

Weight loss social support in 140 characters or less: use of an online social network in a remotely delivered weight loss intervention

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ABSTRACT

Little is known about how online social networking can help enhance weight loss. To examine the types of online social support utilized in a behavioral weight loss intervention and relationship of posting and weight loss. A sub-analysis of the content and number of posts to Twitter among participants ($n=47$) randomized to a mobile, social network arm as part of a 6-month trial among overweight adults, examining weight loss, use of Twitter, and type of social support (informational, tangible assistance, esteem, network, and emotional support). A number of Twitter posts were related to % weight loss at 6 months ($p < 0.001$). Initial reported weight loss predicted engagement with Twitter ($p < 0.01$) but prior Twitter use or initial Twitter engagement did not. Most Twitter posts (total posts $n=2,630$) were informational support ($n=1,981$; 75 %), with the predominant subtype of Teaching ($n=1,632$; 62 %), mainly in the form of a status update ($n=1,319$). Engagement with Twitter was related to weight loss and participants mainly used Twitter to provide Information support to one another through status updates.

KEYWORDS

Social support, Weight loss, Social media, eHealth, Mobile health

INTRODUCTION

There has been a wealth of research examining the relationship between social interactions and social support with health outcomes. People who are socially isolated have been shown to have poorer health outcomes and higher rates of mortality than those who are more socially engaged with others and have sustaining social relationships [1]. Several studies have demonstrated a relationship between social support and improved health outcomes and health-related behaviors, including smoking cessation [2], cardiovascular disease prevention [3], diabetes treatment [4], and depression [5]. Social support has also been shown to be a potentially beneficial component of a weight loss program [6, 7]. Providing a way for participants to receive support from one another in a weight loss trial may not only help to improve weight loss but also reduces the time burden on weight loss counselors,

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Implications

Practice: As part of a behavior weight loss program, engagement in a social network, such as Twitter, mainly provides informational social support, which may assist with weight loss.

Policy: Before investing in making extensive online social networks as part of remotely delivered weight loss programs, resources should be devoted to exploring who benefits from these social networks and how to engage people more effectively.

Research: Research is needed to explore how to engage users in online social networks, or provide them with alternate methods of support, during remotely delivered behavioral weight loss interventions.

who instead rely on fellow study participants to provide much of the interaction that takes place in a behavioral weight loss study [8].

Increasing social support can be an effective way to enhance weight loss outcomes in both traditionally delivered behavioral interventions [9] as well as those delivered online [10]. The internet has been used effectively to deliver behavioral weight loss interventions [11–13]. Several Internet-based weight loss studies have tried to enhance social support by providing participants with access to online discussion forums or chat rooms [11, 14, 15]. Utilization of these features on weight loss websites is often low with one study reporting only 7.8 % of users of an internet weight loss program using a social support message board [16]. Another study utilizing a website for weight loss found that the social support sections of the website were the least utilized and received the lowest ratings of satisfaction from participants [14].

Structural social support, or the availability of social support [8], can be categorized into several forms such as informational, tangible, esteem, network, and emotional support [17]. There are sub-types of each type of major source of support. For example, informational support can be provided

ed in the forms of providing suggestions or advice (suggestion/advice), referring a person to resources (referral), redefining the situation (situation appraisal), or providing new facts or skills (teaching) [17]. Tangible support often provides something of use to a person, like lending something (loan), performing a task to address a stressor (direct task), taking on a responsibility to free up another person's time (indirect task), joining the participant in an activity to provide support (active participation), or showing willingness to perform tasks for someone (willingness) [17]. Esteem support seeks to make someone feel better by complimenting (complement), validating feelings (validation), or relieving blame of an individual (relief of blame) [17]. Network support occurs when someone offers access to new friends (access), shows willingness to be with the person (presence), or highlights the availability of others within the social network (companions) [17]. Lastly, emotional support addresses a person's emotional state through the provision of encouragement (encouragement), prayer (prayer), listening (listening), understanding (understanding/empathy), sympathy (sympathy), confidentiality (confidentiality), physical affection (physical affection), and close relationships (relationship) [17].

