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Preliminary Examination of Metabolic Syndrome Response to Motivational Interviewing for Weight Loss as Compared to an Attentional Control and Usual Care in Primary Care for Individuals with and without Binge-Eating Disorder

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Abstract

Motivational interviewing (MI) treatment for weight loss is being studied in primary care. The effect of such interventions on metabolic syndrome or binge eating disorder (BED; *DSM-5* criteria), both highly related to excess weight, has not been examined. This study conducted secondary analyses from a randomized controlled trial to test the impact of MI for weight loss in primary care on metabolic syndrome. 74 adult participants with overweight/obesity recruited through primary care were randomized to 12 weeks of either MI, an attentional control, or usual care. Participants completed measurements for metabolic syndrome at pre- and post-treatment. There were no statistically significant differences in metabolic syndrome rates at pre-, $X^2(2)=0.16$, $p = 0.921$, or post-, $X^2(2)=0.852$, $p = 0.653$ treatment. The rates in metabolic syndrome, however, decreased for MI (10%) and attentional control (13.8%) participants, but not for usual care. At baseline, metabolic syndrome rates did not differ significantly between participants with BED or without BED across treatments. At post-treatment, participants with BED were significantly more likely to meet criteria for metabolic syndrome than participants without BED, $X^2(1)=5.145$, $p = 0.023$, phi =.273. Across treatments, metabolic syndrome remitted for almost a quarter of participants without BED (23.1%) but for 0% of those with BED. These preliminary results are based on a small sample and should be interpreted with caution, but they are the first to suggest that relatively low intensity MI weight loss interventions in primary care may decrease metabolic syndrome rates but not for individuals with BED.

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Keywords

metabolic syndrome; motivational interviewing; obesity; primary care; binge eating disorder; weight loss

1.1 Introduction

The prevalence of people who are overweight or obese has risen dramatically, with combined estimates at 69.2% in the United States (NHHS (US), 2013). The consequences of excess weight are dire and include increased risk of cardiovascular disease, hypertension, stroke, and metabolic syndrome (Ervin, 2009; Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 2001; Grundy, Brewer, Cleeman, Smith, & Lenfant, 2004; Marchesini et al., 2004). Metabolic syndrome is a cluster of vascular risk factors and is defined by the presence of three out of five of the following: elevated fasting blood glucose, low serum high-density lipoprotein (HDL) cholesterol level, hypertriglyceridemia, hypertension, and central adiposity (Grundy et al., 2005; NCEPEP, 2002). While related to excess weight, metabolic syndrome cannot be accounted for exclusively by overweight/obesity as the syndrome also is relatively common within healthy weight individuals (i.e., 17%; Suliga, Koziel, Gluszek, 2016). A diagnosis of metabolic syndrome increases risk for cardiovascular disease, type II diabetes, and all-cause mortality (Isomaa et al., 2001; Lakka et al., 2002; Ninomiya et al., 2004). Similarly, metabolic syndrome also has additional significant negative impacts on individuals' health-related quality of life (Sullivan, Ghushchyan, Wyatt, Wu, & Hill, 2007) and represents a growing health-care economic burden in the United States (Sullivan, Ghushchyan, Wyatt, & Hill, 2007. The degree of excess weight is directly associated with metabolic syndrome, and as rates of obesity have increased, so too has the prevalence of metabolic syndrome (Ervin, 2009). While the prevalence of metabolic syndrome in U.S. adults is estimated at 24%, nearly 30% and 65% of individuals with overweight or obesity, respectively, are estimated to meet criteria for metabolic syndrome (Barber, Schumann, Foran-Tuller, Islam, & Barnes, 2015; Ervin, 2009; Ford, Giles, & Dietz, 2002; Park, Palaniappan, Heshka, Carnethon, & Heymsfield, 2003). With such life-threatening consequences of excess weight and metabolic syndrome, there is a dire need for effective and easily accessible interventions (Pagoto & Appelhans, 2013).

