ORIGINAL RESEARCH

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Weight Loss in a Community Initiative That Promotes Decreased Energy Intake and Increased Physical Activity and Dairy Consumption: Calcium Weighs-In

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Background: This project addresses the need to identify feasible, effective weight-management programs that can be implemented within communities. The controversial role of dairy products in weight-management programs is also explored. ***Methods:*** The "Calcium Weighs-In" weight-loss program placed equal emphasis on diet and physical activity and was delivered within a community intervention to promote dairy consumption in Calcium, New York. One hundred ninety-nine adults in Calcium, NY, participated in the weight-loss program. Weight loss, increase in dairy intake, increase in steps, decrease in blood pressure, decrease in waist circumference, and decrease in body mass index (BMI) were examined. ***Results:*** The mean weight loss for 116 subjects who completed the program was 6.0 ± 4.2 kg (mean ± SD, $P < .0001$) with a percent weight change of 6.4% ± 4.2% ($P < .0001$). An increase of 3582 ± 4070 steps ($P < .0001$), as well as an increase of 0.8 ± 1.2 dairy servings ($P < .0001$) was seen. Higher average dairy consumption was associated with greater weight loss and a greater decrease in waist circumference. ***Conclusion:*** The results show that effective weight-management programs can be implemented within communities. The results are also consistent with recommendations to include low-fat dairy products and a physical activity component in weight-management programs.

Keywords: nutrition, physical activity, health, teaching

The rapid rise in the number of overweight and obese individuals in the United States is an alarming public health issue.[1] Currently, over 65% of American adults are overweight or obese[1] and thus suffer disproportionately from health and social consequences such as cardiovascular disease, diabetes, cancer, musculoskeletal disorders, and depression.[2] Clinical guidelines released from the National Institutes of Health suggest that most overweight and obese individuals could improve their health with weight loss.[2]

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It is clear that even a moderate amount of weight loss of 5% to 10% can significantly affect health in those who are overweight or obese.[2,3] This amount of weight loss can readily be produced in research settings.[3,4] Limited research has been conducted, however, to evaluate the efficacy of weight-loss programs, either commercial or noncommercial, delivered within a community setting in producing this amount of weight loss. Dansinger et al[5] followed individuals within a community who were following 4 popular diets—Atkins, Ornish, Weight Watchers, Zone—without any additional formal behavioral support. They found that weight loss was modest at 2 months (3.5%–3.8%) and at 1 year (2.1%–3.2%), with no differences among groups. Thus it appears that people are not very successful in achieving a 5% or greater weight loss on their own. In a 2-year study, weight loss produced by Weight Watchers was compared with weight loss produced with a self-help program.[6] The self-help group lost and maintained about 1.3 to 1.4 kg for the first year, but tended to return to their baseline weight after the 2-year study ended. The Weight Watchers group lost and maintained about 4.3 to 5.0 kg at the end of the first year and remained at a 2.7 to 3.0 kg deficit at the end of the 2-year study.[6] Most other commercial, community-based weight-loss programs have not been formally evaluated.

An alternative way to address weight in the community is through interventions that target the entire community. In 1 of the few community intervention programs, residents in a rural Wisconsin town (Pound, WI) volunteered to enter a weight-loss program that used meal replacements (Slim-Fast) for weight loss.[7] After a 12-week weight-loss phase, subjects in the community were weighed biannually. Body-weight data from Pound, WI, was compared with a post hoc cohort group (control). Initial body weight was acquired from the surrounding communities and matched for age and gender. After 5 years, 141 of the original 158 volunteers in Pound, WI, remained in the meal-replacement intervention and were compared with 389 controls. Over the 5-year intervention, the female participants in Pound, WI, lost an average of –4.2 ± 6.9 kg, and the men lost –5.8 ± 5.4 kg. Those in the control group experienced weight gains of +6.7 ± 10.2 kg and +6.5 ± 10.7 kg, respectively, over a 5-year period.

We had the opportunity to test a combined model in which a formal weight-management program was offered to a group of individuals as part of a community-wide initiative to promote dairy consumption. In 2003, the International Dairy Association chose Calcium, NY, as the site of a media promotion aimed to educate the public that dairy products can fit into a healthy diet. We offered a 16-week cognitive weight-loss program (Calcium Weighs-In) to interested residents of Calcium, NY, and evaluated its effect on weight loss, change in waist circumference, physical activity, dairy consumption, and blood pressure in program participants. Most weight loss involves food restriction and increasing physical activity, which our program included. However, because the weight-loss program was offered as part of a community-wide promotion of dairy, we included a dairy recommendation in the dietary advice for program participants. Recent data suggest calcium, especially calcium contained in dairy products, might facilitate weight loss and weight-loss maintenance. Several associational studies have shown a negative relationship between calcium intake and body mass index (BMI), body fat, and the relative risk of obesity.[8-11] Zemel et al[12] found that adding low-fat, calcium-containing dairy products to a weight-loss program leads to greater weight and fat loss and a greater

decrease in waist circumference than the same program without dairy.[12] Harvey-Berino et al,[13] however, found no effect of dairy calcium on weight loss.