Most studies that have examined social support related to remotely delivered weight loss interventions have focused on the utilization of discussion boards [14, 16, 18]. Few studies have examined the use of Web 2.0 tools—which can allow for more interactivity and user-generated content [19]—as a way to facilitate group support and communication among weight loss study participants. Social networking sites, such as Facebook and Twitter, are widely used with 65 % of adult Internet users reporting use of some type of social networking site [20]. Twitter is an online social networking site that allows participants to post messages (140 character limit per post) and follow other people/organizations on Twitter and to read and respond to their posts. Since these sites are already an integrated part of many people's lives, using them to provide social support during a behavioral weight loss intervention has the potential to increase use as compared to accessing a separate discussion board or chat room. Online communication among participants was delivered entirely through Twitter. This study investigated what types of social support were utilized, predictors of Twitter engagement, and the relationship between Twitter engagement and weight loss.

METHODS

Study population and measures

Overweight and obese men and women (BMI 25–45 kg/m², 18–60 years old) were recruited through television advertisements and LISTSERVS in a metropolitan area for a 6-month randomized weight loss trial. Participants were excluded if they were a smoker, had an unstable medical or mental status, history of myocardial infarction or stroke, or

uncontrolled thyroid condition, were unable to attend assessments or increase physical activity, were in treatment for alcohol or drug dependency, had an eating disorder, were currently participating in a weight loss program, or were pregnant, breastfeeding, or planning on becoming pregnant within the next 6 months. All participants were required to own one of four types of internet-capable mobile devices: iPhone, iPod Touch, BlackBerry, or an Android-based phone. More detailed information on the study methods can be found elsewhere [21]. A University Institutional Review Board approved the study and all the participants gave written informed consent. Participants received a \$20 incentive payment for completion of all 3-month assessment activities and an additional \$20 for completion of the 6-month assessment activities.

Intervention and control conditions

Participants were randomly assigned to either the podcast-only (Podcast) or podcast plus enhanced mobile media intervention (Podcast + mobile) groups. Both groups received two podcasts per week for 3 months (15 min each) and two mini-podcasts per week for months 3–6 (5 min each). The podcasts were designed using social cognitive theory [22] and contained the following sections: a review of the previous episode's goal, content on nutrition and exercise (how to calculate caloric needs for weight loss, amount of exercise to aim for each week, ways to self-monitor diet and exercise, etc.), an audio blog of a man and a woman attempting weight loss, an audio soap opera, and a goal-setting activity. More details on the content and design of the podcasts can be found elsewhere [23]. In addition to the podcasts, the Podcast + mobile group was also instructed to download a diet and physical activity monitoring application (app) and a social networking site's (Twitter™) app to their mobile device. Participants could use their existing Twitter account or create a user account and were told to log on daily to read and post messages so they would receive the content delivered by a weight loss counselor and fellow participants. A study weight loss counselor posted two messages a day to Twitter in order to reinforce messages from the podcasts and stimulate discussion. The study coordinator did not participate in discussions initiated by participants, allowing for the potential for this type of intervention to be fully automated.

Outcome measures: weight, twitter outcomes, and social support

Main outcome data, such as body weight, was collected at baseline, 3 months, and 6 months. Weight was measured in light street clothes using a calibrated Tanita BWB-800 digital scale (Tanita, Arlington Heights, IL) accurate to 0.1 kg. Participants completed a weekly questionnaire, which assessed the number of podcasts they had listened to and use of Twitter (Podcast + mobile group). Each week, posts to Twitter were saved for analysis.

Number of posts by participant were calculated each week and tallied over the course of the study. Participants reported each week by questionnaire if they posted to Twitter, only read Twitter, did both, or did neither. The present study sought to categorize participants as active users (Active), users who did not regularly post to Twitter but read the posts (Readers), and those who did neither (Neither). To capture the most objective data, a number of actual posts to Twitter were used to categorize Active posters, regardless of how participants reported their activities on the weekly surveys. Those who posted to Twitter at least once per week were categorized as active. The remaining participants (those who did not post ≥ 1 time per week) were then categorized based on the weekly survey reporting. Participants who did not post at least once per week but reported reading Twitter at least $\geq 50\%$ of the time were categorized as Readers. The remaining participants were categorized as neither (neither regularly posting to Twitter nor regularly reading the posts).

