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The impact of youth internalising and externalising symptom severity on the effectiveness of brief personality-targeted interventions for substance misuse: A cluster randomised trial

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INTRODUCTION

Adolescent mental health problems are associated with substance misuse, with dually diagnosed patients being the norm, rather the exception. Up to 80% of adolescents with a primary Axis I disorder have co-morbid substance use disorder (SUD) [1, 2], with 11-16% of adolescent outpatients diagnosed with a co-occurring SUD [3].

The risk of a dual diagnosis is sizeable in youth [4] and, in addition to representing a challenge for clinicians, has many personal, familial and societal implications. Dual diagnoses are associated with poor treatment outcomes and compliance, more severe psychiatric symptoms, higher relapse rates, suicidal ideation and attempts, and poorer functioning [5-8]. Treatment programs are under-developed for dual diagnoses [9], as many evidence-based practices do not address the additional impact or interaction of conditions co-occurring with the primary diagnosis.

Several theoretical models have been proposed to explain comorbidity between disorders. One influential theory is the "common factor" model, whereby comorbid disorders are explained through their relationship to a common underlying variable, such as personality [10, 11]. Four different personality profiles, Hopelessness, Anxiety-Sensitivity, Impulsivity and Sensation Seeking, play a particularly important role in the onset and development of substance misuse and psychiatric symptoms. Each is associated with different motives for substance use [12], drug use profiles [13] and patterns of non-addictive psychopathology [14]. These high-risk personality traits are targeted in a brief, selective intervention program named Preventure, which was

developed in order to prevent alcohol and drug use problems in adolescence, and has since been validated in five separate randomised controlled trials in Canada, the United Kingdom, The Netherlands and Australia. This cognitive-behavioral intervention has been shown to reduce substance use and related problems up to three years post-intervention [15-21].

It remains to be determined if this intervention approach is as effective for those who may already experience significant mental health problems prior to intervention delivery. Indeed, some evidence suggests that substance misuse interventions may not be as effective in those participants who have co-occurring mental health problems [6, 22]. The Preventure program has been shown to concurrently reduce internalising and externalising problems up to two years post-intervention [23, 24]. This suggests that, through targeting the underlying personality risk factors, Preventure may simultaneously address the adverse emotional and behavioural consequences of these high-risk traits.

The current study aims to examine the moderating effects of pre-existing mental health symptoms on the effectiveness of Preventure interventions on alcohol outcomes. These results will inform on the potential applicability of this intervention to clinical child and adolescent populations, as well as with individuals with a dual diagnoses, who are currently under-served by treatment programs.

METHODS

Participants and procedures

19 secondary schools across 18 London boroughs were recruited to participate in the Adventure cluster-randomised trial, and all grade 9 students were invited to participate (n=3021). The response rate was 87.5% (n=2643). The study selected youth who reported high levels of four personality traits according to the Substance Use Risk Profile Scale (SURPS; [12]). High-risk status was defined as scoring one standard deviation above the school mean on one of the four subscales of the SUPRS. The final study sample consists of 1025 high-risk adolescents (54% male, mean age 13.7 years at baseline, 43% white). This sample represents 84.7% of randomized high-risk participants. The study followed a cluster randomised design in which schools were allocated to intervention or control conditions according to a computerised randomisation procedure. High-risk participants from intervention schools were invited to participate in personality-targeted interventions. These participants were assigned to the personality-targeted intervention for which they showed the most statistical deviance according to z-scores. Please see Figure 1 (CONSORT diagram) for further information on participant enrolment, allocation and follow-up in the study.

Participants were surveyed during class time using self-report questionnaires at 6-month intervals for 2 years. To maximize the accuracy of self-reports, visual prompts were used to assess quantity of alcohol consumption, a reliability check (sham drug

item) was included, and baseline and follow-up assessments were conducted by research, rather than school, staff.

Ethical considerations

Active assent from students and passive consent from parents for both survey and intervention phases were obtained.

All high-risk students were included in the intent-to-treat analysis regardless of whether or not they received an intervention. Please see Figure 1 (CONSORT diagram) for more information.

