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Brief Motivational and Parent Interventions For College Students: A Randomized Factorial Study

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Abstract

Objective—Using a randomized factorial design, we examined the efficacy of a Brief Motivational Intervention (BMI) and Parent-based Intervention (PBI) as universal preventive interventions to reduce alcohol use among incoming college students.

Method—Participants (N = 1,014) were assessed prior to matriculation and at 10-months and 22-months post-baseline. Two-part latent growth modeling was used to simultaneously examine initiation and growth in heavy episodic drinking and alcohol-related consequences.

Results—This study retained 90.8% (n = 921) of randomized students at the 10 month follow-up and 84.0% (n = 852) at the 22-month follow-up. BMI participants were significantly less likely than non-BMI participants to initiate heavy episodic drinking and to begin experiencing alcohol-related consequences. Effect sizes were minimal at 10-months (Cohen's h ranged from 0.02–0.07) and small at 22-months (h's from 0.15–0.22). A significant BMI X PBI interaction revealed that students receiving both the BMI and PBI were significantly less likely to report the onset of consequences beyond the sum of the individual intervention effects (h = 0.08 at 10-month and 0.21 at 22-month). Hypothesized direct BMI effects for reductions in heavy episodic drinking and consequences were not observed. Significant mediated effects via changes in descriptive norms were present for both growth and initiation of heavy episodic drinking and consequences.

Conclusions—To our knowledge, the current study is the first to provide support for BMI as a universal preventive intervention for incoming college students. While hypothesized PBI main effects were not found, mediation analyses suggest future refinements could enhance PBI effectiveness.

Keywords

Alcohol; college student; preventive intervention; randomized factorial trial; parent

Alcohol misuse among college students is a longstanding area of concern, with prevalence rates for heavy episodic drinking demonstrating stability at around 40% for more than 25 years (O'Malley & Johnston, 2002). Alcohol use is linked to approximately 1,825 college student deaths annually in the US and is implicated in more than 796,000 violent and sexual assaults (Hingson, Zha, & Weitzman, 2009). Thus, reduction of heavy episodic drinking among college students has been identified as a primary objective by the Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism (2002).

Matriculation into college is typified by increases in alcohol consumption and associated negative consequences (Sher & Rutledge, 2007). A host of factors, such as a more alcohol-supportive environment and independence from day-to-day parental monitoring, influence the high rates of underage alcohol use and misuse observed in the college population. Thus, entry into college is a period of critical importance for preventive interventions targeting heavy episodic drinking and alcohol-related negative consequences.

Brief Motivational Intervention

To date, brief motivational interventions (BMIs) are the most empirically supported individual-level interventions for reducing alcohol use and consequences among heavy drinking freshmen and upper-level adjudicated students (Carey, Henson, Carey, & Maisto, 2007; Larimer & Cronce, 2002, 2007; Marlatt et al., 1998; Wood, Capone, Laforge, Erickson, & Brand, 2007). The primary goal of BMIs with college student drinkers is to reduce alcohol-related harmful consequences by encouraging students to moderate consumption and avoid high-risk behaviors. BMIs incorporate principles of motivational interviewing (MI), such as empathetic and reflective listening (Miller & Rollnick, 2002), and commonly include the provision of individualized feedback (Dimeff, Baer, Kivlahan, & Marlatt, 1999). Feedback typically consists of information about the student's alcohol use, peer and environmental influences on drinking, and reflects the student's beliefs about alcohol. BMIs present normative information on college student drinking to correct students' inflated perceptions of the amount of alcohol that college students typically consume (i.e., descriptive norms).

Despite the demonstrated efficacy of BMIs across a plethora of studies (see Larimer & Cronce, 2002, 2007), several questions remain. First, the Institute of Medicine (1994) has indicated that universal preventive interventions are a research priority, but traditionally, BMIs have treated populations of adjudicated or at risk students only. Expanding BMIs to include abstainers and lighter drinkers could prevent and/or delay the onset of risky drinking during emerging adulthood (Spoth, Trudeau, Guyll, Shin, & Redmond, 2009). Second, the short-term success of BMIs is well-documented (e.g., one week to six months), but only one study with college students has examined BMI outcomes beyond one year (Marlatt et al., 1998). Third, further investigation into BMI mechanisms of action is a research priority (Apodaca & Longabaugh, 2009). Although changes in descriptive norms have been shown to mediate intervention effects (Borsari & Carey, 2000; Walters, Vader, Harris, Field, & Jouriles, 2009; Wood et al., 2007), many other cognitive and behavioral processes are hypothesized to be active elements of BMI. These include factors related to heavy drinking, such as motivational readiness to change

drinking behavior, self-regulation of alcohol use, and alcohol control strategies (Carey et al., 2007; Larimer et al., 2007). BMIs target self-regulation processes by addressing self-monitoring and self-evaluation techniques and teach specific behavioral strategies believed to reduce alcohol use, such as tracking drinks and avoiding drinking games. These behavioral strategies are discussed using a motivational interviewing style to increase discrepancy and increase motivation to change drinking behavior. Very little research has examined these important processes despite initial evidence suggesting their importance in mediating and moderating BMI effects (Carey et al., 2007; Larimer et al., 2007).

Parent-Based Interventions

Previous research has supported the efficacy of family-based interventions with younger adolescents (Brody et al., 2006; Dishion, Nelson, & Kavanagh, 2003). Extending these efforts to the college population has been recommended (Task Force of the National Advisory Council on Alcohol Abuse and Alcoholism, 2002). The period between ages 18 and 25 represents a unique developmental stage between youth and adulthood that is characterized by the continued influence of and reliance on parents (Arnett, 2000). A growing body of research indicates that parents influence alcohol-related beliefs (Turrisi, Wiersma, & Hughes, 2000) and moderate peer influences on alcohol use throughout the college years (Wood, Read, Mitchell, & Brand, 2004). To date, results from three studies using parent-based interventions (PBI) to reduce college student alcohol use have been reported. Turrisi, Jaccard, Taki, Dunnam, and Grimes (2001) compared drinking outcomes of matriculating college freshmen whose mothers received a handbook the summer before college (n = 106) to a post-test only group (n = 48). At the three-month follow-up, students in the PBI group demonstrated significantly lower alcohol use and consequences than those in the control group. Ichiyama et al. (2009) randomly assigned 724 incoming freshman-parent dyads to PBI or intervention-as-usual groups. PBI effects were observed for both the initiation of alcohol use and for growth in drinking over time. PBI women, but not PBI men, demonstrated less growth in weekly drinking over the 8-month follow-up period. Turrisi et al. (2009) recently examined BMI and PBI with a college matriculating high-risk sample (high school athletes). No PBI effects were observed. There were significant intervention effects on both consumption and consequences for the combined BMI-PBI condition, but cautious interpretation of these findings is warranted due to significant differential attrition, which was greatest in the combined condition.

These initial PBI results are encouraging but refinement of PBI research is needed. For example, mediation analyses for PBI effects have been limited to parental disapproval of alcohol use (e.g. students' perceptions of how acceptable their own alcohol use is to their parents, also termed "parent's injunctive norms"; Turrisi et al., 2009). Constructs such as parent-teen communication (Turrisi et al., 2000), disapproval of drinking (Ary, Tildesley, Hops, & Andrews, 1993), and parental monitoring (Barnes, Reifman, Farrell, & Dintcheff, 2000) are also targeted in the PBI but have not been examined as mechanisms of effect. Turrisi et al. (2000) found that college students who discussed negative effects and misconceptions about alcohol with their mothers held less positive beliefs about alcohol's effects, suggesting communication is an important mechanism to consider. In addition, Wood and colleagues (2004) found that parental monitoring and disapproval of heavy drinking were negatively related to heavy episodic drinking among college students, while drinking permissiveness was positively related.

