Interest in a Twitter-delivered weight loss program among women of childbearing age

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Abstract

Weight management through the childbearing years is important, yet few women have access to efficacious weight loss programs. Online social network-delivered programs may increase reach and thus impact. The aim of this study was to gauge interest in a Twitter-based weight loss intervention among women of childbearing age and the feasibility of recruitment via Twitter. We recruited English-speaking women aged 18–45 years ($N=63$) from Twitter to complete an anonymous online survey including open-ended questions about program advantages and concerns. Forty percent of participants were obese and 83 % were trying to lose weight. Eighty-one percent were interested in a Twitter-delivered weight loss program. Interest was high in all subgroups (62–100 %). Participants (59 %) cited program advantages, including convenience, support/accountability, and privacy. Concerns (59 %) included questions about privacy, support/accountability, engagement, efficacy, and technology barriers. Research is needed to develop and evaluate social media-delivered interventions, and to develop methods for recruiting participants directly from Twitter.

Keywords

Twitter, Weight loss, Women, Childbearing, Social media, Online social networks, Obesity

INTRODUCTION

A third of US women aged 20–39 years are obese [1], and many women experience significant weight gain with pregnancy [2–4]. Due to increased risk of pregnancy complications and obesity in offspring [5–10], women of childbearing age need efficacious and accessible lifestyle interventions [11, 12]. Evidence-based lifestyle interventions have not had broad reach due to high cost and patient and provider burden [13]. Few women have access to formal programs with barriers including work, childcare, and transportation [14, 15]. Innovative delivery models are needed. Delivering efficacious weight loss interventions via an online social network may overcome challenges of in-person lifestyle interventions for women of childbearing age [14, 15].

Implications

For practice: Social media may be a novel platform by which to deliver behavioral programming for weight loss to patients.

For policy: Reimbursement policies should cover technology-based treatments to the extent that evidence supports them and patients are interested in them.

For research: Given interest among women of childbearing age in receiving weight loss programming via Twitter, research is needed to evaluate the efficacy of this approach.

Studies have examined the use of online social networks, including online group chats and message board, primarily to connect participants outside of in-person meetings [16, 17]. Two recent systematic reviews indicated that online social networks have been primarily used as an adjunct to in-person or web-based weight loss interventions, rather than as the primary treatment modality [18, 19]. In previous studies, greater engagement in these online social networks predicted greater weight loss [20–23]. Thus, online social networks may represent an effective modality for delivering the entirety of an evidence-based weight loss program.

Twitter is a popular online social network with 307 million active users [24]. In the USA, 35 % of adults aged 18–29 years and 20 % of adults 30–49 years use Twitter [25], with rapid growth since its inception, especially among younger adults [26]. On Twitter, the majority of activity is public, yet capacity exists for users to create private communities. This combination of features makes it conducive to both reaching large populations for recruitment and delivering intervention messages privately. Before examining the efficacy of a novel weight loss intervention delivered entirely via a private network on Twitter for women of childbearing age, we conducted a survey of women of childbearing age who use Twitter to (1) gauge their

interest in a Twitter-based weight loss intervention, (2) solicit their perspectives of the advantages of such a program and their concerns, and (3) evaluate the feasibility of recruiting this population from Twitter.

METHODS

We recruited women of childbearing age directly from Twitter to reach women already familiar with Twitter and for whom Twitter was already integrated into their daily lives. Three of the authors (@drmollywaring [MEW], @300lbsandrunnin [MME], and @drsherry-pagoto [SLP]) tweeted a link to an anonymous survey during August and September 2014. Interested individuals clicked on the link were asked to answer questions assessing eligibility (female, aged 18–45 years, use Twitter, comfortable completing the survey in English) via a secure web form. [27] Eligible respondents were directed to a page presenting a study fact sheet and those who endorsed consent were directed to the survey. Study data were collected and managed using REDCap (Research Electronic Data Capture) tools hosted at the University of Massachusetts Medical School [27]. The University of Massachusetts Medical School Institutional Review Board approved this study. Participants received no financial incentive or compensation for participation.