The text of the Twitter posts was coded by three separate raters for type of social support. While many similar social support studies have used two raters [18], the addition of a third rater in the present study allowed an additional way to reach consensus (e.g., two out of the raters needed to agree for a code to be assigned). Coders rated each post on six types of social support based on Cutrona and Suhr's research [17], which included informational, tangible assistance, esteem support, network support, and emotional support. Each type was also coded for several different sub-types (as described in the "Introduction"). An additional code for "request for support" was also included. If two of the three raters agreed on the type of support, that type of support was used to categorize the post. If none of the raters recorded the same type of social support code then agreement was reached by consensus. Therefore, each post was coded as only one type of social support. The reliability (Fleiss' kappa (95% CI)) among the three raters of type of social support was 0.58 (0.55, 0.60), indicating moderate agreement [24]. At least two out of the three raters agreed on the type of social support 94% of the time. All three raters agreed on 60% of the posts ($n=1,578$) and two raters agreed on 34% of the posts ($n=894$). Only 6% of the posts ($n=158$) had no agreement among the three raters and required consensus.

Statistical analyses

All data were collected and analyzed between 2011 and 2012. There were three primary aims of the statistical analyses as part of this paper. The first aim was to examine Twitter engagement. Wilcoxon signed rank test was used to examine differences in number of posts to Twitter by participants during months 0–3 and 3–6 and reported as median and interquartile range. Chi-square test of independence was used to assess differences between those who

reported logging on to Twitter at least five times per week during months 0–3 and 3–6. Linear regression analysis was used to examine predictors of Twitter (such as prior use of Twitter). The second aim was to examine the relationship between Twitter engagement and weight loss. Weight loss analyses were conducted using intent-to-treat by baseline observation carried forward. Linear regression analysis was used to examine predictors of weight loss (such as engagement with Twitter). The Kruskal–Wallis test was used to examine differences in age by tertile of Twitter posts. The final aim was to examine the types of social support provided on Twitter by participants. For examining the reliability of the ratings of social support among the three raters, an intraclass correlation coefficient (ICC) was calculated using a two-way mixed model with a 95% confidence interval (CI). All analyses were conducted using SPSS 19.0 for Windows software with a p value of 0.05 used to indicate statistically significant differences (SPSS for Windows, 19.0.0 2010. Chicago: SPSS Inc.).

RESULTS

For the main trial, 96 overweight adults were recruited to participate in a 6-month study. There were no differences in percent weight loss between groups at either 3 months ($-2.6 \pm 3.8\%$ Podcast vs. $-2.6 \pm 3.5\%$ Podcast+mobile; $p > 0.05$ between groups) or 6 months ($-2.7 \pm 5.1\%$ Podcast vs. $-2.7 \pm 5.6\%$ Podcast + mobile; $p > 0.05$ between groups). Additional outcomes of the main trial are presented elsewhere [21]. The goal of this present analysis was to examine the use of Twitter, the relationship between Twitter engagement and weight loss, and the types of social support provided. Because the Podcast-only group did not use Twitter, the present analysis only examined the interaction within the Podcast + mobile group ($n=47$) as this group was encouraged to use Twitter to receive mobile prompts about weight loss, share ideas, and provide social support to other participants. Demographic information for the Podcast + mobile group is presented in Table 1. The Podcast + mobile group had 42 study completers at both three and 6 months.

Twitter engagement

There were a total of 2,630 posts to Twitter over the 6-month study. There was a great deal of variability among participant use of Twitter with a range of 0–385 total posts per participant. Posts to Twitter and type of Twitter involvement (active, reader, or neither) is presented in Table 2. Posts and responses to Twitter posts were significantly lower during the 3–6-month time frame as compared to the 0–3-month time frame. From 0 to 3 months, the majority of participants were active ($n=30$; 64%). From months 3–6, the majority was neither active nor