Peer influences (targeted by the BMI) and parental influences (targeted by the PBI) are key elements in decision making regarding alcohol use during college, providing a rationale for interventions that target these factors. Parents and peers represent divergent but important reference groups who can deliver distinct but potentially complementary interventions (Turrisi et al., 2009). By combining a BMI and PBI in a single factorial design, the unique and combined

influence of these interventions can be examined and their putative mechanisms can be further evaluated through a systematic examination of hypothesized mediators.

The Current Study

The current study was designed to extend previous research and address critical, unresolved issues pertaining to the use of BMIs and PBIs as universal preventive interventions with incoming college students. First, the varied drinking experience of a matriculating college sample facilitates simultaneous examination of intervention effects on initiation as well as growth in heavy episodic drinking and consequences (Brown, Catalano, Fleming, Haggerty, & Abbott, 2005). Heavy episodic drinking, in particular, has been associated with alcohol-related consequences, and both are important from a harm reduction perspective (Wechsler, Lee, Kuo, & Lee, 2000). Second, this study used a factorial design, a much needed but underutilized approach for examining combined intervention effects in randomized trials (Couper, Hosking, Cisler, Gastfriend, & Kivlahan, 2005). Third, a relatively large sample enables systematic examination of putative mediators of intervention effects. Fourth, intervention effects are examined over a 22-month follow-up period.

The primary aims of this study were twofold. First, we examined the effects of BMI and PBI, alone and in combination through the use of the factorial design. It was hypothesized that participants receiving either intervention would be less likely to initiate heavy episodic drinking and to begin experiencing alcohol consequences and would also exhibit less growth in alcohol outcomes over time relative to participants who did not receive the intervention. It was hypothesized that the effects of BMI and PBI would be multiplicative, such that combining the interventions would have a synergistic effect.

Second, we tested the hypotheses that BMI effects are mediated by changes in descriptive norms, drinking strategies, self-regulation, and readiness to change heavy drinking and that PBI effects are mediated by changes in parental permissiveness for drinking, parental disapproval **of alcohol use**, parental monitoring, and drinking-related communication.

Method

Design

The study utilized a 2 × 2 × 3 factorial design, crossing a Brief Motivational Intervention (BMI; yes, no) and a Parent-Based Intervention (PBI; yes, no), with one within-subjects factor (Time; baseline, 10 months, and 22 months). Over two consecutive years, cohorts of parent-student dyads were recruited and randomized by dyad to one of four experimental conditions: BMI only, PBI only, BMI and PBI, or an Assessment-Only Control Group. Urn randomization by computer algorithm was used to ensure that the experimental conditions were balanced on prognostic indicators of college student alcohol use including gender, frequency of heavy episodic drinking, and baseline readiness to change heavy drinking. Participants were not informed of their study condition until after baseline assessments were completed.

Baseline data were collected from students and parents during the summer prior to college matriculation. Follow-ups occurred at 10 and 22 months post-baseline for students and at 12 months post-baseline for parents. Each assessment lasted approximately 45–60 minutes. All assessment data were collected using computer-assisted telephone interviews administered by a local university-based survey center. Interviewers were not members of the research team, were blind to experimental condition, and were trained and monitored in standardized interviewing procedures. Consent forms were mailed to the student/parent household prior to recruitment. All participants provided verbal consent. Parents provided verbal consent for

students under 18 years of age at baseline. All procedures were approved by the university's Institutional Review Board.

Participants

In two successive cohorts, participants (N = 1,014 parent-student dyads) were recruited during the summer prior to matriculation at a mid-sized public northeastern university. The target population was entering full-or part-time students ages 17 to 21. The student sample was 57% (n = 580) women with a mean age of 18.4 years (SD = 0.41) at baseline. The student sample was 89% (n = 906) White/Caucasian, 5% (n = 49) Hispanic, 4% (n = 39) Black/African American, 1% (n = 12) Asian, and 6% (n = 57) "other" (categories are not mutually exclusive). The sample did not differ from the population of incoming students with respect to gender and ethnicity, but did differ in terms of race, X^2 (3, N = 4940) = 11.35, $p < .01$, with slightly less sample representation of African American (4.1% vs. 5.3%) and Asian American (1.2% vs. 2.9%) students. The parent sample (or other legal guardians) was 59% (n = 594) women and 95% (n = 959) were biological parents.

All incoming students were eligible for participation unless they were transfer students, married, not living with a parent/guardian, or reached the alcohol use cut-off criteria (≥40 drinks per week and two symptoms of alcohol dependence). Students (n = 1,537) were contacted by telephone, and 75% (n = 1,155) consented and completed baseline, 16% (n = 252) were ineligible, and 8% (n = 130) refused participation (see Figure 1). Following student recruitment, one parent was randomly selected as the recruitment target. The second parent (when available) was subsequently recruited upon refusal. In all, 1,014 dyads were randomized. Power analyses for the funded grant proposal were conducted for the analysis of variance and hierarchical multiple regression analyses originally proposed. According to those calculations, the sample size was sufficient for detection of small to moderate effect sizes for both main and interaction effects with statistical power > .80. To reduce the possibility of Type I errors in the two-part latent growth curve modeling analyses reported here, we limited our analyses to two outcomes of central interest in harm-reduction interventions: heavy episodic drinking and alcohol consequences.

Measures

Measures used in the current analyses were completed by students at baseline, 10 months, and 22 months. Mean scales were calculated for measures with more than two items, except where otherwise indicated. Coefficient alphas are reported across all time points. Student participants provided demographic information regarding gender, age, race, ethnicity, intended fraternity/sorority involvement, and residential status.

Outcomes

Heavy episodic drinking: Gender-specific heavy episodic drinking was assessed by asking, via an open-ended response format, the number of times in the last month that students had consumed five or more drinks [four or more for women] in a row (Wechsler et al., 2000). One drink was defined as one shot of liquor, 12 ounces of beer, or a 4-ounce glass of wine. "In a row" was defined as one occasion without any breaks of an hour or longer.

Alcohol consequences: Alcohol consequences were assessed with a 17-item version of the Young Adult Alcohol Problems Screening Test (Hurlbut & Sher, 1992). The scale assessed past 3-month frequency of alcohol consequences with response options ranging from 1 (*no, not in the past 3 months*) to 5 (*10 or more times*). For each item, responses were recoded as an estimate of the number of occurrences [e.g., response option "5" (10 or more times) recoded to "12.5"]. Mean scores were then computed across the 17 recoded items (α's = .80–88).

BMI mediators

Descriptive norms: Descriptive norms for alcohol use were measured with two items adapted from the Drinking Norms Rating Form (Baer, Stacy, & Larimer, 1991). Open-ended items assessed perceived quantity and frequency of alcohol use with reference to the typical (target) university student of the participant's gender. The quantity and frequency items were multiplied to reflect drinks per week.

Self-regulation of alcohol use: Self-regulation of alcohol use was measured with a 12-item scale (Wood et al., 2007) assessing (over the past 30 days) respondents' awareness of how much and how often they drank, their drinking compared to their peers, and other BMI-related content (e.g., I have thought about strategies I can use to limit how much I drink) (α's = .89-.93). Response options ranged from 1 (*not at all*) to 5 (*a great deal*).

Drinking strategies: Strategies used to reduce alcohol consumption were assessed with a 9-item scale (α's = .80–82) that was created for the present study based on BMI content (e.g., How often do you count your drinks? How often do you alternate between alcoholic and non-alcoholic beverages?). Response options ranged from 1 (*not at all*) to 5 (*a great deal*).

Readiness to change heavy episodic drinking: Readiness to change heavy episodic drinking was assessed with a five-item measure (Laforge, Maddock, & Rossi, 1998). An algorithm was used to classify participants into one of the five stages of change (i.e., pre-contemplation, contemplation, preparation, action, maintenance) based on whether they had engaged in heavy episodic drinking (in the past 30 days, six months, or ever), and, if so, whether they intended to stop (in the next 30 days or six months).