The intent of this 16-week study was to evaluate the effect of Calcium Weighs-In on weight loss, change in waist circumference, physical activity, dairy consumption, and blood pressure.

Methods

Study Subjects

The study was funded by a grant from the National Fluid Milk Processor Promotion Board (Milk PEP) to the Center for Human Nutrition at the University of Colorado at Denver and Health Sciences Center (UCDHSC). The research study was designed and conducted by the Center for Human Nutrition and was approved by the Institutional Review Board at the UCDHSC. The 16-week, structured weight-loss program Calcium Weighs-In was modeled after the Colorado Weigh program developed at the UCDHSC. Colorado Weigh is a cognitive–behavioral weight-loss program delivered in a group format by registered dietitians. The program focuses on behavior modification to reduce energy intake and increase physical activity through the use of pedometers.

Study Population

Subjects were recruited through local newspaper and radio advertisements. Subjects had to be 18 years of age or older, have a BMI of at least 25, and be able to walk. There were no other criteria because the groups were designed to be representative of community people interested in a community weight-loss program that supports a 1 to 2 pound weekly weight-loss goal. Calcium is a rural community in upstate New York with a population of approximately 3500 people. The average household income at the time of the study was about $30,000 per year. A total of 199 subjects (172 women and 27 men) volunteered to be a part of the 16-week Calcium Weighs-In program in Calcium, NY. The age range was 20 to 76 years.

Procedures

A total of 8 classes, each with 15 to 25 participants, began in June 2003. The program was offered at no cost to residents of Calcium, NY. Community residents were made aware of this opportunity through local media and through postings throughout the community. Classes were held at locations within the community. Local registered dietitians (RDs), trained by the research staff in delivering Colorado Weigh, led the weekly groups and delivered the 16-week curriculum. The classes were closed in that participants stayed in the same class with the same instructor throughout the 16-week program. The topics for each weekly class are provided in Table 1. Each class was an hour in length with a period of 30 minutes before class during which participants could be weighed and interact with the RD. Part of the formal curriculum was helping each participant to set a realistic goal for weight loss and for increased physical activity (ie, increased steps/d). Jeffery et al[14] has shown that combining more aggressive physical activity goals with a standard behavior-therapy

Table 1 Topic Covered Each Week During the 16-Week Program

Week1	Introduction
	• Review of program goals
	• Value of self-monitoring (weight, food intake, and steps per day)
Week 2	Eating For Success
	• Energy balance, calorie and fat budget
	• Food pyramid and importance of dairy intake
	• Value in counting calories, fat grams, and dairy servings
Week 3	Meal Planning
	• Reading food labels and grocery shopping
	• Creating meal and snack menus
Week 4	Move Those Muscles
	• Exercise and weight loss
	• Three types of physical activity
	• Time management and barriers
Week 5	Delightful Dining
	• Tips for dining out
	• Fast food knowledge
Week 6	Changing Your Environment
	• Creating an environment conducive to weight loss
	• Breaking behavior chains
Week 7	Eating Healthy Part 1
	• Diet and heart-disease prevention
	• Physical activity and cardiovascular system
Week 8	Eating Healthy Part 2
	• Fiber and disease prevention
	• Calcium and osteoporosis
Week 9	Rethink Your Negative Self-Talk
	• Awareness of negative self-talk
	• Evaluating validity of thoughts
Week 10	Assessment
	• Evaluate previous fat-gram, step, and weight-loss goals
	• Record revised goals for next 6 weeks
Week 11	Jump Start Your Activity Plan
	• Revising exercise program for continued compliance
	• Exercise and weight control
	• Target heart rates
Week 12	Emotions, Stress, and Weight Management
	• Identify triggers
	• Strategies for stress management
Week 13	Body Image
	• Cultural factors and social rewards
Week 14	Weight Management and Special Occasions
	• Strategies for vacations and travel
	• Tips for parties and holiday eating
Week 15	National Weight Control Registry
	• Characteristics of successful weight loss maintainers
Week 16	Evaluation
	• Review of accomplishments and existing challenges
	• Establish goals for the future

program promotes greater weight loss results at 12 and 18 months. Calcium Weighs-In participants were taught to use the program strategies of planned exercise and lifestyle activity to reach the mounting weekly goal of an additional 500 average daily steps. Over the 16-week program, participants were encouraged to exceed 10,000 steps per day. Weight-loss goals were revised as the program progressed and the reality of weight-loss efforts set in.

Table 2 shows the timetable of data collection during the study. Each participant was weighed weekly by the RD who recorded data in a computer database. Each participant maintained a diary in which food intake, fat-gram intake, physical activity (steps/d), and dairy consumption were recorded. The RD instructor reviewed the diaries on a weekly basis, provided feedback to participants, and recorded data in the computer database.

Outcome Measures

We examined 2 types of outcome measures: behavioral and physiological. Behavioral outcomes measured weekly were physical activity (average number of steps per day) and dairy consumption (average servings of dairy products per day). We have previously found that recording specific foods (eg, dairy) or fat grams is easier for subjects than recording all food consumed. Estimating total energy intake from self-reported food records can be a misuse of time and resources given the strong body of evidence that there is consistent underreporting among self-reported dietary assessment tools.[15] Each participant was given a step counter to wear and was asked to record weekly average steps in the diary. The literature has shown that weight loss is greater when physical activity is combined with a calorie-reduced diet.[16] Participants were asked to record daily dairy servings using the chart shown in Table 3. Physiological outcomes were body weight and BMI measured weekly and waist circumference and blood pressure measured at baseline and at week 16. Blood pressure was also measured at week 8.