Table 1 | Baseline demographic data for Podcast + mobile group participants

	Podcast + mobile group ^a
<i>n</i>	47
Age (years) (mean ± SD)	42.6 (± 10.7)
Sex [<i>N</i> (%)]	
Male	11 (23)
Female	36 (77)
Race, ethnicity [<i>N</i> (%)]	
Non-white	12 (25)
White	35 (75)
Marital status [<i>N</i> (%)]	
Not married	16 (34)
Married	31 (66)
Education [<i>N</i> (%)]	
College or less	24 (51)
Graduate degree	23 (49)
Body mass index (kg/m ²)	32.9 (±4.8)
Number of participants who were members of Twitter at baseline [<i>N</i> (%)]	16 (34)

^a Data are mean (±SD) or *n* (%) unless otherwise indicated

consistently reading ($n=26$; $n=55\%$). The frequency of reported log-ons to Twitter also significantly decreased over time with 51 % ($n=20$) reporting logging on at least five times/week during the 0–3-month period as compared to just 33 % ($n=13$) reporting logging on at that frequency from 3 to 6 months ($p<0.001$).

Predictors of Twitter engagement

Adjusting for age, gender, and ethnicity, analyses explored the effect of being a Twitter user prior to study entry ($n=16$), actively engaging with Twitter within the first 3 weeks of the study ($n=13$, regularly posting and reading messages), and initial weight loss (self-reported weight loss on weekly surveys within the first 3 weeks of the study) had on overall Twitter engagement (total number of posts over the 6-month study). Neither race, gender, initial engagement with Twitter, nor baseline Twitter use (p 's > 0.05) predicted use of Twitter over the 6-month

study. Initial reported weight loss on the weekly surveys, however, was predictive of engagement with Twitter ($B=-18.9$, $t(31)=-2.9$, $p<0.01$) as was age ($B=-3.4$, $t(31)=-2.5$, $p=0.02$). Examining age by tertile of Twitter usage, there was a significant difference ($p=0.03$) in median age among low (median 35 (31, 43) years), medium (median 48.5 (44.3, 53.8) years), and high (median 41 (34.4, 52) years) Twitter posters, with those who posted frequently or rarely being younger than those who posted semi-regularly.

Predictors of weight loss

Next, the relationship between Twitter engagement and weight loss was explored. Adjusting for age, gender, and ethnicity, posts to Twitter significantly predicted % weight loss at 6 months, such that every ten posts to Twitter corresponded with approximately -0.5% weight loss ($B=-0.48$, $t(46)=-4.9$, $p<0.001$).

Table 2 | Posts to Twitter and types/levels of Twitter activity comparing months 0–3 and 3–6 of a 6-month weight loss study

Total participants ($n=47$)	Months 0–3	Months 3–6
Posts to Twitter (total posts=2,630)		
Median (interquartile range) number of posts to Twitter per participant	15 (5, 28)	1 (0, 12) ^a
Median (interquartile range) number of responses to Twitter posts per participant	4 (0, 13)	0 (0, 4) ^b
Categories of participation on Twitter		
Number (%) of active participants on Twitter (≥ 1 post/week)	30 (64 %)	13 (28 %)
Number (%) of reader participants on Twitter (< 1 post/week and reported reading Twitter messages $\geq 50\%$ of the time)	6 (13 %)	8 (17 %)
Number (%) of participants who were neither active nor readers	11 (23 %)	26 (55 %)
Frequency of reported log-ons		
Number (%) reporting logging on to Twitter at least 5 times/week over the examined 3-month period	20 (51 %)	13 (33 %) ^a