PBI mediators

Parent-teen communication about drinking: Drinking-related communication between parents and students was assessed using a 24-item scale, which had been previously adapted to adhere to PBI content (Turrisi et al., 2000) (α = .96 at all time points). Participants indicated whether they had discussed the following topics with their parents: alcohol use, alternatives to drinking, peer/environmental influences on alcohol use, risk-reduction strategies, and alcohol consequences. Response options ranged from 1 (*not at all*) to 4 (*a great deal*).

Parental disapproval and permissiveness: Perceived parental disapproval of alcohol use and impaired driving was assessed with four items that had been previously modified from the Monitoring the Future Study (Johnston, O'Malley, & Bachman, 1996; see also Abar & Turrisi, 2008; Wood et al., 2004). Items assessed how participants thought their parents would feel if they: (a) drank one or two drinks on one occasion, (b) drank four or five drinks on one occasion, (c) drank five or more drinks at once, and (d) drove after having five or more drinks (α's = .68–70). Response options ranged from 1 (*don't disapprove*) to 3 (*strongly disapprove*). Parental permissiveness toward alcohol use was assessed by two questions with open-ended response options that asked students to indicate the number of drinks that each parent would consider to be an upper limit for them to consume on any occasion (Wood et al., 2004).

Parental monitoring: Parental monitoring was measured with a modified version of the Strictness/Supervision Scale whereby only items that appeared more relevant to older adolescents were selected (Abar & Turrisi, 2008; Wood et al., 2004). Our scale included two 4-item subscales that asked students what their parents *try* to know and what their parents *actually* know about their behaviors (α's = .75–.78). Students were asked: "How much do your parents *try* to know/*really* know: (a) where you go at night? (b) what you do with your free time? (c) where you are most afternoons after school? and (d) about your drinking? The two items referring to parents' knowledge of the adolescent's drinking were added in the current

study. Response options were 1 (*don't try/don't know*), 2 (*try a little/know a little*), and 3 (*try a lot/know a lot*).

Intervention Procedures

BMI procedures—The BMI was based on the BASICS program (Dimeff et al., 1999; Marlatt et al., 1998) and included two semi-structured in-person sessions that took place in private, on-campus project spaces. Students met with trained interventionists ($n = 16$). All interventionists held a bachelor's degree or higher, and ten were clinical psychology graduate students. The initial BMI took place during the fall semester of the freshman year and lasted approximately 45–60 minutes. Individualized feedback was used to guide the BMI sessions (Larimer & Cronce, 2007). The feedback data were gathered through an online survey, accessed through an e-mailed link, and completed within two weeks of the scheduled appointment to ensure the use of proximal feedback reflecting current drinking. This survey included questions on alcohol use, consequences, and socio-environmental influences on college drinking. Feedback was tailored so that drinkers received information on their personal drinking patterns, heavy episodic drinking, and alcohol-related consequences. Abstainers received feedback on the safety and health benefits of their choice not to drink, their experiences with second-hand effects of alcohol use, and perceived barriers for maintaining abstinence.[1] Intervention components regarding blood alcohol content, alcohol expectancies, peer and environmental influences on alcohol use, and drinking norms were delivered to all students regardless of drinking status. Self-regulation and harm reduction strategies were discussed, including self-monitoring, not drinking on an empty stomach, counting drinks, slowing consumption rates, and alternating between alcoholic and non-alcoholic beverages.

In the spring of the freshman year, students received a BMI booster session. This session, which lasted 20–30 minutes, was designed to refresh the students' memories of principles discussed in the first session as well as to provide ipsative feedback regarding change in the students' alcohol use over the course of the freshman year. Individualized feedback was created from the original online survey and 10 month follow-up assessment, with feedback tailored according to current and previous drinking status.

PBI Procedures—The PBI is a handbook-based intervention modified from Turrisi and colleagues (2001). It was designed to raise parental awareness of alcohol abuse and consequences among college students and increase parental effort to address this issue with their teen. From its original abstinence-oriented focus, we revised the handbook to include constructs that have shown promotive or protective effects in previous etiologic research, such as encouraging clear expectations about alcohol use (Brody et al., 2004), monitoring (Barnes et al., 2000), and drinking-related communication (Brody et al., 2004). The PBI was mailed to parents in the summer (May–August) prior to college matriculation. The 32-page handbook contained three chapters. Chapter 1 provided an overview of college student alcohol abuse and risks and encouraged parents that their efforts to talk with their son or daughter could make a difference. Chapter 2 provided strategies to enhance general and alcohol-specific communication between parent and teen. Chapter 3 provided strategies on teaching teens to deal with social pressure to drink and identified parental behaviors known to reduce teen drinking, such as parental monitoring, and disapproval of heavy drinking. Parents were mailed a PBI booster in the summer prior to the students' second year of college. This three-page handout included a link to a website containing the original PBI, aggregated student data on alcohol use and consequences from the baseline assessment, and a synopsis of handbook content that parents had evaluated as most useful. Issues especially relevant to the second year of college (e.g., moving to off-campus locations) were also presented.

[1]Additional information on the BMI and PBI interventions used here is available from the first author.

Intervention integrity—To ensure standardized delivery of the BMI, interventionists received two full days of training and were required to demonstrate competency through a supervised role play prior to conducting BMI sessions. During BMI administration, group supervision meetings (1.5 hours) were conducted weekly. Fidelity checks were carried out regularly throughout the study. Each week the supervisor[2] coded two randomly selected audiotapes in their entirety, using the Motivational Interviewing Treatment Integrity scale (Moyers, Martin, Manuel, Hendrickson, & Miller, 2005). The supervisor then provided written feedback to interventionists regarding the use of BMI techniques and adherence to protocol. Student participants and interventionists completed session evaluation forms after each session. These forms contained questions with regards to interventionist adherence to MI principles of empathy, non-judgment, and enhancing self-efficacy, as well as questions regarding BMI content, satisfaction, and usefulness. These questions were rated using Likert scales. To ensure PBI fidelity, all parents received an assessment asking them the extent to which they read, understood, and were satisfied with the parent handbook and how interesting, useful, and relevant they found each chapter. The assessment was mailed with the handbook and a postage paid return envelope. Parents who did not return the evaluation materials were contacted by telephone.

Follow-Up Procedures

Students completed telephone follow-ups at 10 and 22 months. Graduated incentives were offered to students, beginning with $30 at baseline, $40 at 10 months, and $50 at 22 months. For each cohort, a $200 cash prize was awarded to one student randomly selected from those who had completed all assessments. Parents received $40 for each assessment.

Overview of Statistical Analyses

Outcome analyses—Using Mplus Version 5 (Muthén & Muthén, 1998–2007), we fit two-part latent growth curve models (LGCM; Brown et al., 2005; Olsen & Schafer, 2001) to examine intervention effects on transitions into heavy episodic drinking and consequences and growth on these outcomes (Figure 2). Part 1 of the two-part LGCM evaluated binary outcome variables that distinguished no heavy episodic drinking (coded 0) from at least one episode of heavy episodic drinking (coded 1) and no consequences (coded 0) from at least one consequence (coded 1), therefore, evaluating intervention effects on the likelihood of transitioning to heavy episodic drinking or consequences. Part 2 examined intervention effects on growth in heavy episodic drinking and consequences by evaluating log-transformed continuous variables reflecting the frequency of non-zero responses. Part 1 was analyzed as a random-effects logistic growth model for categorical data, while Part 2 used conventional latent growth curve modeling techniques. Full-information maximum likelihood estimation with robust standard error estimation, which assumes data are missing at random, was used in both Parts 1 and 2 (Schafer & Graham, 2002).

For each outcome, the two parts of the model were first fit separately as unconditional models. Fit of Part 1 was evaluated using an adjusted chi-square difference test for the log-likelihood values, comparing intercept-only models to models that included intercept and linear slope factors.[3] Fit of Part 2 was evaluated using an adjusted chi-square difference test for the log-likelihood values as well as the Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA) for the intercept only models and models that included intercept and linear slope factors. We then estimated unconditional two-part LGCMs that conjointly estimated Parts 1 and 2, allowing for covariation among the latent factors across the two parts.

