THE ROLE OF SOCIAL SUPPORT IN WEIGHT LOSS

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Joni M. Snyder, B.S.

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Joni M. Snyder, B.S.

Thesis Advisor: Donna Ruane Morrison, Ph.D.

ABSTRACT

Two-thirds of adult Americans are overweight or obese. Obesity increases an individual's risk for heart disease, type II diabetes, osteoarthritis, sleep apnea, and certain types of cancers. Doctors report that even a modest weight loss of ten percent of one's body weight can greatly reduce these risk factors. This study examines the effect of social support on weight loss among obese Americans who reported losing weight over a one-year period. The data for the analysis come from the Center for Disease Control and Prevention's 2007 Behavioral Risk Factor Surveillance System (BRFSS), an annual survey that measures the health-related behaviors of adult Americans. The concept of social support is captured in the survey question, "How often do you receive the social and emotional support your need?" Respondents' weight loss is measured two ways: with a binary variable that captures whether or not they reached the ten percent benchmark and a continuous variable that represents the actual percentage of weight lost. To determine the effect of social support on weight loss, this study uses bivariate analyses of the various factors that determine an individual's weight as well as regression anaylsis of the

marginal effects of social support on the two measures of weight loss. Using the

available data, this study was not able to detect an effect of the social support

variables on weight loss. However, given that previous empirical studies suggest

that weight loss efforts can benefit from increased social support, the question

deserves further investigation.

I would like to thank my advisor, Professor Donna Morrison, who has made writing this thesis a great joy; to my partner Michael Smith, whose love and support help me in all things; and to those people along the way who are helping me reach my own ten percent.

With Warm Gratitude,
Joni Snyder

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Chapter 1: Introduction

Two-thirds of adult Americans are overweight or obese. While the Departments of Agriculture and Health and Human Services publish guidelines about nutrition and fitness, there is little consensus about the most effective way to encourage healthy behaviors among the target population. In a basic sense, weight loss is achieved by consuming fewer calories than one expends. If losing weight were this simple in practice, however, weight loss would not receive the popular attention it does. The problem for those individuals trying to lose weight seems to lie in making the substantive and permanent behavioral changes necessary for lasting weight loss. The physiological aspects of weight loss are clear cut—researchers are now increasingly interested in the psychological and social aspects of successful weight loss.

A notable trend in weight loss strategies capitalizes on group efforts and social support. Commercial weight loss groups such as Weight Watchers and Jenny Craig gross billions of dollars each year and provide lasting weight loss for millions of customers. Television programs such as *The Biggest Loser* feature team weight loss competitions and have motivated similar team efforts on a smaller scale among workplaces and households across America. Studies have shown positive effects on weight loss of these group approaches and other forms of social support including

support from family members, friends, and personal trainers. The question raised here is whether increased social support can help individuals achieve a significant enough weight loss to lower their risks for obesity-related illnesses such as diabetes and heart disease.

This study examines the effect of social support on weight loss among overweight and obese Americans who lost weight over a one-year period. The data for the analysis come from the Center for Disease Control and Prevention's 2007 Behavioral Risk Factor Surveillance System (BRFSS), an annual survey that measures the health-related behaviors of adult Americans across all 50 states and three territories. A number of demographic, behavioral, and life factors are studied with the survey respondents' perceived level of social support as rated on a scale from 1 to 5 to isolate the effect of the latter on the liklihood of losing at least ten percent of one's initial body weight. That dependent variable is calculated from respondents' reported 2007 and 2006 weights, both collected in the 2007 survey. Values range from "zero" for those respondents who did not reach the ten percent benchmark to "one" for those who lost ten percent or more. Since the dependent variable is binary the quantitative method used is a probit regression. Additionally, a second dependent variable is used—a measure of percent of weight loss—to capture possible effects of social support on those who lost weight but did not meet the ten percent benchmark.

Evidence of a positive correlation between social support and weight loss would provide public health officials with ways to encourage weight loss beyond simple diet and exercise recommendations. Americans understand the math of "calories in versus calories out" but require guidance in making the lifestyle changes that support that behavior modification. Documenting a positive impact of social support would suggest that social approaches—for example, subsidizing the cost of commercial weight loss programs, providing employer incentives for offering worksite interventions, or offering public weight loss support for the overweight and obese— could help to lower American overweight and obesity rates.

Overweight and Obesity as a Disease

Most current estimates indicate that 60 percent or more of adult Americans are overweight or obese. The term *overweight* represents a Body Mass Index (BMI) of 25.0 to 29.9. *Obese* indicates a BMI of 30.0 or more. According to the National Center for Health Statistics (2007), 66 percent of adults 20 years and older are either overweight or obese and 32 percent are obese. The number of overweight and obese Americans has doubled since 1980, leveling off with the 2003-2004 data. In addition, the people at the higher end of the weight distribution are heavier than in previous decades (NCHS 2007). These recent obesity trends represent a great strain on

Americans' health. Overweight and obesity increase an individual's risk for heart disease, type II diabetes, osteoarthritis, sleep apnea, and certain types of cancers.

In a basic sense, the body stores excess weight when it consumes more calories than it expends. In addition to one's personal proclivities toward eating and exercise, there are myriad cultural factors that might explain increased caloric consumption and decreased caloric expenditure. Calorie-rich processed and "fast foods" are more readily available—and served in larger portions—than in previous decades. Increased reliance on technology for work and leisure activities requires less physical movement for day-to-day activities. While it appears, however, that individuals who are overweight and obese tend to engage in less physical activity (or more sedentary activity) than their slender counterparts, studies of this correlation vis-à-vis the current epidemic remain unclear (Wing and Polley 2001).

