

An integrative review of personalized feedback interventions for pain and alcohol

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Interrelations between pain and alcohol consumption are considered to be bidirectional in nature, leading to greater pain and increased drinking over time. Personalized feedback interventions (PFIs), which typically aim to motivate behavior change via presentation of personalized and normative feedback, hold great promise for integrated treatment. There has been no previous review of PFIs for pain, and limited work has focused on examining the utility of PFIs for more established, adult drinkers. Our review of the literature revealed that brief, computer-based PFIs can improve pain outcomes and decrease problematic alcohol consumption. Future research would likely benefit from developing integrated, computer-based PFIs for pain and alcohol misuse. Such approaches offer potential for broad impact, while simultaneously reducing patient and healthcare provider burden.

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Introduction

Accumulating evidence indicates that chronic pain and alcohol use are highly prevalent and co-occurring, accounting for a combined annual economic burden of greater than \$850 billion in the United States alone [1,2]. Relative to the general population, individuals with chronic pain endorse higher rates of excessive alcohol consumption and are up to two times more likely to meet criteria for alcohol use disorder (AUD) [2,3,4^{••}]. Similarly, individuals who drink alcohol tend to report greater prevalence and intensity of pain [5]. For example, 43% of problem drinkers and 75% of individuals with AUD have been shown to endorse current moderate-to-severe pain, compared to 18% in the general population [6–8].

Interrelations between pain and alcohol use have been posited to interact in the manner of a positive feedback loop, worsening both conditions over time [4^{••},9^{••}]. Consistent with this framework, the experience of pain has been shown to increase urge to consume alcohol [10], and excessive alcohol consumption has been associated with the onset and progression of several painful conditions [11,12]. In addition, alcohol has been shown to confer acute analgesia [13], and individuals who use alcohol to cope with pain appear to be at risk for escalating their consumption of alcohol [14]. Indeed, the presence of pain has been linked with a greater likelihood of drinking following inpatient substance use detoxification [6,15], and patients with chronic pain and AUD have cited pain as the primary reason they started to misuse alcohol [14].

Despite substantial impact and emerging research documenting complex interrelations between pain and alcohol consumption, integrated treatments have yet to be developed. Personalized feedback interventions (PFIs) represent one especially promising format for simultaneously addressing both conditions [16,17]. For example, PFIs are customizable and have been administered to individuals who endorse chronic pain and hazardous drinking. Drawing on motivational and social perspectives, PFIs motivate behavior change via psychoeducation and the presentation of personalized feedback (e.g. profiles of current health behaviors, assessment of risk severity) [18,19]. Given that personalized feedback is perceived as being more relevant than non-personalized information, recipients tend to pay more attention to key messages and are more likely to change their behavior [20]. Although components vary, PFIs often incorporate normative comparisons to relevant sociodemographic groups. According to Social Norms Theory, perceptions of how peers think and act can influence behavior [21]. Thus, normative comparisons are hypothesized to alter behavior by correcting misperceptions and highlighting discrepancies. There has also been a growing interest in computer-based PFIs, given that they are portable, adaptable, easy to implement, and can be delivered to a large number of patients by non-specialized providers, thereby reducing patient burden and increasing feasibility [22–24]. The goals of the current review were to briefly examine and synthesize the literature examining computer-based PFIs for pain and alcohol use, to propose future research directions, and to identify factors that may inform the development of novel interventions. Searches were limited to full text papers that were published in English in peer-reviewed scholarly journals.

Personalized feedback interventions for pain

There has been a substantial increase in research examining computer-based treatments for pain, as shown by several recent reviews and meta-analyses [17,25–27]. Nearly 24 million adults report seeking help for chronic pain online [28] and computer-based interventions are more time and cost effective than in-person treatments. Despite growing interest in computer-based PFIs for pain, with eleven studies published over the past five years alone, there has been no previous review of pain-relevant PFIs.

PFIs for pain encompass various computer-based formats (e.g. web programs, smartphone applications), and target both primary (e.g. pain intensity) and secondary outcomes (e.g. improving physical and emotional functioning in the context of pain). Computer-based PFIs for pain can be delivered during a single session or over the course of multiple sessions. Our review of the literature revealed that computer-based PFIs for pain have also been administered to a variety of populations, in which pain is a prominent – if not primary – symptom experience, including individuals with chronic pain [29–34], patients with migraine [35], individuals with co-occurring pain and psychopathology (i.e. depression and/or anxiety) [36], and persons living with human immunodeficiency virus (HIV) [37]. Importantly, these studies provide evidence that computer-based PFIs are both feasible and efficacious across conditions. Specifically, PFIs for pain have been shown to decrease pain intensity ($d = 0.28$ – 1.0) [29–31,36] and pain-related fear/avoidance ($d = 0.33$ – 0.73) [32,33].

