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Healthy Weight in Lesbian and Bisexual Women Aged 40 and Older: An Effective Intervention in 10 Cities Using Tailored Approaches

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ABSTRACT

Background: Lesbian and bisexual women are more likely to be overweight or obese than heterosexual women, leading to increased weight-related health risks.
Methods: Overweight women aged 40 or older who self-identified as lesbian, bisexual, or "something else" participated in five pilot interventions of 12 or 16 weeks' duration. These tailored interventions took place at lesbian and bisexual community partner locations and incorporated weekly group meetings, nutrition education, and physical activity. Three sites had non-intervention comparison groups. Standardized questionnaires assessed consumption of fruits and vegetables, sugar-sweetened beverages, alcohol, physical activity, and quality of life. Weight and waist-to-height ratio were obtained through direct measurement or self-report.
Analytical Plan: Within-person changes from pre-intervention to post-intervention were measured using paired comparisons. Participant characteristics that influenced the achievement of nine health objectives were analyzed. Achievement of health objectives across three program components (mindfulness approach, gym membership, and pedometer use) was compared with the comparison group using generalized linear models.
Results: Of the 266 intervention participants, 95% achieved at least one of the health objectives, with 58% achieving three or more. Participants in the pedometer ($n = 43$) and mindfulness ($n = 160$) programs were more likely to increase total physical activity minutes (relative risk [RR], 1.67; 95% confidence interval [CI], 1.18–2.36; $p = .004$; RR, 1.38; 95% CI, 1.01–1.89; $p = .042$, respectively) and those in the gym program ($n = 63$) were more likely to decrease their waist-to-height ratio (RR, 1.89; 95% CI, 0.97–3.68, $p = .06$) compared with the comparison group ($n = 67$).
Conclusion: This effective multisite intervention improved several healthy behaviors in lesbian and bisexual women and showed that tailored approaches can work for this population.

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Evidence from several published studies indicates that lesbian and bisexual (LB) women are more likely to be obese than heterosexual women (Bowen, Balsam, & Ender, 2008; Conron, Mimiaga, & Landers, 2010; Eliason et al., 2015; Institutes of Medicine (U.S.), 2011; Ward, Dahlhamer, Galinsky, & Joestl, 2014). In 2013, the National Health Interview Survey included questions on sexual orientation for the first time. Researchers found that 37% of gay or lesbian women and 41% bisexual women were obese, compared with 28% of straight or heterosexual women (Ward et al., 2014). A review of the lesbian, gay, bisexual, and transgender (LGBT) literature found no published intervention research addressing this issue in LB women (Rizer, Mauery, Haynes, Couser, & Gruman, 2015). Women who are obese have a higher risk of diabetes, coronary artery disease, depression, low back pain, knee osteoarthritis, asthma and multiple cancers including endometrial, cervical, and breast cancer (Kulie et al., 2011; Eliason, 2014; Simoni, Smith, Oost, Lehavot, & Fredriksen-Goldseen, 2016). In 2011, the Institute of Medicine recommended that effective and rigorous research be conducted on obesity, particularly among LB women owing to the paucity of evidence as to differences in risk compared with heterosexual women (Institutes of Medicine (U.S.), 2011; Yancey, Cochran, Corliss, & Mays, 2003).

To address this gap, the U.S. Department of Health and Human Services, Office on Women's Health provided funding for a coordinated multisite initiative, the Healthy Weight in Lesbian and Bisexual Women: Striving for a Healthy Community (HWLB) program. Healthy weight was defined as the weight at which physical health risks and conditions are reduced to normal ranges or functional and psychosocial status is improved. This is the first large-scale study to test interventions to improve healthy weight among LB women aged 40 and older through changes in nutrition, physical activity, and quality of life. The HWLB program also evaluated three types of interventions (e.g., gym membership, pedometer use, or mindfulness approach) for acceptability and effectiveness.

The Institutes of Medicine (U.S.) (2012) study on Accelerating Progress in Obesity Prevention guided the design of the interventions. The interventions were further tailored based on feedback from 11 focus groups, which were conducted during the formative design phase of the project (Garbers et al., 2015). Results from these focus groups indicated that the norms for the LB women's community were acceptance of women at every size, strong objections to heterosexual norms on weight, and experiences of weight discrimination by health care providers (Garbers et al., 2015). Although the HWLB program was conceived to address obesity in the LB population, based on focus group feedback, promotional material for the study focused on healthy choices as reflected in the following goals to 1) increase consumption of fruits and vegetables, 2) decrease consumption of sugar-sweetened beverages (SSBs), 3) decrease consumption of alcoholic beverages, 4) increase physical activity minutes (2 measures), and 5) increase physical and mental quality of life (2 measures). Data on the goals of 6) decreases in body size, weight, and waist circumference to height ratio (WHtR) were also obtained but met with resistance or refusal by some participants. These six goals were operationalized into nine SMART (Specific, Measurable, Achievable, Realistic, and Timely) objectives which served as the nine hypotheses (H_0) for the study (Harris, 2010; Tables 1 and 3).

Methods and Material

Study Design

The five program sites used varying study designs. Two sites, MOVE (Washington, DC metro area) and SHE (New York City), used a pre–post intervention design. LOLA (St. Louis and

Table 1
SMART Objectives Describing the Goals, Indicators, and Time Period for Within-person Change Analyses

Goal	Indicator	Time Period Behavior Asked about at Pre–Post Intervention	Objective
Dietary choices			
Increased consumption of fruits and vegetables	Average daily consumption of fruits and vegetables	During the past month	10% increase in number of times fruits and vegetables are consumed per day
Reduced consumption of SSBs	Average monthly SSB consumption	During the past month	50% decrease in number of times SSBs are consumed per month, among those who consumed SSBs at baseline
Reduced consumption of alcohol	Average weekly alcohol consumption	During the last 30 days	50% decrease in alcohol consumption among those at baseline who consumed two or more alcohol-containing drinks on a typical day
PA			
Increased physical activity total minutes	Number of weekly minutes of PA (moderate-intensity, vigorous-intensity and walking)	During the last 7 days	20% increase number of total PA minutes
Move up in physical activity category	Number of weekly minutes of PA to move to next IPAQ category or higher ("inactive," "sufficiently active," or "HEPA")	During the last 7 days	Increase in physical activity sufficiently to move to a higher category (inactive, sufficiently active, and HEPA) for 25% of the participants, among those not in highest category at baseline
Quality of life			
Improved physical quality of life	VR-12 PCS	During the past 4 weeks	10% increase in PCS scores
Improved mental quality of life	VR-12 MCS	During the past 4 weeks	10% increase in MCS scores
Body size			
Decreased weight	Decrease weight	At the beginning and end of the intervention	5% decrease in weight
Decreased WHtR	Decrease WHtR	At the beginning and end of the intervention	5% decrease in WHtR

Abbreviations: HEPA, health-enhancing physical activity; IPAQ, International Physical Activity Questionnaire; MCS, Mental Component Score; PA, physical activity; PCS, Physical Component Score; SMART, Specific, Measurable, Achievable, Realistic, and Timely; SSBs, sugar-sweetened beverages; WHtR, waist circumference to height ratio.

Table 2
Baseline Sociodemographic and General Health Characteristics Comparing Intervention Participants with Those Who Did Not Receive the Intervention (Comparison Participants; $n = 333$)

	Intervention Participants ($n = 266$)	Comparison Participants ($n = 67$)	*p*
	n (%)	*n* (%)	
Age (y)			.647
40–59	162 (61.1)	43 (64.2)	
≥60	103 (38.9)	24 (35.8)	
Race/ethnicity			.630
White, non-Hispanic	193 (72.8)	50 (75.8)	
Other race, >1 race, or Hispanic	72 (26.8)	16 (23.6)	
Labor force status			.903
In the labor force (working full time or part time)	160 (60.4)	41 (61.2)	
Not in the labor force (unemployed, retired, disabled, in school full time, homemaker full time)	105 (39.6)	26 (38.8)	
Educational attainment			.448
<4-year college degree	88 (33.2)	19 (28.4)	
≥4-year college degree or higher	177 (66.8)	48 (71.6)	
Sexual orientation			.294*
Lesbian	219 (82.3)	51 (76.1)	
Bisexual	31 (11.7)	13 (19.4)	
Something else	16 (6.0)	3 (4.5)	
Disability			
Yes – physical disability†	64 (24.1)	13 (19.4)	.444
Yes – other disability†	62 (23.3)	12 (17.9)	.342
No	181 (68.3)	46 (69.7)	
General health status			.947
Excellent, very good, good	187 (70.5)	47 (70.1)	
Fair, poor	78 (29.4)	20 (29.9)	
Relationship status			.664
Single (not involved with anyone or somewhat involved with a woman, man, or both)	137 (51.7)	36 (53.7)	
In a committed relationship (with a man, woman or both), living with partner all, most, some of the time or not at all	128 (48.3)	31 (46.3)	

* Fisher's exact test comparing lesbian versus bisexual or something else.
† Physical and other disability categories are not mutually exclusive. Physical disability includes any limitation that affects caring for self, performing manual tasks, walking or standing, and/or lifting or reaching. Other disability affects seeing, hearing, speaking or communicating, learning, thinking, or concentrating, and/or working, or not specified. Significance test compares each disability category to not having that disability category.