Women self-reported characteristics including demographics, weight loss history, and technology use. Body mass index (BMI) was calculated from self-reported height and weight and categorized as underweight ($\text{BMI} < 18.5 \text{ kg/m}^2$), normal weight ($18.5 \text{ kg/m}^2 \leq \text{BMI} < 25.0 \text{ kg/m}^2$), overweight ($25.0 \text{ kg/m}^2 \leq \text{BMI} < 30.0 \text{ kg/m}^2$), or obese ($30.0 \text{ kg/m}^2 \leq \text{BMI}$) [28]. Women reported whether they were currently trying to lose weight. Women also reported frequency of Twitter use in the past 4 weeks. Women were asked “what do you tweet about?” and were provided a list of topics from which to select; topics provided were based on reasons participants reported joining Twitter in our previous research [29].

To gauge women’s interest in a Twitter-delivered weight loss program, we first described the proposed intervention: “We would like to know if you would be interested in participating in a weight loss program that is conducted via Twitter. The program would be specifically designed for women aged 18–45 years. Over 12 weeks, you and other women in the program would receive dietary and exercise coaching to help you meet your weight loss goals in a private Twitter network. We would ask you to set goals and report progress on a regular basis. You could ask questions to the group and health coaches who are experts in weight loss counseling. We would encourage you to interact with the other women in the weight loss group. We would also encourage you to use an app or online tracker, like MyFitnessPal, to track your food, physical activity, and weight loss. To keep the interactions private, we would ask participants to create a second Twitter account and

set it on a privacy setting such that only group members and coaches could view tweets. You could use a nickname and avatar to remain anonymous.” We then asked women “how interested would you be in participating in a weight loss program like this, entirely via Twitter?” Response options were not at all, a little bit, somewhat, quite a bit, or very interested. Women were then asked how interested they were in specific program features: having access to a weight loss coach via Twitter, learning evidence-based strategies for weight loss via professionally written blog posts that are tweeted regularly, watching videos of healthy cooking demonstrations, links to healthy recipes, getting support from other women who are trying to lose weight, participating in scheduled chats with a coach and other women trying to lose weight, using a mobile app to track your diet and exercise, tweeting regularly about your progress, and reading about other women’s progress via their tweets. Response options were not at all, a little bit, somewhat, quite a bit, or very interested. We report responses on this five-level scale and also collapsed into somewhat/quite a bit/very interested versus not at all/a little bit interested. Because participation in a private Twitter network would require their accounts to be on a privacy setting that would only allow the group to see their tweets, women also reported whether they would be willing to create a second Twitter account for use in the study. Response options were not at all, somewhat willing, willing, and very willing. Participants were asked whether they had ever used a wifi scale (a scale that can send weights automatically to a website). Participants were then asked how willing they would be to weigh themselves with a scale that automatically sends their weight to a website, where only the participant and their coaches can see it (not at all willing, somewhat willing, willing, very willing). Finally, we asked women two open-ended questions to assess perceived advantages and disadvantages of a Twitter-delivered weight loss intervention: “What do you like about a weight loss program via a private group on Twitter?” and then “What are you concerned about regarding participating in a weight loss program via a private group on Twitter?”

For each recruitment tweet, research staff manually abstracted the following information from Twitter: date and time of tweet, number of retweets, number of favorites, and accounts who retweeted or favorited the tweet. Research staff then manually abstracted from Twitter the number of followers for the three researchers who tweeted the recruitment tweet and all the accounts that retweeted the recruitment tweet over the course of the study. We summed the number of followers to estimate a maximum potential reach of our recruitment tweets. We estimated the yield from these recruitment efforts as the number of respondents (individuals who completed the eligibility questions) and the number of completed surveys divided by the maximum potential reach.

