Cost of behavioral weight loss programs implemented in clinical practice: The POWER trial at Johns Hopkins

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Abstract

Obesity presents an important public health problem that affects more than a third of the U.S. adult population and that is associated with increased morbidity, mortality, and costs. Previously, we documented that two primary care-based weight loss interventions were clinically effective. To encourage the implementation of and reimbursement for these interventions, we evaluated their relative cost-effectiveness. We performed a cost analysis of the Practice-based Opportunities for Weight Reduction (POWER) trial, a three-arm trial that enrolled 415 patients with obesity from six primary care practices. Trial participants were randomized to a control arm, an in-person support intervention, or a remote support intervention; in the two intervention arms, behavioral interventions were delivered over 24 months, in two phases. Weight loss was measured at 6, 12, and 24 months. Using timesheets and empirical data, we evaluated the cost of the in-person and remote support interventions from the perspective of a health care system delivering the interventions. A univariate sensitivity analysis was conducted to evaluate uncertainty around model assumptions. All comparisons were tested using independent *t*-tests. Cost of the in-person intervention was higher at 6 months (\$113 per participant per month and \$117 per kg lost) than the remote support intervention (\$101 per participant per month and \$99 per kg lost; $p < .001$). Costs were also higher for the in-person support intervention at 24 months (\$73 per participant per month and \$342 per kg lost) than for the remote support intervention (\$53 per participant per month and \$275 per kg lost; $p < .001$). In the sensitivity analyses, cost ranged from \$274/kg lost to \$456/kg lost for the in-person support intervention and from \$218/kg lost to \$367/kg lost for the remote support intervention. A primary care weight loss intervention administered remotely was relatively more cost-effective than an in-person intervention. Expanding the scope of reimbursable programs to include other cost-effective interventions could help ensure that a broader range of patients receive the type of support needed.

Keywords

Behavioral weight loss intervention, Cost analysis, Overweight, Obesity

INTRODUCTION

Obesity presents a serious public health concern, with more than 35% of adults 20 years and older in the USA classified as obese [1]. Obesity is associated with increased medical costs [2], higher risk of

Implications

Practice: Remote support can deliver effective weight loss interventions at a lower cost than in-person interventions.

Policy: Expanding the scope of reimbursable programs to include remotely delivered weight loss interventions could be cost-effective and help ensure a broader range of patients receive the type of support needed.

Research: Future research should further explore alternative methods for delivering behavioral weight loss interventions and should consider both effectiveness and cost components.

other chronic conditions, and increased risk of death [3,4]. Lifestyle-based approaches to weight loss have been demonstrated effective and are recommended first-line treatments for obesity [5–7]. Primary care providers can play an important role in successful behavioral weight loss interventions by diagnosing obesity, and counseling and coordinating care for people living with obesity [8]. Recommendations from the U.S. Preventive Services Task Force [9] and the Centers for Medicare and Medicaid Services [10] highlight the need for effective lifestyle-based weight loss programs for the primary care setting.

Identifying effective lifestyle programs that can be implemented within the constraints of a primary care setting is challenging. There are practical barriers such as primary care or other provider time, training, reimbursement, space needs, and identification of an effective weight loss approach [11]. The Practice-based Opportunities for Weight Reduction (POWER) trial at Johns Hopkins was a comparative effectiveness trial of two behavioral weight loss interventions for people living with obesity in a primary care setting. This trial found that two behavioral interventions, one providing in-person support and the other providing remote support, promoted

comparable weight loss over a period of 24 months. We previously reported details of the study design, intervention, and main results [12].

Given the clinical and societal burden of obesity [13,14], evaluating costs for weight loss interventions is important when choosing which clinically effective program to implement or reimburse. The objective of this analysis is to compare the costs of implementing the two active interventions in the POWER trial at Johns Hopkins, previously found to be clinically effective. This article adapts a five-step framework [15] for estimating the costs of behavioral interventions and presents the following: (a) framework for cost analyses; (b) trial overview and intervention components; (c) data collection; (d) cost and relative cost-effectiveness analyses; and (e) sensitivity analyses.

SUBJECTS AND METHODS

Framework for cost analyses

The time horizon for the cost analysis spanned the 24-month duration of the intervention and was conducted from the perspective of a health care system implementing the intervention. As such, cost analyses are based on two primary assumptions. First, that the intervention was already developed. Although the lifestyle intervention was developed specifically for this trial, the costs to develop the program and the corresponding website were not included in these analyses; instead, we focused on the implementation of an evidence-based program. Second, the cost estimates were limited to activities associated with implementing the intervention and excluded any activities that were strictly a function of the research study (e.g., data collection and recruitment costs). As such, these analyses are focused on the cost of implementing the two lifestyle interventions as developed. Costs of the control arm were minimal and not considered in this analysis, as the objective of this study was to analyze the additional costs required to implement the two weight loss interventions.

