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LOSS

John Cawley
Joshua A. Price

Working Paper 14987
<http://www.nber.org/papers/w14987>

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
May 2009

The authors gratefully acknowledge a research grant from the Economic Research Service of the USDA on Behavioral Health Economics Research on Dietary Choice and Obesity. The authors thank Company X for providing their data and for the generosity of their time in explaining their intervention and discussing the data. For helpful comments, the authors thank Dan Benjamin, Dhaval Dave, Ron Ehrenberg, Michael Grossman, Naci Mocan, and participants in a Cornell work-in-progress seminar, the NBER pre-conference on the Economic Aspects of Obesity, and the NBER Conference on Economic Aspects of Obesity. The views expressed herein are those of the author(s) and do not necessarily reflect the views of the National Bureau of Economic Research.

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Outcomes in a Program that Offers Financial Rewards for Weight Loss

John Cawley and Joshua A. Price

NBER Working Paper No. 14987

May 2009

JEL No. D01,D03,I1,J01

ABSTRACT

Obesity rates in the U.S. have doubled since 1980. Given the medical, social, and financial costs of obesity, a large percentage of Americans are attempting to lose weight at any given time but the vast majority of weight loss attempts fail. Researchers continue to search for safe and effective methods of weight loss, and this paper examines one promising method - offering financial rewards for weight loss. This paper studies data on 2,407 employees in 17 worksites who participated in a year-long worksite health promotion program that offered financial rewards for weight loss. The intervention varied by employer, in some cases offering steady quarterly rewards for weight loss and in other cases requiring participants to post a bond that would be refunded at year's end conditional on achieving certain weight loss goals. Still others received no financial incentives at all and serve as a control group. We examine the basic patterns of enrollment, attrition, and weight loss in these three groups. Weight loss is modest. After one year, it averages 1.4 pounds for those paid steady quarterly rewards and 3.6 pounds for those who posted a refundable bond, under the assumption that dropouts experienced no weight loss. Year-end attrition is as high as 76.4%, far higher than that for interventions designed and implemented by researchers.

John Cawley

124 MVR Hall

Department of Policy Analysis and Management

Cornell University

Ithaca, NY 14853

and NBER

jhc38@cornell.edu

Joshua A. Price

Cornell University

385 Ives Hall East

Ithaca, NY 14853

jap224@cornell.edu

Introduction:

Obesity, defined as a body mass index² (BMI) of 30 or higher, has more than doubled in U.S. since 1980 (Flegal et al. 2002). As of 2003-2004, 66.3 percent of Americans were at least overweight (BMI of 25 or higher) and 32.2 percent were obese (Ogden et al. 2006).

Obesity imposes a variety of health, financial, and psychic costs: greater risk of illnesses such as diabetes and hypertension (Must et al. 1999), higher health care costs (Finkelstein, Fiebelkorn, and Wang 2003), higher job absenteeism (Cawley et al. 2007), lower quality of life, especially for women (Muennig et al. 2006), lower wages for women, especially white women (Cawley 2004), and greater risk of death, especially from cardiovascular disease (Flegal et al. 2007).

A variety of approaches are being used to treat obesity and encourage weight loss. One promising strategy based on psychology and behavioral economics is to offer financial incentives for weight loss. Obesity is costly to health insurance companies (Finkelstein et al. 2003) and employers (Cawley et al. 2007), so for either or both of those organizations to offer monetary incentives for enrollees or employees to lose weight could be mutually beneficial.

This paper studies data from a firm that coordinates a program of financial incentives for weight loss in various worksites in the U.S. We study attrition and weight loss in three types of incentive programs: one that offers no financial rewards for weight loss, one that offers quarterly payments that rise in value with the amount of weight loss, and a third that takes deposits (bonds) that are only refunded if the employee achieves a specific weight loss goal and also includes a quarterly lottery for those who have lost

² BMI is defined as weight in kilograms divided by height in meters squared.

weight. Relative to previous studies of weight loss in response to financial incentives, strengths of this study include a large sample size (2,407) and a long intervention (one year).

A 2007 Institute of Medicine report on obesity prevention set the immediate next step – which it described as an essential priority action for the near future – as “learning what works and what does not work and broadly sharing that information.” (IOM 2007, p. 410). It also notes that “All types of evaluation can make an important contribution to the evidence base upon which to design policies, programs, and interventions.” (Ibid, p. 4). This paper makes a contribution to that effort by documenting enrollment, attrition, and weight loss in one interesting and promising intervention. This paper presents basic patterns in the data; a subsequent paper will estimate regression models to test specific hypotheses about attrition and weight loss.

Conceptual Framework and Previous Literature

For obese people, weight loss would likely result in substantial benefits.³ For example, the health benefits of modest weight loss (defined as 5-10% of starting weight) include decreased blood pressure and cholesterol and a 25% reduction in mortality risk for type 2 diabetics (Vidal, 2002). Weight loss may also improve quality of life (Ford et al. 2001). There may also be financial benefits. Cawley (2004) finds a causal impact of weight on wages, and that obese white females earn roughly 11 percent less than healthy-

³ There are two ways researchers have sought to measure the benefits of weight loss. The first is to examine changes in outcomes associated with losing weight. The second is to compare the outcomes of individuals of different weight, and assume that the difference in outcomes is due to the difference in weight. Each has its limitations: weight loss studies often lack power, and comparisons across weight levels are confounded by differences in unobserved characteristics. Vidal (2002) assesses the evidence on the benefits of weight loss and concludes that modest weight loss (5-10% of initial body weight) improves cardiovascular risk factors and helps prevent or delay the onset of type 2 diabetes and hypertension.

weight white females. Finkelstein et al. (2003) calculate that, relative to the healthy weight, the obese incur \$125 higher annual out-of-pocket health care costs. With two-thirds of Americans overweight or obese (Ogden et al. 2006), and given these potential benefits of weight loss, it may not be surprising that 46 percent of all American women and 33 percent of all American men are trying to lose weight (Bish et al. 2005).

Most people fail in their attempts to lose weight⁴, and many of those who are successful in losing weight regain it in a short period of time.⁵ For example, in one community-based study of weight gain prevention (Crawford et al., 2000), most (53.7%) participants *gained* weight in the first twelve months, three-quarters gained weight over three years, and only 4.6% lost weight and maintained the loss for three years.

Theory and evidence from psychology and behavioral economics provide several explanations for why so many weight loss attempts fail. First, the benefits of weight loss are not salient. For example, foregone quality of life and lost wages are not visible and therefore they are frequently unrecognized as opportunity costs (Bastiat, 1850).

A second possible explanation for repeated failure at weight loss is that the benefits of weight loss may not be immediate. Improvements in health and labor market outcomes may not occur for some time after weight loss, and Ainslie (1975) finds

⁴ Some obese individuals are able to lose weight by modifying their behaviors: eating less and exercising more. In the select group enrolled in the Weight Control Registry, all of whom have lost at least 30 pounds and kept it off for at least one year, 44.6% report losing the weight entirely on their own, that is, without the help of a commercial program, physician, or nutritionist (Wing and Phelan, 2005). Clearly such statistics do not generalize to the population; anyone who failed at initial weight loss is ineligible for this registry of people who maintained weight loss for a year.

⁵ Conventional wisdom is that virtually no one succeeds at maintaining weight loss. This perception has been traced back to a 1959 study of 100 obese individuals in which only 2 percent maintained loss of 20 pounds or more two years after the treatment (Stunkard and McLaren-Hume 1959; Wing and Phelan 2005). However, the 1959 study was based on a crude diet intervention with negligible support or follow-up so its poor results may not generalize to today's much more intensive interventions.

consistent evidence that there is a decline in the effectiveness of rewards as the rewards are delayed from the time of choice.

A third explanation for repeated failure at weight loss is that, contrary to the standard economic model of discounted utility (Samuelson 1937), people may discount hyperbolically, which produces time-inconsistent preferences (Ainsley 1975). In this context, time inconsistent preferences mean that people want to do what is in their long-run interest (lose weight), but they consistently succumb to the temptation to eat and be sedentary. Thaler and Shefrin (1981) describe individual decision-making as a battle between a farsighted planner (who in this context wants to diet) and a myopic doer (who in this context wants to eat and be sedentary).

One intervention, financial rewards for weight loss, may offer a solution to the problems of salience, immediacy, and time-inconsistency. Financial rewards, even though they may be dwarfed in value by the other benefits of weight loss, have the benefit of being salient, with their amount and delivery date known with certainty in exchange for clearly defined objectives. Even small financial incentives can be effective because research has found that people tend not to compare payoffs to their income or wealth but instead “bracket” them - consider them in isolation (Read et al. 1999; Kahneman and Tversky 1979). Lotteries may be particularly cost-effective incentives for healthy behavior. People tend to overweight the probability of unlikely events and underweight the probability of likely events (Kahneman and Tversky 1979), implying that lotteries can be more attractive than certain payments even if the two have equal expected values. Financial rewards can also be paid immediately, before other benefits of weight reduction may be realized.

Financial rewards can also be structured to help people with time-inconsistent preferences stay committed to weight loss. In general, pre-commitment devices may help people with time-inconsistent preferences empower their farsighted planner (Strotz 1956; Laibson 1997). In this context, one could allow people to post a bond that is automatically forfeited if they fail to achieve their weight loss goals. Such a bond allows a person to influence their own future decisions by increasing the punishment for succumbing to short-run temptation. People tend to exhibit loss aversion – they dislike losing their own money more than they like winning an equal amount of someone else’s money (Tversky and Kahneman 1991; Camerer 2005), which suggests that a posted bond may be more effective than a reward of the same size. Using a bond to increase adherence to a weight-loss regimen does not guarantee success. Even individuals who are aware of their time-inconsistent preferences may still be partially naive in that they overestimate their future willpower (O’Donoghue and Rabin 2001) and as a result may either post too small a bond or have too much faith in the bond as a precommitment device.

Motivated by these theories and findings, several businesses now help employers offer financial incentives for employee weight loss. In addition, several businesses help consumers post bonds that are only refunded if one achieves specific weight loss goals. The William Hill betting agency in the U.K. books wagers that the bettor cannot achieve a specified weight loss in a specific period of time and verifies the weight loss with a medical examination (Burger and Lynham 2008).⁶ A company named stickK.com⁷ that

⁶ This market is relatively small – the annual number of applications for such bets is roughly 200 (Burger and Lynham, 2008)

⁷ The website’s Frequently Asked Questions page states that the company’s name includes two K’s because “K” often symbolizes “contract” in legal writing.

was founded by Yale economists Ian Ayres and Dean Karlan allows people to post bonds that are forfeited if they fail to meet their weight loss goal. However, verification is weak: success in achieving one's goal is determined (and refunds are made) based on either the honor system or through verification by a third party chosen by the bettor, and if the third party doesn't submit a report the self-report of the bettor is accepted.

The contribution of this paper is to examine outcomes in a program that offers various financial rewards (including certain payments, lotteries, and refundable bonds) for weight loss. The outcomes we examine include attrition and weight loss, both in pounds and as a percentage of baseline weight.

A substantial literature confirms that financial incentives influence healthy behaviors. Kane et al. (2004) review 42 studies of the effect of economic incentives on preventive behaviors such as immunization, smoking cessation, and exercise; they find that the economic incentives were effective at changing behavior in 73% of studies. Financial incentives form the basis for an innovative substance abuse treatment program known as contingency management. A meta-analysis found overwhelming evidence that such incentives raise compliance (drug abstinence) by an average of 30 percent (Lussier et al., 2006). Consistent with bracketing, even small financial incentives have proven effective; for example, as little as \$2.50 for a single negative test result for cocaine (Higgins et al., 2002).

Specific to the current context, there is mixed empirical evidence on the extent to which weight loss is responsive to financial rewards. A recent review and meta-analysis (Paul-Ebhohimhen and Avenell 2007) identified nine published randomized controlled trials (RCTs) that used guaranteed financial incentives (i.e. certain payments, not

lotteries) for weight loss, with a follow-up of at least one year. The meta-analysis was unable to reject the null hypothesis of no effect of financial rewards on weight loss; it calculated a mean weight loss of 0.4 kg at 12 months, which was not statistically significant. A broader set of studies (including, e.g., those with non-randomized designs or shorter follow-up) are listed in Appendix Table 1.⁸

Relative to past studies, ours has several advantages. This study has a relatively large sample size (2,407); for comparison, the sample size of all published RCTs of financial incentives for weight loss combined totals 424 (treatment N=252, control N=172) (Paul-Ebhohimhen and Avenell, 2007). The intervention studied by this paper also covers a relatively long time period (one year). Moreover, we examine data from a real-world intervention rather than one constructed by and overseen by researchers, which is important because a criticism of studies of weight loss programs is that it is unclear how the results of pilot programs generalize to real-world implementation. A limitation of this study, however, is that it is opportunistic data; individuals were not randomly assigned to different incentive schedules for weight loss.

Description of the Intervention

Our data come from a company (that we will call Company X) that helps employers provide financial incentives for their employees to lose weight; specifically, it monitors employee weight loss and pays the rewards. After an employer contracts with Company X, Company X has a kickoff event in the workplace that explains the program to the employees and encourages them to sign up. Participation is optional. Those who

⁸ There are other studies that offer financial rewards for exercise or for attending weight loss programs, but Appendix Table 1 is limited to studies of financial rewards for weight loss.

sign up select a physical activity regimen at either the foundation (easiest), intermediate, or advanced level. The program consists of several elements: 1) daily email coaching that includes information about healthy and effective methods of weight loss including decreasing calorie intake and increasing physical activity in a manner consistent with the regimen the enrollee chose at baseline; 2) call center support; 3) weigh-ins at least once a quarter; and 4) financial incentives for achieving specific weight loss targets. Only employees who are overweight (BMI of at least 25) are eligible to receive financial rewards, and no financial rewards will be paid once an employee's BMI falls below 25 (i.e. when the employee falls into the "healthy weight" category).

The weigh-ins take place in HIPAA-compliant⁹ kiosks that company X installs in the employer's workplace. Employees enter the privacy-protected kiosk and stand on a scale; their body mass index is recorded and sent over an internet connection to their personal webpage as well as to Company X's database. Participants can weigh themselves as often as they like, and the lowest recorded weight will be counted as that quarter's weight. Financial rewards are paid based on percent of baseline weight lost.¹⁰

Company X has a standard set of incentives that it proposes, but employers can modify it. In our data, there are three incentive schedules. The first is Company X's standard set of incentives: the employee participants pay no fee (all costs are paid by the employer), and employees receive quarterly payments determined by percent of baseline

⁹ The Health Insurance Portability and Accountability Act (HIPAA) regulates the disclosure of health information.

