Balkh International Journal of Natural Science

ISSN – P 0000 -0000 E: 0000- 0000
Vol..1 NO.2 2025
URL: https://bjns.ba.edu.af/index.php/bjns

Investigation of the Chemical Constituents of Narcotic Substances and Their Mechanism of Action on the Human Body

AUTHORS: Sayed Mohammad Ramish[1], Gholam Mohammad Hamdard[2]

1.Senior Teaching Assistant, Department of Chemistry, Faculty of Education, Daykundi University, Band Ramakak –Nili-Afgannistan .

2.Teaching Assistant, Department of Chemistry, Faculty of Education, Daykundi University, Band Ramakak –Nili-Afgannistan.
Corresponding Author Name: Sayed Mohammad Ramish,Band Ramakak –Nili-Afgannistan

Received: 14/1/2026 Accepted: 7/6/2026 Published: 19/7/2026

ABSTRACT

This study examines the chemical compound of narcotic drugs and their mechanisms of action on the human body, emphasizing the link between molecular structure and biological effects. Conducted as a review, it draws on reliable sources, books, and databases such as ScienceDirect, Google Scholar, and Web of Science. The focus is on opioids, methamphetamines, and cannabinoids. Narcotics are natural or synthetic compounds affecting the central nervous system, causing mental, emotional, and physiological changes. They may be plant-derived, like morphine and codeine, or synthetically produced, such as amphetamines and methamphetamines. Based on source, structure, and physiological effects, narcotics are classified as opioids, stimulants, hallucinogens, and depressants. Major chemical constituents include alkaloids, amines, and opioid-like compounds, each with specific biological actions. Opioids bind to μ-opioid

[1]. Email: sm.ramsih@dhei.edu.af or sm.ramish110@gmail.com
Orcid iD: 00090005-7264-6366
[2]. Email:ghulammohammadhamdard20@gmail.com
Orcid iD: 00090005-7264-6366

receptors to block pain and induce euphoria, while stimulants increase dopamine and norepinephrine, enhancing energy and alertness. This review highlights how molecular structure determines potency, metabolism, receptor binding, and the harmful effects of narcotic use.

Keywords:Cannabinoids;Chemicalcompound,Methamphetamines,Narcotic drugs,Opioids.

1.INTRODUCTION

اَلْحَمْدُ للهِ رَبِّ العَالَمِينَ وَالصَّلَاةُ وَالسَّلَامُ عَلى سَيِدِالْمُرْسَلِينَ وَعَلَى اٰلِهِ وَصَحْبِهِ اَجْمَعِينَ.

effects on the central nervous system and various physiological processes in the human body(Volkow et al., 2019). These substances are broadly classified into natural and synthetic categories, each with distinct chemical structures and pharmacological properties. Natural narcotics, such as morphine and codeine, have historically been utilized for their analgesic effects, while synthetic narcotics, including methadone and fentanyl, are widely applied in modern medicine for pain management and opioid substitution therapies.

Despite their therapeutic significance, the increasing global prevalence of narcotic use particularly in non-medical and illicit contexts has raised serious public health concerns(Nwonu & Nwonu, 2025). The interaction of these compounds with specific neural receptors triggers a range of biochemical and physiological responses, including pain relief, euphoria, and alterations in mood and cognition. However, prolonged or uncontrolled use can lead to tolerance, dependence, addiction, and severe disruptions in normal bodily functions(Degenhardt et al., 2018; Hickman-Lewis et al., 2022).

A critical challenge in this field lies in the limited comprehensive understanding of the relationship between the chemical composition of various narcotics and their precise mechanisms of action on the human body. While numerous studies have addressed either the chemical properties or the physiological effects of narcotics, there remains a gap in integrative research that systematically links their molecular structures to their biological and neurological impacts. Therefore, this study aims to investigate the chemical compounds of narcotics and analyze their mechanisms of action on the human body to contribute to a deeper scientific understanding and support more effective prevention and treatment strategies (Zacharia & Jacob, 2024).

At the neurochemical level, narcotics exert their effects by altering neuronal activity, modulating neurotransmitter systems, and inducing neuroadaptive changes that can lead to tolerance and dependence. These

substances are commonly categorized into three principal groups: opioids, stimulants, and hallucinogens, each distinguished by unique chemical structures, receptor binding affinities, lipid solubility, and their capacity to cross the blood–brain barrier (Katzung & Vanderah, 2021).

Opioids primarily act on μ (mu)[opioid receptor (Mu opioid receptor): One of the opioid receptors involved in the regulation of pain, pleasure, and dependence.] κ- [opioid receptor (Kappa opioid receptor): A type of opioid receptor involved in the regulation of pain, mood, and stress responses.] δ- [opioid receptor (Delta opioid receptor) A receptor in the opioid system that plays a role in pain reduction and emotional regulation]. opioid receptors, leading to inhibition of excitatory neurotransmitters such as glutamate and Substance P. This mechanism results in analgesia, sedation, and euphoria, but also contributes significantly to the development of dependence and respiratory depression(Brunton et al., 2018).

