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The Effects of a Brief Motivational Intervention for Alcohol Use through Stages of Change among Non-Treatment Seeking Injured Patients

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Abstract

Background: Little is known about the mechanisms of change underlying brief interventions and the patient characteristics that may affect them. The present study tested whether the stages of change mediate the effects of a BMI with and without a telephone booster relative to brief advice (i.e., multiple mediation). Further, the present study tested whether the effects of the BMI conditions on the stages of change were contingent on patients' alcohol use severity (i.e., moderated mediation).

Methods: The present study is a secondary analysis using data from injured adult patients at three trauma centers who were screened for inclusion in the study and randomly assigned to brief advice ($n = 200$), BMI ($n = 203$), or BMI with a telephone booster ($n = 193$) (Field et al., 2014). Participants completed a baseline assessment and 3-, 6-, and 12-month follow-up assessments that included self-report measures of the stages of change, alcohol use, and alcohol-related problems, as well as other variables of interest.

Results: The results demonstrated significant and consistent mediation at $p < .05$ wherein BMI with a telephone booster increased action at 3-month follow-up leading to reduced likelihood of at-risk drinking, less alcohol use, and fewer alcohol problems at both 6- and 12-month follow-up. However, moderated mediation analyses suggested that the effects of the BMI conditions on the stages of change were not contingent on patients' alcohol use severity.

Conclusions: This study contributes to the understanding of stages of change as potential mechanisms of change of BMI. Directions for future research are discussed.

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Keywords

alcohol use; alcohol-related problems; brief motivational intervention; stages of change; injured patients

Introduction

Brief motivational intervention (BMI) is a practical application of motivational interviewing (MI) which is a person-centered, collaborative conversation style for strengthening a person's motivation and commitment to change (Miller and Rollnick, 2012a). The underlying assumption is that BMIs for alcohol use increase the patient's motivation to reduce drinking and, in turn, reduce alcohol-related problems. Research supports the effectiveness of BMIs in medical settings, specifically within emergency departments (e.g., Monti et al., 2014; Nilsen et al., 2008; Woolard et al., 2011) and trauma care settings (e.g., Field et al., 2010a, 2014; Schermer et al., 2006). However, meta-analyses (Glass et al., 2005, 2016) suggest that BMI may not be related to alcohol use outcomes. Together, these findings suggest that the examination of determinants of BMI treatment effects may be of potential value.

Little is known about the mechanisms through which BMIs exert their effects on alcohol use (Apodaca and Longabaugh, 2009; Heather, 2014; Gaume et al., 2014). Such knowledge would not only inform theoretical models of behavior change, but also inform intervention development and refinement by identifying important targets of behavior change. This could result in increasingly effective interventions which, in turn, will reduce the public health burden of alcohol use and related problems. As summarized by Gaume et al. (2014), numerous potential mechanisms of change have been examined such as various components of brief intervention, MI skills, readiness to change, change talk and others. The present study is a test of the indirect (i.e., mediation) effects of the stages of change—key hypothesized determinants of change (Apodaca and Longabaugh, 2009; Miller and Rollnick, 2012a; Witkiewitz and Marlatt, 2004)—on the effects of a BMI for alcohol use delivered in opportunistic medical settings and whether alcohol use severity moderates these indirect effects.

Stages of Change as a Mechanism of Change

Readiness to change has been proposed as a central treatment target in MI and an important treatment mechanism of BMIs (Apodaca and Longabaugh, 2009; Sammet and Connors, 1998). Although readiness to change has been criticized for being based on discrete stages and being poorly measured (Sutton, 2001; West, 2005), pre-treatment stages of change are proposed to be an important predictor of a wide range of disorders (Norcross et al., 2011) including treatment outcomes for alcohol problems (Cook et al., 2015; Heather and McCambridge, 2013; Demmel et al., 2004). A common conceptualization of motivation for change are the stages of change, which characterize the process of behavior change as progressing through five stages (precontemplation, contemplation, preparation, action, and maintenance), often in a non-linear manner, representing varying degrees of readiness (Prochaska et al., 1992). In the case of opportunistic interventions with non-treatment

seeking individuals, the most relevant stages of change are precontemplation, contemplation, and action (Rollnick et al., 1992). The aim of BMI is to increase motivation for reducing alcohol use and, in turn, alcohol consumption and alcohol-related problems. In terms of the stages of change, it would be expected that compared to BA, BMI and BMI + B should decrease precontemplation and increase contemplation and action, which, in turn, should lead to reductions in drinking and alcohol problems.

In a recent review, readiness to change examined as a mediator in MI interventions in 11 trials, consistently failed to mediate the effects of the interventions (Reid & Carey, 2015). Similarly, readiness to change was examined as a mediator of BMI on alcohol use and alcohol problems in a college sample by Borsai et al. (2009) and in the emergency department by Barnett et al. (2010), but neither found support for mediation through readiness to change. To our knowledge, only one published study has examined readiness to change as a mediator of the effect of BMI on treatment outcomes among seriously injured patients. Stein et al. (2009) found that BMI plus an in-person booster session one week after the initial intervention (BMI + B) resulted in a significantly greater increase in the patient's stage of change from baseline to 3-month follow-up compared to standard care. However, increases in the patient's stage of change at 3-month follow up did not predict alcohol-related problems at 12-month follow-up. Furthermore, no indirect effect of BMI on alcohol-related problems through stage of change was found. Results of tests of moderated mediation suggested that the BMI interventions produced greater increases in stage of change at 3-months compared to the control group. In turn, higher stages of change at 3 months predicted fewer alcohol problems at 12 months; however, this was only the case for patients with the highest stage of change at baseline. The authors note that this finding is inconsistent with MI as it would be expected that patients low in motivation to change would benefit most from an intervention that aims to increase motivation to change. Given that the findings of Stein et al. were opposite of what would be expected, further research is needed to test readiness as a mechanism of change in the context of BMIs delivered in opportunistic medical settings. Both Stein et al. (2009) and Gaume et al. (2014) propose that researchers test moderators of the mediation effect to attempt to determine the specific conditions under which stages of change may mediate the effects of BMI.