Data Analysis

Data were entered into the existing Colorado Weigh access database. Data were analyzed using SAS software (SAS Institute Inc, Cary, NC). Graphical and exploratory analyses were carried out on all outcomes, and all suspicious values were able to be resolved from the original data except for 3 extremely high dairy observations on 1 subject during weeks 14 through 16, which were omitted. One subject who achieved an extremely high weight loss (28.6 kg) was also omitted. Examination of the data showed that the subject was weighed each week and this was in fact a true weight loss. Because it was so unrepresentative of typical results (the next highest weight loss was 17.3 kg), we chose to be conservative and omit this subject. Results are presented as mean ± standard deviation in tables and text to describe variability of individual subject measurements, and mean ± standard error bars are shown on Figures to show the precision of the estimated mean lines.

We carried out analyses to answer the following questions: (1) What were the subjects like at baseline? (2) Were some types of subjects more likely to drop out? (3) Were there changes in behavior (physical activity and dairy consumption) over

Table 2 Time Points and Types of Data Collected in the Calcium Weighs-In Program

	Time point															
	Wk 1	Wk 2	Wk 3	Wk 4	Wk 5	Wk 6	Wk 7	Wk 8	Wk 9	Wk 10	Wk 11	Wk 12	Wk 13	Wk 14	Wk 15	Wk 16
Weight	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Body mass index	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Blood pressure	X							X								X
Waist circumference	X															X
Steps		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Dairy consumption		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 3 What's a Serving of Dairy?

Food[a]	Amount	Calcium (mg)
Milk, whole, low fat, or fat-free	1 cup	300
Milk, evaporated	1/4 cup	90
Dried milk powder	1/4 cup	380
Buttermilk	1 cup	300
Chocolate milk (low fat)	1 cup	300
Yogurt, plain (low fat)	1 cup	300
Yogurt, fruit flavored (low fat)	1 cup	250
Cheese, shredded	1/3 cup	200
cubed	1 in cube	200
block	1 oz	200
slice	1 slice	200
Cheese, Parmesan, grated	1 Tbsp	70
Cheese, Ricotta (part-skim)	1/2 cup	330
Processed cheese spread	3 Tbsp	160
Cottage cheese	1/2 cup	80
Ice cream	1/2 cup	90
Frozen yogurt	1/2 cup	150
Pudding made with milk	1/2 cup	150

[a]Butter, cream cheese, and sour cream are NOT considered dairy servings.

the 16 weeks? (4) Did some types of subjects change behavior more over the 16 weeks? (5) Were there changes in physiological outcomes? (6) Did some types of subjects have greater physiological changes? (7) Did behavior throughout the study (average physical activity and average dairy consumption) correlate with changes in physiological outcomes?

Analyses are based on completers (n = 116) unless otherwise specified. A completer was defined as a participant who attended at least 1 of the 2 baseline weeks, at least 1 of weeks 14 through 16, and at least 12 of the 16 weeks. The completion rate was 59%. Changes during the study were calculated from baseline to the last available measurement during weeks 14 through 16 or were set to missing if no measurements of the outcome were available during weeks 14 through 16. We also carried out last observation carried forward (LOCF) analyses, including all subjects with the last available observation of each outcome substituted for all subsequent measurement times. This is an attempt to examine results for the entire sample using an intent-to-treat approach under 1 reasonable set of assumptions on dropouts.

Independent sample *t* tests were used to compare men and women at baseline (question 1) and to compare completers and dropouts at baseline (question 2). Paired *t* tests were used to estimate and test changes in outcomes from baseline to end of study (questions 3 and 5). Pearson correlations and multiple regression were used to estimate associations between baseline characteristics and changes in behavioral outcomes (question 4), between baseline characteristics and changes in physiological outcomes (question 6), and between behavior throughout the study and physiological changes (question 7). When correlation and regression were used for a given outcome, only subjects who had complete data for all predictors to be used for that outcome were used in all regression analyses to avoid comparing analyses with changing datasets.

Results

1. Completers at Baseline

Baseline characteristics of subjects completing the program are shown in Table 4. Baseline body-weight measurements were obtained on 198 subjects (172 women and 26 men). There were 100 female and 16 male completers (total n = 116). Ages of completers ranged from 25 to 75 years and averaged 48 years. The average BMI was 35 ± 8 kg/m^2. Men weighed more and had larger waist circumferences, but

Table 4 Baseline Characteristics of Completers (n = 116)