¹⁰ We asked Company X whether people gamed the system by trying to weigh more at baseline (from which future weight losses are judged). They said that through the cameras installed in their kiosks they do not see people wearing heavier clothes to the baseline weigh-in than to later weigh-ins; in all cases people seem for vanity reasons to remove shoes and sweaters before weighing in. However, Company X acknowledges that they have no way to know if people (e.g.) hid weights in their pockets or shoes before the baseline weigh-in. If people engage in such deception then we would expect to see significant drops in weight at the first weigh-in after baseline but we do not find this pattern in the data.

weight lost to date. Table 1 lists the standard set of incentives: payment thresholds occur at each percentage point of weight loss up to 5% (1, 2, 3, 4, 5), then thresholds occur every 5 percentage points (5, 10, 15, 20, 25, 30) up to 30% of weight loss. The payment associated with these thresholds varies; for the first seven (1, 2, 3, 4, 5, 10, 15) the reward is a dollar per percentage point of weight loss. Then the per-percentage-point rewards increase: \$25 for losing 20%, \$35 for losing 25%, and \$50 for losing 30%. These are monthly amounts that are paid quarterly, so someone who loses 5% of his weight and keeps it off for three months receives a \$15 check for the quarter (\$5 monthly payment x 3 months). Five employers (with a total of thirteen worksites participating) used this standard incentives schedule.

The second incentive schedule, used by one employer (with two worksites participating), is shown in Table 2 and includes both a lottery and a deposit contract. The lottery takes place each quarter and the prizes are gift certificates (ten \$50 gift cards and ten \$50 salon vouchers); only those who had lost some weight since baseline are eligible for the drawing. The deposit contract is that employees must pay \$9.95 per month (except the first month, which is free), all of which ($11 * \$9.95$ or \$109.45) is refunded at the end of the year if the respondent loses at least 5% of baseline weight by year's end. If the respondent loses 10% or more of their baseline weight, they receive in addition to their refunded fees (\$109.45) a \$100 bonus, for a total of \$229.40. In addition, the "biggest loser" (as a percent of baseline weight) receives a \$250 gift certificate at the end of the year.

Whether a participant would receive a higher payoff in the standard or modified group depends on both quarter and magnitude of weight loss. In quarters one through

three, the standard incentives are more generous than the modified incentives at all levels of weight loss, with the exception that those losing between 0.1% and 0.9% of baseline weight receive no reward in the standard incentives group but are eligible for the lottery for gift cards in the modified incentives group. In quarter four, the standard incentives are more generous for weight loss of between 1% and 4%, but the modified incentives are more generous for weight loss of 5% or more.

The third schedule, used by one employer (with a total of two worksites), offered no incentives for weight loss, but did include one modest incentive to not attrite: participants were promised \$20 if they participated for the entire year (i.e. weighed in at least once in each of the four quarters). This group received all of the features of the Company X intervention (daily emails, call center access, weigh-ins at the kiosk) but were offered no incentives for weight loss, making it useful both as a control group for measuring the impact of financial incentives isolated from all the other program elements, and for estimating the impact of the Company X treatment minus the financial incentives.

Figure 1 presents a flow diagram of attrition and analysis for all three groups (standard incentives, modified incentives, control) combined.

Hypotheses

Part of our purpose in this paper is exploratory - to measure enrollment, attrition and weight loss in these programs. We focus in particular on attrition and weight loss as outcomes because the NIH Technology Assessment Conference Panel (1993) recommends using the percentage of all beginning participants who complete the

program, and the percentage of those completing the program who achieve various degrees of weight loss as measures of program success. The NIH considers a loss of 10% of baseline weight in 6 months to one year to be good progress for an obese individual (NHLBI 2000).

Another purpose of this paper is to test the following hypotheses.

Hypotheses Regarding Enrollment

There will be lower enrollment in the program that required people to post forfeitable bonds. The law of demand states that the quantity demanded falls with price. The program that requires people to post a forfeitable bond raises the expected price of participation, assuming that not all possible participants expect a 100% probability of success (and therefore the return of their bond). The published literature confirms that, all else equal, enrollment in weight loss programs is lower if people are asked to post forfeitable bonds (e.g. Jeffery et al. 1978).

Those who are willing to post a forfeitable bond will be better motivated or prepared for weight loss than those not required to post such a bond.

In other words, we expect differential selection – those unwilling to post a forfeitable bond are excluded from the modified incentives group but are not excluded from the control group or standard incentives group. As a result, we expect that the modified incentives group will be better prepared or motivated for weight loss than the other groups.

Hypotheses Regarding Attrition

There will be lower attrition in the program that required employees to post bonds that are refundable based on achievement of weight loss goals. Those willing

to post a bond are expected to be more motivated or determined to lose weight.

Selection aside, bonds may also increase retention.

Those who attrite will have been relatively unsuccessful at weight loss.

Participants enroll with incomplete information about certain costs and benefits of participating. Those that lose relatively little weight may update their prior beliefs and conclude that it is utility maximizing for them to drop out of the intervention. This is especially true of those in the modified incentives group, who are charged a monthly fee for participation that will not be refunded if year-end weight loss is less than 5% of baseline weight.

Hypotheses Regarding Weight Loss

Weight loss will be greater for those offered financial rewards for weight loss. Both the standard incentives group and the modified incentives group were offered financial rewards for weight loss, whereas the control group were not offered any. In other words, we hypothesize that financial rewards are effective in promoting weight loss.

In quarter 4 weight loss will be greater in the modified incentives group than in the standard incentives group.

This prediction is based on the magnitudes of the incentives; the modified incentives group has much greater incentives for 5% and 10% weight loss by the end of quarter 4. Specifically, the modified incentives group receives a refund of their \$119.40 bond if at least 5% of weight is lost, with an additional bonus of \$100 if 10% of weight is lost. Moreover, those achieving very high weight loss will be in competition for the \$250 bonus for being the “biggest loser”. In contrast, the standard incentives group is paid \$5

per month for losing 5% of starting weight and \$10 per month for losing 10% of starting weight (triple those amounts for the entire quarter). Relative to the standard incentives, the modified incentives create greater incentive for weight loss by the end of quarter four.

In addition, there are two reasons that the relative performance of the modified incentives group by the end of quarter 4 might be better than one would expect based on the magnitude of the rewards alone. First, we expect differential selection - those willing to post a bond are likely better prepared or more motivated for weight loss. Second, the research literature on loss aversion indicates that people are more motivated by a risk of losing their own money (as in the modified incentives group) than they are by the prospect of winning someone else's money (as in the standard incentives group).

In quarters 1 through 3, weight loss will be greater in the standard incentives group than in the modified incentives group.

This prediction is also based on the magnitudes of the incentives. In quarters 1 through 3, the standard incentives group is offered \$5 per month for 5% weight loss, and \$10 per month for 10% weight loss (see Table 1 for the full schedule of financial rewards). In contrast, there is no marginal reward for 5% or 10% weight loss in any of the first three quarters for the modified incentives group (those losing any weight at all are eligible for lottery prizes, but there is no additional reward for any weight loss above the trivial amount that makes one eligible for the lottery).

However, there are three reasons that the relative performance of the modified incentives group in quarters one through three might be better than one would expect based on the magnitude of the rewards alone. The first reason is differential selection. The second reason is loss aversion; the fear of losing one's money at year's end may

motivate members of the modified incentives group to lose weight in the early quarters, even when there are no quarter-specific rewards for doing so. Third, it may take more than one quarter to achieve 5% or 10% weight loss, so in order to meet their year-end goals members of the modified incentives group may have to lose weight in earlier quarters, even though they have no financial incentives for meaningful weight loss in those quarters.

Methods and Data

A limitation of our data is that they are not the result of a randomized controlled trial. They are opportunistic data, provided to us by Company X. As a result, we face two challenges: 1) assignment to the three treatment groups is nonrandom: the incentive schedules were chosen by the employers; 2) the participation of employees is voluntary; there is selection by employees.

Regarding problem #1 (selection by employers into different incentive schedules), we assume that this is ignorable. In other words, we assume that employer preference for incentive structure is uncorrelated with unobserved employee characteristics that affect attrition and weight loss. Company X told us that the reason that one employer requested the modified incentives schedule (with forfeitable bonds) is because the company didn't want to pay for cash rewards. This would be more problematic if the employer requested the modified schedule because the employer thought it would be more effective for their particular employees.

A related problem is that unobserved employee characteristics may vary systematically across the three groups. Company X designed this intervention for office

employees who spend their days in front of computers; it is they, for example, who are most likely to read the daily emails regarding nutrition and physical activity. For the most part, enrollees fit this description. Table 3 lists the industries of the employers. The five employers (with a total of 13 worksites) in the standard incentive group include an HMO office, an HMO clinic (in which enrollees are nurses), two bank offices, and an insurance company. The one employer (with a total of two worksites) that instituted the modified incentive schedule is an insurance company, and the one employer (with a total of two worksites) in the control group is a grocery administrative office. Company X tells us that the nurses (who face the standard incentive schedule) have generally been least compliant with the program; they speculate that it may be because they do not work in front of computers all day and thus derive less benefit from the daily emails and the online tracking of measured weight.

Regarding problem #2 (selection by employees into participation), we consider this to be a limitation for generalizing results to the entire population but not a problem in the sense that any similar intervention is also likely to be optional, and so the findings for a set of volunteers is most relevant. All of the studies in Appendix Table 1 are all based on volunteers recruited to participate in a weight loss program, and are likewise not a random sample of the general population.

An additional problem when studying weight loss is that there is attrition from the program. Weight-loss interventions in general (even those without financial rewards) typically have substantial attrition (Ware 2003; Gadbury et al. 2003). There are several strategies for handling the attrition when evaluating interventions. The definitive is the intent-to-treat analysis, which includes all patients in their groups, regardless of whether

they received the treatment, deviated from the protocol or withdrew (Ware 2003). However, to implement this one must have follow-up data on all of the dropouts, which is not available in this case. Another option is to conduct a “completers” analysis, which examines data only for those who completed the study. This is likely to be biased toward showing an impact of the treatment, as those most likely to quit are probably those for whom the intervention was least effective (Ware 2003). Another option is last-observation-carried-forward, which assumes that the dropouts remained at their last measured weight. This also likely results in upward bias in estimates of program effectiveness, as weight regain is common (Ware 2003; Serdula et al. 1999). Another option is baseline-carried-forward, which assumes that after attriting the subjects return to their baseline weight. This may cause downward bias in the estimate of efficacy, as weight regain may be incomplete or slow. We present findings for completers analysis, last-observation-carried-forward, and baseline-carried-forward.

The total number of employees in the dataset is 2,407: 1,513 facing the standard incentives, 765 facing the modified incentives, and 129 in the control group with no financial incentives. The data cover 2004-2008. We drop from the sample participants with baseline BMI below 25 because they were not eligible for financial rewards. Thirteen participants in the control group were dropped because they were simultaneously participating in another workplace weight-loss intervention.

We estimate attrition rates by quarter and group. We graph the distribution of weight loss by group and quarter, both for a completers analysis (ignoring dropouts), assuming that dropouts stayed at their last measured weight (last observation carried forward) and assuming that dropouts return to baseline (baseline carried forward). We

also calculate the unconditional mean loss in pounds and percent of baseline weight lost by group and quarter, for a completers analysis, last observation carried forward, and baseline carried forward.

Empirical Results

Descriptive statistics:

Table 4 presents the summary statistics for participants by group. Our overall sample (N=2,407) consists of 1,513 participants in the standard incentives group, 765 participants in the modified incentives group, and 129 participants in the control group.

In each of these groups, men are a minority: 15.7% of the standard incentives group, 21.2% of the modified incentives group, and 35.7% of the control group. The average age of participants ranges from 43.0 to 46.2 across groups, and average baseline BMI ranges between 31.3 and 32.8 across groups. In each group there is a strikingly high prevalence of morbid obesity (BMI of greater than or equal to 40). In the U.S. as a whole, the morbidly obese constitute 4.8% of the population and 7.3% of all overweight Americans (Ogden et al. 2006). In contrast, the morbidly obese constitute 28.7% of the standard incentives group, 30.5% of the modified incentives group, and 22.5% of the control group.

Enrollment

We hypothesized that: **There will be lower enrollment in the program that required people to post forfeitable bonds.** Table 5 lists the percent of the workforce that enrolled in the program, by incentive schedule. Ideally we would know the number of employees with BMI of 25 or higher, because only they are eligible for financial

rewards for weight loss. Instead, for the denominator we know only the total number of employees (i.e. those of all BMI). As a result, these are likely to be underestimates of the percentage of those eligible for financial rewards who enrolled in the program. Percent enrollment was 18.6% for the modified incentives (which required a bond), 24.8% for the standard incentives, and 20.3% for the program that offered no financial rewards for weight loss but all of the other program elements (i.e. the control group). The point estimates of enrollment are consistent with our prediction that the requirement of a bond would result in lower enrollment, but the differences are not statistically significant.

We also hypothesized that: **Those who are willing to post a forfeitable bond will be better motivated or prepared for weight loss than those not required to post such a bond.** There are two variables that can give us information about the degree of such differences in selection. The first variable is the level of exercise regimen that the employee chose at the beginning of the program. If those willing to pay the monthly fees in the modified incentives group are more motivated or prepared to lose weight, one should find that they are less likely to choose the easiest exercise regimen. This is confirmed by the data. Table 4 indicates that the easiest exercise regimen (called Foundation) was chosen by 60.1% of the standard incentives group but only 55.0% of the modified incentives group, a difference significant at the 1% level. We also expected that the control group, offered \$20 if they participated for the full year, would be less motivated on average and therefore more likely to choose the easiest exercise regimen than those in the modified incentives group, but we do not find this – an even lower percentage of the control group than the modified incentives group (48.8% versus 60.1%) chose the easiest exercise regimen, but the difference is not statistically significant.