Alcohol Use Severity as a Potential Moderator

Patients' alcohol use severity may be one such characteristic that influences whether the stages of change mediate the effects of BMI. Research has shown that greater readiness to change is associated with greater alcohol use severity (e.g., DiClemente et al., 2009; Miller and Tonigan, 1996; Minugh et al., unpublished manuscript; Williams et al., 2006). Moreover, it has been suggested that patients who have previously experienced more negative consequences as a result of their drinking may be more responsive to less intensive interventions, possibly as a function of greater readiness to change (Field et al., 2010b; Mello et al., 2005). A study comparing brief motivational intervention to standard care found that patients who met DSM-IV diagnostic criteria for alcohol dependence were more likely to benefit from a less intensive intervention (BA in comparison to BMI) than those who did not meet criteria for alcohol dependence (Field and Caetano, 2010). In light of the broader research, these findings suggest that patients with more severe alcohol problems

may be more likely to benefit from less intensive brief interventions because they are more motivated to change their drinking. Therefore, it may be that the role of the stages of change as a mechanism of change is contingent on alcohol use severity. More specifically, it stands to reason that it is unlikely that BMI increases readiness to change among patients with greater alcohol use severity because of the increased readiness to change among these patients. In contrast, BMI may only increase readiness to change among patients with less severe alcohol use problems who may be less motivated to change their drinking.

Summary of a Multisite Randomized Controlled Trial of BMI with Seriously Injured Patients

Field et al. (2014) conducted a multisite randomized controlled trial comparing the effectiveness of brief advice (BA), BMI, and BMI with a telephone booster (BMI + B) for patients admitted to three Level I trauma centers for treatment of a serious injury. Overall, BMI + B compared with BA and BMI showed significantly greater post-intervention reductions in alcohol use across the 3-, 6-, and 12-month follow-ups among all patients (Field et al., 2014). However, patients with more severe alcohol problems (AUDIT score above 15) were more likely to benefit from BMI compared with BMI + B, whereas those with less severe alcohol problems (AUDIT score between 8 and 15) benefitted more from BMI + B compared to BMI (Field et al., 2014). That is, those with more severe alcohol problems benefitted more from a less intensive intervention (BMI) compared to a more intensive one (BMI+B), whereas those with less severe alcohol problems required a more intensive intervention (BMI+B). Therefore, alcohol use severity moderated the effects of brief intervention. One reason for the overall effectiveness of the brief intervention in the parent trial may be that brief interventions result in greater increases in motivation for change as compared to BA. That is, motivation to change may mediate the effects of the brief interventions compared to BA. Consistent with expectations, our research has shown that those with more severe alcohol problems are more motivated to change their drinking at baseline (Richards et al., 2020). Given the observed moderating effect of severity of alcohol use on drinking outcomes observed in the parent study, motivation may mediate the effects of brief intervention for those with less severe alcohol problems but not those with more severe alcohol problems.

The Present Study

The primary aim of the present study was to conduct a secondary data analysis of Field et al. (2014) to test the effects of BMI and BMI + B as compared to BA on at-risk drinking status, alcohol use, and alcohol-related problems at both 6- and 12-month follow-ups through changes in precontemplation, contemplation, and action from baseline to 3-month follow-up within a multiple mediation model. We hypothesized that both BMI and BMI + B would decrease precontemplation and increase contemplation and action scores in comparison to BA. In turn, greater precontemplation would predict an increased likelihood of at-risk drinking and increased alcohol use and alcohol-related problems, whereas greater contemplation and action would predict a decreased likelihood of at-risk drinking and decreased alcohol use and alcohol-related problems. The secondary aim of the present study was to test alcohol use severity as a moderator of the effects of BMI and BMI + B as compared to BA on change in precontemplation, contemplation, and action scores from baseline to 3-month follow-up (i.e., *a* paths) within a moderated multiple mediation model.

We hypothesized that the negative effects of BMI and BMI + B on precontemplation and the positive effects of BMI and BMI + B on contemplation and action would increase in magnitude as alcohol use severity decreased.

Materials and Methods

Participants provided written informed consent to participate in a study designed to improve health outcomes among seriously injured patients. The study was approved by the IRBs of each participating institution. Additionally, a certificate of confidentiality from the U.S. Department of Health and Human Services was obtained. The method described in the article reporting the primary outcomes of this study (Field et al., 2014) adhered to the CONSORT statement (<http://www.consort-statement.org>) for clinical trials which is compatible with the Journal Article Reporting Standards (JARS) endorsed by the American Psychological Association. For additional research design and reporting details, readers are referred to Field et al. (2014).

Participants

Patients were recruited from three urban Level I trauma centers. Patients treated for unintentional injuries such as motor vehicle collisions and falls or intentional or violence-related injuries such as gunshot wounds, stab wounds, and other assault-related injuries were screened for participation. Patients who were intoxicated at the time of their injury or presented with a Glasgow Coma Scale (GCS) < 14 were monitored by research staff for inclusion in the study once they were medically stable. Patients with a GCS < 14 which did not resolve prior to discharge or within 30 days after admission were not eligible for screening or enrollment. The median number of days for hospital stays among all patients enrolled in the study was six days. Patients with an alcohol use disorder or who used other substances were not excluded from participation. Patients had to demonstrate orientation to person, place, and time—as well as adequate recall of recent and remote events—prior to giving written informed consent as indicated by the Mini-Mental Status Exam. Per standard medical care, trauma center staff, in collaboration with research staff screened eligible patients during the study period for at-risk drinking. Patients screened positive based on one or more of the following criteria: 1) positive blood alcohol concentration at the time of admission (BAC > .01); 2) self-reported drinking 6 hours prior to injury, or; 3) gender-specific cutoff scores (score of 3 for women; score of 4 for men) on the consumption questions from the Alcohol Use Disorders Identification Test Consumption (AUDIT-C; Bradley et al., 2007). Most patients screened positive for a positive blood alcohol concentration or self-reported drinking 6 hours prior to injury (n = 460, 77.2%), as compared to those who screened positive based on a positive score on the AUDIT-C (n = 136, 22.8%). Readers are referred to Field et al. (2014) for exclusion criteria.

Procedure

Patients who qualified for the study and agreed to participate were assessed by research staff using a computer-assisted survey, which took place after written informed consent was provided to reduce loss of participants following consent. Research staff and participants were blind to intervention assignment during the baseline assessment. After completing the

baseline assessment, patients were randomized to BA (n = 200), BMI (n = 203), or BMI + B (n = 193). Telephone follow-ups were completed at 3, 6, and 12 months by research staff blind to intervention assignment.

