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The Sleeping Pill Paradox: Better Sleep After Benzodiazepine Discontinuation

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ABSTRACT

Purpose of the study: The objective of this study is to evaluate subjective changes in sleep, insomnia, and dream production in chronic benzodiazepine (BZ) users enrolled in a withdrawal program. BZs, widely prescribed to treat insomnia, are likely to alter sleep structure. This research aims to determine the extent to which discontinuing these treatments promotes the restoration of sleep and dream processes.

Method: The study is based on data from a drug withdrawal program combined with Cognitive Behavioral Therapy for Insomnia (CBT-I), including 107 participants presenting prolonged use of BZs. Assessments were conducted at three time points: before the program (T0), after 3 months on the program (T1), and after 12 months (T2). The main variables included the severity of insomnia (ISI), sleepiness (Epworth), fatigue (Pichot), sleep quality and efficiency (SQ and SE), sleep parameters (diary), and the frequency of dreams and nightmares (non-standardized questions; NFQ). The analyses were conducted using repeated measures ANOVAs and post hoc tests, with withdrawal status and sleep restriction practice as between-subject factors.

Results: The majority of participants managed to stop using BZs completely or reduce their consumption by more than 50%. Overall, all sleep and dream parameters showed improvement with BZs reduction or discontinuation, except for daytime sleepiness. The number of individuals experiencing chronic nightmares also decreased. Individuals who completely stopped using BZs showed a greater reduction in the severity of their insomnia. These improvements associated with BZs reduction were independent of continued use of CBT-I methods.

Conclusion: These results indicate that the observed benefits to sleep quality and wellness, including dream activity, found both in the medium and long term, were mainly attributed to BZs discontinuation, rather than to the application of behavioral techniques (which may hence serve rather to achieve said discontinuation). Discontinuing BZs, preferably through gradual tapering, therefore appears beneficial for improving insomnia and regulating dream activity.

Keywords: Benzodiazepine, Dependence, Insomnia, Cognitive Behavioral Therapy, Tapering.

Introduction

Insomnia is defined as "difficulty falling asleep, staying asleep, or non-restorative sleep"[1]. There are two main therapeutic approaches to treating insomnia: psychotherapy using cognitive behavioral therapy for insomnia (CBT-I), which is recommended as a first-line treatment[2–4], and pharmacological treatment. The latter, based primarily on the use of benzodiazepines and related substances (BZs) due to their hypnotic action, is recommended when CBT-I does not bring about sufficient improvement[2–5], but nonetheless tends to be the most frequently adopted solution[6]. However, studies indicate that BZs produce positive effects, with lowest risk of long-term side effects or dependence, only when their administration is limited to a very short duration[3]. For this reason, health authorities specifically recommend a maximum of 4 weeks of BZs use for hypnotic purposes, and limited dosages[7,8].

Approximately 3% of the population misuse BZs protocols, either by consuming them for longer, or in greater quantities, than recommended[9]. This prevalence is higher among older people[10]. BZs use in general is associated with a number of adverse side effects, both cognitive (increased drowsiness, decreased alertness, memory and learning difficulties) and relating to motor coordination (increasing the risk of driving accidents), that may aggravate with prolonged use[11,12].

Risk of addiction is also a major concern. Tolerance develops quickly and a rebound effect may occur if the medication is stopped abruptly (typically manifesting by a resurgence of insomnia or anxiety symptoms), complicating the process of discontinuing use of these drugs[13]. The intensity of this rebound may be more pronounced when there has been prolonged consumption at high doses[2]. Thus, faced with the sudden recurrence of withdrawal symptoms, patients can quickly become convinced of the need to continue treatment, thereby reinforcing the vicious cycle of dependence [13].

A central issue leading to the misunderstanding of the link between BZs and sleep quality, or studies that examine the effectiveness of BZs, concerns the major contradiction between subjective and objective data. On the one hand, subjective assessments, based on self-report questionnaires, show that the administration of BZs is perceived to be beneficial by consumers: reduced sleep latency, increased total sleep time, and fewer nighttime awakenings[14,15]. These subjective measures give patients the impression that their sleep satisfaction has improved significantly. On the other hand, in terms of objective measures or effects, a systematic review concluded that the use of BZs increases the duration of light slow-wave sleep (stage 2) and decreases the duration of deep sleep (stage 3) and REM sleep[16]. While increased stage 2 sleep is associated with fewer nighttime awakenings and a subjective perception of sleep quality, reduction in deep sleep, considered to be the "brain's rest period," and REM sleep, which are essential for cognitive, emotional, and physical recovery, raises questions on the actual restorative effectiveness of BZs on sleep. These objective data show that, despite perceived improvement, patients' sleep architecture is altered[16]. Though, most of the studies presented in this review have significant methodological limitations: lack of control groups, of study of the effects of BZs on non-insomniacs, or of information on the duration of pre-test BZs consumption.

To address these limitations, two studies compared chronic users of BZs with healthy participants. The study by Manconi et al. (2017) demonstrates an increase in stage 1 sleep, a reduction in delta wave strength during REM sleep, and an extended latency to reach this phase in abusive and chronic users (n = 20) compared to healthy participants (n = 13). Similarly, Barbaux et al., (2025) adopted a comparative approach, studying individuals without sleep disorders (n = 28), insomniacs who do not consume BZs (n = 26) and insomniacs who do consume BZs (n = 47). The results show that among BZs users, the duration of stages 1 and 2 sleep is significantly increased, while that of stage 3 is reduced. These patients moreover experience a longer latency to reach stages 3 and REM, indicating delayed sleep onset in the restorative phases. Intragroup analyses also reveal a positive

correlation between the dose consumed and the increased in latency to stages 2 and 3[18]. These two studies, with their robust methodology, confirm that prolonged use of BZs induces objective changes in sleep that appear to be inconsistent with the subjective improvement reported by users.

If chronic consumption of BZs objectively impairs deep slow-wave sleep and REM sleep, then discontinuing their use should improve sleep parameters. Poyares et al. (2004) observed a resurgence of deep slow wave and delta wave sleep 15 days after discontinuing BZs in 19 long-term users, but no change in REM sleep. They also observed an improvement in sleep quality as reported by the visual analog sleep quality scale. This study is the first to measure changes in sleep following BZs discontinuation, however it does not evaluate changes in insomnia severity or other subjective sleep parameters (such as daytime fatigue), which reflects BZs consumers' perception of their objective sleep parameters, often paradoxical when taking medication. Moreover, the persistence of these improvements over the medium and long term was not assessed. Despite the methodological robustness of this study, the small sample size hinders any generalization of its conclusions.

The objective of this study was to test three hypotheses: 1) subjective sleep quality is maintained in the medium and long term after withdrawal from long-term benzodiazepine use, 2) dream recall enhanced after withdrawal, reflecting a restoration of dream content in REM sleep, and 3) the frequency of nightmares varies according to BZs use status, with an expected decrease among participants who have discontinued use. We analyzed changes in subjective sleep and dream characteristics in a sample of more than 100 patients after withdrawal, taking into account i) their withdrawal status (complete discontinuation or continued use of BZs) and ii) potential confounding factors such as CBT-I use.

Method

POPULATION

We used data from the reference randomized controlled trial that assessed BZs discontinuation as a function of two CBT approaches combined with a BZs tapering schedule[20].

The inclusion criteria for this study were the following: (1) aged between 18 and 70 years old; (2) chronic (at least 4 nights/week) and long-term (over the previous 12 months) BZs users; (3) having an insomnia disorder as defined by the DSM-5; (4) having a sedative, hypnotic, or anxiolytic use disorder as defined by the DSM-5 (Chapoutot et al., 2025).

Participants were interviewed before treatment (T0), i.e., before the withdrawal (discontinuation) program began, then 3 months (T1, medium term) and 12 months (T2, long term) after the end of the withdrawal program. Participants had to complete a two-weeks sleep diary prior to the interviews and were asked to complete a series of questionnaires.

The "BZs consumption" variable, termed "withdrawal status", was assessed at 3 time points (T0, prior to treatment, before the withdrawal program; T1: at 3 months and T2: at 12 months post-withdrawal). It comprises 3 conditions: group 1, subjects who have completely stopped consuming BZs (withdrawn); group 2, those who have reduced their consumption by at least 50%; and group 3, those who have failed withdrawal and continue to consume. Data on the binary variable “sleep restriction” were collected at T1 and T2, differentiating between participants who maintained use of CBT-I methods, particularly sleep restriction coupled with stimulus control, and those who discontinued CBT-I method use.

MEASURES – RESPONSE VARIABLES

The response variables measured on three occasions (T0, T1, and T2) include indicators from the sleep diary and all subjective sleep and wakefulness parameters measured using validated psychometric scales.