The second variable that sheds light on difference in selectivity is the percentage of the program emails that enrollees read. If those willing to pay the monthly fees in the modified incentives group are more motivated or prepared to lose weight, one should find that they read a higher percentage of the program emails. That prediction is confirmed by the data – Table 4 indicates that the average percentage of emails read was 51.0% for members of the modified incentives group compared to 45.7% for members of the standard incentives group, a difference significant at the 1% level. (A caveat is that this variable is missing for 51.1% of the standard incentives group – it simply wasn't recorded for certain employers in certain years.)

The control group, being paid to participate, had the lowest email open rate of 28.7%, which is significantly different from both other groups at the 1% level. It is interesting that the control group had the lowest percentage choosing the easiest exercise regimen (which suggests more motivation or better preparation) but the lowest email open rate (which suggests lower commitment).

Overall, the patterns of both exercise regimen and email opening suggest that the group required to post a bond (i.e. the modified incentives group) was selected to be better prepared and more serious about weight loss than the standard incentives group, and therefore should be less likely to attrite and more likely to lose weight.

Attrition

Table 6 lists the cumulative percentages dropping out, by quarter, for each group. In the standard incentives group, 51.2% of baseline participants have dropped out by the end of quarter 1, and cumulative attrition rises in the three subsequent quarters to 62.1%, 72.0% and 76.4%. In the modified incentives group, attrition is lower: 24.8% after one

quarter, rising in the three subsequent quarters to 33.5%, 39.3%, and 57.4%. Even in the control group, where participants are promised \$20 if they weigh in every quarter for a year, attrition is substantial: 25.6% after one quarter, rising in the three subsequent quarters to 39.5%, 45.0%, and 48.1%. When considering the levels of attrition, one should keep in mind that enrollees were already a select sample. Participation was optional, and most employees declined to enroll.

Attrition is typically substantial in weight loss interventions of all kinds (Ware 2003; Gadbury et al. 2003). However, the attrition in these groups is particularly high. For example, a recent review (Paul-Ebhohimhen and Avenuell, 2007) of RCTs involving financial rewards for weight loss found that the maximum attrition in any such study was 57.9% at 13 months, far below what the standard incentives group experienced in 12 months (76.4%) but roughly equal to what the modified incentives group experienced at 12 months (57.4%). This suggests that real-world interventions may experience far higher rates of attrition than those overseen by researchers (who for the purposes of data quality undertake extensive efforts to keep enrollees from attriting), which raises questions about how well the results of pilot studies such as those in Appendix Table 1 can be duplicated on a larger scale.

We hypothesized that **There will be lower attrition in the program that required employees to post bonds that are refundable based on achievement of weight loss goals.** The data are consistent with this hypothesis; in every quarter, attrition is significantly lower in the modified than the standard incentives group. For example, after quarter 1 attrition in the modified incentives group is only half that in the standard incentives group (24.8% versus 51.2%). It impossible to tell from our data whether the

difference in attrition is due to selection or loss aversion. Selection was evident in the earlier finding that those in the modified incentives group were more likely to choose an advanced physical activity regimen and tend to open more program emails; before entering the program they may have been better prepared and more motivated to lose weight. On the other hand, those in the modified incentives group have “skin in the game” in the form of their deposits, and loss aversion may motivate them to stay in the program.

We also hypothesized that: **Those who attrite will have been relatively unsuccessful at weight loss.** Table 7 lists the weight loss by quarter, categorized by whether the participant dropped out in the following quarter or persisted in the program through the following quarter. The table is divided vertically into four panels: full sample, standard incentives group, modified incentives group, control group. Among the full sample, those who drop out in the subsequent quarter have significantly lower average weight loss than those who persist through the next quarter, in quarters 1, 2, and 3. In each case the difference in mean weight loss to date is statistically significant at better than the 1% level. When we divide the sample by incentive schedule, the same pattern exists for those in the modified incentives group: in each of the first three quarters, weight loss to date is significantly lower among those who drop out in the following quarter than those who persist through the following quarter. Note that those in the modified incentives group have the greatest incentive to drop out if they are not making progress, because to persist would require paying monthly fees that one is unlikely to have refunded. The pattern is weaker for the standard incentives group; in quarter 2 future dropouts have significantly lower weight loss than those who persist

through the next quarter, but the difference is not statistically significant. In quarter 1 and in quarter 3 the sign is in the opposite direction and the difference is not statistically significant. For the control group, in no quarter do future dropouts have significantly lower weight loss to date than those who will persist in the program.

Weight Loss

The distribution of percent weight loss, by quarter, is shown in Figures 2 (for the standard incentives group), Figures 3 (for the modified incentives group), and Figures 4 (for the control group). The horizontal axis shows the percent of baseline weight lost (rounded down to the nearest percentage point¹¹) as of that quarter, and the vertical axis indicates the percentage of that sample. For each group, there is a separate page devoted to the data for each quarter. On each page are three graphs: the top graph is the distribution of weight loss in a completers analysis that ignores dropouts, the middle graph is from a last observation carried forward analysis in which dropouts are assumed to have stayed at their last measured weight, and the bottom graph is the distribution of weight loss in a baseline-carried-forward analysis that assumes that every dropout returned to their baseline weight. For any given page, a comparison of the top, middle, and bottom graphs confirms that how attrition is handled has a substantial impact on estimated weight loss. In the top graphs (the completers analysis), the distribution of outcomes seems more favorable (although the modal outcome is usually zero weight loss), but in the middle and bottom graphs that include information on dropouts, by far

¹¹ We round down so that everyone indicated as having a specific percent weight loss received exactly the reward associated with that percent weight loss. If we rounded to the nearest percentage point, a participant who lost 4.6% of her starting weight would be rounded to 5% even though she would not have qualified for the financial reward associated with achieving 5% weight loss.

the most common outcome is that respondents lost zero weight (largely driven by the assumption of setting dropouts at baseline weight).

Each of the graphs in Figure 3-4 indicate that more people in the modified incentives group are just over the thresholds of 5% weight loss (at which participants are refunded their year's worth of fees, or \$109.46) and 10% weight loss (at which they also receive a \$100 bonus), then just under the thresholds. This is less apparent in quarters 1-3 (Figures 3-1, 3-2, and 3-3), when there were no financial rewards tied to those thresholds for the modified incentives group. Moreover, such heaping is not apparent in the distribution associated with the standard incentive schedule, which has more continuous reward thresholds. This suggests that people may be pushing to achieve the substantial payoffs associated with losing 5% or 10% of baseline weight.

We next discuss the evidence regarding our hypotheses regarding weight loss.

Weight loss will be greater for those offered financial rewards for weight loss. We test for differences in unconditional means of weight loss in pounds and percent of baseline weight by quarter and group. We then test for differences in unconditional probability of losing 5% and 10% of baseline body weight. Note that the differences between the treatment groups and the control group can be interpreted as the effect of the financial incentives, distinct from all of the other program elements (e.g. daily emails and call center support) shared by the control group.

Table 8 lists weight loss in pounds and percent of baseline weight, by group and quarter. The cells also list the minimum and maximum weight loss (a negative minimum weight loss indicates weight gain) for that group in that quarter (the minimum and maximum are not affected by how dropouts are treated, so they are entered in only the

leftmost column for each group). Because so many participants drop out, and attrition is correlated with weight loss success, estimates of average weight loss are extremely sensitive to how attrition is handled. We focus here on the baseline carried forward analysis, which assumes that everyone who dropped out went back to their baseline weight.

In the baseline carried forward analysis, average weight loss in the control group is 2.6 pounds (1.29%) in the first quarter, 1.9 pounds (0.98%) in the second quarter, 1.7 pounds (0.82%) in the third quarter, and 1.7 pounds (0.87%) in the fourth quarter. These can be interpreted as the unconditional average effect of the program elements other than financial rewards (e.g. emails, call center access, and weigh-ins), because in a previous randomized experiment, a control group that received no treatment of any kind experienced virtually no change in average weight after 6 or 12 months (Jeffery, Wing, et al., 1993). This suggests that changes in weight observed in the control group measure the effect of all elements of Company X treatment except financial rewards.

In the standard incentives group, average weight loss is 2.2 pounds (1.13%) in the first quarter, 2.1 pounds (1.04%) in the second quarter, 2.2 pounds (1.03%) in the third quarter, and 1.4 pounds (0.64%) in the fourth quarter. We fail to reject the null hypothesis of no difference between the control and standard incentives group; in fact, average weight loss is consistently lower in the standard incentives group than in the control group.

Despite the small average weight loss in the standard incentives group, there are some substantial success stories; the maximum weight lost since baseline is 58.8 lbs. in quarter 1, 89.4 lbs. in quarter 2, 109.2 lbs. in quarter 3, and 116.8 lbs. in quarter 4. For

any given mean, success stories are balanced by failures; for example, the maximum weight *gain* is 12.6 lbs. in quarter 1, 19.8 lbs. in quarter 2, 25 lbs. in quarter 3, and 25.6 lbs. in quarter 4.

Weight loss in the modified incentives group averages 3.2 pounds (1.55%) in the first quarter, 3.3 pounds (1.58%) in the second quarter, 2.5 pounds (1.21%) in the third quarter, and 3.6 pounds (1.77%) in the fourth quarter. In quarter four (but not earlier quarters) the difference between the modified incentives group and the control group in average weight loss is statistically significant.

We also measure weight loss by success in reaching certain benchmarks. Table 9 lists the percent of participants losing 5% of baseline weight, by group and quarter, for completers, last observation carried forward, and baseline carried forward analyses. In the baseline carried forward analysis, the percentage of the control group that lost 5% of their baseline weight, by quarter, was: 9.3%, 7.8%, 13.2%, and 10.1%.

Relative to the control group, it is generally the case that smaller percentages of the standard incentives group achieved 5% weight loss in each quarter (8.3%, 8.2%, 7.9%, and 5.4%); the difference is statistically significant in quarters 3 and 4.

Relative to the control group, higher percentages of the modified incentives group achieved 5% weight loss in each quarter (12.6%, 16.5%, 14.0%, 19.5%); the differences are statistically significant in quarters 2 and 4.

We also examine the probabilities of losing 10% of baseline weight, the outcome that the NIH (1990) recommends for evaluating weight loss programs. Table 10 lists the unconditional probabilities of losing 10% of baseline weight by group and quarter, for completers, last observation carried forward, and baseline carried forward analyses.

Assuming that dropouts returned to their baseline weight, the percentage of the control group that lost 10% of baseline weight, by quarter, was 0.0%, 2.3%, 2.3%, and 3.1%. These are comparable to the corresponding percentages for the standard incentives group (1.2%, 2.0%, 2.9%, and 2.4%); the differences are not statistically significant. Relative to the control group, higher percentages of the modified incentives group achieved 10% weight loss in each quarter (2.1%, 4.3%, 3.8%, and 6.5%) but the differences are not statistically significant.

We hypothesized that: **In quarter 4 weight loss will be greater in the modified incentives group than in the standard incentives group.** This is true for the unconditional means in Table 8. Assuming dropouts return to their baseline weight (baseline carried forward), average year-end weight loss is 3.6 pounds (1.77%) in the modified incentives group compared to 1.4 pounds (0.64%) in the standard incentives group, a difference significant at the 1% level. Table 9 indicates that at the end of quarter 4, 19.5% of the modified incentives group had lost 5% or more of their baseline weight, compared to only 5.4% of the standard incentives group, a difference significant at the 1% level. Table 10 shows that the percent losing 10% or more of baseline weight was 6.5% in the modified incentives group and only 2.4% in the standard incentives group, a difference significant at the 1% level.

In quarters 1 through 3, weight loss will be greater in the standard incentives group than in the modified incentives group.

Contrary to our prediction, weight loss is greater in the modified incentives group than in the standard incentives group in quarters one through three. Table 8 shows that those in the modified incentives group lost an average of 3.2, 3.3, and 2.5 pounds in the

first three quarters, compared to the standard incentives group average losses of 2.2, 2.1, and 2.2 pounds. This difference is statistically significant at the 1% level in quarters one and two. Table 9 shows that in each case a higher proportion of the modified incentives group than the standard incentives group achieved 5% weight loss: 12.6% versus 8.3% in quarter one, 16.5% versus 8.2% in quarter two, and 14.0% versus 7.9% in quarter three; in each case these differences are statistically significant at the 1% level. Table 10 shows that the probability of losing 10% or more of baseline weight is consistently higher in the modified incentives group than the standard incentives group, and the difference is statistically significant in quarter 2.

These results suggest that the effect of greater financial incentives for the standard incentives group is swamped by some combination of more favorable selection into the modified incentives group, loss aversion, and the necessity of starting early to achieve 5% or 10% weight loss by the end of quarter four.

Discussion:

A 2007 Institute of Medicine report on preventing obesity set the immediate next step – which it described as an essential priority action for the near future – as “learning what works and what does not work and broadly sharing that information.” (IOM 2007, p. 410). It also notes that “All types of evaluation can make an important contribution to the evidence base upon which to design policies, programs, and interventions.” (Ibid, p. 4). This paper makes a contribution to that effort by documenting attrition and weight loss in a large program that offers financial incentives for weight loss.

The program studied is of particular interest because it is a real-world intervention, not a pilot program designed and monitored by researchers. As a result, the data are informative about how such interventions work in the real-world. However, because it is a real-world intervention, it suffers the limitations of selection by employers of incentive schedule, and a relatively small control group (129 out of a total sample of 2,407).

We study the two outcomes recommended by the NIH for evaluating weight loss interventions: attrition and weight loss. We find higher attrition (up to 76.4% after one year) than virtually all previous studies (see Appendix Table 1 and Paul-Ebhohimhen and Avenell, 2007). Another recent study of real-world wagers on own weight loss also found 80% failure (Burger and Lynham, 2008).

We find that the financial rewards in this program are associated with modest changes in weight. After one year, those in the modified incentives group lose 1.9 pounds more than those in the control group, while the weight loss of those in the standard incentives group is not statistically distinguishable from that of the control group. The NIH considers a loss of 10% of baseline weight in 6 months to one year to be good progress for an obese individual (NHLBI 2000). By this standard, very few participants in this program achieve good progress toward weight loss: just 2.4% of the standard incentives group and 6.5% of the modified incentives group lost 10% of their starting weight in 12 months. By most measures, participants in the modified incentives group had 12-month weight loss that was greater than those in the standard incentives group, but it is not clear how much of this is due to selection and how much is due to bonds, controlling for selection.