Intervention Procedures

Clinicians were licensed social workers or graduate students in clinical, counseling, or health psychology programs who demonstrated the ability to achieve and maintain proficiency on the Motivational Interviewing Treatment Integrity or MITI coding system (Moyers et al., 2005). From 197 coded brief interventions (50%) using MITI 3.0, the average global scores from the 197 coded sessions based on the MITI 3.0 were 4.3 (SD=.72) for evocation, 4.1 (SD=.65) for collaboration, 4.3 (SD=.69) for autonomy, 4.4 (SD=.71) for direction, and 4.5 (SD=.6) for empathy. The average of all global ratings from the MITI 3.0 was 4.2 (SD=.55). Of the 197 coded sessions, 84% indicated competency on the MITI 3.0 based on the average global rating of 4.0. An additional 11% of the 197 coded sessions indicated beginning proficiency based on the global spirit rating of 3.5. There were no significant differences in global ratings between those receiving BMI and BMI+B.

All patients, regardless of intervention, received handouts from *Helping Patients Who Drink Too Much: A Clinician's Guide*, including information defining a standard drink and at-risk drinking, a summary of adult drinking patterns in the U.S. and strategies for cutting down (U.S. Department of Health and Human Services, 2007). Patients also received a list of available hospital and community services, including substance abuse treatment and self-help groups, as well as national resources for identifying additional treatment facilities.

Brief advice (BA).

Brief advice represents a minimal intervention that meets the requirements of the American College of Surgeons' Committee on Trauma and can be provided by various healthcare professionals with limited training and supervision (American College of Surgeons, Committee on Trauma, 2014). BA lasted an average of 4.7 minutes ($SD = 2.2$) and included information regarding alcohol screening results, recommendations to quit or cut down, and identification of hospital and community services.

Brief motivational intervention (BMI).

BMI with injured patients has been described elsewhere (Dunn and Ostaffin, 2005; Field et al., 2005). In short, BMI is a practical application of motivational interviewing in the healthcare setting (Miller and Rollnick, 2012a). The primary components consist of acknowledging patients' autonomy regarding their drinking behavior; providing personalized feedback based on screening results, assessing causal attribution of their admission to alcohol use; exploring the pros and cons of their drinking; assessing importance, confidence and readiness to change drinking; supporting patients' self-efficacy; and reinforcing efforts or intentions to make positive changes in drinking. BMIs lasted an average of 22.5 minutes ($SD = 10.4$) and took place during the patient's hospital stay following medical stabilization.

Brief motivational intervention with telephone booster (BMI + B).

One hundred ninety three patients assigned to BMI + B received the BMI described above and 183 received a telephone booster session using personalized drinking feedback that was conducted an average of 40 ($SD = 6.8$) days later and lasted an average of 28 minutes ($SD = 10.4$). The personalized feedback report was similar to those used in other MI trials (Miller et al., 1999; Walters et al., 2009) and included a) comparison of their drinking pattern to lower risk drinking, their typical and peak blood alcohol concentration based on the timeline follow back assessment at baseline, b) risk level based on scores from the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001; Saunders et al., 1993) from the client's baseline assessment and c) benefits to cutting back, strategies for cutting down, indications for quitting drinking and treatment referral resources. After reviewing the personalized feedback, the counselor used the importance and confidence rulers to elicit statements in support of self-efficacy and motivation to change. If applicable, the counselor reinforced taking steps toward change and positive changes in drinking. The counselor also discussed motivation to change drinking and strategies to reduce alcohol consumption and alcohol problems using principles of MI.

Measures

Alcohol use.—Alcohol use was assessed using the Timeline Follow-Back (TLFB) during the past 3 months (baseline and 3- and 6-month follow-up) or the past 6 months (12-month follow-up) (Sobell and Sobell, 1992; Sobell et al., 1979). This method of obtaining self-reported data has been found both reliable and valid (Sobell and Sobell, 1992; Sobell et al., 1979). To accurately assess self-reported drinking, three procedures were used during baseline and follow-up assessments. First, the patient was provided a handout defining a standard drink and providing standard equivalents based on different container sizes, types of alcohol consumed, and alcohol content (http://pubs.niaaa.nih.gov/publications/Practitioner/pocketguide/pocket_guide2.htm). Second, research staff that conducted baseline and follow-up assessments using the TLFB were trained in the conversion of alcoholic beverages to standard drinks based on patient self-reported alcohol use. Finally, research staff used the Center on Alcoholism, Substance Abuse and Addictions Blood Alcohol Concentration and Standard Drink Calculator with liquor database available for download at <http://casaa.unm.edu/dload.html>.

Using self-reported data from the TLFB, the primary drinking outcomes were at-risk drinking and a composite alcohol use variable. At-risk drinking was chosen as the outcome of interest because 1) volume per week obscures important differences in drinking patterns (Russell et al., 2004), 2) is closely associated with health outcomes of interest (Dawson, 2000), and 3) is a common harm reduction strategy adopted by non-treatment seeking populations (e.g., D'Onofrio et al., 2008). In this study, at-risk drinking was defined as > 4 drinks during a single day or > 14 drinks per week for men and > 3 drinks during a single day or > 7 drinks per week for women in the past 3 months per the National Institute on Alcohol Abuse and Alcoholism (NIAAA) (2003). Given the wide range of alcohol use outcomes available in this study, a composite alcohol use variable was created for analyses in addition to at risk drinking. Specifically, we standardized and then computed the mean of three different alcohol use outcomes at each time point: average number of drinks per week,

number of drinks per drinking day, and maximum number of drinks per day. Of note, consistent with Field et al., these three variables were log-transformed prior to standardization due to non-normality. These three outcomes were chosen as the interventions had similar effects across these outcomes (Field et al., 2014). Further, correlations among these outcomes at each time point were of large effect size ($r = .61 - .89$). A similar approach to creating composite alcohol use outcomes has been used in trials of BMI in medical settings (e.g., Barnett et al., 2010).

