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Master's thesis (10ECTS)

**The effects of alcohol treatment as usual
with approach-avoidance training on alcohol
consumption and depression- a two-armed
randomized controlled trial**

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Abstract

Background: The field of cognitive bias modification (CBM) programs is arising nowadays which aims to retrain cognitive biases. These kinds of programs are also used for the treatment for alcohol use disorder (AUD). However, the effectiveness of CBM interventions in clinical settings is already proven while the effectiveness in addition to outpatient treatment is not much researched yet.

Objective: Therefore, the present study investigated the effect of one online CBM program, namely of the Alcohol Avoidance Training (AAT) in addition to treatment-as-usual (TAU) in outpatients suffering from AUD. The second aim of this study was to investigate the impact of the CBM AAT on individual's depressive symptomatology since the comorbidity between AUD and depression is high.

Method: Pre-and post-assessment data from a double blind randomized controlled trial study were used in order to investigate the effectiveness of 8 sessions of AAT in addition to TAU by means of a total of 139 outpatients (at least 18 years old) who had web-based or face-to-face TAU due to their suffering from AUD. They were recruited by their therapists and randomly assigned to either the CBM AAT condition (n=72) or to the CBM Placebo group (n=67).

Results: ANCOVA results revealed no significant between group differences from pre-to post-treatment with regard to individual's alcohol consumption as well as individual's depressive symptoms.

Conclusion: These findings suggest that AAT did not lead to significantly better outcomes. The specific reasons of why AAT was not effective are unclear until now. It was assumed that the setting, individual's motivation and hope might be important influential factors. However, due to the fact that there is limited research concerning CBM interventions for AUD outpatients, the reasons of why no effectiveness was found should be investigated further in order to be able to make improvements with regard to AAT. This might be

meaningful in order to be able to offer it as an additional successful treatment option for outpatients.

KEYWORDS: alcohol use disorder; depression; treatment-as-usual; cognitive bias modification; alcohol-avoidance training

Introduction

‘The worst thing which goes along an addiction is the chronicity. If a dependent person knows at its heart that he/she will consume the substance again, why shouldn’t he/she do it immediately? If there is however a spark of hope, that this circumstance will not be forever the case, everything changes. You stay the course one day, and then you manage to get through it another day and again another one. Hope is like oxygen for an individual who faces to choke on despair’ (Carr, 2008, as cited in Kring, Johnson, & Hautzinger, 2019, p.405). This citation was established in connection to substance dependence disorders and clearly illustrates the importance and meaning of hope for individuals who suffer from a dependence psychopathological disorder. One of them is called alcohol use disorder (AUD). This disease is one of the most prevalent global psychopathological disorder since alcohol is one of the most frequent misused substance: over 34 million adults suffer from this disease (Grant et al, 2015; Han et al., 2017). Individuals who suffer from alcohol use disorder consume alcohol to such a great extent that it causes psychological as well as physiological consequences (World Health Organization, 2018). According to the World Health Organization (2018), around 3 million individuals die each year due to the misuse of alcohol substances.

In many cases, individuals suffering from AUD want to change their addictive behaviour but are not successful and continue drinking. This paradoxical pattern can be explained by the fact that the addictive behaviour is triggered by unconscious automatic reflexes (Stacy, & Wiers, 2010; Strack, & Deutsch, 2004). This is signaled by an inability to control alcohol related stimuli (Bechara, 2005) and can be explained by the dual process model. This model represents and explains behavioural patterns of individual’s who suffer from AUD. According to this model, there is an imbalance between the conscious and the unconscious processes. Thus, the conscious system is underactivated which results in an inability to inhibit alcohol consumption. In turn, the automatic, unconscious system is

overactivated which causes an increased desire to approach alcohol-related stimuli and therefore, a limited capacity to control this desire (Noël, Bechara, Brevers, Verbanck, & Campanella, 2010; Wiers, Gladwin, Hofmann, Salemink, & Ridderinkhof, 2013; Friese, Hofmann, & Wiers, 2011). This is called approach bias. Individual's emotions, forces and motivations guide the unconscious system whereas knowledge about consequences with regard to different behaviours guides the conscious system (Slovic, Peters, Finucane, & MacGregor, 2005). Over time, drug-related responses become habitual. Consequently, it becomes more and more difficult to control the behaviour related to substance stimuli (de Wit, & Dickinson, 2009; Everitt & Robbins, 2005). Thus, affected individuals show an approach bias for alcohol related stimuli (Field, & Cox, 2008; Palfai, & Ostafin, 2003).

In order to overcome AUD and to enable individuals a healthier life style, cognitive behavioural therapy (CBT) is an evidence-based and successful treatment. The focus of CBT is mainly on the conscious processes, whereas the unconscious ones will not be taken into account (Wiers, Becker, Holland, Moggi, & Lejuez, 2015). However, as already described, these unconscious automatic processes play a key role in individual's alcohol misuse behaviour. Therefore, special computerized training programs were developed over the past years in order to target also the automatic processes and therefore reducing the automatic, cognitive biases. This program is called 'cognitive bias modification' (CBM) (Wiers et al., 2013). These kinds of interventions aim to change the approach biases. Therefore, Approach-Avoidance task (AAT) trainings were developed. The main aim of AAT is to retrain the automatic behaviour to approach alcohol stimuli in a way that participants engage in an avoidance reaction when presented with alcoholic stimuli.

Wiers et al., (2011) conducted a study with 214 alcohol-dependent inpatients using the AAT. They found that individuals of the experimental group changed their approach bias concerning alcohol into an avoidance bias. As a result, these participants drank less alcohol after the intervention.

Comorbidity of alcohol use disorder and depression

There is a high prevalence of a comorbidity between AUD and depressive symptoms (Foulds, Adamson, Boden, Williman, & Mulder, 2015; Dennhardt, & Murphy, 2011; Soltis, McDevitt-Murphy, & Murphy, 2017). It was researched that the probability to suffer from depressive symptoms is two to three times higher in individuals suffering from AUD compared to healthy individuals (Lai, Cleary, Sitharthan, & Hunt, 2015). This comorbidity is also called 'dual diagnosis' (Ravikanth, & Sultan, 2020).

In fact, if affected individuals get more control over their alcohol consumption, depressive symptoms decrease, if they developed them dependently on AUD. In contrast, depressive symptoms remain the same after abstinence if individuals suffer from depression independently from AUD (Ramsey, Kahler, Read, Stuart, & Brown, 2004).