Figure 1: CONSORT diagram
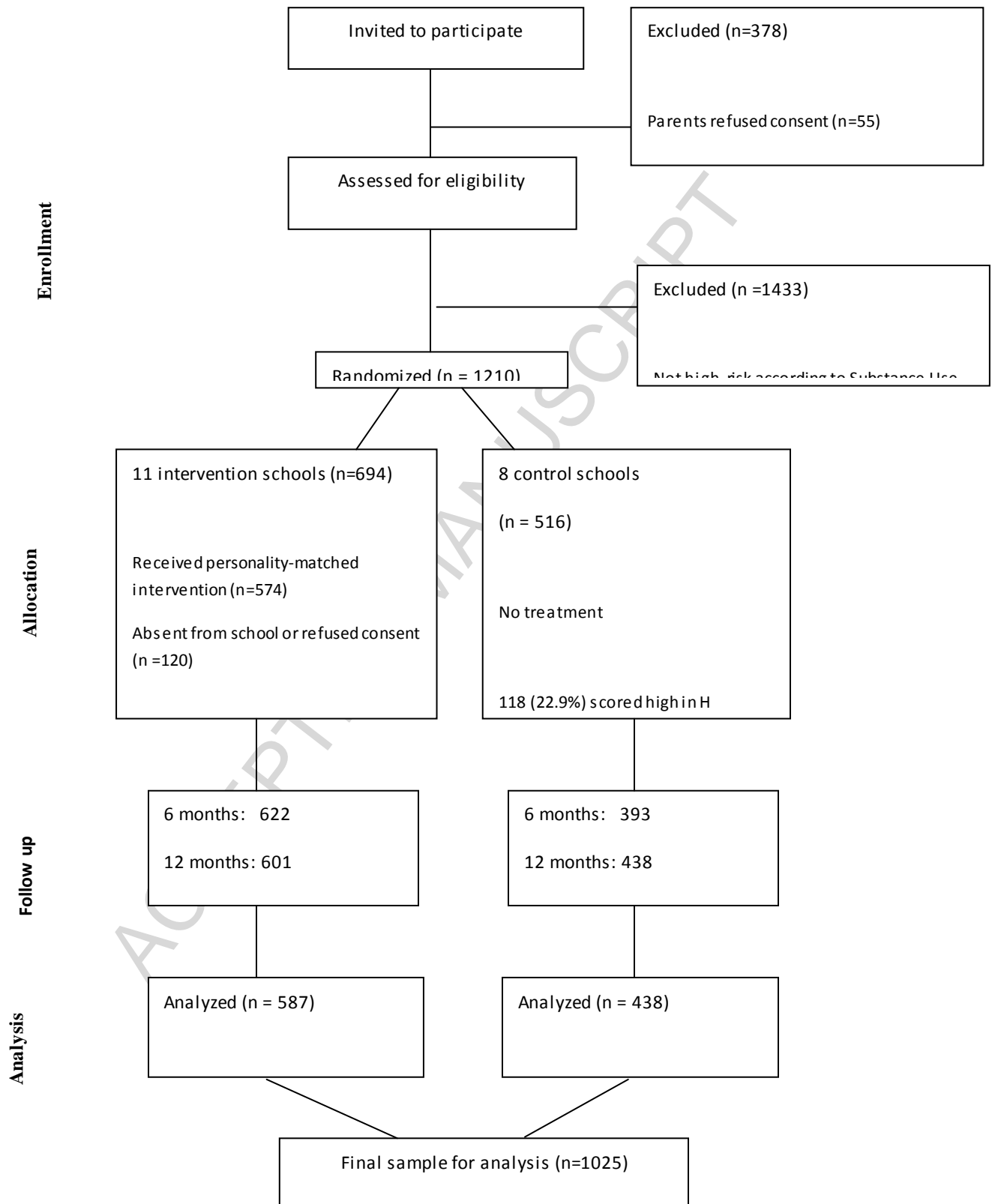
Measures

Demographics

Adolescents provided gender and ethnicity information using a multiple-choice procedure.

Personality risk

The 23-item SURPS questionnaire [12] was used to assess variation in personality risk for substance abuse and dependence including four different dimensions: Sensation-Seeking, Impulsivity, Anxiety-Sensitivity and Hopelessness (referred to in adolescents as Negative Thinking). The SURPS has good concurrent, predictive and incremental validity (relative to other personality measures) in differentiating individuals prone to reinforcement-specific patterns of substance-use [12-15, 25]. It is concurrently and prospectively associated with substance misuse and non substance-related externalising behaviours and internalising symptoms [12, 14, 25], and shows adequate sensitivity and specificity with respect to predicting the majority of youth who will develop substance use and mental health problems, and the types of problems that they develop [14].

Drinking outcomes

Alcohol use was assessed by asking students to report the quantity and frequency of their alcohol consumption over the past 6-months. Binge-drinking was assessed by asking students how often they had consumed 5 or more alcoholic beverages (4 or more for girls) on one occasion. An alcohol problem score was created using a shortened

version of the Rutgers Alcohol Problem Index (RAPI; [26]). RAPI scores were log-transformed in order to compensate for the skewed nature of the data.

Internalising symptoms

Depression and anxiety symptoms over the past 6 months were measured using the Depression and Anxiety subscales from the Brief Symptoms Inventory [27], a standardized self-report symptom inventory. Both depression and anxiety scores were log-transformed in order to compensate for the skewed nature of the data, and were then standardized using z-scores.

Externalising symptoms

Conduct problems and hyperactivity/inattention symptoms were assessed according to the conduct and hyperactivity/inattention subscales of the Strengths and Difficulties Questionnaire [28]. Both are sum scores of 5 items each. Total conduct problem and hyperactivity/inattention scores were standardized using z-scores.

Intervention

All interventions were provided at the participants' schools by a trained facilitator and co-facilitator from January to April 2008. Each intervention involved two 90-minute sessions, with an average of 6 personality-matched adolescents per group, and were

conducted using manuals that included real life 'scenarios' shared by high-risk U.K. youth in specifically-organised focus groups. All 4 personality manuals were based on a cognitive-behavioural therapy model, incorporating psycho-educational and motivational enhancement therapy components [29]. In the first session, participants were guided in a goal-setting exercise designed to enhance motivation to explore personality and new ways of coping with one's personality. Psycho-educational strategies were used to educate participants about the target personality variable and the associated problematic coping behaviors, such as interpersonal dependence, avoidance, aggression, risky behaviors and substance misuse. Participants were then introduced to cognitive-behavioral model and then guided in dissecting a personal experience according to the physical, cognitive and behavioral components of an emotional response. All exercises discussed thoughts, emotions and behaviors in a personality-specific way (*e.g.,* catastrophic thoughts and avoidance in the AS interventions). In the second session, participants were encouraged to identify and challenge personality-specific cognitive distortions that lead to problematic behaviors. For more information regarding the content of the interventions, please refer to previous publications and a recent review article [30, 31].