Indicators resulting from the sleep diary include total sleep time (TST), time in bed (TIB), sleep onset latency (SOL), number of nocturnal awakenings excluding the final awakening (NWAK), total wake time after sleep onset (WASO), time spent in bed after final awakening (TWAK), sleep efficiency (SE) and sleep quality (SQ). These measures enable the assessment

of perceived changes in sleep quality and continuity over time.

Insomnia severity was assessed using the Insomnia Severity Index (Smith, 2003), the scores of which range from 0 to 28, with scores between 15 and 21 indicating moderate clinical insomnia and scores above 22 indicating severe insomnia. Daytime sleepiness was measured using the Epworth Sleepiness Scale[21], which generates a score between 0 and 24, with values between 13 and 15 reflecting moderate sleepiness and values between 16 and 24 reflecting severe sleepiness. Subjective fatigue was measured using the Pichot Fatigue Scale (Pichot & Brun, 1984), with a total score ranging from 0 to 32; a score above 22 indicates excessive fatigue.

Two other complementary dimensions related to dreams and nightmares were explored at T1 and T2 only. The frequency and accuracy of dream recall were assessed using non-standardized questions about subjective dream recall and scored using a 7-point Likert scale. And the frequency of nightmares was measured using the Nightmare Frequency Questionnaire[22], to estimate the frequency and recurrence of nightmares over the previous three months. These scales are described in the appendix (Appendix A).

Additionally, the subject's opinion of their condition was assessed at T2 using a binary score on several items (Did you experience better sleep? Feel more rested the next day? Sleepiness signals in the evening?), as well as ordinal on others: for example a question asked at T1 and T2 "Do you have the impression that you remember your dreams more (or not) since you stopped taking BZs?", scored on a 7-point Likert scale.

Patients' dependence on BZs was assessed on the 3 time points using the Benzodiazepine Dependence Questionnaire (BDEP), and the deterioration of their mental health was evaluated using the Symptom Checklist-90 (SCL-90). These questionnaires are provided in the supplementary data.

STATISTICAL ANALYSES

Descriptive statistics

Collected data were reported in the manuscript as means ± standard deviation (SD) for continuous, count or ordinal variables and as frequency with percentage n(%) for qualitative or binary variables. No imputation for missing values was performed. The binary variable "prone to nightmares" was derived from the number of nightmares per year according to a threshold of ≥ 36 (more than 5 weeks/year).

Similarity of response variables at T0 according to withdrawal status

We verified this similarity between the three withdrawal status groups for the response variables mentioned above, but also for the variables collected at T0 which could potentially have influenced the resumption of BZs consumption after withdrawal (see details in Table S1).

We estimated the group effect on each response variable using linear models.For quantitative variables, a general linear model was used for variables that exhibited a symmetrical (|skewness| < 2) or approximately normal (Shapiro–Wilk test) distribution, either before or after parametric rank normalization. Where variance was heterogeneous between groups, we used a model enabling estimation of intragroup variance (gls function, R nlme package). Binary variables were modeled using a logistic linear model, and ordinal or numerical variables with fewer than 10 levels were modeled using an ordinal or nominal linear model, respectively.

Influence of withdrawal status (at T1 and T2) on the change in response variables since T0

For each response variable collected on the 3 time points, we calculated their difference (T1-T0, T2-T0). We then modeled this difference according to withdrawal status as previously. For the 3 intragroup paired (T1 vs T0; T2 vs T0) comparisons, we used the univariate student t-test comparing the mean difference to 0, Wilcoxon signed rank test with continuity correction, and the exact binomial test for binary data, as appropriate. We reported the

adjusted p-value for multiple comparisons using the Holm correction.

Additive and multiplicative linear models were performed for each response variable with withdrawal status and sleep restriction practice (yes/no) as predictors, to determine whether practicing sleep restriction influences the effect of withdrawal status on the response variables.

The significance level was 0.05. Statistical analysis was performed using R language version 4.4.0, freely available at https://cran.r-project.org.

Results

DESCRIPTION OF THE POPULATION SAMPLE AND GROUP EQUIVALENCE PRIOR TO BZs WITHDRAWAL TREATMENT

107 patients were included from the reference study that consisted of a mean age of 54.6 years (SD = 10.1) ranging between 25 and 70 years, 73.8% female, 49.5% married. The averaged duration of their hypnotic BZs use was 15.0 years (SD = 11.9) with 6.6 (SD = 0.9) weekly hypnotic BZs uses and a daily hypnotic dosage of 5.7 mg (SD = 3.9). Half of the patients used a BZs with a short half-life. According to the BZs dependance questionnaire (BDEPQ), they were highly dependent with a mean score of 42.4 (SD = 13.9), and exhibited some deterioration of mental health with a score of 58.8 (SD = 36.4) on the SCL-90 (Table 1). Almost all variables of interest or potential confounders were verified similar at baseline between the three groups in terms of medium- or long-term withdrawal status (Table 1S).

Table 1. Patient characteristics at baseline and their distribution according to patient consumption of BZs at the 3- (T1) and 12-month (T2) follow-up points.

Characteristics at T0	Total		Withdrawal status at T1			P-value		Withdrawal status at T2			P-value
	n = 107		Group 1 60 (56.1)	Group 2 40 (37.4)	Group 3 7 (6.5)			Group 1 61 (57.0)	Group 2 33 (30.8)	Group 3 13 (12.1)	
Age (years)	54.6±10.1		54.2±10.1	54.6±10.4	57.9±7.6	0.67		54.5±9.5	55.2±11.2	53.5±10.3	0.86
Sexe		s3				0.95					0.89
Male	28(26.2)		15(25.0)	11(27.5)	2(28.6)			15(24.6)	9(27.3)	4(30.8)	
Female	79(73.8)		45(75.0)	29(72.5)	5(71.4)			46(75.4)	24(72.7)	9(69.2)	
Marital status		s5				0.35					0.45
Single	35(32.7)		18(30.0)	15(37.5)	2(28.6)			19(31.1)	13(39.4)	3(23.1)	
Married	53(49.5)		27(45.0)	22(55)	4(57.1)			28(45.9)	16(48.5)	9(69.2)	
Pacs	7(6.5)		6(10.0)	1(2.5)	0(0)			6(9.8)	1(3)	0(0)	
Common-law Relationship	12.0(11.2)		9(15.0)	2(5.0)	1(14.3)			8(13.1)	3(9.1)	1(7.7)	
Duration of hypnotic use (years)	15.0±10.9		14.2±10.8	16.3±11.4	14.3±10.2	0.64		14.2±11	15.1±11.1	18.5±10.2	0.43
Weekly frequency of hypnotic use	6.6±0.9	s7	6.6±0.9	6.6±0.9	6.8±0.6	0.92		6.7±0.9	6.6±0.8	6.4±1.3	0.64
Half-life of benzodiazepine		s3				0.18					0.65
Short (n)	53(49.5)		25(41.7)	24(60)	4(57.1)			29(47.5)	16(48.5)	8(61.5)	
Moderate / long (n)	54(50.5)		35(58.3)	16(40)	3(42.9)			32(52.5)	17(51.5)	5(38.5)	
Hypnotic dosage (daily diazepam equivalent in mg)	5.7±3.9		6.1±4.4	5.2±3	5.3±3.5	0.88	*	5.9±4.1	5.6±4	4.8±2.4	0.63
BQDEP	42.4±13.9		39.7±13.1	45±14	51.1±15.9	0.04		39.9±13.7	42.4±14.2	54.2±7.9	0.003
SCL-90 (total)	58.8±36.4		58.8±39.1	60.6±34.7	48.3±18.9	0.72		58.5±39.1	60.4±34	55.7±30.4	0.92

Mean ± SD and n(%) for quantitative and qualitative data, respectively

T1: at 3 months follow-up, T2: at 12 months follow-up

Group 1 : Drug-free , Group 2: Reduction more than 50% of BZs , Group 3: Failed reduction

P-values were obtained using general linear model by default or logistic (s3) or nominal logistic (s5) linear model or Kruskal-Wallis test (s7)

* Data normalization before general linear modeling

Over half of the participants (56.1% and 57.0%) remained completely abstinent in the medium (3-month, T1) and long (12-month, T2) term. Respectively, only 7 and 13 patients (6.5% and 12.1%) were unsuccessful at these time points, with a relapse of more than 50% of initial BZs consumption in the medium and long term. No difference in baseline variables according to BZs consumption over time was observed, except for patients' dependence on BZs (T1: $p = .04$, T2: $p = .003$). The least BZ-dependent patients at baseline were more successful in maintaining abstinence. In the medium and long term, 45.0% and 36.3% of participants respectively still practiced sleep restriction.

CHANGES IN SLEEP PARAMETERS AFTER BENZODIAZEPINE WITHDRAWAL

All sleep parameters improved or remain stable after withdrawal regardless of the individual's medium- or long-term withdrawal status and without interaction with the practice of sleep restriction on this status (Tables 2 and S2).