^a Months 3–6 is significantly different from months 0 to 3, $p<0.001$

^b Months 3–6 is significantly different from months 0 to 3, $p=0.001$

Twitter and social support

The types of support offered during the study, number of posts by category, and examples of each type are presented in Table 3. The majority of posts were categorized as Informational ($n=1,981$; 75 %), with most coming from subtype of teaching (providing new facts or skills) ($n=1,632$; 62 %). One of the most frequent types of teaching posts was a status update about the participant that was not in response to anything else posted but was a statement about what the participant did or planned to do (providing new facts, e.g., “I avoided eating a pastry this morning at a breakfast meeting! I did have a skim Mocha without whipped cream... not too bad”). Of the 1,632 posts categorized as teaching, 1,319 (81 % of teaching posts) could be further subcategorized as a status update. Other types of support that were common in the study were suggestions or advice (under informational support, 10 %), listening (under emotional support, 6.6 %), and compliments (under esteem support, 4.6 %). Tangible assistance was the least used form of social support with no examples of direct tasks, indirect tasks, or active participation observed. Only two social support categories saw increases from months 0–3 to 3–6. Posts categorized under the compliment sub-type of esteem support increased from 44 posts (3 % of total posts) at 0–3 months to 78 posts (7 % of total posts) during months 3–6 and posts categorized as the sub-type of Listening under emotional support increased from 70 (5 % of total posts during 0–3 months) to 103 (9 % of total posts during 3–6 months).

DISCUSSION

Engagement with social networks

The present study examined the role an online social networking site played with promoting weight loss and social support in a virtual health community [25] as part of a 6-month randomized clinical trial. Social networking and status update sites, such as Twitter, have seen a rapid rise in use over the past few years with 19 % of Internet users in 2009 reporting regular use of a status update site vs. 11 % in 2008 [26]. African Americans and Hispanics are more likely to be users of Twitter than whites [27] so Twitter also represents a way to deliver health-related messages to populations that may be difficult to reach.

In the present study, not everyone equally engaged with Twitter and active participation decreased over time. This is similar to other studies that employed electronic forms of message delivery, finding utilization of these sources of support declines over time [11, 15]. While prior Twitter use or initial Twitter engagement in this study did not predict overall Twitter use, initial reported weight loss was predictive. Other researchers have also found that initial weight loss is related to adherence and success within weight loss programs [28]. It is possible that Twitter produced a level of social comparison—such that participants who were successful with weight loss were active posters, leading

less successful participations to discontinue posting. Research has shown that viewing profiles of successful or attractive people within a social network can lead to feelings of inadequacy and greater feelings of negative body image [29]. There appeared to be a curvilinear relationship between Twitter usage and age with both high and low frequency posters being slightly younger than medium posters. While there was a wide range of ages in the study (range 18–60), the majority of participants (47 %) were 35–49 years old.

The present study also sought to capture participants who read Twitter posts but do not actively engage online (often termed “lurkers” [30]). The number of lurkers in the present study was small but was relatively constant over time. Other studies have found that lurkers can make up 46 % of online health communities [31] and are important to virtual communities in that they often discuss the topics read online with people outside the community [30].

Social networks and weight loss

The goal of the online social network was to allow participants to provide each other with social support interactions that are present in face-to-face delivery but adding the possibility of in-the-moment posts and responses. The literature surrounding the relationship of social support with weight loss has been mixed [32]. Some studies have found that increases in social support are related to weight loss [33] or improvements in weight loss-related behaviors [6, 34], while others have found no benefit of increasing social support for weight loss outcomes [35].

In the present study, after adjustment for potential confounders, Twitter use was found to predict weight loss. The direction of this relationship cannot be determined in that it is not clear if those who were successful at weight loss were motivated to post to Twitter or posting to Twitter provided a benefit to participants that assisted them in losing weight (e.g., social support, reinforcement of weight loss messages, sense of accountability). What is evident is that participation in the online social network was beneficial to some participants. This finding demonstrates the need for future studies to explore who benefits most from participating in online social networks and tailoring the method of social support delivery at the beginning of an intervention, perhaps giving participants a choice of support delivery methods.

Twitter and social support

This study also sought to assess the type of support delivered via Twitter within a mobile, weight loss program. The main type of support provided within this study was Informational. Studies examining social support provided via discussion boards have also found Informational to be a predominant source of support [18, 36]. There was an increase in posts providing compliments or demonstrating listening over the 6-month study. It is possible that as the

Table 3 | Type and frequency of social support used during a mobile weight loss intervention using Twitter