Data analysis

Baseline symptoms of depression, anxiety, conduct disorder and hyperactivity/inattention were examined separately as moderators of the intervention

effect on each of the drinking outcomes, *i.e.* alcohol use, binge-drinking, and alcohol-related problems over two-year post-intervention. Two-part latent growth curve models of alcohol consumption were created using Mplus version 6.11 [32]. This statistical strategy allowed us to model both onset and frequency of substance–related behaviours as correlated events and also allowed for the observation of main effects of the intervention across time (*i.e.,* the intercept centered at 6-months) and time-dependent effects of the intervention (*i.e.,* the growth from 6 to 24 months). In part 1 of the model, the probability of a drinking event in the past 6 months was separated from the rest of the distribution by creating binary variables representing presence or absence of the behaviour in the past six months. This variable was then modelled through a random effects probit model in which the probability of use was regressed on an intercept (centered at the 6-month follow-up) and a growth parameter. The intercept refers to any group differences in drinking at the first follow-up (and the extent to which that effect carries over to subsequent follow-up scores) and the linear slope refers to change in probability of the behaviour from 6-24 months (capturing any linear increase or decreases in group differences over time). In part 2 of the model, the continuous indicators of the behaviour (frequency of drinking, quantity of drinking, frequency of binge drinking and severity of problem drinking symptoms) were modelled given their onset. In this model, only cases reporting the behaviour at a particular time point were included in the analysis.

Interaction terms were then created between intervention status and symptoms scores, and included in these models along with intervention status, symptom scores and

baseline substance use measures. The impact of each moderator variable was examined separately whilst controlling for the three other potential moderators. This allowed us to examine the impact of individual symptoms (*e.g.,* depression) over and above the influence of other comorbid problems (*e.g.,* anxiety). Baseline demographic variables (gender and ethnicity) were used as covariates in all analyses.

To clarify the impact of a moderator, the effect of the intervention was tested and plotted at different levels of a moderator, i.e. one standard deviation above ("high" symptoms) and below ("low" symptoms) the mean.

The main aim of the analyses was to investigate overall impact of the interventions at 6 months and on the symptom slope from 6 to 24 months. Namely, there were no time-specific hypotheses regarding time by intervention interaction from 6 to 24 months.

Intra-cluster correlations for all outcome variables were below 5% at each time-point, indicating that the variance attributable to the cluster (school) was negligible. Therefore, statistical analyses did not take school clusters into account. (A previous publication using this sample showed no effect of controlling for cluster on main effects of intervention on all drinking outcomes [18]).

Missing data

Missing data were imputed using full information maximum likelihood estimation in SPSS statistical software (SPSS Inc.) [33], which enabled us to use all available data. This

procedure is considered valid for data missing not at random when less than 25% of a dataset is missing, which was the case for this database.

RESULTS

Baseline sample demographics, depression, anxiety, conduct problems and hyperactivity/inattention symptoms by intervention versus control groups are reported in table 1. There were no significant differences between groups on psychiatric symptoms (*i.e.,* moderators) and demographics, with the exception of age (t(939.6) =-2.007, p=.05).

Table 1. Baseline characteristics

	Control	Intervention
Male (%)	57	51.9
White (%)	43.5	42
Age (mean)	13.69	13.73
Depression symptoms(mean)	13.99	14.53*
Anxiety symptoms (mean)	9.16	9.55

Conduct problem symptoms (mean)	3.55	3.49
Hyperactivity/inattention symptoms (mean)	5.05	4.99

Note. * significant difference relative to control group. p<.05

Overall effects

Table 2 presents results from the four 2-part growth curve models of the intervention effects on the different drinking outcomes when no moderators were included in the analysis (*i.e.* the primary outcomes of the trial, [18]). As previously reported, there was a significant treatment effect on the intercepts of all alcohol use outcomes. When drinking was reported, high-risk youth were also shown to benefit from the interventions over the 24-month follow-up on overall quantity of drinking, (b =-0.098, p=0.04), and growth in drinking problems, (b =-0.098, p=.04).

Table 2. Intervention effects on alcohol consumption with no moderators

Dichotomous Model		Estimate	S.E.	Continuous Model		Estimate	S.E.
Alcohol frequency	ID	-0.45***	0.13	Alcohol frequency	IC	-0.08	0.05
	SD	0.11*	0.06		SC	0.01	0.02
Alcohol quantity	ID	-0.45***	0.13	Alcohol quantity	IC	-0.10*	0.05
	SD	0.12*	0.06		SC	-0.01	0.02
Binge drinking	ID	-0.39**	0.16	Binge drinking frequency	IC	-0.06	0.05
	SD	0.05	0.07		SC	0.01	0.02
Alcohol-related problems	ID	-0.25*	0.12	Alcohol-related problems	IC	0.04	0.12
	SD	-0.07	0.06		SC	-0.10*	0.05

Note. S.E. : Standard Error. Est. : Estimate. ID: Intercept. dichotomous part of the model. SD: Slope.

dichotomous part of the model. IC: Intercept. continuous part of the model. SC: Slope. continuous part of

the model. *:p≤.05,**:p≤.01 , ***:p≤.001

Effects in symptomatic individuals

<u>Depression and anxiety</u>

None of the interaction terms for depression and anxiety symptoms were significantly

associated with drinking, binge-drinking, and drinking problems, suggesting that

presence of these symptoms did not moderate any of these intervention effects.

