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The role of group cohesion in a group-based behavioral weight loss intervention

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Abstract

Behavioral weight loss interventions are often delivered in groups; group cohesion may enhance program attendance and, thereby, weight loss. In this secondary analysis, our goals were to: 1a) assess whether group cohesion measured early in a behavioral weight loss intervention predicts program attendance and weight loss outcomes and, if so, 1b) explore whether attendance mediates the link between group cohesion and weight loss; 2) characterize the association between change in group cohesion and weight loss throughout the intervention. 504 Veterans initiated a 16-week, group-based behavioral weight loss program involving biweekly in-person group visits. In linear regression models, early group cohesion was unrelated to group attendance or weight loss. Although group cohesion significantly increased during the intervention, this change was not associated with weight loss. These findings are consistent with the limited literature; however, they are inconsistent with theoretical assertions and clinical observations of the influence of group factors on outcomes.

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The authors declare no conflicts of interest.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individual participants included in the study.

Keywords

group cohesion; social support; obesity; weight loss

Behavioral weight loss interventions have demonstrated efficacy in producing clinically significant weight loss (Foster et al., 2010). Group-based delivery of behavioral weight-loss interventions is more common and effective than individual-based delivery (Befort et al. 2010; Jovanovic et al., 2009; Paul-Ebhohimhen & Avenell, 2009; Renjilian et al., 2001). Participants in group-based behavioral weight loss programs often comment on the value of being a group member in promoting their weight loss success (Middleton et al., 2013). Anecdotally, interventionists often note the importance of the cohesiveness of a weight loss group for outcomes. Group cohesion is defined as "a dynamic process that is reflected in the tendency for a group to stick together and remain united in the pursuit of its instrumental objectives and/or for the satisfaction of member affective needs" (Carron et al., 1998). Group cohesion has been found to relate to better outcomes in multiple types of groups including group exercise programs and psychotherapy groups (Burke et al., 2008; Burlingame et al., 2011).

Why might group cohesion matter for weight loss? Many theorists split cohesion into two dimensions: task-focused integration (focused on group "task", i.e., weight loss) and social attraction to the group (focused on the social relationships within the group) (Carron et al., 1998). A high level of task-focused integration may promote more accountability and increase opportunities for learning by observing others within the group (Lorig & Holman, 2003). A high level of social attraction to the group may increase social support and promote normalizing challenges associated with weight loss (Milsom et al., 2011). Importantly, individuals in highly cohesive groups may show increased rates of intervention adherence, which can also promote improved outcomes (Middleton et al., 2013).

Group cohesion is rarely measured in group weight loss studies despite expert suggestions to do so (Milsom et al., 2011). Furthermore, there is minimal empirical support for the role of group cohesion on weight loss outcomes. One key exception was a 24-week group-based weight loss intervention for obesity evaluated in a randomized controlled trial with 125 women (Nackers et al., 2015). Nackers and colleagues measured multiple group-level factors related to cohesion, including group conflict, engagement, avoidance, social support, and group attraction, hypothesizing that these factors would relate to group attendance and weight loss outcomes.

Group conflict was negatively associated with attendance and weight loss, and attraction was related to better attendance. No other factors related to attendance or weight loss outcomes. Notably, all group-level variables were measured at the conclusion of the group intervention. Thus, we cannot make any conclusions about the temporal relationships between these variables. Measurement of group cohesion earlier in the study would allow an investigation of whether cohesion predicts subsequent attendance and weight loss. Additionally, group-level factors are dynamic (Carron et al., 1998); measurement at multiple time points would enable evaluation of change in these factors over time.