Alcohol-related problems.—Alcohol-related problems were assessed at baseline and 6- and 12-month follow-up using the 21-item Short Inventory of Problems + 6 (SIP + 6; Soderstrom et al., 2007). The SIP + 6 consists of the 15-item SIP (Miller et al., 1995), which is a short version of the Drinker Inventory of Consequences (Miller et al., 1995), and 6 additional items assessing injury-related behaviors. Participants respond to items on a 5-point response scale ranging from 0 (Never) to 4 (Daily or almost daily) in relation to the past 90 days for baseline and the past 180 days for both 6- and 12-month follow-up. The 21 items were summed to create a total score. The SIP + 6 demonstrated high reliability at all three time points ($\omega = .94$).

Alcohol use severity.—Alcohol use severity was assessed at baseline using the Alcohol Use Disorders Identification Test (AUDIT; Babor et al., 2001; Saunders et al., 1993). The AUDIT includes 3 items that assess alcohol use and 7 items that assess alcohol-related problems. Each item is scored on a scale ranging from 0 to 4 and the individual items are summed to create a total score. As part of its initial development, the AUDIT was validated in samples from six countries for use in primary care settings (Saunders et al., 1993). The AUDIT demonstrated high reliability ($\omega = .88$).

Stages of change.—The 15-item RCQ[TV] (Heather et al., 1999) assesses stages of change in relation to alcohol use (i.e., reduce, quit). Although the RCQ[TV] is a revised version of the original Readiness to Change Questionnaire (RCQ; Rollnick et al., 1992) for treatment-seeking populations, the primary difference between the RCQ[TV] and original RCQ is that the RCQ[TV] references quitting drinking in addition to reduced drinking in the items. Thus, the RCQ[TV] is also applicable to non-treatment seeking populations with the added benefit of incorporating both reduced drinking and abstinence as goals. The RCQ[TV] consists of three subscales, each assessed by 5 items, representing the precontemplation, contemplation, and action stages of change as described by the TTM (Prochaska et al., 1992). Each item is responded to on a 5-point response scale ranging from -2 (Strongly disagree) to 2 (Strongly agree). Mean scores for each of the three subscales were used. The precontemplation, contemplation, and action subscales demonstrated acceptable reliability at both baseline ($\omega = .74$, $\omega = .83$, and $\omega = .86$, respectively) and 3-month follow-up ($\omega = .74$, $\omega = .80$, and $\omega = .88$, respectively) in the present study.

Data Analysis

Descriptive characteristics were computed and compared across treatment groups. To test the hypothesized mediation effects, six tests of multiple mediation (e.g., Preacher and Hayes, 2008) were conducted using full information maximum likelihood (FIML)

estimation in *Mplus* 8 (Muthén and Muthén, 1998-2017). Bias-corrected 95% confidence intervals generated using 10,000 bootstrapped resamples with replacement were used to determine the statistical significance of the indirect effects (MacKinnon et al., 2004). Effect size estimates for statistically significant indirect effects were computed by fully standardizing the indirect effects (e.g., Cheung, 2009), which has been shown to perform better than other measures of effect size for indirect effects (e.g., proportion and ratio; Mio evi et al., 2018). Further, six additional moderated mediation analyses were conducted to compute indices of moderated mediation that test whether the indirect effects were moderated by AUDIT score (Hayes, 2015). Bias-corrected 95% confidence intervals for each index of moderated mediation were generated using 10,000 bootstrapped resamples with replacement to determine statistical significance. For both statistically significant mediation and moderated mediation effects at $p < .05$, we considered 99% confidence intervals as a correction for multiple comparisons. In addition, we tested more parsimonious models excluding control variables when the results of the mediation or moderated mediation analyses were significant as a sensitivity analysis.

Treatment group, a three-category variable, was the focal predictor. Treatment group was represented with two dummy variables where BA was the referent category. Precontemplation, contemplation, and action subscale scores at 3-month follow-up were the mediators. To model change in the mediators, precontemplation, contemplation, and action subscale scores at baseline were entered as covariates. There were three outcome variables of interest assessed at both 6- and 12-month follow-up: 1) a dichotomous variable indicating whether the participant had exhibited a pattern of at-risk drinking in the past three months (Yes = 1, No = 0), 2) a composite alcohol use variable, and 3) SIP + 6 score. Given that there were two focal predictors, three mediator variables, and six outcome variables (three outcome variables at each of two time points), we tested 6 indirect effects in each of 6 models and thus 36 indirect effects in total. Consistent with prior analyses of the data, all analyses controlled for age, gender, race/ethnicity (non-Hispanic white [referent], non-Hispanic black, Hispanic, any other race/ethnicity), educational attainment (at least a high school diploma/GED vs less than a high school education), perceived intent of the injury (intentional vs. not intentional), and recruitment site and baseline AUDIT score (Field et al., 2014). Additionally, based on the findings of Field et al. (2014), in all multiple mediation and models, the product terms of AUDIT and BMI as well as AUDIT and BMI + B were entered as covariates of the outcome variables. In the moderated mediation analyses, these product terms were additionally entered as predictors of each mediator. The number of moderated mediation effects tested is equivalent to the number of indirect effects tested (i.e., 6 per model and 36 in total).

Results

Participant characteristics and variable descriptive statistics are presented in Table 1 for each treatment group. The only statistically significant difference between treatment groups was recruitment site.

Multiple Mediation Analyses

As shown in Tables 2 and 3, BMI + B predicted greater increases in action scores from baseline to 3-month follow-up as compared to BA. Higher action scores at 3-month follow-up predicted a decreased likelihood of at-risk drinking, less alcohol use, and fewer alcohol-related problems at both 6- and 12-month follow-up. The indirect effects of BMI + B on all three alcohol outcomes at both time points through action scores were statistically significant using 95% confidence intervals with small effect sizes according to the conventions (.02 is small, .15 is medium, and .40 is large) proposed by Kenny (2018) (see Table 4). However, only one of these indirect effects was statistically significant using 99% confidence intervals—the effect of BMI + B on SIP + 6 scores at 6-month follow-up through action scores. Finally, a more parsimonious model of the mediation analyses excluding control variables was tested but did not influence the statistically significant results.

No other indirect effects were statistically significant. Neither BMI nor BMI + B (as compared to BA) predicted precontemplation or contemplation scores. However, contemplation scores at 3-month follow-up predicted an increased likelihood of at-risk drinking and more alcohol-related problems at both 6- and 12-month follow-up; precontemplation scores did not predict alcohol outcomes.