[2]Ph.D. level clinical psychologist with extensive BMI experience.

[3]Chi-square difference tests were conducted using the log-likelihood values and scaling correction factors obtained with the MLR estimator in Mplus, following guidelines provided by Muthén and Muthén, available at http://www.statmodel.com/chidiff.shtml.

Finally, gender and the three intervention codes were included in the conditional two-part models. Consistent with the factorial design, we tested for the BMI main effect, the PBI main effect, and the BMI X PBI interaction (Couper et al., 2005). Main effects compared participants who received the intervention to those who did not (e.g., BMI main effect: BMI group and combined BMI-PBI group compared to PBI group and assessment-only group). The interaction effect tests for the presence of a multiplicative (i.e., synergistic) effect when the two interventions are combined, such that the total intervention effect when combined is greater than the sum of the individual intervention effects. All analyses were conducted as intent-to-treat.

Mediation analyses—For BMI mediators, we examined descriptive norms, self-regulation of alcohol use, drinking strategies, and readiness to change heavy drinking separately for each outcome. For PBI mediators, we examined perceived parental permissiveness for drinking, monitoring, parents' disapproval of alcohol use, and drinking-related communication separately for each outcome. Descriptive norms at baseline and 10 months demonstrated skew and kurtosis greater than 2 and 4, respectively, and we adjusted "far outliers" to equal one value greater than the largest non-far outlying value, which resulted in skew and kurtosis values below 2 and 4. Since mediation may exist in the absence of an overall intervention effect, mediated effects were examined regardless of the overall intervention effects (MacKinnon, 2008). Mediators were assessed at baseline and 10 months in order to control for the baseline measure of the mediator. Only drinkers were assessed on drinking strategies and self-regulation; as a result, only participants who were drinkers at baseline (n = 732) were included in the analyses for those two mediators. In addition, only students engaging in heavy episodic drinking at baseline were included in the mediation analysis for readiness to change heavy drinking (n = 641). In all mediation analyses, we estimated the effects of the BMI, PBI, and BMI X PBI on the 10 month mediator, which allowed us to examine whether the BMI or PBI affected any of the hypothesized mediators (i.e., for either the BMI or PBI). Paths were also estimated from the 10 month mediator to the slope factors in both parts of the model. We used the distribution of the product method and asymmetric 95% confidence intervals to test the indirect effects (MacKinnon, 2008; MacKinnon, Fritz, Williams, & Lockwood, 2007). Support for mediation was evidenced by: 1) a significant path from the intervention to the 10 month mediator, 2) a significant path from the 10 month mediator to the slope factor in Part 1 or Part 2 of the model, 3) a significant test of the indirect effect, and 4) asymmetric confidence intervals that did not include zero.

Results

Descriptive Statistics

Twenty-eight percent of students (n = 281) reported abstaining from alcohol for at least one year prior to the baseline assessment, decreasing to 17% (n = 154) at the 10 month follow-up, and 13% (n = 112) at the 22 month follow-up (percentages adjusted for attrition). Approximately half of the baseline sample (49%, n = 497) reported one or more episodes of heavy episodic drinking in the past month. The mean number of heavy episodic drinking episodes was 1.94 (SD = 3.02) at baseline, 2.70 (SD = 3.44) at 10 months, and 3.28 (SD = 3.86) at 22 months. At baseline, 57% (n = 576) of students reported experiencing one or more alcohol-related consequence in the past three months. The mean number of consequences experienced was 5.39 (SD = 7.67) at baseline, 6.27 (SD = 8.59) at 10 months, and 7.2 (SD = 9.34) at 22 months.

Intervention Delivery and Fidelity

A majority of the 502 participants[4] in the BMI conditions received the BMI and booster sessions (95% and 90% respectively; see Figure 1). A majority of the students completed the

pre-intervention assessments used to generate personalized feedback (90% for the first BMI and 89% for the booster). For participants who did not complete the pre-intervention assessment, feedback was created using data from the most recently completed assessment. BMI evaluations were completed by 87% ($n = 414$) of participants. Both drinkers and abstainers reported that all key elements were delivered for at least 95% ($n = 692$) of the in-person sessions. Most students (92%) indicated high clinician rapport, empathy, and professionalism, and 88% indicated feelings of enhanced self-efficacy. All PBI parents ($n = 505$) were mailed the PBI handbook, and 89% ($n = 448$) completed the PBI evaluation. Overall, 89% of parents reported being "mostly" or "very" satisfied, and 90% reported reading "most" or "all" of the handbook. Questions regarding interest, readability, utility, and ease of comprehension for each chapter were quite positive and compare favorably to those reported by Turrisi et al. (2001).[5]

Success of Randomization and Retention

Randomization achieved baseline equivalence across experimental conditions. There were no group or cohort differences at baseline on student gender, race, ethnicity, intention to affiliate with fraternities or sororities, drinker/abstainer status, or parenting variables. Study retention was high; 90.8% ($n = 921$) of randomized students completed the 10 month assessment and 84% ($n = 852$) completed the 22 month assessment (Figure 1). At the 10 month assessment, retention was significantly higher when comparing the assessment-only group (94.5%) to the combined BMI-PBI group (86.8%). At the 22 month assessment, there were no significant differences in attrition by experimental group. Finally, there were no baseline differences on any outcome variables between study completers and non-completers.

Unconditional Models

Part 1 of the unconditional models exhibited a significantly better fit when both the intercept and linear slope factors were included rather than the intercept only: heavy episodic drinking, ΔX^2 (3, $N = 1014$) = 168.10, $p < .001$, and alcohol-related consequences, ΔX^2 (3, $N = 1014$) = 84.11, $p < .001$. Similarly for Part 2, model fit was significantly improved when both the intercept and linear slope factors were included: heavy episodic drinking, ΔX^2 (3, $N = 762$) = 45.48, $p < .001$, and alcohol-related consequences, ΔX^2 (3, $N = 800$) = 17.13, $p < .001$. Overall model fit for Part 2 was well within the acceptable range for heavy episodic drinking (CFI > .99, RMSEA = .01) and consequences (CFI = .99, RMSEA = .05).

Next we estimated the unconditional two-part LGCMs for each outcome. There was significant variation in the intercept factors in both Parts 1 and 2 for heavy episodic drinking and consequences (p's < .001), indicating individual variability in the mean levels of alcohol involvement and the mean frequency of alcohol involvement at baseline. There was also significant variation in the linear slope factors in both Parts 1 and 2 for heavy episodic drinking and consequences (p's < .01, except for the slope variance in Part 2 for heavy episodic drinking where $p < .05$, one-tailed), indicating individual variability in the likelihood of transitioning to alcohol involvement and in growth in alcohol involvement over time.

Conditional Models

Conditional two-part latent growth model for heavy episodic drinking—In Part 1 of the model, gender was significantly and negatively associated with the intercept factor, indicating that at baseline, women were significantly more likely than men to report heavy episodic drinking in the last month (Table 1). However, as indicated by the significant positive association between gender and the slope factor, men were more likely to transition into heavy

[4]Two of the 502 BMI participants were administratively dropped from the study when it was discovered after randomization that they began working at the university survey research center collecting data for the study.