Trial overview

The POWER trial was a three-arm trial that tested two behavioral weight loss interventions in 415 people living with obesity with at least one cardiovascular risk factor. Participants were enrolled from six primary care practices in Maryland and as reported previously 63.6% were female and 41.0% were black [12]. Each participant was equally likely to be randomized to each study arm. One intervention arm provided participants with remote telephone weight loss support ($n = 139$), and the other intervention arm provided participants with in-person support ($n = 138$); the remaining participants ($n = 138$) were assigned to the control arm [12].

Details of the trial have been previously reported [16]. In brief, participants in both intervention arms had access to a study website on which they were

asked to enter their weight at least once per week and to review online educational modules. All participants were encouraged to lose 5% of their baseline weight by engaging in behavioral goals related to reducing calorie intake, increasing physical activity, and self-monitoring. Months 1–6 represented the intensive phase of the intervention, whereas months 7–24 represented the maintenance phase of the intervention. Participants in the control group met with a weight loss coach at the time of randomization.

Frequency of contacts is listed in Table 1. During the first 6 months, those in the remote support intervention were offered 15 coaching calls, and those in the in-person support intervention were offered 12 group sessions and 9 individual coaching sessions (in person or by telephone). From month 7 to the end of the study, remote support participants were offered monthly calls, and in-person support participants were offered both individual and group sessions monthly. Primary care physicians (PCP) played a supportive role. Specifically, PCPs were provided with a weight progress report about their patients in the study in advance of patient appointments. They were asked to review the report with their patients during routine visits and to encourage their patients' efforts at weight loss.

Mean weight change at 6 months was -6.1 kg in the remote support intervention and -5.8 kg in the in-person support intervention. Mean weight change at 12 months was -5.7 kg in the remote support intervention and -5.4 kg in the in-person support intervention. Over the entire 24-month intervention, mean change in weight was -4.6 kg in the remote support intervention and -5.1 kg in the in-person support intervention [12]. There was no significant difference in weight change between remote support and in-person support at 6, 12, or 24 months [12].

Intervention components

In both active interventions, weight loss coaches used a motivational interviewing approach and focused discussions on key weight management behaviors (reduced calorie intake while following the Dietary Approaches to Stop Hypertension [DASH] diet, increased exercise, and self-monitoring). In addition, participants received encouragement to log on at least weekly to the study-specific website that contained weight management learning modules, opportunities for self-monitoring of weight, calorie intake and exercise, and feedback on these behaviors.

The coaches for the in-person support group were employees of Johns Hopkins University. The coaches for the remote support group were employees of Healthways. Coaches were trained before the intervention started and on a quarterly basis thereafter.

Data collection

Every 3 months, all coaches and the intervention director completed 2-week logs of their activities

Table 1 | Average minutes per episode of *scheduled* activities sampled in the POWER trial

	Months 1–6				Months 7–24				<i>p</i> ^b
	In-person support		Remote support		In-person support		Remote support		
	Expected sessions	Minutes per session, mean (SE)	Expected sessions	Minutes per session, mean (SE)	<i>p</i> ^a	Expected sessions	Minutes per session, mean (SE)	Expected sessions	Minutes per session, mean (SE)
Coach activities									
Scheduled contact time									
Group session ^c	12	67.8 (7.9)			—	18	70.7 (8.7)		—
Individual face-to-face counseling	6	35.3 (3.1)			—	6	32.5 (2.1)		—
Individual telephone counseling	3	17.7 (1.4)	15	27.52 (1.4)	<.001***	12	18.0 (0.7)	18	22.9 (0.6)
Scheduled noncontact time									
Group session preparation	12	45.6 (8.5)			—	18	41.5 (4.9)		—
Case management ^{d,e}	4	53.6 (15.0)	4	53.6 (15.0)	—	6	70.1 (13.8)	6	70.1 (13.8)
Other time									
Physician contacts ^f	1	0.1	1	0.1	—	1	0.1	1	0.1
POWER Practice-based Opportunities for Weight Reduction.									
Independent <i>t</i> -test comparing mean minutes per session for in-person support and remote support for months 1–6 of the intervention.									
Independent <i>t</i> -test comparing mean minutes per session for in-person support and remote support for months 7–24 of the intervention.									
Group sessions were facilitated by two interventionists.									
Case management sessions were attended by two interventionists and one intervention director.									
Due to lack of reporting of time spent on case management in the remote support intervention, mean time spent on case management was estimated for the in-person support intervention and assumed to be the same for the remote support intervention.									
Physician contacts assumed to last 5 min each.									
***Significant at the 0.001 level									

POWER Practice-based Opportunities for Weight Reduction.