Table 3. Moderation of depression and anxiety symptoms on intervention effects on alcohol use outcomes

Dichotomous Model			Estimate	S.E.	Continuous Model		Estimate	S.E.
Depression x Intervention								
	Alcohol frequency	ID	-0.21	0.14	Alcohol frequency	IC	0.002	0.05
		SD	0.12	0.06		SC	-0.01	0.02
	Alcohol quantity	ID	-0.21	0.14	Alcohol quantity	IC	0.001	0.05
		SD	0.12	0.06		SC	-0.02	0.02
	Binge drinking frequency	ID	-0.27	0.16	Binge drinking frequency	IC	0.002	0.06
		SD	0.07	0.08		SC	0.00	0.02
	Alcohol-related problems	ID	-0.20	0.12	Alcohol-related problems	IC	0.03	0.12
		SD	0.09	0.06		SC	0.02	0.05
Anxiety x Intervention								
	Alcohol frequency	ID	-0.22	0.14	Alcohol frequency	IC	-0.01	0.05

|								
		SD	0.07	0.06		SC	-0.01	0.02
		ID	-0.22	0.14		IC	-0.05	0.05
	Alcohol quantity	SD	0.07	0.06	Alcohol quantity	SC	0.01	0.02
		ID	-0.29	0.15		IC	0.03	0.05
	Binge drinking	SD	0.06	0.07	Binge drinking frequency	SC	-0.01	0.02
		ID	-0.11	0.12		IC	-0.08	0.12
	Alcohol-related problems	SD	0.06	0.06	Alcohol-related problems	SC	0.06	0.045

Hyperactivity/Inattention (H/I)

H/I symptoms did not moderate intervention effects on probability of drinking, growth in probability of drinking (dichotomous model), or frequency or growth in frequency of drinking when drinking occurred (continuous model). However, a significant interaction was found for growth in drinking quantity in the continuous model (b=0.040, p=0.04), indicating a beneficial effect of the intervention on growth in drinking quantity in adolescents reporting lower (1 SD below the mean) H/I symptoms (b =-0.061, p=0.05), but not in adolescents reporting higher (1 SD above the mean) H/I symptoms (b=0.020, p=0.46).

H/I moderated the intervention effect on probability of binge drinking (b=-0.391, p=0.01): Youth who reported higher H/I symptoms benefited from the intervention in terms of reducing their probability of binge-drinking (b=-0.727, p=0.001), while youth who reported lower symptoms did not (b=0.055, p=0.81) (See Figure 2).

Figure 2. Intervention x Baseline Hyperactivity/Inattention (high/low) on Binge Drinking onset
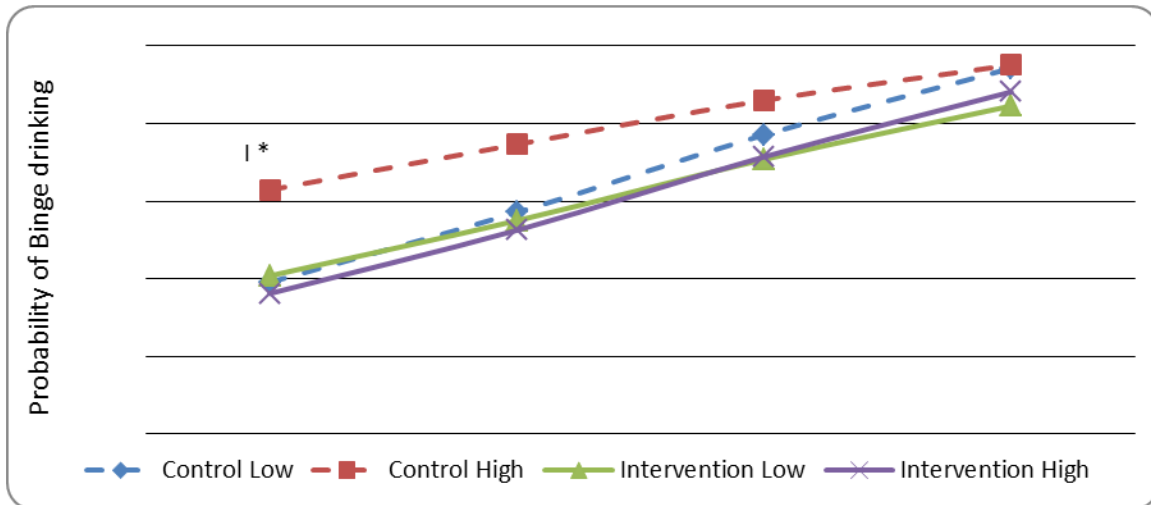
I (Intercept) : significant difference relative to Intervention High, p<0.05

Control Low: Control group, Low on Hyperactivity/inattentive problems (1 S.D. below the mean)

Control High: Control group, High on Hyperactivity/inattentive problems (1 S.D. above the mean)

Intervention Low: Intervention group, Low on Hyperactivity/inattentive problems (1 S.D. below the mean)

Intervention High: Intervention group, High on Hyperactivity/inattentive problems (1 S.D. above the mean)

H/I did not significantly moderate the effect of the intervention on probability of problem drinking at 6 months, but did moderate the effect on this outcome across time (b=0.186, p=0.001): the intervention was associated with a decreased probability in reporting drinking problems across time in adolescents low in H/I symptoms (b=-0.265, p=0.001),

but not in those reporting higher H/I symptoms (b=0.106, p=0.17). The continuous model did not reveal any significant moderation of H/I on intervention effects.

Conduct problems (CP)

CP significantly moderated intervention effect on probability of drinking at 6-months (b=-0.366, p=0.01): the intervention was associated with lower probability of drinking for adolescents with higher CP (b=-0.816, p<0.001), but not for adolescents reporting lower CP (b=-0.084, p=0.64). The CP by intervention interaction for growth in probability of drinking over the course of the trial was also significant (b=0.114, p=0.04), showing that the intervention was associated with an increase in growth of probability of drinking across time for adolescents reporting higher conduct problems (b=0.230, p=0.01), but not for adolescents reporting lower problems (b=-0.003, p=0.97) (See Figure 3).