There is also evidence that brief, computer-based interventions (i.e. those typically comprises a single treatment session) can successfully address both primary and secondary pain outcomes, while also reducing patient and provider burden. For example, Sciamanna *et al.* tested the effects of a brief, web-based PFI that was designed to increase communication between patients with migraine and medical providers [35]. Participants in this study ($N = 53$) completed a screener assessing current migraine treatment and symptom frequency/severity, before being randomized to receive personalized feedback based on their responses (e.g. specific questions they could ask their provider, migraine management education) either before (intervention group) or after (control group) their physician visit. Results indicated that 89% of patients in the intervention group discussed pain symptoms with their doctor (versus 54% of patients in control). Although these initial empirical data suggest that PFIs can enhance pain-relevant patient-provider communication, additional trials are warranted.

In another study, 645 patients with chronic pain completed a single session, remote, online PFI that assessed a range of pain-relevant factors at baseline (e.g. pain

quality/location, stress, sleep, current methods of managing pain, motivation/self-efficacy for managing pain, and use of prescription pain medications) [38]. On the basis of their responses, participants then received a personalized action plan (e.g. skills for pain management, advice regarding medication adherence, enhancing social support), as well as access to online pain management tools. Reductions in self-reported pain intensity and unpleasantness ratings were observed at both one- and six-months post-treatment, with effect sizes that may be characterized as medium-to-large in magnitude ($d = 0.69$ – 0.90). Participants also reported increased quality of life at six months post-treatment. Although these studies, collectively, provide preliminary evidence regarding the efficacy of pain-relevant PFIs, additional research is needed. For example, given that most of the literature (i.e. 8 out of 11 studies) testing PFIs for pain did not include a control comparison, there is a specific need for randomized controlled trials.

Personalized feedback interventions for alcohol

PFIs for alcohol typically aim to reduce or prevent hazardous drinking and deleterious outcomes by providing personalized feedback regarding current alcohol consumption (e.g. frequency of drinking, binge drinking, time/money spent drinking alcohol, impairment in functioning) and comparison of current drinking behavior to normative groups. Although PFIs administered by a clinician tend to be less intensive than other in-person interventions, they still require substantial effort and clinical expertise. Thus, computer-based PFIs for alcohol represent an appealing alternative, as they are less costly and can be translated for a variety of electronic formats. Computer-based administration of PFIs may be particularly useful for addressing problematic alcohol use, as regular/heavier drinkers are often reluctant to discuss their use of alcohol with healthcare providers [39,40].

A recent meta-analysis comparing in-person with computer-delivered PFIs for drinking among college students and adults revealed that both modalities were equally efficacious at follow-up (≤ 4 months) for all outcomes (e.g. frequency, alcohol-related problems, binge episodes; $d = 0.18$ – 0.19) [23]. Despite this and emerging evidence supporting the efficacy of computer-based PFIs for alcohol [24], it is important to note that much of the extant research has been conducted solely among adolescent or college-aged populations [41]. Although this focus makes sense given that adolescence/college is recognized as a transitional period with risk for elevated levels of hazardous alcohol use [42,43], there is also a critical need to separately assess the efficacy of PFIs among adults who are more established alcohol users. The only meta-analysis to examine electronic PFIs among adult drinkers — independently from adolescents/college students — observed small-to-moderate sized effects for reduced

frequency of drinking [44]. However, given that these analyses were limited to five studies published before 2010, they do not reflect a body of literature that has grown in a manner commensurate with the widespread adoption of mobile technologies over the past decade. Since 2010, eight randomized controlled trials of computer-based PFIs for adult drinkers have been published [45,46,47,48–52].

Similar to PFIs for pain, PFIs for alcohol can be delivered in a single session or over multiple sessions, with the preponderance of evidence indicating similar efficacy for brief and extended treatments [53]. Our review of the literature found that, in comparison to control conditions, brief, computer-based PFIs reduced both alcohol consumption and number of alcohol use problems among adults with hazardous alcohol use [45,46,48,54,55], and increased planning/motivation to address drinking among older adults [51]. For example, among 450 treatment-seeking heavy alcohol users, those who were randomized to a brief, online PFI (that provided normative feedback on current alcohol consumption and personalized feedback regarding current health risks and severity of drinking) were almost twice as likely (versus general health information control) to reduce their drinking to a healthy level at one month post-treatment ($OR = 1.7$) [48]. Another trial randomized 490 treatment-seeking risky drinkers to either a brief (10 min) web-based PFI (that was designed to provide normative feedback regarding quantity/frequency of drinking, and personalized feedback regarding severity of alcohol consumption), or a multisession internet-based cognitive behavioral intervention [47]. Although no differences were observed at 12 months post-treatment, all participants reduced their consumption by an average of 10 drinks per week. Collectively, this work provides preliminary evidence regarding the efficacy of brief, computer-based PFIs for reducing alcohol consumption when compared to control conditions or established, time-intensive alcohol interventions.