In general, individuals who suffer from both disorders make more use out of the offered therapeutic services compared to individuals who suffer from one of these two diseases exclusively (Burgess et al., 2009): for instance, only one fifth of affected individuals suffering solely from AUD seek professional help (Probst, Manthey, Martinez, & Rehm, 2015). This can be explained due to a greater intensity of symptoms if affected individuals suffer from a dual-diagnosis. Consequently, they might recognize that they need expertise and professional help in order to overcome their problems and that they are not able anymore to handle it on their own. Additionally, individuals who suffer from this comorbidity show an increased impaired functioning and are more inclined for suicidal attempts (Davis et al., 2006). Hobden, Carey, Bryant, Sanson-Fisher, & Oldmeadow (2020) conducted a study with 203 outpatients who currently seek AUD treatment. Out of the 203 participants, 111 (55%) reported to also suffer from depressive symptoms. According to the researchers of this study, there is an urgent need to provide a very effective treatment for those affected individuals due to the high comorbidity rate. In fact, interventions, which have a positive effect with regard to both pathologies, have an influence on the improvement of symptoms, on the recovery

process and on the relapse rates (Foulds et al., 2015). Thus, it becomes clear that there is an urgent need to find a fitting and successful treatment for individuals who suffer from both psychiatric disorders and/or to improve existing treatments to make them even more effective by expediting the treatment process. Treatments for psychiatric disorders are often related to a long and difficult healing process in order to reach the goal. It demands a lot of patience since it might take some time if one can recognize improvements. However, if affected individuals do not recognize a step forward, they might become unmotivated and often give up too early which might have a negative influence on the further treatment process. That is why both experts as well as clients can profit from an improvement of already successful treatments in a way that affected individuals might recognize improvements earlier and therefore expedite the treatment process. Another aspect is that individuals might regain hope with regard to a positive future if they recognize improvements. In this case, hope might also contribute a lot to the further treatment process and has a positive influence on individual's motivation to fight further against the disorder (Kring et al., 2019).

Approach-avoidance tendencies of depressed individuals

Individuals, who suffer from depressive symptoms, show approach as well as avoidance biases, too. Affected people exhibit a diminished approach bias of positive stimuli and a diminished avoidance of negative stimuli (Loijen, Vrijssen, Egger, Becker, & Rinck, 2020). This can be retrained through specialized training programs. For instance, Becker et al. (2019) found that depressive symptoms were reduced after positivity-approach training.

Present study

An online task of AAT is also used in the current study in order to retrain the automatic behaviour to approach alcohol stimuli. The effectiveness of the online AAT is already proven in clinic inpatient samples (Field et al., 2007; Wiers, Eberl, Rinck, Becker, &

Lindenmeyer, 2011). However, to my knowledge, it is not known until now whether this training has also an effect on outpatients. Therefore, one of the main aims of this study is to overcome this research gap and to investigate whether and to what extent this specific training has an effect in an outpatient sample. Due to the fact that the effectiveness of this training is already proven in inpatients, it is expected that the outpatients in the AAT condition will reach a significantly larger decrease in their alcohol consumption compared to individuals in the AAT placebo condition. All in all, it can be assumed that both groups will reach a decrease in their alcohol consumption since the effectiveness of TAU is already proven and both groups will be involved in TAU. However, it is assumed that the experimental group will be significantly more successful within this specific time frame of the intervention due to the addition of AAT. Thus, it is expected that the control group will need more time than the experimental group to reach a significant decrease without the AAT. Therefore, the first research question is: 'Will the AAT training lead to a significantly larger decrease in individual's alcohol consumption in the alcohol avoidance training group compared to the placebo group?'. The related hypothesis is: 'The AAT training will lead to a significant decrease in individual's alcohol consumption in the alcohol avoidance training group compared to the individuals of the placebo group.'

With regard to the comorbidity of alcohol use disorder and depressive symptoms, it is known until now that there is a relation between both psychopathologies and that specialized training programs using approach-avoidance tasks are effective treatments for both pathologies, respectively. However, to my knowledge it is unknown whether and to what extent the specific established alcohol approach-avoidance program also has an effect on individual's depressive symptoms. Thus, whether an individual's level of depression decreases through only the Alcohol Avoidance Training added to the treatment as usual (TAU) and not implementing any specific Approach-Avoidance treatment for depression. Due to the proven comorbidity and due to the fact that implicit cognitive biases are key processes

in the maintenance in both pathologies, it is in general hypothesized that depressive symptoms will decrease significantly more within this time span through the online Alcohol Avoidance training in the experimental condition compared to the control group. There are two main reasons of why this is assumed. First, it is assumed that the AAT has an additional positive influence on the effectiveness of the treatment process within this time span and that individuals might recognize their success earlier compared to the placebo group. Through the recognition of a step towards their goal, thus, getting more control over the disease related difficulties, they might regain hope for a positive future which is very meaningful and important for affected individuals and for the whole treatment process. This in turn might have a positive effect on individual's mood because the recognition of their improvement might give them extra energy and motivation. Consequently, this might have an influence in a way that individuals focus more on positive things in their daily life, conscious as well as unconscious, instead of mainly focusing on the negative things since this is what depressed individuals mainly do. Second, due to the fact that it is expected that the CBM AAT group will profit from this additional training within this time frame, by getting earlier more control over the alcohol consumption compared to the control group, it is expected that this in turn also has an influence on individual's depressive symptoms of this group. This is because as already described above, several individuals also suffer from the dependent dual diagnosis. This implies that if there is a dependent relationship between both pathologies, it might be the case that the experimental group will show significant less depressive symptoms within this time frame of the intervention compared to the control group due to their earlier decreased alcohol consumption. The control group might also reach their goal but it is expected that they might need more time compared to the experimental group since they cannot profit from the additional AAT. Therefore, the second research question is: 'Will the alcohol approach-avoidance training lead to a significantly larger decrease in depressive symptoms in individuals of the AAT group compared to the placebo group?' With regard to this second

study aim, two hypotheses were established since it is assumed that there is a decrease in depressive symptoms due to a direct as well as an indirect effect. First: 'The AAT directly has a significant influence on individual's depressive symptoms in individuals of the AAT group compared to the placebo group.' Second: 'The AAT has an indirect influence on depressive symptoms mediated by the reduced alcohol consumption due to the expectations that AAT speeds up the recovery process and the goal of reducing the drinking level.' Figure 1 visually shows the expected direct as well as indirect effect.

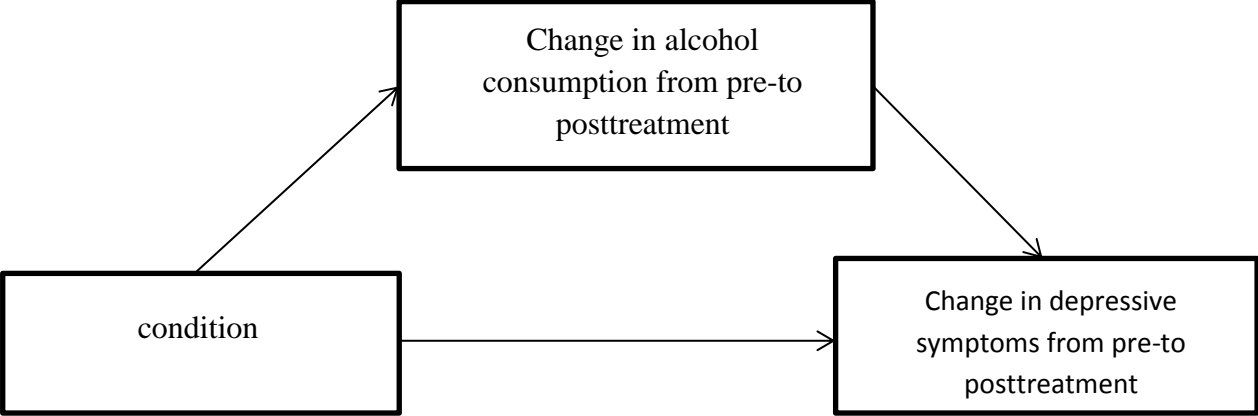


Fig.1. the mediational model of the expected direct as well as indirect effect

Method

Design

In the current study, a secondary analysis of a double-blind randomized placebo-controlled trial between-group experiment with an allocation ratio of 1:1 was conducted (Bratti-van der Werf et al., 2018). The participants were randomly assigned to either the experimental group who received the CBM Alcohol Avoidance Training or to the control group who received CBM placebo training. Before participants took part in this study, they gave their informed consent. The flow chart of the study procedure can be found in the protocol paper (Bratti-van der Werf et al., 2018).