An important and accessible place to address metabolic syndrome may be at individuals' primary care provider appointments (Mehring et al., 2013; Plourde & Prud'homme, 2012). Unfortunately, while both patient and provider understand the importance of addressing excess weight, primary care providers often are overburdened and treatment provided by primary care offices is limited (Bleich, Pickett-Blakely, & Cooper, 2011; Davis, Emerenini, & Wylie-Rosett, 2006; Galuska, Will, Serdula, & Ford, 1999; Malterud & Ulriksen, 2010; Scott et al., 2004; Tsai & Wadden, 2009). Patients do want their medical providers to discuss weight loss but feel their providers' ability to provide resources is insufficient (Malterud & Ulriksen, 2010), and medical providers are unlikely to provide weight loss counseling at appointments (Bleich et al., 2011; Jackson, Wardle, Johnson, Finer, & Beeken, 2013;

Kraschnewski, Sciamanna, Pollak, Stuckey, & Sherwood, 2013a; Kraschnewski et al., 2013b).

A promising option for primary care providers may be motivational interviewing. Fortunately, general medical practitioners without prior psychotherapeutic training can be trained to provide motivational interviewing (Barnes, White, Martino, & Grilo, 2014). Motivational interviewing is a directive and client-centered method of intervention focused on enhancing intrinsic motivation by discussing and addressing ambivalence (Miller & Rollnick, 2012). Reviews of the literature (Barnes & Ivezaj, 2015; DiLillo & West, 2011) and meta-analyses (Armstrong, Mottershead, Ronksley, Sigal, Campbell, & Hemmelgarn, 2011; Burke, Arkowitz, & Menchola, 2003; Lundahl, Kunz, Brownell, Tollefson, & Burke, 2010) support the effectiveness of motivational interviewing for weight-related behavior change and weight loss. Consequently, medical offices started incorporating relatively low intensity motivational interviewing treatments. Preliminary evidence suggests motivational interviewing interventions in primary care may positively impact individual components of metabolic syndrome such as blood pressure (Hardcastle, Taylor, Bailey, & Castle, 2008; Hardcastle, Taylor, Bailey, Harley, & Hagger, 2013; Williams, Hollis, Collins, & Morgan, 2014; Woollard et al., 1995) and high-density lipoproteins (Drevenhorn, Bengtson, Nilsson, Nyberg, & Kjellgren, 2012). None of the primary care motivational interviewing for weight loss treatments, however, examined the impact of motivational interviewing on these variables combined as in metabolic syndrome (Barnes & Ivezaj, 2015). Another limitation of the motivational interviewing for weight loss in primary care literature is the lack of attentional control comparison conditions. The vast majority of randomized controlled trials compared motivational interviewing to conditions such as usual care. Therefore, based on the existing literature, we cannot determine if motivational interviewing specifically results in weight loss or if the additional attention to the weight loss is responsible (Barnes & Ivezaj, 2015).

The motivational interviewing for weight loss in primary care literature also has overlooked binge-eating disorder (BED) (Barnes & Ivezaj, 2015; APA, 2013). BED, defined by recurrent binge eating without regular compensatory behaviors, is now officially recognized as an eating disorder in the *Diagnostic and Statistical Manual of Mental Disorders-5* (APA, 2013). BED is related to excess weight (Kessler et al., 2013) and increased medical co-morbidity and health-care utilization even after accounting for weight (Johnson, Spitzer, & Williams, 2001; Marques et al., 2011). Unhealthy eating behaviors common in individuals with BED (e.g., consuming large quantities of calories in brief amount of time, meal skipping) are associated with metabolic syndrome and metabolic abnormalities (Kral et al., 2001, Roehrig et al., 2009, and Sierra Johnson et al., 2008). In fact, a longitudinal study reported individuals who reported binge eating were at greater risk for newly diagnosed metabolic syndrome symptoms, compared with non-binge eaters (Hudson et al., 2010). Consequently, individuals with BED and excess weight have been underscored as a significant subgroup with increased risk for developing metabolic syndrome (Abraham, Massaro, Hoffmann, Yanovski, & Fox, 2014; Barnes et al., 2011; Blomquist et al., 2012; Hudson, Hiripi, Pope, & Kessler, 2007; Mitchell, 2015; Sheehan & Herman, 2015; Udo, McKee, White, Masheb, Barnes, & Grilo, 2014a; Udo, McKee, White, Masheb, Barnes, & Grilo, 2014b). It is critical, therefore, to examine these individuals, with excess weight,