^aIndependent *t*-test comparing mean minutes per session for in-person support and remote support for months 1–6 of the intervention.^bIndependent *t*-test comparing mean minutes per session for in-person support and remote support for months 7–24 of the intervention.^cGroup sessions were facilitated by two interventionists.^dCase management sessions were attended by two interventionists and one intervention director.^eDue to lack of reporting of time spent on case management in the remote support intervention, mean time spent on case management was estimated for the in-person support intervention and assumed to be the same for the remote support intervention.^fPhysician contacts assumed to last 5 min each.

***Significant at the 0.001 level.

related to the implementation of the interventions in the POWER trial. Coach activities were divided into four mutually exclusive categories PCP time was also included.

- *Scheduled contact time* included activities that happened on a schedule (group sessions, face-to-face individual counseling, and calls) and that involved direct interaction with participants and the associated typical preparation and documentation. This included time spent conducting the group sessions and documenting attendance in the web application (for the in-person support intervention only).
- *Scheduled noncontact time* included activities that happened on a schedule but did not include direct contact with participants such as case management and quarterly training. Preparation associated with the first implementation of a specific group curriculum was included in this category. Two coaches and an intervention director spent time every month on *case management*, the process by which coaches reviewed participants in their case load to gain ideas how to best assist them with their weight loss. Time spent on case management was only collected for the in-person support intervention and not for the remote support intervention. Time spent on case management was therefore assumed to be the same in the in-person and remote support intervention.
- *Nonscheduled contact time* included events that occurred as needed and involved direct interaction with the participant such as supplemental telephone calls, telephone re-engagement calls, emails, and technical assistance with the study website. *Telephone supplemental calls* were scheduled on a case-by-case basis to help participants who needed and wanted additional support for weight management. They could also be used when participants had missed regular contact windows for legitimate scheduling reasons. No more than four supplemental contacts per year were allowed and no more than four total contacts in any 1-month period were allowed. *Re-engagement calls* were made by coaches in both interventions when participants did not login to the study website after a 2-week period and had received two automated re-engagement emails from the web application. The intent of these re-engagement calls was to encourage login behavior, not to deliver the intervention. *Emails* were used in both treatment interventions for rescheduling missed contacts. *Technical assistance* referred to contact with a participant solely for troubleshooting issues with their web interface.
- *Nonscheduled noncontact time* included activities that did not follow a set schedule and did not involve participant contact such as administrative tasks related to the intervention and supplemental training sessions. *Administrative* time included calls and meetings with the intervention director and chart review for QA/QC; emails to the intervention director, project coordinator, or website helpdesk were also included in this category. Finally, this category included time *the intervention*

director spent in administration related to implementation of the intervention (e.g., scheduling, reports, staffing, preparing for training).

- *Physician time.* Participants did not have study-specific visits with their primary care physicians (PCP). Rather, these visits were scheduled, as needed, for management of chronic and acute conditions. PCPs received and reviewed a progress report on their patients who had been assigned to an intervention. PCPs used this report to provide their patients with basic guidance (i.e., reduce calorie intake and increase exercise) and to motivate their patients to continue with the intervention. The report included a graph generated from the website by the intervention director showing the patient's baseline, target, and self-reported weights.

Cost analyses

Overview

An economic analysis was conducted to assess the relative cost-effectiveness of the two interventions (remote support and in-person support). Resource use (interventionists' time) and outcome data (weight loss) for the economic analysis were collected prospectively. Costs were estimated in 2016 U.S. dollars. The time horizon for the study and the cost analysis spanned the 24-month duration of the intervention. The study took a health care payer perspective, which included all costs attributable to the intervention. This perspective was taken to estimate how much a health system would need to invest to implement the remote support or in-person support intervention. Costs associated with the research components of the intervention were not included, including recruitment or costs associated with developing the intervention and the intervention website. Costs associated with the control arm were mostly research related, except for the costs of the initial visit with a weight loss coach, and were not considered in this analysis. All tests comparing time and costs between different interventions were conducted using independent *t*-tests.