The study was approved by the Ethics Committee of Amsterdam Academic Medical Centre in January 2015 (reference number 2014_154#C20141463) and has been registered at the Netherlands Trial Register (NTR5087).

Participants

The participants were outpatients at the Tactus Addiction Treatment Institute in the Netherlands who followed TAU due to a primary alcohol problem. They were at least 18 years old. The inclusion criterion was to be able to access and to use the Internet, since the CBM trainings were offered online. The exclusion criteria were if one suffers from a serious psychiatric illness or if there was a risk anticipated to develop a serious physical illness due to trying to compensate the decreased alcohol consumption.

Interventions

Treatment as usual (TAU)

The usual treatment of the outpatients was based on principles of CBT as well as on motivational interviewing (Miller, & Rollnick, 2002). This treatment was tailored to the patient's needs and preferences. Thus, TAU could be implemented face-to-face or online. With regard to the intensity of the treatment, either 5 weeks or 3 months, a choice had to be taken. This individualized and tailored technique was also used during the study process. However, the whole process of this treatment was the same for all participants. They had to make a registration every day, their alcohol consumption was analyzed and behaviour change components were taken into account. The only difference was that the contact between the therapist and the client was synchronous in the face-to-face version and asynchronous in the web-based version (Postel, de Haan, & de Jong, 2010). During the three months treatment process, the client and the therapist had a session once or twice a week. This treatment consisted of two parts: first, the analysis of the client's alcohol consumption and second, after

goal setting the behaviour change. Individuals who decided to take the five week treatment route grappled merely with the goal setting part.

With regard to the investigation of the effectiveness of the online CBM Alcohol Avoidance Training in addition to TAU, no differentiation between the different formats was made since participants were divided into the two groups randomly. Thus, it was assumed that there were no huge differences with regard to the treatment intensity and modality.

CBM

This Alcohol Avoidance training was based on the Approach-Avoidance Task (AAT) (Wiers, Rinck, Dictus, & van den Wildenberg, 2009). In this training, pictures of alcoholic as well as non-alcoholic drinks appeared. These were tilted either three degrees to the left or to the right. The task of the client was to respond to the format of the picture and not to the content of the picture (alcoholic drink or non-alcoholic drink). Through this irrelevant cue, patients were blinded to which of the two groups (experimental or placebo group) they belonged. Pressing the 'u' on the keyboard provoked an avoidance response. Consequently, the size of the picture decreased. In contrast, the 'n' causes an approach response which entailed that the size of the picture increased.

In total, the training comprised eight sessions. In the beginning of each session, 12 practice trials with gray squared pictures were used. Hereinafter, 160 trials followed. These trials were divided into 4 different blocks in order to allow for variety between the different trials and therefore avoid a standardized process. The 40 trials of each block were divided into two sets (A and B) and into alcoholic beverage pictures and non-alcoholic drink pictures (Pronk, van Deursen, Beraha, Larsen, & Wiers, 2015). Set A and B for either the assessment or for training trials were randomly divided within and between the participants in order to safeguard generalizability. In the training condition, all 40 pictures were repeated four times in which the alcoholic stimuli were presented in an avoidance format and the non-alcoholic

drinks in an approach one. This was in order to retrain participants to avoid alcohol-related stimuli and to approach non-alcoholic ones. In the control condition, all 40 trials were also presented four times (two formats tilted to the left or right). Alcoholic pictures as well as non-alcoholic drink pictures were presented equally frequently in both formats and for three seconds. In order to make sure that the participants were focused on the task, a fixation cross was presented before each trial.

Procedure

Outpatients from Tactus Addiction Treatment Institute were recruited by their therapists and were informed about the CBM treatment and about the study. After the usual intake and the baseline questionnaire, the regular treatment began. After they agreed via the informed consent form, patients received login credentials for the CBM training program from the researchers for the creation of their individual account. This was in order to safeguard anonymity. After the registration and with the use of the method of minimization (Scott, McPherson, Ramsay, & Campbell, 2002), it was ensured that participants were equally randomly assigned to one of the two possible conditions, either the Alcohol Avoidance training group or the Placebo group. Through this specific method, an equilibrium state with regard to the different TAU treatment formats (face-to-face vs. online) was given. The whole randomization process was conducted with the use of the computer. Participants also received the link to the website for the CBM training. After the first login, they received further instructions with regard to the specific training. Both groups began their training at the same time in the beginning of the behavioural change part of their treatment process. Participants were asked to participate in a 15 minutes training session twice a week for a period of five weeks. Altogether, the training contained 8 sessions. Before the first training session, they had to complete a pre-assessment and after the eighth session, they had to fill in the post-assessment. At the beginning of each training session, participants were asked to fill

in the additional questionnaire of the study which consisted of self-report questions regarding their weekly alcohol consumption. For minimizing the drop-out rate, participants were reminded by email or phone to complete the questionnaire in case of nonresponse. There was always the possibility given to contact one of the investigators in case of questions.

Measures

Due to the fact that this is a secondary study, only measures necessary for the secondary analyses were described. At baseline, demographic characteristics like the gender, the age and the nationality and the educational level of the individuals were assessed.

Alcohol consumption. The Alcohol Timeline Follow Back (TLFB) method was used in order to assess the individual's weekly consumption of alcohol. Participants completed these questions retrospectively with regard to the number of standard units of how much alcohol they consumed every day of the previous week (Sobell, & Sobell, 1992). Low-risk alcohol consumption was defined as drinking below 22 standard units per week for men whereas for women the low-risk drinking limit was below 15 standard units per week (Robins, 1995). The psychometric properties of the TLFB alcohol questionnaire are good across different samples (Sobell, & Sobell, 1992).

Depression. The Depression Anxiety Stress Scale (DASS-21) is a 21-item scale which measures inter alia the individual's level of depression as well as emotional states of anxiety and stress. The relevant items for this study which measure individual's emotional states of depression assesses dysphoria, hopelessness, devaluation of life, self-deprecation, the lack of interest/involvement, anhedonia and inertia. Participants had to answer each item on a 3-point Likert scale (ranging from 0= *'did not apply to me at all'* to 3= *'Applied to me very much or most of the time'*). The mean of all items measuring depression were summated and divided by 7. A score between 0 and 21 will appear while a higher score indicates a greater suffering from depressive symptoms. The internal consistency of this questionnaire is very high:

Cronbach's α in a study by Antony, Bieling, Cox, Enns, & Swinson (1998) was .94. Cronbach's α in the present study could not be calculated due to the fact that only the total scores were available to the author. The concurrent validity was also in the acceptable to excellent range.

Statistical analysis

All data were handled confidentially and were only used for research purposes. The necessary analyses were conducted with the SPSS version 24 and 2-tailed tests with a significance level of $p < .05$. The results were presented according to the Consolidated Standards of Reporting Trials (CONSORT) for randomized controlled trials (Moher et al., 2010). Intention-to-treat (ITT) analyses with the expectation-maximization method were conducted because according to the results of the Little's MCAR test, data were missing completely at random (84,17%; Little's MCAR test: $\chi^2(117) = 0.609, p > .05$), indicating that data could be imputed using the expectation-maximization method.