Table 1 | Characteristics of the sample: women of childbearing age who use Twitter, N (%)

	Number (%)
Age	
21–29 years	13 (21)
30–34 years	24 (38)
35–39 years	13 (21)
40–45 years	13 (21)
Race/ethnicity	
Non-Hispanic white	48 (79)
Non-Hispanic black	9 (15)
Other race/ethnicity (including multiracial)	4 (7)
Education	
<HS/HS/Associate's	16 (25)
Bachelors, some graduate work	17 (27)
Graduate degree	30 (48)
Marital status	
Married	29 (46)
Living with partner	15 (24)
Single, separated, or divorced	19 (30)
Children in the household	
None	43 (68)
One child	10 (16)
Two or more children	10 (16)
Smoking status	
Never smoker	48 (77)
Former smoker	10 (16)
Current smoker	4 (6)
Body mass index	
Normal weight	17 (30)
Overweight	17 (30)
Obese	23 (40)
Currently trying to lose weight	50 (83)
Twitter use	
Less than daily	18 (31)
Once per day	10 (17)
Multiple times daily	31 (53)

Information missing for race/ethnicity ($n = 2$), smoking ($n = 1$), BMI ($n = 6$), currently trying to lose weight ($n = 3$), and frequency of Twitter use ($n = 4$)

Statistical analysis

Descriptive statistics were used to summarize sample characteristics and the proportion of women who were interested in the proposed intervention, willing to create a second Twitter account, and willing to use a wifi scale. Data management and quantitative analyses utilized SAS 9.3 (SAS Institute, Inc., Cary, NC). The first author (MEW) reviewed the open-ended responses of program advantages and concerns and identified thematic categories emerging from the data [30]. Then, two coders (MEW and RSX) independently coded each response as fitting one of more of these themes (i.e., each response was coded as fitting or not fitting each of the themes). We calculated the percent agreement on coding and kappas for the coding of each theme [31]. For the survey responses with discrepantly coded themes, the coders reached consensus through discussion.

RESULTS

Researchers tweeted study recruitment messages 28 times over 4 weeks. The recruitment tweets were retweeted 95 times by 72 unique Twitter accounts, for a maximum potential reach of 349,244 Twitter accounts. Of the 144 individuals who clicked on the

survey link, one did not complete the eligibility questions, 19 were ineligible (due to age [$n = 13$], sex [$n = 2$], Twitter use [$n = 3$], or not speaking English [$n = 1$]), 34 screened eligible but exited the survey without providing consent for participation, and 25 answered only the first page of survey questions. Sixty-three women completed the survey, for 2.3 completed surveys per recruitment tweet, and 1.8 completed surveys per 10,000 Twitter accounts potentially reached.

Participants ($N = 63$) were from 22 US states, Washington, DC, and 7 other countries. Participants' mean age was 34.0 (SD 5.8) years and 79 % were non-Hispanic white. Additional participant characteristics are shown in Table 1. The majority of women (83 %) were trying to lose weight and 69 % used Twitter at least daily. Women reported that they tweeted about several topics: personal updates (51 %), work (48 %), hobbies (40 %), entertainment (38 %), physical activity (30 %), nutrition (27 %), health other (25 %), politics (25 %), sports (19 %), and weight loss (10 %). Forty-one percent reported tweeting about weight loss, nutrition, and/or physical activity; an additional 10 % reported that they tweeted about other health-related topics.

The majority (81 %) of women expressed that they were at least somewhat interested in a weight loss program delivered via Twitter private group; 25 % were quite a bit interested and 27 % were very interested (Table 2). The proportion of participants who were at least somewhat interested in a Twitter-delivered weight loss intervention exceeded 60 % in all subgroups (62–100 %; Table 2). Among our primary target population, women with obesity who want to lose weight (as indicated by report that they are currently trying to lose weight), 95 % ($n = 18/19$) reported that they were at least somewhat interested in a Twitter-delivered weight loss program.

The majority of women were at least somewhat interested in each of the program components (Table 3). Women were interested in using a mobile app to track diet and exercise (92 %), receiving links to healthy recipes (90 %), accessing a weight loss coach on Twitter (84 %), learning weight loss strategies via tweeted blog posts (84 %), and reading about others' progress (83 %). Most were also interested in support from other women (78 %), tweeting their progress regularly (71 %), scheduled chats (67 %), and healthy cooking demo videos (63 %). The majority (87 %) were at least somewhat willing to open a second Twitter account specifically for use in a weight loss program (13 % not at all willing, 26 % somewhat willing, 35 % willing, and 26 % very willing). While 11 % of women reported that they had ever used a wifi scale, 89 % were at least somewhat willing to use a wifi scale that automatically sent their weight to the coach (11 % not at all willing, 21 % somewhat willing, 29 % willing, and 40 % very willing).

