

GLP-1 agonists in addiction therapy – review

Agoniści receptora GLP-1 w terapii uzależnień – przegląd piśmiennictwa

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Abstract

Substance use disorders (SUDs) represent a major global public health challenge, and currently available pharmacological treatments remain only moderately effective. Glucagon-like peptide-1 receptor agonists (GLP-1RAs), widely used in the treatment of obesity and type 2 diabetes, have recently attracted attention as potential therapeutic agents in addiction medicine due to their effects on reward-related neural pathways. The aim of this review was to evaluate the efficacy and safety of GLP-1RAs in adults with substance use disorders. A total of nine studies met the inclusion criteria and were included in the qualitative analysis. The available evidence suggests that semaglutide and exenatide may reduce alcohol consumption, decrease craving, and support the maintenance of nicotine abstinence, while also contributing to weight control. In contrast, clinical data regarding stimulant use disorders remain limited. Across the analysed studies, GLP-1RAs demonstrated a favourable safety profile. The most commonly reported adverse effects were mild gastrointestinal symptoms, and no significant neuropsychiatric safety concerns were identified. Overall, GLP-1RAs may represent a promising adjunctive approach in the treatment of substance use disorders. However, potential plateau effects and rebound phenomena after

treatment discontinuation suggest that long-term therapeutic strategies may be required. Further large-scale randomized clinical trials are needed to confirm these findings and to determine the optimal role of GLP-1RAs in addiction treatment.

Keywords: substance use disorder, alcohol use disorder, nicotine use disorder, GLP-1 receptor agonists, craving

Streszczenie

Zaburzenia używania substancji (SUD) stanowią poważne wyzwanie dla zdrowia publicznego na świecie, a obecnie dostępne leczenie farmakologiczne wykazuje jedynie umiarkowaną skuteczność. Agoniści receptora glukagonopodobnego peptydu-1 (GLP-1RA), powszechnie stosowani w leczeniu otyłości i cukrzycy typu 2, przyciągnęli ostatnio uwagę jako potencjalne środki terapeutyczne w medycynie uzależnień ze względu na ich wpływ na ścieżki neuronalne związane z układem nagrody. Celem niniejszego przeglądu była ocena skuteczności i bezpieczeństwa stosowania GLP-1RA u dorosłych z zaburzeniami używania substancji. Kryteria włączenia spełniło łącznie dziewięć badań, które poddano analizie jakościowej. Dostępne dowody sugerują, że semaglutyd i eksenatyd mogą redukować spożycie alkoholu, zmniejszać głód substancji oraz wspierać utrzymanie abstynencji nikotynowej, przyczyniając się jednocześnie do kontroli masy ciała. W przeciwieństwie do tych wyników, dane kliniczne dotyczące zaburzeń używania stymulantów pozostają ograniczone. W analizowanych badaniach GLP-1RA wykazały korzystny profil bezpieczeństwa. Najczęściej zgłaszanymi działaniami niepożądanymi były łagodne objawy żołądkowo-jelitowe, nie zidentyfikowano natomiast istotnych obaw dotyczących bezpieczeństwa neuropsychiatrycznego. Podsumowując, GLP-1RA mogą stanowić obiecujące podejście wspomagające w leczeniu zaburzeń używania substancji. Jednak potencjalny efekt plateau oraz zjawisko „odbicia” po zakończeniu leczenia sugerują, że konieczne może być stosowanie długoterminowych strategii terapeutycznych. Potrzebne są dalsze badania kliniczne z randomizacją na dużą skalę, aby potwierdzić te doniesienia i określić optymalną rolę GLP-1RA w leczeniu uzależnień.

Słowa kluczowe: zaburzenie używania substancji, zaburzenie używania alkoholu, zaburzenie używania nikotyny, agoniści receptora GLP-1, głód substancji

Introduction

Substance use disorder (SUD) represents one of the most significant global public health crises, generating a socioeconomic and medical burden. Despite the availability of

approved treatments, such as naltrexone for alcohol use disorder (AUD) and varenicline for nicotine use disorder (NUD), their real-world clinical efficacy remains suboptimal. These limitations stem not only from a modest impact on reducing compulsive substance-seeking behaviour but, primarily, from adverse event profiles that drastically reduce patient adherence. Consequently, there is an urgent clinical need to identify innovative pharmacological interventions capable of modulating the mechanisms of addiction.