Descriptive statistics of participant's characteristics were calculated using their data at baseline. For the comparison of baseline characteristics between the AAT and the placebo group as well as for the comparison of baseline characteristics between drop-outs and completers, Pearson χ^2 -tests for categorical variables and one-way analysis of variance (ANOVA) for continuous variables were conducted. For the investigation of an impact of the condition with regard to study drop-outs, one-way analysis of variance (ANOVA) was performed. Participants with any missing and therefore incomplete data at pre-assessment and/or at post-assessment were defined as drop-outs.

Paired-samples t-test analyses were used in order to investigate whether there were significant improvements in terms of individual's alcohol consumption as well as with regard to depressive symptoms in the whole sample.

Between group effect sizes were calculated using Cohen's *d* by subtracting the mean difference score from the experimental group from the mean difference score of the placebo group divided by the pooled standard deviation. The 95% confidence intervals (CI's) were also computed. For these analyses, the following formula was used:

$$Cohen's\ d = \frac{(M_2 - M_1)}{Pooled\ SD}$$

Effect sizes up to .49 are considered as small, whereas the range between .50 and .79 are interpreted as moderate and between .80 and 1.29 as large. Effect sizes above 1.30 are considered as very large.

For the investigation of whether there were significant changes with regard to individual's alcohol consumption from pre-to posttest dependent on the condition, an analysis of covariance (ANCOVA) was conducted with the alcohol consumption score at pre-intervention as co-variate and the post-intervention score as outcome variable. For the examination of the direct effect of AAT on individual's depressive symptoms, an ANCOVA analysis was executed as well, using the pre-treatment depression score as covariate and the post-intervention score as dependent variable. For the investigation of an indirect effect of the AAT on individual's depressive symptoms due to the decrease of alcohol consumption, a mediation analysis by applying the guidelines according to Hayes (2009) using the PROCESS tool was conducted using the difference alcohol consumption score from pre-to postassessment as the mediator, the condition variable as the independent and the difference depression score from pre-to postintervention as the dependent variable. All described analyses will also be conducted with the completers-only sample.

Results

Baseline characteristics

Table 1 shows the baseline characteristics of the CBM AAT as well as the CBM Placebo condition. In total, 72 individuals were randomized into the CBM AAT condition whereas the CBM Placebo condition consisted of 67 participants. With regard to age, gender, nationality and the educational level, there were no significant differences between both conditions. Altogether, 84 males (60.4%) and 55 females (39.6%) took part in this study. Of the 139 participants, the age ranged from 23-69 with a mean age of 47.78 years.

Table 1. Baseline characteristics of participants of the CBM AAT group and the CBM placebo group

Group	CBM AAT	CBM Placebo	Analysis		
	(n=72)	(n=67)			
			X ² /F	df	p
Age, M (SD)	48.8 (10.5)	46.7 (11.9)	1.17	1,137	.28
Range	27 - 67	23 - 69			
Education, n (%)			.01	1,137	.91
Gender, n (%)			0.86	2	.65
Male	41 (56.9)	37 (55.2)			
Female	29 (40.3)	26 (38.8)			
Unknown	2 (2.8)	4 (6.0)			
Nationality, n (%)			1.03	2	.60
Dutch	63 (87.5)	58 (86.6)			
Unknown	9 (12.5)	9 (13.4)			
Alcohol consumption ^a , M (SD)					

Baseline	27.8 (18.5)	29.3 (27.3)	0.13	1,137	.72
Depression ^b M (SD)					
Baseline	11.50 (8.1)	9.81 (8.6)	1.41	1,137	.24

^a Timeline follow back

^b DASS 21-item Depression Anxiety Stress Scale

* $p < .05$

Of the 139 recruited participants, 65 individuals did not start or fill in all necessary baseline questionnaires. Of this group, 39 participants (54.17%) belong to CBM AAT condition and 26 participants (38.81%) to the CBM Placebo condition.

Figure 2 shows the flow chart of participants.

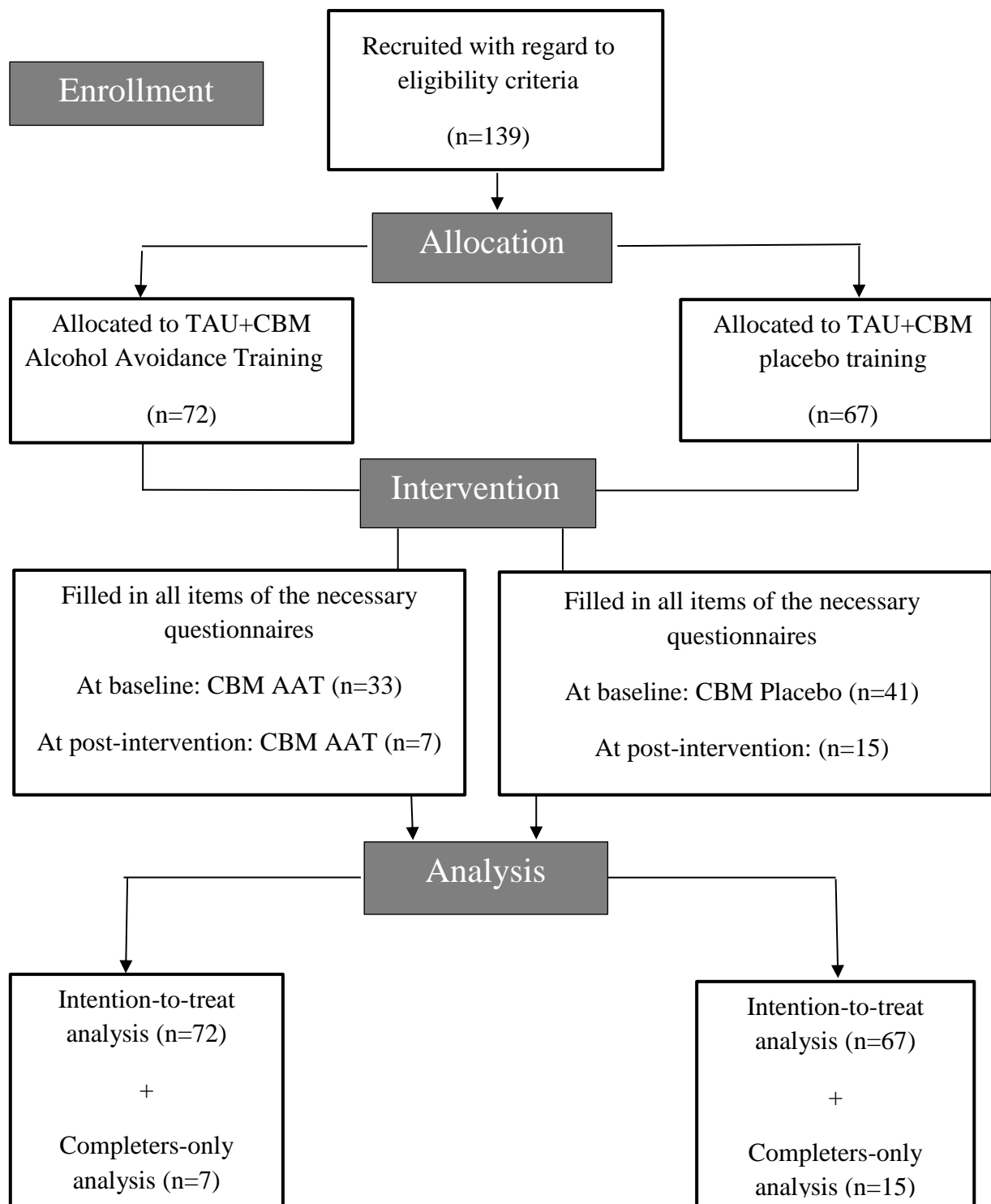


Fig. 2. CONSORT diagram: Flow-chart of participants in the RCT study

Drop-out versus completers

A total of 117 participants dropped out from the study (CBM AAT = 65; CBM Placebo = 52). The difference in number of drop-outs between the AAT and placebo group is significant ($p = .041$), indicating that more participants from the CBM AAT group dropped out from the study in comparison to the CBM Placebo group. With regard to the comparison of the baseline characteristics between drop-outs and completers, there were no significant differences (see Table 2). These findings indicate that the completers seem to be representative for the full sample.