The weight loss associated with the program we examine is generally smaller than that documented in the previous literature. For example, Volpp et al. (2008) estimate mean 16-week weight loss to be 13.1 lbs. when rewards take the form of a lottery with a daily expected value of \$3, and 14.0 lbs. when the rewards take the form of deposit contracts or bonds, whose amount is chosen by the enrollee but can vary between \$0 and \$3 per day and is matched 1:1 if the weight loss goal is achieved.

Our findings are closer to those of Finkelstein et al. (2007), who find modest weight loss (between 2.0 and 4.7 lbs.) at three months, but no significant weight loss at six months, associated with financial rewards that varied between \$7 and \$14 per percentage point of weight lost after six months. Likewise, Butsch et al. (2007) find no significant difference in 12-week weight loss between a treatment group offered a \$150 refund of their enrollment fee if they lost 6% of their initial weight, and a control group which was not eligible for such a refund.

Overall, our findings regarding attrition and weight loss suggest that the experience of pilot programs (such as those described in Appendix Table 1) may be overoptimistic about what can be achieved on a larger scale.

To put our findings in a the broader context of what works to promote weight loss, a literature review (Douketis et al. 2005) found that dietary and lifestyle therapy tends to result in less than 5 kg weight loss after 2-4 years, pharmacologic therapy results in 5-10 kg weight loss after 1-2 years, and surgical therapy results in 25-75 kg weight loss after 2-4 years. At this point, financial rewards remain a promising method for weight loss but it remains to be seen whether they can be as effective as traditional medical approaches.

This paper presents the basic patterns in the data. Our follow-up work will estimate hazard models of attrition and estimate regression models of weight loss to measure the change in weight associated with the incentive schedules, controlling for the observable characteristics of participants. Future research in this area should also focus on the optimal design of financial incentives for maximizing loss of excess weight, finding ways to decrease attrition, whether offering extrinsic rewards decreases intrinsic motivation, and whether weight loss is maintained after financial incentives for weight loss are removed.

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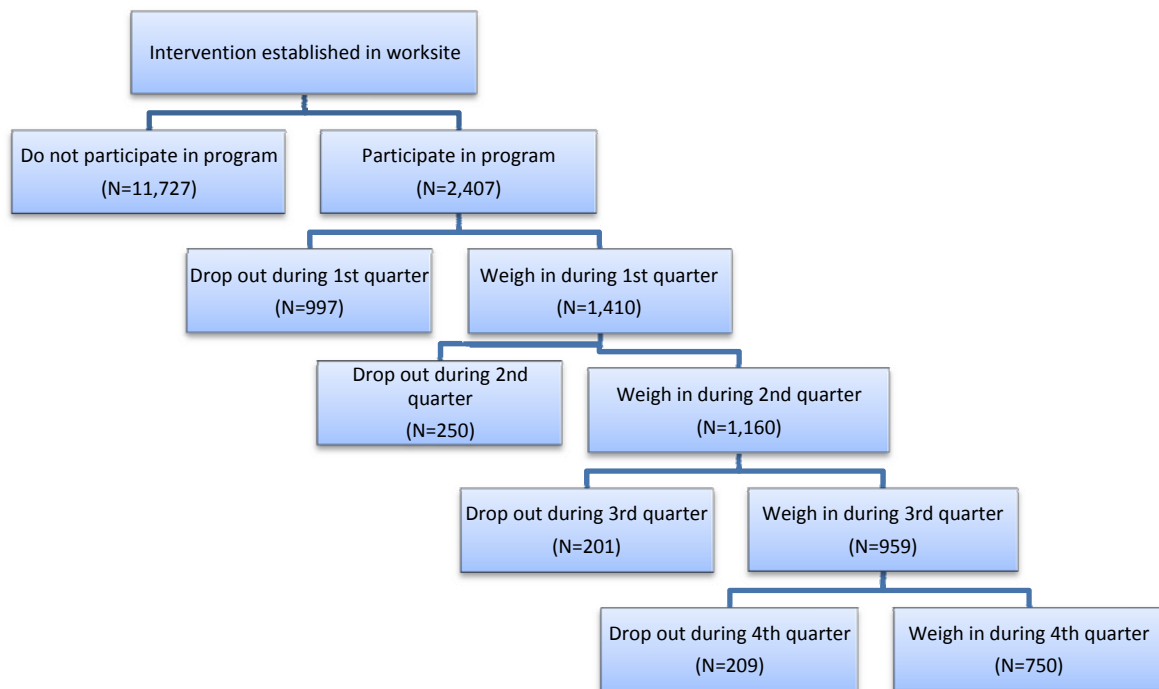
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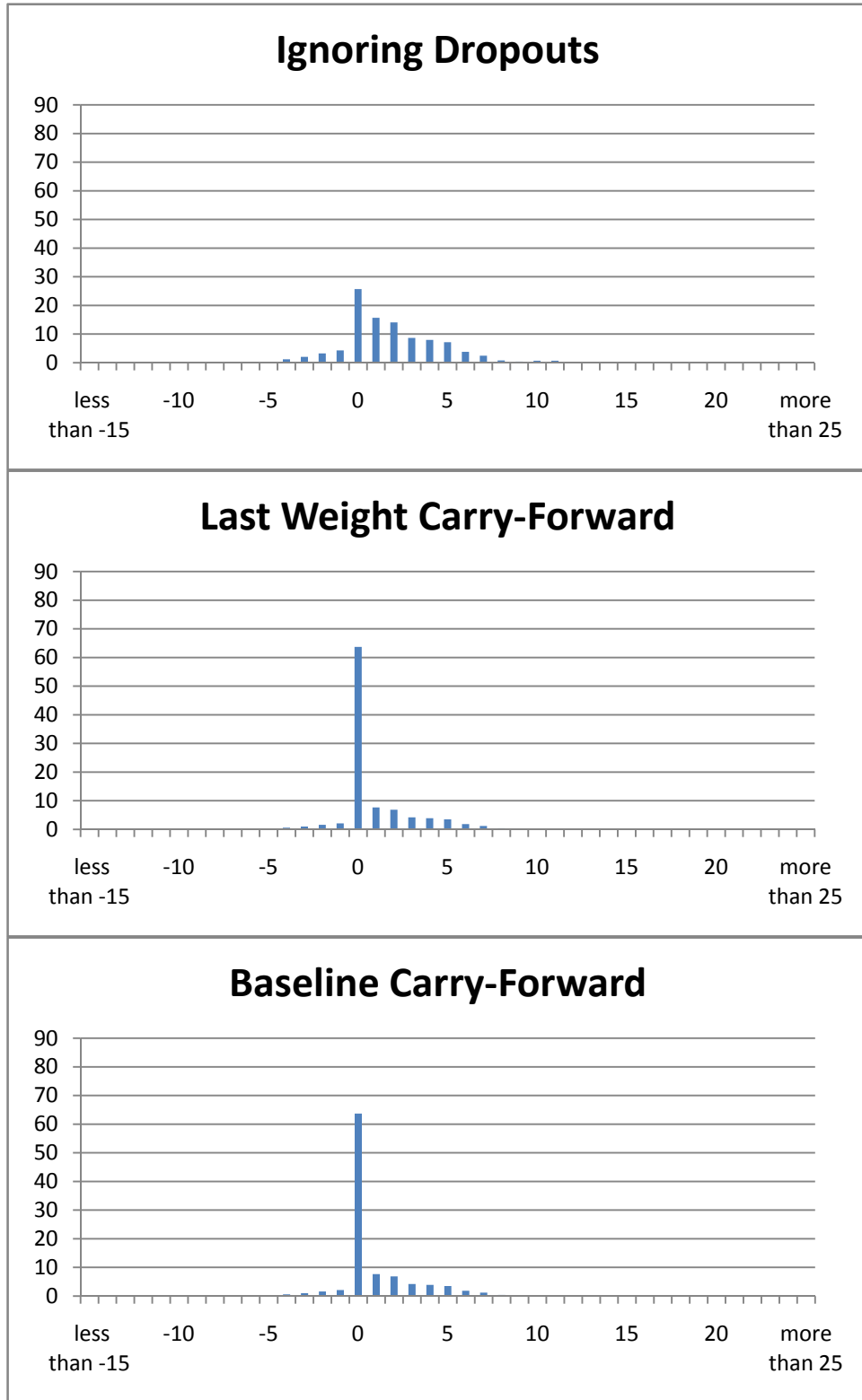
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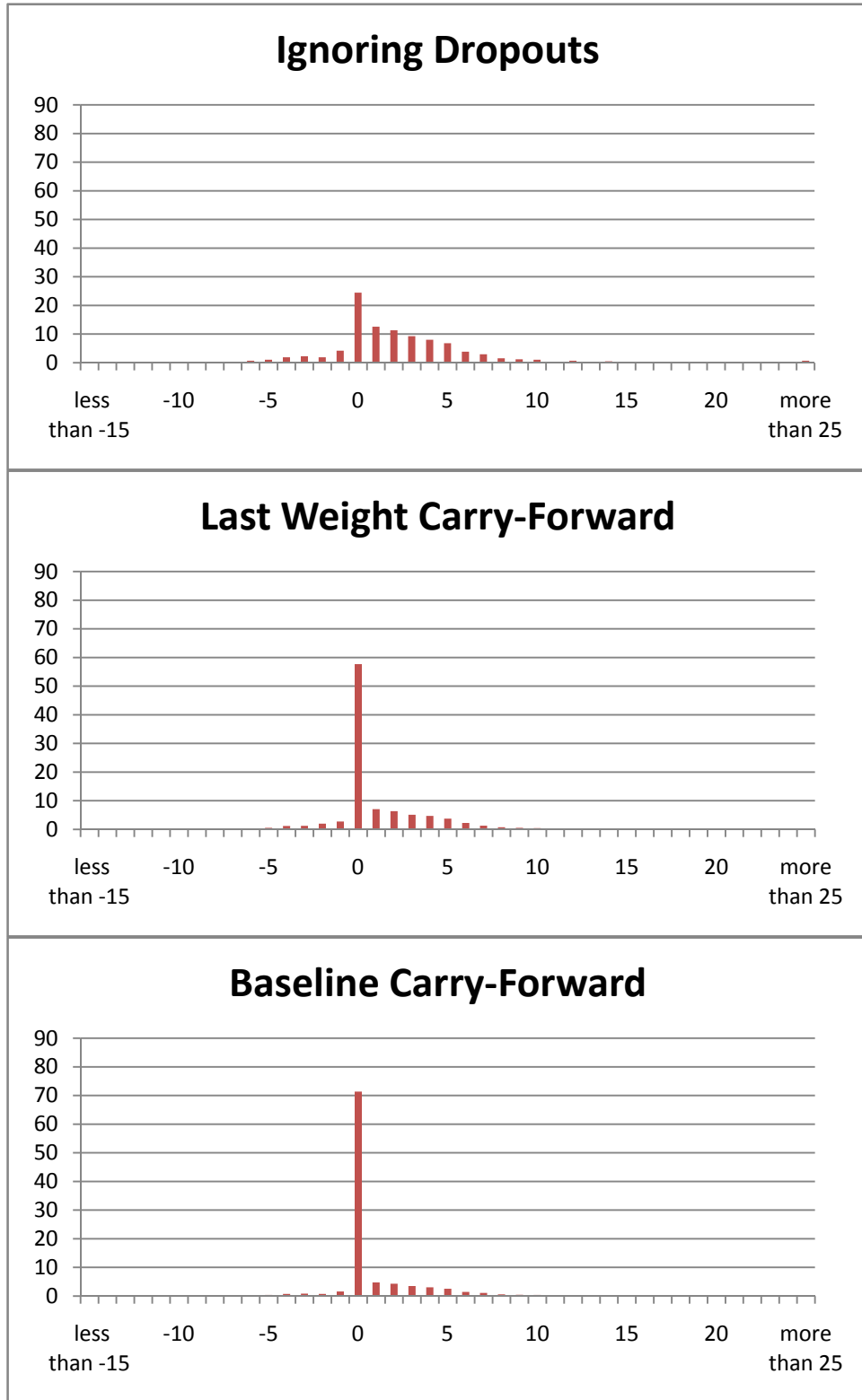
Figure 1:
Flow Diagram of Attrition and Analysis



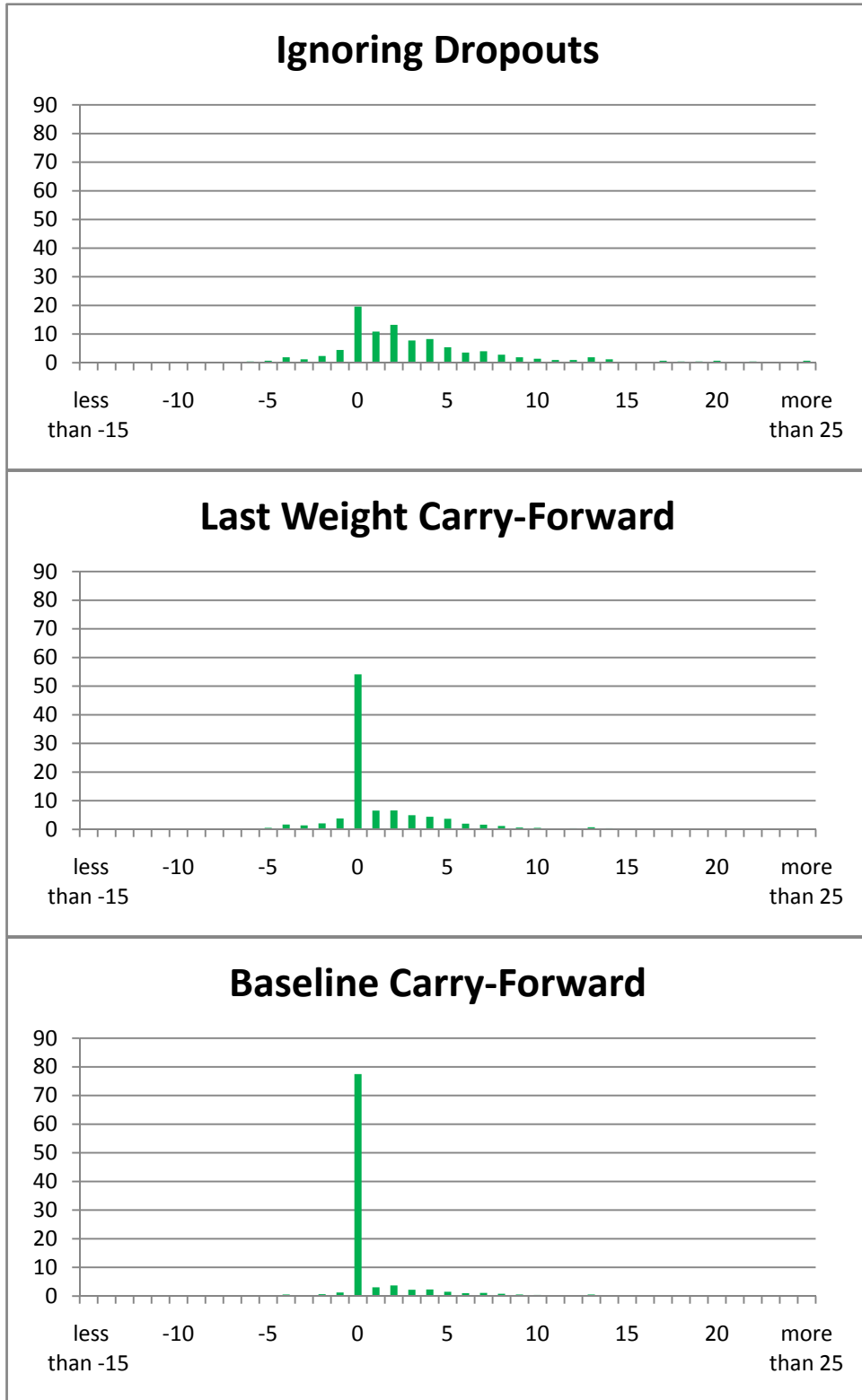
**Figure 2-1: Distribution of Percent Weight Loss under Standard incentives
Quarter 1**