metabolic syndrome, and binge eating disorder, as they may be at extreme risk for harmful health-related consequences. In fact, researchers recently stressed the importance of not overlooking psychological disorders such as BED as they are an important part of the obesity crisis (Amianto, Lavagnino, Avvate-Daga, & Fassino, 2011). To our knowledge, no study has compared how metabolic syndrome responds to a motivational interviewing weight loss trial in primary care for individuals with BED.

It currently is unknown if a brief motivational interviewing weight loss intervention delivered in primary care can decrease incidence of metabolic syndrome and the role that a diagnosis of BED may play in an individual's response. Since metabolic syndrome and BED both confer health-related risks beyond those attributable to excess weight, assessing the impact of such an intervention on metabolic syndrome may provide primary care providers a means of helping their patients. Therefore, in the current study, we sought to conduct a preliminary examination of metabolic syndrome before and after motivational interviewing treatment for weight loss in primary care for participants with BED and without BED. This will include one of the first comparisons of motivational interviewing for weight loss in primary care to not only usual care but also an attentional control condition. Weight loss data previously were published and secondary analyses currently are presented (Barnes et al., 2014). It was hypothesized that when compared the attentional control and usual care conditions, participants in the motivational interviewing group would experience significant decreases in the rates of metabolic syndrome. Weight loss was expected to be related to decreases in metabolic syndrome diagnosis. Participants without BED were hypothesized to experience greater decreases in metabolic syndrome compared to participants with BED.

2.1 Materials and Methods

2.2 Participants

Adult participants were 74 individuals with overweight or obesity (body mass index (BMI)≥ 25, ≤55) receiving primary care services at an urban university-based medical healthcare center. Participants between the ages of 18 and 65 were recruited through primary care provider referrals and flyers placed in waiting/patient rooms. Exclusion criteria included: severe psychiatric problems (e.g., schizophrenia); severe medical problems (e.g., cardiac disease); pregnancy/breastfeeding; or uncontrolled liver; thyroid disease (TSH>6.75); hypertension (>160/95); or diabetes (HbA1c>8.0).

Participants had a mean age of 47.8 years (*SD*=10.9) and a mean BMI of 35.1 kg/m2 (*SD*=7.1). Women accounted for 73.0% (*n*=54) of the sample. BED was diagnosed in 27.0% (*n*=20) of the participants. The sample was relatively diverse: 68.9% (*n*=51) of participants identified as White, not Hispanic, 2.7% (*n*=2) as White, Hispanic, 21.6% (*n*=16) as Black, and as 6.8% (*n*=5) as bi/multiracial. Metabolic syndrome was defined by the National Cholesterol Education Program Adult Treatment Panel III (ATP III) and updated in 2005 by the American Heart Association and the National Heart Lung and Blood Institute (See Table 1) (Grundy et al., 2005; National Cholesterol Education Program Expert Panel, 2002). Participants' medication use was not assessed at post-treatment so diagnosis was based solely on objective measurements, consistent with some previous BED and metabolic

syndrome literature (Barnes et al., 2011; Blomquist et al., 2012). Based on these criteria, 35.1% (n=26) met criteria for metabolic syndrome.

2.3 Materials

Physical and Metabolic Measurements—Height was measured at baseline only, using a wall-mounted measure within a quarter of an inch. At baseline and post-treatment assessment, measurements were obtained in a standardized manner by the clinicians: weight was measured using a large capacity digital scale without shoes, and blood pressure and pulse were measured using automated blood pressure monitors (recorded readings were an average of two measurements). Blood work was drawn and analyzed by Quest Diagnostics.