Columbia, MO) used a three-arm randomized controlled trial (pedometer use, gym membership, and control) with an 8-month post-intervention follow-up. WHAM (San Francisco Bay Area) used a randomized delayed start design, with those randomly assigned to the delayed arm serving as their own control in the initial 12-week period. Finally, DIFO (San Francisco Bay Area) used a pre–post intervention design and enrolled a non-equivalent comparison group with a 4-month post-intervention follow-up. See Appendix 1 for more study design details. Participants in three programmatic components—1) mindfulness approach (WHAM, DIFO), 2) gym membership (MOVE, LOLA's gym group), and 3) pedometer use (SHE, LOLA's pedometer group)—were mutually exclusive. See Fogel et al. (2016) for a detailed description of these programs.

All programs partnered with local LGBT community or resource centers and incorporated core elements including weekly support group meetings (12 or 16 weeks), education on dietary choices (≥3 sessions), and physical activity opportunities. Interventions began in the fall of 2013, except one program that began in the winter of 2014.

[1] Although all recruitment material stated LB women were sought for the study, 25 women chose "something else" instead of lesbian, gay, or bisexual when completing the baseline survey question on sexual orientation.

Participants

Eligibility criteria included being aged 40 or older, identifying as a lesbian or bisexual woman,[1] and meeting weight or body mass index requirements: (BMI ≥ 25 kg/m^2) or self-identifying as overweight and interested in "getting healthier." Transgender women were eligible for participation if they met the criteria. The study was approved by the U.S. Office of Management and Budget and the sites' respective institutional review boards. All participants provided written consent.

A total of 376 individuals were enrolled in the HWLB study, with 298 in the intervention group and 78 in the comparison group (Figure 1). Analyses were conducted on 89% of the 298 participants ($n = 266$) who participated in any intervention component and completed both the pre-intervention and post-intervention survey. The comparison group's analytic sample comprised 67 participants who completed both the pre-intervention and post-intervention survey and attended no intervention activities. The comparison group came from DIFO ($n = 34$), LOLA ($n = 23$), and WHAM ($n = 10$).

Data were collected from participants to be able to evaluate nine SMART objectives as described in Table 1. As provided in Fogel's paper (2016), the rationale for the SMART objectives was as follows.

"The SMART objective to increase fruits and vegetables by 10% was thought to be achievable, based on the low intake

Table 3
Descriptive Statistics at Baseline of the Nine Domains of the Comparison and Intervention Group and by Sexual Orientation Subgroups in the Intervention Group

Baseline Domains	Comparison Group (n = 67)	Intervention Participants (n = 266)			
		Lesbian (n = 219)	Bisexual (n = 31)	Something Else (n = 16)	All Intervention (n = 266)
Fruit and vegetable consumption (median) per day					
Vegetables (all types)	2.0	1.8	1.5	1.9	1.8
Fruit and fruit juice	1.0	1.1	0.8	1.0	1.0
Fruit, fruit juice, and vegetables	3.2	3.5	2.1	3.8	3.4
Sugar-sweetened beverage consumption (%)					
≥1 serving in last 30 days	73.1	66.2	77.4	68.8	67.7
No servings in last 30 days	26.9	33.8	22.6	31.3	32.3
Alcohol consumption (%)					
Lifetime abstainers	0.0	4.6	0.0	6.3	4.2
Abstainers past month	38.8	30.1	35.5	43.8	31.6
Light (0–3/week)	38.8	34.3	38.7	18.8	33.8
Moderate (4–7/week)	14.9	21.8	16.1	12.5	20.5
Heavy (>7/week)	7.5	9.3	9.7	18.8	9.9
Alcohol, any binge drinking*					
Any binge drinking (%)	19.5	13.9	30.0	25.0	16.3
Physical activity (%)					
Met physical activity guidelines†	29.9	26.9	29.0	25.0	27.1
Total minutes (median)	180	180	170	120	175
Physical activity categories (%)					
Inactive	47.8	47.0	48.4	68.8	48.5
Sufficiently active	31.3	39.3	41.9	25.0	38.7
Health-enhancing physical activity	20.9	13.7	9.7	6.3	12.8
Quality of life					
Physical Component Score (mean)	45.1	42.7	40.2	41.5	42.4
Mental Component Score (mean)	46.2	45.8	42.1	39.3	45.0
Weight					
Measured (median)	195	196	218	210	202
Self-reported (median)	197	199	220	—‡	204
All modes (median)	196	197	220	215	202
Waist-to-height ratio					
Measured (median)	0.63	0.63	0.65	0.65	0.64
Self-reported (median)	0.65	0.67	0.67	—‡	0.68
All modes (median)	0.64	0.64	0.65	0.66	0.65

* Only asked of those who consumed alcohol in last 30 days.
† At least 150 minutes of moderate physical activity, 75 minutes vigorous activity per week, or an equivalent combination of the two.
‡ Data were suppressed owing to cell sizes (<5 participants).

nationwide (≤3 per day) as reported by the Centers for Disease Control and Prevention's (2013) Behavioral Risk Factor Surveillance System (Moore & Thompson, 2015). Reducing sugar-sweetened beverage consumption by 50% was determined to be reasonable for the 12- or 16-week intervention period because between 30% and 50% of the recommended daily limits for women aged 40 to 75 for solid fats and sugars come from sugared drinks (Institutes of Medicine (U.S.), 2012). The objective for cutting alcohol consumption in half was based on the National Institute of Alcohol and Alcoholism's recommendations to consume 1 drink of alcohol a day (National Institute on Alcohol Abuse and Alcoholism, 2016). Given the older age and condition of some of the participants, increasing the number of minutes of self-reported physical activity by 20% was felt to reflect a minimum goal that would be achievable and have some impact even at the level of walking. This was based in part on a 2007 systematic review of interventions incorporating pedometer use that found an average 26.9% increase in the number of steps taken per day (which for an average person represents a 27% increase in minutes walked) and a concomitant decrease in body weight and blood pressure over an average 18-week intervention period (Bravata et al., 2007). Reports have also shown improved health with as little as 5% decrease in weight or WHtR (Blackburn, 1995; Kushner & Ryan, 2014; Thomas, Institutes of Medicine (U.S.), & Committee to Develop Criteria for Evaluating the Outcomes of Approaches to Prevent and Treat Obesity, 1995; Page et al., 2009; Mertens & Van Gaal, 2000)," (p. S59)

Little consensus has been reached on meaningful change differences in quality of life scores and these scores may be slow to change (Crosby, Kolotkin, & Williams, 2003; Eklund, 2015). Therefore, a modest 10% change in the Veterans RAND 12-item questionnaire was hypothesized. See Appendix 2 for information on source of standardized instruments for SMART objectives.

A 54-item core questionnaire with well-established standardized instruments was used to assure validity and reliability. This included questions on participants' sociodemographics and a set of questions for each SMART objective. See Appendix 3 for the questionnaire. Step counts were also consistently obtained by two programs (LOLA's pedometer group and SHE) from either self-reported daily logs or electronically retrieved from the pedometer.

Statistical Analysis

Intervention (n = 266) and comparison (n = 67) group participants were compared using baseline survey responses to socio-demographic characteristics with statistical significance tests (t-tests for normally distributed continuous variables $\alpha \le 0.05$). For statistical tests in which the χ^2 expected cell value for one or more cells was lower than n = 5, χ^2 tests were

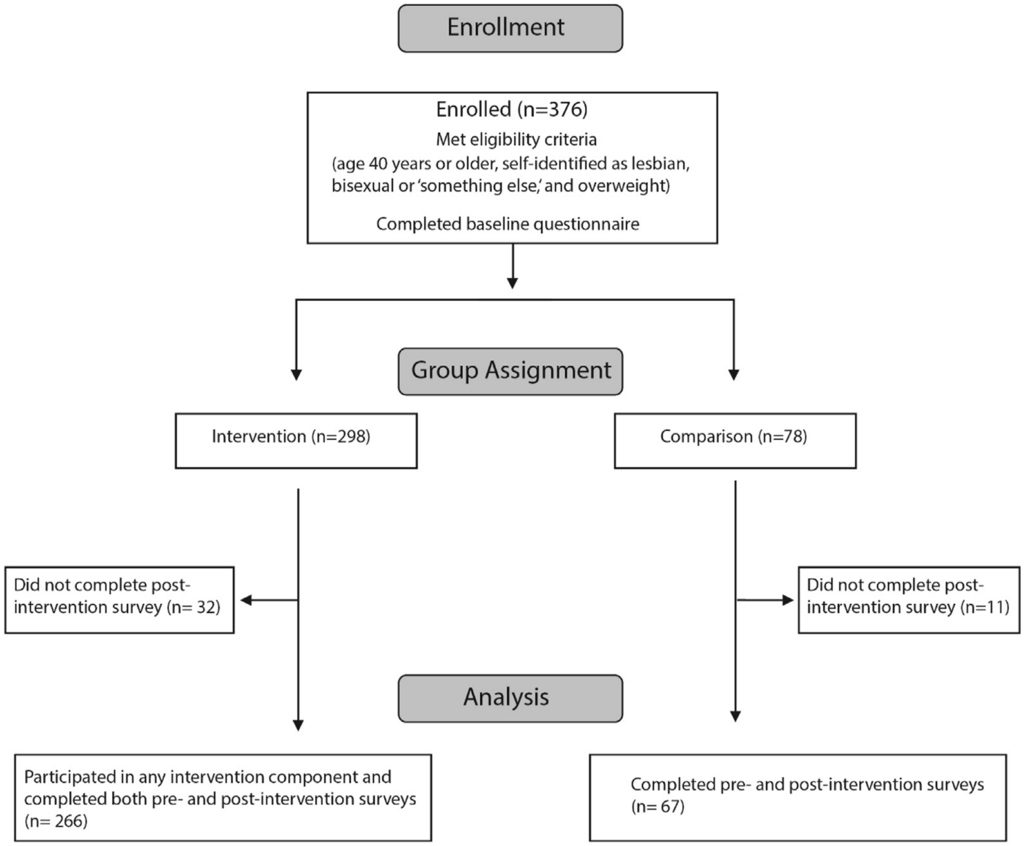

Figure 1. Enrollment of intervention and comparison participants.