The objective of the current study was to address the limitations of Nackers and colleagues' (2015) study by measuring group cohesion at two time points during the intervention in order to better assess 1) temporal relationships between cohesion and outcomes and 2) the dynamic nature of cohesion. We sought to evaluate the role of early group cohesion in group attendance and weight loss outcomes in a group-based behavioral weight loss program. This program consisted of eight biweekly group sessions over 16 weeks. Group cohesion was measured early (at session 3) and late (session 8) to capture changes that might occur across the intervention period. Weight was measured at session 1 and about 2 weeks after session 8. Our key questions were as follows: 1a) does early (session 3) group cohesion predict program attendance and weight loss outcomes? 1b) If so, does attendance mediate the link between early group cohesion and weight loss? We hypothesized that early cohesion would predict both attendance and weight loss and that attendance would partially mediate the link between cohesion and weight loss. 2) We also asked whether group cohesion changes from session 3 to 8, and, if so, whether change in group cohesion relates to weight loss. We predicted that group cohesion would increase over the course of the intervention and that the increase would be associated with greater weight loss.

Methods

Study Design and Setting

This study is a secondary analysis of a two-arm, parallel randomized trial that tested the efficacy of a weight loss maintenance intervention. All participants received active weight loss initiation counseling for 16 weeks, after which participants who lost at least 4 kg (8.8 lb) during the 16 weeks were randomized to receive the MAINTAIN intervention or usual care for 56 weeks. These analyses focus exclusively on the initial 16-week, group-based weight loss intervention.

Participants were enrolled from the Durham Veterans Affairs Medical Center (VAMC) and the Raleigh community-based outpatient clinic. The study protocol was approved by the Durham VAMC Institutional Review Board (IRB) and Research and Development committees. Because group meetings took place on the Duke University campus due to space constraints at the Durham VAMC, the protocol was also approved by the Duke University Medical Center IRB.

Screening and Recruitment

Recruitment was conducted using advertisements posted at the Durham VAMC, referrals by health care personnel via a consult option in the electronic medical record (EMR), and recruitment letters sent to potentially eligible participants identified by a data pull from the EMR.Details of eligibility criteria have been reported (Voils et al., 2017). Briefly, patients had to be aged 18 to 75 years, have a body mass index (BMI) of 30 kg/m^2 or greater, have a primary care provider, agree to attend visits, and have access to a telephone and reliable transportation.

Exclusion criteria included unstable physical health; history of weight loss surgery; active dementia, severe psychiatric illness, or substance abuse; weight loss of 10 lb. or more in the

previous 3 months; current enrollment in a lifestyle program; current weight loss medication; pregnancy or plans to become pregnant in the next 6 months; breastfeeding or lack of birth control if premenopausal; pacemaker or defibrillator (because of the use of a bioelectronics impedance scale); emotional problems that would impede intervention adherence or interacting in a group environment; and inability to stand for measurements. Participants were screened by study staff members first by telephone, then at an in-person screening visit.

Weight Loss Initiation Intervention

The intervention was delivered in 6 cohorts. Each cohort comprised five to six groups of 10 – 20 participants each, yielding 33 total groups. Each group was led by one of two study interventionists, both registered dieticians, who had been trained in the protocol. Groups met every 2 weeks (8 sessions total over 16 weeks). Participants who missed their regularly scheduled meeting were allowed to attend the meeting of a different group the same week.Participants were weighed individually upon arrival at every session and were verbally reinforced by study staff and investigators for any amount of weight loss that they achieved between meetings. Participants were prescribed a low fat/low calorie diet fitting national dietary recommendations (Voils et al., 2014; Voils et al., 2017). Sessions included instructions on behavioral goal setting and a didactic education on calorie and fat restriction in addition to other behavioral techniques such as mindfulness.

Measures

Study measurements were performed or collected by study staff, who were not blinded because no participant was yet randomized. Participants who wished to discontinue the intervention were asked to return for the 16-week assessment visit. Participants received $20 for the follow-up visit.

Self-reported demographic information was recorded at the screening visit, which occurred up to eight weeks prior to the first group session. Body weight was assessed during the screening visit, each of the eight biweekly group meetings, and the individual follow-up visit that occurred within 2 weeks of the last scheduled group meeting. Weight was measured at approximately the same time of day, on the same standardized digital scale, with participants wearing light clothing and shoes removed. Attendance at each group visit was recorded, and the total number of sessions (of 8) was calculated for each participant.

