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Changes in peer norms as a mediator of reduction in adolescent alcohol use

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Abstract

Background: Evidence from college samples suggests that changes in peer norms (perception about peer use) mediates changes in alcohol use. There is relatively little intervention-based research in adolescents.

Objectives: To investigate whether changes in peer norms mediate the relationship between a brief intervention to reduce alcohol use, and level of use. Additionally, to determine whether any mediation effects differ by adolescent age.

Methods: Eighty-four adolescents aged 14–18 (Mean=16.49, SD=1.00), presenting to school-based health centers with moderate to high risk alcohol use were randomized to receive an electronic screening and feedback tool (*Check Yourself*) in addition to their visit, or their visit alone. *Check Yourself* includes provision of normative feedback regarding adolescent alcohol use. Measures of self-reported alcohol use, and peer norms were collected at baseline and 2-month follow-up.

Results: Changes in perceptions of the proportion of peers using alcohol significantly mediated the relationship between the intervention and all three alcohol outcomes (frequency, typical quantity and maximum quantity) such that reductions in perceived peer use were associated with reduced use. Moderated mediation suggested that these effects were stronger for younger adolescents compared with older adolescents. Perceptions of the frequency and quantity of peer use were not significant mediators of alcohol use.

Conclusions / Importance: Results suggest that integrating normative feedback regarding peer alcohol use is a promising approach in adolescent focused school interventions. They extend

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Disclosure statement:

CM, the Principal Investigator on this study, has intellectual property with the Tickit Health, Inc. company as a co-inventor of the Check Yourself Tool. Seattle Children's Hospital and Shift Health have entered into an agreement under which CM will receive a share of the royalties related to sales of the Check Yourself tool. Seattle Children's has a plan in place to oversee CM interests with Tickit Health, Inc.

previous findings by suggesting that perceptions of the proportion of peers using may be particularly meaningful, and that effects may be more pronounced in younger adolescents.

Keywords

Alcohol; peer norms; mediation analysis; alcohol use; adolescent health; school health

Alcohol use typically has its onset during adolescence and is associated with increased risk of impulsive or antisocial behavior (Bonomo et al., 2001), unintentional injury (Hingson and Zha, 2009) as well as a range of adverse health outcomes including psychiatric illness, substance dependence, and mortality (McCambridge et al., 2011; Swendsen et al., 2012). Peer norms are social perceptions regarding alcohol use, with perceived descriptive norms being an individual's perception of their peers' level of alcohol use (Baer and Carney, 1993; Jackson et al., 2014; Perkins et al., 1999). Many studies have found a positive association between peer norms and high-risk alcohol use (Brooks-Russell et al., 2014; Perkins and Wechsler, 1996; Song et al., 2012), such that perceiving more peers drink alcohol and drink in larger quantities is associated with more personal alcohol use (For a review see Borsari and Carey, 2001).

Research has found that adolescents and young adults systematically overestimate how much alcohol their peers use (Baer and Carney, 1993), and that this is particularly the case with alcohol users (Henry et al., 2011). The combination of an association between peer norms and alcohol use, and evidence that peer norms are typically inaccurate has led researchers to investigate whether interventions that change peer norms can impact alcohol use. There is evidence from a number of studies in colleges that interventions aimed at reducing one's perceived norms for typical student alcohol use has positive flow on effects on one's own alcohol use (e.g. LaBrie et al., 2013; Mattern and Neighbors, 2004; Neighbors et al., 2006; Perkins and Craig, 2006). It is also important to note that normative beliefs regarding how much close friends use alcohol are likely to have stronger impacts than belief about peers more generally (Campo et al., 2003; Ecker, Cohen and Buckner, 2017).

It is unclear to what extent peer norms function as a mediator of alcohol use in adolescents. Evidence from the cannabis literature suggests that personal norms, or internalized values are particularly predictive of use (Elek, Miller-Day & Hecht, 2006), and that, in heavy users, descriptive norms strongly predict cannabis use (Walker et al., 2011). Regarding alcohol, several naturalistic longitudinal studies have established that perceived descriptive norms are associated with drinking, and that reductions in norms across time are associated with reduced alcohol use (Brooks-Russell et al., 2014; D'Amico and McCarthy, 2006; Eisenberg et al., 2014). Yet, there is relatively little intervention based research to demonstrate what tools or treatments can impact peer norms *in adolescents*. One study used a school based face-to-face motivational enhancement intervention including normative feedback and found that reductions in peer norms predicted reduced alcohol use (Schulte et al., 2010). There is also some evidence that targeting peer norms related to tobacco, marijuana and other substance use in adolescents may impact on levels of use (Duan et al., 2009; MacArthur et al., 2016).