repeated, collapsing categories. After collapsing categories, if any expected cell size was $n < 5$, a Fisher's exact test was used. Pre-intervention and post-intervention values were assessed for normality using the Shapiro-Wilk test (with $\alpha \leq 0.05$) and Q-Q (quantile-quantile) plots (Ghasemi & Zahediasl, 2012). Because only the quality of life's Physical Component Score (PCS) and Mental Component Score (MCS) scores were normally distributed, median values (rather than means) are presented, with Kruskal–Wallis independent tests used for non-normally distributed variables.

The proportion of intervention participants who achieved each SMART objective was calculated. Changes from pre-intervention to post-intervention using paired comparisons assessed within-person change (McNemar's test for yes/no or other 2-level ordinal questions, paired t tests for normally distributed continuous outcomes [PCS and MCS] or Wilcoxon signed-rank for non-normally distributed continuous outcomes [all other outcomes]). Age was stratified at 60 years because this was the youngest age for membership at one of the community partner sites, SAGE NYC, and a dichotomous variable (40–59 years, 60–85 years) was created. Engagement was defined as the percent of sessions or structured activities that subjects participated in at their respective site. A dichotomous variable of less than 75% engagement or 75% or greater engagement was created. Achievement of SMART objectives was analyzed by physical disability status (yes/no), age group, employment status (in the labor force vs. not), educational attainment (less than 4-year college degree vs. 4-year college degree or higher), sexual orientation (lesbian, bisexual, or "something else"), and relationship status (single [not involved or somewhat involved] vs. in a committed relationship). A question on Hispanic ethnicity (yes/no) was combined with one on race to produce the following categories: Hispanic, non-Hispanic White, non-Hispanic Black, and non-Hispanic multiple races/other races.

Because more than one behavioral change may occur during the intervention, we examined the percentage of intervention participants who achieved two SMART objectives. Table 4 represents a matrix where the diagonal values indicate achievement of each SMART objective. The off diagonal values represent achievement of two SMART objectives. Among those who achieved one SMART objective listed in the column header, the percent indicated those who also achieved the second SMART objective listed in the row header. In other words, each off diagonal reflects a 2×2 contingency table whereby both column and row SMART objectives are jointly achieved.

Two approaches were used to compare the achievement of the SMART objectives across intervention components. First, crude risk ratios of achieving each SMART objective were calculated, comparing the three intervention components (pedometer use, gym membership, or mindfulness approach) with the comparison group. Site was omitted from these models because site and intervention component were collinear. Risk ratios (RRs) with 95% confidence intervals (CIs) were constructed, and correction for multiple imputation was applied. Multivariable adjusted relative risk models were also constructed comparing gym component to pedometer use and to mindfulness component.

Table 4
Matrix of Percent of Intervention Participants Who Achieved Each SMART Objective on the Diagonal and Who Achieved Two SMART Objectives Displayed on the Off-Diagonal Row*

Second SMART Objective Achieved	SMART Objective Achieved								
	Fruits and Vegetables (%)	Sugar-Sweetened Beverages (%)	Alcohol Consumption (%)	Total Physical Activity Minutes (%)	Physical Activity Category (%)	Physical Component Score (%)	Mental Component Score (%)	Weight (%)	Waist-to-Height Ratio (%)
Fruits and Vegetables	**50.6**	65.2	69.4	52.0	51.7	45.1	58.9	59.6	47.5
Sugar-Sweetened Beverages	34.1	**39.0**	33.3	23.0	26.4	22.0	28.4	23.4	28.8
Alcohol Consumption	18.9	17.4	**41.4**	13.2	10.3	13.2	15.8	12.8	15.3
Total Physical Activity Minutes	59.8	50.7	55.6	**57.4**	94.3	68.1	63.2	68.1	50.8
Physical Activity Category	34.1	33.3	25.0	53.9	**37.7**	40.7	36.8	34.0	27.1
Physical Component Score	31.1	29.0	33.3	40.8	42.5	**34.2**	23.2	42.6	42.4
Mental Component Score	42.4	39.1	41.7	39.5	40.2	24.2	**35.7**	40.4	40.7
Weight	21.2	15.9	16.7	21.1	18.4	22.0	20.0	**18.6**	35.6
Waist-to-Height Ratio	21.2	24.6	25.0	19.7	18.4	27.5	25.3	44.7	**28.6**
Number who achieved the column listed SMART objective	132	69	36	152	87	91	95	47	49

Abbreviation: SMART, Specific, Measurable, Achievable, Realistic, and Timely.
Bold diagonal values indicate achievement of each SMART objective alone.
* To determine the joint occurrence of two SMART objectives, start with the column SMART objective. Percent who jointly achieve a second SMART objective is listed in the respective row.

For the intervention participants, regression models were used to describe the achievement of each SMART objective controlling for site, age, and effect of baseline characteristics. Baseline characteristics found in bivariate analyses to be associated with a SMART objective at $p \leq .10$ were included. Generalized linear models, with Poisson distribution, log link, and robust variance estimates were used to account for the fact that odds ratios can overestimate risk when the outcome event is common (Barros & Hirakata, 2003; Deddens & Petersen, 2008). To adjust for type I error owing to multiple testing, the Benjamini Hochberg procedure, false discovery rate, was used for the crude and adjusted relative risk regression models (Benjamini & Hochberg, 1995). The false discovery rate q value of 0.15 or less was chosen as recommended by Efron (2007) as a reasonable choice to balance a very low proportion (e.g., q value $\leq$ 5%) versus an unacceptably high proportion (e.g., q value $\leq$ 20%) of false discoveries. As Benjamini and Hochberg (1995) explained, the false discovery rate approach allows researchers to describe as many as possible significant differences, while being willing to admit a prespecified proportion of misses. RRs and 95% CIs were reported in the regression models.

Statistical analyses were conducted using IBM SPSS Statistics 22 (IBM Corporation, Chicago, IL) for bivariate analyses, SAS 10.1 (SAS Institute, Cary, NC) for crude risk ratios, and STATA: Release 13 (StataCorp, College Station, TX) for regression modelling.

Results

Participant Characteristics

A majority of the 266 intervention participants were non-Hispanic White (73%), were currently in the workforce (60%) either part or full time, had a 4-year college degree or higher (67%), and identified as lesbian (82%). Participants' ages ranged from 40 to 85 years, with 61% younger than 60 years old. Approximately one-half of the participants (48%) reported being in a committed relationship and approximately one-quarter of the participants (24%) reported having a physical disability (Table 2).

SMART Objectives (Pre–Post Intervention Change)

The following section describes the results for each of the nine hypotheses.

H_1: 10% increase in number of times fruits and vegetables are consumed per day in the previous 30 days

At baseline, intervention participants reported consuming fruit and fruit juice a median of one time per day (mean = 1.5 times, SD = 1.3) and vegetables a median of 1.8 times per day (mean = 2 times, SD = 1.4), with a combined median of 3.4 times per day (mean = 3.6, SD = 2.2) of total fruit and vegetable consumption in the previous 30 days (Table 3). Few participants reported no consumption of any fruit (excluding fruit juice; 3.1%) or vegetables (0.4%).

One-half of the participants (51%) in the interventions demonstrated improvement in this SMART objective (Table 4). The proportion achieving this SMART objective was significantly higher among women with less than a 4-year college degree versus those with a 4-year college degree or higher (61% vs. 45%) and among disabled versus non-disabled women (64% vs. 45%; Table 5). At baseline, women with less than a 4-year college degree were similar in daily fruit consumption (p = .3), significantly lower in vegetable consumption (p = .04), and therefore marginally significantly different in fruit and vegetable consumption (p = .06) compared with those with a 4-year college degree or higher. In contrast, at baseline no difference was observed in fruit and vegetable consumption by disability status. No difference was found between the intervention and comparison groups by program component (Table 6, Figure 2). Increases from baseline were driven primarily by changes in consumption of vegetables, including dark green (20% increase) and orange (23% increase) vegetables.