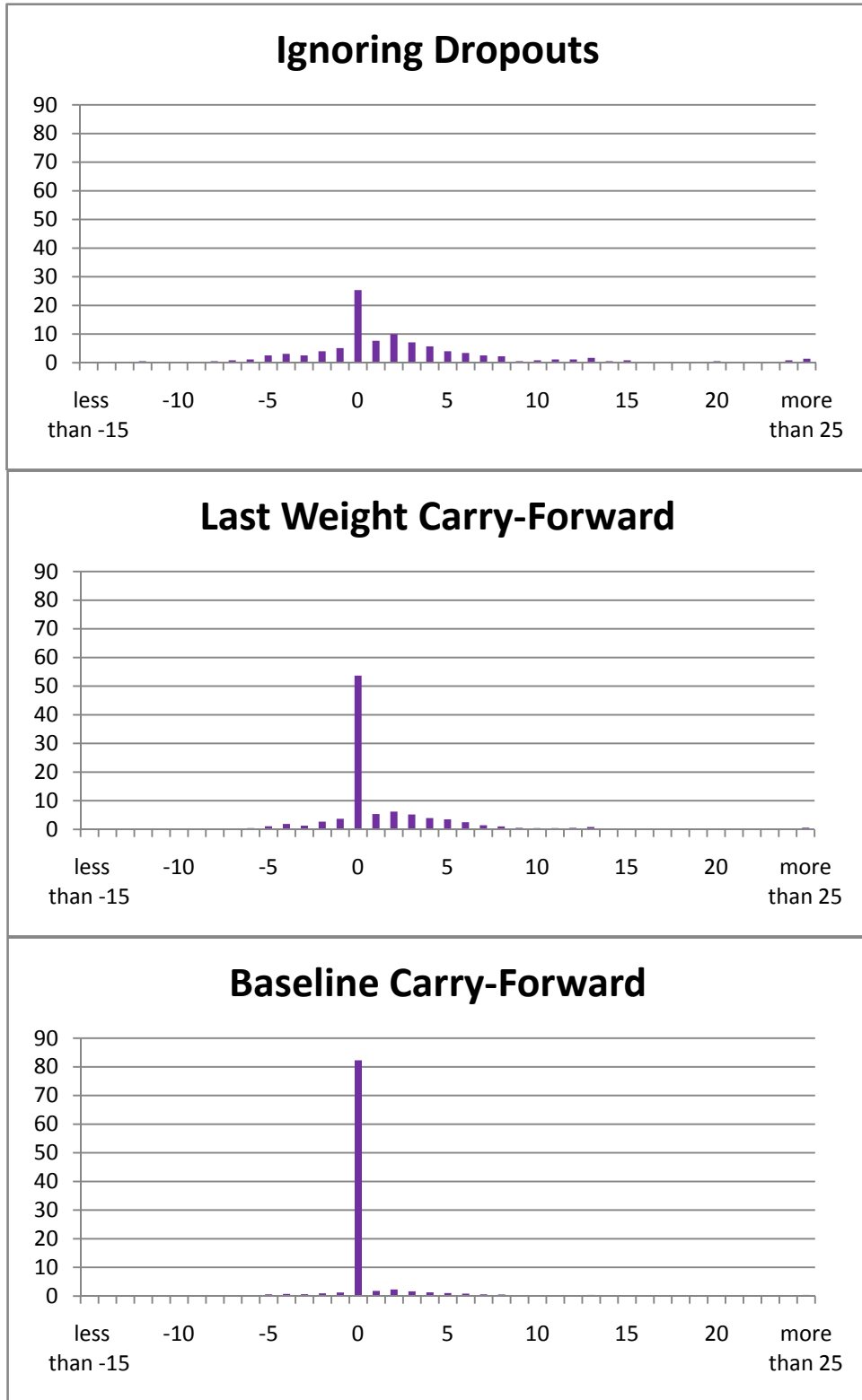
**Figure 2-2: Distribution of Percent Weight Loss under Standard incentives
Quarter 2**



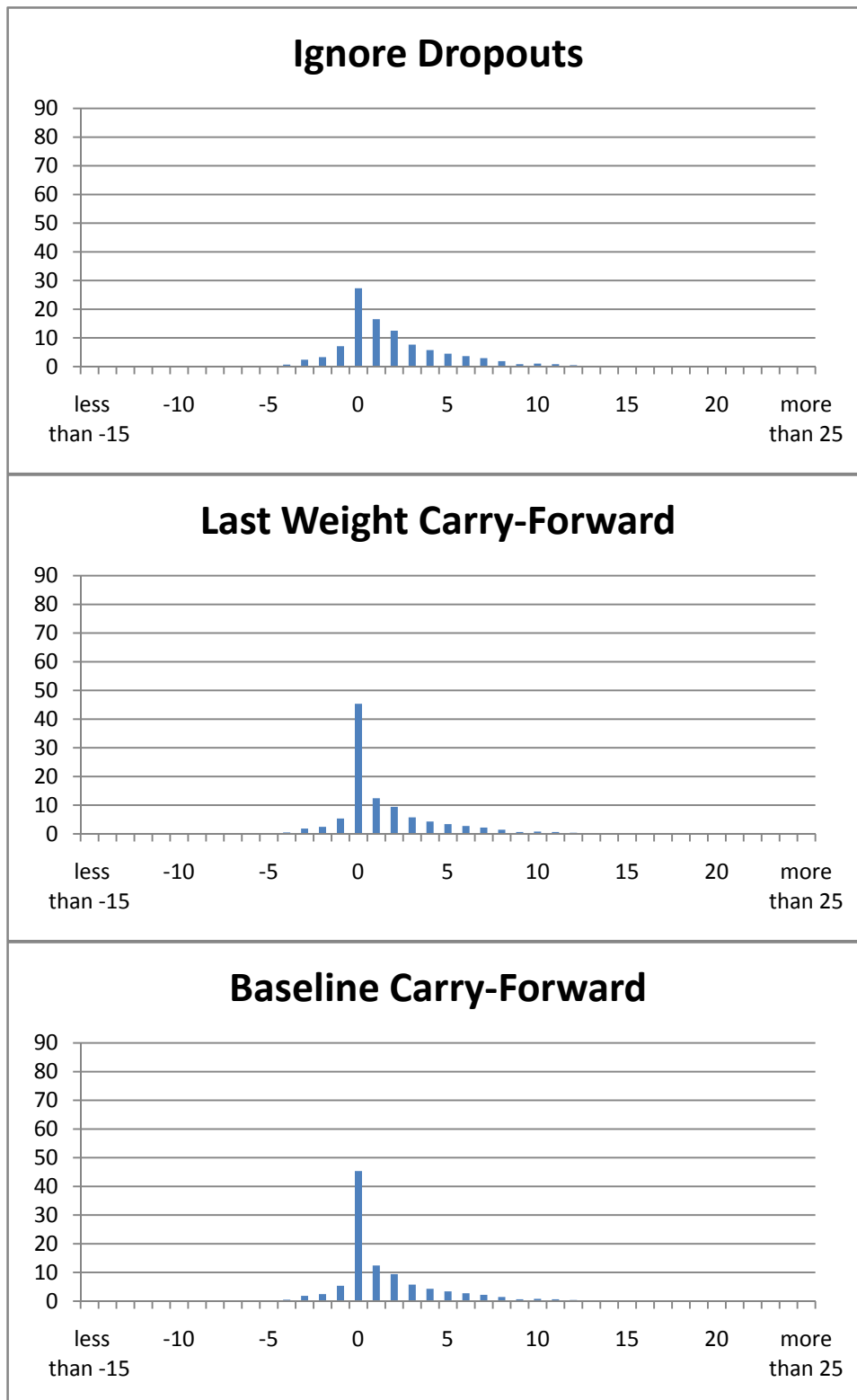
**Figure 2-3: Distribution of Percent Weight Loss under Standard incentives
Quarter 3**



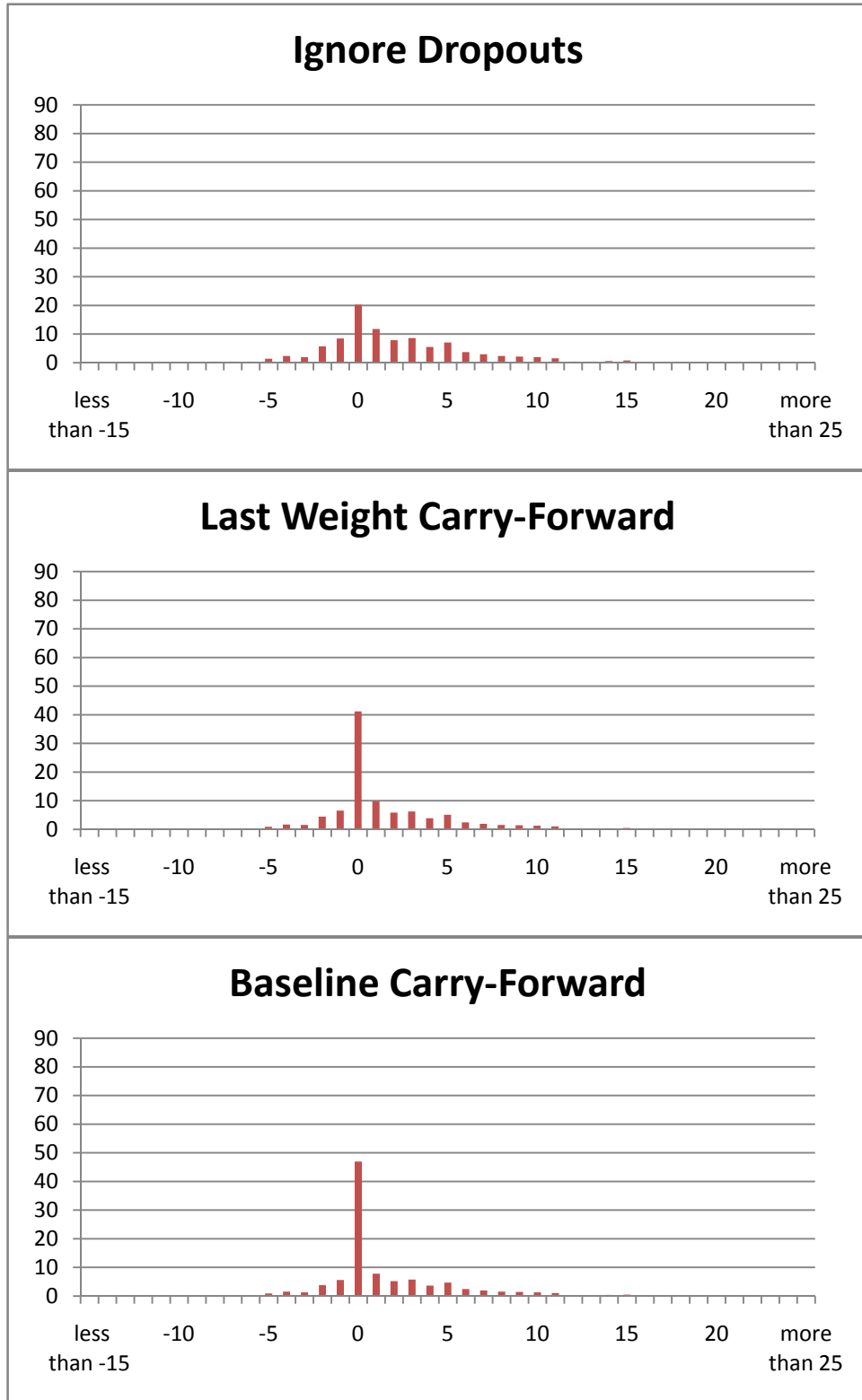
**Figure 2-4: Distribution of Percent Weight Loss under Standard incentives
Quarter 4**