In addition to lifestyle patterns (i.e., diet and exercise) there are physiological and demographic factors that determine a person's weight. Physiological factors include genetics, metabolism, hormones, and disease (for example, hyperthyroidism). Age, sex, race/ethnicity, and socioeconomic factors can also determine overweight and obesity. Overweight prevalence increases with age, peaking at around 50 years old (Wing and Polley 2001). While men and women have similar overweight and obesity rates throughout most of the BMI distribution (rates among women are only slightly

higher), women tend to be overrepresented at the higher BMI groups. Black and Hispanic Americans have greater obesity rates than white Americans (one-third, one-third and one-fifth of their populations, respectively). Low socioeconomic status tends to predict a higher BMI (Valdez and Williamson 2002). These various physiological and demographic factors might contribute directly to excess weight or exacerbate the effects of a sedentary lifestyle and increased diet.

That such a large percentage of the population is affected by obesity is worrisome from a public health perspective. Fortunately, even modest weight loss can improve a person's long-term health. Weight loss as low as five percent of one's initial body weight can reverse the onset of heart disease and type II diabetes. A loss of 10 to 20 percent can sustain those benefits for up to five years (Blackburn 2002). In light of these benefits—and to encourage gradual, sustainable success—physicians usually advise overweight and obese patient to aim for an initial weight loss of five to 10 percent rather than the patient's "ideal weight" (Wing and Polley 2001).

Treatment of Excess Weight

For most overweight and obese people, shedding excess weight means eating less and exercising more. Surgical and pharmaceutical interventions for obesity exist but represent only a small percentage of weight loss regimens (and even they require,

at the very least, that patients limit their food intake). The body expends energy (i.e., burns calories) in three ways. First is the resting metabolic rate, or RMR. This is the energy the body uses to maintain basic functions such as breathing and represents 60 to 70 percent of daily calorie burn. The second way—what most people know as "metabolism"—accounts for 10 percent of calorie expenditure and is the energy required to process food. "Voluntary exercise" is the third component of energy expenditure and accounts for 20 to 30 percent in a sedentary person. A person aiming to lose weight can boost calorie burn in this third category by moving more throughout the day; there is also evidence to suggest that additional voluntary exercise bolsters the resting metabolic rate and metabolism (Wing and Polley 2001). The CDC currently recommends "150 minutes of moderate-intensity aerobic activity, 75 minutes of vigorous-intensity aerobic activity, or an equivalent mix of the two each week" to maintain one's current body weight (CDC 2008).   To lose weight, a person should aim for at least 60 minutes of moderate exercise "most days of the week." Increased exercise, when combined with calorie restriction, creates a calorie deficit that forces the body to tap into fat reserves to provide extra energy. To lose one to two pounds per week (the highest rate deemed safe by most physicians), a person has to ensure a calorie deficit of 500 to 1000 calories per day (CDC 2009).

It appears that weight loss is a matter of simple math—calories out must exceed calories in—and yet the prevalence of overweight and obesity suggest that losing weight is not an easy task. It is insufficient for doctors to simply instruct patients to eat less and move more; for most people, these two prescriptions require (sometimes substantial) behavior modification. There is a growing trend in weight loss literature to discuss cognitive-behavioral approaches to weight loss. Foster et al. (2005) point out the difficulty an overweight or obese patient faces in the weight loss struggle:

> Overcoming barriers is a difficult endeavor in a fast-paced environment that encourages overconsumption of energy-dense, palatable, low-cost foods and promotes energy-saving devices. A healthy lifestyle requires significant planning, proficiency in making healthy choices and estimating portion sizes, and diligence in monitoring caloric intake and activity, all of which take time to develop and maintain (231S).

Calorie reduction and increased activity may be the cornerstones of weight loss, but they must be supplemented by cognitive-behavioral methods that support an overweight individual's attempts at successful, sustained behavior modification. Examples of such methods include "self-monitoring, stimulus control, cognitive restructuring, stress management and social support" (Poston and Foreyt 2000, 3615).

Of these cognitive-behavioral methods, this study is concerned with social support. Ashby and Filer (2001) define social support as the "resources and interactions provided by others that may be useful for helping a person to cope with a

problem" (209). Within this definition, there are two types of social support: structural and functional. Structural social support speaks to the number of people (friends, family, etc.) available to an individual. Functional social support measures the perceived quality of one's social network, regardless of its size or make-up. Interestingly, studies find only a weak correlation between structural and functional social support; in other words, having more friends and family members available to help does not necessarily mean that one feels more satisfied with the quality of support received (210). Sheldon Cohen's *Social Support and Health* (1985) is the most comprehensive study of the impact of social support on health outcomes and is still widely cited today. Cohen offers a number of possible models to describe both direct and indirect effects of social support on health.

Social support can work directly or indirectly on health outcomes. There is some evidence to suggest that social support directly affects certain health indicators, for example, strong social support might naturally lower a person's blood pressure. Social support can also improve health outcomes indirectly through health-related mediators. For example, caring individuals in a person's circle may provide the encouragement needed to adopt positive health behaviors as well as the accountability needed to overcome unhealthy behaviors. Similarly, having supportive relationships reduces stress and anxiety, thereby putting a person in a better state of mind to adopt

healthy behaviors or eliminate harmful ones (Ashby and Filer 2001). The conceptual framework for this study considers the indirect effect of social support as it operates through the behavioral interventions of diet and exercise.