Table 2. Baseline characteristics of completers and drop-outs

Group	completers	drop-outs	Analysis		
	(n=22)	(n=117)	X ² /F	df	<i>p</i>
Age, M (SD)	47.7 (13.0)	47.8 (11.2)	0.00	1,131	.98
Range	25 - 67	23 - 69			
Education, n (%)			0.23	1,128	.64
Gender, n (%)			0.18	1	.67
Male	12 (54.5)	66 (56.4)			
Female	10 (45.5)	45 (38.5)			
Unknown		6 (5.1)			
Nationality, n (%)			2.69	1	.10
Dutch	18 (81.8)	103 (88.0)			
Unknown	4 (18.2)	14 (12.0)			
Alcohol consumption M (SD)					

Baseline	26.82 (21.04)	28.91 (25.86)	0.13	1,117	.72
Depression M (SD)					
Baseline	9.82 (10.18)	10.96 (10.06)	0.21	1,89	.65

* $p < .05$

Effects on individual's alcohol consumption

Paired-samples t-test analysis demonstrated that there were statistically significant differences in the intention-to-treat sample (n=139) from pre-to posttest with regard to the TLFB scores ($t(138) = -5.132, p = .000, d = -.37 [-.709- -.038]$). This result indicates that in general, participants decreased their alcohol consumption, independently of the group individuals were allocated to. In contrast, the paired-samples t-test results in the completers-only sample (n=22) are different. These results display that there was no significant difference in the TLFB score from pre-to posttreatment ($t(21) = -1.836, p = .081, d = -.46 [-1.311-.383]$), although this implies that even though this finding displays only a marginal effect, there was a decrease in alcohol consumption from pre-to posttreatment which is consistent with the result of the IIT-analysis. Figure 3 visually represents the change in alcohol consumption from pre-to posttreatment of the ITT-sample as well as of the completers-only sample. Thus, it seems that the low number of participants is responsible for the non-significance of the completers-only analysis since the decrease in alcohol consumption is comparable in both samples.

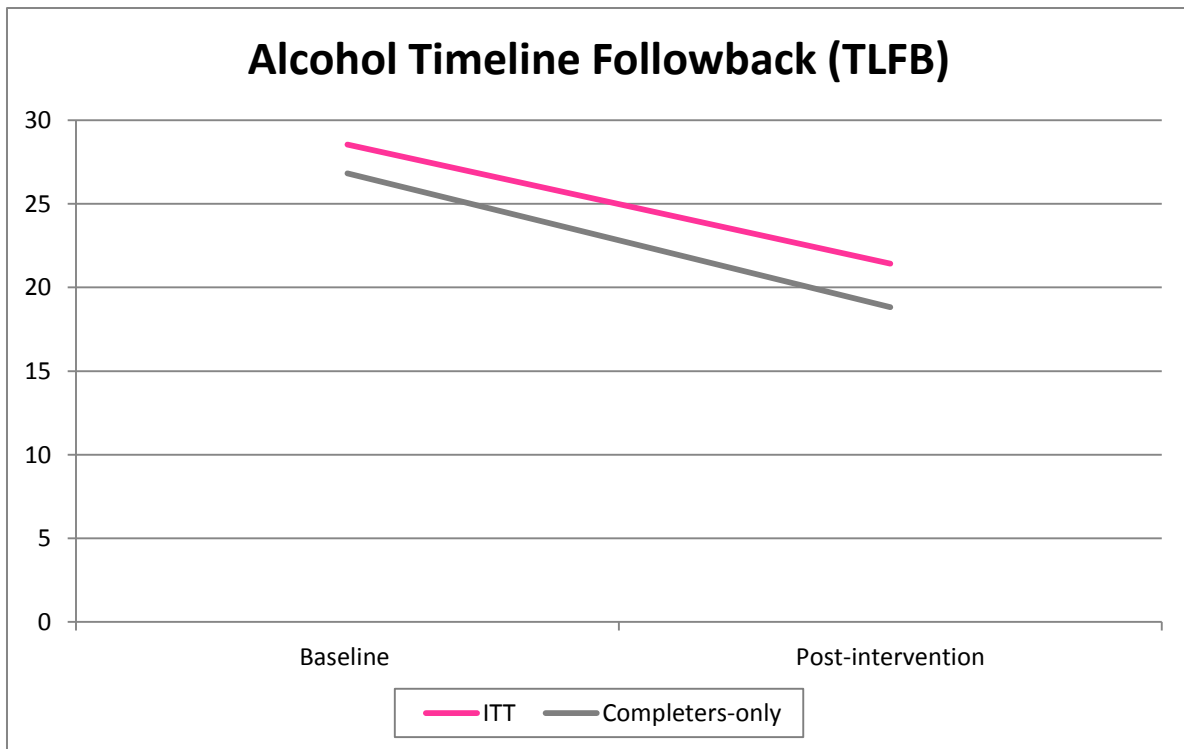


Fig. 3. Alcohol timeline followback (TLFB) of the whole ITT sample and the completers-only sample

Effects on individual's depressive symptoms

The paired samples t-test analysis revealed that there were significant differences in both the intention-to-treat sample ($n=139$) as well as in the completers-only sample ($n=22$) from pre-to posttest with regard to the DASS depression scores ($t(138)=-10.607, p = .000, d = -.89 [-1.234--.538]$; $t(21) = -.2.793, p = .011, d = -.71 [-1.568-.155]$, respectively). These findings indicate that also with regard to individual's depressive symptoms, participants showed lower depression scores at post-intervention. Figure 4 represents the change in the depression score from pre-to posttreatment of the ITT-sample and the completers-only sample.