Thirty-seven women (59 %) reported program advantages and 37 (59 %) reported concerns; 32 (51 %) women reported both advantages and concerns. Program advantages reported included support/accountability (51 %), convenience (38 %),

Table 2 | Proportion of the sample interested in a Twitter-delivered weight loss intervention, among women of childbearing age who use Twitter, *N* (%)

	Not at all interested	A little bit interested	Somewhat interested	Quite a bit interested	Very interested	At least somewhat interested ^a
Overall sample	4 (6)	8 (13)	18 (29)	16 (25)	17 (27)	51 (81)
Age						
21–29 years	2 (15)	3 (23)	2 (15)	1 (8)	5 (38)	8 (62)
30–34 years	–	1 (4)	8 (33)	12 (50)	3 (13)	23 (96)
35–39 years	2 (15)	1 (8)	4 (31)	–	6 (46)	10 (77)
40–45 years	–	3 (23)	4 (31)	3 (23)	3 (23)	10 (77)
Race/ethnicity						
Non-Hispanic white	4 (8)	5 (10)	12 (25)	13 (27)	14 (29)	39 (81)
Non-Hispanic black	–	2 (22)	3 (33)	2 (22)	2 (22)	7 (78)
Other race/ethnicity (including multiracial)	–	1 (25)	1 (25)	1 (25)	1 (25)	3 (75)
Education						
HS/HS/Associate's	–	1 (6)	3 (19)	6 (38)	6 (38)	15 (94)
Bachelors, some graduate work	1 (6)	4 (24)	6 (35)	3 (18)	3 (18)	12 (71)
Graduate degree	3 (10)	3 (10)	9 (30)	7 (23)	8 (27)	24 (80)
Marital status						
Married	2 (7)	4 (14)	7 (24)	6 (21)	10 (34)	23 (79)
Living with partner	1 (7)	3 (20)	4 (27)	4 (27)	3 (20)	11 (73)
Single, separated, or divorced	1 (5)	1 (5)	7 (37)	6 (32)	4 (21)	17 (89)
Children in the household						
None	4 (9)	5 (11)	13 (30)	10 (23)	11 (26)	34 (79)
One child	–	3 (30)	1 (10)	3 (30)	3 (30)	7 (70)
Two or more children	–	–	4 (40)	3 (30)	3 (30)	10 (100)
Smoking status						
Never smoker	4 (8)	7 (15)	15 (31)	13 (27)	9 (19)	37 (77)
Former smoker	–	1 (10)	1 (10)	2 (20)	6 (60)	9 (90)
Current smoker	–	–	1 (25)	1 (25)	2 (50)	4 (100)
Body mass index						
Normal weight	2 (12)	2 (12)	7 (41)	3 (18)	3 (18)	13 (76)
Overweight	1 (6)	3 (18)	3 (18)	5 (29)	5 (29)	13 (76)
Obese	–	2 (9)	4 (17)	8 (35)	9 (39)	21 (91)
Currently trying to lose weight						
Yes	3 (6)	5 (10)	13 (26)	13 (26)	16 (32)	42 (84)
No	1 (10)	2 (20)	4 (40)	2 (20)	1 (10)	7 (70)
Twitter use						
Less than daily	1 (6)	2 (11)	7 (39)	4 (22)	4 (22)	15 (83)
Once per day	1 (10)	2 (20)	1 (10)	4 (40)	2 (20)	7 (70)
Multiple times daily	2 (6)	3 (10)	8 (26)	7 (23)	11 (35)	26 (84)

Information missing for race/ethnicity (*n* = 2), smoking (*n* = 1), BMI (*n* = 6), currently trying to lose weight (*n* = 3), and frequency of Twitter use (*n* = 4)

^a Somewhat, quite a bit, or very interested

Table 3 | Proportion of the sample interested in components of a Twitter-delivered weight loss intervention, among women of childbearing age who use Twitter, *N* (%)

