adolescents Who Become Obese Adults	86%
% Obese Female Adolescents Who Become Obese Adults	90%
% Non-Obese Male Adolescents Who Become Obese Adults	20.2%
% Non-Obese Female Adolescents Who Become Obese Adults	20.9%

Notes: Medical costs are adjusted for inflation using historical data (2000 to 2012) from the (medical care) Consumer Price Index of the U.S. Bureau of Labor Statistics. Future values are discounted at a rate of 7.0 percent per year. Parameters on the obesity/non-obesity transitions between adolescence and adulthood are from a study by Freedman et al. (2005).

Breakdown of the savings by age group:

Table 7: Reduce Obesity rate for children between 2-5 by 1 percentage point

		Change
from	10.64%	-0.093
to	9.64%	

Estimated 20 year Medical Costs of Obesity for Current Cohort of Alaska Residents between the ages of 2 and 19

Age Range	Obese Population	Estimated Medical Costs
7 to 24	34,834	90,265,645.31
12 to 29	38,391	149,892,251.43

17 to 34	41,412	185,028,263.83
22 to 39	43,271	198,809,688.94
		623,995,849.51

Savings $380,000

Table 8: Reduce Obesity rate for children between 6-11 by 1 percentage point

		Change
from	16.45%	-0.0608
to	15.45%	

Estimated 20 year Medical Costs of Obesity for Current Cohort of Alaska Residents between the ages of 2 and 19

Years in Future	Age Range	Obese Population	Estimated Medical Costs
5	7 to 24	34,302.93	89,860,070.53
10	12 to 29	38,274.69	149,537,948.93
15	17 to 34	41,164.79	183,690,970.62
20	22 to 39	43,079.89	197,801,071.31
			620,890,061.38

Savings $3,486,618

Table 9:Reduce Obesity rate for children and adolescents between 12 to19 by 1 percentage point

		Change
from	16.65%	-0.05996
to	15.67%	

Estimated 20 year Medical Costs of Obesity for Current Cohort of Alaska

Residents between the ages of 2 and 19

Years in Future	Age Range	Obese Population	Estimated Medical C
5	7 to 24	33,760.03	87,481,82
10	12 to 29	37,154.99	146,108,17
15	17 to 34	40,738.04	182,119,13
20	22 to 39	42,931.69	197,174,99
			612,884,13

Savings: $11,492,542

Table 10: 1 percentage point decrease in the transition of obese adolescents into obese adults

Years in Future	Age Range	Obese Population	Estimated Medical Costs
5	7 to 24	34,769	89,966,449
10	12 to 29	38,264	149,241,593
15	17 to 34	41,275	184,184,806
20	22 to 39	43,153	198,256,807
Total			**621,649,656**
Savings 2,904,957			

Key Model Parameters:

%Currently Obese Children and Adolescents	15.2%
% Obese Male Adolescents Who Become Obese Adults	85% compared to 86%
% Obese Female Adolescents Who Become Obese Adults	89% compared to 90%
% Non-Obese Male Adolescents Who Become Obese Adults	20.2%
% Non-Obese Female Adolescents Who Become Obese Adults	20.9%

Table 11**:** 1 percentage point decrease in the transition of non-obese adolescents into obese adults

Years in Future	Age Range	Obese Population	Estimated Medical Costs
5	7 to 24	34,504	88,762,534
10	12 to 29	37,750	146,617,943
15	17 to 34	40,495	180,532,803
20	22 to 39	42,360	194,340,511
Total			**610,253,791**
Savings 14,300,822			

Key Model Parameters:

%Currently Obese Children and Adolescents	15.2%
% Obese Male Adolescents Who Become Obese Adults	86%
% Obese Female Adolescents Who Become Obese Adults	90%
% Non-Obese Male Adolescents Who Become Obese Adults	19.2% compared to 20.2%
% Non-Obese Female Adolescents Who Become Obese Adults	19.9% compared to 20.9%

Appendix 1:

Appendix: Summary of Obesity Costs

Cost category	Estimates/explanations	Costs
Medical spending	Relative medical costs of overweight (*vs* normal weight)	10-20% higher
	Relative medical costs of obese (*vs* normal weight)	36-100% higher
	Annual costs of childhood obesity	14.3 billion
	Nationwide annual "excess" medical spending attributable to overweight/obesity	86-147 billion (total), 640 million (women only)
Productivity costs		
Absenteeism	Excess days of work loss due to obesity	1.02-4.72 days
	Relative risk ratio of having high absenteeism	1.24-1.53 times higher
	National costs of annual absenteeism from obesity	$79-132 per obese person. $3.38-6.38 billion.

		$57,000 per employee (1998 USD). $8 billion (2002 USD).
Presenteeism	Relative productivity loss due to obesity	1.5% or higher
Disability	Relative risk ratio of receiving disability income support	5.64-6.92 percentage points higher
Mortality	Years of life lost due to obesity	1-13 years per obese person
Human capital accumulation costs	Days absent from school	1.2-2.1 schooldays
	Highest grade completed	0.1-0.3 fewer grades completed

Source: Hammond RA, Levine R. "The Economic Impact of Obesity in the United States. Diabetes Metab Syndr Obes, 2010:3:28, 5-295.

Appendix 2:

National Estimates

Finkelstein et al (2009) estimate additional costs that can be attributed to obesity in the following way:

Using the medical expenditure panel survey data, they estimate obesity attributable fractions for each payer (Medicare/Medicaid/Private). The dependent variable in each case is payer specific spending and the explanatory variable are the respondent's characteristics along with his/her BMI. The inclusion of an individual's BMI in the regressions allows them to determine the impact of weight (specifically obesity) on medical expenditures (they use normal weight as the reference group).

They calculate the average increase in medical spending attributable to obesity relative to normal weight by subtracting the predicted expenditures of each obese person when their obesity dummy variable is set 1, from average predicted spending for the same individual when the obesity variable is set to 0. These obesity specific allow them to generate obesity attributable fractions:

OAF=Total Predicted Spending attributable to Obesity/ Total predicted Spending for the entire sample

Their NHEA estimates are generated by multiplying the OAF's times the total spending for the corresponding insurance category.

State Specific Estimates:

Trogdon et al (2011)

In order to generate state level estimates, they supplement the national estimates described above with state representative data from the BRFSS. In essence, they combine the coefficients estimated from MEPS with the BRFSS state specific data. The OAF at the state level is measured in a similar manner to the national procedure. Once the OAF is obtained, they multiply it by the total expenditures for the state of interest/payer of interest to get overall obesity attributable expenditures. Since BRFSS does not have information on insurance status at the individual, they allocated all people over 65 to Medicare and had to model the probability of having Medicaid. For example Alaska's OAF's are:

Alaska Medicaid obesity attributable fraction =9.6% (point estimate)

Alaska's Medicare obesity attributable fraction=13.5 %(point estimate)

Alaska's State Level obesity attributable fraction=10.5% (point estimate)

The obesity attributable expenditures for the state are calculated by multiplying the fractions above times the overall expenditures by payer.