H_2: 50% decrease in number of times SSB are consumed per month, among those who consumed SSB at baseline

Approximately two-thirds of the intervention participants (n = 179) reported consuming SSB at baseline (Table 3). Sweetened coffee/tea was consumed daily by 56% of the intervention participants, whereas fewer women reported consuming the

Table 5
Relative Risk Regression Models for Achieving SMART Objectives Adjusted for Program Site, Age, and Relevant Covariates as Shown for Each SMART Objective, Among Intervention Participants Who Completed Data Collection ($n = 266$)

SMART Objectives	Achieved SMART Objective (%)	Adjusted* RR (95%CI)	p
1. Fruit & vegetable consumption ($n = 258$)†			
Age (y)			
40–59 ($n = 157$)	52.9	1.0 (reference)	
60–84 ($n = 103$)	47.6	0.95 (0.72–1.25)	.726
Educational attainment			
≥4-year college degree ($n = 174$)	45.4	1.0 (reference)	
Some college, high school, or less ($n = 86$)	60.5	1.28 (1.01–1.62)	.039‡
Disability status			
No disability ($n = 177$)	44.6	1.0 (reference)	.016‡
Any disability ($n = 83$)	63.9	1.37 (1.06–1.77)	
2. Alcohol consumption ($n = 87$)†			
Age (y)			
40–59 ($n = 67$)	46.3	1.0 (reference)	
60–84 ($n = 20$)	25.0	0.48 (0.22–1.04)	.064
Labor force status			
Working full or part time ($n = 58$)	29.3	1.0 (reference)	
Not in labor force (retired, disabled, unemployed, full-time student, full-time homemaker; $n = 29$)	65.5	2.93 (1.73–4.97)	<.001‡
3. Total physical activity minutes ($n = 263$)†			
Age (y)			
40–59 ($n = 161$)	54.7	1.0 (reference)	
60–84 ($n = 103$)	62.1	1.06 (0.85–1.33)	.618
Educational attainment			
Some college, high school, or less ($n = 88$)	48.9	1.0 (reference)	.042‡
≥4-year college degree ($n = 176$)	61.9	1.28 (1.008–1.63)	
Sexual orientation			
Bisexual ($n = 31$)	35.5	1.0 (reference)	.110
Lesbian ($n = 218$)	58.7	1.47 (0.92–2.37)	
Something else ($n = 16$)	81.3	2.20 (1.29–3.74)	.004‡
4. PCS quality of life ($n = 262$)†			
Age (y)			
40–59 ($n = 162$)	28.4	1.0 (reference)	
60–84 ($n = 103$)	43.7	1.40 (0.95–2.07)	.093
Labor force status			
Working full or part time ($n = 160$)	28.7	1.0 (reference)	
Not in labor force (retired, disabled, unemployed, full-time student, full-time homemaker; $n = 105$)	41.9	0.90 (0.62–1.31)	.595
Disability status			
No disability ($n = 181$)	30.9	1.0 (reference)	.985
Any disability ($n = 84$)	41.7	0.997 (0.69–1.43)	
General health status at baseline			
Excellent, very good, good ($n = 187$)	28.3	1.0 (reference)	
Fair or poor ($n = 78$)	48.7	1.59 (1.12–2.26)	.009‡
5. Weight loss ($n = 252$)†			
Age (y)			
40–59 years ($n = 153$)	14.4	1.0 (reference)	
60–84 years ($n = 99$)	25.3	1.48 (0.82–2.67)	.191
Intervention engagement			
Participated in less than 75% of sessions or content ($n = 121$)	13.2	1.0 (reference)	.093‡
Participated in 75% or more of sessions or content ($n = 132$)	23.5	1.66 (0.92–2.99)	
6. Waist circumference to height ratio ($n = 204$)†			
Age (y)			
40–59 ($n = 130$)	24.6	1.0 (reference)	
60–84 ($n = 27$)	36.0	1.42 (0.86–2.36)	.175
Labor force status			
Working full or part time ($n = 133$)	25.6	1.0 (reference)	
Not in labor force (retired, disabled, unemployed, full-time student, full-time homemaker; $n = 72$)	34.7	1.21 (0.76–1.93)	.422

Abbreviation: SMART, Specific, Measurable, Achievable, Realistic, and Timely.
Note: No sociodemographic characteristics were found to be significantly related to SMART objectives for sugar-sweetened beverages or Mental Component Score; physical activity category SMART objective regression models not presented.
* Relative risk regression using Poisson distribution with log link, also adjusted for program site.
† Number for fully adjusted model.
‡ Statistically significant after adjusting for multiple testing, using Benjamini–Hochberg approach and false discovery rate, q value = 15%.

other sweetened beverages daily (sports drinks, 2%; fruit drinks or regular soda/pop, 5%). Not only was coffee/tea the most popular SSB consumed daily, but it was the only SSB that was consumed more than once daily (range, 1–4 times a day). About 40% of participants consumed other sweetened drinks 4 to 27 times over a 30-day period (soda/pop, 42%; sports drinks, 39%; and/or fruit drinks, 44%).

This SMART objective was achieved by 39% of intervention participants (Table 4). Of those who achieved this SMART objective, approximately one-half completely eliminated one or

Table 6
Proportion and Relative Risk for Achieving Each SMART Objective, Comparing Each Intervention Component to the Comparison Group

SMART Objective (n = intervention, comparison participants)	Pedometer Component (n = 43)		Gym Component (n = 63)		Mindfulness Component (n = 160)		No Intervention Comparison Group (n = 67)	
	% Who Achieved	RR (95% CI)	% Who Achieved	RR (95%CI)	% Who Achieved	RR (95%CI)	% Who Achieved	RR (Reference Group)
10% increase in times eaten all fruits and vegetables combined per month	48.8	1.13 (0.75–1.70) p = .566	41.9	0.97 (0.65–1.45) p = .878	54.5	1.26 (0.92–1.72) p = .146	43.3	1.0
50% decrease in number of times SSB consumed, among those who consumed SSB at baseline (n = 177, 49)	34.5	1.21 (0.62–2.37) p = .584	37.5	1.31 (0.72–2.39) p = .374	40.7	1.43 (0.863–2.35) p = .164	28.6	1.0
50% decrease in alcohol consumption from baseline, among those who usually consumed ≥2 alcohol-containing drinks on any occasion in the 30 days before baseline (n = 87, 19)	41.7	1.13 (0.46–2.80) p = .790	41.4	1.12 (0.54–2.35) p = .758	41.3	1.12 (0.56–2.23) p = .744	36.8	1.0
Increase number of total minutes of physical activity (vigorous, moderate, and walking) by 20%	69.8	**1.67 (1.18–2.36) p = .004**[†]	47.6	1.14 (0.78–1.67) p = .506	57.9	**1.38 (1.01–1.89) p = .042**	41.8	1.0
Increase level of physical activity to a higher level as measured by the categorical score on the IPAQ, among those not in highest category at baseline (n = 231, 53)	59.5	**2.10 (1.27–3.49) p = .004**[†]	34.0	1.20 (0.68–2.13) p = .532	33.3	1.18 (0.72–1.92) p = .512	28.3	1.0
10% increase in PCS scores from baseline	44.2	1.56 (0.94–2.59) p = .088	17.5	0.62 (0.32–1.19) p = .150	38.1	1.34 (0.87–2.07) p = .177	28.4	1.0
10% increase in MCS scores from baseline	25.6	0.75 (0.40–1.37) p = .345	33.3	0.97 (0.60–1.57) p = .905	39.4	1.15 (0.78–1.68) p = .484	34.3	1.0
5% decrease in weight from baseline*	18.0	1.01 (0.43–2.40) p = .979	12.9	0.73 (0.31–1.69) p = .459	21.1	1.19 (0.64–2.20) p = .588	17.7	1.0
5% decrease in waist circumference to height ratio from baseline*	23.7	1.16 (0.51–2.63) p = .726	38.7	**1.89 (0.97–3.68) p = .06**	24.5	1.20 (0.61–2.35) p = .597	20.5	1.0

Abbreviations: IPAQ, International Physical Activity Questionnaire; MCS, Mental Component Score; PCS, Physical Component Score; SMART, Specific, Measurable, Achievable, Realistic, and Timely; SSBs, sugar sweetened beverages.
Note: Relative risks approximated using Poisson distribution with log link with robust error variance.
* Pre-intervention and post-intervention weight data available for n = 261 intervention and 62 comparison participants; waist-to-height ratio data available for n = 204 intervention and 44 comparison participants.
[†] Statistically significant after adjusting for multiple testing, using Benjamini–Hochberg approach and false discovery rate, q value = 15%.

more SSB from their diet, with a handful of participants completely eliminating all SSB from their diet (n = 8). Approximately three-quarters (72%) eliminated fruit drinks, followed by sports drinks (63%), and sweetened coffee/tea drinks (60%). The least likely SSB to be eliminated completely was regular soda/pop (49%). None of the participants' characteristics were different between those who achieved this SMART objective and those who did not. No difference was observed between intervention and comparison group by program component who achieved this SMART objective (Table 6, Figure 2).

H_3: 50% decrease in alcohol consumption among those at baseline who consumed two or more alcohol-containing drinks on a typical day

At baseline, approximately one-third of the intervention participants had not consumed any alcohol in the last 30 days. Among the drinkers, 10% were heavy drinkers and 16% reported binge drinking (≥4 drink within a 2-hour period; Table 3). An equal number of binge drinkers were among the light, moderate, and heavy drinking categories (data not shown). Among the group of binge drinkers, 90% reported binge drinking 1 to 3 days in the past 30 days.