These findings warrant further investigation and can be extended in two important ways. First, it is important to clarify whether the role of peer norms as a mediator of alcohol use extends to adolescents, and whether this effect varies by adolescent age. There is evidence that younger adolescents are more susceptible to the influence of peer drinking (Kelly et al., 2012) and that the capacity to resist peer influences grows in a linear fashion from ages 14 to 18 (Steinberg and Monahan, 2007). Therefore it is worthwhile to study whether the impact of changes in peer norms on alcohol use varies according to the age of the adolescent.

Second, it is important to understand which descriptive norms are associated with changes in alcohol use in adolescents. Previous studies have used perceptions regarding frequency of peer use (Brooks-Russell et al., 2014; Clapp and McDonell, 2000; Mattern and Neighbors, 2004; Schulte et al., 2010), quantity of peer use (Borsari and Carey, 2000; Neighbors et al., 2006; Schulte et al., 2010), and the proportion of peers who use alcohol (D'Amico and McCarthy, 2006; Eisenberg et al., 2014), but few studies have investigated all three of these norms. This will help to identify which normative alcohol reference would be most beneficial to target for resulting reductions in alcohol use. This insight can be used in order to guide interventions that may be face-to-face (Barnett et al., 1996; Borsari and Carey, 2000), computerized (Neighbors et al., 2004), or media based (Thombs and Hamilton, 2002).

This study aims to investigate whether perceived descriptive norms (focused on alcohol quantity, frequency, and proportion of adolescents using) mediates the relationship between a brief intervention to reduce alcohol use in adolescents, and alcohol use. Further, it will study whether any mediation effects vary according to the age of the adolescent.

Methods

Participants and Procedure

Study procedures were approved by the Western Institutional Review Board (IRB) and authorized by the schools' relevant local IRB. Adolescents were drawn from a larger randomized controlled trial (McCarty et al., In Press) of 148 adolescents with moderate to high risk alcohol use, investigating the impact of screening and brief intervention in school based health centers. Participants were recruited between November 2015 and February 2017. Participants were drawn from three school based health centers in Seattle Washington. Participants who had an appointment at any clinic for any reason were approached to participate in the study. Participation was voluntary. Clinic administration staff asked adolescents if they were interested in participation and research staff followed up those that were interested. Due to the fact that adolescents were receiving confidential care without parents present, a waiver of parental consent was obtained and youth provided consent to participate in the study. A total of 462 eligible adolescents were approached for the study and 93% (n=428) consented to participate and were screened.

Adolescents completed an electronic baseline screening tool prior to their appointment and were randomized to receive either the *Check Yourself* tool within the context of their school based health center (SBHC) visit or a SBHC visit alone. Alcohol risk was classified for frequency of use according to National Institute on Alcohol Abuse and Alcoholism (2011)

guidelines; quantity of use was classified using Donovan's (2009) age and gender based criteria (see McCarty et al., under review for further detail regarding the methodology). Only those screening for moderate to high level alcohol risk (n=148) were invited to complete follow-up assessments. Follow-up peer norm data were only available for those using alcohol at the 2-month time point (n=84). The present sample of 84 participants comprises of those with follow-up data for both alcohol use and peer norms.

Intervention Groups—All providers in both conditions were given a brief online training on the *Check Yourself* tool and brief live training on screening and brief intervention, including role plays using motivational interviewing techniques. Each school based health clinic had at least one Advanced Registered Nurse Practitioner and a mental health provider.

Check Yourself + SBHC visit (intervention): *Check Yourself* is an app-based tool that provides computerized feedback to adolescents including 1) how their alcohol use compares to age and gender specific norms. This information was presented in sentences such as “91% of teens your age and sex report that they don't drink” and also visually with a bar graph comparing the teen's estimate of alcohol use in peers and rates from national surveys; 2) personal motives for and consequences of substance use; 3) prompts to attend to discrepancies between their chosen goals and their alcohol use; 4) strategies to reduce use. Health providers were provided with a summary report prior to the appointment that included information regarding the adolescents screening information, goals, alcohol use in comparison to peers and perceived consequences and motives for substance use.

SBHC visit (active control): Participants completed the electronic screening measures without receiving feedback, or identifying goals or strategies. Providers did not receive a summary report. Providers were encouraged to administer their usual screening tools and provide care as usual.

Measures

Alcohol Use was assessed with self-report measures at baseline and 2-month follow-up. Adolescents reported frequency of use (number of days using), in the past year at baseline, and the past 30 days at baseline and follow-up. Using items adapted from the Daily Drinking Questionnaire (Collins et al., 1985), participants also reported their typical drinking quantity and the maximum number of drinks they have consumed in the past 30 days.

Perceived Descriptive Norms were assessed using three self-report items. The first item asked participants to estimate the percentage of same age and gender peers who drink alcohol. The second item addressed frequency - perceptions of how many days per month peers use alcohol. The third assessed quantity - perceptions of the typical number of drinks that peers consume.