Figure 3. Intervention x Baseline Conduct Problems (high/low) on Drinking onset
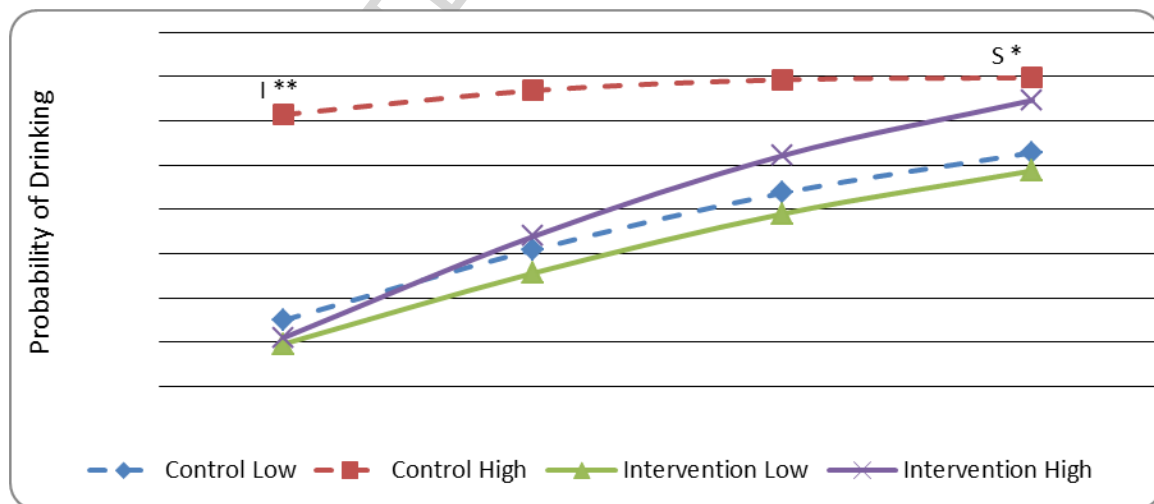
I (Intercept) : significant difference relative to Intervention High, p<0.01

S (Slope) : significant difference relative to Intervention High, p<0.05

Control Low: Control group, Low on Conduct problems (1 S.D. below the mean)

Control High: Control group, High on Conduct problems (1 S.D. above the mean)

Intervention Low: Intervention group, Low on Conduct problems (1 S.D. below the mean)

Intervention High: Intervention group, High on Conduct problems (1 S.D. above the mean)

The probability of binge drinking at 6-months was also moderated by CP (b=-0.315, p=0.05): the intervention was associated with lower probability of binge drinking for adolescents reporting higher CP (b=-0.680, p=0.002), but not for adolescents reporting lower CP (b=-0.005, p=0.82) (See Figure 4). However, the interaction for growth in probability of binge drinking did not reach significance, suggesting that the benefits of the intervention for children with high levels of CP were maintained over the 24-month period.

Figure 4. Intervention x Baseline Conduct Problems (high/low) on Binge Drinking onset

I (Intercept) : significant difference relative to Intervention High, p<0.05

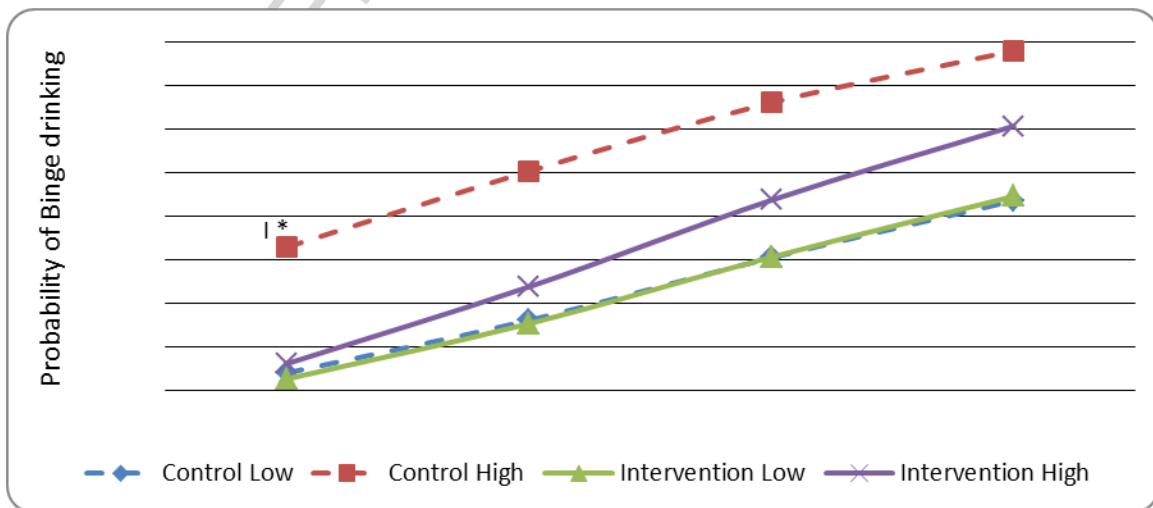Control Low: Control group, Low on Conduct problems (1 S.D. below the mean)

Control High: Control group, High on Conduct problems (1 S.D. above the mean)

Intervention Low: Intervention group, Low on Conduct problems (1 S.D. below the mean)

Intervention High: Intervention group, High on Conduct problems (1 S.D. above the mean)

Finally, CP did not moderate the effect of the intervention on probability of drinking problems, but significantly moderated the intervention effect on growth in probability of drinking problems (b=0.117, p=0.03): the intervention was associated with lower probability of reporting drinking problems for adolescents reporting lower CP (b=-0.195, p=0.02), but not for those reporting higher CP (b=0.038, p=0.61).