Labor cost analyses

Coaches' logs were used to calculate the average time spent per instance of scheduled contact activities identified on the logs. We then multiplied the average minutes per instance by the number of expected intervention contacts to calculate the total amount of time spent in scheduled contact activities throughout the intervention. It was assumed that one staff member led all individual sessions and two staff members led all group sessions in the in-person support intervention.

To estimate the time spent in nonscheduled contact time, nonscheduled noncontact time, and scheduled noncontact time, a multiplier method was used [17]. The ratio of total recorded time for each of the above categories to total recorded scheduled

contact time in the timesheets was calculated. This ratio, or multiplier, was then multiplied by the total calculated amount of scheduled contact time, which had been calculated using the average time per episode method outline above. This gave us an estimate of the total amount of time spent on non-scheduled contact time and noncontact time (both nonscheduled and scheduled) throughout the intervention. The multiplier was calculated separately for nonscheduled contact time, noncontact time, and intervention director time. We also calculated separate multipliers for months 1–6 (intense phase) and 7–24 (maintenance phase). For illustrative purposes, assume that in the remote support arm for the first 6 months of the intervention, the time tracking indicated 396 min of nonscheduled contact time for every 5,312 min of scheduled contact time (scheduled individual telephone counseling), which resulted in a multiplier, or ratio, of nonscheduled contact time to scheduled contact time of 0.0745. Scheduled individual telephone sessions averaged 27.52 min per call and were scheduled to be conducted 15 times for each participant for a total of 412.85 min per participant. Therefore, employing the multiplier method, scheduled noncontact time in the first 6 months of the remote support arm was calculated at 30.78 min per participant (412.85×0.0745).

The time (in hours) spent per participant per month for each component of the intervention was calculated from total time spent on the intervention. Time per participant was then multiplied by the salary for the coaches and intervention director to calculate cost per participant per month and total cost of each component of the intervention. Coach and intervention director salaries were derived from wages for dietitians and nutritionists reported by the Census Department Bureau of Labor and Statistics [18]. We used current information for the benefit to wage ratio of 0.464 [19].

Analyses of other costs

Physician time spent on weight loss counseling was calculated by assuming that the average amount of time physicians spent per visit was 5 min. It was assumed that participants paid one visit to their physician in the first 6 months of the intervention and then one visit in the next 18 months per participant, which were the average number of physician visits that occurred in the POWER trial. Cost for physician time was based on CPT codes for a level 4 office visit with at least moderate intensity at \$100 for a 25-min visit.

Website maintenance costs were adapted from a costing study conducted by Smith et al. [20]. Rent was calculated by multiplying estimated size of office space and the rent per square foot per month in Baltimore County for 24 months. Rent for the rooms in which the group classes were held was only calculated for the percent of time that

the rooms were used (http://www.loopnet.com/Baltimore_Maryland_Market-Trends).

Sensitivity analysis

A univariate sensitivity analysis was conducted in which individual inputs for the costing analysis were changed. Factors changed included assumptions about effectiveness of the intervention (weight loss), number of group sessions and individual counseling sessions conducted, number of physician visits per intervention, website maintenance cost, rent, and time spent on different components of the intervention.

RESULTS

Table 1 presents the average minutes per episode of scheduled time in the two active interventions. For the in-person support intervention, coaches spent 67.8 min in months 1–6 and 70.7 min in months 7–24 leading each group session. On average, coaches spent 45.6 min in months 1–6 and 41.5 min in months 7–24 preparing for each group session. In both months 1–6 and months 7–24, coaches spent more time per individual telephone counseling session for the remote support intervention than for the in-person support intervention ($p < .001$). Mean time spent on case management was estimated and assumed to be equal between the in-person and remote support interventions at 53.6 min per session (SE 14.9) for months 1–6 and 70.1 min per session (SE 13.8) for months 7–24.

Table 2 presents the average minutes per episode of nonscheduled time recorded in the timesheets. It also presents the ratio of total time for the nonscheduled activities to scheduled contact time recorded in the timesheets. A lower ratio indicates that less time was recorded on the nonscheduled component than was recorded for scheduled contact time. These estimates were used in conjunction with **Table 1** estimates to determine total time spent on the intervention.