Not surprisingly, empirical studies have documented positive contributions of social support to weight loss. Marcoux et al. (1990) surveyed participants in a weight loss program to measure their perceptions of the adequacy of the social support they received as well as the frequency with which they received support of specific types and sources. The three types of support studied were *positive affective* (motivation and positive thinking), *appraisal* (praise for adhering to the diet and exercise plan), and *instrumental* (help with carrying out the program's requirements). From among six possible options (neighbors, spouse, friends, family, co-workers, and other), respondents were asked to identify the top sources from which they received each type of support and the quality of that support both in general and as it related to their weight loss program. Appraisal support was the most highly correlated with weight loss. Surprisingly, the impact of the family was minimal. Instead, the most common providers of appraisal support were neighbors and friends, co-workers and friends gave the most instrumental support, and neighbors and others topped the list of sources of positive affective support. Moreover, the role of spouses was ambiguous; equivalent

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percentages of respondents listed their spouses as both the most helpful (40 percent) and the least helpful in their weight loss efforts.

Direct participation of a companion might prove to be especially effective for weight loss. Gorin et al. (2005) studied participants in a weight loss program in which each participant was encouraged to bring one or more partners to join the program. While the weight loss of participants was not affected by the number of partners involved, sharing success in the program with one's companion was beneficial. Those whose partners lost at least ten percent of their starting weights were more likely to reach or exceed that achievement themselves. Participants with at least one successful partner lost 25 pounds on average after the six-month intervention, versus an average of only 14 pounds for those without such accomplished partners.

Wing and Jeffery's often-cited 1999 study examines the benefits of both natural social support and support facilitated in a clinical setting. They recruited volunteers either alone or along with up to three friends (the natural support) and then randomly assigned participants to weekly weight loss programs with or without additional social support interventions (manipulated social support). These additional social support interventions included the use of team work within the meetings, weight loss competitions among teams, and the encouragement of intragroup phone calls outside of meeting hours. While the recruitment strategy proved to be more heavily correlated

with weight loss, both social support methods were statistically significant. Controlling for the clinical social support intervention, those who brought their own partners lost an average of 19 pounds while those who joined alone lost an average of 15. Among participants who joined alone, 76 percent completed the program and only 24 percent maintained a weight loss for six months after treatment. The comparable figures increase to 95 percent and 66 percent, respectively, for those who joined with friends.

In addition to contributing to weight loss, social support may help prevent relapses among those who have successfully trimmed pounds. Kayman et al. (1990) interviewed women who reported losing more than 20 percent of their body weight at some point in the past. They classified participants as either "maintainers," those who sustained the 20 percent loss for two years or more or "relapsers," those who gained the weight back one or more times. Relapsers not only had less available social support, they also utilized their social networks less effectively than maintainers. Moreover, individual assessments showed that maintainers had more sophisticated coping and emotional skills than those who regained weight. The authors postulated that social support may act as a buffer to stress among that group. It is also possible, however, that those with greater emotional resilience are more successful in building strong social relationships.

Conceptual Framework

Theoretical perspectives drawn from psychology, sociology and medicine inform the conceptual framework guiding this investigation of the relationship between social support and weight loss success among men and women whose BMI scores exceed medically-established markers for healthy weight. As shown in Figure 1, weight loss is assumed to be a function of numerous interrelated and sometimes countervailing factors, including physiological (genes, metabolism, disease, general health, and mental health), demographic (sex, age, region, race, ethnicity, marital status, education, income, type of work), and lifestyle risks (poor diet, little exercise) and behavioral and cognitive protectors, including beneficial modifications in diet and exercise. The relationships among these variables are complicated, and each one may have multiple effects on weight loss. Specifically, the risk factors below can have a direct, negative effect on an individual's weight; they might also negatively affect the behavioral interventions, making it harder for that already more obese individual to make positive steps toward weight loss.

For this study, social support is assumed to influence weight loss indirectly by facilitating the necessary behavioral modifications. Specifically, functional support in the form of outside help and motivation is presumed to make it easier for individuals to adopt positive changes in diet and exercise. The hypothesis in this study is that social

support increases the likelihood that overweight and obese individuals will reach or surpass the ten percent weight loss benchmark advocated by health professionals.

Figure 1: Conceptual Model
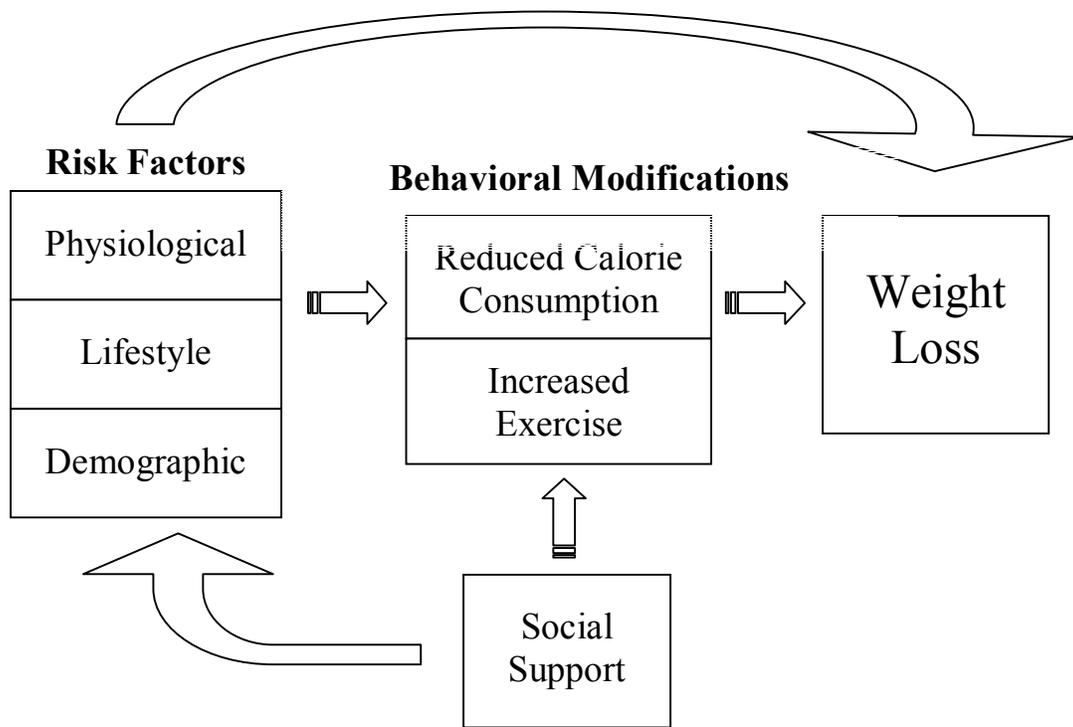
Chapter 2: Data and Methods