Table 4: Moderation of hyperactivity/inattention and conduct problem symptoms on intervention effects on alcohol use outcomes

Dichotomous Model		Estimate	S.E.	Continuous Model		Estimate	S.E.
Hyperactivity x Intervention							
	ID	-0.24	0.14		IC	0.04	0.05
Alcohol frequency	SD	0.09	0.06	Alcohol frequency	SC	0.02	0.02
	ID	-0.22	0.14		IC	-0.04	0.05
Alcohol quantity	SD	0.08	0.06	Alcohol quantity	SC	0.04*	0.02
	ID	-0.39**	0.16		IC	0.05	0.05
Binge drinking	SD	0.14	0.07	Binge drinking frequency	SC	-0.01	0.02
	ID	-0.24	0.13		IC	-0.07	0.11
Alcohol-related problems	SD	0.19***	0.06	Alcohol-related problems	SC	0.04	0.05
Conduct Problems x Intervention							
	ID	-0.37**	0.13		IC	0.05	0.05
Alcohol frequency	SD	0.12*	0.06	Alcohol frequency	SC	-0.02	0.02
Alcohol quantity	ID	-0.36**	0.13	Alcohol quantity	IC	-0.04	0.05

		Est.	S.E.			Est.	S.E.
	SD	0.11*	0.06		SC	0.03	0.02
	ID	-0.32*	0.16		IC	0.06	0.05
Binge drinking	SD	0.02	0.07	Binge drinking frequency	SC	-0.01	0.02
	ID	-0.21	0.12		IC	0.11	0.12
Alcohol-related problems	SD	0.12*	0.05	Alcohol-related problems	SC	-0.02	0.05

Note. S.E. : Standard Error. Est. : Estimate. ID: Intercept. dichotomous part of the model. SD: Slope. dichotomous part of the model. IC: Intercept. continuous part of the model. SC: Slope. continuous part of the model. *:p≤.05,**:p≤.01 , ***:p≤.001

Odd ratios were calculated to estimate the relative benefits of the intervention. Youth with high levels of H/I symptoms had 2.7 (95% CI = 2.6-2.9) lower odds of having initiated binge drinking 6 months after the intervention relative to those with equally elevated H/I symptoms who did not receive the intervention. Adolescents with high levels of CP had 2.9 (95% CI = 2.7-3.1) and 2.5 (95% CI = 2.2-2.8) lower odds of having initiated alcohol consumption and binge drinking, respectively, relative to those with similarly high levels of CP who did not receive the intervention.

DISCUSSION

This study examined whether psychiatric symptoms moderated the effect of personality-targeted interventions on adolescent substance use in the Adventure trial [18]. This is the first examination of whether children with preexisting mental health symptoms would benefit equally from this intervention approach. Results indicate that high-risk youth with depression and anxiety symptoms did not respond differently to the intervention with regards to reducing their alcohol consumption or alcohol-related problems. These results contrast with other studies indicating that individuals with depression/anxiety symptoms have a poorer response to substance use interventions [34, 35]. Prior research has also shown that adolescents with high levels of substance use have a poorer response to depression interventions [8]. Together, these studies suggest that, for individuals with comorbid depression/anxiety and risk for substance misuse, targeting the underlying personality risk factors for these problems (hopelessness or anxiety-sensitivity) may be the most appropriate intervention strategy to address both sets of symptoms. In the Preventure program, for instance, youth are guided in understanding that substance use is a risky way of coping with their personality profiles as, while it may provide short-term relief, it is associated with negative outcomes in the longer term for their particular symptoms (*e.g.*, anxiety or depression).

Meanwhile, symptoms of H/I and CP significantly moderated the effects of intervention on adolescents' alcohol misuse in this study, but in a time-limited way. This intervention

approach appeared to decrease the likelihood of alcohol-related problems in youth with high levels of H/I symptoms and CP relative to youth with lower levels of these problems. Furthermore, there was some evidence that youth with high levels of externalising symptoms at baseline benefited more from the interventions at earlier follow-up periods (6 months post-intervention), with an almost threefold reduced odds of binge drinking in youth with high levels of externalising problems. However, the lack of interaction between CP and intervention for binge-drinking slope suggests that intervention effects on binge drinking in youth with elevated CP were maintained over the 24-month period. It is also noteworthy that, whilst adolescents reporting more symptoms at baseline benefited most from the intervention at 6 months, they also had a higher increase on every outcome over two years. These results could potentially be explained by the increased relevance of therapeutic concepts for this population (hence the enhanced beneficial effects at 6 months). Additional or booster sessions may be necessary to prolong these beneficial effects.

In the overall high-risk sample, when the impact of moderators was not considered, this intervention approach was shown to be associated with a 3-year reduction on all drinking outcomes [20]. Early-onset initiation was found to be delayed in intervention participants, yet not prevented completely. This is to be expected due to the fact that experimentation with substances is normative [36]. Since delaying the age of onset of consumption by one year reduces the odds of alcohol dependence by 9% [37], this effect is certainly not negligible. It may even suggest a protective effect in these youth, who are already considered vulnerable due to their struggle with other emotional and

behavioral concerns. This intervention has resulted in clinically significant symptoms of depression, anxiety and conduct disorder over 2-years [24]. Taken together, these set of findings suggest that the personality-targeted approach may be particularly effective for helping youth with externalising problems to delay onset of and rapid progression to binge-drinking.