Group cohesion was measured during group sessions 3 and 8 using the Group Cohesion Scale-Revised (GCS-R) (Treadwell et al., 2001). We administered it during the third session so that participants would have some familiarity with others in the group, and during the last session so that changes could be examined; this is consistent with the way the measure has been administered previously (Treadwell et al., 2001). The 25-item measure assesses group cohesion in five proposed dimensions: interaction and communication among group members (including domination and subordination), decision-making, vulnerability among group members, and consistency between group and individual goals (e.g., “There are positive relationships among the group members” and “Group members usually feel free to

share information") [54]. The response scale ranged from 1 (*strongly disagree*) to 4 (*strongly agree*).

Analyses

Although GCS-R subscales have been reported, we could not identify a published principal components or factor analysis to support the hypothesized structural validity of the scale. From the published literature, we determined that the goal of the scale is to create one or more index variables from a larger set of measured variables, which is consistent with the goals of principal components analysis (PCA). Accordingly, we conducted PCA on group cohesion data from session 3 to identify the optimal number of components and choice of measured variables for each component. Initially, components with Eigenvalues >1 were retained for further examination. We evaluated several solutions, taking into account not only Eigenvalues, but also number of items per component and methods artifacts such the clustering of reverse-scored items. Items included in the final solution were averaged to create a total group cohesion score that could range from 1 to 4, with higher numbers indicating greater cohesion.

Although 504 people attended session 1 and thus provided a baseline weight, analyses reported herein were restricted to the subset of 324 participants who provided a group cohesion score at session 3. Follow-up weight at 16 weeks was missing for 80 individuals and group cohesion at session 8 was missing for 133 individuals; therefore, we multiply imputed weight and the group cohesion scale for these individuals. Multiple imputation was conducted via PROC MI in SAS (v 9.4, Cary, NC) with baseline demographics (e.g., age, education, marital status, race, employment) and all weight and group cohesion measurements included in the imputation model. Twenty imputations were created, and analytical results across the imputations were combined with PROC MIANALYZE. Weight loss over the 16-week period was calculated as the difference between baseline weight and the final weight, so positive values indicate greater weight loss.

To address research question 1a, whether early group cohesion predicts program attendance and weight loss outcomes, we estimated two different linear regression models. In the first model, attendance was regressed on group cohesion at session 3. Note that because attendance is a count variable, we also considered a Poisson regression. Results were similar between the linear and Poisson regression, so for ease of interpretation, we chose to only present results from the linear regression. In the second model, weight loss during the 16-week intervention period was regressed on group cohesion at session 3. If the regression for 1a showed links between group cohesion, group attendance, and weight loss, we planned a mediation regression analysis to address research question 1b. To address research question 2, whether group cohesion changes during the intervention period, we tested the difference in mean group cohesion from session 3 to session 8 via a random-effects model with a group-level random effect to account for clustering groups. We then used a linear mixed-effects model to examine whether change in group cohesion was associated with weight loss, with a group-level random effect. Analyses were conducted in SAS (v 9.4, Cary, NC). A significance level of $p \leq .05$ was used for all analyses.

Results

Details of the CONSORT flow diagram have been reported (Voils et al., 2017). The 324 participants included in these analyses were 60.5 (SD=9.1) years old on average; 77.8% were male, 45.4% were White, and 46.0% were Black.

The first PCA included all items on the GCS-R and revealed six components with Eigenvalues >1. The first component accounted for the largest proportion of variance (27%; Eigenvalue 6.82), followed by a precipitous drop for the second component (variance 12%, Eigenvalue 2.92) and leveling of subsequent components (variance .04% to .05%, Eigenvalues.05 to 1.35). Three of these six components had positively scored items, and three had reverse-scored items (a methods artifact). We ran a second PCA that excluded the reverse-scored items (items 5, 9, 11, 15, 16, 18, 22, 24, 25), which yielded three components with Eigenvalues >1. As with the first solution, the first component accounted for the largest proportion of variance (42% of variance, Eigenvalue 6.67), followed by components 2 (9% variance, Eigenvalue 1.47) and 3 (6%, Eigenvalue 1.03). Only one item loaded on each of the second and third components. These two items were removed (items 20 and 21), and the resulting PCA yielded two components. This yielded a two-component solution in which the first component accounted for the greatest proportion of variance (variance 46%, Eigenvalue 6.48). Although the second component had an Eigenvalue >1 (variance 9%, Eigenvalue 1.25), all items loaded on the first component (range 0.58 to 0.75). Based on this solution, we created a total score that reflected the average of all 14 positively scored items.