Data

The data for this study come from the Center for Disease Control and Prevention's 2007 Behavioral Risk Factor Surveillance System (BRFSS), an annual survey that measures the health-related behaviors of adult Americans across all 50 states, DC, Puerto Rico, Guam, and the Virgin Islands. "The object of the BRFSS is to collect uniform, state-specific data on preventive health practices and risk behaviors that are linked to chronic diseases, injuries, and preventable infectious diseases in the adult population" (*BRFSS Overview* 2007). The sample is intended to be generalized to adult Americans 18 and over who live in households. Surveys were conducted by state health departments in conjunction with the CDC using computer-assisted telephone interviewing (CATI). The questionnaire has three parts: the core component (used by all states), optional modules (questions about specific health issues, chosen by states), and state-added questions.

The unit of analysis for the BRFSS data set is the individual: 430,912 respondents participated in the 2007 survey. To ensure random sampling, the CDC used a disproportionate stratified sample (DSS) design to account for differences between high-density and medium-density regions. In addition, weight adjustments have been used by the survey designers to control for telephone access bias,

interruptions in phone calls, and other factors that undermine the randomness of the sample. A final weight variable was created to account for these various survey designs and will be utilized in statistical analyses to obtain correctly estimated standard errors.

Limitations

The BRFSS contains a wealth of information about Americans' health behaviors but it also has some fundamental weaknesses. First, data are self-reported which may introduce bias via both inaccurate recollection and false reporting. Misrepresentation is a particular risk when survey questions involve sensitive or potentially embarrassing subjects, such as weight, eating habits and exercise. Second, the BRFSS study is cross-sectional and as with any point-in-time data it is not possible to establish the causal direction of relationships between or among variables. In the present study, if a positive association is found between social support and weight loss it may reflect one variable's influence on the other in both directions.

Another notable limitation of the data for this study concerns the availability of information on the process of weight loss. Specifically, the notion of intentionality in weight loss is overlooked by the survey writers: the question "Was your change in weight intentional?" was asked only of those respondents who reported either gaining

or losing weight over the previous year. There is no way of discerning from the data which individuals set out to lose weight but were unsuccessful or fell short of their initial goals. Additionally, the BRFSS data set lacks questions about the weight loss process that would illuminate successful approaches. It would be helpful to know, for example, when respondents started trying to weight or what approaches they took to weight loss.

A final challenge for the present study is the limited information about social networks and relationships ascertained from respondents. Although the existing literature treats social support as a multidimensional construct, the BRFSS contains only one relevant question; "How often to you receive the social and emotional support you need?" This ordinal variable ranges from "never" to "always" on a 5-point scale. Ideally one also would be able to measure a respondents' skillfulness in acquiring and utilizing support from family, friends, neighbors and others in the community as well as the specific sources from whom respondents receive particular types of encouragement. Finally, it is not possible to measure changes in a respondent's social support network over time or differences in its effect under various circumstances. Given these limitations it is important to exercise caution when interpreting the findings of this study.

Analysis Sample

As the aim of this study is to examine the contribution of social support to weight loss among men and women at unhealthy levels at the start, the analysis sample is restricted to BRFSS respondents who were (1) obese in the year prior to the survey year (BMI≥30) and (2) maintained or decreased their weight over the year. Respondents in the 2007 survey were asked to report their current weight and their weight one year prior to the study. Further, they were asked whether the change in weight was intentional. Pregnant women and people over 65 were excluded from the study sample since both of these factors affect a person's weight and the ability or safety of losing excess weight. Reporting and/or recording errors left a small number of observations (less than 0.01 percent) implausible (for example, a two-foot tall respondent weighing 500 pounds). These outliers were dropped from the analysis. The final analysis sample consists of 126,458 observations.

Variables

Dependent variables

This study uses two separate dependent variables. The binomial dependent variable *tenpercent* represents the likelihood of an individual obese respondent losing ten percent or more of initial body weight. This variable is calculated as a percentage

based on respondents' reported weight during the time of the survey and their reported weight for a year prior to the study. Of the 126,458 respondents, 19.7 percent lost ten percent or more of their starting weight. An additional, continuous, dependent variable, *percentchange,* is used to capture a more nuanced picture of respondents' weight loss. This allows for exploration of weight losses smaller than ten percent. The mean percent of initial weight lost by the sample respondents was 4.8 percent. The highest reported percentage lost was 47 percent, though this number was on the far end of a very thin distribution tail.