Moderated Mediation Analyses

Moderated mediation analyses indicated that none of the indices of moderated mediation were significantly different from zero. Given that none of the indices of moderated mediation were statistically significant, results of the moderated mediation analyses are not presented further.

Discussion

This study demonstrated significant and consistent simple mediation wherein BMI + B increased action leading to reduced likelihood of at-risk drinking, reduced alcohol use and alcohol-related problems at both 6- and 12-month follow-ups at $p < .05$. These mediation effects were small and should be interpreted with caution given the large number of parameters included in the models and the lack of a control for Type I error inflation. Further, only one mediation effect remained statistically significant at a more stringent alpha level of $p < .01$ to account for the multiple comparisons. Future research is needed to replicate the effects of BMI with booster sessions on alcohol outcomes through action. A statistically significant moderating effect of alcohol use severity on the mediating effect of BMI on alcohol outcomes through stages of change was not observed. Given that this study was not initially designed to test the current study hypotheses, additional examination of moderated mediation should be pursued. In addition, other potential models of moderated mediation should be also be considered. Nevertheless, the current study represents a major contribution to the research by examining potential mechanisms of change with a more sophisticated approach using moderated mediation and more nuanced operationalization of readiness (i.e., subscales for each individual stage as opposed to stage allocation).

The current study goes beyond the research by Stein et al. in several important ways and, therefore, advances our understanding of motivation to change as a mediator of brief intervention on drinking outcomes. Although research by Stein et al. contributed to the understanding of the patient characteristics under which changes in readiness result in reductions in alcohol problems, their findings did not allow for conclusions about the patient characteristics under which BMI impacts readiness and, subsequently, alcohol-related problems. Stein et al (2009) also only examined the effect on alcohol related problems and not alcohol use. In addition, Stein et al. used a single item to assess stage of change, specifically, a Contemplation Ladder (Beiner and Abrams, 1991), which assigns participants to a stage of change based on the rung on the ladder chosen by participants. The current study uses a comprehensive assessment of the stages of change by using the RCQ[TV], which assesses precontemplation, contemplation, and action for reducing or quitting drinking using a continuous measure for each. A psychometric evaluation of the RCQ[TV] conducted using data from the present trial supported a three-factor model of the RCQ[TV], which is consistent with previous psychometric evaluations of the RCQ[TV] (e.g., Heather et al., 1999). Furthermore, this psychometric evaluation found that contemplation and action subscale scores demonstrated associations with alcohol outcomes in opposite directions (Richards et al., 2020). These findings suggest against using an overall readiness to change measure using a total score (i.e., [contemplation + action] - precontemplation). Thus, rather than operationalizing motivation as a single construct, the current study test continuous measures of precontemplation, contemplation, and action as mediators simultaneously

A significant strength of the current study over prior studies examining stages of change as a mechanism of change following brief intervention is the use of a multiple mediation model (e.g., Preacher and Hayes, 2008). The advantages of using a multiple mediation model is evidenced in the additional insights it provided into the influence of contemplation on alcohol outcomes. Although unexpected, contemplation at 3-month follow-up significantly and consistently lead to increased likelihood of at-risk drinking, increased alcohol use and alcohol related problems at 6- and 12-month follow up. That is, those higher in contemplation at the 3-month follow-up are more likely to engage in at-risk drinking, drink more, and experience alcohol problems up to one year later. These findings are consistent with a previous analysis of these data which found that higher contemplation scores predicted more alcohol use at 3-month follow-up (Richards et al., 2020). Further, these findings suggest that additional intervention may be required for those who remain ambivalent about making changes in their drinking at 3-months. These findings should be cause for concern as they are among the first findings suggesting negative outcomes following brief motivational intervention, at least for a subgroup of patients.

The integration of the current findings with those from the parent study provide additional insights into the impact of BMI + B. The primary outcome analyses for the parent study demonstrated that BMI + B relative to BA decreased alcohol use at follow-up (Field et al., 2014). The current study suggests that these effects may be due, in part, to the effect of BMI + B on action scores. In addition, the analysis of primary outcomes from the parent study suggested no direct effect of BMI or BMI + B on alcohol-related problems. The present findings suggest that BMI + B indirectly reduced alcohol-related problems through increased action scores. Thus, the findings from the current study suggest that the benefits of

BMI + B in the parent study may be the result of the mediating effect of readiness, specifically action, which is defined as trying to drink less and changes in drinking habits. Increased action is likely a precursor, hence a mediator, to changes in drinking outcomes. However, this is notable because brief interventions are usually conceptualized as primarily decreasing ambivalence, not necessarily increasing action. As mentioned previously, however, these findings should be treated as preliminary given the lack of mediation effects at $p < .01$.

In the current study, we examined the influence of readiness to change by using a continuous measure of readiness for each stage of change simultaneously. This approach contrasts with prior approaches examining readiness as a mediator that either relied on assignment to a discreet stage of change or an overall continuous measure of readiness. In addition to examining mediated moderation, this novel approach may help explain prior null findings of the mediating effect of readiness (Borsari et al., 2009 and Barnett et al., 2010). The use of an overall measure of readiness to change without consideration of the influence of changes within the individual stages following the intervention may underestimate the potential effects of readiness. The finding that action and contemplation have differential and opposite effects on alcohol outcomes should also serve as fair warning to researchers examining the role of readiness to change by combining individual scores on the stages of change to derive an overall measure of readiness. In sum, this study strongly suggests that stages of change need to be examined simultaneously yet separately to accurately using a continuous variable to accurately capture their potential influence.

Researchers (Gaume et al., 2014; Stein et al., 2009) have suggested the use of a moderated mediation framework to better understand the context in which readiness mediates the effects of BMI. This study examined one potential moderator (alcohol use severity) on the effect of BMI on readiness to change (i.e., a path). Herein, we examined the a path as opposed to the b path (as in Stein et al., 2014) because of the potential implications for intervention. Although statistical support for alcohol use severity as a moderator was not found, there may be other variables that moderate the effect of BMI on readiness that were beyond the scope of the present study but warrant future consideration. For example, Barnett et al. (2010) examined drinking at the time of admission to the emergency department, attribution of the medical event to alcohol use, aversiveness of the event as moderators of brief intervention all of which merit consideration as potential moderators of the mediation between readiness and brief intervention. Thus, the extent to which BMI increases readiness may depend on the aversiveness and/or the involvement of alcohol in the injury event. Likewise, there may also be variables that uniquely moderate the mediating effect of readiness on drinking outcomes that were beyond the scope of the present study, such as self-efficacy, discrepancy or perceptions of drinking norms (Gaume, et al., 2014). Thus, moderators of the indirect effects of stages of change merit further theoretical elaboration and empirical validation.