Stimulants, including cocaine and amphetamines, increase synaptic concentrations of dopamine and norepinephrine by blocking reuptake or enhancing release, thereby elevating alertness, energy levels, and reinforcing addictive behaviors(Pan et al., 2024)

Hallucinogens, such as lysergic acid diethylamide (LSD)[Lysergic acid diethylamide): A potent hallucinogen that alters perception and mood by acting on serotonin receptors.] and psilocybin, primarily exert their effects through agonism of HT2A[receptor (Serotonin receptor subtype 2A): A serotonin receptor involved in perception, cognition, and the effects of hallucinogens]. serotonin receptors, leading to profound alterations in perception, cognition, and temporal awareness. Recent studies have highlighted their potential therapeutic applications in treating psychiatric conditions, including depression, anxiety, and post-traumatic stress disorder (Carhart-Harris & Goodwin, 2017; Reiff et al., 2020)

The rising prevalence of narcotic use and its associated health risks underscore the necessity for a comprehensive understanding of their chemical properties and mechanisms of action. Investigating the pharmacokinetics, pharmacodynamics, and biological impacts of these substances provides critical insights into the processes of addiction and dependence. Such knowledge is essential for the development of effective treatment modalities, preventive strategies, and clinical management approaches.

This review aims to present an integrated analysis of the chemical, biological, and therapeutic dimensions of narcotic drugs, thereby contributing to evidence-based clinical practices, informed public health

policies, and a deeper understanding of their complex interactions within the human body.

This study is based on an integrated framework combining pharmacokinetic–pharmacodynamic principles, receptor ligand interaction theory, and the brain disease model of addiction. Pharmacokinetics explains the movement of narcotics in the body, while pharmacodynamics describes their interaction with neural receptors to produce biological effects(Koob & Volkow, 2016).

The receptor–ligand theory highlights that the chemical structure of narcotics determines receptor binding and neurochemical responses. In addition, the brain disease model explains addiction as a chronic disorder resulting from neuroadaptive changes in brain reward pathways(Koob & Volkow, 2016).

Conceptually, the chemical composition of narcotics influences receptor interactions, leading to physiological effects and long-term outcomes such as dependence and addiction.

2.MATERIALS AND METHODS

This study was carried out using a descriptive and analytical approach. Information was collected by searching books and scientific articles from reputable sources such as ISI, ScienceDirect, and Google Scholar. The main goal of the research is to identify the chemical compouds of narcotic substances and understand how they affect the human body.

2-1. Chemical Compound of Narcotic Substances

Narcotic substances are composed of various chemical compounds, typically including complex organic structures such as alkaloids, opioid derivatives, amphetamines, and synthetic compounds. Although these substances differ in chemical structure, they all affect the central nervous system.

These compounds alter the activity of brain chemicals, especially dopamine, leading to changes in emotions, pain relief, and the development of dependence.

2-1-1. Opium Alkaloids

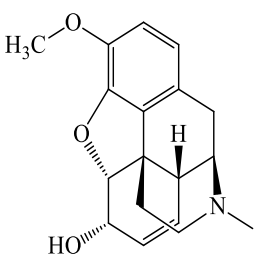
Opium is a substance obtained from the dried latex of the poppy plant. This latex is collected by making small cuts on the seed capsules, which are the fruit of the poppy, and allowing the sap to dry. Approximately 12% of opium consists of morphine, which is a powerful opioid alkaloid with strong pain-relieving properties. Morphine is widely used in medicine and also serves as a key precursor for the production of certain narcotic drugs.

Through chemical processes, morphine can be converted into heroin and other opioid compounds. In addition to morphine, opium contains several other alkaloids, including codeine, narcotine, papaverine, noscapine, and thebaine. When opium is processed into morphine, nearly 88% of its original weight is reduced, which makes transportation and illegal trafficking easier. Furthermore, converting morphine into heroin significantly increases its potency approximately doubling its effect and raises its relative market value (On Drugs, 2024).

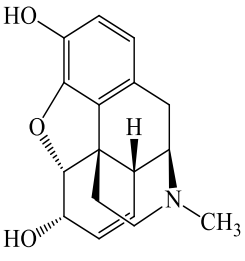
Figure (1). Latex exuded from the poppy seed capsule following incision(Dhungana et al., 2023; On Drugs, 2024).

Opium contains two major groups of alkaloids. The first group consists of phenanthrene alkaloids, including morphine, codeine, and thebaine, which are considered the primary active constituents of opium. The second group includes isoquinoline alkaloids, such as papaverine and noscapine, which do not have a significant effect on the central nervous system. The structural formulas of selected alkaloids are presented (scheme 1)(Dhungana et al., 2023).