The importance of this study lies in the fact that patients with clinical levels of mental health symptoms may benefit from personality-targeted interventions as a supplement to their usual therapy. Indeed, personality-targeted interventions should be considered in future studies of improvement of health services available to this population [9]. Future studies could conduct a comparative analysis of personality-targeted intervention versus treatment-as-usual in youth receiving psychological treatment for mental health issues, in order to assess whether personality-targeted interventions may be sufficient as a stand-alone treatment for dually diagnosed patients (or, instead, whether they may be more suitable as an adjunct to existing treatments). It would also be of interest to test whether an extended version of the personality-targeted intervention program may prolong the enhanced intervention effects on substance related outcomes reported by youth with high levels of externalising problems (*e.g.*, binge drinking and alcohol-related problems), which were time-limited in the current study (although intervention effects were maintained over the 24-month follow-up period). An extended follow-up period in future studies would also allow a measurement of the impact of these brief interventions on the risk of addiction in late

adolescence (this question is currently being examined in a five-year trial of personality-targeted interventions in Canada [38]).

The strengths of this study include the intent-to-treat analysis, long-term and multiple follow-ups allowing measurement of intervention effects over an extended period, and statistical methods that capture onset and growth in trajectories of outcomes and the complex structure of drinking outcome data, which all contribute to an evidence base extending this prevention model to more severely affected psychiatric populations and settings. However, a number of limitations should be noted. It is widely accepted that self-report questionnaires can be used to measure externalising and internalising symptoms among adolescents, which might go unnoticed by parents and teachers, but they need to be interpreted with caution. In this study, several methods were used to maximize the accuracy and reliability of self-report data, including the addition of a sham drug item, assuring confidentiality and no consequences to self-report use, as well as having the data collection performed by research assistants rather than teachers. Finally, in a previous publication [18], we report that youth self-report age of onset of alcohol use is highly reliably reported across multiple assessments (chronbach alphas=0.90).

A pilot project is currently underway in a clinical setting at CHU Ste-Justine, Montreal, Canada in order to attempt to replicate these results in a clinical population (Prevention and Reduction of Alcohol and Drug Problems in a Clinical Psychiatric Youth Population; unique identifier: NCT01595568).

CONCLUSION

This is the first study demonstrating that brief, personality-targeted interventions are effective in reducing substance misuse over a two-period in youth who are at particularly high-risk for addiction and mental health problems, namely those experience significant mental health problems in adolescence. These results suggest that personality-targeted interventions should be considered as a potential treatment adjunct in order to improve the provision of mental health services to at-risk youth. Although the current study describes the efficacy of this approach in a community sample, it is possible that personality-targeted interventions may equally be effective in youth with a dual diagnosis of mental health and substance use problems, as a previous trial demonstrated that a personality-targeted approach was effective in reducing substance use in an adult, clinical population [39]. These results have significant clinical implications given the recognised difficulties in effectively treating individuals with a dual diagnosis.

REFERENCES

1.   Deas-Nesmith, D., S. Campbell, and K.T. Brady, *Substance use disorders in an adolescent inpatient psychiatric population.* J Natl Med Assoc, 1998. **90**(4): p. 233-8.
2.   Garcia-Carretero, M.A., et al., *Psychopathological profile and prevalence of dual pathology on patients with alcoholic dependence undergoing outpatient treatment.* Actas Esp Psiquiatr, 2017. **45**(1): p. 1-11.

3.   Kramer, T.L., et al., *Detection and outcomes of substance use disorders in adolescents seeking mental health treatment.* J Am Acad Child Adolesc Psychiatry, 2003. **42**(11): p. 1318-26.

4.   Costello, E.J., et al., *Prevalence and development of psychiatric disorders in childhood and adolescence.* Arch Gen Psychiatry, 2003. **60**(8): p. 837-44.

5.   Baker, K.D., et al., *Impact of co-occurring substance use on 6 month outcomes for young people seeking mental health treatment.* Aust N Z J Psychiatry, 2007. **41**(11): p. 896-902.

6.   Grella, C.E., et al., *Drug treatment outcomes for adolescents with comorbid mental and substance use disorders.* J Nerv Ment Dis, 2001. **189**(6): p. 384-92.

7.   King, R.D., et al., *The co-occurrence of psychiatric and substance use diagnoses in adolescents in different service systems: frequency, recognition, cost, and outcomes.* J Behav Health Serv Res, 2000. **27**(4): p. 417-30.

8.   Gau, J.M., et al., *Negative life events and substance use moderate cognitive behavioral adolescent depression prevention intervention.* Cogn Behav Ther, 2012. **41**(3): p. 241-50.

9.   Salvo, N., et al., *Prevention of substance use in children/adolescents with mental disorders: a systematic review.* J Can Acad Child Adolesc Psychiatry, 2012. **21**(4): p. 245-52.

10.   Castellanos-Ryan, N. and P.J. Conrod, *Personality and substance misuse: evidence for a four-factor model of vulnerability*, in *Drug Abuse and Addiction in Medical Illness*. 2012, Humana/Spring Press: New-York, NY.

11.   Pihl, R.O. and J.B. Peterson, *Alcoholism: the role of different motivational systems.* J Psychiatry Neurosci, 1995. **20**(5): p. 372-96.

12.   Woicik, P.A., et al., *The Substance Use Risk Profile Scale: a scale measuring traits linked to reinforcement-specific substance use profiles.* Addict Behav, 2009. **34**(12): p. 1042-55.

13.   Conrod, P.J., et al., *Validation of a system of classifying female substance abusers on the basis of personality and motivational risk factors for substance abuse.* Psychol Addict Behav, 2000. **14**(3): p. 243-56.