2.4 Methods

The Human Investigation Committee (IRB) approved the protocol, and participants provided informed consent. Participants were screened for eligibility and BED by master's or doctoral level psychology clinicians trained in eating and weight disorders but treatment was provided by medical assistants. Participants were randomly assigned to one of three conditions and randomization was stratified by the presence or absence of BED diagnosis (APA, 2013; See Barnes et al., 2014 for more details regarding procedure, treatment, and weight loss results). The treatment conditions included Motivational Interviewing and Internet Condition (MIC, n=30, n=8 with BED); Nutrition Psychoeducation and Internet Condition (NPC; an attentional control, n=29, n=7 with BED); or Usual Care (UC, n=15, n=5 with BED). The MIC included a manual to allow clinicians to flexibly work with their patients within the MI framework, including addressing BED or metabolic syndrome if requested by the participant but neither topic was required as part of the treatment. The NPC also included a manual and was designed as an attentional control condition and included basic nutritional information (e.g., how many fruits/vegetables to eat each day, examples of healthy sources of calcium, tips for eating healthier at restaurants). Participants in both the MIC and NPC were directed to a free website (Livestrong.com; to increase generalizability) where they could track their caloric intake, exercise, and set weight loss goals. Participants saw their MIC or NPC clinician for up to five sessions, the first one was 1 hour, and the subsequent sessions were 20 minutes each over 12 weeks. The treatment was designed to be implemented within overburdened primary care offices. Treatments were provided by medical assistants with no previous motivational interviewing training. Separate clinicians were trained for MIC and NPC to maintain treatment fidelity. The medical assistant clinicians demonstrated adequate treatment delivery in mock treatment sessions prior to meeting with randomized participants and received ongoing group and individual supervision. Fidelity testing of randomly selected audio taped sessions (i.e., 20% of total sessions were reviewed) showed that clinicians delivered their respective interventions satisfactorily (See Barnes et al., 2014 for more detail).

3.1 Results

Post-treatment data were collected for 69 participants (93.2%), and data are presented for these completers only when examining baseline to post-treatment changes and post-treatment data. At baseline, similar numbers of participants met criteria for metabolic

syndrome across the three treatment groups, MIC (33.3%), NPC (37.9%), and UC (33.3%), $X^2(2)=0.16$, $p = 0.921$. When examining participants meeting metabolic syndrome criteria for each component individually, there also were no differences at baseline (see Table 1). At post-treatment, there were no statistically significant differences among groups for metabolic syndrome rates, $X^2(2)=0.852$, $p = 0.653$, or individual criteria (see Table 2). A pattern emerged, however, to suggest decreased metabolic syndrome rates for participants in MIC (33.3% to 23.1%) and NPC (37.9% to 24.1%), but not for UC participants (33.3% to 35.7%). The decreases in metabolic syndrome rates appear attributable to a 17.9% decreased rate of participants meeting criteria for elevated blood pressure in MIC and a 13.8% decreased rate of participants meeting criteria for elevated blood pressure and triglycerides in NPC.

Across treatments, participants were categorized by those who experienced no change in metabolic syndrome diagnosis from baseline to post-treatment ("no change," n=51; 73.9%), those who did not meet criteria for metabolic syndrome at baseline but newly met criteria at post-treatment ("new diagnosis," n=6; 8.7%), and those who met criteria for metabolic syndrome at baseline but no longer met criteria at post-treatment ("improvement," n=12; 17.4%). Chi-square analysis showed a significant difference in likelihood to reach 5% or more weight loss from baseline to post treatment assessment among these groups, $X^2(1) = 6.601$, $p = 0.033$, phi = 0.314. Follow-up analyses indicate that participants who had "no change" in metabolic syndrome diagnosis were significantly less likely to have lost 5% or more of their initial body weight by post-treatment compared to participants who had met metabolic syndrome criteria as baseline but no longer met criteria at post-treatment ("improvement"), $X^2(1) = 6.618$, $p = 0.010$, phi = 0.324. There were no other significant differences among the groups.