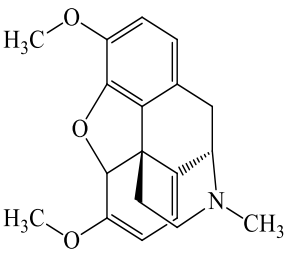
scheme 1



codiene or methyl morphine



morphine

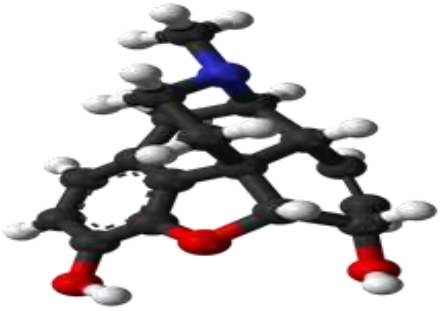


Tabaiene or paramorphine

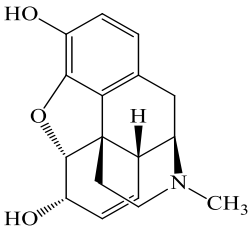
Morphine is the most important and common alkaloid in opium, making up approximately 10 to 16% of its total alkaloid content. It is also the main compound responsible for some of opium's adverse effects, such as respiratory constriction, breathing difficulties, coma, and certain cardiovascular and pulmonary issues.

Morphine (French: Morphine, English: morphine, or Morf) is an alkaloid from the opioid family naturally present in the latex of the poppy plant (opium). It acts directly on the central nervous system, producing effects such as pain relief, reduced anxiety, and increased euphoria. Its strong action on the nervous system makes morphine one of the most widely used analgesic drugs, but these same effects also increase its potential for abuse (Kayser, 2024).

In clinical practice, morphine is used to manage both acute and chronic pain, commonly prescribed for pain from heart attacks, kidney stones, or childbirth. It can be administered orally, intramuscularly, subcutaneously, intravenously, epidurally, or as a suppository. Peak effects occur about 20 minutes after intravenous injection and around 60 minutes after oral administration, typically lasting 3 to 7 hours. Extended-release formulations of morphine are also available. Molecular structure and three-dimensional conformation of morphine (Scheme 2)(Collins, 2021).



scheme 2



morphine

In general, the alkaloids found in opium, such as morphine, codeine, and thebaine, possess aromatic and cyclic structures. Morphine, with the chemical formula $C_{17}H_{19}NO_3$, is the main representative of this group and interacts strongly with μ-opioid receptors in the central nervous system.

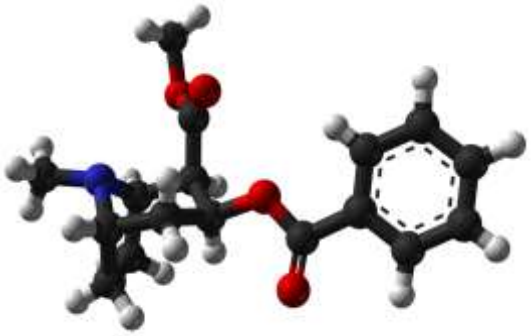
2-1-2. Cocaine

Cocaine (*Cocaine*), commonly known by the informal name “coke” and sometimes referred to in street language as “Tony” (a reference to Tony Montana), is a powerful and highly addictive stimulant. It is extracted from the leaves of the coca plant, which is native to South America (Collins, 2021).

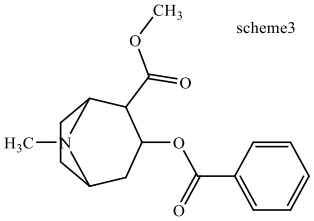
Cocaine is widely used for illegal recreational purposes; however, it also has limited medical applications, mainly as a local anesthetic prior to certain surgical procedures. This stimulant is produced in various forms, with the most common street form appearing as a fine, white, crystalline powder.

Figure 2**.** (a) Cocaine hydrochloride powder (b) Street form of cocaine, referred to as “Tony Montana” (Collins, 2021)

Cocaine is an ester alkaloid with the chemical formula $C_{17}H_{21}NO_4$ that affects the dopaminergic system. It blocks dopamine reuptake, increasing its concentration in the synaptic cleft and producing stimulating and reinforcing effects (scheme 3) (Johnson, 2014).



scheme3



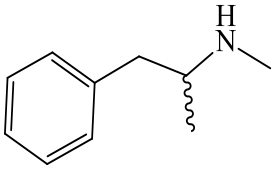
Cocaine

2-1-3. Methamphetamine

Methamphetamine is a powerful central nervous system (CNS)[Central Nervous System): The central nervous system consists of the brain and spinal cord and is responsible for controlling the body's vital functions]. stimulant, primarily used recreationally or to enhance mental and physical performance. It is less commonly prescribed as a second-line treatment for attentiondeficithyperactivitydisorder(ADHD)**(**AttentionDeficit/HyperactivityDisorder): Aneuro developmental disordercharacterized byinattention, hyperactivity, and impulsivity.

or obesity. Methamphetamine is a synthetic compound belonging to the phenethylamine family, with the chemical formula $C_{10}H_{15}N$ (scheme 4). It easily crosses the blood-brain barrier and triggers the release of large amounts of dopamine in the brain (Song et al., 2024).

scheme 4



N-methyl-1-phenylpropan-2-amine (Methamphetamine)

Methamphetamine use often causes severe and sometimes irreversible effects in otherwise healthy individuals. The drug enters the central nervous system and triggers a rapid release of dopamine in the brain, stimulating neural cells and leading to increased aggression and excessive physical activity. After the effects wear off, users may experience irritability, depression, and motor disturbances resembling Parkinson's disease.