Four out of 10 intervention participants who reported drinking at baseline (41%) achieved this SMART objective (Table 4). Younger women (40–59 years) constituted a slightly higher proportion of drinkers (68%) as compared with the older age group (59%). More younger women reduced their alcohol consumption by 50% (46% compared with 25% of those aged 60 or older; marginal p = .06). A similar, although statistically significant, pattern was observed for employment status. Those not in the labor force were more likely to achieve this SMART objective (66% compared with 29% of those in the labor force, p < .001; Table 5). The percent of intervention participants who achieved this SMART objective was virtually the same for each program component compared with comparison group at approximately 41% (Table 6, Figure 2).

H_4: 20% increase in total physical activity minutes and H_5: 20% move to a higher physical activity category for 25% of participants, among those not in highest category at baseline

The median number of physical activity minutes per week for intervention participants at baseline was 175 minutes (range 0–2,130; mean, 263; SD = 325) and 27% of the participants met the physical activity guidelines at the beginning of the study

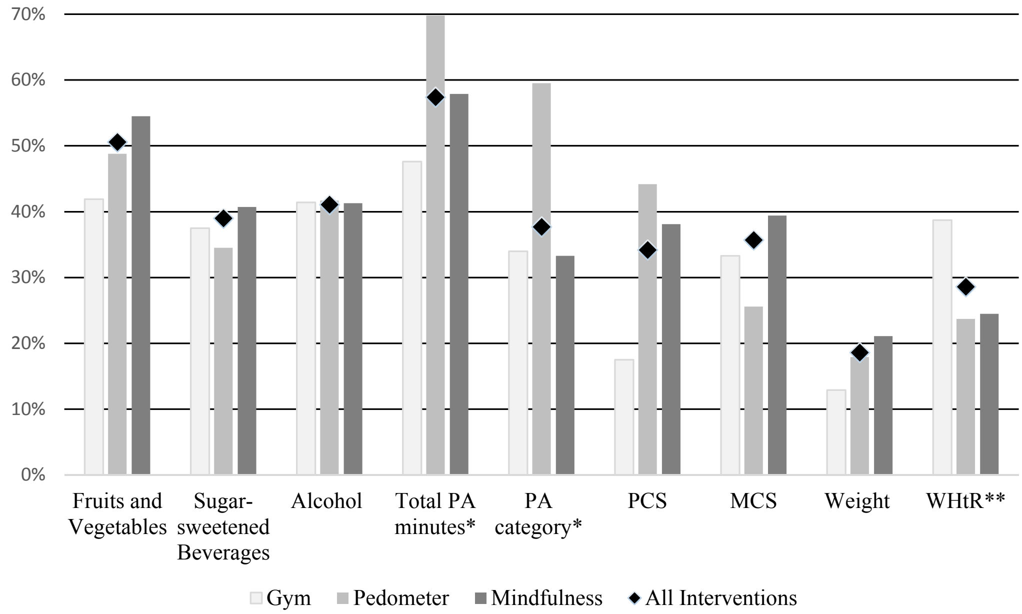

Figure 2. Percent of intervention participants who achieved SMART objectives by program components. *$p \leq .05$ and statistically significant after adjusting for multiple testing, using Benjamini–Hochberg approach and false discovery rate, q value = 0.15. **$p = .06$ and not statistically significant after adjusting for multiple testing, using Benjamini–Hochberg approach and false discovery rate, q value = 0.15.

(Table 3; U.S. Department of Health and Human Services, 2015). In contrast, approximately one-half (48%) of participants were in the inactive category at baseline.

Intervention participants demonstrated improvement in both physical activity SMART objectives: 57% increased total PA minutes and 38% moved to a higher category of physical activity (Table 4). Significantly more intervention participants who engaged in pedometer or mindfulness program components achieved the total PA minutes SMART objective compared with the comparison group (RR, 1.67 [95% CI, 1.18–2.36]; RR, 1.38 [95% CI, 1.01–1.89], respectively; Table 6, Figure 2). A higher proportion of those with 4-year college degrees or higher (62%) met the total PA minutes SMART objective compared with those with less than a 4-year college degree (49%, $p = .04$). Significant differences were observed by sexual orientation, with a lesser proportion of women who identified as bisexual achieving the total PA minutes SMART objective (36%) compared with lesbians (59%) or those who identified as something else (81%; $p = .004$; Table 5). Similarly, a smaller proportion of bisexuals (25%) positively changed their level of physical activity compared with lesbians (37%) or those who identified as something else (38%).

At baseline, pedometer use participants walked slightly, but not significantly, less than participants in non-pedometer program components (135 vs. 165 minutes per week) as self-reported on the physical activity questionnaire. However, after the intervention, pedometer participants reported significantly higher minutes of walking per week compared with non-pedometer participants (416 vs. 183 minutes per week).

At the beginning of the intervention, for the pedometer groups ($n = 43$), approximately one-quarter of the participants walked fewer than 4,000 steps a day while 30% were already walking at least 8,000 steps a day. The average number of steps per day obtained from either self-report logs or retrieved from the pedometer in the first week of the intervention was similar between the two programs that had a walking component (6,200 steps; LOLA and SHE). The average in the last 3 weeks of the intervention was 8,027 steps per day with differences between the two programs: LOLA had 8,551 steps per day (data retrieved from pedometer) and SHE had 7,502 steps per day (data obtained from daily logging). That translated into approximately 18 and 10 minutes more of walking per day, respectively.

For the groups in which gym membership was provided (LOLA and MOVE), the average number of visits over the course of the intervention was considerably different between the two sites. LOLA program had an average of 1.9 gym visits per week (range, 0-5) and MOVE program had an average of 0.7 gym visits per week (range, 0-2). Besides the number of visits, the site with a higher number of gym visits per week also had 12 sessions out of 16 weeks with a personal trainer, which likely led to high quality workouts for those 12 sessions. Before enrollment in this component, almost no one had a gym membership and most had never joined a community fitness center or gym.

H_6: 10% increase in the quality of life PCS and H_7: 10% increase in MCS

Both PCS and MCS mean scores at baseline were below the standardized population mean of 50 at baseline ($PCS_{mean} = 42$, $SD = 11.1$; $MCS_{mean} = 45$, $SD = 11.7$; Table 3). More than one-third of intervention participants achieved these SMART objectives (34% for PCS; 36% for MCS; Table 4). Women aged 60 and older were 40% more likely to achieve the PCS SMART objective compared with those in the younger age group (RR, 1.40; 95% CI, 0.95–20.7, $p = .09$). A greater proportion of those who reported fair or poor health at baseline achieved the PCS SMART objective compared with those who reported excellent, very good, or good health (49% vs. 28%, $p = .009$; Table 5). No differences were observed by participant characteristics for the MCS SMART objective. The proportion of intervention participants who achieved the PCS or MCS SMART objective was not different by program component compared with the comparison group (Table 6, Figure 2).

H_8: 5% decrease in weight and H_9: 5% decrease in WHtR

At baseline, the median weight of all participants was 202 pounds (mean, 215) and varied by subgroups, with lesbians' median weight being the lowest (197 pounds) and bisexuals having the highest (220 pounds). The mean WHtR at baseline was 0.65 (Table 3). Weight did not follow a normal distribution and was skewed toward heavier women. This was anticipated because the study was designed to recruit overweight women. Likewise, WHtR exceeded the recommended goal of keeping your waist circumference to less than one-half your height (Klein et al., 2007).

The HWLB program resulted in a greater downward movement of WHtR than of weight per se. Overall, 29% of participants achieved the SMART objective for WHtR, while 19% achieved the SMART objective of 5% weight loss (Table 4). Participants aged 60 and older were 1.5 times more likely to lose 5% of their weight than women aged 40 to 59, although this did not reach statistical significance. Higher engagement (75% or more) was marginally significantly associated with a greater proportion of participants achieving 5% weight reduction ($p = .09$; Table 5). Of note, approximately one-half (51%) of participants attended 75% or more of the program sessions. The relative risk for intervention participants who achieved the WHtR SMART objective was marginally significant only for the gym component (RR, 1.89; 95% CI, 0.97–3.68, $p = .06$; Table 6) compared with the comparison group.

Most of the participants' weight (62%) and WHtR measurements (77%) were obtained by professional staff at pre-intervention and post-intervention. No differences in achievement of the weight and WHtR SMART objectives were observed when comparing participants whose measures were by professional staff compared with those whose measures were self-reported. For weight, excluding those whose mode of measurement was different at the two time periods ($n = 5$), 16% of those directly measured by professional staff achieved the SMART objective, compared with 23% of those using self-report. For WHtR, 29% of those directly measured achieved the SMART objective, compared with 30% using self-report. Similarly, when we examined the percent of intervention participations who had any reduction in their weight, there were no differences by recording (53% self-report vs. 60% professional staff).