	Women			Men			All		
Variable	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**
Age (y)	100	48.3	10.6	16	48.2	10.6	116	48.4	10.6
Weight (kg)	100	91.3	20.8	16	106.7[a]	21.9	116	93.5	21.5
Body mass index (kg/m^2)	100	35.0	8.0	16	35.4	7.1	116	35.0	7.8
Waist circumference (in)	91	39.6	7.0	15	45.2[a]	6.1	106	40.4	7.1
Systolic blood pressure (mm Hg)	85	129	15	15	134	14	100	130	15
Diastolic blood pressure (mm Hg)	85	79	9	15	82	10	100	79	9
Steps per day	99	5616	3702	15	5427	5496	114	5592	3954
Dairy intake (servings/d)	99	2.2	1.0	16	2.2	1.2	115	2.2	1.1

[a] $.001 < P < .01$ for testing equality of male and female means. Differences are nonsignificant for all other variables ($P > .20$).

otherwise men and women did not differ in baseline characteristics. At baseline, completers recorded an average of 5592 ± 3954 steps per day and an average of 2.2 ± 1.1 dairy servings per day. Baseline average systolic pressure was 130 ± 15 mm Hg, and baseline average diastolic pressure was 79 ± 9 mm Hg.

2. Completers Versus Dropouts at Baseline

Table 5 shows baseline characteristics for completers (n = 116) and dropouts (n = 82). The completion rate was 59%. Weight completers and dropouts had very similar characteristics except that dropouts were younger (42 versus 48 years, $P = .0001$).

3. Behavior Changes Over 16 Weeks

Table 6 shows changes in behavior from baseline to end of study, and Figure 1 shows the average physical activity (steps per day) for each week of the study period for completers and for dropouts. Both lines show similar patterns of rapid increase during the first few weeks followed by continued but less steep increases for completers and inconsistent results because of small numbers of subjects for dropouts. For completers, average daily steps increased by an average of 3582 ± 4070 steps per day ($P < .0001$). In the LOCF analysis, average daily steps increased by an average of 2930 ± 3622 steps per day ($P < .0001$).

Figure 2 shows the average dairy consumption (servings per day) for each week of the study period for completers and for dropouts. The pattern is similar to that for steps, with a rapid increase for both completers and dropouts during the first few weeks, continued less-steep increases for completers, and inconsistent results because of small numbers of subjects for dropouts. For completers, average dairy consumption increased by an average of 0.8 ± 1.2 servings per day ($P < .0001$), which brought the subjects' baseline dairy consumption of 2.2 servings up to the recommended 3 servings per day. In the LOCF analysis, average dairy consumption increased by an average of 0.7 ± 1.2 servings per day ($P < .0001$).

Table 5 Baseline Characteristics of Completers (n = 116) and Dropouts (n = 82)

	Completers			Dropouts		
Variable	**n**	**Mean**	**SD**	**n**	**Mean**	**SD**
Age (y)	116	48.4	10.6	76	42.4[a]	10.7
Weight (kg)	116	93.4	21.5	82	96.7	20.7
Body mass index (kg/m^2)	116	35.0	7.8	82	35.6	7.0
Waist circumference (in)	106	40.4	7.1	66	41.5	5.7
Systolic blood pressure (mm Hg)	100	130	15	53	129	14
Diastolic blood pressure (mm Hg)	100	79	9	53	80	9
Steps per day	114	5592	3954	62	5749	3240
Dairy intake (servings/d)	115	2.2	1.1	65	2.2	1.0

[a] $P = .0001$ for testing equality of completer and dropout means. Differences are nonsignificant for all other variables ($P > .30$).

Table 6 Changes During Study for Completers

Variable	Women			Men			All		
	n	Mean	SD	n	Mean	SD	n	Mean	SD
Behavioral outcomes									
steps per day	90	3252[d]	3732	13	5080[b]	5858	103	3482[d]	4070
dairy intake (servings/d)	94	0.8[d]	1.1	13	0.7	1.4	107	0.8[d]	1.2
Physiological outcomes									
weight (kg)	100	–5.8[d]	3.9	16	–7.7[d]	5.8	116	–6.0[d]	4.2
percent weight (%)	100	–6.3[d]	4.1	16	–7.1[d]	5.2	116	–6.4[d]	4.2
body mass index (kg/m^2)	100	–2.2[d]	1.5	16	–2.6[c]	2.0	116	–2.2[d]	1.7
waist circumference (in)	85	–2.4[d]	1.7	14	–3.0[c]	2.2	99	–2.5[d]	1.8
systolic blood pressure (mm Hg)	77	–9[d]	14	13	–6	11	90	–9[d]	13
diastolic blood pressure (mm Hg)	77	–4[c]	10	13	–4[a]	6	90	–4[d]	9

[a] $.01 < P < .05$.

[b] $.001 < P < .01$.

[c] $.0001 < P < .001$.

[d] $P < .0001$ for testing change equal to zero.