Even from the initial use, methamphetamine can cause permanent brain damage, including memory loss, heightened aggression, abnormal behaviors, as well as cardiovascular and neurological complications in individuals without prior attention disorders.

A common long-term effect is "Meth Mouth," characterized by severe dental decay and oral infections. This condition results primarily from the vasoconstrictive effects of methamphetamine and its side effects, such as dry mouth, reduced motivation, neglect of oral hygiene, and excessive consumption of beverages to compensate for dehydration.

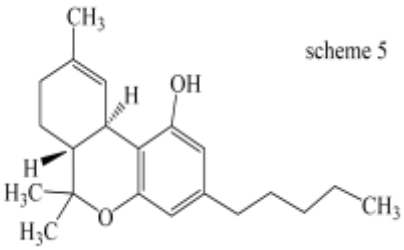
Figure 3. Severe dental and gum decay in a suspected methamphetamine user (Song et al., 2024)

2-1-4. Hashish and THC

Hashish, also known as charas, is a substance extracted from the resin of the cannabis plant. Unlike marijuana, which is made from the dried leaves and flowers, hashish contains essentially the same active compounds but in a more concentrated form. The leaves and buds of the plant are commonly referred to as "grass."

The oil obtained from cannabis resin represents a purified form of the psychoactive compound tetrahydrocannabinol (THC). The effects of hashish are primarily due to THC, which is classified as an entheogen. Hashish can be consumed in various ways, including smoking through a pipe, heating on a spoon, using a chillum, or, most commonly, as a cigarette mixed with tobacco or grass.

THC, the active compound in cannabis, has the chemical formula $C_{21}H_{30}O_2$ (scheme 5) and interacts with CB1 and CB2 receptors in the endocannabinoid system (Mohamed, 2023).



scheme 5

Figur4: *This image illustrates a cannabis plant, one of the primary sources of psychoactive substances worldwide. According to reports by*

the United Nations Office on Drugs and Crime (UNODC), cannabis accounts for the largest share of global production of psychoactive drugs, followed by cocaine and heroin as the second and third most prevalent substances, respectivel. https://fa.wikipedia.org/wiki/Cannabis_sativa_Koehler_drawing.jpg

2-2. Pharmacokinetics and Pharmacodynamics of Narcotics

From a pharmacokinetic perspective, narcotics are rapidly absorbed into the body through various routes, including oral, inhalation, and injection. Lipophilic compounds such as morphine, heroin, and cocaine cross the blood-brain barrier quickly due to their fat solubility, producing rapid effects (Smith, 2019; Williams et al., 2013).

During distribution, lipophilic drugs like methamphetamine and THC **[**Tetrahydrocannabinol):The main active compound in cannabis responsible for its psychoactive effects].are stored in fat tissues, which prolongs their effects and allows gradual release into the bloodstream. The liver plays a key role in drug metabolism, with CYP450[1][Tetrahydrocannabinol): The main active compound in cannabis responsible for its psychoactive effects]. enzymes converting many of these substances into active or semi-active metabolites. Narcotics are primarily excreted through urine, but some metabolites, such as THC, remain in the body for extended periods, contributing to addiction. Some metabolites are also eliminated via bile(Volkow et al., 2016).

From a pharmacodynamic perspective, narcotics alter neuronal activity by binding to specific receptors, including μ, κ, and δ opioid receptors, as well as dopamine and serotonin receptors. These interactions suppress pain, produce euphoria, increase energy, alter perception, and ultimately lead to dependence. Chronic activation of these receptors results in tolerance and both physical and psychological dependence, forming the basis of addiction (Nemets et al., 2025).

2-3. Mechanisms of Action of Narcotics

a. Interaction with opioid receptors

Opiate drugs interact with μ, κ, and δ opioid receptors, leading to reduced neuronal activity, pain relief, and increased feelings of euphoria.

b. Dopamine reuptake inhibition

Cocaine and amphetamines block dopamine transporters, increasing

dopamine levels in the synapse. This mechanism is the main reason for the strong addictive potential of these substances (Nemets et al., 2025).

c. Endocannabinoid system activation

THC binds to CB1 receptors in the brain, causing alterations in perception, memory, and motor timing.