The methods used in this analysis also allowed us to examine the women who gained weight, a statistic not often reported in weight loss studies that commonly describe mean differences in weight. Of those participants who gained weight ($n = 78$), approximately two-thirds gained less than 5 pounds, whereas 15% gained 10 to 16 pounds over the course of the 12 or 16 weeks. Participants who gained any amount of weight were significantly more likely to be older and to be in the labor force compared with the group that lost 5% or more weight (data not shown). Significantly fewer women who gained weight achieved the SMART objective of increasing total PA minutes and fewer improved their quality of life PCS scores, compared with those who achieved these SMART objectives (data not shown). Weight gain also appeared to be inversely associated with participation. Approximately two-thirds (62%) of the women who gained weight were not actively engaged (<75% engagement) in the intervention as opposed to 34% of the participants who had lost any amount of weight.

Overall Measure of SMART Objectives' Achievements

An assessment of the overall effectiveness of the program was undertaken by determining how many of the nine SMART objectives were achieved by each participant. If a participant was already at the healthy level for alcohol consumption, not consuming any SSB, or at the highest physical activity level, they were not counted as achieving a SMART objective. Of the 266 intervention participants, 95% achieved one or more SMART objectives (Figure 3), with most (60%) achieving one to three. Few (5%) achieved no SMART objectives and approximately the same percent achieved six to eight SMART objectives. No commonality in sociodemographic characteristics was observed in the 14 participants who were unable to achieve any of the SMART objectives.

As expected, the joint achievement of the physical activity category SMART objective (column variable) with the second SMART objective of total PA minutes was high (row variable; 94%; Table 4). Other noteworthy SMART objective pairings were for total PA minutes (row) with either PCS (column) or weight (column) at 68% (Table 4).

The relationship between the multiple SMART objectives achieved by the participants was also assessed to evaluate if there was any clustering of SMART objective achievements. Of the 192 different patterns (e.g., WHtR + total PA minutes; fruit and vegetable consumption + MCS + weight), there was no pattern in which any combination of multiple SMART objectives was achieved by more than a few participants.

Discussion

This is one of the largest physical health intervention studies and the first to focus on healthy weight for LB women to be conducted in the United States (Rizer et al., 2015). In addition to the overall intervention protocol, three design components (gym membership vs. pedometer use vs. mindfulness approach) were tested for effectiveness in achieving nine SMART objectives. The HWLB project included diverse geographic communities, from the East Coast, Midwest, and West Coast; from modest sized towns and communities adjacent to large metropolitan areas to very large cities. This coverage added strength to the applicability of the intervention for other studies.

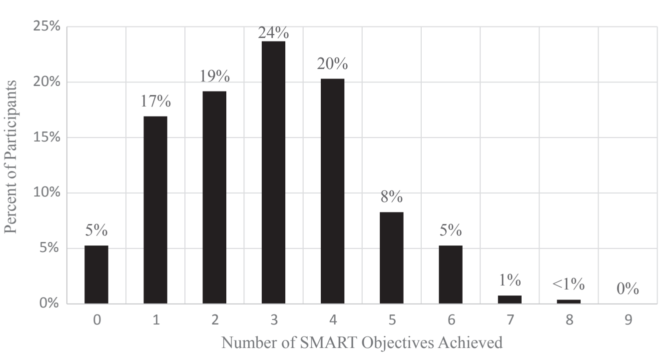

Figure 3. Percent of intervention participants by number of SMART objectives achieved.

Previous qualitative research identified unique concerns, barriers, and perceptions related to weight interventions among LB women (Bowen, Balsam, Diergaarde, Russo, & Escamilla, 2006; Fogel, Young, & McPherson, 2009; McElroy, Washington, Wintemberg, Williams, & Redman, 2016). These include the desire for a safe environment that allows for open discussion about partners or other sexual identity-related concerns, a program design that fosters a sense of community, a focus on achieving health and physical fitness rather than thinness, and a recognition of the specific stressors experienced by LB women. The HWLB program focused on tailoring interventions to respond to these needs of LB women and the uniqueness of each local setting (Brittain, Dinger, & Hutchinson, 2013; Roberts, Stuart-Shor, & Oppenheimer, 2010).

Fruit and Vegetable Consumption

In 2013, only 13% of adults met the recommended guidelines for daily fruit consumption and only 9% of adults met the vegetable consumption guidelines (Moore & Thompson, 2015; U.S. Department of Agriculture, 2011). Several studies have examined differences in fruit and vegetable consumption among women by sexual orientation. Most have found similar levels of consumption across groups (Boehmer, Miao, Linkletter, & Clark, 2012a; Garland-Forshee, Fiala, Ngo, & Moseley, 2014). In this study, participants consumed fruits and vegetables at levels that are similar to those reported in the CDC state indicator report (Centers for Disease Control and Prevention (CDC), 2013; Moore & Thompson, 2015). Participants with less than a college education were more likely to increase fruit and vegetable consumption as compared with their counterparts. It is notable that this suggests a promising trend of accessibility of healthy food choices (cdfifund.gov, 2016). However, in another study, lesbian women consumed vegetables significantly fewer times per day than heterosexual women (Minnis et al., 2016). These findings of fruit and vegetable consumption being as low, if not lower, in LB women compared with the general population of U.S. adult women demonstrate the need for significant dietary improvements in both populations.

In this study, participants consumed fruits and vegetables at levels that are similar to those reported in the Centers for Disease Control and Prevention state indicator report (CDC, 2013; Moore & Thompson, 2015). Since one-half of participants in the HWLB program (51%) achieved a 10% or greater increase post-intervention in the number of times they consumed fruits and vegetables per day, this constitutes a significant short-term shift in this indicator of dietary behavior. Interventions that make even modest dietary changes are regarded as having the potential to have important long-term effects on chronic disease risk (Artinian et al., 2010).

Sugar-Sweetened Beverage Consumption

SSBs are the largest source of added sugar and an important source of energy intake in the United States (Block, 2004; Guthrie & Morton, 2000). Many studies have shown an association between increased SSB consumption and weight gain in older women (Chen et al., 2009; Chen et al., 2010; Gibbs, Kinzel, Pettee, Chang, & Kuller, 2012; Malik, Schulze, & Hu, 2006; Palmer et al., 2008; Schulze et al., 2004). Data from the National Health and Nutrition Examination Survey show that one-half of the U.S. population consumes SSBs every day and 25% of those consumers obtain 200 calories from such drinks (Hu, 2013).

In the WOMAN study (Gibbs et al., 2012), participants included 465 overweight and obese postmenopausal women with a mean age of 57 years at baseline, who consumed very few SSB servings per day. Despite this low consumption, there was a correlation between weight change and consuming SSBs in the control group. These findings are fairly consistent with our results, which showed very low daily consumption of fruit drinks, sports drinks, and regular soda/pop in our sample of LB women aged 40 and older. However, of those who drank SSB daily, the majority consumed sugar-sweetened coffee or tea. Future research should examine in more detail the patterns of sweetened coffee and tea consumption in older populations of LB women and assess whether this type of SSB is associated with indicators of poor health.

Alcohol Consumption

The proportion of heavy drinkers (>7 drinks per week) at baseline for our participants (lesbians 9%, bisexuals 10%) was within the range reported in the literature (Hughes et al., 2006; Przedworski, McAlpine, Karaca-Mandic, & VanKim, 2014; Reczek, Liu, & Spiker, 2014; Valanis et al., 2000). The proportion of binge drinkers in our HWLB study (14% of lesbians, 30% of bisexuals) was also comparable to that reported in the literature (Boehmer et al., 2012b; Blosnich, Farmer, Lee, Silenzio, & Bowen, 2014; Fredriksen-Goldsen, Kim, Barkan, Muraco, & Hoy-Ellis, 2013; Przedworski et al., 2014; McCabe, Hughes, Bostwick, West, & Boyd, 2009). No comparable data were available for either heavy or binge drinking rates for individuals identifying as something else.

None of the studies noted above evaluated weight status and alcohol consumption. Heavy drinking and binge drinking can be associated with significant health risks, so our finding that more than 40% met the SMART objective for reducing alcohol consumption in half is encouraging. We found that more women not in the workforce reduced their alcohol consumption, suggesting that the stresses of employment may be a barrier to healthier behavior with regard to alcohol consumption.

The prevalence of heavy alcohol drinking in the lesbian community has been conceptualized as a form of a maladapted coping strategy in response to the chronic stress and/or depression associated with sexual minority status (Williamson, 2000). However, this concept may be most applicable to younger sexual minority women, as they were significantly more likely to drink frequently and heavily compared with older sexual minority women as reported here and in other studies (Austin & Irwin, 2010; Boehmer et al., 2012a, 2012b; Burgard, Cochran, & Mays, 2005; Gruskin, Hart, Gordon, & Ackerson, 2001).

Physical Activity

The U.S. Department of Health and Human Services' Office of Disease Prevention and Health Promotion's newest guidelines recommend at least 150 minutes of moderate intensity or 75 minutes of vigorous intensity physical activity per week (or an equivalent combination of the two) with additional health benefits provided by increasing to 5 hours (300 minutes) a week of moderate intensity aerobic physical activity, or 150 minutes a week of vigorous intensity physical activity, or an equivalent combination of both (U.S. Department of Health and Human Services, 2015). Up to 60% of the U.S. population do not meet minimal physical activity guidelines (CDC, 2015b). Our study had even more women at baseline who did not achieve the minimal physical activity guidelines: 73%.