Data Analysis

The primary statistical analysis was a mediation analysis, which is useful for defining mechanisms of change in intervention research (Kazdin, 2007). Mediation analysis is

appropriate for making inferences about intermediary variables in a causal association between two variables (Mackinnon et al., 2007).

Statistical analysis was conducted using the Mediation package for R (Tingley et al., 2014). This package uses a model-based analysis that estimates an average causal mediated effect (ACME) or indirect effect (Imai et al., 2010; Tingley et al., 2014). In this case, the direct effect was the impact of the intervention group on the level of alcohol use. The mediator was changes in peer norms; therefore the indirect, or mediated, effect examined whether intervention group status impacted peer norms, which impacted alcohol use.

We used linear regression models with a robust standard error estimate. A quasi-Bayesian Monte Carlo method based on normal approximation was conducted with 1000 simulations (Imai et al., 2010). This simulation based approach is useful for mediation analysis in small samples, in order to avoid distributional assumptions (Preacher et al., 2007).

We also conducted a moderated mediation analysis. Moderated mediation considers whether the mediation effect differs in strength at different levels of a moderator, or pre-treatment variable (Mackinnon et al., 2007; Preacher et al., 2007). In our case, we used the techniques described by Tingley and colleagues (2014) in order to test whether significant mediation effects differed for younger adolescents (aged 14) compared with older adolescents (aged 18). This involves adding age as a covariate (moderator) to the mediational models used above, and then separately estimating the statistical significance of the mediation models with participant age set at 14 and 18 (Imai et al., 2010; Tingley et al., 2014).

Results

Descriptive statistics

Participants were aged 14–18 (Mean=16.49, SD=1.00), and were 82% female and 18% male. In terms of racial / ethnic demographics, participants were 56% Caucasian, 13% Asian, 11% African American, 4% Hispanic, 2% Native American, and 14% other. Descriptive statistics for alcohol use and peer norms in the intervention and control groups across time points are presented in Table 1.

Mediation analysis

As evident in Table 2, the perceptions about the proportion of peers who use alcohol was a significant mediator of the relationship between the intervention and all three alcohol use outcomes: frequency of drinking, typical quantity drinking and maximum quantity drinking. The negative values of the Average Causal Mediation Effect estimates reflect that the direction of this effect was that the intervention was associated with reductions in perceptions of the proportion of peers using alcohol. Reductions in these peer norms were associated with reduced alcohol use. Finally, when controlling for the mediated effect, the direct effect of the intervention on alcohol use was no longer significant.

The other two descriptive peer norms, perceptions of frequency and quantity of peer alcohol use, were not significant mediators of the relationship between the intervention and alcohol use outcomes.

Age effects

For the significant effects related to perceptions about the proportions of peers using alcohol, we conducted a moderated mediation analysis to determine whether the strength of the mediation effect varied by age. This estimated the strength of the average causal mediated effect (ACME) in younger (aged 14, $n=10$, 70% female) and older (aged 18, $n=15$, 87% female) adolescents. When testing frequency of alcohol use as an outcome and peer norms regarding the proportion of peers using alcohol for moderated mediation, there was a trend towards a significant effect for younger (ACME = -1.80 , 95% CI -4.53 , $.04$, $p=.06$) but not older (ACME = $-.56$, 95% CI -1.86 , $.28$, $p=.26$) adolescents. Using typical drinks of alcohol as an outcome, the mediation effect was significant for younger (ACME = $-.90$, 95% CI -1.93 , $-.12$, $p=.02$) but not older (ACME = $-.28$, 95% CI $-.75$, $.12$, $p=.19$) adolescents. Similarly, using maximum drinks as an outcome, the mediation effect was significant for younger (ACME = $-.75$, 95% CI -1.44 , $-.18$, $p=.01$) but not older (ACME = $-.41$, 95% CI -1.24 , $.20$, $p=.24$) adolescents.

Discussion

This study provides evidence of the role of peer norms as a mediator of changes in alcohol use in adolescents. This finding reinforces previous studies that have established the role of peer norms in contributing to reductions in alcohol use (Brooks-Russell et al., 2014; Eisenberg et al., 2014; Mattern and Neighbors, 2004; Neighbors et al., 2006; Perkins and Craig, 2006; Schulte et al., 2010). Our results extend the evidence base in two important ways.