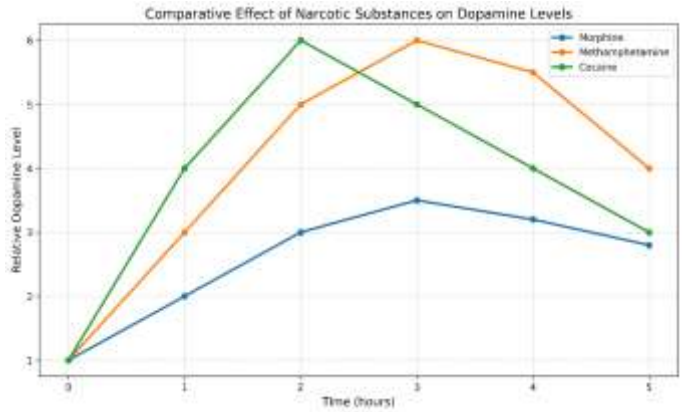
d. Mechanism of hallucinogens

Hallucinogenic substances alter perception of reality and the nature of objects. The most well-known hallucinogen is LSD, commonly available as tablets or blotter paper. These substances act on 5-HT2A serotonin receptors, modifying cortical activity and leading to hallucinations and cognitive changes (Ciuc\ua Anghel et al., 2023).

Graph 1. The graph illustrates changes in brain dopamine levels over a 5-hour period following administration of morphine, methamphetamine, and cocaine. Methamphetamine produces the highest and most prolonged elevation of dopamine due to its strong ability to stimulate dopamine release and block its reuptake in the mesolimbic reward pathway. Cocaine, on the other hand, causes a rapid but short-lived increase by directly inhibiting dopamine reuptake transporters, leading to an immediate accumulation of dopamine in synaptic spaces.

Morphine induces a slower and more moderate rise in dopamine indirectly through activation of opioid receptors, which reduces inhibitory control over dopaminergic neurons. These differences are mainly related to variations in chemical structure, receptor targets, and metabolic processing of each substance. Overall, the findings indicate that drugs producing stronger and more sustained dopamine elevation tend to have a higher potential for addiction and dependence.

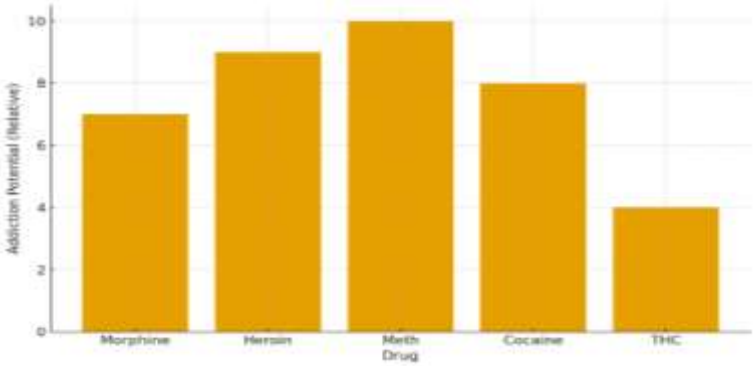
Graph 1 shows how three different substances affect brain dopamine levels through different mechanisms over time. It demonstrates that narcotic substances vary in their impact on the brain’s reward system, with methamphetamine and cocaine producing a much stronger increase in dopamine compared to morphine. This stronger dopamine response helps explain their higher potential for psychological dependence and severe addiction.



The graph is based on comparative neuropharmacological data on dopamine activity in the brain's reward system, adapted from published studies in addiction neuroscience (Volkow et al., 2016).

Analytical Section

Narcotics interact with specific neuronal receptors and affect signal transmission pathways, causing widespread changes in the nervous system

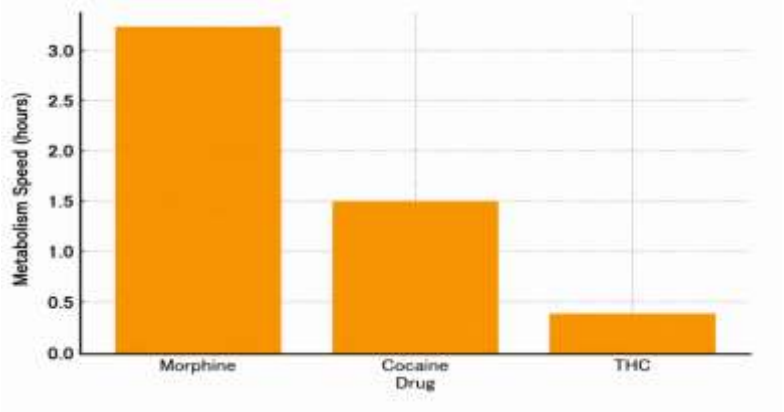


and endocrine function. These mechanisms may include increased dopamine release, inhibition of neurotransmitter reuptake, activation of opioid receptors, and modulation of the endocannabinoid system.