As reviewed by Eliason et al. (2015), the majority of studies report no differences in self-reported physical activity levels by sexual orientation (lesbian vs. bisexual vs. heterosexual women); however, almost all these studies enrolled women with mean ages less than 50 years (Blosnich et al., 2014; Boehmer & Bowen, 2009; Boehmer et al., 2012a, 2012b; Davids & Green, 2011; Dilley, Simmons, Boysun, Pizacani, & Stark, 2010; Everett & Mollborn, 2013; Fredriksen-Goldsen, Kim, & Barkan, 2012; Fredriksen-Goldsen, Kim, Barkan, Balsam, & Mincer, 2010; Hatzenbuehler, McLaughlin, & Slopen, 2013; Kim, Cho, Fuller, & Kang, 2015; McElroy & Jordan, 2014; Polimeni, Austin, & Kavanagh, 2009; Richmond, Walls, & Austin, 2012).

Of the few studies that evaluated physical activity prevalence among older sexual minority women (mean age ≥50 years), results were inconsistent. The Women's Health Initiative reported a similar percent of older women (mean age 60 years) engaged in moderate intensity or vigorous intensity physical activity at 45% (lesbians), 50%, (bisexual), and 45% (heterosexual) women (Valanis et al., 2000). Similarly, Zaritsky and Dibble (2010) reported that the percent of lesbians who exercised at least weekly was the same as their heterosexual sisters (32% and 33%; mean age for both was 64 years).

A review by Rizer et al. (2015) identified only one published intervention program targeting middle-aged lesbian women designed to improve physical activity. This small study of 16 self-identified adult lesbians (29–55 years old) used an accelerometer to measure physical activity, and an educational component was used to encourage increased physical activity. In the pre-intervention–post-intervention test, no differences between intervention and control participants were observed (Brittain & Dinger, 2014).

The HWLB interventions had a substantial impact on LB participants, with more than 50% achieving physical activity SMART objectives. As noted by Wilder, Schuessler, Hendricks, and Grandjean (2010), effective physical activity programs that engage community members need to provide accessibility and flexibility, as well as encouragement. These characteristics were the mainstays of the HWLB programs.

Women with more education may be more receptive to both self-management of health, principles of patient-centered care, and public health messaging (de Boer, Delnoij, & Rademakers, 2013; Key, Allen, Spencer, & Travis, 2002; Kontos, Emmons, Puleo, & Viswanath, 2011; Swenson et al., 2004). Our study found that college educated LB participants were more likely to achieve increased total PA minutes compared with less than college educated participants. Although physical limitations can present an additional challenge to physical activity, disability status was not a significant predictor of increasing total PA minutes by 20% or more.

Among the three types of interventions (gym membership, pedometer use, and mindfulness approach), the pedometer groups were the most effective in achieving the SMART objectives of increased physical activity. The relatively low resource intensive intervention of pedometer use has gained considerable popularity. Providing step counts, trend data, social support groups, and challenges that fit into one's own lifestyle are features that may be associated with our participants increasing their physical activity by walking more (Fausset et al., 2013; Fukuoka, Lindgren, & Jong, 2012).

Aoyagi and Shepard (2013) quantified the number of steps related to health outcomes as follows: 4,000 to 5,000 steps per day for better mental and psychosocial health; 7,000 to 8,000 steps per day for a lesser likelihood of markers of aortic arteriosclerosis, osteoporosis, sarcopenia (loss of muscle tissue associated with aging) and greater physical fitness; 8,000 to 10,000 steps per day for better metabolic health including lower risk of hypertension and hyperglycemia. Excluding those 30% who were already walking at Aoyagi's highest category, over the course of the intervention, 45% of the remaining participants made substantial improvements by increasing their number of steps per day enough to move up to a healthier category.

Our indication of the effectiveness with gym membership groups in decreasing WHtR is consistent with the study by Yancey et al. (2006). This 8-week gym intervention among African American women had a 1-year follow-up. At 2 months, improvements on body composition were observed, although by 12 months, controls exhibited a significant advantage in waist circumference stability compared with intervention participants. The long-term sustainability of results achieved from gym-based interventions needs to be further studied because of inconsistent results (Mangani et al., 2006; Wilbur et al., 2016; Yancey et al., 2006).

Quality of Life Measures

Health implies the presence of physical, social, and mental health well-being. Health researchers are increasingly including measures of quality of life to assess the impact of interventions on all aspects of health (Kolotkin et al., 2009). Mean scores on both the PCS and the MCS are affected by age, chronic disease risks, gender, and other factors, with generally lower PCS scores for females, older individuals, and those with one or more chronic diseases (Iqbal et al., 2007; Hopman et al., 2009). Previous large-scale studies assessing quality of life in LB women (using measures similar to the VR-12) found that bisexual women were more likely to report lower quality of life (Valanis et al., 2000) or clinically meaningful impairments in functioning owing to mental health issues (7% lower), as compared with heterosexual women (Case et al., 2004). Both LB groups in the Nurse's Health Study II reported approximately 3% lower physical functioning scores as compared with heterosexual women, which was hypothesized to be explained by higher body mass index among LB women (Case et al., 2004; Fredriksen-Goldsen et al., 2010).

Mean baseline PCS score in our study was higher compared with women completing the latest Medicare Health Outcomes Survey who were of comparable age (≥40 years) and weight, whereas the MCS score was slightly lower. Specifically, obese women (body mass index ≥ 30 kg/m^2) in the Medicare group had mean PCS score of 33 and MCS of 49 (S. Qian, personal communication, June 22, 2015).

Overall, the HWLB intervention had a small but positive effect on both physical and mental quality of life. Quality of life changes were commensurate with previous studies demonstrating increases in perceived physical and mental health in conjunction with lifestyle interventions (Fontaine & Barofsky, 2001; Kolotkin et al., 2009; Rippe et al., 1998). A recent meta-analysis concluded it was unclear whether or not increases in quality of life found in the reviewed studies could be attributed to weight loss (Carson, Hidalgo, Ard, & Affuso, 2014). As anticipated, given the relatively short duration of the intervention period, absolute changes in quality of life scores were relatively small.

Weight and WHtR

The concept of a "healthy weight" is relatively new; it was first referenced in the 1995 Institute of Medicine report Weighing the Options (Thomas et al., 1995). There is no agreement in the literature on its definition. However, there is clearly a movement to encourage women to be healthy at any weight and to evaluate weight in the context of other comorbidities (Bacon, 2010; Institutes of Medicine (U.S.), 2012; McElroy, Gilbert, Hair, Mathews, Redman, & Williams, 2016). A program focus on being healthy and more active, rather than weight loss, was effective in that weight and WHtR SMART objectives were achieved by some participants. This occurred in a culture where the norm is acceptance of larger body sizes (Fogel et al., 2009; Garbers et al., 2015). The interventions intentionally did not include weekly weigh-ins, but focused on improving health by increasing physical activity and movement, eating healthier foods and drinks, and drinking less alcohol in a mindful and thoughtful way. All of these behavioral changes are associated with long-term weight control (Mozaffarian, Hao, Rimm, Willett, & Hu, 2011). Waist circumference measurement was included, because it may be a more acceptable marker of body size (and clothes size) than weight per se for our participants, with the benefit that it is also an appropriate measure of abdominal fat (Klein et al., 2007). However, 25% of our participants declined or were unable to provide waist circumference measurements, suggesting a need to more fully explore the utility and efficacy of this measure.

Using the healthy weight approach concomitant with the relatively short intervention period, achievement of a 5% decrease in WHtR was not expected for a majority of intervention participants over the 12- or 16-week interventions. However, this SMART objective was achieved by more participants (28%) than the 5% or more weight loss objective (19%).

Rossner (1992) described elements of progress in obesity reduction for the United States and sustaining one's weight is an important element. In the HWLB study, 17% of participants kept the same weight from pre-intervention to post-intervention. Maintaining weight can be viewed as movement in the right direction considering that annual weight gain with age is a common experience among females (Wang, Colditz, & Kuntz, 2007). The HWLB programs were conducted over the late fall and winter months. Yanovski et al. (2000) reported winter holiday seasonal weight gain (mean 0.8 pounds; range, −15.3 to 9.0) that was not reversed during spring and summer months. Over the course of 1 year, the group averaged a 1.1-pound weight gain (Yanovski et al., 2000).

The fact that the weight gainers in our study were significantly less likely to engage in physical activity than the group who lost 5% of weight is revealing. Future research could explore other factors not evaluated in our study, such as injuries or falls, illnesses, depression, stressful life events, or adverse childhood experiences, to explain the weight gain phenomena (Williamson, Thompson, Anda, Dietz, & Felitti, 2002).

Older participants (≥60 years) were more likely to see weight and WHtR loss than younger women (40–59 years). This finding has been reported in the literature (e.g., Wing et al., 2011), but has not been fully explored. Several factors could be involved with older LB women's weight and WHtR loss. First, they are more likely to be experiencing poor health or physical morbidities that could be reduced with weight loss, and this recognition could serve as an incentive to lose weight. Second, they may have been advised multiple times by their physicians to modify their health-related behavior. This may "prime" patients to become more receptive to health-based programs, such as our HWLB programs (Kreuter, Chheda, & Bull, 2000). Third, older women may have more time to focus on themselves, especially if they are retired from work. Fourth, the child-rearing years may be over, giving them more time to prioritize their own health. Whatever the explanation, healthy weight interventions for middle age and older LB women seem to be promising for future research and practice.