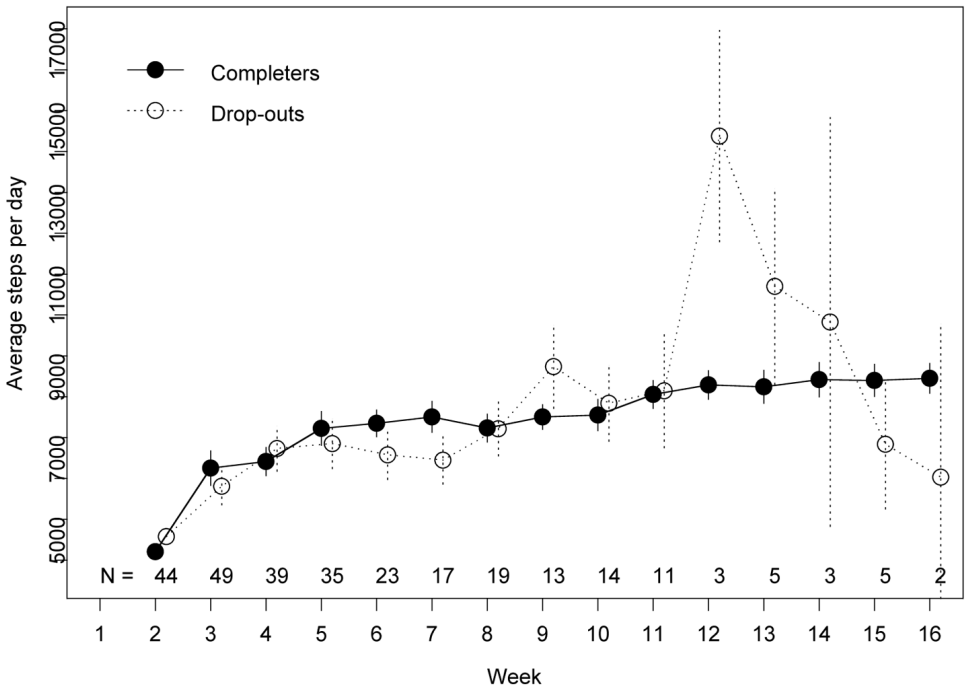

Figure 1 — Average steps per day (mean ± SE) for completers (solid points and line) and dropouts (open points and dotted line, points offset slightly to avoid overlap). The upper scale is truncated to avoid compressing the remainder of the graph. All available measurements were used at each time, and N = number of subjects in dropout average.

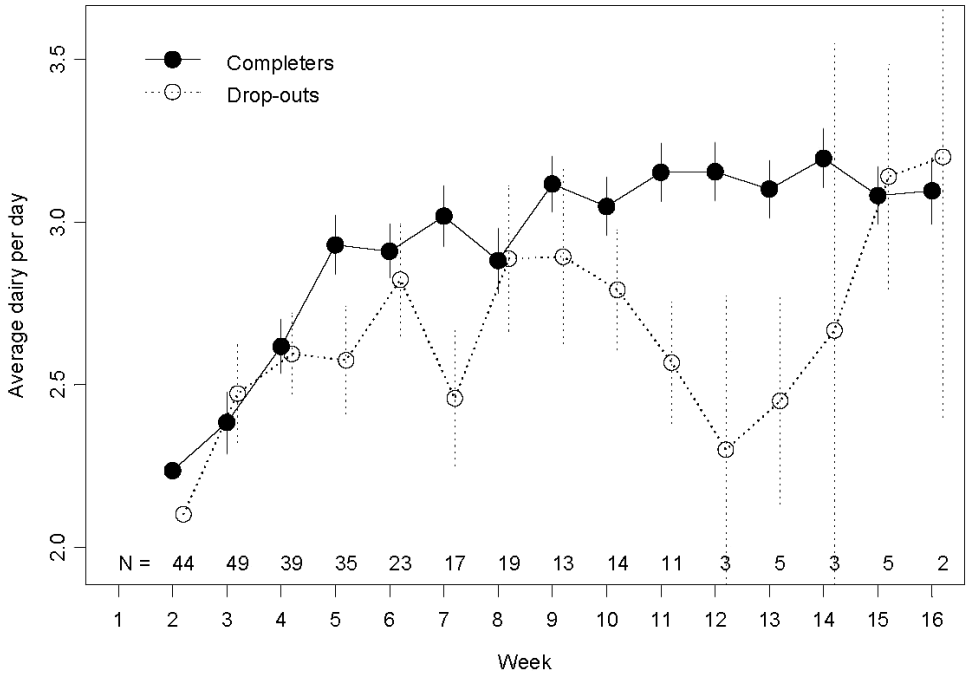

Figure 2 — Average dairy servings per day (mean ± SE) for completers (solid points and line) and dropouts (open points and dotted line, points offset slightly to avoid overlap). All available measurements were used at each time, and N = number of subjects in dropout average.

4. Association of Baseline Characteristics and Behavior Changes

We examined the association between the baseline characteristics of sex, age, weight, BMI, and waist circumference and changes in behavior. There were no significant associations between any of the baseline variables and changes in physical activity (steps per day) or changes in dairy consumption (servings per day) when the variables were examined separately with correlations or when baseline weight, BMI, and waist circumference were adjusted for age and sex in a multiple regression. The same results were seen in the LOCF analysis, except that older age was related to greater increases in dairy consumption ($r = .19$, $P = .017$ with age alone, $P = .01$ in a multiple regression). This is likely related to the greater likelihood of younger subjects to drop out, as noted previously and in Table 5.

5. Were There Changes in Physiological Outcomes?

Figure 3 shows weekly average weight for completers and for dropouts. Completers (n = 116) showed a steady pattern of weight loss. There is some indication from Figure 3 that dropouts did not lose weight during the study period.