Despite meta-analytic evidence that brief interventions administered in primary care have small-to-moderate effects on reducing alcohol consumption in hazardous and harmful drinkers [56], the two studies that examined computer-based alcohol PFIs among patients in primary care observed no post-treatment differences in drinking behavior [49,50]. Johnson *et al.* administered a brief, alcohol PFI (versus screening alone) to 837 patients waiting to meet with their physician [50]. At both the six-month and twelve-month follow-up, there was no effect of the intervention on alcohol consumption or alcohol use problems. Similarly, no differences in drinking behavior were observed at one-month and two-month follow-ups among 150 patients in primary care who were randomized to either a web-based alcohol PFI or a general health information control condition while waiting to meet with

their health care provider [49]. These null findings could be due to participants in both trials endorsing relatively low severity of drinking, and thus being less concerned about altering their alcohol use. As a majority of PFIs are administered to treatment-seeking hazardous or risky drinkers, future research is needed to assess and compare the efficacy of PFIs in a variety of treatment settings (e.g. remotely or in primary, secondary, and tertiary care) and among persons not necessarily seeking treatment for their alcohol use.

Personalized feedback interventions for pain and alcohol

Collectively, the literature suggests that brief, computer-based PFIs can improve pain and alcohol-relevant health behaviors, while simultaneously reducing patient and provider burden. Considering the efficacy of this type of intervention for addressing both conditions, PFIs may be a promising strategy to address the comorbidity of pain and problematic alcohol use. Despite the high prevalence and bidirectional nature of co-occurring pain and alcohol consumption, we are not aware of any interventions that have attempted to address both conditions in an integrated fashion. Integrated treatments are often preferable to traditional approaches for treating co-occurring disorders (e.g. sequential and parallel treatment) because they are more efficient, cost-effective, and do not mandate that one condition takes precedent over another [57]. Brief, computer-based PFIs are especially conducive to integrated treatment, as their structure/content can be easily and dynamically customized, and they can be administered across a variety of settings and platforms. In one recent study, 68 cigarette smokers with comorbid pain and HIV were randomized either to an integrated PFI (aimed at increasing confidence to quit smoking among individuals with pain) or to a nutrition education control PFI [37]. Components of the integrated PFI included individual profiles of pain symptoms and cigarette smoking, pain-smoking psychoeducation, and the benefits of quitting in the context of pain and HIV. Post-test results indicated small effects of the integrated PFI on increasing knowledge of interrelations between pain and smoking and increasing confidence to quit.

Given established interrelations between pain and alcohol use, there is a clear need for additional research focused on the development and testing of integrated PFIs to simultaneously address both conditions. Integrated PFIs for pain and alcohol may benefit from incorporating pain-alcohol psychoeducation (e.g. analgesic properties of alcohol, negative effects of alcohol on pain symptoms), personalized profiles for pain (e.g. pain intensity, duration, and impairment) and alcohol consumption (e.g. frequency of drinking, indicators of hazardous drinking), and normative feedback regarding current drinking behaviors. Other areas of focus should include perceived interrelations between pain and alcohol [37],

pain-related fear/avoidance behaviors [58], alcohol-related health risks [59], and teaching more adaptive (e.g. non-substance related) strategies for managing pain symptoms [60,61]. An integrated PFI should increase motivation to address problematic alcohol use among persons with pain through increasing understanding of harmful pain-alcohol interrelations, correcting normative misperceptions of drinking patterns, and developing discrepancy between current alcohol consumption and desired pain outcomes.

Future research directions and conclusions

Future integrated treatments for pain and alcohol may benefit from also addressing concurrent use of prescription opioids. Mixing alcohol with opioids can cause serious health problems, opioid overdose, and death [62–65]. Furthermore, it has been suggested that pain patients may be reluctant to discuss their drinking [4**]. Preliminary evidence indicates that brief, computer-based psychoeducation [66] and personalized feedback [67*] can increase knowledge of opioid risk behaviors among individuals with chronic pain or opioid use disorder, and this work should be extended to the context of co-occurring pain and alcohol consumption. Future work in this emerging domain would also benefit from incorporating longer follow-up periods, testing effects across treatment settings, recruiting larger samples with varying patterns of pain and problematic drinking, and comparing the efficacy of PFIs with more established, time-intensive interventions.

In summary, brief, computer-based PFIs offer great promise for addressing co-occurring pain and alcohol misuse in an integrated fashion. We are not aware of any treatments that have been developed to either reduce drinking in the context of pain or enhance self-efficacy to manage pain in the absence of drinking. Future work aimed at adapting brief and portable interventions for adult drinkers with chronic pain will help to address a critical public health need among a population that has been generally underrepresented in clinical research.

Conflict of interest statement

Nothing declared

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Treatment-seeking participants with opioid-dependence completed a brief computer-based personalized feedback intervention (PFI) that assessed current risky opioid use behaviors at baseline. On the basis of their responses, participants received psychoeducation and personalized feedback regarding current risk for opioid overdose. There was no effect of the intervention on increasing self-efficacy to better manage opioid use; however, participants reported increased knowledge of risky opioid use behaviors.