Table 3 presents intervention time spent per participant, cost per participant, and total cost in both interventions for the different phases and for the overall intervention period. The total cost to implement the in-person support intervention was \$240,672, which was substantially higher than \$175,838, the total cost to implement the remote support intervention ($p < .001$). At 6 months, cost per participant per month for the in-person support intervention was higher (\$113 per participant per month) than for the remote support intervention (\$101 per participant per month). For the overall intervention, cost per participant per month for the in-person support intervention was higher (\$73 per participant per month) than for the remote support intervention (\$53 per participant per month). There was a large difference in per participant spending on

Table 2 | Time spend on *nonscheduled* activities sampled in the POWER trial

Coach activities	Months 1–6					Months 7–24				
	In-person support		Remote support		<i>p</i> ^c	In-person support		Remote support		
	Minutes per session, mean (<i>SE</i>) ^a	Ratio to scheduled time (%) ^b	Minutes per session, mean (<i>SE</i>) ^a	Ratio to scheduled time (%) ^b		Minutes per session, mean (<i>SE</i>) ^a	Ratio to scheduled time (%) ^b	Minutes per session, mean (<i>SE</i>) ^a	Ratio to scheduled time (%) ^b	
Nonscheduled contact time										
Telephone supplemental call	20.0 (5.1)	2	33.0 (–)	4	>.9	28.3 (4.4)	1	17.4 (4.1)	1	>.9
Telephone re-engagement call	11.0 (7.1)	1	18.8 (2.3)	1	1.0	9.4 (2.7)	6	14.6 (2.6)	4	>.9
Email	8.0 (0.8)	1	5.7 (2.2)	2	>.9	6.3 (1.1)	0.3	10.6 (1.2)	1	>.9
Technical assistance	13.2 (2.2)	5	9.0 (1.5)	1	>.9	20.8 (6.9)	1	3.5 (2.5)	0	1.0
Nonscheduled noncontact time										
Training and administration	37.6 (3.4)	86	34.3 (9.5)	65	.5	32.8 (1.8)	22	20.4 (2.8)	15	.9
Intervention director activities	25.3 (2.3)	35	25.3 (2.3)	39	.7	30.9 (1.9)	38	30.9 (1.9)	31	.8

POWER Practice-based Opportunities for Weight Reduction.

^aThe average number of minutes for each session of the intervention component recorded in the timesheets.

^bCalculated as total time of intervention component recorded in time sheets divided by total scheduled contact time recorded in time sheets for listed intervention months. A lower ratio indicates that less time was recorded on the intervention component than on scheduled contact time.

^cT-tests of two independent proportions comparing ratio to scheduled time for in-person support and remote support for months 1–6 of the intervention.

^dT-tests of two independent proportions comparing ratio to scheduled time for in-person support and remote support for months 7–24 of the intervention.

Table 3 | Intervention costs in U.S. dollars

	Months 1–6				
	In-person support		Remote support		<i>p</i> ^a
	Cost per participant per month	Total cost in USD (SE)	Cost per participant per month	Total cost in USD (SE)	
Scheduled contact time	36	29,928 (1,055)	44	37,043 (1,827)	<.01
Group session	8	6,297 (734)	—	—	
Individual face-to-face counseling	23	18,890 (1,680)	—	—	
Individual telephone counseling	6	4,741 (378)	44	37,043 (1,827)	<.01
Nonscheduled contact time ^b	3	2,467 (87)	3	2,761 (136)	.47
Noncontact time ^{c,d}	59	48,442 (1,067)	42	35,178 (1,115)	<.01
Physician contact ^e	3	2,760 (—)	3	2,780 (—)	
Other costs (total)	12	9,739 (—)	8	6,563 (—)	
Website maintenance ^f	2	1,563 (—)	2	1,563 (—)	
Rent	10	8,176 (—)	6	5,000 (—)	
Total costs	113	93,336 (1,044)	101	84,326 (1,635)	<.01
Months 7–24					
Scheduled contact time	19	46,447 (849)	15	36,951 (987)	<.01
Group session	4	9,858 (1,210)	—	—	
Individual face-to-face counseling	7	17,388 (1,131)	—	—	
Individual telephone counseling	8	19,201 (755)	15	36,951 (987)	<.01
Nonscheduled contact time ^b	1	3,286 (60)	2	6,163 (165)	<.01
Noncontact time ^{c,d}	29	73,009 (750)	11	28,755 (485)	<.01
Physician contact ^e	1	2,760 (—)	1	2,780 (—)	
Other costs (total)	9	21,834 (—)	7	16,863 (—)	
Website maintenance ^f	1	1,863 (—)	1	1,863 (—)	
Rent	8	19,971 (—)	6	15,000 (—)	
Total costs	59	147,336 (722)	37	91,512 (717)	<.01
24 Months					
Scheduled contact time	23	76,375 (1,153)	22	73,994 (1,553)	.23
Group session	5	16,155 (1,298)	—	—	
Individual face-to-face counseling	11	36,278 (1,775)	—	—	
Individual telephone counseling	7	23,942 (874)	22	73,994 (1,553)	<.01
Nonscheduled contact time ^b	2	5,753 (87)	3	8,925 (201)	<.01
Noncontact time ^{c,d}	37	121,451 (973)	19	63,934 (644)	<.01
Physician contact ^e	2	5,520 (—)	2	5,560 (—)	
Other costs (total)	10	31,573 (—)	7	23,426 (—)	
Website maintenance ^f	1	3,426 (—)	1	3,426 (—)	
Rent	8	28,147 (—)	6	20,000 (—)	
Total costs	73	240,672 (1,103)	53	175,838 (1,357)	<.01