Limitations

Despite the added value of examining moderated mediation and the novel approach to assessing readiness to change as a mediator, this study is not without limitations. First, this is

a secondary analysis and, thus, the present study was not designed to test the proposed moderated mediation effects. Second, the parent study was conducted in an inpatient hospital setting and may, as a result, represent a unique population of non-treatment seeking individuals with alcohol problems. Specifically, these findings may not necessarily generalize for BMIs in other settings, such as primary care. Third, because this study recruited injured patients, it is a predominantly male sample which may influence the examination of alcohol use and alcohol problems as outcomes and, more generally, limit the generalizability of the results. Fourth, we used precontemplation, contemplation and action scores at multiple time points and, to our knowledge, no study has demonstrated longitudinal factorial invariance of the RCQ[TV]. Finally, the study focuses on two specific determinants of treatment outcomes based on prior research (i.e., alcohol use severity and readiness) and is not intended to be an exhaustive model of the treatment process underlying the effectiveness of BMI. Nevertheless, this study refines and elaborates upon prior research that tested readiness as a mechanism of change following BMI for alcohol use among individuals who are not seeking formal treatment for their alcohol use problems.

Conclusion

This study represents an advancement in our understanding of the effect of BMI on drinking outcomes through readiness to change. The current study elaborates on prior research with a more comprehensive assessment of readiness to change which allows for individual assessment of the relevant stages of change using a continuous measure rather than overall measure of readiness. By doing so, action was found to be a consistent mediator of the effects of BMI + B on both alcohol use and alcohol outcomes at 6- and 12-month follow-up. All but one of these mediation effects, however, remained statistically significant using a more stringent alpha level and future research is needed to determine whether action does indeed mediate the effects of more intensive (booster session) BMI. The lack of statistically significant indirect effects for precontemplation and contemplation suggest that there is still much work to be done in understanding the motivational processes underlying changes in drinking following BMI. Other theoretical frameworks of motivation may be useful in this regard, especially self-determination theory as strong parallels between self-determination theory and motivational interviewing have been discussed (e.g., Markland et al., 2005; Miller and Rollnick, 2012b). Of more pressing concern, these findings suggest that supplementary intervention may be helpful for patients who continue to experience ambivalence as they appear prone to continue to engage in at-risk drinking and experience alcohol related problems. However, contrary to hypotheses, the effects of BMI on readiness were not contingent on alcohol use severity in the present study. Future research is needed to further test whether stages of change directly mediate the effects of BMI for alcohol use among seriously injured patients and whether alcohol use severity or other variables moderate this mediation effect. This will likely provide further insight into who benefits from brief interventions in opportunistic inpatient medical settings and how these benefits are conferred, which is essential to advancing knowledge regarding when, where, who and how brief interventions improve alcohol outcomes.

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Table 1

Sample Descriptive Statistics by Intervention Condition (N = 596)

	BA (n = 200)	BMI (n = 203)	BMI+B (n = 193)
Categorical variables	n (%)		
Gender			
Female	44 (22.0)	57 (28.1)	39 (20.2)
Male	156 (78.0)	146 (71.9)	154 (79.8)
Race/ethnicity			
Non-Hispanic White	85 (42.5)	83 (40.9)	69 (35.8)
Black	47 (23.5)	59 (29.1)	52 (26.9)
Hispanic	58 (29.0)	54 (26.6)	60 (31.1)
Other	10 (5.0)	7 (3.4)	12 (6.2)
Education			
Less than GED/diploma	17 (9.0)	19 (10.1)	26 (14.4)
GED/diploma or more	172 (91.0)	170 (89.9)	155 (85.6)
Injury intent			
Unintentional	156 (78.0)	148 (72.9)	131 (67.9)
Intentional	44 (22.0)	55 (27.1)	62 (32.1)
Site *			
Site 1	107 (53.5)	112 (55.2)	102 (52.8)
Site 2	86 (43.0)	77 (37.9)	69 (35.8)
Site 3	7 (3.5)	14 (6.9)	22 (11.4)
At-risk drinking (baseline)			
Yes	84 (42.2)	77 (37.9)	85 (44.0)
No	115 (57.8)	126 (62.1)	108 (56.0)
At-risk drinking (6-month)			
Yes	38 (24.2)	37 (23.7)	28 (18.8)
No	119 (75.8)	119 (76.3)	121 (81.2)
At-risk drinking (12-month)			
Yes	44 (30.3)	30 (21.1)	30 (21.6)
No	101 (69.7)	112 (78.9)	109 (78.4)
Continuous variables	Mean (SD)		
AUDIT (baseline)	11.01 (7.16)	10.15 (7.00)	10.61 (8.00)
Precontemplation (baseline)	-0.33 (3.98)	-0.57 (3.87)	-0.67 (4.09)
Precontemplation (3-month)	0.24 (4.05)	0.27 (4.50)	-0.26 (4.30)
Contemplation (baseline)	0.76 (4.56)	0.38 (4.50)	0.64 (4.82)
Contemplation (3-month)	-0.31 (4.56)	0.01 (4.73)	0.30 (4.37)
Action (baseline)	1.95 (4.84)	1.66 (4.29)	1.80 (4.68)
Action (3-month)	1.98 (4.90)	2.40 (5.06)	2.99 (4.79)
Average drinks (baseline)	20.01 (34.77)	14.95 (23.04)	20.44 (31.56)
Average drinks (3-month)	9.79 (23.77)	8.58 (24.80)	7.00 (19.62)