Social Support

The key explanatory variable in this study is social support. It is operationalized using responses from the survey question, "How often to you receive the social and emotional support you need?" Respondents rated their perceived support on a scale from 1-5 representing, respectively, *always*, *usually*, *sometimes*, *rarely*, and *never*. For this study, separate dummy variables were created for each of the five categories, coded '1' if the respondent gave the particular response and '0' otherwise. Despite the weaknesses of this measure discussed previously, an advantage is that it captures respondents' *perceived* quality of social support which taps functional rather than structural forms of social support. The literature suggests that functional support might be more germane to the case of weight loss. For example, in

the Gorin et al. study, the mere presence of companions did not increase weight loss, but the presence of companions who were themselves successful at losing weight did. In that study, it was the quality of support received that was key— presumably, the successful companions were better able to provide motivation and reinforce the healthy behaviors that led to weight loss.

Other explanatory variables from the conceptual model are included in this study as available. Some of the concepts, for example, genetics and metabolism, are not able to be captured in a survey; others, such as adoption of a comprehensive weight loss regimen were simply not included as BRFSS questions. Table 1 provides means for all of the variables used in this analysis before the means were imputed for the regression analysis.

Table 1: Operationalization of Concepts and Variable Means

Concept	Variable	Mean
Dependent Variable: Weight (four measures)		
		(as percentage)
Lost weight	lostweight	45.5
Number of pounds lost	numeratorlb	11.5
Percentage of initial body weight lost	percentchange	4.8
Lost ten percent of initial body weight	tenpercent	19.7
Independent Variable of Interest: Social Support (five categories)		
Always has needed social support	ssalways	47.3
Usually has needed social support	ssusually	32.3
Sometimes has needed social support	sssometimes	12.9
Rarely has needed social support	ssrarely	4.1
Never has needed social support	ssnever	3.4

DEMOGRAPHIC

| **Sex** | female | 45.2 |
| | male | 54.8 |

Age	18to24	6.1
	25to34	18.3
	35to44	26.2
	45to54	26.9
	55to64	22.5

Region	south	26.1
	midwest	23.7
	otherregion	50.1

Race	black	12.3
	white	78.8
	otherrace	8.9

| **Hispanic** | hispanic | 13.8 |
| | nonhispanic | 86.2 |

Marital Status

Married	married	65.8
Domestic partnership	cohabit	3.5
Single	single	30.6

Education Level

College graduate	college	31.3
High school graduate	highschool	60.0
Did not graduate from high school	lessschool	8.6

Routine Daily Activity

| Work involves walking or demanding labor | routinex | 35.5 |

| **Income** (quasi-continuous) | incomenew | $69,695 |
| Income above U.S. average ($50,233) | medianinc | 51.8 |

PHYSIOLOGICAL

| **General Health** | goodhealth | 82.0 |

| **Mental Health** | depressed | 11.9 |

Starting BMI (all greater than 30.0)	bmiyrago	35.4
BEHAVIORAL		
Diet		
Zero fruits and vegetables per day	fruitveg0	5.3
One fruits and vegetables per day	fruitveg1	37.3
Three fruits and vegetables per day	fruitveg3	34.1
Five fruits and vegetables per day	fruitveg5	23.3
Intentional Exercise		
Meets recommendation for moderate exercise	moderatex	34.5
Meets recommendation for vigorous exercise	vigorousex	25.8
Insufficient physical activity	somex	41.6
No physical activity	nox	12.1

Methodology

Two measures of weight loss are used as dependent variables for the regressions. Given the particular significance for overweight and obese individuals of a weight loss amounting to ten percent or more of starting body weight loss, this study first uses a probit regression models to examine the effect of social support on the likelihood of achieving this goal. Additionally, a continuous version of weight loss – pounds lost as a percentage of starting weight — is regressed on the social support and other explanatory variables. This allows for exploration of the importance of social support among those whose drop in weight had not (or not yet) reached the recommended ten percent level (sample average = 4.8 percent).

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Since the sample includes a sizable number of whose weight remained unchanged over the year, a tobit model is used for the continuous version of weight loss to correct for the right-skew in the distribution. Three versions of the tobit model are used to isolate the effects of the background variables (physiological and demographic factors), the behavioral interventions of diet and exercise, and finally the social support variables. The first model includes only background variables. Behavioral interventions of diet and exercise are added to the second model. The social support variables are added into the third model to assess their effects on weight loss net of the other explanatory factors. All models estimated in this study include a final sample weight created by the BRFSS authors to account for their survey design. To account for missing values in some of the observations, the variable means have been imputed for the regression models.

One important methodological challenge in this study is that the models cannot take into account unobservable correlations among weight loss, social support, and the various explanatory variables. If a statistically significant relationship exists between social support and weight loss, it would be unclear whether the effect came directly from the support or from the variables that might be highly correlated with higher levels of social support. For example, if people who went to college are better able to make changes to their diet and also attract a higher quality of social support, it would

be difficult isolate the effect of social support from the dietary changes. Given the possible correlations among the variables used in this study, any findings about effects of social support should be approached cautiously.

Chapter 3: Findings

This analysis begins by exploring the bivariate relationships between weight loss and the explanatory variables. Next is a bivariate analysis of social support and the explanatory variables to detect correlations between explanatory factors and perceived social support received. The final bivariate analysis looks at weight loss and social support to view the distribution of perceived social support among the group that lost ten percent or more of initial weight and the group that did not. This is followed by estimating the series of regression models described in the previous section to detect the incremental effect of social support on the weight loss outcomes achieved.