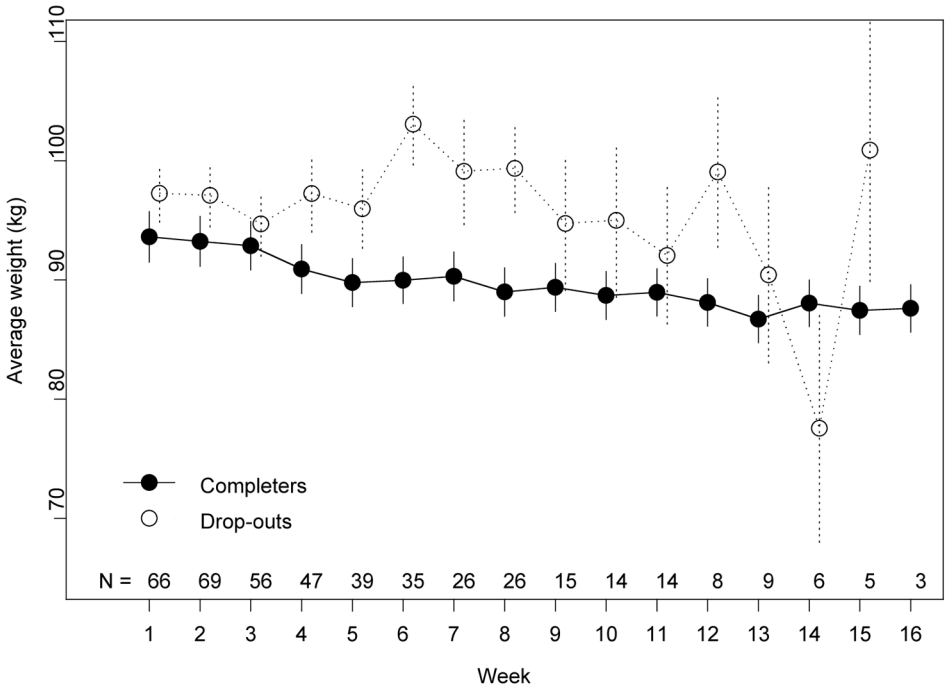

Figure 3 — Average weight in kg (mean ± SE) for completers (solid points and line) and dropouts (open points and dotted line, points offset slightly to avoid overlap). The upper scale is truncated to avoid compressing the remainder of the graph. N = number of subjects in dropout average.

Table 6 shows physiological changes for completers overall and by sex. Mean weight loss for completers was 6.0 ± 4.2 kg or 6.4% ± 4.2% of initial body weight ($P < .0001$ for both). In the LOCF analysis, mean weight loss was 4.1 ± 4.2 kg or 4.3% ± 4.3% of initial body weight ($P < .0001$ for both). Weight changes for completers ranged from 17.3 kg lost to 2.7 kg gained, with 93% of completers losing weight, 53% of completers losing at least 5% of initial body weight, and 23% of completers losing at least 10% of initial body weight. Women and men both achieved substantial weight losses of 5.8 ± 3.9 kg ($P < .0001$) and 7.7 ± 5.8 kg ($P < .0001$), respectively, as well as significant reductions in BMI and waist circumference (see Table 6). Improvements in blood pressure were also seen, averaging 8 ± 13 mm Hg in systolic pressure and 4 ± 9 mm Hg in diastolic pressure ($P < .0001$ for both). In the LOCF analysis, these improvements were 6 ± 11 mm Hg for systolic pressure and 3 ± 8 mm Hg in diastolic pressure ($P < .0001$ for both).

6. Did Some Types of Subjects Have Greater Physiological Changes?

We examined the association between the baseline characteristics of sex, age, weight, BMI, and waist circumference and changes in physiology. Correlations or regressions showed that weight loss (kg) was greater in subjects who had higher initial weight ($r = .37$, $P < .0001$), BMI ($r = .27$, $P = .005$), and waist circumference ($r = .34$, $P < .0003$). Only initial weight remained significant in a multiple regression for weight loss ($P = .04$). Very similar results, with slightly lower correlations, were seen in the LOCF analysis. There were no associations of any of these baseline characteristics, however, with percent weight loss in either correlations or multiple regressions, indicating that the significant associations just mentioned are size related.

Correlations showed a tendency for blood pressure decrease to be greatest for subjects with the highest initial weight, BMI, and waist circumference. These correlations with diastolic pressure were $r = .25$, $P = .019$ with initial weight, $r = .27$, $P = .011$ with initial BMI, and $r = .21$, $P = .048$ with initial waist circumference. Corresponding correlations with systolic pressure were $r = .19$, $P = .075$ with initial weight, $r = .21$, $P = .045$ with initial BMI, and $r = .20$, $P = .059$ with initial waist circumference. Results were similar when adjusting for age and sex in multiple regressions. Again, results were slightly weaker in the LOCF analysis, but patterns were very similar.

7. Did Behavior Throughout the Study (Average Physical Activity and Dairy Consumption) Correlate With Changes in Physiological Outcomes?