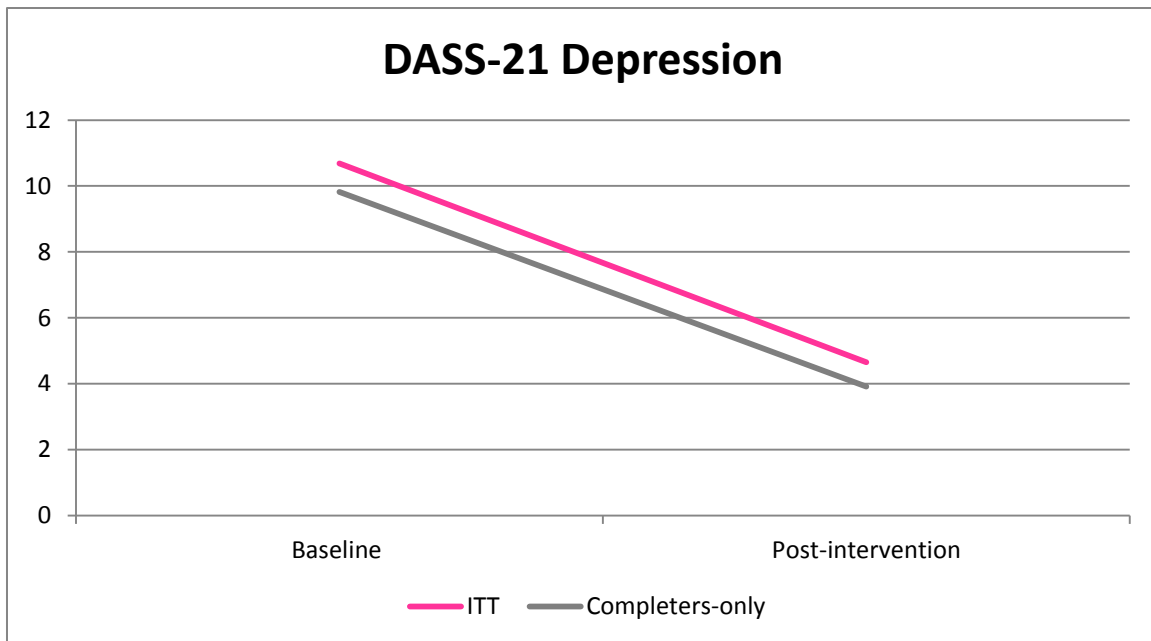


Fig. 4. DASS-21 Depression score of the whole ITT and completers-only sample

Between-group differences in individual's alcohol consumption

Table 3 and 4 represent the means and standard deviations from the outcome measure alcohol consumption at baseline and at post-intervention, from the intention-to-treat sample and from completers-only from the CBM AAT and CBM Placebo group, respectively. ANCOVA analyses revealed that there were no significant differences between both groups with regard to participant's change in alcohol consumption from pre-to post-intervention, using the pre-intervention TLFB score as covariate and the post-intervention score as the dependent variable, ($F(1,136) = .411, p = .523; d = .12 [-.213-.453]$). This result is also accordance with the outcome of the ANCOVA analysis with the completers-only sample ($F(1,19) = .232, p = .635; d = -.237 [-1.137-.663]$). These results indicate that the CBM AAT intervention did not lead to significantly better outcomes concerning individual's alcohol consumption compared to the CBM placebo training. Figure 5 visually represents the outcomes of the alcohol consumption score per condition at baseline and at post-intervention from the ITT and completers-only sample.

Table 3. The means and standard deviations of alcohol consumption and depression scores per condition. (ITT) (N=139)

	CBM AAT (n=72)	CBM Placebo (n=67)	<i>p</i> -value	Effect size <i>d</i>	[95% CI]
Alcohol consumption, M (SD)			.523	.12	[-.213-.453]
Baseline	27.84 (18.5)	29.26 (27.3)			
Post-treatment	20.63 (11.1)	22.29 (16.2)			

Table 4. The means and standard deviations of alcohol consumption and depression scores per condition. (completers-only) (N=22)

	CBM AAT (n=7)	CBM Placebo (n=15)	<i>p</i> -value	Effect size <i>d</i>	[95% CI]
Alcohol consumption, M (SD)			.719	-.237	[-1.137-.663]
Baseline	27.86 (20.5)	26.33 (22.0)			
Post-treatment	20.86 (14.2)	17.87 (11.9)			

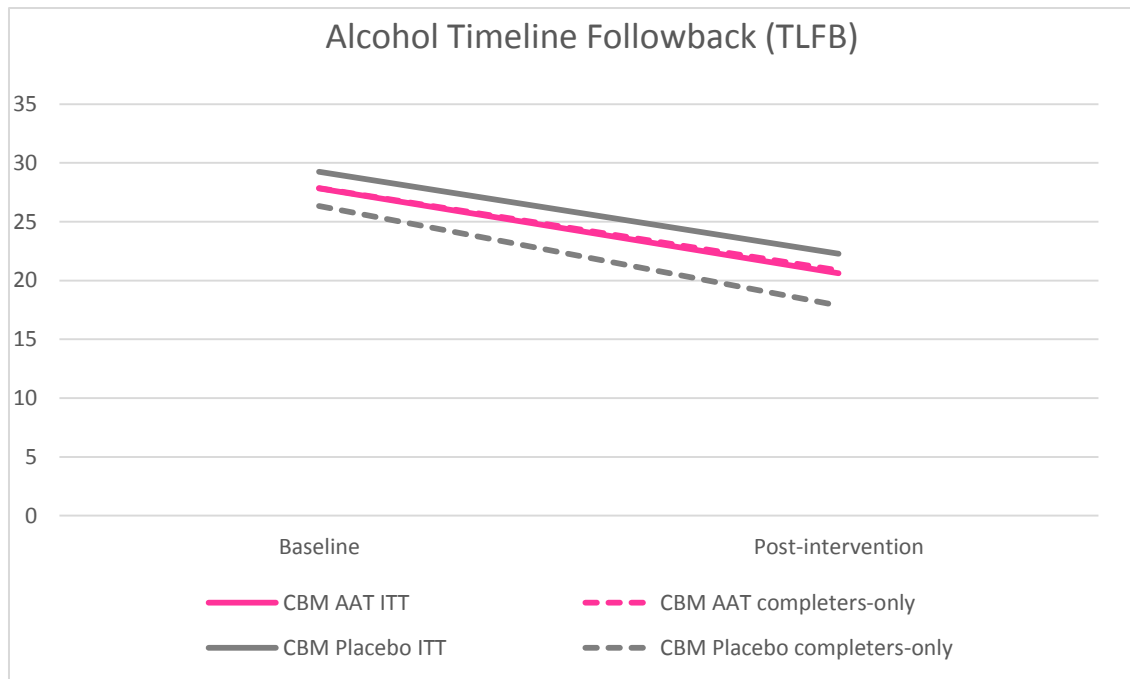


Fig. 5. Alcohol timeline followback (TLFB) score per group at each time point of the ITT and completers-only sample

Between-group differences in individual’s depressive symptoms

Table 5 and 6 represent the means and standard deviations from the outcome measure depressive symptoms at baseline and at post-intervention, from the intention-to-treat sample and from completers-only from the CBM AAT and CBM Placebo group, respectively. Results of the ANCOVA analysis with the ITT sample revealed that there was no statistical significant difference between both groups after using the pre-intervention depression score as a covariate and the post-intervention score as the dependent variable ($F(1,136) = .451, p = .503; d = -.195 [-.528-.139]$). This outcome is again in accordance with the result of the ANCOVA analysis using the completers-only sample ($F(1,19) = .546, p = .469; d = .187 [-.712-1.086]$), indicating that even though both groups showed decreased depression scores, the difference was not significant between the CBM AAT and the CBM Placebo group.

Figure 6 represents the depressive symptoms scores from both groups of the ITT and the completers-only sample at baseline and at post-intervention.