Among men and women classified as overweight or obese based on their BMI scores from a year ago, 46 percent lost weight, with a mean drop of 11.5 pounds. Expressed as a ratio of starting weight, this amounts to an average loss of 4.8 percent. Twenty percent of the entire sample reached or exceeded the ten percent benchmark recommended by physicians for obese individuals. Table 2 shows the means of the explanatory variables for those who reached the ten percent benchmark, those who did not, and for the sample as a whole. As expected, the "ten-percent losers" tended to eat more fruits and vegetables (32 percent eat five or more) than their counter-parts (21 percent). They also reported engaging in more frequent—and more strenuous— exercise (43 percent meet the CDC recommendation for moderate exercise, 35 percent

for vigorous exercise) than those who did not reach ten percent (32 and 24 percent, respectively). A greater percentage of those who lost at least ten percent of their starting weight were female (54 percent), young (31 percent), and single (39 percent), compared to 42, 23, and 29 percent, respectively, for those who did not reach the benchmark. Interestingly, the men and women who reached or exceeded the ten percent milestone had higher mean BMI scores the year before than those who did not meet it. Contrary to expectation, those who reached the ten percent benchmark were more likely to be depressed than those with less weight loss. This may be due to the fact that, while the survey question asked about depression in the past 30 days, the cross-sectional data do not tell us when the weight losses occurred.

Table 2. Demographic, Physiological, and Behavioral Characteristics, by Weight Loss Status

	10% Threshold Met (tenpercent=1)	10% Threshold Not Met (tenpercent=0)	Average Percent Weight Lost
Demographic Factors			
	(as percentage)		
Male	43.6	57.6	4.1
Female	56.4	42.4	5.7
18 to 24	9.4	5.2	7.0
25 to 34	21.6	17.5	5.6
35 to 44	26.1	26.3	4.7
45 to 54	24.2	27.6	4.5
55 to 64	18.7	23.4	4.2
South	26.4	26.0	4.9
Midwest	21.2	24.4	4.4
Other regions	52.4	49.6	5.0

Black	12.8	12.2	5.2
White	78.8	78.9	4.8
Other race	8.5	9.0	4.9
Hispanic	14.1	13.8	5.1
Non-Hispanic	85.9	86.2	4.8
Married	57.2	67.9	4.3
Domestic partnership	4.1	3.4	5.4
Single	38.7	28.6	5.8
College graduate	29.0	31.8	4.6
High school graduate	62.8	59.3	4.9
Did not graduate high school	8.1	8.7	4.6
Work involves walking or demanding labor	39.4	34.6	4.9
Income	$65,704	$70,676	-
Above median U.S. income ($50,233)	47.5	52.8	4.5
Physiological Factors			
General health (goodhealth=1)	81.6	82.0	4.8
Depressed	15.7	11.0	6.1
Starting BMI	37.4	34.9	-
Behavioral Factors			
Zero fruits and vegetables per day	4.7	5.4	4.3
One fruits and vegetables per day	30.6	39.0	4.0
Three fruits and vegetables per day	32.8	34.5	4.7
Five fruits and vegetables per day	31.8	21.2	6.4
Meets recommendation for moderate exercise	42.5	32.5	4.7
Meets recommendation for vigorous exercise	35.2	23.5	5.2
Insufficient physical activity	33.3	43.6	3.7
No physical activity	9.8	12.7	3.3

Close to the majority of people—47 percent—reported always having the social

support they need. Thirty-two percent reported usually having the support they

needed, and 13 percent reported sometimes having it. Fewer than eight percent

reported rarely or never having support. Table 3 gives a breakdown of characteristics for each of the five social support categories. The group with the strongest ratings of social support (usually and always) is disproportionately white, married, female, and college-educated. In contrast, blacks, Hispanics, and those who classified their jobs as "physically demanding" were over-represented among the groups reporting rarely or never having the social support they need. Additionally, those reporting less social support tended to have poorer diets and exercise habits as well as a stronger tendency toward depression.

Table 3 Relationship Between Social Support and Other Explanatory Variables

	Social Support				
	Always	Usually	Sometimes	Rarely	Never
Demographic Factors					
			(as percentage)		
Male	57.1	52.5	48.3	51.4	63.9
Female	42.9	47.5	51.7	48.6	36.1
18 to 24	6.5	5.9	5.6	6.2	4.3
25 to 34	17.7	19.7	18.3	17.0	13.9
35 to 44	25.5	27.2	27.0	24.3	24.9
45 to 54	27.0	25.9	27.9	29.4	28.1
55 to 64	23.3	21.3	21.1	23.1	28.8
South	28.7	22.1	26.8	26.2	26.6
Midwest	22.9	27.3	22.4	25.4	17.7
Other regions	48.4	50.6	50.8	48.4	55.7
Black	12.2	8.0	16.5	16.3	23.8
White	79.6	84.8	73.9	72.2	57.8
Other race	8.2	7.2	9.7	11.6	18.4
Hispanic	13.2	11.0	15.6	18.8	27.7

Non-Hispanic	86.8	89.0	84.4	81.2	72.3
College graduate	32.3	37.7	23.9	21.5	9.5
High school graduate	59.9	57.5	63.3	63.2	63.7
Did not graduate from high school	7.7	4.9	12.7	15.2	26.1
Married	71.9	66.3	53.5	47.8	49.4
Domestic Partnership	3.1	3.9	4.2	3.2	4.7
Single	25.0	29.8	42.3	49.0	45.9
Work involves walking or demanding labor	36.1	32.3	36.2	40.5	50.7
Income	$74,260	5,523	55,315	45,565	42,726
Income above U.S. average ($50,233)	56.5	57.2	38.2	27.6	24.5

Physiological Factors					
General health (goodhealth=1)	86.0	85.6	71.7	58.2	66.4
Depressed	6.5	10.2	24.1	38.7	24.4
Starting BMI	35.3	35.3	36.0	36.2	35.9