14.   Castellanos-Ryan, N., et al., *Sensitivity and specificity of a brief personality screening instrument in predicting future substance use, emotional, and behavioral problems: 18-month predictive validity of the Substance Use Risk Profile Scale.* Alcohol Clin Exp Res, 2013. **37 Suppl 1**: p. E281-90.

15.   Conrod, P.J., N. Castellanos, and C. Mackie, *Personality-targeted interventions delay the growth of adolescent drinking and binge drinking.* J Child Psychol Psychiatry, 2008. **49**(2): p. 181-90.

16.   Conrod, P.J., N. Castellanos-Ryan, and C. Mackie, *Long-term effects of a personality-targeted intervention to reduce alcohol use in adolescents.* J Consult Clin Psychol, 2011. **79**(3): p. 296-306.

17.   Conrod, P.J., N. Castellanos-Ryan, and J. Strang, *Brief, personality-targeted coping skills interventions and survival as a non-drug user over a 2-year period during adolescence.* Arch Gen Psychiatry, 2010. **67**(1): p. 85-93.

18.   Conrod, P.J., et al., *Effectiveness of a selective, personality-targeted prevention program for adolescent alcohol use and misuse: a cluster randomized controlled trial.* JAMA Psychiatry, 2013. **70**(3): p. 334-42.

19.   Conrod, P.J., et al., *Efficacy of cognitive-behavioral interventions targeting personality risk factors for youth alcohol misuse.* J Clin Child Adolesc Psychol, 2006. **35**(4): p. 550-63.

20.   Newton, N.C., et al., *The long-term effectiveness of a selective, personality-targeted prevention program in reducing alcohol use and related harms: a cluster randomized controlled trial.* J Child Psychol Psychiatry, 2016. **57**(9): p. 1056-65.

21. Lammers, J., et al., *Effectiveness of a selective intervention program targeting personality risk factors for alcohol misuse among young adolescents: results of a cluster randomized controlled trial.* Addiction, 2015. **110**(7): p. 1101-9.

22. Brown, S.A., et al., *Correlates of success following treatment for adolescent substance abuse.* Applied and Preventive Psychology, 1994. **3**(2): p. 61-73.

23. Castellanos, N. and P.J. Conrod, *Brief interventions targeting personality risk factors for adolescent substance misuse reduce depression, panic and risk-taking behaviours.* J Ment Health, 2006. **15**(6): p. 645-58.

24. O'Leary-Barrett, M., et al., *Two-year impact of personality-targeted, teacher-delivered interventions on youth internalising and externalising problems: a cluster-randomized trial.* J Am Acad Child Adolesc Psychiatry, 2013. **52**(9): p. 911-20.

25. Krank, M., et al., *Structural, concurrent, and predictive validity of the Substance Use Risk Profile Scale in early adolescence.* Addict Behav, 2011. **36**(1-2): p. 37-46.

26. White, H.R. and E.W. Labouvie, *Towards the assessment of adolescent problem drinking.* J Stud Alcohol, 1989. **50**(1): p. 30-7.

27. Derogatis, L.R., *Brief Symptom Inventory*. 1993, Mineapolis, MN: NCS Pearson Inc.

28. Goodman, R., *The Strengths and Difficulties Questionnaire: a research note.* J Child Psychol Psychiatry, 1997. **38**(5): p. 581-6.

29. Carroll, K.M., et al., *Internal validity of Project MATCH treatments: discriminability and integrity.* J Consult Clin Psychol, 1998. **66**(2): p. 290-303.

30. Conrod, P.J., *Personality-targeted interventions for substance use and misuse.* Curr Addict Rep, 2016. **3**(4): p. 426-436.

31. O'Leary-Barrett, M., et al., *Mechanisms of personality-targeted intervention effects on adolescent alcohol misuse, internalising and externalising symptoms.* J Consult Clin Psychol, 2016. **84**(5): p. 438-52.

32. Muthén, L.K. and B.O. Muthén, *Mplus User's Guide* 6ed. 2010, Los Angeles: Muthén & Muthén.

33. Carpenter, J.R. and M.G. Kenward *Missing data in randomised controlled trials — a practical guide*. 2007: London School of Hygiene & Tropical Medicine, UK.

34. Dobkin, P.L., et al., *Predictors of outcome in drug treatment of adolescent inpatients.* Psychol Rep, 1998. **83**(1): p. 175-86.

35. Tomlinson, K.L., S.A. Brown, and A. Abrantes, *Psychiatric comorbidity and substance use treatment outcomes of adolescents.* Psychol Addict Behav, 2004. **18**(2): p. 160-9.

36. O'Malley, P.M., L.D. Johnston, and J.G. Bachman, *Alcohol use among adolescents.* Alcohol Health Res World, 1998. **22**(2): p. 85-93.

37. Grant, B.F., F.S. Stinson, and T.C. Harford, *Age at onset of alcohol use and DSM-IV alcohol abuse and dependence: a 12-year follow-up.* J Subst Abuse, 2001. **13**(4): p. 493-504.

38. O'Leary-Barrett, M., et al., *A cluster-randomised controlled trial evaluating the effects of delaying onset of adolescent substance abuse on cognitive development and addiction following a selective, personality-targeted intervention program: The Co-Venture trial.* Addiction, 2017.

39. Conrod, P.J., et al., *Efficacy of brief coping skills interventions that match different personality profiles of female substance abusers.* Psychol Addict Behav, 2000. **14**(3): p. 231-42.

Highlights

- Personality-targeted interventions reduce binge drinking in high-risk youth.

- Youth with high (vs. low) externalising symptoms benefitted more from the intervention.

- Personality-targeted interventions may effectively treat dually diagnosed youth.

- The presence of high internalising symptoms didn't moderate intervention effects.