	Not at all interested	A little bit interested	Somewhat interested	Quite a bit interested	Very interested	At least somewhat interested ^a
Using a mobile app to track diet and exercise	–	5 (8)	17 (27)	20 (32)	21 (33)	58 (92)
Links to healthy recipes	2 (3)	4 (6)	12 (19)	21 (33)	24 (38)	57 (90)
Having access to a weight loss coach via Twitter	6 (10)	4 (6)	13 (21)	19 (30)	21 (33)	53 (84)
Learning evidence-based weight loss strategies via blog posts	–	10 (16)	9 (14)	19 (30)	25 (40)	53 (84)
Reading other women's progress via their tweets	4 (6)	7 (11)	11 (17)	29 (46)	12 (19)	52 (83)
Getting support from other women	4 (6)	10 (16)	10 (16)	24 (38)	15 (24)	49 (78)
Tweeting regularly about progress	8 (13)	10 (16)	19 (30)	15 (24)	11 (17)	45 (71)
Scheduled chats with a coach and other women trying to lose weight	12 (19)	9 (14)	14 (22)	15 (24)	13 (21)	42 (67)
Watching videos of healthy cooking demonstration	11 (18)	12 (19)	16 (26)	10 (16)	13 (21)	39 (63)
Information missing for watching videos of healthy cooking demonstration (<i>n</i> = 1)						

^a Somewhat, quite a bit, or very interested

and privacy/lack of feeling judged (30 %). Concerns included low support/accountability (27 %), technology concerns (27 %), lack of privacy (22 %), not engaging (16 %), and concern that the program would not be efficacious (8 %). The examples of responses for each theme are presented in Table 4. Sixteen percent (*n*=6) of responses explicitly stated that the participant had no concerns. Eight percent (*n*=3) of advantage and 5 % (*n*=2) of concern responses were coded as “miscellaneous” as they did not fit clearly into any of the themes. The coders averaged 96 % agreement across themes (range 92–100 % agreement). All kappas were in the acceptable range or higher (miscellaneous advantages kappa=0.62, miscellaneous concerns kappa=0.65, kappas for other themes range 0.80–1.0). Across themes, the average kappa was 0.85.

DISCUSSION

We found that the majority of women surveyed would be interested in a Twitter-delivered weight loss intervention: 81 % of the sample, 91 % of women with obesity, and 95 % of women with obesity who were currently trying to lose weight. These results support the acceptability of a Twitter-delivered weight loss intervention in women of childbearing age. This delivery mode may be particularly appropriate for mothers, given the barriers to in-person interventions [32]. Indeed, 100 % of women with multiple children in our sample were at least somewhat interested in a Twitter-delivered weight loss program (compared to 70 % of women with one child and 79 % of women with no children). A recent systematic review of weight management interventions targeting women aged 18–35 years concluded that “high-quality randomized controlled trials evaluating interventions that are tailored to the unique needs of young women, and that can be disseminated broadly, are urgently needed to address the unmet needs of this high-risk group.” [33] One possible approach to addressing this critical research need is by reaching and intervening on obesity among women of childbearing age via Twitter. Online social networking in general is a novel, understudied weight loss tool [18], with great potential for impacting the obesity epidemic. Two recent systematic reviews indicated that online social networks have been primarily used as an adjunct to in-person or web-based weight loss interventions, rather than as the primary treatment modality [18, 19]. We recently conducted a series of pilot studies that demonstrated that delivering a weight loss intervention via a private Twitter group is feasible and acceptable [34]. Our results suggest that women of childbearing age are interested in a weight loss program delivered entirely via Twitter.