	BA (n = 200)	BMI (n = 203)	BMI+B (n = 193)
Categorical variables	n (%)		
Average drinks (6-month)	13.94 (31.73)	11.10 (24.20)	10.15 (26.99)
Average drinks (12-month)	14.83 (28.23)	12.76 (31.01)	11.60 (26.87)
Max drinks (baseline)	13.33 (9.65)	12.50 (10.29)	14.51 (13.15)
Max drinks (3-month)	7.86 (14.12)	8.29 (22.11)	5.54 (7.19)
Max drinks (6-month)	9.01 (15.54)	9.35 (18.77)	6.86 (9.31)
Max drinks (12-month)	11.02 (16.46)	10.23 (13.10)	8.84 (11.46)
DDD (baseline)	2.87 (5.00)	2.14 (3.29)	2.97 (4.68)
DDD (3-month)	1.41 (3.40)	1.25 (3.58)	1.00 (2.80)
DDD (6-month)	1.30 (3.31)	2.21 (13.65)	1.85 (8.12)
DDD (12-month)	1.38 (8.10)	0.84 (3.52)	4.32 (45.14)
SIP + 6 (baseline)	11.16 (12.03)	11.89 (12.96)	11.66 (12.60)
SIP + 6 (6-month)	4.68 (8.93)	6.16 (11.56)	5.32 (10.24)
SIP + 6 (12-month)	5.75 (9.91)	6.37 (11.63)	4.85 (9.70)

Note. BA = brief advice; BMI = brief motivational intervention; BMI + B = brief motivational intervention plus telephone booster; AUDIT = Alcohol Use Disorders Identification Test; Precontemplation = Precontemplation subscale of the Readiness to Change Questionnaire (Treatment Version); Contemplation = Contemplation subscale of the Readiness to Change Questionnaire (Treatment Version); Action = Action subscale of the Readiness to Change Questionnaire (Treatment Version); Average drinks = Average number of drinks per week; Max drinks = Maximum number of drinks per day; DDD = Number of drinks per drinking day; SIP + 6 = Short Inventory of Problems + 6.

*
 $p < .05$.

Table 2

Path Estimates for Multiple Mediation Models with 6-month Outcomes

Predictor	Mediators (3-month)			Outcomes (6-month)		
	PC	C	A	At-risk drinking	Alcohol use	SIP + 6
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)
Covariates (baseline)						
Age	-0.04* (0.01)	0.04** (0.01)	-0.02 (0.02)	0.02 (0.01)	0.00 (0.00)	-0.01 (0.03)
Male	0.28 (0.45)	-0.69 (0.43)	-1.12* (0.51)	-0.15 (0.42)	0.12 (0.09)	-0.82 (0.95)
Black	-0.45 (0.52)	1.21* (0.48)	1.08 (0.62)	0.44 (0.53)	0.15 (0.11)	2.13 (1.25)
Hispanic	0.30 (0.45)	0.66 (0.45)	0.09 (0.55)	-0.52 (0.52)	-0.08 (0.10)	-0.96 (0.94)
Other ethnicity	-0.11 (0.83)	-0.41 (0.89)	-0.15 (0.98)	-0.05 (0.81)	-0.15 (0.14)	0.16 (1.37)
Site 3	0.56 (0.80)	-0.14 (0.77)	-0.47 (1.06)	0.69 (0.77)	-0.16 (0.18)	0.15 (1.57)
Site 2	0.09 (0.41)	-0.21 (0.40)	0.03 (0.50)	0.20 (0.42)	0.08 (0.09)	-0.04 (0.98)
Injury intent	-0.00 (0.44)	-0.15 (0.41)	0.15 (0.56)	-0.35 (0.49)	0.06 (0.10)	0.02 (1.09)
Education	0.41 (0.60)	-0.06 (0.64)	0.36 (0.80)	-0.32 (0.74)	-0.02 (0.15)	0.62 (1.44)
SIP + 6	-0.04 (0.02)	0.06* (0.03)	-0.03 (0.03)	-0.02 (0.02)	0.01 (0.01)	0.31** (0.07)
At-risk drinking	-0.24 (0.49)	0.30 (0.51)	-0.75 (0.62)	1.13* (0.48)	0.12 (0.11)	-1.23 (1.14)
Alcohol use	-0.09 (0.29)	-0.13 (0.31)	-0.19 (0.40)	0.81** (0.31)	0.33** (0.07)	1.88* (0.75)
Precontemplation	0.32** (0.06)	-0.05 (0.06)	-0.04 (0.07)	-0.05 (0.07)	0.01 (0.01)	0.16 (0.15)
Contemplation	-0.12 (0.07)	0.34** (0.07)	0.18* (0.09)	0.09 (0.08)	0.01 (0.01)	-0.05 (0.15)
Action	-0.03 (0.05)	0.01 (0.05)	0.27** (0.07)	-0.13* (0.06)	-0.02* (0.01)	-0.09 (0.10)
Predictors (baseline)						
AUDIT	0.01 (0.04)	0.09* (0.04)	0.06 (0.05)	0.07 (0.05)	0.04** (0.01)	0.23 (0.15)
BMI	0.06 (0.42)	0.39 (0.41)	0.53 (0.53)	0.80 (0.83)	0.39* (0.15)	0.90 (1.70)
BMI + B	-0.41 (0.41)	0.53 (0.42)	1.24* (0.53)	1.06 (0.88)	0.22 (0.15)	3.46* (1.58)
BMI x AUDIT				-0.06 (0.06)	-0.03* (0.01)	0.02 (0.19)
BMI + B x AUDIT				-0.13* (0.06)	-0.04** (0.01)	-0.31 (0.17)
Mediators (3-month)						

Predictor	Mediators (3-month)				Outcomes (6-month)			
	PC	A	At-risk drinking	Alcohol use	SIP + 6			
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)			
Precontemplation			0.00 (0.06)	0.02 (0.01)	-0.12 (0.14)			
Contemplation			0.13 * (0.05)	0.04 ** (0.01)	0.63 ** (0.15)			
Action			-0.18 ** (0.04)	-0.05 ** (0.01)	-0.50 ** (0.10)			

Note. Statistically significant regression coefficients are emphasized in boldface. BMI = effect of brief motivational intervention versus brief advice; BMI + B = effect of brief motivational intervention plus telephone booster versus brief advice; AUDIT = Alcohol Use Disorders Identification Test; PC = Precontemplation subscale of the Readiness to Change Questionnaire (Treatment Version); C = Contemplation subscale of the Readiness to Change Questionnaire (Treatment Version); A = Action subscale of the Readiness to Change Questionnaire (Treatment Version); Alcohol use = Composite alcohol use variable; SIP + 6 = Short Inventory of Problems + 6.

* $p < .05$.
** $p < .01$.