30.6% of compensation is benefits or ratio of benefits to wages = 0.464.

^aIndependent *t*-test comparing total cost for in-person support and remote support.

^bTime for other contact activities, training administration, and intervention director time was calculated using the ratio of time spent on individual coaching sessions to time spent on the relevant activity recorded in timesheets.

^cSalary + benefits for intervention director = 56.41/h; other interventionist activities = 38.73/h.

^dNoncontact time includes scheduled and nonscheduled noncontact time.

^ePhysician contact based on CPT code for a level 4 office visit with at least moderate intensity at \$100 for a 25-min visit.

^fWebsite maintenance costs were adapted from a costing study conducted by Smith et al. Cost-effectiveness of an internet-delivered lifestyle intervention in primary care patients with high cardiovascular risk.

noncontact time between the in-person intervention (\$37 per participant per month) and remote support intervention (\$19 per participant per month).

Table 4 and Fig. 1 present cost per participant per kilogram of weight loss. At 6 months, the in-person support intervention had a higher cost per kilogram

(\$117/kg) than the remote support intervention (\$99/kg; *p* < .001). Over the 24-month intervention, the cost per kilogram lost in the in-person support intervention (\$342/kg lost) was higher than the corresponding cost in the remote support intervention (\$275/kg lost; *p* < .001). To facilitate comparisons

Table 4 | Cost per participant per kilogram lost over the entire intervention

	Cost per participant per kilogram lost (\$/kg lost)				
	6 Months		p^b	24 Months	
	In-person support	Remote support		In-person support	Remote support
	Mean (SE)	Mean (SE) ^a		Mean (SE) ^a	Mean (SE)
Coach activities	101 (1)	88 (2)	<.001	289 (2)	230 (2)
Physician contact	3 (–)	3 (–)		8 (–)	9 (–)
Other cost	12 (–)	8 (–)		45 (–)	37 (–)
Total intervention	117 (1)	99 (2)	<.001	342 (2)	275 (2)

^aSE denoted by (–) indicates no variation in cost estimates due to assumptions of fixed cost estimates (physician contact was fixed at 5 min and cost of website maintenance and rent was fixed).

^bIndependent *t*-test comparing \$/kg lost for in-person support and remote support at month 6 of the intervention.

^cIndependent *t*-test comparing \$/kg lost for in-person support and remote support at month 24 of the intervention.

Fig. 1 | Costs of the Practice-based Opportunities for Weight Reduction (POWER) intervention.

with other studies and programs, the 12-month cost per kilogram is also reported, which was \$180 for the in-person support intervention and \$138 for the remote support intervention.

Figure 2 displays the effects on cost per kilogram of weight loss when changing assumptions related to key features of the two interventions. The largest range in cost per kilogram lost for both interventions occurred when the effectiveness of the intervention was varied from 75% to 125% of mean weight loss observed (range in-person support intervention: \$274/kg lost–\$456/kg lost, range remote support intervention: \$220/kg lost–\$367/kg lost). The least variation in cost per kilogram lost for both interventions occurred when the time spent on nonscheduled contact interventions was varied from 75% to 125% of estimated mean time (range in-person support intervention: \$340/kg lost–\$344/kg lost, range

remote support intervention: \$272/kg lost–\$278/kg lost).