As demonstrated in the reference study, sleep quality improved after medium ($t(101) = 3.13$, $p = .002$) and long ($t(101) = 4.98$, $p < .001$) term withdrawal for all patients as did sleep efficiency ($t(101)=3.03$, $p = .003$ and $t(101)=2.58$, $p = .011$) (Table 2). The severity of insomnia also decreased at both follow-ups (T1: $t(106) = -12.27$, $p < .001$; T2: $t(106) = -12.20$, $p < .001$) with a significant effect of withdrawal status on the difference in long-term ISI scores (T2: $F(2,104) = 3.218$, $p = .044$). The most significant decrease occurred in the group of patients who had discontinued BZs use (-8.15±6.2, $t(60) = -10.27$, $p < .001$). Daytime sleepiness decreased in the long term in all patients (T2: $t(106)=-2.5$, $p = .014$) with no effect of withdrawal status on the Epworth score. Fatigue decreased at both follow-ups (T1: $t(106) = -6.71$, $p < .001$; T2: $t(106) = -6.78$, $p < .001$) with a significant effect of withdrawal status on the Pichot score only at T2 ($F(2,104) = 3.882$, $p = .024$), the decrease being greatest in the group of patients having discontinued BZs use (-5.89±7).

Dream recall was more frequent at both time points (T1: Wilcoxon signed rank test $V = 1831.5$, $p < .001$; T2: $t(103) = 6.09$, $p < .001$) as was accuracy of dream recall (T1: $t(97) = 6.6$, $p < .001$; T2: $t(103) = 6.51$, $p < .001$) for all patients. Withdrawal status had no significant effect on these outcomes (P2 < 0.16et P4 < 0.52, Table 3). Participants suffered fewer nightmares in the long term ($chi2(1) = 6.75$, $p = .009$).

No significant interaction between withdrawal status and sleep restriction practices was found for these variables (P3 and P6 > 0.05, Table 2).

Table 2. Changes in sleep parameters after medium- and long-term withdrawal

	Pre-treatment	3-month FU	T1-T0	*n1*	*P1*		*P2*	*P3*		Pre-treatment	12-month FU	T2-T0	*n2*	*P4*		*P5*	*P6*	
Sleep																		
Diary - Sleep Efficiency (SE)	81.6±9.5	83.7±11	**2.04±6.81**	102	*0.003*		*0.33*	*0.24*		*81.8±9.6*	83.8±10.5	**2.02±7.91**	102	*0.011*		*0.72*	*0.16*	
Drug-free	81.6±10.4	83.5±13.1	**1.83±6.79**	58	*0.09*					*81.1±10.2*	83.6±11.9	**2.44±8.06**	59	*0.024*				
Reduction more than 50% of BZs	81.6±8.3	84.5±7.9	**2.96±6.16**	37	*0.018*					*81.6±8.9*	82.9±7.8	**1.29±6.95**	31	*0.31*				
Failed reduction	82±8.5	80.8±6.4	**-1.12±9.8**	7	*0.77*					*85.4±7.6*	87.3±8.9	**1.88±9.84**	12	*0.52*				
Diary - Sleep Quality (SQ)	0.6±0.2	0.6±0.2	**0.04±0.13**	102	*0.002*		*0.36*	*0.32*		*0.6±0.2*	0.6±0.2	**0.07±0.14**	102	*0.000*		*0.42*	*0.18*	
Drug-free	0.6±0.2	0.6±0.2	**0.06±0.13**	58	*0.004*					*0.6±0.2*	0.6±0.2	**0.08±0.15**	59	*0.000*				
Reduction more than 50% of BZs	0.6±0.2	0.6±0.2	**0.03±0.15**	37	*0.53*					*0.6±0.2*	0.6±0.1	**0.05±0.13**	31	*0.06*				
Failed reduction	0.6±0.1	0.6±0.1	**-0.01±0.1**	7	*0.91*					*0.6±0.1*	0.7±0.1	**0.04±0.11**	12	*0.27*				
Insomnia - ISI	18±5	11±6.2	**-6.97±5.8**	107	*0.000*		*0.07*	*0.67*		*18±5.0*	11.1±6.0	**-6.93±5.87**	107	*0.000*		*0.044*	*0.78*	
Drug-free	17.5±5.1	9.5±6.5	**-8±6.13**	60	*0.000*					*18±5.1*	9.8±6.2	**-8.15±6.2**	61	*0.000*				
Reduction more than 50% of BZs	18.8±4.4	12.7±4.9	**-6.05±5.4**	40	*0.000*					*18±4.8*	12.6±5.8	**-5.39±5.12**	33	*0.000*				
Failed reduction	18.1±6.7	14.7±6.9	**-3.43±4.0**	7	*0.07*					*18.3±4.9*	13.2±3.8	**-5.08±4.99**	13	*0.003*				
Sleepiness - Epworth	5.5±4.2	5±3.8	**-0.5±3.04**	107	*0.10*		*0.50*	*0.53*		*5.5±4.2*	4.7±3.7	**-0.84±3.48**	107	*0.014*		*0.94*	*0.43*	
Drug-free	6.2±4.4	5.4±4	**-0.78±3.21**	60	*0.19*					*5.8±4.4*	4.9±3.9	**-0.93±3.88**	61	*0.19*				
Reduction more than 50% of BZs	4.8±3.9	4.7±3.7	**-0.05±2.8**	40	*1.00*					*5.7±4.3*	5±3.6	**-0.67±3.11**	33	*0.43*				
Failed reduction	4±3.9	3.4±2.1	**-0.57±2.4**	7	*1.00*					*3.9±2.8*	3.1±2.1	**-0.85±2.34**	13	*0.43*				
Fatigue - Pichot	10.6±7.8	6.3±6.7	**-4.28±6.6**	107	*0.000*		*0.20*	*0.95*		*10.6±7.8*	6.2±5.9	**-4.42±6.74**	107	*0.000*		*0.024*	*0.92*	
Drug-free	11±8.2	5.7±7.2	**-5.3±6.76**	60	*0.000*					*12±8.2*	6.1±6.6	**-5.89±7**	61	*0.000*				
Reduction more than 50% of BZs	10.2±7.5	7.2±6.2	**-3±6.16**	40	*0.008*					*8.8±7.3*	6.9±5.3	**-1.97±6.15**	33	*0.07*				
Failed reduction	9.9±6.1	7±4.2	**-2.86±7.0**	7	*0.33*					*8.7±5.9*	4.9±3.1	**-3.77±5.26**	13	*0.048*				
Dreams and Nightmares																		
Dream recall frequency	2.3±2.1	3.8±1.9	**1.51±2.32**	98	*0.000*	*s11*	*0.18*	*0.36*	*s5*	2.3±2.1	3.8±2	**1.49±2.5**	104	*0.000*		*0.52*	*0.13*	
Drug-free	1.9±1.9	3.9±1.9	**1.95±2.24**	55	*0.000*	*s11*				*2.2±2.1*	3.9±2.1	**1.72±2.68**	60	*0.000*				
Reduction more than 50% of BZs	2.8±2.2	3.8±1.9	**1.03±2.47**	36	*0.038*	*s11*				*2.4±1.9*	3.5±1.8	**1.09±2.32**	32	*0.024*				
Failed reduction	2.9±2.7	3.4±2.7	**0.57±1.51**	7	*0.13*	*s13*				*2.8±2.4*	4.2±2.1	**1.42±2.02**	12	*0.033*				
Dream recall accuracy	2.2±2	3.6±1.7	**1.41±2.09**	98	*0.000*		*0.16*	*0.25*		2±1.9	3.3±1.7	**1.38±2.17**	104	*0.000*		*0.25*	*0.32*	*s2*
Drug-free	2±2	3.8±1.6	**1.76±2.13**	55	*0.000*					*1.9±2*	3.5±1.7	**1.67±2.27**	60	*0.000*				
Reduction more than 50% of BZs	2.5±1.9	3.5±1.7	**0.97±2.01**	36	*0.013*					*2.2±1.8*	3.2±1.6	**1.03±2.15**	32	*0.021*				
Failed reduction	2.1±2.3	3±2.2	**0.86±1.86**	7	*0.27*					*1.8±1.6*	2.8±1.9	**0.92±1.51**	12	*0.06*				
Number of nightmares per month	17.1±51.3	13.9±43.2	**-3.2±34.8**	98	*0.85*	*	*0.60*	*0.99*		22.1±58.2	9.4±25.7	**-12.7±51.5**	104	*0.92*	*	*0.11*	*0.14*	
Drug-free	17.6±53.5	12.7±29.9	**-4.9±39.9**	55	*1.00*					*24.2±64.6*	9.7±30.2	**-14.5±52.8**	60	*0.63*				
Reduction more than 50% of BZs	18.4±53.3	17.5±61.3	**-0.9±29.4**	36	*1.00*					*20.8±56.1*	5.9±10.7	**-14.9±56.4**	32	*0.97*				
Failed reduction	7.1±9.2	4.4±5.8	**-2.7±9.6**	7	*1.00*					*14.8±20.9*	17.3±29.5	**2.6±25.1**	12	*0.40*				
Prone to nightmare	10(42.9)	8(5.1)		98	*0.72*	*s12*	*0.28*	*1.00*	*s5*	*14(31.7)*	4(4.8)		104	*0.009*	*s12*	*0.86*	*0.11*	
Drug-free	5(9.1)	6(10.9)		55	*1.00*	*s12*				*7(11.7)*	2(3.3)		60	*0.39*	*s12*			
Reduction more than 50% of BZs	5(13.9)	2(5.6)		36	*0.50*	*s12*				*5(15.6)*	1(3.1)		32	*0.39*	*s12*			
Failed reduction	0(0)	0(0)		7		*s12*				*2(16.7)*	1(8.3)		12	*1.00*	*s12*			