Long-term effects of drug use include structural changes in synapses, reduced volume in certain brain regions, and hormonal imbalances. For example, the above graph illustrates the action of three chemical narcotics morphine, methamphetamine, and cocaine and how they increase dopamine release while disrupting brain, structural, and hormonal balance.

Graph 2. Addiction potential of narcotics. Research analysis indicates that all narcotics morphine, heroin, methamphetamine (crystal meth), cocaine, and hashish induce dependence. Methamphetamine shows the highest

addictive potential, followed by heroin, cocaine, morphine, and hashish, respectively.



Graph 2: This graph compares the addiction potential of five substances (morphine, heroin, methamphetamine, cocaine, and THC). Methamphetamine and heroin show the highest addiction potential, followed by cocaine and morphine, while THC shows the lowest level, indicating differences in dopamine system activation in the brain's reward pathway. This comparison is based on established neuropharmacological and addiction neuroscience research describing variations in dopamine release and reinforcement mechanisms among different psychoactive substances (Volkow et al, 2019).

Graph 3. Comparison of the metabolic rates of different narcotics in the body.

Graph3:Shows the metabolic rate of different narcotic substances in the body based on how quickly they are broken down and how long they remain active (Katzung, et al, 2021).

3.Analysis

Graph 3 illustrates the metabolic rate of narcotic substances in the body based on their duration of breakdown and interaction. According to the graph, hallucinogenic substances, particularly tetrahydrocannabinol (THC), exhibit the fastest metabolic rate and are metabolized in less than half an hour. Stimulant drugs such as cocaine follow, remaining active in

the body for approximately one and a half hours. In contrast, opioid narcotics like morphine show the slowest metabolic rate and can interact with opioid receptors and neural binding sites for more than three hours. These differences significantly influence the intensity, duration of action, and addictive potential of narcotic substances (Bertol & Favretto, 2022).

Table 1. Comparison of Chemical Properties of Selected Narcotic Drugs

Substance	Chemical Formula	Primary Effect	Half-life (hours)
Morphine	$C_{17}H_{19}NO_3$	Potent analgesic, induces dependence	2–3
Heroin	$C_{21}H_{23}NO_5$	Intense euphoria, very high addiction potential	0.5
Methamphetamine	$C_{10}H_{15}N$	Dopamine release, strong CNS stimulation	10–12
Cocaine	$C_{17}H_{21}NO_4$	Inhibition of dopamine reuptake	1
THC (Tetrahydrocannabinol)	$C_{21}H_{30}O_2$	Interaction with CB1 receptors	20–30

Note: This table has been condensed based on previous studies to facilitate clearer understanding and easier comparison of the presented information.

2-4. Physiological Effects of Narcotic Drugs

In addition to their adverse social and familial consequences, narcotic drugs primarily pose serious threats to the physical health of individuals and can be fatal in many cases. By disrupting the normal function of vital organs, these substances lead to acute and chronic physiological complications. Some of the major physiological effects of narcotic drugs are summarized in Table (2).

Table 2. Physiological Effects of Narcotic Drugs on Body Systems

No.	Affected Body System	Mechanism of Action and Negative Effects	Reference
1	Cardiovascular system	Stimulant drugs can increase blood pressure, cause tachycardia, and elevate the risk of stroke and cardiac events.	(Ciucă Anghel et al., 2023)
2	Respiratory system	Opioids suppress the respiratory center in the brain, which may lead to respiratory depression and death.	(Ciucă Anghel et al., 2023)
3	Nervous system	Common consequences include dependence, insomnia, anxiety, hallucinations, and memory impairment.	(Stewart, 2024)
4	Hormonal system	Narcotic drugs disrupt levels of cortisol, testosterone, and dopamine, leading to hormonal imbalance.	(Ciucă Anghel et al., 2023)

3.RESULTS

The comparative analysis of existing literature indicates that narcotic substances exhibit distinct pharmacological and neurochemical profiles that are primarily determined by their chemical structures. Across major drug classes including opioids, stimulants, cannabinoids, and hallucinogens consistent differences were observed in receptor targeting, neurotransmitter modulation, and metabolic behavior.

Opioids demonstrate high affinity for μ-opioid receptors, resulting in strong analgesic effects accompanied by a high risk of tolerance and dependence. Stimulants primarily enhance dopaminergic transmission through reuptake inhibition or increased release, which is strongly associated with elevated central nervous system activity and addiction potential. Cannabinoids act on CB1[The primary receptor of the endocannabinoid system in the brain, involved in memory, perception, and appetite.] receptors of the endocannabinoid system, producing alterations in cognition and perception, while their lipophilic nature contributes to prolonged retention in body tissues. Hallucinogens primarily interact with serotonergic (5-HT2A) receptors, leading to perceptual and cognitive distortions with emerging evidence of therapeutic potential.