At baseline, metabolic syndrome rates did not differ significantly between participants with BED (6/20; 30.0%) or without BED (20/54; 37.0%), $X^2(1)=0.32$, $p = 0.573$ across treatments (see Table 3). At post-test, participants with BED (8/17; 47.1%) were significantly more likely to meet criteria for metabolic syndrome than participants without BED (10/52; 19.2%), $X^2(1)=5.145$, $p = 0.023$, phi =.273. There also was a significant difference between participants with and without BED among the aforementioned metabolic syndrome categories ("no change," "new diagnosis," & "improvement"), $X^2(1)=6.219$, $p = 0.045$, phi =.300 (see Table 3). Participants with BED were significantly more likely to fall within the "no change," $X^2(1)=4.235$, $p = 0.040$, phi =.259, or "new diagnosis," $X^2(1)=7.200$, $p = 0.007$, phi =.632, categories than the "improvement" category. In fact, no BED participants fell within with "improvement" category, compared to 23.1% of participants without BED.

4.1 Discussion

To our knowledge, this is the first initial assessment of the impact of motivational interviewing for weight loss in primary care on metabolic syndrome. Metabolic syndrome and BED were common within this weight loss treatment-seeking sample of individuals with overweight and obesity. Baseline rates of metabolic syndrome (35%) were on the lower end of U.S. estimates for individuals with overweight or obesity (30–65%) (Ervin, 2009). There

are two likely explanations for this. First, medication management was not taken into consideration. Based on the literature, including participants who are medically managed for these metabolic abnormalities may have increased baseline rates by approximately 8% (Barber et al., 2015). Second, the sample was recruited from primary care versus the general population; perhaps individuals recruited through their primary care providers are more likely to successfully manage metabolic symptomatology (Barnes et al., 2011; Blomquist et al., 2012). BED rates (27%) were on par with estimates of BED within treatment and non-treatment seeking obese populations (20% to 40%; (Fitzgibbon, Stolley, & Kirschenbaum, 1993; Pagoto et al, 2007; Simon et al, 2006; Wadden, Womble, Stunkard, & Anderson 2002), which is well above the general lifetime estimated BED prevalence of 0.8% and 1.6% for men and women, respectively (APA, 2013).

There were no significant differences in metabolic syndrome rates at baseline or post-treatment among participants randomized to the three conditions. Rates of metabolic syndrome, however, dropped by 10% and 13.8% for participants in the MIC and NPC conditions, respectively, whereas rates for participants in usual care did not decrease. MIC and NPC were designed to generalize to any primary care office and included approximately 2 hours and 20 minutes of individual treatment over the course of three months. While exceedingly preliminary and not statistically significant, the decreased rates are quite promising and have clinical significance when considering intensive lifestyle programs that are years in duration (e.g., Diabetes Prevention Program) report decreased rates of metabolic syndrome by approximately 40% (Goldberg & Mather, 2012; Orchard et al., 2005). The current interventions are much briefer and likely easier to implement within primary care offices. From a public health perspective, the average PCP is overloaded with a 2,300 patient panel (Alexander, Kurlander, & Wynia, 2005) and if almost 70% of these individuals are overweight or obese, decreased metabolic syndrome rates of 10–14% could have widespread implications for decreasing mortality and healthcare costs.

Of similar importance is the finding that both the MIC and NPC resulted in similar metabolic syndrome rate decreases. One weakness of existing motivational interviewing for weight loss in primary care literature is the lack of attentional control conditions; most often, motivational interviewing was compared to usual care (Barnes & Ivezaj, 2015). While some research suggests that medical clinicians without prior experience in conducting psychotherapy can learn to adequately deliver motivational interviewing, the training and supervision required to ensure satisfactory delivery can be time consuming and costly. It is not surprising then that research criticizes the motivational interviewing for weight loss in primary care literature as lacking fidelity assessments (Barnes & Ivezaj, 2015). The NPC, which was designed to provide participants basic nutritional psychoeducation and serve as an attentional control for the MIC, appears to have had similar positive impacts on metabolic syndrome. The NPC required significantly less training and supervision of clinicians to ensure treatment fidelity as the intervention was straightforward. More research is needed that compares motivational interviewing to comparison treatment conditions, rather than usual care, to improve our understanding of the efficacy of motivational interviewing.