Mean ± SD and n(%) for quantitative and qualitative data

T1: at 3 months follow-up, T2: at 12 months follow-up

Group 1 : Drug-free , Group 2: Reduction more than 50% of BZs , Group 3: Failed reduction

P-valus P1, P3 were obtained using univariate Student test per default, Wilcoxon signed rank test (s11), Mac Nemar test (s12) or binomial exact test (s13)

P-values P2, P3, P5, P6 were obtained using general linear model by default or general linear model taking into account heteroscedasticity (s2) or logistic (s3), ordinal

* Data normalization before general linear modeling

Discussion

The main objective of this study was to examine subjective changes in sleep and dream recall in participants enrolled in a benzodiazepine (BZ) withdrawal program combined with cognitive behavioral therapy for insomnia (Chapoutot, Gustin et al., 2025), compared to those who did not achieve total abstinence but reduced their consumption over a 12-month period.

Overall, participants maintained either total abstinence (57%) or a reduction of more than 50% of their initial doses (31%). Only 12% continued their initial consumption. This high therapeutic efficacy presents a ceiling effect bias which reduces the statistical power of interactions and effects related to this latter group. Nevertheless, it should be noted that, taken as a whole and with a sufficient sample size, following a BZs withdrawal program, subjective sleep parameters and dream recall remained stable while sleep efficiency and quality improved. The Number of aWAKenings (NWAK), Wake time After Sleep Onset (WASO), and Time spent in bed after final aWAKening (TWAK), as well as severity of insomnia and fatigue all decreased. Participants who were fully or partially withdrawn reported, at 12 months, sleeping more naturally and having regained natural sleep onset signals (e.g., yawning), which they stated had been lost while taking BZs (Table S2). Frequency and accuracy of dream recall increased. It is important to note that although the therapeutic intervention did not focus on chronic nightmares, the proportion of participants suffering from nightmares decreased significantly in the long term. Only daytime sleepiness did not change over time, which is unsurprising given that it was non-pathological prior to treatment (Epworth < 10).

The most robust effect of this study, beyond the ceiling effect of BZs reduction, was the group x time interaction on the Insomnia Severity Index (ISI): that is, patients who remained completely abstinent at 3 and 12 months experienced greater reduction in insomnia severity compared to other groups.

The observed improvements in sleep could have been explained by the continuation of methods taught during CBT-I. However, this is not the case, as this variable did not interact with any outcome, in line with the previous analyses (Chapoutot, Gustin, et al., 2025). Whether or not participants continued to apply sleep restriction or stimulus control, they showed significant clinical improvements. We cannot ignore the fact that, to our knowledge, CBT-I had no effect on dream parameters. The observed improvements in these dimensions is an argument in favor of the fact that they cannot be attributed solely to the massive reduction in BZs in the reference study[20].

Physiologically, these effects could be explained by a regulation of sleep architecture after withdrawal[19]. Previous studies have shown that BZs induce a reduction in deep slow-wave sleep (stage N3) and a decrease in REM sleep, thereby impairing the restorative quality of sleep[16]. Conversely, discontinuation is often followed by recovery of these sleep stages: in the study by Poyares et al. (2004), within two weeks, subjects who had discontinued their BZs use regained a proportion of stage 2 and 3 sleep comparable to that of healthy subjects, despite unchanged subjective perception of sleep efficiency. Our results, spanning a period of twelve months, substantiate these observations by demonstrating a sustained improvement in perceived insomnia, supporting the notion of a gradual restoration of deep slow-wave sleep and REM sleep following withdrawal. As underscored by Chennaoui and Léger (2022), slow-wave sleep represents a major physiological recovery phase for the body and brain. Subjective improvement in insomnia, without significant change in total sleep time, could thus reflect a qualitative rather than quantitative restructuring of sleep. In other words, withdrawal may promote more restful sleep, without necessarily prolonging sleep duration. Regarding dream processes, previous studies have shown that BZs consumption not only reduces the amount of REM sleep and the intensity of the waves characteristic of this phase, but also increases sleep latency[16–18].

However, this is the phase during which dream activity is most intense[24]. In our study, participants having discontinued BZs use presented an increase in frequency of dream recall. This variation may be interpreted as the manifestation of a rebound in REM sleep following BZs discontinuation[24,25]. This rebound corresponds to a temporary increase in REM sleep after discontinued use of a substance that suppressed it, before stabilizing at normal physiological levels. Thus, our results suggest that individuals undergoing BZs withdrawal experience a phase of REM sleep regulation, resulting in more frequent dream activity, followed by restoration of dream recall.

CLINICAL AND SOCIETAL IMPLICATIONS

This study adds an additional argument to the paradox of BZs: although BZs are prescribed to improve sleep, sleep quality often improves after significant dose reduction or discontinuation of these molecules. Individuals suffering from chronic insomnia who use BZs are doubly penalized: their drug-induced sleep is objectively of poorer quality, and they develop a lasting dependence on the substance. An appropriate withdrawal program therefore offers them a twofold release: an end to their substance-related disorder and improvement in their sleep. However, adequate support is still needed to ensure that users beginning withdrawal are informed about withdrawal syndrome, particularly the rebound effect of insomnia, which is a temporary condition, i.e., a short-term cost to pay before a significant and lasting improvement in their sleep.

Without reiterating the other adverse effects of this type of long-term consumption as presented in the introduction[26,27], withdrawal from benzodiazepines is possible and seems necessary in the context of chronic insomnia. BZs prescriptions should, in accordance with regulations[28], be reduced over time and coupled from the beginning of use with a gradual withdrawal program. Furthermore, healthcare professionals have a duty to inform patients about the addictive nature of these substances from the outset, as well as their paradoxical effects on sleep, warning them that "in the long term, you will sleep less well when taking these medications."

LIMITATIONS AND PERSPECTIVES FOR FUTURE RESEARCH

The groups were necessarily formed retrospectively, and the small number of participants not having discontinued BZs use is a significant limitation, considerably reducing the statistical power of comparisons of clinical improvements between groups. Nonetheless, the consistency of the results observed over time, particularly the maintenance of improvements at 12 months, supports the overall validity of the conclusions.

It is possible that the sleep-related clinical improvements are driven by the medium- and long-term effects of CBT-I. Although continued use of these methods did not interact with our variables (and strictly speaking we can conclude that there was no effect), the effects obtained on dream variables and the reduction in the number of nightmare sufferers cannot be explained by the effect of CBT-I, since these are neither therapeutic targets nor classic effects observed following CBT-I. It would be useful to repeat this study without any therapeutic intervention aimed at treating insomnia.

The use of self-report measures could constitute a major criticism. Notwithstanding the fact that this study is a complementary analysis of a reference study (Chapoutot, Gustin et al., 2025) which did not allow us to choose the experimental design, these self-assessments are of fundamental importance since satisfaction with these drugs is inherently subjective despite their objective adverse effects. The fact that, overall, long-term users who stop or reduce their use of BZs report subjective improvements in their sleep in the medium and long term is relevant in support of the objective assessments made by Poyares et al. (2004). Nevertheless, future similar research would gain in methodological robustness if coupled with objective measures such as actimetry or polysomnography, despite a significant increase in costs.

Although this study somewhat broadens the generalization of the findings of Poyares et al. (2004) with a larger sample size, it should be viewed with caution given that the participants included in the study wanted to stop using BZs and may have been dissatisfied with their consumption compared to other users. This nuance potentially represents a selection bias that should be taken into account in future studies by assessing patients' degree of satisfaction with BZs prior to withdrawal.

Finally, the evaluation of dream factors should be carried out using standardized measures such as the MADRE[29] or a dream diary recorded prospectively[30].