While the majority of women reported at least moderate interest in all program components proposed, women expressed greater interest in some components than others. The two proposed program components with the lowest proportion of women reporting that they were at least somewhat interested were watching videos of healthy cooking demonstration

Table 4 | Perceived advantages and concerns about a Twitter-delivered weight loss intervention reported by women of childbearing age who use Twitter

Themes	Number (%)	Illustrative examples
Advantages (<i>N</i> = 37)		
Support/accountability	19 (51 %)	<p>"I can get answers instantly from health behavior coaches. I can also interact immediately with other women trying to lose weight. If other participants ask questions that I may not have thought of to the coaches, then I can see the answers."</p> <p>"Accountability and support"</p> <p>"the ability to connect with other women who are losing weight"</p>
Convenience	14 (38 %)	<p>"Convenience, I can access twitter anywhere and whenever my schedule allows. Versus an in-person meeting, I can't always commit to the same time/day every week."</p> <p>"I'm already on Twitter a lot as it is—one less program to try to use and incorporate into my daily day..."</p> <p>"Practical: I have my mobile phone always in my pocket."</p>
Privacy/lack of judgment	11 (30 %)	<p>"It's easier to talk about weight problems in a private group on social media."</p> <p>"colleagues wouldn't see it"</p> <p>"I am about 100 lbs overweight. I hate admitting that to my peers. I would love the format of having support, but I don't want to talk about my weight with any of them."</p>
Concerns (<i>N</i> = 37)		
Low support/accountability	10 (27 %)	<p>"The fact that I may not feel accountable to a group online vs one I have to physically report to"</p> <p>"Easy to not be accountable on twitter as 'virtual'."</p> <p>"Accountability. If the group isn't very active I may feel abandoned or lose interest."</p>
Technology concerns	10 (27 %)	<p>"Manageability. How does a private Twitter group work? I don't mind Tweeting as myself and making my results public. Plus, I don't want to manage another account."</p> <p>"Tweet overload"</p>
Lack of privacy	8 (22 %)	<p>"Still concerned about privacy—nothing is really 'private' online in today's age. Worried about someone hacking the account."</p> <p>"I am not very comfortable with sharing personal info online."</p> <p>"Who owns the data"</p>
Not engaging	6 (16 %)	<p>"My concern is how engaging could it possibly be?"</p> <p>"Will lose interest"</p>
Lack of efficacy	3 (8 %)	<p>"I won't complete my goal"</p> <p>"I'm worried it'll be a waste of time and I won't have benefited at all."</p>

and scheduled chats with a coach and other women trying to lose weight. Given the asynchronous nature of Twitter, scheduled chats might be of less interest than unscheduled engagement that comprises the majority of Twitter interactions. We found that a greater proportion of women were interested in reading about other women's progress via their tweets (83 %) than were interested in tweeting about their own progress (71 %). Despite evidence that engagement is strongly related to outcomes [35–40], waning use is common in web-based behavioral interventions [41]. More frequent engagement in an online social network for weight loss is associated with better outcomes [22]. Research is needed to devise innovative strategies for engaging participants. Future studies could include asking women to evaluate how engaging they would find specific posts or articles, and also examining which types of posts netted the most engagement. In our previous study of a Twitter-delivered weight loss intervention, participants reported that one of the biggest barriers to engaging was not being sure what to post [34], suggesting that providing participants with guidance on what to post may be one avenue for enhancing engagement. Research is needed to understand how to increase engagement in behavioral interventions delivered via online social networks, including how to encourage visible interactions from participants who prefer to lurk (i.e., read content without visibly engaging) [42].

This study adds to what is known about women's perceptions of the strengths and challenges of online resources for weight loss. Program advantages reported included convenience, support/accountability, and privacy/lack of feeling judged, similar to social support themes reported by users of an online weight loss community [43]. Women spoke to the convenience of a weight loss intervention delivered with Twitter including Twitter already being a part of their daily interactions (53 % reported accessing Twitter multiple times per day and another 17 % access Twitter once a day) and also the "whenever/wherever" ease of access. These advantages of delivering evidence-based weight loss strategies entirely via Twitter may overcome challenges with in-person attendance, and can be leveraged to enhance engagement. In contrast to Facebook, which many adults use to keep in touch with family and in-person friends [44], more adults use Twitter to connect with strangers who share common interests [45, 46]. This plus the ability to create an anonymous account compose features that correspond to women's perceived strengths of privacy and support/accountability. Indeed, our previous research found that adults who tweet about weight loss feel support from their followers, and that many reported greater support and less judgment from their Twitter network than their in-person friends and family [45]. Especially for women whose in-

person social networks may not be supportive of weight loss, Twitter offers the opportunity to create a supportive network.