Across treatments, participants' components of metabolic syndrome (e.g., glucose) did not differ significantly at baseline or post-test. The decreased rates of metabolic syndrome for

participants in the MIC and NPC treatments appears to be due to decreases in blood pressure and triglycerides. The reduction in blood pressure mirrors previous motivational interviewing interventions for weight loss in primary care, which resulted in decreased blood pressure as compared to usual care comparison groups (Hardcastle et al., 2008; Hardcastle et al., 2013; Williams et al., 2014; Woollard et al., 1995). Furthermore, participants who lost 5% or more of their initial body weight by post-treatment were more likely to no longer meet criteria for metabolic syndrome than participants whose weight remained the same from baseline to post-treatment. This finding supports literature that suggests losing 5% of initial body weight is associated with attenuating weight-related health consequences (Blackburn, 1995).

From baseline to post-treatment, metabolic syndrome rates increased by 17.1% for participants with BED, whereas rates decreased by 17.8% for participants without BED, regardless of treatment condition. Participants with BED were more likely to experience no change in their metabolic syndrome status. They also were more likely progress to meeting criteria for metabolic syndrome by post-treatment as compared to participants without BED. No participants with BED who met criteria for metabolic syndrome at baseline ceased meeting criteria at post-treatment. In other words, no participants with BED fell within the “improved” category. The changes somewhat mimic a naturalistic study that found individuals with overweight or obesity and BED were more likely to develop metabolic syndrome symptoms over time as compared to individuals without BED (Mitchell, 2015). In addition to BED possibly conferring additional risk for metabolic syndrome beyond body mass index (Hudson et al., 2010), the diagnosis also may negatively impact weight loss treatment adherence (Susin et al., 2015), perhaps also explaining the current findings.

Limitations of the current study include a very small sample size and secondary analyses. Perhaps with more participants, differences between participants receiving treatment and those in usual care would have reached statistical significance. The sample of individuals with BED was small, and it limited the analyses we were able to conduct, including assessing the impact of BED on metabolic syndrome remissions rates by treatment condition. Similarly, any conclusions regarding the results about individuals with BED and metabolic syndrome need to be made with caution. Additionally, medication management was not accounted for when categorizing participants as meeting or not meeting metabolic syndrome criteria. Lastly, individuals with significantly uncontrolled hypertension and diabetes were excluded from participation, therefore, results may not generalize to these populations.

The current results preliminarily suggest that motivational interviewing and a nutritional psychoeducation may be a promising method for decreasing incidence of metabolic syndrome in primary care. Importantly, the interventions were brief in duration and provided by previously untrained medical assistants. These treatments may be particularly useful in cases when patients do not have access to weight loss treatment outside of their primary care clinics or when medication management is not feasible due to contraindicated medications or medical conditions.

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Highlights

1. Study assessed impact of motivational interviewing in primary care on metabolic syndrome.
2. Little is known about the role binge eating disorder (BED) may play.
3. Rates of metabolic syndrome decreased in interventional groups but not usual care.
4. Weight loss was related to improvements in metabolic syndrome diagnoses.
5. BED diagnosis was related to new metabolic syndrome diagnoses at post-treatment.