DISCUSSION

In this comparative effectiveness trial of primary care-based weight loss programs, both the in-person support and the remote support interventions resulted in clinically significant weight loss in the short (6 months) and long term (24 months). The first 6 months of the intervention were the most cost-effective for both the in-person (\$117/kg) and the remote support (\$99/kg) interventions as this period also corresponds with the largest weight loss. Accounting for the 24-month time frame of POWER trial, cost can be converted into cost per kilogram-year (\$171/kg-year for in-person support and \$138/kg-year for remote support).

Putting the POWER trial costs in context of other weight loss studies is informative. The POWER-Up

Fig. 2 | Univariate sensitivity analysis for estimated cost per kilogram lost by type of intervention. Figure represents variations in costs per kilogram based on changes in assumptions around intervention components. Text next to each intervention component in parentheses indicates how assumptions around the component were varied.

Study, which also examined the 2-year effectiveness of weight loss programs, including an intervention with meal replacement delivered in the primary care setting, reported annual cost of \$238/kg–\$284/kg of weight loss [21]. Ahern et al. examined weight loss among participants who were referred by their primary care provider to a commercial weight loss program for either a 12- or 52-week program [22]. Although weight loss was slightly higher immediately following the weight loss program, the 2-year weight loss was 3 and 4 kg for the 12- and 52-week programs, respectively. The cost per kilogram lost was \$150/kg (£91/kg) and \$262/kg (£159/kg) for the 12- and 52-week programs, respectively (British Pounds were converted using the average exchange rate in 2014). Although this suggests a lower cost per kilogram lost over 2 years, the overall weight loss was lower than in the POWER study.

These cost estimates for the POWER trial appear comparable to many commercial weight loss plans

such as Weight Watchers (\$155/kg lost) and Vitrim (\$213/kg lost) [23]. In addition, they are similar to other behavioral weight loss programs [14,15] and the Diabetes Prevention Program [13]. Our findings support earlier work that found in-person weight loss programs costlier than remotely delivered interventions [23,24]. Most of the savings for the remote intervention were due to lower noncontact time costs per participant, compared with the in-person intervention. These differences might be a function of operational efficiencies.

The marginal savings of the remote intervention could be multiplied if the program were implemented on a large scale, but it is not clear if there would be an economy of scale for the remote intervention due to its reliance on one-on-one telephonic coaching. However, the remote delivery does afford greater flexibility when offered at a larger scale than the in-person support condition that requires staff and meeting space within a convenient distance to

the participants. Although group sessions offered in the in-person intervention could be relatively cost-effective, when ensuring optimal attendance rates, they do create additional logistic concerns.

The costs associated with the POWER remote intervention exceed the billable allowance provided by the Centers for Medicare and Medicaid for intensive weight loss counseling by primary care providers [10]. However, even if the POWER interventions met the billable allowance, neither condition would qualify for reimbursement as they were delivered by a trained health coach and not by a primary care provider. The reimbursement for intensive weight loss counseling by the Centers for Medicare and Medicaid program is limited by (a) modest reimbursement that may not align with most evidence-based programs, (b) limited training opportunities for primary care providers to develop expertise in behavioral weight loss approaches, and (c) limited resources in primary care setting for additional counseling (space, staff, time with patient). Expanding the scope of reimbursable programs to include other evidence-based models could help ensure that a broader range of patients receive the type of support needed.

Some individuals may need the intensive level and type of coaching present in the POWER intervention for successful weight loss. However, even with this level of intensity, some individuals failed to meet the weight loss goals in the POWER intervention. Being able to identify individuals who are unlikely to reach the weight loss goals of interventions and developing alternative interventions for them could help improve clinical effectiveness and reduce inefficient resource use. Triaging individuals and monitoring their success with different weight loss approaches could help develop a portfolio of weight loss support options and optimize the balance between relative cost and effectiveness of weight loss programs. There could be cost savings to finding individuals who respond well to interventions that are less staff intensive.

This cost analysis had several limitations. First, case management time was not reported for the remote support arm. Therefore, it was assumed that equal time was spent on case management for both interventions. However, it is possible that the amount of time that was spent on case management for the two interventions was different.

Second, certain costs were excluded from our analyses. Costs of recruitment were not included, even though it has been recommended that the costs of recruitment should be included in economic analyses of behavioral interventions [15]. These costs were not included because recruitment in a trial is likely to be costlier than recruitment in medical practice. Furthermore, costs of recruitment in medical practice would likely be the same for both interventions. Costs of program development

were also not included in this study. Although the research grant for POWER covered the costs of developing the intervention, getting the program ready for wide-scale dissemination took additional costs. In addition, we did not include cost for the initial coach training. The coaches for the in-person support were employees of Johns Hopkins with a minimum of a bachelor's degree in a health-related field. The coaches for the remote support were employees of Healthways and had experience with telephonic coaching. The length for initial training would depend on the coaches' background and experience ranging from a two-day orientation to a week-long intensive training.