Descriptive statistics for group cohesion, attendance, and weight are provided in Table 1.The mean number of participants attending the group decreased over time: Session 1 mean group size = 15.27, SD = 4.89; Session 3 mean group size = 10.85, SD = 4.14; Session 8 mean group size = 7.63, SD = 3.38. However, there does not appear to be a link between group size and mean group cohesion: When stratified by quartiles of group size, mean group cohesion at session 3 was 3.13 (SD = 0.53) for quartile 1; 3.23 (SD = 0.44) for quartile 2; 3.14 (SD = 0.47) for quartile 3; and 3.10 (SD = 0.45) for quartile 4. Mean group cohesion at session 8 was 3.34 (SD = 0.44) for quartile 1; 3.31 (SD = 0.43) for quartile 2; 3.38 (SD = 0.46) for quartile 3; and 3.25 (SD = 0.44) for quartile 4. The group cohesion measure produced reliable scores at session 3 (alpha = 0.91) and session 8 (alpha = 0.88).

For research questions 1a and 1b, group attendance was positively associated with weight loss, estimate = 1.9 (95% CI: (1.2, 2.5); $p < .001$). Group cohesion at session 3 was not significantly associated with attendance, estimate = −0.28 (95% CI: −0.67, 0.11), $p = 0.16$, or weight loss, estimate = −0.58 (95% CI: −2.85, 1.69), $p = 0.62$. For research question 2, mean group cohesion increased from 3.16 at session 3 to 3.35 at session 8, mean difference = 0.19 (95% CI: 0.13, 0.26); $p < .0001$; however, change in cohesion was not significantly associated with weight loss, estimate = 1.33 (95%CI: −1.89, 4.54), $p = .42$.

Discussion

Efficacious weight loss interventions frequently are delivered in groups to reduce cost and capitalize on the presumed benefit of interacting with similar others (Paul-Ebhohimhen &

Avenell, 2009). We explored relationships between group cohesion and attendance and weight loss during a 16-week weight loss program. Consistent with prior research on dose-response relationships, group attendance was associated with weight loss (Moroshko et al., 2011; Yancy et al., 2015). Contrary to our hypotheses, however, neither early group cohesion nor increased group cohesion over time was associated with group attendance or weight loss.

Our findings are consistent with a study by Nackers and colleagues indicating that positive group characteristics (e.g., group cohesion, engagement, social support) are unrelated to weight loss (Nackers et al., 2015). Although the current study did not assess negative group interactions, findings from Nackers' study and ours raise the possibility that only very negative interactions in groups may affect weight loss. However, these findings are inconsistent with theoretical assertions and anecdotal evidence on the relations between group factors and outcomes. These findings highlight the importance of measuring negative group interactions in future studies, including, for example, group conflict as measured in Nackers' study, social sabotage (Kiernan et al., 2012), and the extent to which group members are distant from one another (MacKenzie, 1983) or seem to irritate one another (Piper, Marrache, Lacroix, Richardsen, & Jones, 1983).

There are several possible alternate explanations for the lack of associations between group cohesion and attendance and weight loss. For one, other individual-level constructs from health behavior models may be more important in predicting attendance and weight loss, such as self-efficacy, behavioral intentions, favorable expectations about outcomes, and outcome expectancies (Luszczynska et al., 2007; Rothman, 2000; Schwarzer, 2008). Furthermore, other interpersonal constructs may be more important than group cohesion. Emotional, informational, or instrumental social support from social network members, especially cohabitating intimate partners or other household members, may be strongly associated with outcomes (Gorin et al., 2006; Sallis et al., 1987; Verheijden et al., 2005). The amount of support received from one's social network may affect the relative importance of cohesion and associated support received from the weight loss group (Kiernan et al., 2012). Future work testing the quality and relative contributions of study-related vs. social network support may further elucidate this possibility.