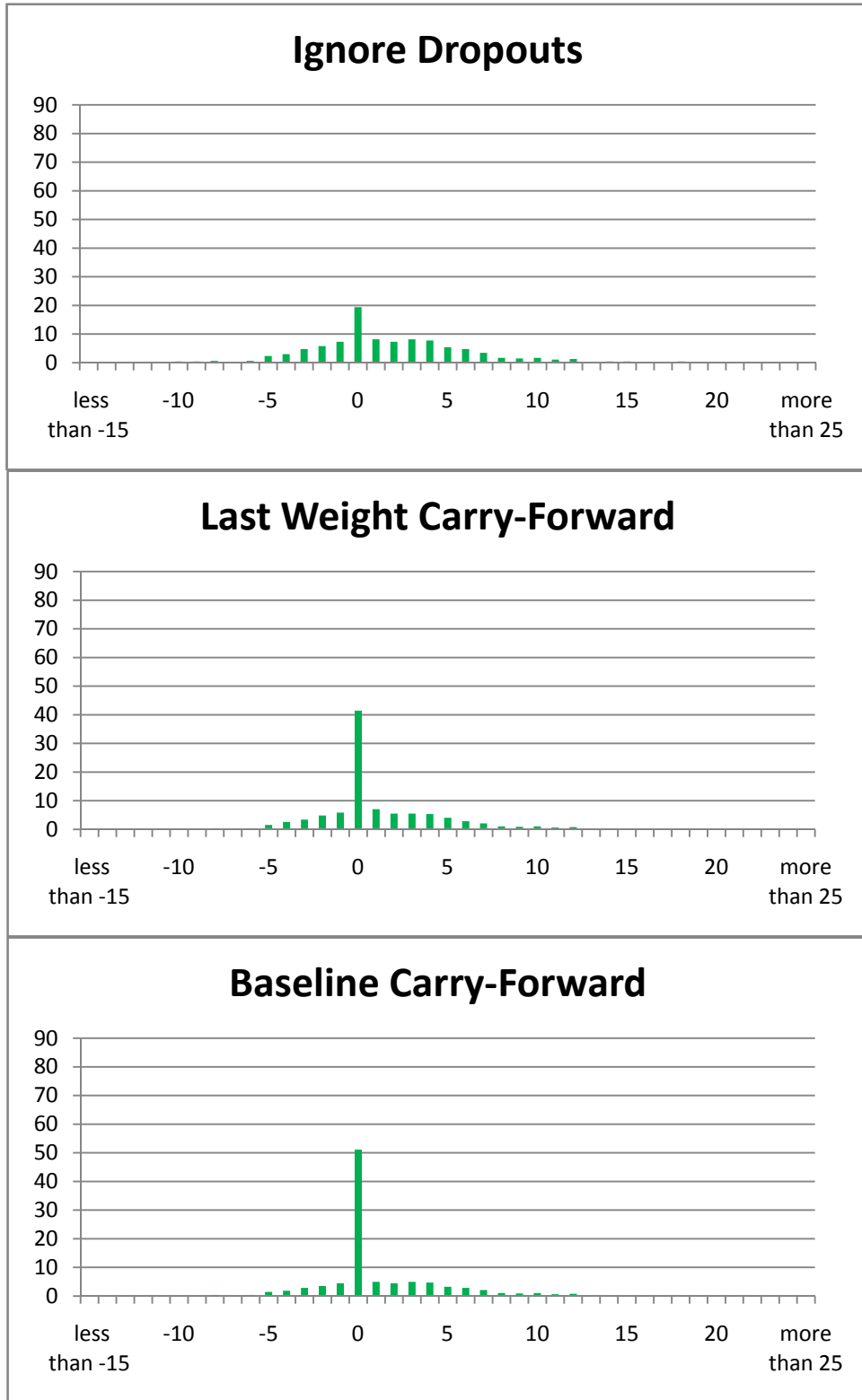
**Figure 3-1: Distribution of Percent Weight Loss under Modified incentives
Quarter 1**