Metabolic analysis further reveals variability among these classes, with opioids generally showing slower elimination rates, stimulants exhibiting

rapid but intense effects, and cannabinoids demonstrating prolonged biological activity due to tissue accumulation. Collectively, the reviewed studies consistently report that all narcotic classes induce significant neurophysiological changes, particularly within brain reward pathways, which are closely linked to dependence and addiction development

4. DISCUSSION

The chemical compounds of narcotic substances and their impact on the human body represent a major area of study in medical sciences, pharmacology, and social research, given their scientific, social, and economic significance (Meyer et al, 2022). Narcotic drugs affect the central nervous system (CNS), altering consciousness, perception, emotions, and behavior. They can be categorized as natural, semi-synthetic, or synthetic, with each type exhibiting distinct pharmacological properties. Natural opioids, such as morphine and codeine, are derived from opium, whereas semi-synthetic derivatives like heroin are processed from morphine. Synthetic compounds, including methamphetamine and LSD, are produced in laboratories.

The pharmacological effects of narcotics are largely determined by their chemical structure. Opioids, including morphine, heroin, and codeine, are fentanyl-type alkaloids that interact strongly with μ-, κ-, and δ-opioid receptors, producing analgesia, sedation, and euphoria. However, chronic activation of these receptors can cause respiratory depression, tolerance, and physical dependence. Stimulants such as methamphetamine and cocaine act primarily by increasing synaptic dopamine, either by stimulating its release or inhibiting reuptake, which results in heightened CNS activity, hyperactivity, and high addiction potential. Methamphetamine produces the most sustained elevation of dopamine levels, explaining its severe neurotoxic and behavioral effects (Stewart, 2024).

Cannabinoids, represented by THC from hashish or marijuana, interact with CB1 receptors of the endocannabinoid system, inducing alterations in perception, memory, motor coordination, and appetite. Although THC is metabolized relatively quickly, its lipophilic nature allows accumulation in adipose tissue, prolonging its physiological and cognitive effects. Hallucinogens, such as LSD and psilocybin, exert effects through serotonin 5-HT2A receptors, causing perceptual distortions and intense sensory alterations. Cocaine and its derivatives, as tropane alkaloids, act as potent CNS stimulants, primarily by inhibiting dopamine reuptake, which contributes to rapid-onset euphoria and high addiction risk.

Chronic consumption of narcotics results in persistent structural and functional changes in the brain. Studies show that long-term use can lead to synaptic remodeling, decreased volume in specific brain regions, gene expression alterations, and hormonal imbalances, some of which may be irreversible. These neurochemical and structural modifications disrupt the brain's reward system, making the individual dependent on the substance for normal function or pleasure. Moreover, prolonged use impairs cardiovascular, respiratory, and immune system function, which significantly increases morbidity and mortality risks (Smith, 2019).

The social and economic consequences of narcotic misuse are equally substantial. Illegal trafficking, recreational use, and addiction impose severe burdens on families, communities, and public health systems. Even medically justified consumption, such as morphine for pain management, can be risky if not properly supervised. Ethically and legally, the recreational or therapeutic use of some substances, including cannabis, remains debated in various countries, reflecting differing regulatory and societal perspectives (Barg, 2025).

Based on the findings of this study, we believe that the chemical compounds of narcotic substances play a decisive role in determining their physiological, neurological, and psychological effects on the human body. Differences in the molecular structure of these substances are responsible for variations in the speed of action, degree of dependence, and severity of damage to the central nervous system. Opioids such as morphine and heroin activate opioid receptors, producing analgesic and euphoric effects; however, prolonged use results in severe physical dependence, respiratory disorders, and impairment of normal brain function. Likewise, stimulants such as methamphetamine and cocaine cause abnormal increases in dopamine levels, leading to excessive nervous system activity and strong psychological addiction.

We further believe that chronic narcotic consumption does not produce only temporary effects, but also causes permanent structural and functional alterations in the brain, hormonal imbalance, and damage to vital body systems. From our perspective, addiction is not merely a behavioral problem but a complex neurobiological, medical, and social disorder that threatens individual health, family stability, and social security. Therefore, increasing scientific awareness, strengthening medical supervision, and developing effective prevention and treatment programs are considered essential to reduce the harmful consequences of narcotic substances.

5. CONCLUSION

This study demonstrates that the chemical structure of narcotic substances significantly influences their pharmacological activity, receptor binding affinity, and addiction potential. Different classes of narcotics, including opioids, stimulants, cannabinoids, and hallucinogens, show distinct mechanisms of action on the central nervous system, although some overlap in neurochemical pathways is observed.

The findings also indicate that, regardless of structural differences, most narcotic substances interfere with normal neurochemical signaling, particularly within the brain's reward system. This disruption contributes to the development of dependence, tolerance, and a range of neurological and psychological disorders.

In conclusion, the relationship between chemical structure and biological activity is central to understanding the effects of narcotic substances. This understanding is important for toxicological assessment, pharmacological research, and clinical management of substance-related disorders.