Type of support	Support subtype code	Subtype name	Total posts 0–6 months	Percentage of total posts, %	Example ^a
Informational	1A	Suggestion/advice	262	10.0	@PODStudy12 Got an insulated lunch bag? Sure helps w/healthy eating at work. Good lunch bags avail. at kitchen store at the mall.
	1B	Referral	82	3.1	@pod_32 if you scroll to bottom of daily food diary page, click RDJ field, then you can calculate your recommended daily goal
	1C	Situation appraisal	5	0.2	About healthy snacks, usually baby carrots or raw almonds no salt, the stone wheat crackers from Trader Joe's also satisfy crunchy need
	1D	Teaching	1,632	62.1	Buyer beware: I compared reduced fat & full fat feta (same brand) & the red fat had more calls! I got the fat free. I do love a Greek salad.
Tangible assistance	2A	Loan	0	0.0	
	2B	Direct Task	0	0.0	
	2C	Indirect Task	0	0.0	
	2D	Active Participation	0	0.0	
	2E	Willingness	7	0.3	@podmember sounds delicious! I just bought some vegan chick tenders from Bjs. Haven't tried them yet, but the picture looks good!! :)
Esteem support	3A	Compliment	122	4.6	@momof3 Good for you!!
	3B	Validation	48	1.8	@UNTR Same here! Start fresh next week!
	3C	Relief of Blame	1	<1	@JamiePod Just get back on the wagon!
Network support	4A	Access	4	<1	Hosting trivia tonight at XXXX restaurant from 8 to 10 pm. Please come out.
	4B	Presence	0	0.0	
Emotional support	4C	Companions	10	0.4	@Pod45 You seem to run a lot. What week/day of c25k are you on? I am modifying and repeating week 1/day 1 until I reach success?
	5A	Sympathy	15	0.6	@Podstudy35 Ouch, hope you have a speedy recovery!
Request for support	5B	Listening	173	6.6	@Podstudy3 I was just in New York too! I thought all the walking would be enough to offset the food, but I was sorely mistaken.
	5C	Understanding/empathy	13	0.5	@podstudy_rick I hear you on the weight plateau.
Totals	5D	Encouragement	62	2.4	@JanePod Don't feel bad, tomorrow is another day. Eat healthy and make sure to get some exercise!
	6	Request for support	194	7.4	Guys! Help I fell off the wagon! Too much free food! Bakalava and beer... :(feel bad.
Totals			2,630		

^a Twitter user names have been altered to protect participant identity

participants felt more comfortable with one another, those two types of support (which both represent a conversation with other participants versus posting a simple status update) began to emerge more. Future research should explore how the types of social support provided via online social networking sites during a weight loss intervention change over time.

Conclusions

There are several strengths to the present study. This weight loss study allowed for an in-depth examination of the interactions that took place among a group of people who were all actively receiving a behavioral weight loss program. The study was able to capture lurkers (who primarily read posts) by utilizing information from weekly surveys. And although researchers have used Twitter and other social networking sites to examine health trends and explore how people use these sites to discuss health-related questions and topics [37, 38], the present study is one of the first to examine the use of Twitter as part of a behavioral weight loss intervention. In addition, three separate raters coded the type of support presented in each post to Twitter. Some limitations of the study include a study population that was mostly white and female. Participants also knew their messages were being read by study personnel and that may have affected what they posted. And although there was a control group (podcast-only), there was not a group that received social support in another manner (such as face-to-face group meetings), which prevented a direct comparison between two types of social support delivery methods. Participants were also required to own their own mobile device, which may have resulted in a different population than would have occurred if mobile devices were provided to participants. Participants using their own mobile device may also be viewed as a strength in that participants were familiar with their own mobile phone and were not required to carry a study-provided phone plus their own device. This design also allowed for the delivery of the intervention across three different mobile platforms, increasing the generalizability.

In conclusion, this 6-month, remotely delivered weight loss study examined the role an online social networking site may play in helping to deliver information and increase social support. Participants in the present study mainly provided one another with Informational support—primarily in the form of providing status updates. Engagement with Twitter was associated with greater weight loss. Having a Twitter account prior to study entry or early engagement with Twitter was not predictive of Twitter use but early weight loss was. This suggests that there may be a need to provide participants with a variety of methods to access information and enhance engagement based on initial weight loss success. Additional studies should be conducted to find ways to provide social support for participants in remotely delivered weight loss programs in ways that are engaging, rewarding, and useful for a wide variety of participants.

This trial was registered on [ClinicalTrials.gov](https://clinicaltrials.gov).

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