Table 3

Path Estimates for Multiple Mediation Models with 12-month Outcomes

Predictor	Mediators (3-month)				Outcomes (12-month)			
	PC	C	A	At-risk drinking	Alcohol use	SIP + 6		
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)		
Covariates (baseline)								
Age	-0.04* (0.02)	0.04** (0.01)	-0.02 (0.02)	0.03 (0.01)	-0.00 (0.00)	-0.02 (0.03)		
Male	0.28 (0.45)	-0.69 (0.43)	-1.12* (0.51)	-0.46 (0.38)	0.15 (0.10)	-2.07 (1.19)		
Black	-0.44 (0.52)	1.20* (0.48)	1.08 (0.62)	0.58 (0.48)	0.17 (0.11)	3.27* (1.40)		
Hispanic	0.30 (0.45)	0.66 (0.45)	0.10 (0.55)	0.09 (0.47)	0.05 (0.11)	0.10 (1.07)		
Other ethnicity	-0.12 (0.83)	-0.40 (0.89)	-0.14 (0.98)	0.35 (0.75)	0.16 (0.20)	1.58 (1.61)		
Site 3	0.57 (0.80)	-0.15 (0.77)	-0.47 (1.06)	-1.15 (2.30)	-0.31 (0.19)	-0.67 (2.06)		
Site 2	0.09 (0.41)	-0.21 (0.40)	0.01 (0.50)	0.45 (0.39)	0.09 (0.09)	1.35 (1.08)		
Injury intent	-0.01 (0.44)	-0.15 (0.41)	0.15 (0.56)	-0.52 (0.47)	0.061 (0.11)	-1.21 (1.12)		
Education	0.40 (0.60)	-0.07 (0.64)	0.35 (0.80)	0.05 (0.67)	-0.01 (0.16)	-0.85 (1.40)		
SIP + 6	-0.04 (0.02)	0.06* (0.03)	-0.03 (0.03)	-0.00 (0.02)	0.01 (0.01)	0.28** (0.08)		
At-risk drinking	-0.24 (0.49)	0.31 (0.51)	-0.74 (0.62)	1.51** (0.51)	0.22 (0.12)	-0.18 (1.18)		
Alcohol use	-0.09 (0.29)	-0.13 (0.31)	-0.19 (0.40)	0.40 (0.31)	0.29** (0.08)	1.44 (0.88)		
Precontemplation	0.32** (0.06)	-0.05 (0.06)	-0.04 (0.07)	0.01 (0.07)	0.03* (0.01)	0.23 (0.15)		
Contemplation	-0.12 (0.07)	0.33** (0.07)	0.18* (0.09)	-0.00 (0.07)	0.01 (0.02)	-0.08 (0.16)		
Action	-0.03 (0.05)	0.01 (0.05)	0.27** (0.07)	-0.04 (0.05)	-0.01 (0.01)	0.04 (0.13)		
Predictors (baseline)								
AUDIT	0.01 (0.04)	0.09* (0.04)	0.06 (0.05)	0.02 (0.04)	0.03** (0.01)	0.21 (0.16)		
BMI	0.06 (0.42)	0.39 (0.41)	0.53 (0.53)	-0.59 (0.76)	0.167* (0.17)	1.95 (1.91)		
BMI + B	-0.40 (0.41)	0.53 (0.42)	1.22* (0.53)	-0.14 (0.73)	0.32 (0.16)	1.85 (1.89)		
BMI x AUDIT				0.01 (0.05)	-0.02** (0.02)	-0.13 (0.20)		
BMI + B x AUDIT				-0.03 (0.06)	-0.05 (0.02)	-0.25 (0.20)		
Mediators (3-month)								

Predictor	Mediators (3-month)				Outcomes (12-month)			
	PC	C	A	At-risk drinking	Alcohol use	SIP + 6		
	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)	B (SE)		
Precontemplation				0.01 (0.05)	0.01 (0.01)	-0.24 (0.13)		
Contemplation				0.14** (0.05)	0.04** (0.01)	0.57** (0.15)		
Action				-0.19** (0.04)	-0.04** (0.01)	-0.43** (0.10)		

Note. Statistically significant regression coefficients are emphasized in boldface. BMI = effect of brief motivational intervention versus brief advice; BMI + B = effect of brief motivational intervention plus telephone booster versus brief advice; AUDIT = Alcohol Use Disorders Identification Test; PC = Precontemplation subscale of the Readiness to Change Questionnaire (Treatment Version); C = Contemplation subscale of the Readiness to Change Questionnaire (Treatment Version); A = Action subscale of the Readiness to Change Questionnaire (Treatment Version); Alcohol use = Composite alcohol use variable; SIP + 6 = Short Inventory of Problems + 6.

* $p < .05$.

** $p < .01$.

Table 4

Summary of the Statistically Significant Mediation Effects

Path	<i>ab</i>	95% BCI	99% BCI	Std. <i>ab</i>
BMI + B → Action → At-risk drinking (6-month)	-0.217	-0.463, -0.019	-0.557, 0.053	-0.040
BMI + B → Action → Alcohol use (6-month)	-0.064	-0.131, -0.014	-0.152, 0.002	-0.031
BMI + B → Action → SIP + 6 (6-month)	-0.614	-1.316, -0.164	-1.548, -0.012	-0.027
BMI + B → Action → At-risk drinking (12-month)	-0.228	-0.479, -0.006	-0.588, 0.066	-0.043
BMI + B → Action → Alcohol use (12-month)	-0.049	-0.109, -0.010	-0.132, 0.003	-0.024
BMI + B → Action → SIP + 6 (12-month)	-0.520	-1.195, -0.115	-1.431, 0.012	-0.023

Note. BMI + B = effect of brief motivational intervention plus telephone booster versus brief advice; A = Action subscale of the Readiness to Change Questionnaire (Treatment Version); Alcohol use = Composite alcohol use variable; SIP + 6 = Short Inventory of Problems + 6; *ab* = estimate of the indirect effect, or cross-product of the coefficients of the *a* and *b* paths; 95% BCI = 95% confidence interval constructed around the indirect effect using bias-corrected bootstrapping with 10,000 resamples; 99% BCI = 99% confidence interval constructed around the indirect effect using bias-corrected bootstrapping with 10,000 resamples; Std. *ab* = estimate of the completely standardized indirect effect.