Conclusion

Although based on self-reported observations, this study highlights what patients consistently report to us in routine care: they experience more natural, better-quality sleep and remember their dreams more when they stop taking BZs. This is the second study to observe this striking clinical phenomenon, which highlights the iatrogenic and paradoxical effects of long-term use of this type of substances in the context of chronic insomnia: stopping consumption of sleep aid substances promotes better sleep!

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Author Contributions:

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The authors have no conflict of interest to declare.

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Supplementary Data

DESCRIPTION OF THE MAIN MEASURES

Sleep Diary: Participants maintained a sleep diary and tracked their medication use over 14 days preceding each evaluation interview, enabling the collection of the following parameters: total sleep time (TST), time in bed (TIB), sleep onset latency (SOL), number of nocturnal awakenings (NWAK), total wake time after sleep onset (WASO), time spent in bed after final awakening (TWAK), sleep efficiency (SE), sleep quality (SQ), doses and number of medications taken for sleep, and the diazepam-equivalent dosage of BZs consumption over the recorded period (total dosage and daily average).

The **Insomnia Severity Index** is a self-report questionnaire consisting of 7 items rated on a 5-point Likert scale, used to assess the perceived severity of sleep disorders. The questions focus on sleep satisfaction, daytime impact (fatigue, attention, mood, overall functioning), and anxiety related to sleep difficulties. The total score ranges from 0 to 28, with higher scores indicating more severe insomnia.

The **Epworth Sleepiness Scale**[21] is a self-administered scale comprising 8 common situations, in which the person must estimate the likelihood of falling asleep on a scale of 0 to 3 (from "never" to "highly likely"). It measures subjective daytime sleepiness, i.e., the tendency to fall asleep in low-stimulation situations in everyday life. The overall score ranges from 0 to 24.

The **Pichot Fatigue Scale**[31] comprises 8 items rated on a 5-point Likert scale. It is used to assess the level of physical and mental fatigue experienced over the preceding days. The total score ranges from 0 to 32, with higher scores indicating increased fatigue.

The **Benzodiazepine Dependence Questionnaire** (BDEPQ)[32] measures the severity of benzodiazepine dependence through 30 items rated on a 4-point scale, divided into three subscales: general dependence, pleasurable effects, and perceived need.

The **Symptom Checklist-90 (SCL-90)**[33,34] assesses nine psychopathological dimensions through 90 items rated on a 5-point scale: Somatization, Interpersonal Sensitivity, Depression, Anxiety, Hostility/Aggression, Obsessive-Compulsive Symptoms, Phobic Anxiety, Paranoid Ideation, and Psychoticism.

Effect of withdrawal: At 12 months, each participant answered yes or no to the following questions: "Do you feel your sleep is more natural than before the withdrawal program?", "Do you feel more alert during the day than before the withdrawal program?", "Do you feel you experience more signals of sleepiness (yawning, heavy eyelids, etc.) than before the withdrawal program?"

Dream recall measurement: Dream recall was assessed using two levels of non-standardized questions.

The first question, administered after the program (retrospectively), concerned perceived changes in dream recall: "Do you feel that you remember more (or less) of your dreams since you stopped taking benzodiazepines?" Responses were provided on a 7-point Likert scale, ranging from *0 = "I remember them much less"* to *6 = "I remember them much more"*.

The second set of questions, also administered retrospectively, concerned the frequency of dream recall before and after the program, formulated as follows: "Before the Benzostop program, how often did you remember your dreams?" and "After the Benzostop program, how often did you remember your dreams?" Responses were also rated on a 7-point Likert scale, ranging from *0 = "never"* to *6 = "nearly every morning"*.

The **frequency of nightmares** was also measured retrospectively using the Nightmare Frequency Questionnaire[22], a self-assessment tool for quantifying the occurrence of nightmares and disturbing dreams over the preceding three months.

Table S1: Patient characteristics at baseline and their similarity according to the patient's consumption of BZs at 3- and 12-month follow-up.

Characteristics at T0		Withdrawal status at T1					Withdrawal status at T2					Total
		Group 1	Group 2	Group 3	P-value		Group 1	Group 2	Group 3	P-value		
		60 (56.1)	40 (37.4)	7 (6.5)			61 (57.0)	33 (30.8)	13 (12.1)			n = 107
Sleep												
Diary - Total Sleep Time (TST)		6.8±1.1	6.5±0.7	7±1	0.16	*	6.7±1.1	6.6±0.8	7±0.7	0.46		6.7±1
Diary - Time In Bed (TIB)		8.3±0.9	8±0.8	8.6±1.1	0.08		8.3±0.8	8.1±0.9	8.3±0.7	0.56		8.2±0.9
Diary - Sleep Onset Latency (SOL)		0.6±0.5	0.6±0.3	0.6±0.5	0.71	*	0.6±0.4	0.6±0.5	0.6±0.4	0.93	*	0.6±0.4
Diary - Number of aWAKenings (NWAK)		1.2±0.7	0.9±0.7	1.1±0.6	0.07		1.3±0.7	1±0.7	0.6±0.6	0.01		1.1±0.7
Diary - Wake time After Sleep Onset (WASO)		0.6±0.5	0.5±0.4	0.7±0.4	0.27		0.6±0.5	0.5±0.4	0.3±0.3	0.04		0.6±0.5
Diary - Terminal WAKefulness (TWAK)		0.5±0.4	0.5±0.4	0.6±0.5	0.62		0.5±0.4	0.5±0.3	0.5±0.4	0.68		0.5±0.4
Diary - Sleep Efficiency (SE)		81.7±10.4	81.8±8.1	82±8.5	1.00		81±10.1	81.8±8.7	84.9±7.5	0.40		81.7±9.4
Diary - Sleep Quality (SQ)		0.6±0.2	0.6±0.2	0.6±0.1	0.65		0.6±0.2	0.6±0.2	0.7±0.1	0.12		0.6±0.2
Insomnia - ISI		17.5±5.1	18.8±4.4	18.1±6.7	0.48		18±5.1	18±4.8	18.3±4.9	0.98	*	18±5
Somnolence - Epworth		6.2±4.4	4.8±3.9	4±3.9	0.15		5.8±4.4	5.7±4.3	3.9±2.8	0.34		5.5±4.2
Fatigue - Pichot		11±8.2	10.2±7.5	9.9±6.1	0.85		12±8.2	8.8±7.3	8.7±5.9	0.11		10.6±7.8
Chronotype - Horne et Ostberg		15.4±4.1[50]	15.3±3.5[30]	16.6±3.9[7]	0.74		15.4±4[51]	15.8±3.9[24]	15.2±3.5[12]	0.91		15.5±3.9[87]
Stress/anxiety.before/during.bedtime (%)		32.2±26.9	31.5±28.1	41.4±26.1	0.67		32.3±26.5	31.5±29.3	36.2±26	0.87		32.5±27.1
Ruminations.before/during.bedtime (%)		35.2±26.1	39.8±32	35.7±34.1	0.74		36.6±26.7	37.3±32.4	37.7±30.3	0.99		36.9±28.7
Dreams and Nightmares												
Dream recall frequency	s4	1.9±1.9[55]	2.8±2.2[36]	2.9±2.7[7]	0.16		2.2±2.1[60]	2.4±1.9[32]	2.8±2.4[12]	0.65		2.3±2.1[104]
Dream recall accuracy	s4	2±2[55]	2.5±1.9[36]	2.1±2.3[7]	0.44		1.9±2[60]	2.2±1.8[32]	1.8±1.6[12]	0.61		2±1.9[104]
Number of nights with one or more nightmares per month		17.6±53.5[55]	18.4±53.3[36]	7.1±9.2[7]	0.93	*	24.2±64.6[60]	20.8±56.1[32]	14.8±20.9[12]	0.89	*	22.1±58.2[104]
Number of nightmares per month		17.6±53.5[55]	18.4±53.3[36]	7.1±9.2[7]	0.93	*	24.2±64.6[60]	20.8±56.1[32]	14.8±20.9[12]	0.89	*	22.1±58.2[104]
Prone to nightmares	s3	5(9.1)[104]	5(13.9)[104]	0(0)[104]	0.36		7(11.7)[98]	5(15.6)[98]	2(16.7)[98]	0.82		14(4.8)[104]
Benzodiazepine												
BZD-304.10 - Mild.(2-3.symptoms present)	s3	11(18.3)	1(2.5)	2(28.6)	0.017		11(18)	2(6.1)	1(7.7)	0.19		14(0.9)
BZD-304.10 - Moderate (4-5.symptoms present)	s3	18(30)	13(32.5)	2(28.6)	0.96		17(27.9)	10(30.3)	6(46.2)	0.45		33(12.1)
BZD-304.10 - Severe.(>6.symptoms present)	s3	31(51.7)	26(65)	3(42.9)	0.32		33(54.1)	21(63.6)	6(46.2)	0.50		60(24.3)
ECAB		7.2±2.2[60]	7.3±2[39]	6.3±2.7[7]	0.54		7±2.3[61]	7.1±1.8[32]	8.1±1.8[13]	0.22		7.1±2.1[106]
Number of withdrawal attempts		8.6±18.6	9.7±21.7	5.3±2.6	0.59	*	7.1±14.1	10.4±23.8	12.5±26.8	0.75	*	8.8±19.2
Several hypnotics	s3	35(58.3)	26(65)	6(85.7)	0.30		34(55.7)	24(72.7)	9(69.2)	0.23		67(24.3)
Motivation to stop BZs (%)	s4	3.5±0.7	3.5±0.7	3.6±0.5	0.98		3.5±0.7	3.5±0.7	3.5±0.7	0.88		3.5±0.7
BZs craving before/during bedtime (%)		10.2±18.6	15.8±27.4	32.9±36.8	0.15	*	10±18.4	15.5±25.6	26.9±37.3	0.19	*	13.7±24
Confidence in stopping BZs (%)		62±29.6	61.5±24.8	35.7±38.2	0.07		63±29.5	59.7±29	47.7±24.5	0.23		60.1±28.9
Confidence in your ability to sleep without BZs (%)		51.7±30.7	51±26.4	21.4±31.8	0.017	*	52.3±30.1	50.9±29.8	32.3±25.2	0.09		49.4±29.9
ACT												
AAQ2		43.8±10.4[60]	44.2±9.9[40]	46.3±12[6]	0.84		44.6±11.1[61]	43±9.1[33]	44.2±9[12]	0.77		44.1±10.2[106]
MAAS		57.5±14.3[60]	57.6±14.1[40]	58±6.4[6]	1.00		56.6±12.9[61]	57.8±16.2[33]	61.4±11.1[12]	0.54		57.5±13.8[106]
COMPACT		85.7±18.3	89.5±18.8	86.7±20.2	0.59		85.5±17.2	90.9±21.6	85.7±15.6	0.38		87.2±18.5