**Figure 3-2: Distribution of Percent Weight Loss under Modified incentives
Quarter 2**



**Figure 3-3: Distribution of Percent Weight Loss under Modified incentives
Quarter 3**



**Figure 3-4: Distribution of Percent Weight Loss under Modified incentives
Quarter 4**

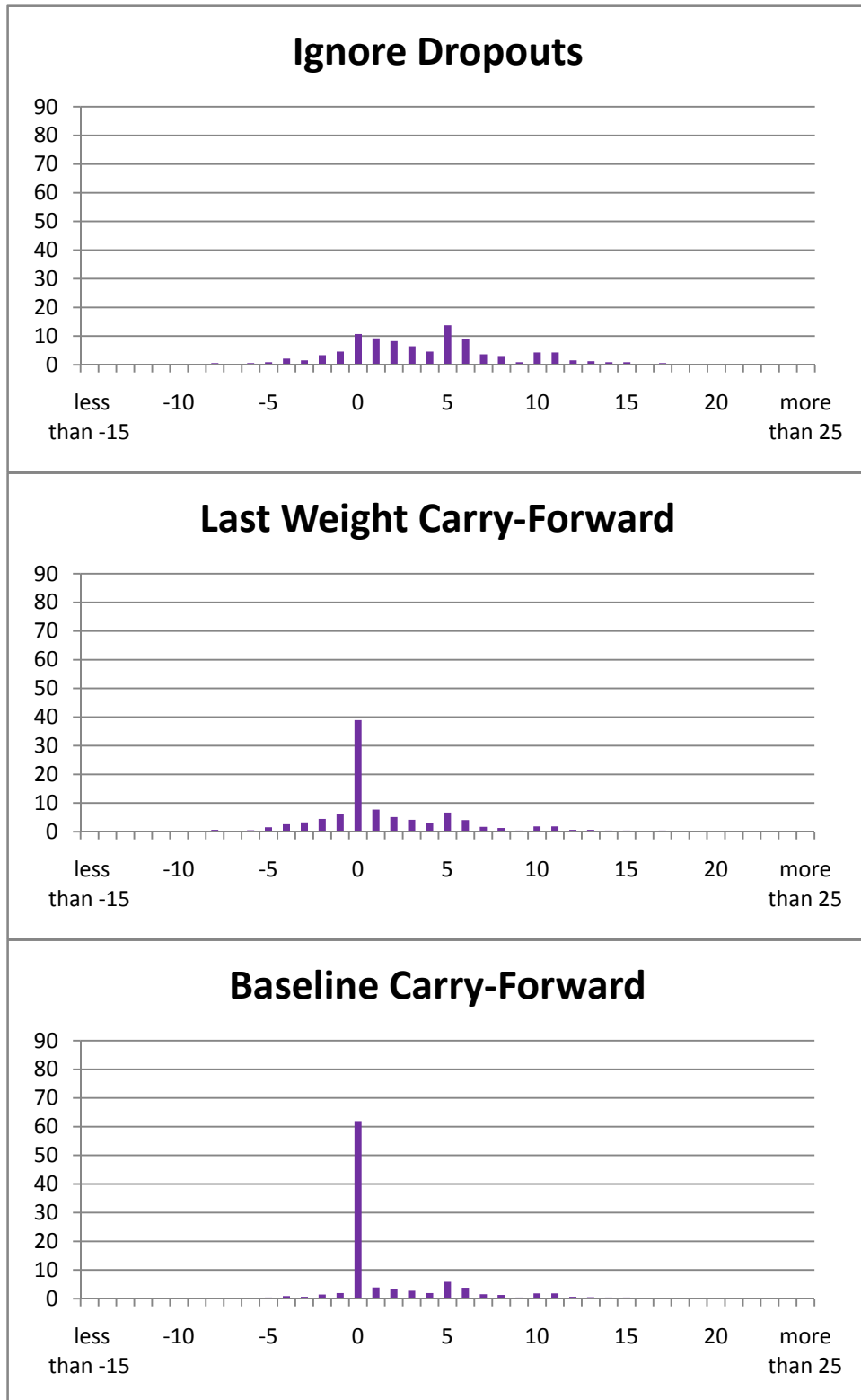


Figure 4-1: Distribution of Percent Weight Loss in the Control Group Quarter 1

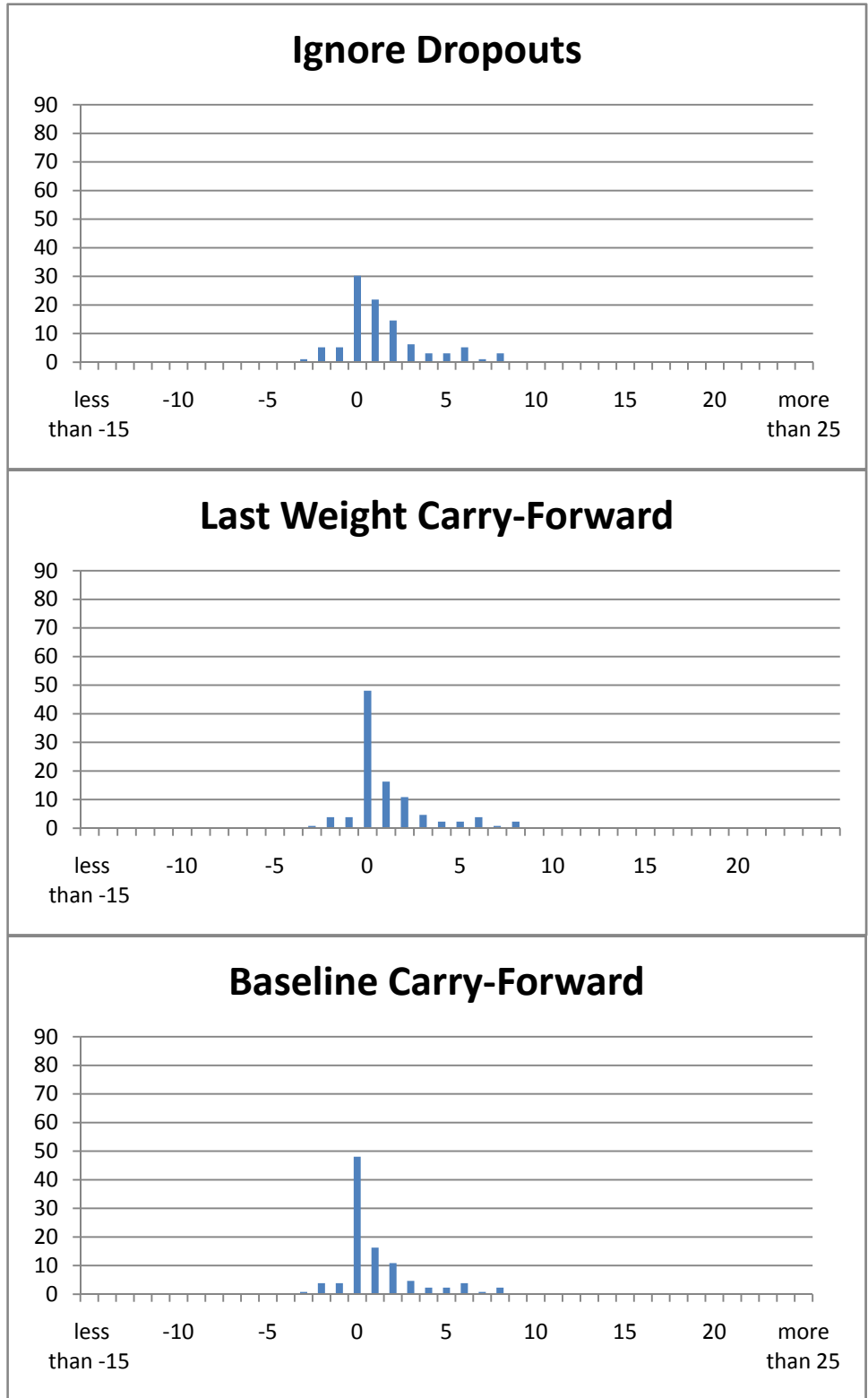


Figure 4-2: Distribution of Percent Weight Loss in the Control Group Quarter 2

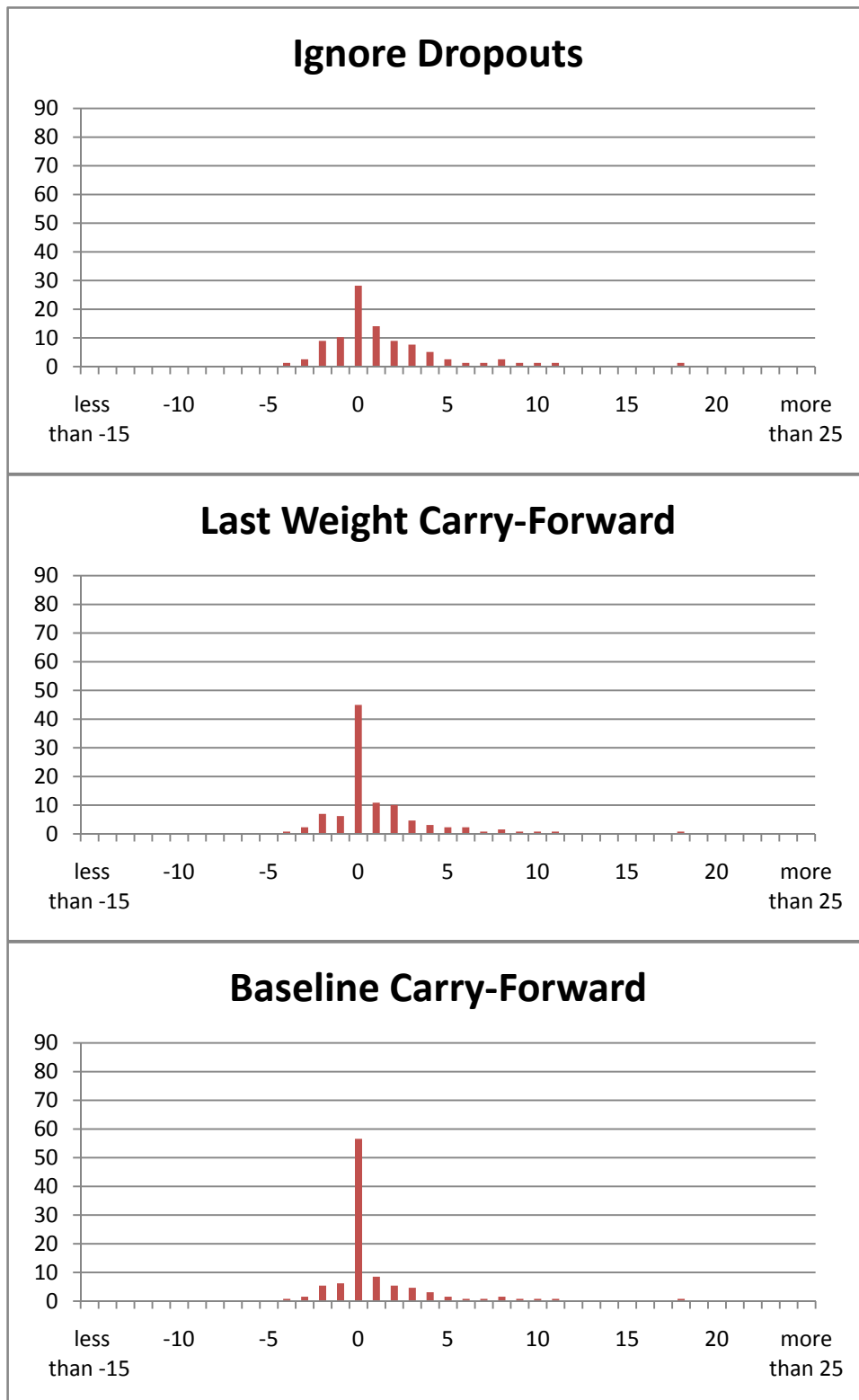


Figure 4-3: Distribution of Percent Weight Loss in the Control Group Quarter 3

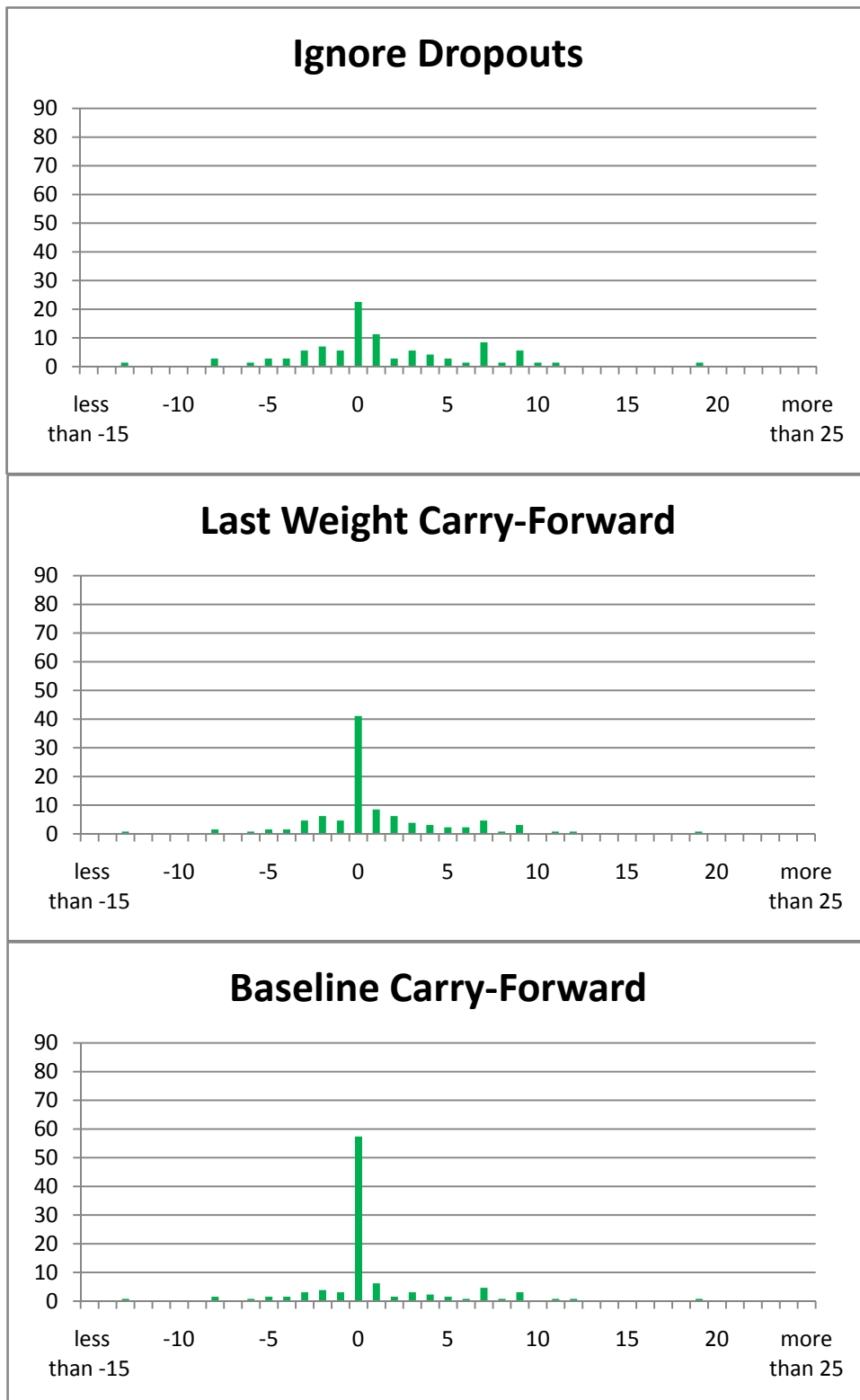
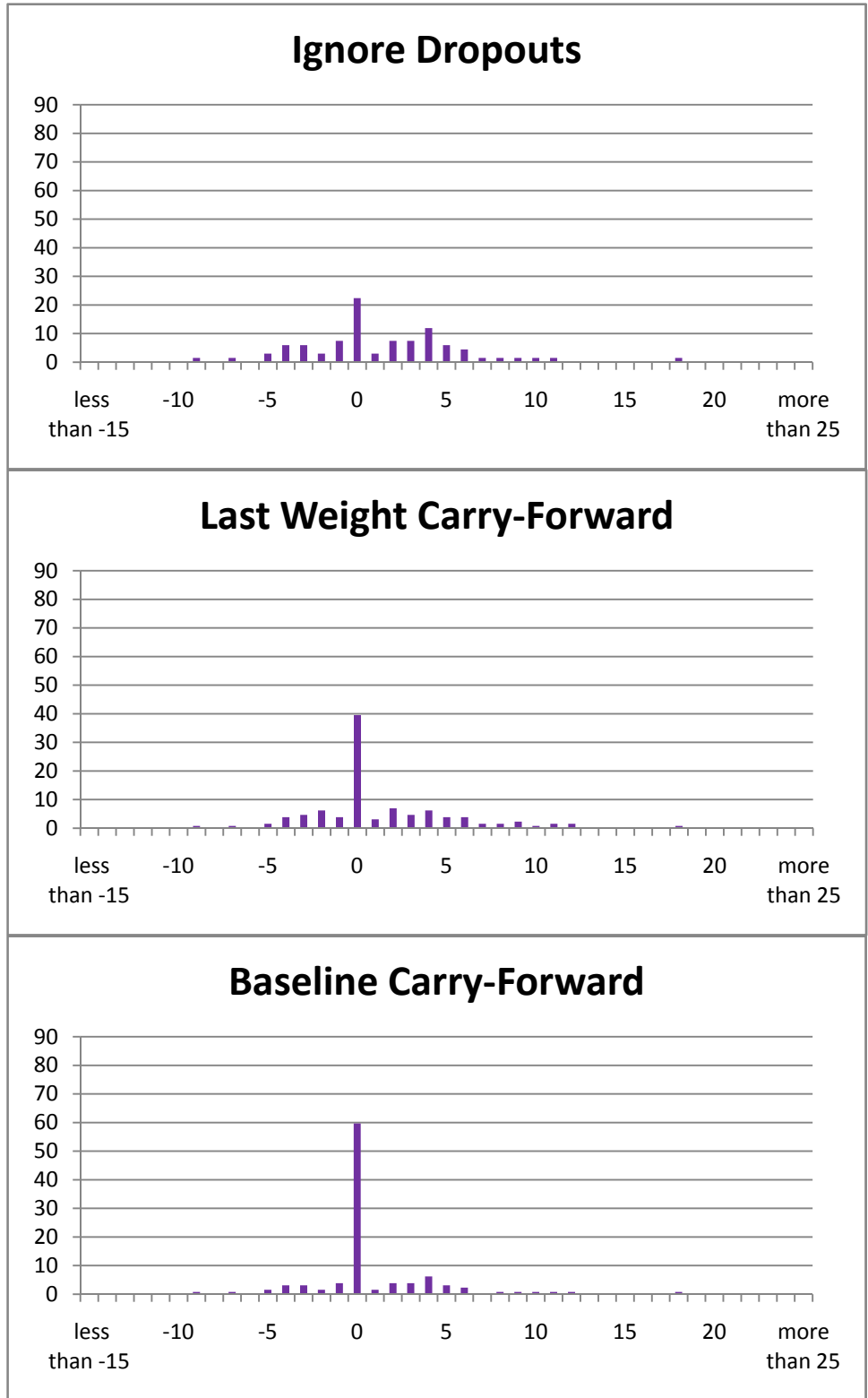


Figure 4-4: Distribution of Percent Weight Loss in the Control Group Quarter 4



**Table 1: Financial Rewards Based on Weight Loss
“Standard incentives”**

Weight Loss (as % of Baseline Weight)	Dollar Reward Per Month (Paid Quarterly)
1	1
2	2
3	3
4	4
5	5
10	10
15	15
20	25
25	35
30	50

Notes: Only participants with BMI over 25 (that is, those who are overweight or obese) are eligible to receive incentives. Moreover, people can only get incentives for weight loss down to a BMI of 25 – there is no financial incentive for anyone in the healthy weight (18.5 to 25) or underweight (<18.5) BMI categories to lose weight.

**Table 2: Financial Rewards Based on Weight Loss
“Modified incentives”**

Weight Loss (as % of Baseline Weight)	Reward (Some Quarterly, Some Annual)
Greater than zero	Entered into quarterly drawing for gift certificates: ten \$50 gift cards each quarter and ten \$50 salon vouchers each quarter.
5	Complete reimbursement of monthly fees (11 * \$9.95 = \$109.45), paid at end of year
10	Complete reimbursement of monthly fees (11 * \$9.95 = \$109.45) plus \$100 bonus, paid at end of year
“Biggest loser” (as % of baseline) at worksite	\$250 gift certificate, awarded at end of year, plus the appropriate award listed above for the specific amount of weight loss

Notes: Only participants with BMI over 25 (that is, those who are overweight or obese) are eligible to receive incentives. Moreover, people can only get incentives for weight loss down to a BMI of 25 – there is no financial incentive for anyone in the healthy weight (18.5 to 25) or underweight (<18.5) BMI categories to lose weight.

Table 3: Description of Employers

Employer	Description	Incentive Schedule
1	HMO clinic - nurses	Standard
2	Banking office	Standard
3	HMO office	Standard
4	Banking office	Standard
5	Insurance office	Standard
6	Insurance company	Modified
7	Grocery administrative office	Control

Table 4: Summary Statistics by Group

Variable	Standard Incentives			Modified Incentives			Control Group		
	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev
Initial BMI	1513	32.8	6.24	765	32.8	6.00	129	31.3	5.72
Male	1513	0.157	0.364	765	0.212	0.409	129	0.357	0.481
Age	1513	46.2	10.4	765	43.0	8.8	129	44.4	10.6
Height	1513	65.5	3.41	765	66.1	3.42	129	66.7	4.25
Overweight (30>BMI>=25)	1513	0.412	0.492	765	0.382	0.486	129	0.519	0.502
Obese (40>BMI>=30)	1513	0.301	0.459	765	0.314	0.464	129	0.256	0.438
Morbidly Obese (BMI>=40)	1513	0.287	0.452	765	0.305	0.461	129	0.225	0.419
Foundation exercise regimen	1513	0.601	0.490	765	0.550	0.498	129	0.488	0.502
Intermediate exercise regimen	1513	0.337	0.473	765	0.374	0.484	129	0.426	0.496
Advanced exercise regimen	1513	0.062	0.241	765	0.076	0.265	129	0.085	0.280
Email open rate	740	45.7	36.41	765	51.0	35.09	129	28.7	32.47

Table 5: Enrollment Rates

	Control Group (1)	Standard Incentive Group (2)	Modified Incentive Group (3)	p-value (1) equals (2)	p-value (1) equals (3)	p-value (2) equals (3)
Mean	0.203	0.248	0.186	0.613	0.839	0.477
(Std. Dev.)	(0.100)	(0.115)	(0.024)			

Note: Enrollment rates are calculated by the fraction of those who enroll in the program by the total population of the work place. Individuals with BMI<25 may enroll in the program, but receive no payouts.

Table 6: Cumulative Attrition, by Group and Quarter

Quarter	Standard Incentives	Modified Incentives	Control Group
1	51.2%* [†]	24.8%	25.6%
2	62.1%* [†]	33.5%	39.5%
3	72.0%* [†]	39.3%	45.0%
4	76.4%* [†]	57.4%*	48.1%

* represents significant difference with the control group at the 5% level

[†] represents significant difference between standard and modified incentive groups at the 5% level

Table 7: Weight Loss by Future Attrition Status

Full Sample			
Quarter	Persist in next quarter	Dropout next quarter	ttest p-value
1	4.67 (2.3%)	3.49 (1.8%)	0.004
2	5.73 (2.8%)	3.33 (1.7%)	0.000
3	6.38 (3.1%)	4.23 (2.0%)	0.008
Standard Incentive Group			
Quarter	Persist in next quarter	Dropout next quarter	ttest p-value
1	4.90 (2.5%)	4.07 (2.1%)	0.122
2	6.67 (3.2%)	3.99 (2.0%)	0.003
3	6.93 (3.2%)	8.96 (4.3%)	0.128
Modified Incentive Group			
Quarter	Persist in next quarter	Dropout next quarter	ttest p-value
1	4.66 (2.3%)	1.03 (0.6%)	0.000
2	5.36 (2.6%)	0.76 (0.3%)	0.001
3	6.77 (3.4%)	-1.91 (-1.0%)	0.000
Control Group			
Quarter	Persist in next quarter	Dropout next quarter	ttest p-value
1	3.42 (1.8%)	3.54 (1.5%)	0.929
2	3.46 (1.9%)	1.36 (0.6%)	0.325
3	1.82 (0.9%)	7.99 (4.0%)	0.041

Weight loss in pounds (Percent weight loss in parenthesis)

Table 8: Weight Loss in Pounds and Percent of Baseline Weight, by Group and Quarter

Quarter	Standard Incentives			Modified Incentives			Control Group		
	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward
1	4.6 (2.31%) Min = -12.6 Max = 58.8	2.2' (1.13%)	2.2' (1.13)	4.2 (2.06%) Min = -11.6 Max = 34.6	3.2 (1.55%)	3.2 (1.55%)	3.4 (1.73%) Min = -6.0 Max = 19.6	2.6 (1.29%)	2.6 (1.29%)
2	5.5*' (2.73%) Min = -19.8 Max = 89.4	2.7 (1.34%)	2.1' (1.04%)	4.9 (2.38%) Min = -18.4 Max = 52.8	3.3 (1.64%)	3.3 (1.58%)	3.1 (1.62%) Min = -8.8 Max = 30.2	2.4 (1.21%)	1.9 (0.98%)
3	7.77*' (3.68%) Min = -25 Max = 109.2	3.2 (1.54%)	2.2 (1.03%)	4.1 (2.00%) Min = -29.8 Max = 53.6	2.6 (1.27%)	2.5 (1.21%)	3.0 (1.49%) Min = -22.2 Max = 32	2.2 (1.06%)	1.7 (0.82%)
4	6.1' (2.75%) Min = -25.6 Max = 116.8	3.2 (1.52%)	1.4' (0.64%)	8.4* (4.15%) Min = -30.6 Max = 61.2	3.3 (1.61%)	3.6* (1.77%)	3.2 (1.68%) Min = -13.8 Max = 30.8	2.9 (1.47%)	1.7 (0.87%)

Note: A positive number indicates weight lost. A negative number (e.g. for the minimum weight loss) indicates weight gain.