Recently, the off-target central effects of glucagon-like peptide-1 receptor agonists (GLP-1RAs) have drawn significant attention as a potential pharmacological approach to addiction. Increasing attention has been paid to their role in the gut-brain axis. Research indicates that endogenous gut hormones modulating appetite exhibit a functional antagonism in the regulation of the reward system. Orexigenic signals, such as ghrelin, enhance reward-seeking behaviour. In contrast, anorexigenic signals like endogenous GLP-1 appear to regulate the mesolimbic dopaminergic pathway and may reduce neural sensitivity to drug-related cues [15]. The hypothesis regarding the anti-addictive potential of GLP-1RAs is supported by neuroanatomy and preclinical evidence. The central site of action for these drugs in humans has been demonstrated in neuroimaging studies, confirming the presence of GLP-1 receptors in key structures, including the hypothalamus, medulla oblongata, and parietal cortex. Notably, the administration of liraglutide significantly modulated the reactivity of these regions to salient stimuli in functional magnetic resonance imaging (fMRI) [6]. Furthermore, extensive reviews of animal models demonstrate that GLP-1R agonists, administered both systemically and directly into structures such as the nucleus accumbens and the ventral tegmental area, suppress dopaminergic surges [5]. From a behavioural perspective, these neurobiological effects manifest as a dose-dependent reduction in the operant self-administration of ethanol, cocaine, amphetamine, and nicotine in preclinical models. Notably, this suppression is achieved without the induction of a compensatory pathological rebound following treatment cessation [3]. While preclinical findings support the anti-addictive potential of GLP-1RAs, their clinical utility in human populations remains to be definitively established through systematic synthesis. This review provides a critical assessment of the therapeutic impact and safety of these agents in adults diagnosed with SUD, leveraging a comprehensive analysis of original clinical trials and population-level data published to date.

Methods

The present review was designed and conducted in accordance with the latest PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

A literature search was performed through March 3, 2026, across the following electronic databases: PubMed/MEDLINE, Scopus, and Web of Science. The search strategy included a highly sensitive combination of controlled vocabulary terms and specific keywords within titles and abstracts to identify studies investigating GLP-1RAs in patients with SUD.

Furthermore, a manual search of the references of identified systematic reviews and meta-analyses was conducted to identify any potentially overlooked primary studies. Only articles satisfying the rigorous eligibility criteria were included in the final qualitative synthesis. A comprehensive overview of the inclusion and exclusion criteria, structured according to the PICOS (Population, Intervention, Comparison, Outcome, and Study Design) framework, is provided in Table 1.

Table 1. Inclusion and Exclusion Criteria (PICOS Framework)

Category	Inclusion Criteria	Exclusion Criteria
Population	- Adult patients. - Individuals demonstrating problematic substance use or holding a formal diagnosis of SUD.	- Preclinical studies (animal models: rodents, primates) and <i>in vitro</i> research. - Patients with non-substance addictive behaviours. - Studies involving patients with obesity or diabetes evaluated without an SUD-specific context.
Intervention	Pharmacological administration of GLP-1RAs or dual agonists (e.g., semaglutide, liraglutide, exenatide, dulaglutide, tirzepatide).	- Absence of GLP-1RA administration. - Studies evaluating only endogenous changes in GLP-1 concentrations induced by other factors.
Outcomes	- Reporting of direct, empirical measures of addiction-related variables (e.g., changes in consumption quantity, days of abstinence, or validated craving scales). - Objective indicators (e.g., fMRI neural cue-reactivity to drug/alcohol stimuli, or addiction-related hospitalization rates in registry-based studies).	Lack of assessment regarding SUD-specific parameters (e.g., publications evaluating only weight reduction, glycemic control, or gastrointestinal adverse events).
Study Design	- Completed, original human clinical investigations with definitive quantitative outcomes. - RCTs, crossover designs, and secondary/post-hoc analyses of RCT data. - Large-scale retrospective or prospective observational cohort studies - Studies published between 2016 and 2026.	- Systematic reviews and meta-analyses (utilized solely for manual reference searching). - Study protocols, preprints, and analyses of ongoing trial registries (e.g., ClinicalTrials.gov). - Case reports, letters to the editor, and narrative review articles. - Publications in languages other than English.

The study selection process was executed independently by six investigators to ensure objectivity and minimize bias. Risk of bias was evaluated using Cochrane RoB 2 for

randomized controlled trials (RCTs) and ROBINS-I for the observational studies. Most RCTs demonstrated a moderate risk of bias, primarily driven by missing outcome data due to participant attrition, which is typical in addiction trials. The observational studies also showed a moderate risk of bias due to potential residual confounding inherent to retrospective analyses. Nevertheless, the overall evidence quality was deemed sufficient to support the qualitative synthesis.

Results

The database search identified several hundred potentially relevant records. After removing duplicates and screening titles and abstracts, nine studies met the inclusion criteria.

The resulting evidence base comprised the following:

- Four original RCTs [1, 9, 13, 19];
- Four secondary or post-hoc analyses derived from existing RCT data [2, 11, 12, 18];
- One large-scale cohort study utilizing electronic health record (EHR) data [4].