Future research should focus on detailed molecular drug–receptor interactions, improved analytical techniques for detecting metabolites and impurities, and the role of genetic variation in individual responses to these substances.

6.REFERENCES

Barg, J. (2025). Drug Addiction and Brain Damage. Research Journal of Innovative Studies in Medical and Health Sciences V2. I1, 44.

Bertol, E., & Favretto, D. (2022). Pharmacokinetics: Drug Absorption, Distribution, and Elimination. In Karch's Drug Abuse Handbook (pp. 133–178). CRC Press.

Brunton, L. L., Knollmann, B. C., Hilal-Dandan, R., & others. (2018). Goodman \& Gilman's the pharmacological basis of therapeutics (Vol. 13). McGraw-Hill Education New York.

Carhart-Harris, R. L., & Goodwin, G. M. (2017). The therapeutic potential of psychedelic drugs: past, present, and future. Neuropsychopharmacology, 42(11), 2105–2113.

Ciuc\ua Anghel, D.-M., Nițescu, G. V., Tiron, A.-T., Guțu, C. M., & Baconi, D. L. (2023). Understanding the mechanisms of action and effects of drugs of abuse. Molecules, 28(13), 4969.

Collins, E. A. (2021). Cocaine Confessions. The University of Western Ontario (Canada).

Degenhardt, L., Charlson, F., Ferrari, A., Santomauro, D., Erskine, H., Mantilla-Herrara, A., Whiteford, H., Leung, J., Naghavi, M., Griswold, M., & others. (2018). The global burden of disease attributable to

alcohol and drug use in 195 countries and territories, 1990--2016: a systematic analysis for the Global Burden of Disease Study 2016. The Lancet Psychiatry, 5(12), 987–1012.

Dhungana, R. R., Pandey, A. R., Joshi, S., Luitel, N. P., Marahatta, K., Aryal, K. K., & Dhimal, M. (2023). The burden of mental disorders in Nepal between 1990 and 2019: Findings from the Global Burden of Disease Study 2019. Cambridge Prisms: Global Mental Health, 10, e61.

Hickman-Lewis, K., Moore, K. R., Hollis, J. J. R., Tuite, M. L., Beegle, L. W., Bhartia, R., Grotzinger, J. P., Brown, A. J., Shkolyar, S., Cavalazzi, B., & others. (2022). In situ identification of Paleoarchean biosignatures using colocated Perseverance Rover analyses: Perspectives for in situ Mars science and sample return. Astrobiology, 22(9), 1143–1163.

Katzung, B. G., & Vanderah, T. W. (2021). Introduction to Pharmacology. Basic \& Clinical Pharmacology. 15th Ed. New York: McGraw-Hill.

Koob, G. F., & Volkow, N. D. (2016). Neurobiology of addiction: a neurocircuitry analysis. The Lancet Psychiatry, 3(8), 760–773.

Meyer, J. S., Meyer, J., Farrar, A. M., Biezonski, D., & Yates, J. R. (2022). Psychopharmacology: Drugs, the brain, and behavior. Oxford University Press.

Nemets, V. V, Grinevich, V. P., & Gainetdinov, R. R. (2025). Neurochemical Mechanisms of Addiction. Neurochemical Journal, 19(3), 334–348.

Nwonu, C. N., & Nwonu, P. C. (2025). Pharmaceutical and non-pharmaceutical therapies in substance use disorder. Sch Bull, 11(5), 81–90.

On Drugs, U. N. O. (2024). Global report on trafficking in persons 2024. Stylus Publishing, LLC.

Pan, N., Ma, T., Liu, Y., Zhang, S., Hu, S., Shekara, A., Cao, H., Gong, Q., & Chen, Y. (2024). Overlapping and differential neuropharmacological mechanisms of stimulants and nonstimulants for attention-deficit/hyperactivity disorder: a comparative neuroimaging analysis. Psychological Medicine, 54(16), 4676–4690.

Reiff, C. M., Richman, E. E., Nemeroff, C. B., Carpenter, L. L., Widge, A. S., Rodriguez, C. I., Kalin, N. H., McDonald, W. M., on Biomarkers, W. G., & Novel Treatments, a D. of the A. P. A. C. of R. (2020). Psychedelics and psychedelic-assisted psychotherapy. American Journal of Psychiatry, 177(5), 391–410.

Smith, D. E. (2019). The evolving understanding of substance use disorder. Journal of Psychoactive Drugs, 51(1), 1–3

Volkow, N. D., Koob, G. F., & McLellan, A. T. (2016). Neurobiologic advances from the brain disease model of addiction. New England Journal of Medicine, 374(4), 363–371.
Volkow, N. D., Michaelides, M., & Baler, R. (2019). The neuroscience of drug reward and addiction. Physiological Reviews, 99(4), 2115–2140.
Zacharia, G. S., & Jacob, A. (2024). Liver disorders in substance abusers. Hepatology Forum, 6(1), 34.