Some women expressed concerns about a lack of privacy, low support/accountability, low engagement, lack of efficacy, and technology. Engagement and creating group cohesion in online behavioral interventions is an ongoing area of inquiry. Many of the technology-related and privacy concerns were either hesitation to create a second Twitter account, or concerns that may reflect a poor understanding of the nature and process of interacting within a private Twitter network. Some privacy concerns, such as ownership of the data and use of anonymous accounts with pseudonyms and avatars must be clearly communicated to participants during the recruitment and consent process to alleviate the majority of these concerns. Subsequent development of a Twitter-delivered weight loss program should capitalize on perceived program advantages and proactively address women's concerns about this mode of intervention delivery.

This study also provides insight into the potential of Twitter for recruitment of women interested in losing weight. We were able to recruit women via Twitter with less effort and staff time than more traditional, in-person recruitment methods. As others have found [47], online social networks such as Twitter may be an effective strategy for recruiting women of childbearing age into research strategies. Three of the authors tweeted recruitment messages from our Twitter accounts, which focus on research and health promotion, with an emphasis on weight management and fitness. Thus, we suspect that our sample may be more interested in topics related to weight management and health research than the larger population of US women of childbearing age. While the 72 unique Twitter accounts that retweeted our recruitment messages disseminated this message further than our own followers, we did not reach more than a degree or two into the larger Twitter network. Research is needed to develop and validate methods for systematically penetrating the Twitter network to recruit women of childbearing age and other populations who may be in need of and interested in obesity programming but are not currently following health researchers offering such interventions.

This study has additional strengths and limitations. Our sample size was modest, limiting power for statistical comparisons. Our sample was predominantly non-Hispanic white (79 %) and highly educated (48 % had a graduate degree), and, thus, our results may not be generalizable to women of other races/ethnicities or less educated women. Only a third of our sample had children in her household; future work could explore interest and perceived strengths and concerns specifically among mothers. We did not directly ask women whether they desired to lose weight; however, 83 % of participants reported that they were currently trying to lose weight, indicating that at least this majority desired weight loss. As 70 % of the overweight or obese women in the sample who were not

currently attempting weight loss reported that they were at least somewhat interested in a Twitter-delivered weight loss intervention, our study provides insights into interest among women who would benefit from weight loss (i.e., overweight and obese women), regardless of current motivation to lose weight. We did not confirm that respondents' IP addresses were unique, thus leaving open the possibility that women completed the survey more than once [48]. However, participants received no compensation for participation, thus reducing the likelihood of duplicate responses. We calculated the recruitment yield as the number of respondents and the number of completed surveys divided the potential reach. We estimated 2.3 completed surveys per recruitment tweet, and 1.8 completed surveys per 10,000 Twitter accounts potentially reached. These rates are similar to rates in our previous work [45] and others' [49]. Given the small effort required to send recruitment tweets, this method of recruitment is time- and cost-efficient. However, there are a few things to consider when interpreting these results. Our calculation of maximum potential reach did not account for network density, i.e., overlap in followers between our accounts and the Twitter accounts that retweeted our recruitment messages. Our estimates of reach are the number of Twitter accounts potentially reached—not necessarily the number of accounts of women of childbearing age. Additionally, many Twitter users, especially those who follow many accounts, may use lists to view tweets from only a subset of the accounts they are following, and timing and frequency of logins likely caused many “exposed” accounts to miss the recruitment messages. We collected data on the number of followers a few weeks after recruitment, yet the number of followers tends to increase with time. Thus, our method of estimating reach and recruitment yield overestimates our reach, but underestimates the rate of survey completion per accounts reached.

Our findings have implications for the design of a Twitter-delivered weight loss intervention for women of childbearing age. Our study documents a high level of interest in Twitter-based weight loss interventions among women of childbearing age who actively use this online social network. Subsequent intervention development should build on perceived program advantages, conform to women's expressed preferences for program components, and proactively address concerns reported by women in this target population. Given the importance of weight management during the childbearing years for both women's and children's long-term health [5–10], efficacious and available weight management programming is greatly needed [11, 12], and the development of such programming has the potential to significantly impact the important public health issue of obesity.

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