We used average daily steps and average daily dairy servings during weeks 4 to 16 as measures of accumulated physical activity and dairy consumption, respectively, for completers. The correlation between average steps and average dairy servings was $r = .19$ ($P = .06$). Subjects with the highest initial weight, BMI, and waist circumference tended to take fewer steps throughout the study ($r = –.24$, $P = .017$ for weight; $r = –.24$, $P = .019$ for BMI; $r = –.30$, $P = .004$ for waist circumference). No correlations of initial subject characteristics with average dairy consumption were significant ($P > .3$). LOCF results were very similar.

Figure 4 shows weight loss during the study versus average daily dairy consumption during the study for completers. Weight loss, percent weight loss, BMI decrease, and waist circumference decrease were all significantly correlated with average daily dairy servings ($r > .33$ for all, $P < .0004$ for all). Percent weight loss versus average daily physical activity (steps per day) during the study for completers had a correlation of $r = .24$ ($P = .0131$). Weight loss (kg), percent weight loss, BMI decrease, and waist circumference decrease were all less significantly correlated with average daily steps ($.18 < r < .25$ for all, $.013 < P < .069$ for all). The same pattern was seen when both variables (dairy servings and steps) were used in a multiple regression adjusting for sex, age, baseline weight, BMI, and

waist circumference, as well as average steps and dairy servings (for dairy servings, $P < .003$ for all outcomes; for steps, $.025 < P < .055$ for all outcomes). This association between body-weight improvement and dairy servings, therefore, is independent of physical activity and of initial body size, which could potentially be correlated with food and dairy consumption. In the LOCF analysis, correlations of these outcomes with average daily dairy servings were slightly greater than for completers ($r > .37$ for all outcomes). Correlations of the outcomes with average daily steps were also somewhat greater and were all significant ($P < .026$ for all outcomes). Similar results were seen in multiple regressions including both average steps and average dairy and adjusting for baseline subject characteristics, with both average steps and average dairy significant ($P < .005$ for steps, $P < .0001$ for dairy) in the presence of the other.

Decrease in diastolic blood pressure was significantly correlated with higher average daily dairy servings alone ($P = .03$) and in a regression with average daily steps and the baseline subject characteristics ($P = .005$). There were no significant correlations of decrease in diastolic blood pressure with average daily steps in any of these models ($P > .2$ for all). Decrease in systolic blood pressure was not significantly related with average dairy or average steps in any of these models ($P > .32$ for all). In LOCF analyses, changes in blood pressure were not significantly related to average daily steps or average daily dairy consumption either individually or in multiple regressions.

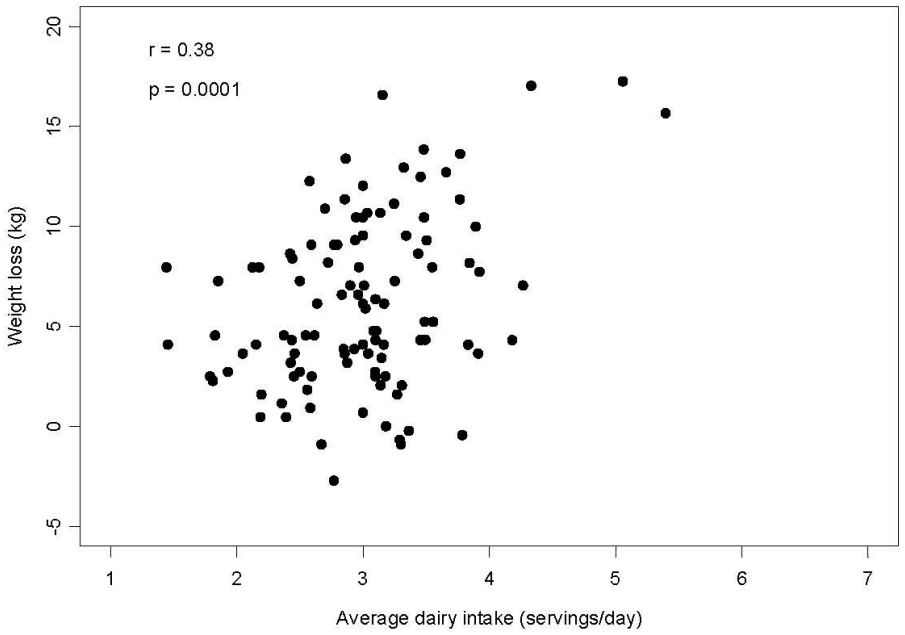

Figure 4 — Weight loss (kg) from baseline to end of study versus average dairy intake (servings per day) for completers.

Discussion

We were successful in implementing a weight-loss program in Calcium, New York, as a part of a larger community initiative to promote dairy consumption. The population that was attracted to the program was one that could potentially benefit from weight loss. A substantial portion of enrollees participated throughout the program, and participants made impressive increases in physical activity and dairy consumption and achieved a meaningful weight loss, a significant reduction in waist circumference, and a significant decrease in blood pressure. The results also support the recommendation to include low-fat dairy products in weight-loss programs. The results from Calcium Weighs-In illustrate that it is possible to implement weight-loss programs within the community that can help many residents achieve sufficient weight loss to improve health.