Impact of GLP-1RAs on Alcohol Use Disorder (AUD)

The evidence supporting the utility of GLP-1 receptor agonists in alcohol use disorder (AUD) is currently the best studied indication.

In a Phase II RCT, a nine-week period of semaglutide administration in patients with moderate AUD resulted in a statistically significant reduction in laboratory-based alcohol self-administration (decreased g-ETOH, $P=0.01$) and a reduction in peak breath alcohol concentration (peak BrAC) ($P=0.03$) [8]. Furthermore, participants in the semaglutide cohort reported a substantial attenuation in alcohol cravings, as quantified by the Penn Alcohol Craving Scale (PACS) ($P=0.01$) [8].

The clinical efficacy of earlier-generation agents was demonstrated in a 26-week trial of extended-release exenatide, which evidenced a reduction in heavy drinking days when utilized as an adjunctive therapy to the standard of care [12]. Secondary analyses of this cohort provided further objective validation: the exenatide-treated group exhibited significant reductions in blood phosphatidylethanol concentrations – a direct biomarker of alcohol consumption – alongside favourable shifts in pro-inflammatory and metabolic marker profiles [11].

These promising clinical findings are strongly supported by real-world data; a retrospective analysis of the extensive TriNetX database revealed that patients prescribed sema-

glutide exhibited a significantly lower risk of both incident AUD diagnoses and AUD recurrence [4].

Impact of GLP-IRAs on Nicotine Use Disorder (NUD)

Tobacco dependence is another area where clinical evidence is emerging.

A pilot, double-blind RCT demonstrated that the integration of once-weekly exenatide into a regimen of standard nicotine replacement therapy patches and behavioural counselling significantly enhanced biologically verified 7-day abstinence rates at week 6. The intervention also reduced the post-cessation weight gain typically associated with tobacco withdrawal [18].

Importantly, a subsequent secondary analysis of this trial revealed that the therapeutic response to exenatide was heterogeneous, mediated by baseline predictors such as body mass index, depressive symptomatology, and the *CHRNA5* receptor genotype. These findings suggest the potential for personalized treatment strategies within the context of NUD [17].

Long-term safety was also supported by a 52-week follow-up of patients receiving dulaglutide alongside varenicline, which revealed no cardiovascular red flags, specifically regarding systolic blood pressure reductions, among participants maintaining abstinence. This confirms the metabolic and anti-addictive benefits of GLP-1RA therapy [2].

Notably, anti-addictive effects were observed in alcohol-focused trials: patients receiving semaglutide for AUD also demonstrated a reduction in daily cigarette consumption ($P=0.005$) [8].

Impact of GLP-IRAs on Stimulant Use Disorder (StUD)

Although preclinical studies have shown promising results, the clinical translation of these findings to human cohorts with stimulant use disorders remains in an experimental stage. Currently available clinical evidence is constrained by isolated trials characterized by very small sample sizes (e.g., $n=13$), which precludes the generalizability of findings and indicates a need for validation in larger, high-powered cohorts.

Our review identified a singular, methodologically rigorous laboratory-based crossover study in which individuals with cocaine use disorder (CUD) were administered a single dose of exenatide three hours prior to a testing session [1]. The pharmacological interven-

tion elicited a measurable reduction in subjective ratings of euphoria and drug-seeking intent. This effect translated into a significant decrease in the number of cocaine infusions selected by participants during an operant self-administration paradigm [1].

Safety and Tolerability Profile

Across the appraised clinical trials, the administration of GLP-1RAs in patients with SUD was characterized by a favourable safety and tolerability profile. The most frequently reported adverse events were localized to the gastrointestinal tract, primarily manifesting as mild nausea and, less frequently, emesis. These symptoms were typically transient in nature and resolved during the initial titration phase [8, 12].

No significant safety concerns related to severe neuropsychiatric effects were identified in the analysed studies. There was no evidence of treatment-induced major depressive disorder or suicidal ideation following the administration of this pharmacological class. This lack of neuropsychiatric risk is particularly significant given the vulnerability of the SUD population to co-morbid psychiatric conditions.

Discussion

The findings of this review indicate that GLP-1 receptor agonists may have therapeutic potential in reducing behaviours associated with SUD. The available evidence demonstrates beneficial effects on alcohol consumption, craving reduction, and the maintenance of nicotine abstinence [8, 12, 18]. However, clinical evidence regarding stimulant use disorders remains limited [1].