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Table 1

Participants Meeting Metabolic Syndrome Criteria at Baseline

	Total N (%) (N=74)	**MIC n (%) (n=30)**	**NPC n (%) (n=29)**	**UC n (%) (n=15)**	**Chi-Square Analyses**
Blood Pressure ≥130/≥85 mm Hg	33 (44.6)	10 (33.3)	15 (51.7)	8 (53.3)	$X^2(2)=2.60$, $p = 0.273$
Waist Circumference Men >102 cm (>40 in) Women >88 cm (>35 in)	67 (90.5)	28 (93.3)	26 (89.7)	13 (86.7)	$X^2(2)=0.56$, $p = 0.755$
HDL Men<40 mg/dL Women <50 mg/dL	20 (27.0)	10 (33.3)	7 (24.1)	3 (20.0)	$X^2(2)=1.10$, p = 0.576
Fasting Glucose ≥100 mg/dL	22 (29.7)	9 (30.0)	9 (31.0)	4 (26.7)	$X^2(2)=0.09$, p = 0.955
Triglycerides ≥150 mg/dL	17 (30.0)	7 (23.3)	7 (24.1)	3 (20.0)	$X^2(2)=0.10$, $p = 0.952$
Full Metabolic Syndrome 3+ criteria met	**26 (35.1)**	**10 (33.3)**	**11 (37.9)**	**5 (33.3)**	**$X^2(2)=0.16$, $p = 0.921$**

Note. MIC=Motivational Interviewing and Internet Condition; NPC=Nutrition Psychoeducation and Internet Condition; UC=Usual Care.

Table 2

Participants Meeting Metabolic Syndrome Criteria Post Treatment

	Total N (%) (N=69)	**MIC n (%) (n=26)**	**NPC n (%) (n=29)**	**UC n (%) (n=14)**	**Chi-Square Analyses**
Blood Pressure >130/>85 mm Hg	20 (29.0)	4 (15.4)	11 (37.9)	5 (35.7)	$X^2(2)=3.78$, $p = 0.162$
Waist Circumference Men >102 cm (>40 in) Women >88 cm (>35 in)	61 (88.4)	23 (88.5)	25 (86.2)	13 (92.9)	$X^2(2)=0.41$, $p = 0.816$
HDL Men<40 mg/dL Women <50 mg/dL	20 (29.0)	8 (33.8)	9 (31.0)	3 (21.4)	$X^2(2)=0.49$, $p = 0.784$
Fasting Glucose >100 mg/dL	19 (27.5)	7 (26.9)	8 (27.6)	4 (28.6)	$X^2(2)=0.12$, $p = 0.994$
Triglycerides >150 mg/dL	12 (17.4)	7 (26.9)	3 (10.3)	2 (14.3)	$X^2(2)=2.74$, $p = 0.254$
Full Metabolic Syndrome 3+ criteria met	**18 (26.1)**	**6 (23.1)**	**7 (24.1)**	**5 (35.7)**	$X^2(2)=0.85$, $p = 0.653$

Note. MIC=Motivational Interviewing and Internet Condition; NPC=Nutrition Psychoeducation and Internet Condition; UC=Usual Care.

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Table 3

Metabolic syndrome diagnosis from baseline to post-treatment based on Binge Eating Disorder (BED) status.

	Total N (%) (N=69)[a]	**Non-BED n (%) (n=52)[b]**	**BED n (%) (n=17)[c]**	**Chi-Square Analyses**
Metabolic Syndrome Diagnosis at Baseline	26 (35.1%)[a]	20 (37.0%)[b]	6 (30.0%)[c]	$X^2(1)=0.32$, $p = 0.573$
Metabolic Syndrome Diagnosis at Post-Treatment	18 (26.1%)	10 (19.2%)	8 (47.1%)	$X^2(1)=5.145$, $p = 0.023$, phi =.273
Change in Metabolic Syndrome Diagnosis from Baseline to Post-Treatment				$X^2(1)=6.219$, $p = 0.045$, phi =.300
No Change	51 (73.9%)	37 (71.2%)	14 (82.4%)	
New Diagnosis	6 (8.7%)	3 (5.8%)	3 (17.6%)	
Improvement	12 (17.4%)	12 (23.1%)	0 (0.0%)	

[a] Note. n=54 at baseline.

[b] n=54 at baseline.

[c] n=20 at baseline.