With these results, we successfully demonstrated that a cognitive–behavioral weight-management program that was developed within an academic setting could be implemented with effectiveness within a community setting. Calcium Weighs-In maintained several aspects of the more-intense Colorado Weigh program, including use of closed groups (in which each person stays with the same group throughout the weight-loss period), use of registered dietitians to lead the groups, and use of the Colorado Weigh curriculum.

The outcomes from Calcium Weighs-In were positive for lifestyle, weight loss, and improvement of health. Improvements in lifestyle were seen through increases in walking and dairy consumption. Increases in physical activity have been associated with many health improvements and decreased risk of chronic disease even independently of weight loss.[17] Over the 16-week program, participants could have achieved a 7000 average daily step increase from baseline given the repetitive weekly physical activity goal of 500 more steps per day. There was a gap between the potential average step totals of 7000 plus baseline, 5592 ± 3954, and the actual average step total of baseline plus the reported increase, 3582 ± 4070. A few things might have occurred. The novelty of wearing a pedometer might have yielded a higher than normal baseline step total, or perhaps there might be a threshold of total activity or time investment that was reached during 4 months of intervention. Nonetheless, program completers were very near the targeted 10,000 average daily steps by the end of the intervention. Further follow-up would be insightful as to the permanency of the small, incremental physical activity increases observed with weight loss in this study. Improvements in health were seen indirectly with decreases in weight, BMI, and waist circumference. We know that reductions in waist circumference are associated with reductions in visceral fat,[18] and this is associated with reduced risk of developing metabolic disorders such as type 2 diabetes.[19] Direct improvements in health were seen with decreases in blood pressure. We also found a mild correlation between physical activity and weight loss and a substantial correlation between average dairy consumption and weight loss during the study.

The intent of Calcium Weighs-In was to evaluate weight loss. We recognize, however, that people who lose weight also need help to maintain that weight loss. We did not have the opportunity to evaluate the extent to which these participants were able to sustain their weight loss over the long term, but future programs should, if possible, include this element.

The dropout rate in this study was 41% based on subjects having a weight measurement at weeks 14 through 16 and attending at least 12 of the 16 weeks. This is higher than is seen with weight-loss trials conducted in more controlled (eg, university) settings because these trials usually involve resources devoted to retention of subjects. Our dropout rate was comparable with that seen in trials of popular diets[5] in which few resources are available for subject retention. It is likely that most people who dropped out probably did not do well with weight loss as evidenced in Figure 3, our LOCF analysis. We produced meaningful weight loss, however, in at least 59% of the participants in Calcium Weighs-In. We are optimistic with these results because it is unlikely that any intervention will be effective for everyone. As seen with Honas et al,[20] we noted that younger subjects were more likely to drop out, information that could possibly be helpful in suggesting changes to the program to improve compliance.

Calcium Weighs-In was offered free of charge to participants. We were concerned that this might affect the dropout rates or the weight loss as compared with the Colorado Weigh program in which there was an enrollment fee. Participants who have to pay might be more invested in remaining in the program. Although the results are not directly comparable, the dropout rate in Calcium Weighs-In was slightly higher than in Colorado Weigh (28%–30% dropouts) and higher than the 31% and 30% dropout rates reported by Honas et al[20] and Teixeira et al,[21] respectively. Both of these group-based weight-loss intervention studies reported attrition rates at 16 weeks.[20,21] The average weight loss achieved at 16 weeks with Calcium Weighs-In was slightly lower (8%–9% in Colorado Weigh).

A potential limitation to translating this program to other communities is the costs required to deliver the program. If offered commercially, the costs would likely be a barrier for many communities such as Calcium, NY. In some instances, it might be possible for low-income participants to receive assistance from local or state resources to participate in such a program. The way this study was brought to the community of Calcium, NY, however, highlights further opportunities for communities to partner with the private sector in initiating a community-wide intervention such as was done here and in Pound, WI, by Slim-Fast. Several companies have products that have been found to be helpful in weight management, and communities could engage with these companies to develop and implement community-wide interventions. An important factor in the translation of Calcium Weighs-In is the use of registered dietitians (RDs) to lead the weight-loss groups. Generally available in any community and recognized as experts in the field of nutrition, dietitians can play a pivotal role in obesity treatment. It is likely that other health professionals, such as psychologists or exercise physiologists, could also be effective as group leaders.

Further research could evaluate the extent to which the community could be engaged in helping individuals maintain their weight loss. This could include identifying ways to provide incentives within the community for maintaining the diet and physical activity patterns achieved during weight loss.

These results, particularly the associations between higher average dairy consumption with improvements in body weight independent of baseline body size or average physical activity, tend to support the recommendation to include low-fat dairy products in weight-management programs. Zemel et al[22] saw nearly a twofold greater weight loss in subjects consuming 3 daily servings of dairy over

their counterparts consuming 1 daily serving.[22] Thompson et al also showed weight loss with dairy, although no additional weight-loss benefit was achieved beyond a moderate calcium diet of 800 mg.[23] Clearly, more carefully controlled studies are needed to rule out other possible confounders such as physical activity or diet differences or subject selection. Also, more research is needed to better understand how calcium and dairy consumption aid in weight loss and to identify the optimum amount for weight loss.

In summary, Calcium Weighs-In is a model that can be used in other communities to help residents lose weight, increase physical activity, and improve health.

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