[5]These data are not presented due to space limitations but are available from the first author.

episodic drinking over time. We observed a significant BMI effect on the slope factor in Part 1 of the model, indicating that participants who received a BMI were less likely than non-BMI participants to transition into heavy episodic drinking. Using the sample proportions of participants who reported heavy episodic drinking at each time point, we computed Cohen's *h*, which is an effect size measure for the difference between two proportions (Cohen, 1988). For the BMI main effect, participants who received a BMI (BMI only plus combined BMI-PBI) were compared to those who did not (PBI only plus assessment-only control). Effect size computations yielded a near zero ($h = 0.02$) BMI effect at 10 months and a small effect size ($h = 0.22$) at 22 months. We observed no significant effects for the PBI or the BMI X PBI interaction on the slope factor in Part 1 of the model. For Part 2 of the model, which evaluated growth in heavy episodic drinking over time, we did not observe any significant effects for gender or the interventions on either the intercept or slope factors.[6]

Conditional two-part latent growth model for alcohol-related consequences—

As initially specified, the two-part latent growth model for alcohol-related consequences would not converge. Therefore, we re-estimated the model after fixing the non-significant covariance between the Part 1 intercept and slope factors to zero (Muthén & Muthén, 1998–2007). No significant gender or intervention effects were observed on the intercept factors (Table 2). In Part 1, male gender was significantly associated with beginning to experience alcohol consequences. There was also a significant main effect for BMI, indicating that BMI participants were less likely than non-BMI participants to begin experiencing negative consequences. Cohen's *h* was 0.07 at 10 months and 0.15 at 22 months. We also observed a significant BMI X PBI interaction effect on the slope in Part 1, indicating that the combined intervention had a synergistic effect on the likelihood of beginning to experience consequences. Specifically, the unique combination of the BMI and PBI further decreased the likelihood that participants began experiencing consequences. Comparing proportions for those who received both interventions versus assessment only plus those receiving either intervention alone, Cohen's *h* was 0.08 at 10 months and 0.21 at 22 months. No significant gender or intervention effects were observed for either the intercept or slope factors in Part 2 of the model, which evaluated growth in alcohol-related consequences over time.

Mediation Analyses

Across all models tested BMI was not associated with any PBI mediators, nor was PBI associated with any BMI mediators. Therefore, we focus on the hypothesized mediators specific to each intervention.

Examination of BMI mediation

Descriptive norms: BMI produced significant decreases in descriptive norms at 10 months, and the remaining criteria for mediation were met for each of our two outcomes in both Part 1 and Part 2 of the models. Specifically, descriptive norms mediated the significant, direct BMI effects on the likelihood of transitioning into heavy episodic drinking ($z = -2.64$, $p < .01$) and consequences ($z = -2.60$, $p < .01$). Although no main effect for BMI was observed in the continuous portion of the two-part models, descriptive norms mediated relations between BMI and heavy episodic drinking ($z = -3.41$, $p < .001$) and consequences ($z = -2.90$, $p < .01$).

Drinking strategies: Drinking strategies did not mediate BMI effects. Greater use of drinking strategies at 10 months was associated with a lower likelihood of transitioning to heavy episodic

[6]Although not reported in detail here due to space limitations, we observed very similar intervention effect patterns for another targeted outcome, drinking game participation. BMI was negatively and significantly associated with the slope in Part 1 of the model for drinking game participation ($b = -0.26$, $SE = 0.09$, $p < .001$), indicating that BMI participants were less likely than non-BMI participants to participate in drinking games over the first two years of college.

drinking ($b = -.39$, $SE = .18$, $p < .05$) and consequences ($b = -.53$, $SE = .18$, $p < .01$) as well as less growth in heavy episodic drinking ($\beta = -.24$, $p < .01$) and consequences ($\beta = -.24$, $p < .001$). However, BMI was not significantly related to increased drinking strategies at 10 months.

Self-regulation of alcohol: BMI was not associated with changes in self-regulation of alcohol at 10 months, which in turn was not associated with the slope factors for either outcome. Therefore, we observed no evidence of self-regulation of alcohol as a mediator.

Readiness to change heavy drinking: Higher readiness to change at 10 months was associated with a lower likelihood of transitioning to heavy episodic drinking ($b = -1.10$, $SE = .17$, $p < .001$) and consequences ($b = -.61$, $SE = .13$, $p < .001$) and less growth in heavy episodic drinking ($\beta = -.50$, $p < .001$) and consequences ($\beta = -.41$, $p < .001$). However, BMI was not significantly related to readiness at 10 months, thus mediation was not supported.

Examination of PBI mediation—None of the parent factors examined met all criteria for PBI mediation. To inform subsequent discussion, we briefly present relevant findings from these analyses.

Parental permissiveness: PBI was not significantly related to changes in parental permissiveness for drinking at 10 months. For Part 1, higher perceived parental permissiveness for drinking at 10 months was associated with a greater likelihood of transitioning to heavy episodic drinking ($b = .36$, $SE = .08$, $p < .001$).

Parental disapproval: PBI was significantly associated with increases in students' perceptions of parent disapproval for alcohol use at 10 months ($\beta = .06$, $p < .05$). Higher perceived parent disapproval at 10 months was associated with a lower likelihood of transitioning to heavy episodic drinking ($b = -1.01$, $SE = .34$, $p < .01$) and consequences ($b = -.60$, $SE = .26$, $p < .05$), but tests of indirect effects were not significant.

Parental monitoring: Contrary to expectations, the PBI was associated with lower levels of parental monitoring at 10 months ($\beta = -.07$, $p < .05$). Furthermore, parental monitoring at 10 months was not significantly associated with the slope factors for either outcome.

Drinking-related communication: The PBI was not associated with changes in drinking-related communication at 10 months, which in turn was not associated with the slope factors for either outcome.

Secondary Moderation Analyses

We examined whether the BMI effect on growth was moderated by the students' baseline level of the outcome (i.e., the intercept factor in Part 2). Results suggested that the BMI was not differentially effective among students who drank more at baseline or among those experiencing higher levels of consequences at baseline.[7]

[7]We also conducted a series of secondary analyses to investigate other potential moderators of BMI and PBI. First, we observed no evidence that parent gender moderated PBI effects. Second, we found no evidence that student gender moderated intervention effects for weekly drinking or consequences, but we were unable to draw conclusions regarding heavy episodic drinking due to model non-convergence. Third, in testing parent-student gender match, we found that for different-sex parent-student pairs, participants who received the PBI were less likely to begin experiencing consequences, $p < .05$, while for same-sex parent-student pairs there was no PBI effect for alcohol-related consequences. Fourth, we were unable to examine whether PBI may have been moderated by student residential status at the 10 month follow-up (i.e., living with parents or relatives or not) due to multicollinearity since a majority (87.0%) of students reported at 10 months that they did not live with parents or relatives. Additional details on the secondary analyses are available from the first author.

Clinical Significance

In order to quantify the BMI effects on the likelihood of transitioning to alcohol involvement and the multiplicative effect on consequences, we examined the proportion of students who transitioned to heavy episodic drinking and consequences over the 22-month period according to intervention condition. We also computed Number Needed to Treat (NNT), a clinically relevant measure of treatment effects for binary outcomes (Cook & Sackett, 1995). NNT is the inverse of the absolute risk reduction, is reported as an integer, and indicates the number of individuals who need to be treated in order to prevent one additional adverse event (e.g., onset of heavy episodic drinking). Accordingly, NNT represents the number of patients who need to be treated for one to benefit as compared with a control condition in a clinical trial. Among participants who did not report heavy episodic drinking at baseline, we examined the proportion of participants who later reported heavy episodic drinking at 10 months or 22 months, with parallel analyses for those who did not report consequences at baseline. Regarding the BMI main effect on heavy episodic drinking, 44.8% (113/252) of the BMI participants transitioned to heavy episodic drinking compared to 57.0% (150/263) of the non-BMI participants (NNT = 9). Regarding the BMI main effect on consequences, 46.7% (99/212) of BMI participants began experiencing consequences compared to 55.3% (125/226) of the non-BMI participants (NNT = 12). Participants in the combined BMI-PBI condition were the least likely to begin experiencing consequences (43.1%; 44/102). In comparison, 50.0% (55/110) of participants in the BMI only condition, 60.0% (66/110) in the PBI only condition, and 50.9% (59/116) in the assessment only control condition began experiencing consequences. The NNT is 13 when comparing the BMI-PBI condition to the assessment only control condition.