Third, the only benefits included in the analysis were weight loss. Benefits from weight loss might include improvement in other health conditions, reduced medication costs, and overall improvements in quality of life. These benefits were not considered in the analysis. For example, we did not calculate changes in health state utilities for the different intervention arms. We did this to keep estimates close to the direct clinical benefit of a weight loss program and to reduce the number of assumptions needed. Furthermore, as changes in health-related quality of life due to weight loss are expected to be relatively small in the short term, we did not think that an analysis including health state utilities would be informative.

Fourth, the overall cost and benefits of weight loss in the long term were not examined. It has been suggested that the best cost/benefit examination of a weight loss program would include a long-term follow-up to capture future health benefits of weight loss [25]. The true cost-benefit of a weight loss program is probably realized in years, not months. This creates barriers in bringing clinically effective behavioral weight loss programs to market. Many companies, insurers or providers are beholden to annual cost savings; the long-term investment and benefit are not readily incorporated into their business model. Addressing this gap is another important aspect of the public health efforts to address the burden of overweight and obesity.

Fifth, unlike traditional cost-effectiveness analyses that generally compare one or multiple interventions with a standard of care or control arm, this analysis did not consider costs of the control arm. Costs of the control arm were mostly research related. Furthermore, the objective of this manuscript was not to conduct a traditional cost-effectiveness study resulting in incremental cost-effectiveness ratios, but rather to provide information on the additional costs required to implement two different behavioral weight loss interventions.

The remote intervention tested in POWER was commercialized after the completion of the trial. This rapid move to market is attributed to early and sustained involvement of key stakeholders [26]. In this case, the stakeholder was Healthways Inc., Franklin, TN, a

wellness company that provided technical assistance in developing the POWER website and staffing assistance for the remote condition during the trial. Given that Healthways had first-hand knowledge of both the logistic challenges of this lifestyle approach and clinical evidence of its effectiveness, they developed Innergy, a commercialized version of the remote intervention. Innergy incorporated a few changes to update web content and functionality; it also decreased the contact frequency in year 2 to ensure a sustainable business model. Creating early partnerships with private companies is a viable strategy to help bridge the gap between clinically effective programs and sustained scalable lifestyle change programs to improve health.

CONCLUSION

This study estimated the costs of implementing two behavioral weight loss interventions for people living with obesity attending primary care clinics—one intervention provided in-person support and the other provided remote support. The analysis focused on providing information to groups interested in implementing similar interventions. The costs of implementing the POWER intervention were very similar to implementing other intensive behavioral weight loss interventions. The remote support intervention was more cost-effective than in-person support intervention. Incorporating widespread behavioral weight loss interventions into primary care practices requires financial resources. Policies that address these issues should consider including reimbursement schemes for remote or call-center-directed behavioral interventions.

Compliance with Ethical Standards

Conflict of Interest: Healthways Inc. developed the website for both interventions used in the POWER trial in collaboration with Johns Hopkins investigators and provided coaching effort for the transtelephonic intervention. Healthways also provided some research funding to supplement NIH support. Under an institutional consulting agreement with Healthways, the Johns Hopkins University received fees for advisory services to Healthways during the POWER trial. Faculty members who participated in the consulting services received a portion of the university fees. On the basis of POWER trial results, Healthways developed and is commercializing a weight loss intervention program called Innergy. Under an agreement with Healthways, Johns Hopkins faculty monitor the Innergy program's content and process (staffing, training, and counseling) and outcomes (engagement and weight loss) to ensure consistency with the corresponding arm of the POWER trial. Johns Hopkins receives fees for these services and faculty members who participate in the consulting services receive a portion of these fees. Johns Hopkins received royalty on sales of the Innergy program.

Primary Data: The findings from this study have not been submitted or presented elsewhere. The authors have full control of all primary data, and we agree to allow the journal to review the data if requested.

Authors' Contributions: All authors were involved in the preparation of this manuscript and read and approved the final version.

Ethical Approval: There were no human or animal rights issues. The POWER trial was reviewed and approved by the Johns Hopkins University School of Medicine, as did an independent data and safety monitoring board.

Informed Consent: Informed consent was obtained from all individual participants included in the study.

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