Behavioral Factors					
Zero fruits and vegetables per day	3.8	4.8	7.7	10.7	11.4
One fruits and vegetables per day	35.6	37.7	41.5	39.2	37.9
Three fruits and vegetables per day	34.9	35.2	30.7	33.7	30.1
Five fruits and vegetables per day	25.7	22.3	20.1	16.4	20.6
Meets recommendation for moderate exercise	36.4	33.6	33.3	30.2	27.4
Meets recommendation for vigorous exercise	28.9	25.0	21.6	19.0	18.4
Insufficient physical activity	39.8	45.0	41.5	39.5	36.2
No physical activity	10.6	10.0	15.7	20.4	26.3

Table 4 examines the relationship of particular interest, that between social support and weight loss. There is not an obvious difference in reported levels of social support between the two. Regardless of whether they reached the ten percent benchmark, the plurality of individuals perceive always or usually having the social support they needed. There is a slight difference between the "loser" and "non-loser"

groups in the percentage of people who rated social support as "sometimes" available when needed --14 and 13 percent, respectively. Also consistent with the overall sample means, fewer than eight percent of respondents in both groups reported rarely or never having social support less.

Table 4. Relationship Between Social Support and Weight Loss

	10% Threshold Met (tenpercent=1)	10% Threshold Not Met (tenpercent=0)	Average Percent Weight Lost
	(as percentage)		
Always has needed social support	47.0	47.4	4.8
Usually has needed social support	31.8	32.4	4.8
Sometimes has needed social support	13.5	12.7	5.0
Rarely has needed social support	4.0	4.1	4.9
Never has needed social support	3.6	3.4	4.8

Having provided evidence of correlation between social support and other predictors of weight loss, it is important to control for these factors when assessing its independent effect. The multivariate analysis begins with a probit model to estimate the relationship between the explanatory variables and the likelihood of losing ten percent or more of one's starting weight. The dprobit function in Stata estimates the marginal effects of each of the independent variables. As shown in Table 4, young, single, white women were slightly more likely to reach the ten percent benchmark. Specifically, being female was associated with a 0.07 percent increase in the likelihood

of reaching ten percent. The 18 to 24 category showed a modest 0.03 percent increase, while the married and black categories decreased the likelihood by 0.03 percent and 0.02 percent, respectively. None of the social support variables were significant in this model specification.

Table 5. Dprobit Coefficients (Standard Errors) for Predicting *tenpercent* Likelihood		
Female	0.07	(.003)**
18to24	0.03	(.012)**
35to44	-0.02	(.006)**
45to54	-0.03	(.005)**
55to64	-0.04	(.005)**
South	0.01	(.004)**
Midwest	-0.02	(.004)**
Black	-0.02	(.006)**
Other race	0.01	(.007)**
Hispanic	0.01	(.007)
Married	-0.03	(.004)**
Domestic partnership	-0.02	(.010)
College graduate	-0.01	(.004)**
Did not graduate high school	0.00	(.006)
Work involves walking or demanding labor	0.03	(.004)**
General health (goodhealth=1)	0.00	(.004)
Depressed	0.04	(.005)**
Starting BMI	0.01	(.000)**
One fruit or vegetable per day	0.00	(.008)
Three fruits and vegetables per day	0.03	(.008)**
Five fruits and vegetables per day	0.08	(.009)**
Meets recommendations for moderate exercise	0.06	(.004)**
Meets recommendations for vigorous exercise	0.09	(.004)**
Insufficient physical activity	0.01	(.009)**
Always has needed social support	0.00	(.009)
Usually has needed social support	-0.01	(.009)
Sometimes has needed social support	0.00	(.010)
Never has needed social support	-0.10	(.010)

Coefficients marked with asterisks (**) are statistically significant

The tobit models were used next to estimate the relationship between social support and the continuous measure of weight loss. These results largely mirror those from the probit models. As before, being female, white, and 18 to 24 revealed positive and statistically significant effects on the percent weight lost. Having a physically demanding job boosted weight loss somewhat (1.2 percent). Being married seemed to decrease weight loss (0.6 percent). An impact of races emerges here that was not detectable in Table 2: being black and Hispanic both made statistically significant contributions to additional weight loss: -1.9 and -3.2 percentage points, respectively.

Model 2 examines the incremental effects of diet and exercise on weight loss. The impacts here meet prior expectations about the effects of these behaviors in weight loss efforts. A healthier diet, as represented by daily consumption of five or more fruits and vegetables led to increase in weight loss of 3.3 percentage points. Meeting the CDC requirements for vigorous exercise increased weight loss by 3.8 percentage point, and moderate exercise, by 2.1.

The social support variables are added into the third iteration of the tobit model. Of the four examined against a base of "no social support," only one, *rarely*, had a statistically significant coefficient. The direction of its influence is counter to what was expected. People who indicated they rarely had the social support they needed tended to lose 1.5 percentage points fewer than those reporting never having social

support. Table 5 gives the coefficients and standard errors of each iteration of the

model.