Discussion

The current study evaluated the effects of a brief motivational intervention (BMI) and a parent-based intervention (PBI) on college student alcohol use and consequences. We found support for our hypotheses that the BMI would reduce transitions into heavy episodic drinking and alcohol-related consequences. At the 10 month follow-up, observed effects were minimal (*h*'s ranged from .02 to .07) and were small at the 22 month follow-up (*h*'s ranged from .15 to .22). Hypothesized main effects for BMI in reducing growth in heavy episodic drinking and consequences were not observed. However, we found a consistent indirect BMI intervention effect through descriptive norms on both the onset and growth of heavy episodic drinking and consequences. Also in contrast to our hypotheses, the PBI did not reduce growth or delay the onset of heavy episodic drinking or consequences. Evidence for the combined effect of BMI and PBI was limited to alcohol consequences with no combined effect observed on heavy episodic drinking. Consistent with the BMI main effects, the combined intervention effect on consequences was larger at the 22 month follow-up than the 10 month follow-up, but still small (*h* = .21) in magnitude. These delayed intervention effects are at odds with typically observed patterns of intervention decay (Hettema, Steele, & Miller, 2005). A potential explanation is that our BMI booster session was especially useful for delaying the onset of heavy episodic drinking and consequences among those who had not yet initiated these behaviors, perhaps by explicitly emphasizing that many other college students also avoid heavy drinking and consequences and by enhancing participants' self-efficacy.

The lack of a direct BMI intervention effect on growth in alcohol use and consequences over time contradicts our hypotheses and a number of other studies with heavy drinking samples (Borsari & Carey, 2000; Carey, Carey, Maisto, & Henson, 2006; Marlatt et al., 1998; Walters et al. 2009; Wood et al., 2007). Our BMI procedures, protocol, intervention content, one-on-one delivery, and provision of individualized feedback were quite similar to (and largely drawn from) previous college-based BMI studies. Differences include, most notably, the timing of follow-ups and the population-based nature of our sample. Specifically, our 10 and 22 month

follow-ups may have failed to capture time-limited intervention effects among baseline drinkers. While two previous BMI studies with heavy drinking college students have observed intervention effects up to 12 months (Carey et al., 2006) and 24 months (Marlatt et al., 1998), the magnitude of these intervention effects diminished over time. This pattern was also observed in a recent meta-analysis of BMI in which the average effect size (Cohen's *d*) among studies with follow-ups longer than 12 months was 0.11, a small effect (Hettema et al., 2005). Moreover, in the current study, secondary moderation analyses did not suggest enhanced efficacy of BMI among heavier drinkers in our sample, which would most closely replicate the heavy drinking samples of the above studies. The statistical difficulty of detecting theorized moderator effects has long been recognized (McClelland & Judd, 1993), with interaction tests in field studies often demonstrating less than 20% of the statistical power of experimental interaction tests. Resolution of these possible explanations awaits further research as does our somewhat anomalous finding that women were significantly more likely than men to have engaged in heavy episodic drinking at baseline.

The above qualifications notwithstanding, our findings, with the largest sample and second longest follow-up period reported to date, extend a sizeable body of research demonstrating the efficacy of BMI with college students (Larimer & Cronce, 2002, 2007). To our knowledge, this is the first demonstration of BMI as a successful intervention for delaying the onset of heavy episodic drinking and consequences, which, consistent with recent findings using an adolescent sample and long-term follow-up (Spoth et al., 2009), suggests the utility of universal interventions in reducing alcohol abuse risks during the developmental period in which such risks peak. While the consistency of our findings across the transition into heavy episodic drinking and consequences enhances confidence in this intervention effect, the lack of intervention effects on growth of heavy episodic drinking and consequences suggests that BMI, at least as tested in this study, is not effective across the drinking spectrum in a college population. Our findings that descriptive norms were a consistent mediator of BMI effects replicate earlier findings (Borsari & Carey, 2000; Walters et al., 2009; Wood et al., 2007) and extend them to two-part latent growth curve models. Contrary to expectations, other hypothesized mediated effects of both the BMI and PBI were not observed. However, mediation analyses are important both for identifying indirect effects as well as for suggesting active or inert intervention components. Notably, the importance of mediation analyses when direct intervention effects are not observed is increasingly recognized by methodologists (Collins, Graham, & Flaherty, 1998; MacKinnon, 2008) and was emphasized in a recent review of mechanisms of change in BMI (Apodaca & Longabaugh, 2009). The current study found that the use of drinking strategies was consistently negatively related to transitions into and growth in heavy episodic drinking and consequences, but in contrast to two previous studies (Barnett, Murphy, Colby, & Monti, 2007; Larimer et al., 2007), did not mediate BMI effects. Additionally, despite the motivational underpinnings of BMI we found no evidence of mediation for readiness to change, which is consistent with a growing body of literature (Barnett et al., 2007; Wood et al., 2007). Likewise, hypothesized mediating effects for self-regulation were not observed. For both drinking strategies and self-regulation, we utilized brief measures that were developed for the current study rather than standardized instruments such as those used in other studies (Barnett et al., 2007; Carey et al., 2007; Larimer et al., 2007), a common practice recently discouraged by Apodaca and Longabaugh (2009).

Despite largely null findings for the PBI, our large sample size and follow-up intervals substantially extend previous research. To date, in three other randomized trials of college-based PBIs, reductions in alcohol outcomes have been modest (Ichiyama et al., 2009; Turrisi et al., 2001) or observed only in conjunction with BMI (Turrisi et al., 2009). Collectively, findings point to the need to consider conceptual and methodological issues, notably, developmental factors, intervention dosage and modality (e.g., a web-based intervention or

group sessions with parents rather than a mailed handbook), and design issues (described below).

Strengths and Limitations

Study strengths include (a) the use of a factorial design to examine unique and combined BMI and PBI effects, (b) the novel application of an emerging data analytic approach in the area of preventive interventions for college student alcohol use and consequences, (c) explicit tests of hypothesized mediators using current analytic techniques, and (d) length of follow-up. In addition, the inclusion of abstainers in our study is consistent with universal preventive intervention efforts and allowed for the examination of BMI and PBI effects on both the onset and growth in alcohol-related consequences, which typically accompanies college matriculation. Although we observed no PBI effects as a function of parent or student gender (see Footnote [7]), this is the first college PBI study to include fathers and test for these moderating effects.

In addition to those already noted, our findings should be considered in the context of several limitations. These include the use of an ethnically homogenous sample recruited from a single institution and reliance on self-reported alcohol use and consequences. We attempted to minimize threats associated with self-report data through repeated assurances of confidentiality. In addition, potential therapist effects were not analyzed, nor were empirically supported tests of MI fidelity conducted. However, adherence to MI principles and content was systematically evaluated by the supervisor, interventionists, and student participants.

The spacing and number of follow-up intervals constitute additional limitations. Long-term follow-ups were chosen to maximize assessment at time periods during which intervention effects have not readily been established. However, an additional short-term assessment would have allowed for the observation of short-term and potentially transient intervention effects and afforded the opportunity to examine non-linear trajectories (Wood et al., 2007). Our observation of limited intervention effects may also be a function of insufficient statistical power for the two-part latent growth curve analyses reported here, which as noted, was not originally proposed in the grant from which this work emanated. Furthermore, our lack of PBI or mediation effects may also be a function of assessment reactivity among our non-PBI participants. In order to model mediation as a change process by including the baseline assessment of putative mediators, parents in all conditions received an extensive baseline assessment on parental attitudes and behaviors. This assessment may have served as an impetus for parent student communication about alcohol use in college. Lastly, several of the measures used to assess mediation for both interventions were slightly modified for our study purposes and test-retest reliability and construct validity have not been examined.