* represents significant difference with the control group at the 5% level

' represents significant difference between standard and modified incentive groups at the 5% level

Table 9: Percent of Respondents Losing 5% of Baseline Weight, by Group and Quarter

Quarter	Standard Incentives			Modified Incentives			Control Group		
	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward
1	17.1%	8.3% ^t	8.3% ^t	16.7%	12.6%	12.6%	12.5%	9.3%	9.3%
2	21.6%	10.8% ^t	8.2% ^t	24.8%*	16.9%	16.5%*	12.8%	10.1%	7.8%
3	28.1%	13.0%	7.9%* ^t	23.1%	15.0%	14.0%	23.9%	15.5%	13.2%
4	22.7% ^t	13.3% ^t	5.4%* ^t	45.7%*	20.9%	19.5%*	19.4%	17.8%	10.1%

* represents significant difference with the control group at the 5% level

^t represents significant difference between standard and modified incentive groups at the 5% level

Table 10: Percent of Respondents Losing 10% of Baseline Weight, by Group and Quarter

Quarter	Standard Incentives			Modified Incentives			Control Group		
	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward	Ignoring Dropouts	Last Weight Carry-Forward	Baseline Carry-Forward
1	2.4%	1.2%	1.2%	2.8%	2.1%	2.1%	0.0%	0.0%	0.0%
2	5.2%	2.2% ^t	2.0% ^t	6.5%	4.3%	4.3%	3.8%	2.3%	2.3%
3	10.4% ^t	3.8%	2.9%	6.3%	4.1%	3.8%	4.2%	2.3%	2.3%
4	10.1% ^t	4.4% ^t	2.4% ^t	15.3% *	6.8%	6.5%	6.0%	4.7%	3.1%

* represents significant difference with the control group at the 5% level

^t represents significant difference between standard and modified incentive groups at the 5% level

**Appendix Table 1:
Previous Literature on Financial Incentives for Weight Loss**

Study	Study Design	Intervention and Incentives	Sample Size and Population	Duration	Weight Loss	Attrition
Volpp et al. (2008)	Randomized controlled trial	3 groups: Deposits contract of \$0-\$3 / day matched 1:1. Lottery for daily prize with E[V]=\$3. Self-reported daily weight. \$20 for monthly weigh- in, unconditionally	N=57 (19 in each of 3 groups) Patients at Philadelphia Veterans Affairs Medical Center with BMI 30-40	16 weeks	Mean weight loss: Lottery: 13.1 lbs Deposit contracts: 14.0 Control: 3.9 lbs.	8.8%
Burger and Lynham (2008) working paper	Opportunistic data from William Hill betting agency for 1993-2006	Maximum bet of \$65. William Hill offered odds ranging from 5:1 to 50:1; potential payoff averaged \$1,926. Average duration of bet is 8 months, weight to be lost ranges from 28-168 lbs. Each bettor weighed at start and end of bet by physician. No control group.	N=51 Self-selected members of British population.	Average of 8 months	Approximately 80% of people betting on their weight loss lose the bet	Approximately 80% of people betting on their weight loss lose the bet
Finkelstein et al. (2007)	Randomized trial, no control group	Three groups: Back loaded: \$0 at 3 months, \$14 per % point lost at 6 months Front loaded: \$14 per % point lost at 3 months, \$0 at 6 months Steady payment: \$7 per % point lost at	N=207 (72 in Back Loaded, 64 in Front Loaded, 71 in Steady Payment) Overweight and obese employees at one university and 3	6 months	Mean weight loss 3 months: 2 lbs for Back Loaded, 4.7 lbs for Front Loaded, 3 lbs for Steady Payment Mean weight loss at 6	54% in Back Loaded, 45% in Front Loaded, 31% in Steady Payment

		both 3 months and 6 months Weigh-ins at 3 months and 6 months. Incentives only up to 10% weight loss (\$140)	community colleges in NC		months not significantly different from zero	
Butsch et al. (2007)	Sequential control-intervention, not randomized	Treatment group eligible for 50% reimbursement of enrollment fee (\$150 of \$300) if lose 6% of initial weight and attend 10 of 12 group sessions Control group was not eligible for reimbursement	N=401 (241 intervention of which 59 enrolled, 160 control of which 40 enrolled) Participants in Univ. Alabama at Birmingham EatRight Lifestyle Program BMI 30 and over.	12 weeks	Mean weight loss: 2.25% in control group, 3.27% in intervention group; difference not statistically significant	Not stated
Hubbert et al. (2003)	Propensity score matching of 4 controls to each member of intervention group	Treatment group eligible for 50% of cost of program fees (\$150 of \$300) if lose 6% of initial weight and attend 10 of 12 group sessions. Control group was not eligible for reimbursement	N=125: 25 in intervention group, 100 in control group Participants in Univ. Alabama at Birmingham EatRight Lifestyle Program and members of UAB-owned HMO BMI 30 and over.	12 weeks	Mean weight loss: 7.3 kg (6.1%) in intervention group, 4.0 kg (3.9%) in control group; both differences are statistically significant	Not stated
Jeffery, Forster, et al. (1993)	Block-randomized controlled experiment (worksites randomized)	Worksites divided evenly between treatment and control groups. Treatment (Healthy Worker Project) consisted of health education classes and payroll deductions that served as	32 worksites in Minneapolis / St. Paul metropolitan area. Of 10,000 employees in treatment worksites,	2 years	No treatment effect was found for weight. In cohort survey, average change in BMI was 0.08 units for	No attrition of worksites.

		<p>bonds – refunded if achieve weight loss goals or donated to charity otherwise.</p> <p>Goals chosen by employee and ranged from minimum of 0 lb and maximum of 1% body weight loss each week.</p> <p>Participants chose amount of payroll deduction (minimum of \$5 biweekly).</p> <p>200 employees surveyed at baseline and again after 2 years (cohort). Another 200 employees surveyed after 2 years (cross-section).</p> <p>Weight self-reported but corrected for reporting error.</p>	2,041 employees participated in weight control program.		<p>control group, -0.02 units for treatment group; not statistically significant.</p> <p>In cross-sectional survey, average change in BMI was -0.05 in both the treatment and control groups.</p>	
Jeffery, Wing, et al. (1993)	Randomized controlled experiment	<p>Five groups: 1) control; 2) standard behavioral therapy (SBT); 3) SBT plus food provision; 4) SBT plus incentives; 5) SBT plus food provision plus incentives.</p> <p>Weekly incentives: \$0 if gained weight, \$2.50 if did not gain weight; \$12.50 if weight loss was 50% of goal, \$25 if weight loss reached goal.</p> <p>Weight-loss goals could be either 14, 18, or 23 kg during course of program.</p> <p>Weight measured at baseline, 6, 12, and 18 months. There were also optional weekly weigh-ins.</p>	<p>N=202 men and women from Pittsburgh and Minneapolis-St. Paul, of which 40 to 41 were in each of the 5 groups.</p> <p>Had to be 14-32 kg overweight</p>	18 months	No effect of financial incentives or the interaction of financial incentives with food provision	11% attrition at 6 months, 13% at 12 months, 15% at 18 months
Jeffery et al. (1990)	Randomized experiment	Two groups: 1) offered a weight control newsletter program for price of \$5; 2) offered the same program for	N=1,304 residents of Bloomington Minnesota:	6 months	Weight loss averaged about 4 lbs for \$5 program and 8 lbs for	3.8% did not return survey

		<p>free but requiring a \$60 deposit that would be refunded based on (proportional to) success in weight loss.</p> <p>Individuals chose weight loss goals of not more than 4 lb a month.</p> <p>Weight self-reported (questionnaire, telephone survey). For subset of respondents, validation of self-report through measurement of weight.</p>	<p>1,190 in the \$5 newsletter program group and 114 in newsletter plus incentive program group</p>		<p>incentive program.</p>	
Kramer et al. (1986)	Randomized controlled experiment	<p>Three groups: 1) monthly financial contingencies for weight maintenance; 2) monthly financial contingencies for participation in training sessions to solidify behavioral changes; 3) no treatment.</p> <p>\$120 deposit. For each of 12 sessions not attended, participant forfeited \$10. Refund also withheld if weighed more than “baseline” (post-first-treatment) weight. Withheld refunds (forfeited moneys) were distributed among those who were at or below “baseline” weight at final session.</p> <p>Weight measured at “baseline” and at one year.</p>	<p>N=85 individuals who had already lost 10% or more of their body weight through a 15-week weight-loss program.</p>	1 year	<p>Incentives had no impact on weight maintenance / amount of weight regained. Average weight regain: 10.3 lbs in control group, 11.9 lbs. in group with incentives.</p>	<p>6 of 28 (21%) of the incentives group refused to attend final weigh-in. They self-reported weight, and 5 lbs was added to account for under-reporting.</p>
Jeffery et al. (1984)	Randomized controlled experiment	<p>Three groups: 1) regular contract, 2) difficulty-grade contract; 3) no contract (control)</p> <p>All deposited \$150. Immediately refunded to control group. Regular contract group received \$30 for each 5-lb. increment of weight loss</p>	<p>N=113</p> <p>Roughly half recruited from population sample and the other half from newspaper advertisements</p>	15 weeks	<p>Average weight loss: 26.2 lbs (12.8%) in difficulty-grade contract 21.7 lbs (10.8%) in regular contract 17.7 lbs (8.5%) in control group</p>	<p>11 subjects (10%) refused to attend final weigh-in. They self-reported weight, and 5</p>

		Difficult-grade contract group received \$5 for first 5 lbs lost, \$10 for second, \$20 for third, \$40 for fourth, and \$75 for fifth.				lbs was added to account for under-reporting.
Jeffery et al. (1983)	Randomized experiment	<p>Six treatment groups: 3 levels of deposit (\$30, \$150, \$300) times two types of payoff criteria: individual weight loss or mean group weight loss.</p> <p>All received 15-week behaviorally oriented program. Goal was 30 pounds lost.</p> <p>Cash refunds per week at rate of \$1, \$5, or \$10 per pound up to 2 pounds per week.</p> <p>Monies not refunded for weight loss by end of program were distributed equally among those who achieved the 30-pound weight loss goal.</p> <p>Participants were weighed weekly.</p>	<p>N=89</p> <p>Men in the Minneapolis area with self-reported weight at least 30 pounds above the ideal.</p>	15 weeks	<p>Individuals rewarded for group performance lost on average 5 lbs. more weight. This difference was maintained over 1 year follow-up.</p> <p>No significant effects of contract size.</p>	None
Coates et al. (1982)	Randomized experiment	<p>Four treatment groups: 2 incentivized behaviors (weight loss or decrease in calorie consumption) by 2 frequencies of therapeutic contact (5 times or 1 time per week)</p> <p>Deposits were equal to 15 weeks' allowance or 50% of earnings from part-time work; amounts varied from \$15-\$240 (mean=\$67.75). Source of payment: parents (51.5%), subjects (39.4%), shared (9.1%).</p>	<p>N=36</p> <p>Adolescents at least 10% above average weight-for-height.</p>	15 weeks	<p>The treatment group receiving rewards for weight loss and coming to the clinic 5 times per week was the only group to significantly reduce the percent overweight. Treatment effects maintained over a 6-month follow-up period.</p>	None

		<p>Weight loss goal was 1 lb. per week, or caloric reduction necessary to lose 1 lb. per week. Monetary reward was delivered either once per week or once per week at treatment center.</p> <p>Weighed at each clinic visit. Food records checked</p>			<p>Significant correlation between initial monetary deposit and percent overweight lost.</p> <p>No significant difference based on whether parents or subject paid the deposit</p>	
Jeffery et al. (1978)	Randomized controlled experiment.	<p>Three treatment groups: deposits were returned contingent on either attendance, calorie restriction, or weight loss. Also a control group.</p> <p>Each of the three treatment groups deposited \$200. One group paid \$20 for losing 2 lbs. per week. Another paid \$20 for calorie restrictions calculated to cause loss of 2 lbs. per week. Third group paid \$20 for weekly attendance.</p>	<p>N=31</p> <p>Respondents to newspaper advertisement for people who need to lose 50 lbs. or more.</p>	10 weeks	<p>Groups rewarded for weight loss or calorie reductions lost an average of 20 lbs, significantly more weight loss than either the group rewarded for attendance (8.6 lbs) or the control group (12.4 lbs).</p>	4 of 7 in control group quit.
Mann (1972)	Single-subject reversal design	<p>Subjects deposited a large number of valuables (e.g. money, jewelry, medals) with the researcher and signed a Contingency Contract allowing the researcher to switch them from treatment to control conditions, with the treatment being valuables being either returned or forfeited based on weight loss.</p> <p>One valuable was returned for each 2 lb weight loss over a 2-week period.</p>	<p>N=8</p> <p>Respondents to newspaper advertisement. All agreed to lose 25 pounds or more and had physician approval.</p>	Durations of treatments varied; total study ran at least 400 days	Average weekly weight loss of 1.6 to 1.7 pounds during treatment, regain of 1.4 pounds per week when incentives removed.	None

		Subjects weighed every Monday, Wednesday, and Friday.				
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