Table 6. Tobit Coefficients (Standard Errors) for Models Predicting *percentchange*

	Model 1	Model 2	Model 3
Female	-1.0 (0.14)**	-1.1 (0.15)**	-1.1 (0.15)**
18to24	-2.8 (0.34)**	-2.4 (0.34)**	-2.4 (0.34)**
25to34	-	-	-
35to44	1.9 (0.20)**	1.5 (0.20)**	1.4 (0.20)**
45to54	3.1 (0.20)**	2.5 (0.20)**	2.5 (0.20)**
55to64	4.4 (0.23)**	3.5 (0.23)**	3.5 (0.23)**
South	0.6 (0.17)**	0.5 (0.17)**	0.4 (0.17)**
Midwest	1.1 (0.17)**	0.8 (0.17)**	0.8 (0.17)**
Other region	-	-	-
Black	-1.9 (0.22)**	-1.9 (0.22)**	-1.9 (0.22)**
White	-	-	-
Other race	0.1 (0.27)	0.1 (0.27)	0.1 (0.28)
Hispanic	-3.2 (0.23)**	-3.3 (0.23)**	-3.2 (0.24)**
Non-hispanic	-	-	-
Married	0.6 (0.17)**	0.5 (0.17)**	0.6 (0.17)**
Domestic partnership	-0.1 (0.37)	-0.2 (0.37)	0.0 (0.38)
Single	-	-	-
College graduate	-0.5 (0.16)**	-0.1 (0.16)	-0.1 (0.16)
High school graduate	-	-	-
Did not graduate high school	1.4 (0.31)**	1.2 (0.31)**	1.2 (0.32)**
Work involves walking or demanding labor	-1.2 (0.15)**	-0.9 (0.15)**	-0.9 (0.15)**
Income	0.0 (0.00)	0.0 (0.00)	0.0 (0.00)
General health (goodhealth=1)	-1.1 (0.23)**	-0.7 (0.23)**	-0.7 (0.23)**
Depressed	-2.0 (0.24)**	-2.2 (0.24)**	-2.2 (0.25)**
Starting BMI	-0.5 (0.01)**	-0.5 (0.01)**	-0.5 (0.01)**

Five fruits and vegetables per day		-3.3 (0.36)**	-3.4 (0.36)**
Three fruits and vegetables per day		-1.0 (0.35)**	-1.1 (0.35)**
One fruit or vegetables per day		-0.1 (0.35)	-0.2 (0.35)
Zero fruits and vegetables per day	-	-	-
Meets recommendation for vigorous exercise		-3.8 (0.19)**	-3.8 (0.19)**
Meets recommendation for moderate exercise		-2.1 (0.19)**	-2.1 (0.19)**
Insufficient physical activity		-1.1 (0.21)**	-1.0 (0.21)**
No physical activity	-	-	-
Always has needed social support			0.7 (0.44)
Usually has needed social support			0.5 (0.45)
Sometimes has needed social support			0.5 (0.47)
Rarely has needed social support			1.5 (0.57)
Never has needed social support	-	-	-
Pseudo R^2	0.12	0.18	0.18

Coefficients marked with asterisks (**) are statistically significant

Chapter 4: Discussion and Policy Implications

This study explored the effect of social support on the likelihood of obese survey respondents losing ten percent or more of their initial weight. A weight loss of ten percent is the benchmark recommended by physicians for reducing the risks of heart disease, type II diabetes, osteoarthritis, and other ailments related to obesity. Given that a majority of Americans are now overweight or obese, finding successful approaches to weight loss has become a crucial matter in public health. The rising popularity of group weight loss approaches combined with documented benefits of social support in empirical studies suggests that social support might provide an important key to success in dropping excess weight. This study hypothesized that higher reported levels of social support would increase the likelihood that previously obese survey respondents in the CDC's 2007 BRFSS would have lost ten percent or more of their weight by the time of the survey.

Nearly 46 percent of the sample respondents lost weight. The mean overall weight loss was 4.8 percent of initial weight, or 11.5 pounds. Twenty percent of respondents met or exceeded the ten percent benchmark. As expected, that group tended to eat more fruits and vegetables and reported in engaging in more frequent exercise than their counterparts. The group that lost ten percent or more of their

starting weight was, on average, more highly represented by young, single white women.

Although a statistically significant effect of the contribution of social support to successful weight loss was not detected in the multivariate models, there are three plausible explanations. First, the BRFSS data contained very limited information about the intentionality of weight loss. Only those whose weight had actually changed during the past year were asked whether their weight loss had been intentional. It is quite likely however, that additional men and women had similar intentions the prior year, but for whatever reason were not successful. Without a way to differentiate them, the "non-loser" group is comprised of both those who may have taken active steps toward losing weight with those who had not. To the extent that those who set weight loss goals share similarities, irrespective of the degree of their success, this minimizes the chances that a statistically significant effect of social support will be discernible. Second, given the cross-sectional nature of the data, the timing of a given level of social support vis-à-vis weight loss cannot be determined. A more substantial problem appears to be the way social support is described in the BRFSS survey. The question as phrased for the 2007 survey does not capture the finer nuances of this broader concept, for example, the sources of social support and how it is utilized. A more

extensive array of social support survey questions may have shown the relationship between social support and weight loss that the literature supports.

Despite the limitations of this study, social support remains a promising part of a comprehensive approach to weight loss. Overweight and obesity are threatening America's health, and weight loss interventions that take a group approach might provide an efficient way to target large groups of high-risk individuals. Commercial weight loss groups have capitalized on the idea of mutual support for years. Policymakers might investigate the success of those models as well as the new wave of groups that have become popular in the past few years— employer-sponsored weight loss competitions, community challenges, and informal weight loss monitoring among friends, neighbors, and co-workers—to find best practices among successful "losers." Social support could be encouraged in weight loss efforts in a number of ways. Public health recommendations could encourage overweight and obese individuals to enlist companions in their weight loss efforts. State or local health programs could subsidize the cost of enrolling in a commercial or public weight loss group. The tax code might be used to provide employer incentives for offering worksite interventions. Whatever policy is pursued, it has become clear that overweight and obesity are no longer the problem of a few individuals, and comprehensive group approaches are necessary.

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