Table 5. The means and standard deviations of depression scores per condition. (ITT)

(N=139)

	CBM AAT (n=72)	CBM Placebo (n=67)	<i>p</i> -value	Effect size <i>d</i>	[95% CI]
Depression, M (SD)			.503	-.195	[-.528-.139]
Baseline	11.50 (8.1)	9.81 (8.6)			
Post-treatment	5.09 (5.0)	4.18 (4.3)			

Table 6. The means and standard deviations of depression scores per condition (completers-only) (N=22)

	CBM AAT (n=7)	CBM Placebo (n=15)	<i>p</i> -value	Effect size <i>d</i>	[95% CI]
Depression, M (SD)			.469	.187	[-.712- 1.086]
Baseline	11.43 (11.2)	9.07 (10.0)			
Post-treatment	3.14 (2.8)	4.27 (7.0)			

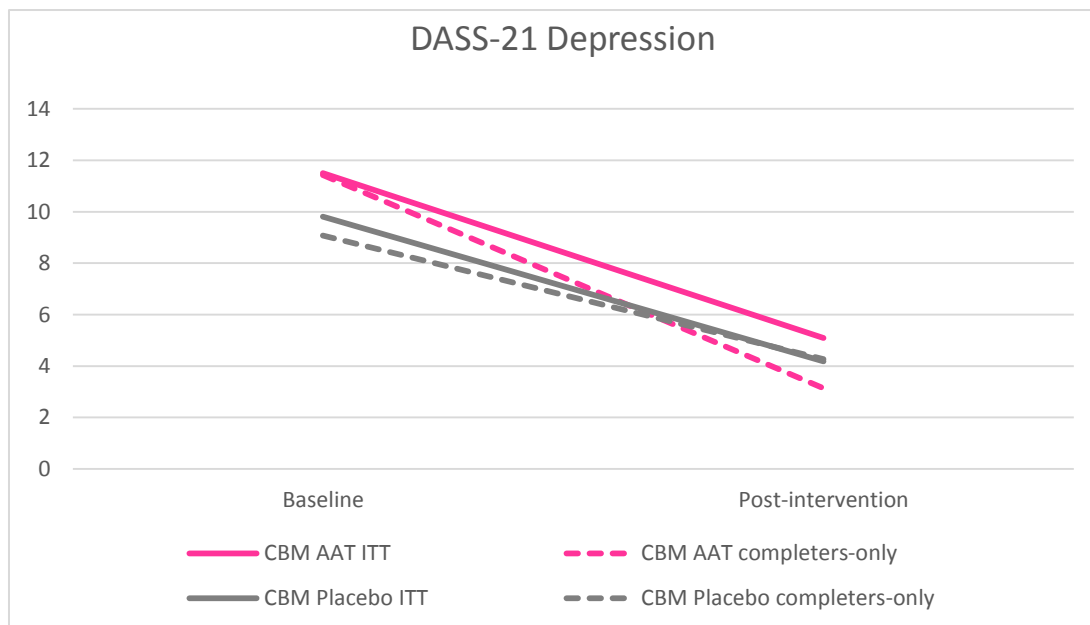


Fig. 6. DASS-21 depression score per group at each time point of the ITT and completers-only sample

Mediation analysis ITT-sample

In step 1 of the mediation model, the regression of the condition individuals were allocated to on the difference depression score was not significant $b=-.77$, $t(137)=-.67$, $p = .5020$. Step 2 revealed that the regression of the condition on the mediator, the difference of individual's alcohol consumption from pre-to postintervention, was also not significant $b=-.24$, $t(137)=-.09$, $p = .9313$. Results of step 3 of the mediation process indicate that the mediator, the difference in alcohol consumption from pre-to postintervention, controlling for the condition, was also not significant, $b=-.00$, $t(136)=-.08$, $p = .9377$. In step 4, it was analyzed whether the condition is a significant predictor on individual's difference depressive scores, after controlling for the difference in alcohol consumption. Findings in this step also indicate no significant results, $b=-.77$, $t(136)=-.67$, $p = .5032$.

Mediation analysis completers-only sample

The results of the completers-only mediation analysis are in concordance with the findings of the mediation analysis with the ITT-sample. Also in this model, no mediation effect was found ($R\text{-sq}=.17$, $F(2,19)=.27$, $p=.7630$). Results revealed no significant direct ($b=-3.48$, $CI [-13.34, 6.38]$, $p=.4688$) as well as no significant indirect effect ($b=-.00$, $CI [-.6868, 1.9182]$, $p=.9970$) of the condition on individual's depressive symptoms.

Discussion

The first aim of this study was to investigate whether individuals of the experimental group were considerable better able to reduce their alcohol consumption compared to individuals of the placebo condition. Findings with regard to this aim revealed that the CBM AAT did not have a significant effect on participant's alcohol consumption and therefore, the first hypothesis could be rejected.

The second aim of this study was to investigate whether the CBM AAT intervention had a remarkable positive influence on individual's depressive symptoms, directly as well as indirectly, in comparison to the placebo group. Study findings demonstrated a substantial decrease in depressive symptoms from pre-to post-intervention in the whole sample in both the IIT-sample as well as in the completers-only sample. However, no between group differences could be found, indicating that the CBM AAT did not have a direct and also no indirect effect on participant's depressive symptoms. As a result, the two different hypotheses which were established with regard to this study aim can be rejected.

Alcohol consumption

The current study findings with regard to alcohol consumption are in contrast to what Field et al. (2007), Wiers et al. (2011) and Eberl, Wiers, Pawelczack, Rinck, Becker, & Lindenmeyer (2013) found in their studies in a clinical setting since both research groups

found significant improvements in individuals alcohol consumption after the AAT program. However, taking into account findings of the study by Wiers, Houben, Fabardi, van Beek, Rhemtulla, & Cox (2015), who also used web-based CBM, it can be concluded that findings are in accordance with the current study findings, since they also found a general decrease in terms of alcohol consumption in all conditions, independently of experimental or control conditions, but no between group differences. One possible explanation for this discrepancy might be the two different settings in which the studies were conducted. Field et al. (2007), Wiers et al. (2011) and Eberl et al. (2013) conducted their study in a clinical setting while Wiers et al. (2015) also conducted the study with outpatients. One relevant point concerning the different settings might be related to individual's motivation. Integrating motivational interventions into CBM trainings is something Wiers et al. (2015) recommend in order to improve results concerning alcohol consumption. Wiers, Boffo, & Field (2018) also support the motivational aspect. According to them, changing implicit processes and therefore eliciting a behavioural change is only possible if affected individuals are motivated to overcome the difficulties related to AUD like for instance the approach tendencies. Thus, they assume that motivation is a crucial aspect and a prerequisite for a successful and effective CBM intervention. It is also assumed that clinical patients are more motivated to overcome their difficulties and to change their alcohol consumption in contrast to outpatients (Wiers, Boffo, & Field, 2018). This might be expected due to the different treatment goals of inpatients and outpatients. The treatment goal of inpatients is abstinence while the goal of outpatients is consuming less alcohol which is also the case of these study participants. Thus, the motivational aspect and the different treatment goals might explain the discrepancies between the different study findings.

Next to the motivational aspect is the related concept of hope. This might be a very crucial and essential factor during the therapy process for affected individuals in a way that they really recognize the hope and that they internalize that they have the abilities to

overcome this disease. According to Snyder (2009), future oriented thinking is embedded in his definition of hope which consists of two components: pathways and agency. Pathways entails the aspect of feeling being able to reach one's goals via different ways, while agency includes the motivational aspect that the individuals are motivated to make use of their abilities to implement these ways in order to reach the goal. However, against the assumption that AAT leads to feelings of hope due to the earlier recognition of improvements and recognizing that one comes closer to one's goals within treatment process through the additional AAT, it can be assumed that in contrast to the expectations, AAT did not lead to an increased motivation and hope feelings in this study. Consequently, no significant effect of AAT was found.