Psychopathology										
BFI-10 - Extraversion		3.9±1.4	4.1±1.2	3.1±1.6	0.19		3.9±1.4	3.9±1.3	4.2±1.5	0.79	3.9±1.4
BFI-10 - Agreeableness		5.2±1.2	5.4±1	5.4±1.2	0.71		5.3±1.1	5.1±1.2	5.3±0.9	0.77	5.3±1.1
BFI-10 - Conscientiousness		5.9±0.9	5.9±1.1	6.3±0.4	0.56		5.9±0.9	5.9±1.1	6±0.7	0.90	5.9±0.9
BFI-10 - Neuroticism		3.6±1.2	3.2±1.3	3.4±0.7	0.36		3.6±1.2	3.2±1.3	2.9±0.9	0.06	3.4±1.2
BFI-10 - Openness		4.8±1.2	5±1.2	5.4±1	0.45		4.8±1.2	5.2±1.1	5±1.3	0.28	4.9±1.2
WBSI		45.4±13.1[59]	45.9±10.6[40]	41.9±18.7[7]	0.73		45±13.8[60]	46.6±10.8[33]	44.2±11.1[13]	0.77	45.4±12.6[106]
Control variables											
Alcohol units per day	s6	0.4±0.7	0.6±1.1	0.1±0.4	0.16		0.4±0.7	0.6±1.1	0.5±0.8	0.35	0.5±0.9
Number of cigarettes per day	s5	0.5±1.8	0.9±3	2.9±7.6	0.16		0.5±1.7	1.7±4.6	0±0	0.23	0.8±2.9
Other Mental Disorders	s3	19(31.7)	11(27.5)	2(28.6)	0.90		20(32.8)	7(21.2)	5(38.5)	0.38	32(10.3)
Organic Disease	s3	34(56.7)	19(47.5)	6(85.7)	0.14		35(57.4)	15(45.5)	9(69.2)	0.29	59(17.8)
BMI		23.9±4	22.3±3.5	22.4±3.1	0.11		23.9±4	22±3.3	22.8±4.1	0.08	23.2±3.8
WHOQOL26 - Physical		53.7±15.6	58.8±17.2	61±13.7	0.22		52±16.7	62.7±13.9	58.4±14.5	0.007	56.1±16.2
WHOQOL26 - Psychological		57.4±15.6	58.2±15.7	56.3±18	0.94		58.7±15.5	55.7±16.3	57.4±15.4	0.68	57.6±15.6
WHOQOL26 - Social relationship		57.1±16.8	57.8±18.3	51.7±4.5	0.07	s2	57.4±16.4	55.9±18.3	58.1±16.3	0.89	57±16.8
WHOQOL26 - Environment		70.7±13.2	73.2±10.4	75±4.9	0.44		71.2±13.1	72.4±10.7	74.2±8.2	0.68	71.9±11.8
Nijmegen		17.1±9.2	17.6±10.2	21.6±11.6	0.52		18±8.6	16.4±9.4	18.5±15	0.71	17.6±9.7
MC-SDS		6.6±1.6	6.6±1.6	6.7±1.5	0.97		6.6±1.5	6.8±1.7	6.2±1.4	0.58	6.6±1.5
WAI therapist - Development of bond		23.8±4.3[59]	24±3.8[38]	22.6±3[7]	0.70		23.7±4.2[59]	23.9±3.9[33]	23.9±3.7[12]	0.97	23.8±4[104]
WAI therapist - Tasks		24.4±4.5[59]	24.4±4[38]	22.7±3.6[7]	0.59		24.2±4.5[59]	24.2±4[33]	25.2±4.2[12]	0.77	24.3±4.3[104]
WAI therapist - Agreement on goals		24.1±4.9[59]	24.7±3.8[38]	22.4±3.8[7]	0.47		23.7±4.9[59]	24.6±3.6[33]	25.2±4.7[12]	0.50	24.2±4.5[104]
WAI patient - Development of bond		25.9±3.5[47]	25.5±3.2[31]	23.8±4.9[4]	0.48		25.8±3.6[45]	25.1±3.4[28]	26.2±2.9[9]	0.57	25.6±3.5[82]
WAI patient - Tasks		23.7±4.5[47]	23.5±4.4[31]	23.5±3.9[4]	0.97		23.5±4.6[45]	23.4±4.4[28]	24.7±3.7[9]	0.74	23.6±4.4[82]
WAI patient - Agreement on goals		24.6±4.2[47]	25.2±3[31]	20.2±6[4]	0.06		24.6±4.2[45]	24.6±3.6[28]	25±4[9]	0.96	24.6±4[82]
CSQ-8		30.1±2.6[57]	29.6±3[38]	28.8±4.2[6]	0.54		30.3±2.6[56]	29.8±2.4[33]	27.7±4.2[12]	0.018	29.8±2.9[101]

Mean ± SD and n(%) for quantitative and qualitative data, respectively
T1: at 3 months follow-up, T2: at 12 months follow-up
Group 1 : Drug-free , Group 2: Reduction more than 50% of BZs , Group 3: Failed reduction
P-values were obtained using general linear model by default or general linear model taking into account heteroscedasticity (s2) or logistic (s3), ordinal logistic (s4), nominal logistic (s5), poisson (s6) linear model
Data normalization before general linear modeling
* significant result

AAQ-II - Acceptance and Action Questionnaire [35],
BFI-10 - Big Five Inventory [36],
CIWA-B - Clinical Institute Withdrawal Assessment-B [37],
CompACT - Comprehensive Assessment of Acceptance and Commitment Therapy Processes [38],
CSQ-8 - Consumer Satisfaction Questionnaire [39],
DPQ - Dependent Personality Questionnaire [40],
ECAB - Cognitive Attachment to Benzodiazepines Scale [41]
MC-SD - Marlowe-Crowne Social Desirability Scale [42],
MAAS - Mindful Attention Awareness Scale [43],
Nijmegen Questionnaire [44],
WBSI - White Bear Suppression Inventory [45]
WHOQOL-26 - WHOQOL-BREF [46,47],
WAI-SR Working Alliance Inventory-Short Revised [48]