Limitations

One global limitation in the HWLB study results was the reliance on self-reported core survey measures. Self-reported information can be affected by social desirability (SocD) bias even from valid and reliable instruments. SocD is the tendency for participants to respond to questions in a way that may be perceived as more positive or acceptable (King & Bruner, 2000). A review of 14,275 studies published between 2004 and 2005 identified only 31 studies that used a SocD scale, with 55% of these 31 studies influenced by SocD responses (van de Mortel, 2008). Socially sensitive questions are more likely to be biased by SocD (King & Bruner, 2000). In our study these would be physical activity (Adams et al., 2005), dietary intake (Miller, Abdel-Maksoud, Crane, Marcus, & Byers, 2008; Mossavar-Rahmani et al., 2013; Scagliusi, Polacow, Artioli, Benatti, & Lancha, 2003; Tooze et al., 2004), and alcohol use (Embree & Whitehead, 1993; McGilloway & Donnelly, 2004). We were not able to adjust for this construct in our analysis, although we did not share our SMART objectives with participants in advance. Therefore, SocD bias may have been reduced.

Besides being a socially sensitive question with known susceptibility to SocD bias, some validity studies have shown self-report to overestimate physical activity in comparison to objective measures (Lee, Macfarlane, Lam, & Stewart, 2011). In contrast, self-recorded and transmitted steps (using a smart pedometer) have high agreement, thereby reducing bias (Fukuoka, Kamitani, Dracup, & Jong, 2011). Our study found the pedometer use group with data retrieved from the device had a higher average number of daily steps at the end of the study compared with the group that used self-reported logs of their daily steps.

Researchers have reported differences in self-reported weight versus those measured by professional staff (Ramos, Lopes, Oliveira, & Barros, 2009; Richmond et al., 2012; Rowland, 1990). In the HWLB study, four sites had professional staff measure participants' weights/waist circumference and one site was self-reported. The results indicated achievement of weight/WHtR SMART objectives may have been biased owing to the inclusion of the self-reported data from one site.

Some of the participants were already engaged in health promotion behaviors by not drinking SSB, limiting alcohol to seven or fewer drinks per week, and meeting or exceeding the recommended level of physical activity. Therefore, our analytic sample size for these domains was reduced by 33%, 69%, and 15% respectively. Further, for one program, a high percent of intervention participants (47%) were unable (e.g., used wheelchairs) or refused to provide waist circumference measurement. The other four sites obtained waist circumference measurements in 94% of the participants. Overall, 23% of WHtR measures were missing for the intervention sample.

Another characteristic of the HWLB programs was the pre-intervention and post-intervention design. Each program enrolled a targeted group of women and collected a core set of data which was used to test our nine SMART objectives across the programs. Follow-up data on those who were part of the DIFO (4 months) and LOLA (8 months) programs will provide additional information about the effectiveness of these interventions.

The HWLB program did not require sites to conduct randomized controlled trials because a lack of prior research among the LB population prevented Office on Women's Health from defining a detailed protocol for randomized controlled trials. Approximately one-half of the comparison group was comprised of participants who were not able to join the intervention for various reasons (e.g., scheduling, work conflict). Although the demographics of the intervention and comparison group were similar, the small number of comparison participants and lack of a true control group in which participants were randomly allocated should be addressed in future studies by using randomly assigned control groups.

Intrapersonal factors that can influence the effectiveness of a program, such as motivational readiness or exercise self-efficacy, were not collected by all sites (Mama et al., 2015). This study used convenience sampling and enrolled women who were interested in improving their health. This intention towards making positive change introduced selection bias (Preusse, Mitzner, Fausset, & Rogers, 2014). Finally, the majority of participants were lesbians, and the limited representation of bisexual women and those identifying as "something else" means our findings may not be generalizable to these populations.

Implications for Practice and/or Policy

A growing interest in the financial burdens of illness may be contributing to the increasing emphasis on prevention and wellness (e.g., screenings, diet, exercise) for middle-aged adults, including LB women (Baicker, Cutler, & Song, 2010). Behavioral change to improve health at middle age is also appropriate given increasing life expectancies and associated chronic conditions (Weiss & Lang, 2012). Workplace health promotion programs can offer multiple opportunities to improve employees' health and productivity while reducing health care, workers' compensation, and disability costs (Goetzel & Ozminkowski, 2008). For example, providing tools, such as smart pedometers, classes on mindfulness for stress reduction or intuitive eating as seen in our study, and paid time off or flexible work hours to allow employees to engage in physical activity can be opportunities that meet employees' needs and interests. Similarly, policies that reduce financial barriers to physical activity (e.g., insurance companies paying for gym memberships or fitness classes or making these expenses tax deductible) could encourage individuals to increase their physical activity levels. These efforts may be equally effective for LB and heterosexual women and need further study. The HWLB interventions were culturally tailored for LB women, so future research needs to compare tailored approaches to general population approaches.

One aspect of pedometer use in health promotion may be the shift to patient-centered care, in which self-management of health is becoming increasingly important (Bodenheimer, Lorig, Holman, & Grumbach, 2002; Coleman, Austin, Brach, & Wagner, 2009; Ng et al., 2012). Concurrent with this trend in health care are public health messages about the importance of physical activity, especially walking (CDC, 2015a; The Office of the Surgeon General, 2015). Similarly, physicians are recommending exercise regimes to patients for managing many chronic conditions (e.g., diabetes, Olson & McAuley, 2015; cardiovascular disease, Berntson, Stewart, Vrany, Khambaty, & Stewart, 2015; and sarcopenia, Denison, Cooper, Sayer, & Robinson, 2015).

As shown in this initiative, effective research and programs engaging sexual and gender minorities can take place outside of large metropolitan areas, such as college towns, as well as in mainstream retirement communities.

Conclusions

Women 40 years and older comprise approximately 46% of the female population (U.S. Census Bureau, 2013) with those 65 to 105 years old making up 15%. The HWLB study bridged two general cohorts: middle-aged LB women, who are more likely to be managing wellness activities, such as screenings, exercise, sleep and diet, and older LB women, who are often managing both maintenance of health through wellness activities and chronic illnesses, such as medication regimes, monitoring symptoms (e.g., glucose or blood pressure), and coordinating medical appointments (Mitzner, McBride, Barg-Walkow, & Rogers, 2013). Both of these cohorts, albeit for different reasons, may be predisposed to participating in health promotion interventions.

Most studies on lesbian aging suggest that lesbians grow more confident and well-adjusted over time (Friend, 1991; Herdt & de Vries, 2004; Quam & Whitford, 1992), indicating that the association with minority stress and unhealthy lifestyle choices (e.g., heavy alcohol consumption) may be less prominent or more amenable to interventions as lesbian women age. This improved status may be mediated by resilience. For example, McElroy et al. (2016) reported that LGBT adults with high resilience, regardless of stress level, were significantly less likely to be depressed. Wagnild (2014) also noted that resilience scores increased with age.

The older LB age group is in the period of life in which the greatest heterogeneity exists along psychological, medical, and social dimensions, making it exceptionally difficult to design a study that meets the needs of any particular woman (Herdt & de Vries, 2004). Tailored interventions described in the HWLB study effectively negotiated the heterogeneity of this older LB cohort by having participants make a meaningful lifestyle change over the course of the intervention.

One notable achievement was the significant change in increased physical activity by almost two-thirds of the LB women, with the pedometer use group significantly more likely to achieve this SMART objective. Further, one-half of participants (51%) in the HWLB program achieved a 10% or greater increase in reported number of times they consumed fruits and vegetables per day. Approximately 43% of the comparison group increased consumption of fruits and vegetables. This suggests that merely enrolling in a study that addresses health can have a beneficial effect.

One of the strongest determinants of health-promoting behaviors was defining health beyond the absence of illness for older women (Pullen, Walker, & Fiandt, 2001). The HWLB programs encouraged a more expansive perception of health and our findings support a positive effect. We found that the influence of employment, regardless of age, may decrease the chance of reducing alcohol consumption and this area warrants additional research. Replicating our findings using approaches that obtain validated measures, though very costly, would add confidence to our findings.

In this large, multisite study, a tailored approach to improving the health of LB women aged 40 and older was effective, with 95% of the participants achieving at least one of the nine SMART objectives. These results may rest on three common components across the sites. One commonality was partnering with local LGBT community or resource centers that provided a safe space. These partnerships also supported enrollment of LB participants into the intervention. Expert LB community advice also contributed to effective implementation of the projects. The other two common themes were the encouragement of more physical activity and the weekly group support meetings that addressed health-related topics and concerns as well as provided crucial support and networking opportunities in an LB women-supportive environment.

Finally, this landmark study has demonstrated the effectiveness of focusing on LB women in healthy weight programs. Future healthy weight initiatives should include LB women using tailored approaches. Insurance health plans, health maintenance organizations, LGBT community centers and clinics, women's health centers, senior centers, the private sector, and state and federal agencies now have five models to use for LB women. The free availability of the five programs' protocols and materials can reduce future programs' startup costs. Other researchers are welcome to replicate the models with longer follow-up in different geographic areas, urban and rural, and in different racial/ethnic groups with the ultimate goal of achieving healthy weight in all LB communities across the country.

Supplementary Data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.whi.2016.05.002.

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