Next to this, it might also be the case that the AAT did not have an effect on individual's alcohol consumption due to the conduction at a wrong time point within the treatment process. Manning et al. (2018) conducted AAT during the withdrawal training in a clinical setting as a stand-alone intervention because according to them, AAT is most effective if individuals are within the withdrawal process. This is because during alcohol withdrawal, the brain reorganizes, restructures and recovers itself. Within the first two weeks of alcohol withdrawal, there is a significant increase in grey matters in the insular and anterior cingulate cortices. These are the areas in the brain which are responsible for the individual's cognitive control and as already described in the introductory part above, individuals suffering from AUD have limited cognitive control and therefore difficulties to control their approach system. Due to this, Manning et al. (2018) assume that conducting AAT during alcohol withdrawal is most effective in order to reform the cognitive biases. Of course, for affected people it might be easier to completely withdraw from alcohol if one is in a clinical setting with the goal of full abstinence from alcohol compared to being in one's own daily setting which was the case in this current study and working on a decrease in alcohol consumption.

Co-morbidity alcohol consumption and depression

With regard to the assumption that there is a direct effect of CBM AAT to individual's depressive symptoms, there is to my knowledge no research which investigated this relationship. However, an explanation for this finding might be related to the concept of hope. Hope is linked to positive affect which is important for depressed individuals since they suffer from negative affect (Ciarrochi et al., 2015). However, as already assumed, the AAT might not lead to increased feelings of hope in this study and that might be why the participants did not develop positive affect which would probably have decrease individual's depressive symptoms. Therefore, depressive symptoms did not decrease significantly.

Taking the finding with regard to the investigation of an indirect effect into account, it can be concluded that due to the fact the CBM AAT did not lead to significant better outcomes in terms of alcohol consumption, no mediation effect was found. There is one study which investigated this relationship the other way round and with a different intervention. However, the principle is the same: Strid, Hallgren, Forsell, Kraepelien, & Öjehagen (2019) found significant reductions in individual's depressive symptoms through the treatment for depression but individual's alcohol consumption did not change even though there was a dual diagnosis. Relating Strid et al. (2019) study findings to the current research findings, it can be concluded that even if AAT would have had a significant effect on individuals alcohol consumption, it might not automatically also has a positive influence on individual's depressive symptoms even if there is a dual-diagnosis. However, this is non-confirming with the outcomes of regular addiction treatment where depressive symptoms often disappear when people decrease their alcohol consumption. Nevertheless, the results show that it might be important to focus on both pathologies during the treatment process in terms of a mixed CBM AAT which targets both disorders and not only one in order to get successful treatment outcomes concerning both pathologies. Due to the fact that literature is lacking concerning

mixed CBM programs, only assumptions can be made concerning the effectiveness of a mixed CBM program.

Strengths and limitations

The present study offers several strengths. First, the study quality was increased by taking into account and implementing the CONSORT guidelines throughout the study process. In this manner, participants were randomly allocated to one of the two possible conditions in order to avert allocation biases. Additionally, the intention-to-treat analysis was conducted using the expectation-maximization method for all missing data. On the basis of this, the results of the intention-to-treat analysis could be compared with the findings of the completers-only analysis in order to guarantee and report correct findings and conclusions. Second, the effect of a CBM online treatment program in an ambulatory setting was researched which is to my knowledge not much investigated.

Next to the study strengths, there are also some study limitations. First, the intervention was not tested priori in a pilot study (Leon, Davis, & Kraemer, 2010). Thus, the feasibility, the effect, the impact and the implementation of the intervention was not tested beforehand. Therefore, no improvements of the intervention were made before the actual study to make the intervention even more effective. Related to this aspect is the second limitation of this study: the study drop-out rate is very high (84,17%) which maybe could have been prevented if a pilot study would have been conducted. However, the high drop-out rate could be due to several different reasons. Possible explanations are with regard to the ambulatory setting. It could be that participants were not that motivated to implement the online AAT with full concentration and without any distractions from their surroundings. Further, it is much more difficult to implement the AAT in one's daily life if one still has to meet daily obligations. Thus, it might be that affected individuals are working besides the whole treatment process and that they have other obligations which they do not have to

perform if they are in a clinical setting. Therefore, points of improvements and reasons for possible non-adherence or drop-out from the study could have been identified after a pilot study and before conducting the actual larger scale study in order to prevent the high study drop-out rate. However, it might be difficult to prevent since the drop-out rate is also high in regular addiction treatment. Third, no long term effects and follow-up data were taken into account. This might be important since it might be that the effect of AAT need more time and that individuals of the CBM AAT condition would have significant better results in the long-term after a few months of the actual end of the intervention.

Future research and practical implications

A recommendation for future research is to investigate whether the ambulatory setting was appropriate for the affected individuals since it might be that they were distracted from their surrounding or that they were not able to motivate themselves to implement it in between of their daily routines. Another burden could be that they were motivated to implement the AAT but that it was difficult to realize and to implement besides their daily obligations which they would not have to perform in a clinical setting. Future research should also investigate whether the concept of hope and whether including motivational strategies within the AAT intervention would lead to better results, since there are several studies which recommend to include both aspects and for this current study, only assumptions can be made since no data regarding these two concepts are available in this study. One possibility to include these two concepts is by adding motivational and hopeful sentences in-between of the AAT in order to re-motivate and to remind the individuals that it might be worth to fight further. Whether these added sentences were valued as useful or not can be assessed through measuring hope and motivation using questionnaires at pre-and post-intervention but also through face-to-face interviews with the participants afterwards. Thus, there are several different aspects which could have an influence on the interpretation of the results and that is why it is very

meaningful to investigate further by means of retrospective interviews with the study participants and subsequently with an adapted experimental study. This might be meaningful in order to investigate whether results are still the same or different.

Due to the fact that there is often the ‘dual-diagnosis’ of AUD and depression, it is very meaningful to improve the already existing treatments which are offered in an ambulatory setting. This is important since individuals who are suffering from two psychopathologies make more use out of therapeutic services which is always related to additional societal costs, especially if the therapeutic services of the clinical settings are used (Knapp, McCrone, Fombonne, Beecham, & Wostear, 2002). Therefore, effective ambulant treatments might lower the related costs if more affected individuals make more use of the offered ambulant treatments then. However, for being able to make the already existing treatments even more effective, it is important to first identify the burden of the offered ambulatory CBM intervention of this study. An additional interesting and meaningful experiment for addiction treatment organizations might be to develop mixed CBM programs and to investigate the related effects in order to make improvements of already existing addiction treatments but also concerning treatment for depressive symptoms and/or for the dual diagnosis. Further, especially experts like psychologists and therapist who convoy the participants ambulatory should be informed about how to support the client at the best within the ambulant treatment process.

Conclusion

Altogether, the addition of the online alcohol approach-avoidance training to TAU did not lead to significantly better results with regard to individual’s alcohol consumption as well as with regard to their depressive symptoms in outpatients. Due to the fact that there is until now not much literature which investigated the effects of CMB in addition to outpatient treatment interventions, this is something which should be investigated further.

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