Table S2: Changes in sleep parameters after medium- and long-term withdrawal

	Pre-treatment	3-month FU	dif T1-T0	*n1*	*P1*		*P2*	*P3*		Pre-treatment	12-month FU	dif T2-T0	*n2*	*P4*		*P5*	*P6*	
Sleep																		
Diary - Total Sleep Time (TST)	6.7±1	6.7±1.1	**-0.03±0.73**	102	*0.64*		*0.24*	*0.03*		*6.7±1*	6.7±1.1	**-0.02±0.78**	102	*0.81*		*0.56*	*0.63*	
Drug-free	6.8±1.1	6.8±1.3	**-0.03±0.74**	58	*1.00*					*6.8±1.1*	6.7±1.2	**-0.04±0.79**	59	*1.00*				
Reduction more than 50% of BZs	6.5±0.8	6.5±0.9	**0.05±0.67**	37	*1.00*					*6.6±0.9*	6.5±0.8	**-0.07±0.77**	31	*1.00*				
Failed reduction	7±1	6.6±0.7	**-0.46±0.97**	*7*	*0.77*					*7±0.7*	7.2±1	**0.21±0.78**	12	*1.00*				
Diary - Time In Bed (TIB)	8.2±0.8	8±0.7	**-0.25±0.61**	102	*0.000*		*0.63*	*0.07*		*8.2±0.9*	8±0.8	**-0.23±0.62**	102	*0.000*		*0.33*	*0.43*	
Drug-free	8.3±0.8	8.1±0.7	**-0.23±0.64**	58	*0.024*					*8.3±0.8*	8±0.8	**-0.28±0.57**	59	*0.001*				
Reduction more than 50% of BZs	8±0.8	7.7±0.6	**-0.26±0.61**	37	*0.029*					*8.1±1*	7.9±0.7	**-0.23±0.73**	31	*0.17*				
Failed reduction	8.6±1.1	8.1±0.9	**-0.47±0.38**	*7*	*0.029*					*8.2±0.7*	8.2±0.6	**0.02±0.52**	12	*0.91*				
Diary - Sleep Onset Latency (SOL)	0.6±0.4	0.5±0.6	**-0.05±0.53**	102	*1.00*		*0.71*	*0.87*		*0.6±0.4*	0.5±0.4	**-0.07±0.43**	102	*0.11*		*0.69*	*0.31*	
Drug-free	0.6±0.5	0.5±0.7	**-0.03±0.59**	58	*1.00*					*0.6±0.4*	0.5±0.5	**-0.08±0.35**	59	*0.20*				
Reduction more than 50% of BZs	0.6±0.3	0.5±0.4	**-0.11±0.39**	37	*1.00*					*0.6±0.5*	0.5±0.4	**-0.08±0.49**	31	*0.77*				
Failed reduction	0.6±0.5	0.8±0.6	**0.14±0.65**	*7*	*1.00*					*0.6±0.4*	0.6±0.5	**0.03±0.6**	12	*0.86*				
Diary - Number of aWAKenings (NWAK)	1.1±0.7	0.9±0.7	**-0.26±0.56**	102	*0.000*		*0.03*	*0.97*	*s2*	*1.1±0.7*	1±0.8	**-0.11±0.66**	102	*1.00*	*	*0.30*	*0.72*	*s2*
Drug-free	1.2±0.7	0.9±0.7	**-0.37±0.6**	58	*0.000*					*1.3±0.7*	1.1±0.9	**-0.16±0.77**	59	*1.00*				
Reduction more than 50% of BZs	0.9±0.7	0.8±0.6	**-0.16±0.48**	37	*0.11*					*1.1±0.7*	1±0.8	**-0.08±0.5**	31	*1.00*				
Failed reduction	1.1±0.6	1.3±0.4	**0.14±0.31**	*7*	*0.28*					*0.6±0.6*	0.7±0.5	**0.08±0.41**	12	*0.42*				
Diary - Wake time After Sleep Onset (WASO)	0.6±0.5	0.5±0.4	**-0.1±0.40**	102	*0.014*		*0.46*	*0.68*		*0.6±0.5*	0.5±0.5	**-0.07±0.42**	102	*0.12*		*0.82*	*0.59*	
Drug-free	0.6±0.5	0.5±0.4	**-0.13±0.46**	58	*0.11*					*0.6±0.5*	0.5±0.5	**-0.08±0.48**	59	*0.62*				
Reduction more than 50% of BZs	0.5±0.4	0.5±0.3	**-0.04±0.33**	37	*0.49*					*0.5±0.4*	0.5±0.4	**-0.07±0.34**	31	*0.62*				
Failed reduction	0.7±0.4	0.5±0.2	**-0.2±0.3**		*0.26*					*0.2±0.3*	0.2±0.2	**0.07±0.28**	12	*0.95*				
Diary - Terminal WAKefulness (TWAK)	0.5±0.4	0.4±0.3	**-0.17±0.29**	102	*0.000*		*0.43*	*0.65*		*0.5±0.4*	0.4±0.4	**-0.12±0.36**	102	*0.001*		*0.36*	*0.62*	
Drug-free	0.5±0.4	0.4±0.4	**-0.08±0.28**	58	*0.06*					*0.5±0.4*	0.4±0.4	**-0.13±0.37**	59	*0.025*				
Reduction more than 50% of BZs	0.5±0.4	0.4±0.3	**-0.16±0.28**	37	*0.005*					*0.5±0.3*	0.4±0.2	**-0.05±0.31**	31	*0.39*				
Failed reduction	0.6±0.5	0.4±0.2	**-0.17±0.4**	*7*	*0.31*					*0.5±0.4*	0.3±0.3	**-0.21±0.41**	12	*0.21*				
Diary - Sleep Efficiency (SE)	81.6±9.5	83.7±11	**2.04±6.81**	102	*0.003*		*0.33*	*0.24*		*81.8±9.6*	83.8±10.5	**2.02±7.91**	102	*0.011*		*0.72*	*0.16*	
Drug-free	81.6±10.4	83.5±13.1	**1.83±6.79**	58	*0.09*					*81.1±10.2*	83.6±11.9	**2.44±8.06**	59	*0.024*				
Reduction more than 50% of BZs	81.6±8.3	84.5±7.9	**2.96±6.16**	37	*0.018*					*81.6±8.9*	82.9±7.8	**1.29±6.96**	31	*0.31*				
Failed reduction	82±8.5	80.8±6.4	**-1.12±9.88**	*7*	*0.77*					*85.4±7.6*	87.3±8.9	**1.88±9.84**	12	*0.52*				
Diary - Sleep Quality (SQ)	0.6±0.2	0.6±0.2	**0.04±0.13**	102	*0.002*		*0.36*	*0.32*		*0.6±0.2*	0.6±0.2	**0.07±0.14**	102	*0.000*		*0.42*	*0.18*	
Drug-free	0.6±0.2	0.6±0.2	**0.06±0.13**	58	*0.004*					*0.6±0.2*	0.6±0.2	**0.09±0.15**	59	*0.000*				
Reduction more than 50% of BZs	0.6±0.2	0.6±0.2	**0.03±0.15**	37	*0.53*					*0.6±0.2*	0.6±0.1	**0.05±0.13**	31	*0.06*				
Failed reduction	0.6±0.1	0.6±0.1	**-0.01±0.14**	*7*	*0.91*					*0.6±0.1*	0.7±0.1	**0.04±0.12**	12	*0.27*				
Insomnia - ISI	18±5	11±6.2	**-6.97±5.88**	107	*0.000*		*0.07*	*0.67*		*18±5.0*	11.1±6.0	**-6.93±5.87**	107	*0.000*		*0.044*	*0.78*	
Drug-free	17.5±5.1	9.5±6.5	**-8±6.13**	60	*0.000*					*18±5.1*	9.8±6.2	**-8.15±6.2**	61	*0.000*				
Reduction more than 50% of BZs	18.8±4.4	12.7±4.9	**-6.05±5.46**	40	*0.000*					*18±4.8*	12.6±5.8	**-5.39±5.12**	33	*0.000*				
Failed reduction	18.1±6.7	14.7±6.9	**-3.43±4.08**	*7*	*0.07*					*18.3±4.9*	13.2±3.8	**-5.08±4.99**	13	*0.003*				
Sleepiness - Epworth	5.5±4.2	5±3.8	**-0.5±3.04**	107	*0.10*		*0.50*	*0.53*		*5.5±4.2*	4.7±3.7	**-0.84±3.48**	107	*0.014*		*0.94*	*0.43*	
Drug-free	6.2±4.4	5.4±4	**-0.78±3.21**	60	*0.19*					*5.8±4.4*	4.9±3.9	**-0.93±3.88**	61	*0.19*				
Reduction more than 50% of BZs	4.8±3.9	4.7±3.7	**-0.05±2.89**	40	*1.00*					*5.7±4.3*	5±3.6	**-0.67±3.11**	33	*0.43*				
Failed reduction	4±3.9	3.4±2.1	**-0.57±2.44**	*7*	*1.00*					*3.9±2.8*	3.1±2.1	**-0.85±2.34**	13	*0.43*				
Fatigue - Pichot	10.6±7.8	6.3±6.7	**-4.28±6.6**	107	*0.000*		*0.20*	*0.95*		*10.6±7.8*	6.2±5.9	**-4.42±6.74**	107	*0.000*		*0.024*	*0.92*	
Drug-free	11±8.2	5.7±7.2	**-5.3±6.76**	60	*0.000*					*12±8.2*	6.1±6.6	**-5.89±7**	61	*0.000*				
Reduction more than 50% of BZs	10.2±7.5	7.2±6.2	**-3±6.16**	40	*0.008*					*8.8±7.3*	6.9±5.3	**-1.97±6.15**	33	*0.07*				