First, they offer support for the role of descriptive peer norms in contributing to alcohol related change in an adolescent population. Previous adolescent studies have generally been naturalistic longitudinal studies (Brooks-Russell et al., 2014; D'Amico and McCarthy, 2006; Eisenberg et al., 2014) and the one adolescent intervention study involved participants self-selecting for the intervention (Schulte et al., 2010) which poses questions about potential confounds. The randomized design of the current study allows for increased confidence in the causal inference that the *Check Yourself* intervention led to reduced peer norms. The moderated mediation analysis suggests that the role of changes in peer norms in contributing to reduced alcohol use is stronger in younger adolescents, compared to older adolescents. This is consistent with empirical evidence that peer influence is stronger in younger adolescents (Kelly et al., 2012; Steinberg and Monahan, 2007) and suggests that young adolescents may particularly benefit from interventions focused on peer norms. This is an important addition to the research demonstrating the importance of peer norms in college students (LaBrie et al., 2013; Mattern and Neighbors, 2004; Neighbors et al., 2006; Perkins and Craig, 2006).

Second, the results suggest that effects may differ depending on the type of peer norm being investigated. The present study's findings suggest that a reduction in the perceived proportion of peers who use alcohol was a significant mediator of the association between the intervention and reduced alcohol use. The fact that the mediation effect was stronger in younger adolescents may be related to the fact that the normative feedback informed younger adolescents that a majority of peers had not used alcohol, whereas 18-year olds

received feedback that a majority of peers had used alcohol. By contrast, norms regarding the frequency with which peers use alcohol and quantity of peer use were not significant mediators. It is possible that effects of peer norms relating to frequency and quantity on adolescent alcohol use may be smaller, and that they may be better captured in larger studies, or studies that focus on friendship groups, where social impacts may be stronger than with peers more generally (Campo et al., 2003; Ecker, Cohen and Buckner, 2017).

The results suggests that messages to adolescents that impact perceptions of *how many* peers use alcohol may be more impactful than perceptions about *how frequently or heavily* peers use alcohol. This is a useful implication that can be tested further. Public campaigns that highlight the proportion of peers who drink and drive have been demonstrated to be effective in young adults (Perkins et al., 2010). This approach could be further investigated in adolescent populations, with social media offering a promising context for implementing peer norm focused interventions (Litt and Stock, 2011; Nesi et al., 2017). Studies that test the impact of targeting different specific types of norms will be particularly useful in this regard.

The study should be understood in the context of a number of limitations. First, due to a programming error in data collection, peer norm data were only available for adolescents who endorsed any alcohol use at follow-up. This may have impacted the results, and findings should therefore be considered preliminary and further studies should seek to build upon these findings. Second, the sample were all moderate to high risk alcohol users at baseline, therefore it is not clear whether these mediational effects would hold for low risk users. Third, the 2-month follow up limited our ability to comment on medium to long term impacts of changes to peer norms. Fourth, we do not have recording of the health appointments that were provided and therefore cannot make firm conclusions about how different session content may have impacted on adolescents. Fifth, the moderated mediation analysis relied on small numbers of 14 and 18 year olds, and therefore this result should be tested in larger samples.

In conclusion, this study provides support for changes in perceptions regarding the proportion of peers who drink as a mediator of reductions in alcohol use in adolescents. This provides support for integrating individualized normative feedback in adolescent focused alcohol interventions.

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Table 1.
Descriptive statistics of alcohol use and peer norms in intervention and control groups (n=84)

Measure	Control		Intervention	
	Baseline	Follow-Up	Baseline	Follow-Up
M (SD)				
Peer Norm / Mediator				
Proportion of peers who drink alcohol (%)	68.02 (17.67)	71.05 (15.91)	62.32 (20.74)	41.34 (22.78)
Frequency of peer alcohol consumption (days per month)	5.26 (4.60)	5.60 (3.74)	4.49 (3.27)	3.12 (2.29)
Quantity peer alcohol consumption (drinks when drinking)	4.56 (2.27)	5.00 (3.16)	4.61 (2.77)	2.89 (1.52)
Days drinking in past month	2.77 (2.28)	4.23 (4.08)	2.32 (2.27)	4.15 (5.36)
Typical number of drinks consumed	2.91 (1.63)	2.84 (2.44)	2.95 (1.83)	2.71 (1.42)
Maximum number of drinks consumed	6.53 (3.95)	3.63 (2.67)	6.15 (3.68)	2.80 (2.08)

Mediation analysis of change in peer norms as a mediator of the relationship between the intervention and alcohol use (n=84)

Table 2.

Measure	Outcome		
	Frequency drinking	Typical quantity drinking	Maximum quantity drinking
	Average Causal Mediated Effect Estimate (95% confidence interval)		
Peer Norm / Mediator			
Proportion of peers who drink alcohol (%)	-.93* (-2.03, -.05)	-.52* (-.91, -.20)	-.66* (-1.28, -.17)
Frequency of peer alcohol consumption (days per month)	-.27 (-1.00, .15)	-.20 (-.73, .16)	-.06 (-.29, .09)
Quantity peer alcohol consumption (drinks when drinking)	-.36 (-1.27, .37)	-.66 (-1.95, .26)	-.21 (-.62, .13)

Note:

*
 $p < .05$