Findings from smaller randomized trials are increasingly supported by real-world observational studies. A recent meta-analysis of extensive observational studies demonstrated that GLP-1RA utilization in patients with obesity and type 2 diabetes is associated with a statistically significant 28% reduction in the risk of AUD diagnosis compared to other therapeutic interventions [13]. This phenomenon is further corroborated by a systematic review of EHRs, which indicates that the initiation of semaglutide pharmacotherapy not only substantially mitigates the risk of incident AUD and recurrence [4] but also significantly reduces intoxication episodes and the risk of fatal overdose in patients with opioid use disorders (OUDs) [9]. These results suggest that incretin mimetics may influence both metabolic processes and neural pathways involved in addiction [9].

Current research increasingly focuses on newer agents such as semaglutide, while also exploring their use in more severe SUDs, such as methamphetamine and cocaine use disorders [14].

Combination pharmacotherapy may also play an important role in future treatment strategies. As suggested by pioneering research protocols, optimal clinical outcomes may be achieved by integrating the innovative central mechanisms of GLP-1 agonists with conventional peripheral therapeutic modalities, such as nicotine replacement therapy [17, 18].

Limitations

The current literature regarding the use of GLP-1RAs in addiction therapy has several notable limitations that must be addressed.

One notable limitation is the limited number of neuroimaging studies specifically involving SUD populations. As SUDs are chronic disorders, long-term neuroadaptive mechanisms may influence treatment response. Although GLP-1RAs initially reduce activity within reward centres, fMRI studies in patients treated with high-dose liraglutide have identified the emergence of counter-regulatory mechanisms. Following the induction of initial weight loss, the brain initiates a homeostatic response, paradoxically heightening activation in the right orbitofrontal cortex (OFC) upon exposure to salient cues [7]. Increased OFC reactivity may contribute to the plateau effect observed in some patients, thereby limiting the long-term efficacy of GLP-1RAs in suppressing pathological cravings. This risk is further compounded by the rebound effect observed following drug discontinuation, suggesting that the management of SUD with this pharmacological class may require a chronic maintenance model rather than transient pharmacotherapy [7]. This hypothesis is supported by secondary analyses in smokers, where participants maintaining abstinence showed a significant increase in systolic blood pressure after the discontinuation of dulaglutide at 52 weeks [2].

Additionally, several systemic barriers may limit the real-world application of GLP-1RAs in addiction treatment. As demonstrated in a comprehensive meta-analysis of cohort studies, patients with psychiatric comorbidities – including SUDs – receive a significantly lower quality of metabolic care and have a lower likelihood of being prescribed novel anti-diabetic therapies compared to the population without a psychiatric history [16].

Finally, the studies included in this review were conducted almost exclusively in Western populations. Therefore, it is uncertain whether these findings can be fully generalized to other global populations, which may differ in genetic backgrounds and cultural contexts regarding addiction. Furthermore, there are significant global disparities in the real-world accessibility of GLP-1RAs. While these medications may be widely available in some regions, patients in other countries frequently face practical barriers, such as high costs, ongoing supply chain shortages, and limited availability in local pharmacies.

Conclusions

In conclusion, GLP-1RAs show considerable promise as a novel pharmacological approach for SUD. Current evidence indicates they can help reduce alcohol intake, decrease cravings, and support smoking cessation. The clinical application of incretin mimetics offers a “dual-benefit” profile unique within addiction psychiatry – simultaneously reducing pathological reward system reactivity while addressing co-morbid metabolic complications. However, it must be noted that current clinical evidence regarding StUD remains limited and necessitates further exploration.

Additional research is necessary before GLP-1RAs can be incorporated into clinical practice and approved for these indications. These agents are likely to be most effective as adjunctive pharmacotherapies, integrated with established behavioural and psychological interventions. Furthermore, in light of identified neurobiological adaptations and potential post-discontinuation rebound phenomena, the execution of multicentre Phase III randomized controlled trials is required. Such investigations are essential to definitively establish optimal treatment durations, standardized dosing protocols, and long-term safety profiles within this vulnerable patient population.

Acknowledgements

None

Conflict of Interest Statement: The authors declare no conflicts of interest

Abbreviation list

- AUD – Alcohol Use Disorder
- CUD – Cocaine Use Disorder
- EHR – Electronic Health Records
- GLP-1 – Glucagon-Like Peptide-1
- GLP-1RA – Glucagon-Like Peptide-1 Receptor Agonist
- NUD – Nicotine use disorder
- OFC – Orbitofrontal Cortex
- OUD – Opioid Use Disorder
- PACS – Penn Alcohol Craving Scale
- PICOS – Population, Intervention, Comparison, Outcomes, Study design
- PRISMA – Preferred Reporting Items for Systematic Reviews and Meta-Analyses
- RCT – Randomized Controlled Trial
- StUD – Stimulant Use Disorder

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