Failed reduction	9.9±6.1	7±4.2	**-2.86±7.08**	*7*	*0.33*					*8.7±5.9*	4.9±3.1	**-3.77±5.26**	13	*0.048*				
Sleep more natural after withdrawal program?											52(68.4)		76	*0.002*	*s13*	*0.83*	*0.27*	*s3*
Drug-free - n (%)											35(70)		50	*0.020*	*s13*			
Reduction more than 50% of BZs - n (%)											16(66.7)		24	*0.30*	*s13*			
Failed reduction - n (%)											1(50)		2	*1.00*	*s13*			
More alert after withdrawal program?											44(57.9)		76	*0.21*	*s13*	*0.14*	*0.03*	*s3*
Drug-free - n (%)											33(66)		50	*0.10*	*s13*			
Reduction more than 50% of BZs - n (%)											10(41.7)		24	*1.00*	*s13*			
Failed reduction - n (%)											1(50)		2	*1.00*	*s13*			
more signals of sleepiness after withdrawal program?											42(55.3)		76	*0.42*	*s13*	*0.000*	*0.97*	*s3*
Drug-free - n (%)											36(72)		50	*0.008*	*s13*			
Reduction more than 50% of BZs - n (%)											6(25)		24	*0.045*	*s13*			
Failed reduction - n (%)											0(0)		2	*0.50*	*s13*			
Dreams and Nightmares																		
Feeling of remembering more dreams after taper-program		3.9±1.6		98	*0.000*		*0.31*	*0.20*	*s4*		3.7±1.7		104	*0.000*		*0.06*	*0.21*	*s4*
Drug-free		4±1.7		55	*0.000*						4±1.7		60	*0.000*				
Reduction more than 50% of BZs		3.7±1.6		36	*0.000*						3.4±1.5		32	*0.000*				
Failed reduction		3.4±1		*7*	*0.000*						3.2±1.8		12	*0.000*				
Dream recall frequency	2.3±2.1	3.8±1.9	**1.51±2.32**	98	*0.000*	*s11*	*0.18*	*0.36*	*s5*	2.3±2.1	3.8±2	**1.49±2.5**	104	*0.000*		*0.52*	*0.13*	
Drug-free	1.9±1.9	3.9±1.9	**1.95±2.24**	55	*0.000*	*s11*				*2.2±2.1*	3.9±2.1	**1.72±2.68**	60	*0.000*				
Reduction more than 50% of BZs	2.8±2.2	3.8±1.9	**1.03±2.47**	36	*0.038*	*s11*				*2.4±1.9*	3.5±1.8	**1.09±2.32**	32	*0.024*				
Failed reduction	2.9±2.7	3.4±2.7	**0.57±1.51**	*7*	*0.13*	*s13*				*2.8±2.4*	4.2±2.1	**1.42±2.02**	12	*0.033*				
Dream recall accuracy	2.2±2	3.6±1.7	**1.41±2.09**	98	*0.000*		*0.16*	*0.25*		2±1.9	3.3±1.7	**1.38±2.17**	104	*0.000*		*0.25*	*0.32*	*s2*
Drug-free	2±2	3.8±1.6	**1.76±2.13**	55	*0.000*					*1.9±2*	3.5±1.7	**1.67±2.27**	60	*0.000*				
Reduction more than 50% of BZs	2.5±1.9	3.5±1.7	**0.97±2.01**	36	*0.013*					*2.2±1.8*	3.2±1.6	**1.03±2.15**	32	*0.021*				
Failed reduction	2.1±2.3	3±2.2	**0.86±1.86**	*7*	*0.27*					*1.8±1.6*	2.8±1.9	**0.92±1.51**	12	*0.06*				
Number of nights with one or more nightmares per month	17.1±51.3	13.9±43.2	**-3.2±34.8**	98	*0.85*	*	*0.60*	*0.99*		22.1±58.2	9.4±25.7	**-12.7±51.5**	104	*0.92*	*	*0.11*	*0.14*	
Drug-free	17.6±53.5	12.7±29.9	**-4.9±39.9**	55	*1.00*					*24.2±64.6*	9.7±30.2	**-14.5±52.8**	60	*0.63*				
Reduction more than 50% of BZs	18.4±53.3	17.5±61.3	**-0.9±29.4**	36	*1.00*					*20.8±56.1*	5.9±10.7	**-14.9±56.4**	32	*0.97*				
Failed reduction	7.1±9.2	4.4±5.8	**-2.7±9.6**	*7*	*1.00*					*14.8±20.9*	17.3±29.5	**2.6±25.1**	12	*0.40*				
Number of nightmares per month	17.1±51.3	13.9±43.2	**-3.2±34.8**	98	*0.85*	*	*0.60*	*0.99*		22.1±58.2	9.4±25.7	**-12.7±51.5**	104	*0.92*	*	*0.11*	*0.14*	
Drug-free	17.6±53.5	12.7±29.9	**-4.9±39.9**	55	*1.00*					*24.2±64.6*	9.7±30.2	**-14.5±52.8**	60	*0.63*				
Reduction more than 50% of BZs	18.4±53.3	17.5±61.3	**-0.9±29.4**	36	*1.00*					*20.8±56.1*	5.9±10.7	**-14.9±56.4**	32	*0.97*				
Failed reduction	7.1±9.2	4.4±5.8	**-2.7±9.6**	*7*	*1.00*					*14.8±20.9*	17.3±29.5	**2.6±25.1**	12	*0.40*				
Prone to nightmare	10(42.9)	8(5.1)		98	*0.72*	*s12*	*0.28*	*1.00*	*s5*	*14(31.7)*	4(4.8)		104	*0.009*	*s12*	*0.86*	*0.11*	
Drug-free	5(9.1)	6(10.9)		55	*1.00*	*s12*				*7(11.7)*	2(3.3)		60	*0.39*	*s12*			
Reduction more than 50% of BZs	5(13.9)	2(5.6)		36	*0.50*	*s12*				*5(15.6)*	1(3.1)		32	*0.39*	*s12*			
Failed reduction	0(0)	0(0)		*7*		*s12*				*2(16.7)*	1(8.3)		12	*1.00*	*s12*			
Benzodiazepines																		
Hypnotic dosage (daily lorazepam equivalent in mg) - mean (sd)	5.7±3.9	0.8±1.4	**-4.9±3.7**	102	*1.00*	*	*0.001*	*0.32*		*5.7±3.8*	1.1±2.1	**-4.6±3.9**	102	*1.00*		*0.00*	*0.99*	
Drug-free	6.1±4.4	0.2±0.7	**-5.9±4.1**	58	*0.10*					*5.8±4*	0±0.3	**-5.7±4.1**	59	*0.00*				
Reduction more than 50% of BZs	5.2±3	1.5±1.4	**-3.8±2.4**	37	*0.12*					*5.8±4.1*	1.8±2.2	**-4±3.1**	31	*0.41*				
Failed reduction	5.3±3.5	2.8±2.1	**-2.5±2.8**	*7*	*0.12*					*5.1±2.2*	4.6±2.8	**-0.5±1.8**	12	*0.00*				
QDEP - mean (sd)	42.4±13.9	16.3±15.2	**-26.1±14.8**	107	*0.000*		*0.000*	*0.58*		*42.4±13.9*	16.3±15.9	**-26.1±15.7**	107	*0.00*		*0.00*	*0.23*	
Drug-free	39.7±13.1	8.4±9.1	**-31.2±14.1**	60	*0.000*					*39.9±13.7*	7.8±9.4	**-32.1±14.4**	61	*0.00*				
Reduction more than 50% of BZs	45±14	24.6±15.2	**-20.4±13.5**	40	*0.000*					*42.4±14.2*	23.1±14.3	**-19.3±13.9**	33	*0.00*				
Failed reduction	51.1±15.9	35.7±16.2	**-15.4±11.3**	*7*	*0.011*					*54.2±7.9*	39.3±13.2	**-14.9±13**	13	*0.00*				

Mean ± SD and n(%) for quantitative and qualitative data, respectively

T1: at 3 months follow-up, T2: at 12 months follow-up

Group 1 : Drug-free , Group 2: Reduction more than 50% of BZs , Group 3: Failed reduction

P-valus P1, P3 were obtained using univariate Student test per default, Wilcoxon signed rank test (s11), Mac Nemar test (s12) or binomial exact test (s13)

P-values P2, P3, P5, P6 were obtained using general linear model by default or general line

* Data normalization before general linear modeling