Implications and Conclusions

The success of BMI as a universal preventive intervention in reducing transitions into heavy episodic drinking and alcohol-related consequences over the first two years of college is encouraging and suggests, in conjunction with the larger literature, that BMIs targeting both light and heavy drinkers are efficacious. It should be reiterated that the effect sizes observed here were small, and the BMI was time and resource intensive; thus, there is a clear need for further refinement and tailoring of this intervention with abstaining or light drinking college students. A valuable next step would be to conduct research on more easily disseminated interventions that incorporate aspects of BMI, such as mailed (Larimer et al., 2007) or computerized individualized feedback (Neighbors, Larimer, & Lewis, 2004). Research on such approaches should include long-term outcome assessments, such as those used in the current study, to facilitate comparisons of clinical effectiveness (such as NNT). The NNT's for this study ranged from 9–13, which, while modest in magnitude (Kraemer et al., 2003), are similar

to those observed for parallel outcomes in more intensive school-based universal preventive interventions in younger populations (Foxcroft, Ireland, Lister-Sharp, Lowe, & Breen, 2003). Future research should determine whether less expensive and more easily disseminated interventions can yield a more favorable ratio of clinical effectiveness to intervention cost.

As indicated, the intervention effect for the transition into heavy episodic drinking was larger at 22 months than at 10 months, perhaps as a result of the booster session; thus, the utility of adding booster sessions to BMIs warrants additional investigation. There is a clear need for systematic investigation of revised PBIs in college student populations as well as younger (e.g., high-school) populations (Spoth, Greenberg, & Turrisi, 2008). The Institute of Medicine (1994) has recommended a three-stage developmental process for preventive interventions, consisting of (a) identification of a target problem (e.g., college student alcohol abuse), (b) review and investigation of research that can inform etiologic models and identify protective factors, and (c) preventive interventions that target these factors, ideally using experimental designs and mediation analyses. While the development of the current PBI was consistent with these guidelines, questions remain about the timing of the intervention with a matriculating college sample and whether a more intensive PBI is needed to demonstrate efficacy in a college-aged population.

Although evidence for mediated effects was limited to descriptive norms, the observed associations between hypothesized BMI and PBI mediators (i.e., drinking strategies, readiness to change heavy drinking, parental permissiveness for drinking, and parents' disapproval of alcohol use) and changes in alcohol involvement underscore the relevance of these factors in the development of college student drinking. For PBI, further examination of these hypothesized mediators in conjunction with critical components of successful family-based interventions with younger populations (Brody et al., 2006; Dishion et al., 2003), may be a potentially fruitful direction for future research. Finally, research that elucidates important moderators of the intervention effects is also needed. The elucidation of particular constellations of student and parent factors using person-centered approaches (Hersh & Hussong, 2006) would represent one innovative approach.

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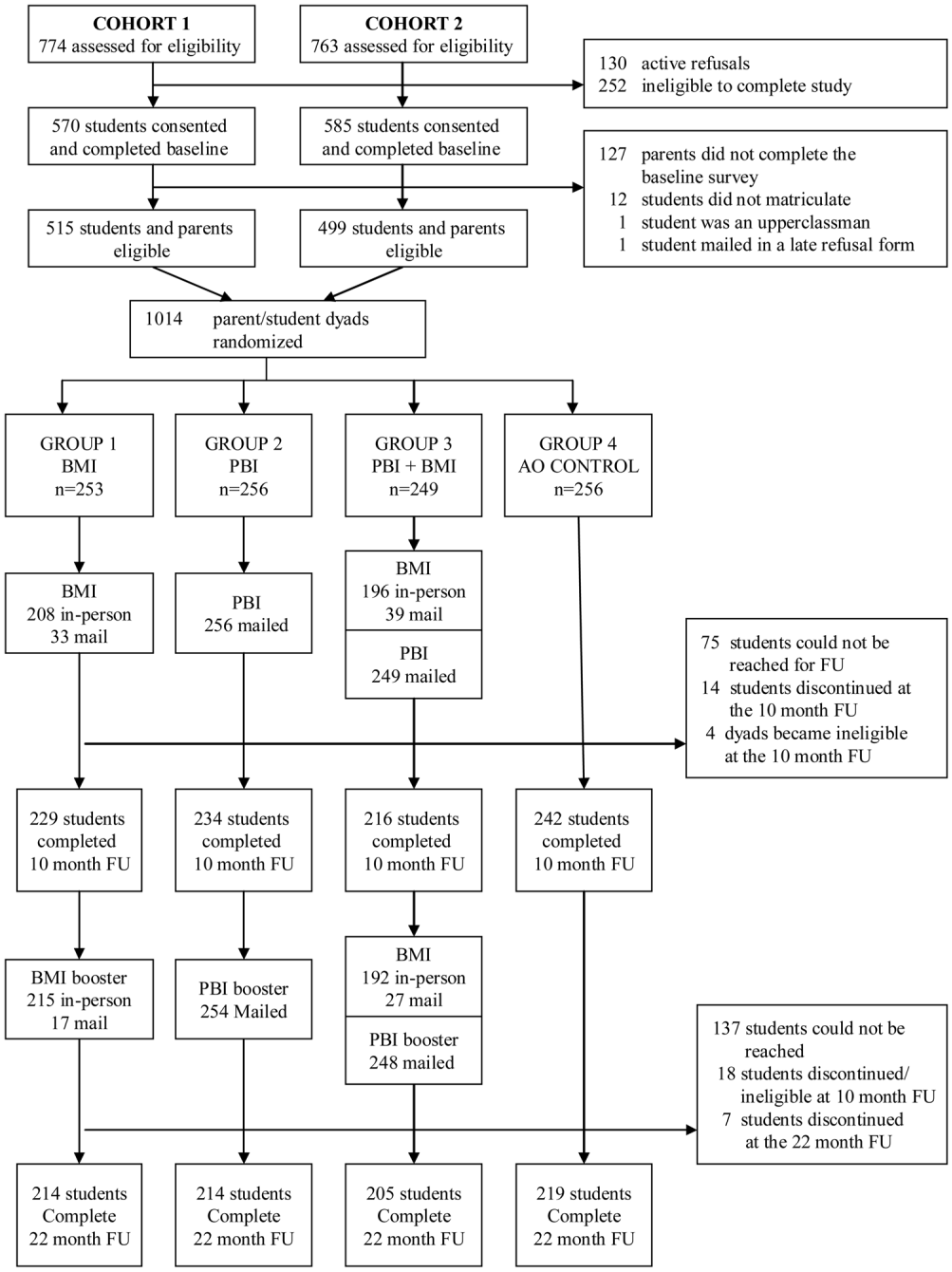

Figure 1.
Flow chart depicting recruitment and retention of participants across the study. BMI = brief motivational intervention; PBI = parent-based intervention; AO = assessment only; FU = follow-up.