Alternatively, perhaps group cohesion is important, but the measure we used was not reliable or valid for our population. The GCS-R was developed and validated among primarily undergraduate psychology majors who were participating in courses in the use of cognitive and psychodramatic techniques. Furthermore, although the GCS-R was intended to measure several subdomains, various domains were not supported by our psychometric analyses, and we did not uncover published data regarding structural validity. Other research groups have assessed group processes in health contexts, which may be better suited for future studies like ours. For example, Cutrona and colleagues developed the Social Provisions Scale, which assesses several domains: attachment, social integration, reassurance of worth, reliable alliance, guidance, and nurturance (Cutrona & Russell, 1987). Carron developed the Group Environment Questionnaire for use in sports teams; this measure assesses task- and social-related integration and attraction to the group (Carron et al., 1998).

Assuming an appropriate measure of group cohesion is identified, several questions could be addressed in future research. For example, future studies should measure and model proposed mediators of change via group cohesion, such as self-efficacy, modeling, and social persuasion, to determine active processes of change. Future studies should also identify the optimal timing for measurement of group cohesion. Measuring cohesion during the first group session is impractical as cohesion has not yet formed. We measured it during the third session, once participants had some familiarity with one another. This timing is consistent with how the scale authors measured it during semester-long psychology courses (i.e., during the third and last classes; Treadwell et al., 2001). Measuring cohesion during the last session may capture the most information about the group, but it limits our ability to make conclusions about whether cohesion predicts attendance and weight loss over the course of the intervention. Furthermore, later assessment does not account for dropout that might occur among participants with lower perceived group cohesion. Because cohesion is defined as a dynamic process, as demonstrated in the current study, repeated measurements are recommended instead of a single measurement. Another question relates to whether group cohesion is modifiable. Some experimental work suggests that it is (Carron & Brawley, 2012), although much may depend on personality fit within the group.

This study has some limitations. Although participants were assigned to a group day and time, they attended other groups as needed to make up for missed sessions. Although we can say anecdotally that this did not occur frequently, we did not accurately measure the frequency and therefore could not account for this in analyses. We did not collect data on which groups were led by which interventionist; thus, we were unable to determine if there were differences in group cohesion by interventionist. We did not use the full GCS-R in analyses due to the fact that the reverse-scored items performed differently than the positively scored items. The analyses were completed among the subset of participants who attended session 3 to provide an initial group cohesion score, and these 324 individuals may differ from the 180 individuals who initiated the weight loss program but did not provide an early group cohesion score. Although group cohesion increased significantly during the intervention, the fact that the GCS-R has not been linked to clinical outcomes in this population limits our ability to determine the clinical significance of this increase. Finally, results are from Veterans at a single Veterans Affairs Medical Center and may not generalize to other populations. Veterans share a common background that may facilitate social connections. Demographic diversity within a group may affect cohesion ratings, especially early in the study (Harrison, Price, & Bell, 1998). Different proportions of males and females in a group, for example, have been shown to impact group climate ratings (LoCoco, Gullo, Lo Verso, & Kivlighan Jr., 2013; West, Heilman, Gullett, & Moss-Racusin, 2012).

Social interactions with group members have been hypothesized to contribute to success in group-based weight loss interventions. Our study suggests that neither early group cohesion nor increased group cohesion is associated with attendance or weight loss. Future research should evaluate the role of specific positive and negative behaviors among group members in attendance and weight loss.

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Compliance with Ethical Standards

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Table 1.

Descriptive statistics for group cohesion, group attendance, and weight (n=324).

Variable		Mean (SD)
Group cohesion (possible range 1–4)		
	Session 3	3.16 (0.48)
	Session 8	3.35 (0.44)
	Change	0.19 (0.41)
Attendance (# of sessions, 0–8)		6.33 (1.71)
Weight (lbs.)		
	Baseline (session 1)	239.47 (44.00)
	16-week follow-up	228.02 (43.50)
Percent weight loss (Baseline – 16-week follow-up)		5.2% (0.04)
Change in BMI (Baseline – 16-week follow-up_		1.71 (1.37)