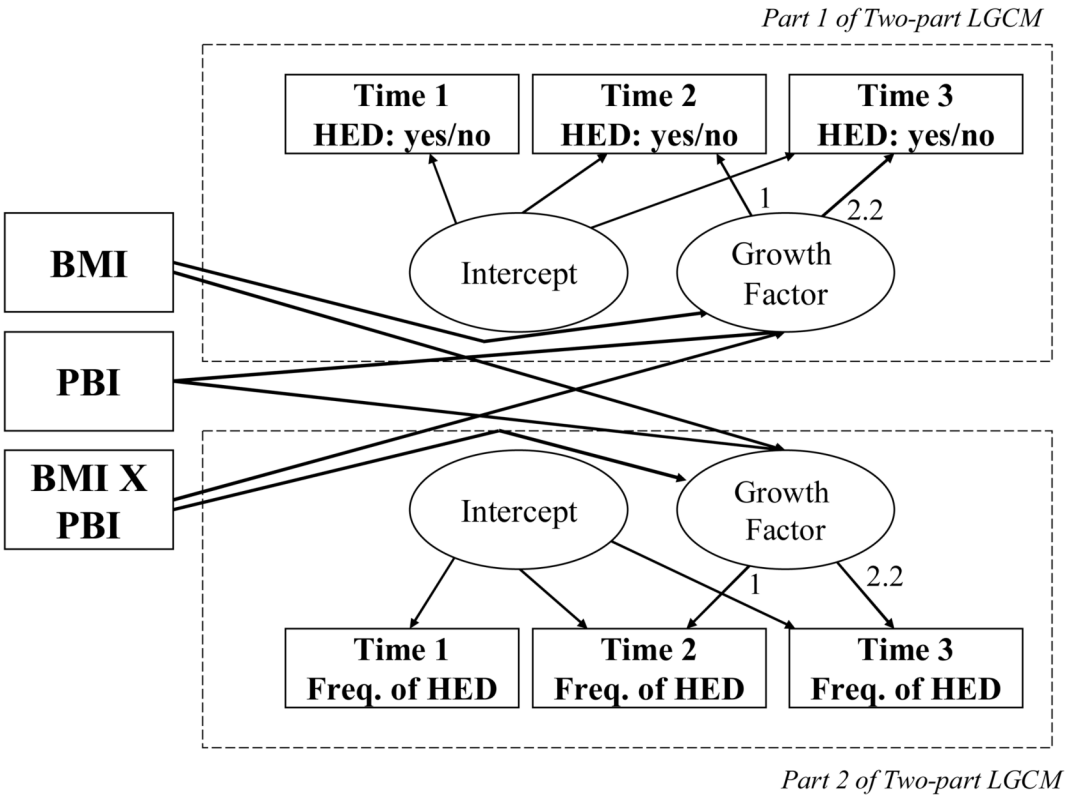

Figure 2.
Depiction of the two-part latent growth curve model for heavy episodic drinking. LGCM = latent growth curve model; BMI = brief motivational intervention; PBI = parent-based intervention; HED = heavy episodic drinking; Freq. = frequency. Only the paths of primary interest are depicted.

Table 1

Results of Two-Part Latent Growth Model for Past Month Heavy Episodic Drinking

	Intercept					Slope				
	b	***SE***	**Lower 95% CI**	**Upper 95% CI**	**β**	***b***	***SE***	**Lower 95% CI**	**Upper 95% CI**	**β**
Part 1 (heavy episodic drinking versus no heavy episodic drinking)										
Growth factor mean	−0.17	0.18	−0.52	0.17	--	1.05***	0.18	0.70	1.39	--
Gender	−0.54*	0.27	−1.08	−0.01	--	0.59**	0.21	0.18	1.00	--
BMI	0.11	0.13	−0.15	0.37	--	−0.34**	0.11	−0.54	−0.13	--
PBI	−0.01	0.13	−0.27	0.25	--	−0.07	0.10	−0.27	0.14	--
BMI X PBI	0.01	0.13	−0.25	0.27	--	0.05	0.10	−0.15	0.25	--
Part 2 (frequency of heavy episodic drinking)										
Growth factor mean	0.67***	0.07	0.54	0.79	0.96	0.12**	0.04	0.04	0.20	0.62
Gender	0.09	0.07	−0.05	0.23	0.13	0.04	0.04	−0.03	0.11	0.21
BMI	−0.03	0.04	−0.09	0.04	−0.04	0.00	0.02	−0.04	0.04	0.01
PBI	0.03	0.03	−0.04	0.10	0.04	−0.01	0.02	−0.04	0.03	−0.03
BMI X PBI	0.05	0.04	−0.02	0.11	0.06	−0.03	0.02	−0.07	0.01	−0.15

Note. Gender: Women = 0, Men = 1, CI = confidence interval, BMI = Brief Motivational Intervention, PBI = Parent-Based Intervention. For ease of interpretability, standardized estimates are reported for the continuous portion (Part 2).

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Table 2

Results of Two-Part Latent Growth Model for Past 3 Months Alcohol-related Consequences

	Intercept					Slope				
	b	***SE***	**Lower 95% CI**	**Upper 95% CI**	**β**	***b***	***SE***	**Lower 95% CI**	**Upper 95% CI**	**β**
Part 1 (consequences versus no consequences)										
Growth factor mean	−0.89***	0.20	−1.29	−0.50	--	0.65***	0.14	0.37	0.93	--
Gender	−0.48	0.30	−1.07	0.11	--	0.46*	0.19	0.09	0.82	--
BMI	0.06	0.15	−0.23	0.35	--	−0.22*	0.09	−0.41	−0.04	--
PBI	0.13	0.15	−0.16	0.42	--	−0.09	0.09	−0.27	0.09	--
BMI X PBI	0.03	0.15	−0.26	0.32	--	−0.19*	0.09	−0.37	−0.00	--
Part 2 (frequency of consequences)										
Growth factor mean	−1.38***	0.06	−1.51	−1.26	−1.68	0.06	0.04	−0.02	0.14	.20
Gender	0.07	0.08	−0.08	0.22	.08	−0.01	0.04	−0.08	0.07	−.03
BMI	0.01	0.04	−0.06	0.09	.02	−0.03	0.02	−0.07	0.01	−.10
PBI	0.05	0.04	−0.02	0.13	.07	−0.02	0.02	−0.06	0.02	−.06
BMI X PBI	0.01	0.04	−0.07	0.08	.01	−0.02	0.02	−0.05	0.02	−.05

Note. Gender: Women = 0, Men = 1, CI = confidence interval, BMI = Brief Motivational Intervention, PBI = Parent-Based Intervention. For ease of interpretability, standardized estimates are reported for the continuous portion (Part 2).

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Appendix

CONSORT Checklist

Paper Section and Topic	Descriptor	Reported on Page #
Title and Abstract	How participants were allocated to interventions (e.g., randomized, random allocation….)	8
Introduction/Background	Scientific Background and Rationale	3–8
Participants	Eligibility Criteria for participants and the settings and locations where the data were collected	8, 9
Interventions	Precise details of the intervention(s) intended for each group and how and when the were actually administered	13–14
Objectives	Specific Objectives and Hypotheses	7
Outcomes	Clearly defined primary and secondary outcome measures and, when applicable, any methods used to enhance the quality of measurement (e.g. multiple observations, training of assessors)	10–12
Sample Size	How sample size was determined and, when applicable, explanation for any interim analyses and stopping rules	9
Randomization: Sequence Generation	Method used to generate the random allocation sequence, including details on any restriction (e.g. blocking stratification)	8
Randomization: Allocation concealment	Method used to implement the random allocation sequence (e.g. numbered containers, or central telephone), clarifying whether the sequence was concealed until interventions were assigned	8
Randomization: Implementation	Who generated the allocation sequence, who enrolled participants, and who assigned participants to their groups	8
Blinding (Masking)	Whether or not participants, those administered the interventions, and those assessing the outcomes were blinded to group assignment. If done, how the success of blinding was evaluated	8
Statistical Methods	Statistical Methods used to compare groups for primary outcome(s); methods for additional analyses, such as subgroup analyses and adjusted analyses	15–18
Results: Participant Flow	Flow of participants through each stage (a diagram is strongly recommended) Specifically, for each group report the numbers of participants randomly assigned, receiving the intended treatment, completing study protocol, and analyzed for the primary outcome. Describe protocol deviations from study as planned, together with reasons	Fig 1; 18–19
Recruitment	Dates defining the periods of recruitment and follow-up	8
Baseline data	Baseline demographic and clinical characteristics of each group	18
Numbers analyzed	Number of participants (denominator) in each group included in each analysis and whether the analysis was by “intention to treat.” State the results in absolute numbers when feasible (e.g. 10, 20, not 50%)	17
Outcomes and estimation	For each primary and secondary outcome, a summary of results for each group and the estimated effect size and its precision (e.g. 95% confidence interval)	Table 1, 2; 19–25
Ancillary analyses	Address multiplicity by reporting any other analyses performed, including subgroup analyses and adjusted analyses, indicating those prespecified and those exploratory.	24; Footnote 6, 7
Adverse events	All important adverse events or side effects in each intervention group	N/A
Discussion: Interpretation	Interpretation of the results, taking into account study hypotheses, sources of potential bias or imprecision, and the dangers associated with multiplicity of analyses and outcomes	24–31
Generalizability	External validity of the trial findings	30–31

Paper Section and Topic	**Descriptor**	**Reported on Page #**
Overall evidence	General Interpretation of the results in the context of current evidence.	25–28