*Republic of Iraq*

*Ministry of Higher Education*

*University of Maysan*

*College of Science*

*Department of Chemistry*

# *Measuring dopamine levels in people who stay up late at night in Amara city, Maysan Governorate.*

*A RESEARCH SUBMITTED TO*

*CHEMISTRY DEPARTMENT*

*COLLEGE OF SCIENCE/MAYSAN UNIVERSITY*

**BY**

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2025

بِسْمِ اللَّـهِ الرَّحْمَـٰنِ الرَّحِيمِ

((هُوَ الَّذِي جَعَلَ لَكُمُ اللَّيْلَ لِتَسْكُنُوا فِيهِ وَالنَّهَارَ مُبْصِرًا  إِنَّ فِي ذَٰلِكَ لَآيَاتٍ لِقَوْمٍ يَسْمَعُون))

(صدق الله العظيم)

[سورة يونس: 67]

## Dedication & Acknowledgment

All praise is due to Allah, whose guidance and mercy illuminated my path to completing this work.

we dedicate this humble effort to my beloved parents, whose unwavering support and heartfelt prayers have been my greatest strength.

With sincere appreciation, weextend my deepest gratitude to my supervisor, assist.prof. Alaa Hussein Khanouba. for his valuable guidance, patience, and encouragement throughout the journey of this research.

To myself, for every step taken, every hour spent, and every challenge faced with determination—this achievement is a tribute to perseverance.

To all who believed in me and stood by me, this work is also yours.

Zahraa Majid Mohsen & Shahad Talib Abdul Redha.

## Abstract

This research examines the relationship between circadian rhythm disruption and dopamine levels in the body by integrating both theoretical and practical frameworks. In the theoretical section, the concept of the biological clock is explained as the internal regulator that controls the organism's biological rhythm throughout the day, influencing various physiological processes such as sleep, hormonal secretions, and body temperature. Special emphasis is placed on the impact of nocturnal wakefulness and sleep disorders on hormonal balance, particularly dopamine, which is a vital compound associated with mood regulation, motivation, and cognitive functions.

In the practical aspect, dopamine levels were measured in blood samples from individuals experiencing sleep pattern disturbances due to nocturnal wakefulness and compared with dopamine levels in individuals who maintain regular nighttime sleep. Contrary to the initial hypothesis that predicted lower dopamine levels in night owls, the results showed that some of them had higher dopamine levels. Through questionnaires and direct communication, it was found that these individuals consumed high amounts of protein, leading researchers to link the intake of tyrosine-rich foods—an essential amino acid for dopamine production—with elevated levels of dopamine in the blood.

The research concluded that circadian rhythm disruptions can negatively affect dopamine balance; however, this impact can be partially modulated or compensated for by dietary factors. Thus, dopamine levels are not solely influenced by sleep patterns but are significantly intertwined with dietary habits. This highlights the importance of adopting a holistic perspective when studying hormonal effects associated with lifestyle, considering both behavioral and nutritional factors.

## Introduction

Time is embedded in our genes. Cells are the true 'miracle' of evolution, for they are the basis of life and among their amazing abilities they can tell the time. Biological clocks can be found everywhere, from simple bacteria through to worms, birds and, of course, us. The reason for this expanse of clocks is clear: all life evolved and lives on a planet that ro- tates on its axis once a day, and so is exposed to large periods of day and night, light and dark. We humans spend about a third of our lives asleep. For the average person this amounts to more than twenty years spent in a horizontal position. No other human activity takes up such a large part of our lives.(1)

Many biological processes, both at the multicellular and cellular levels of organization, undergo regularly recurring quantitative and qualitative changes. Highs in these processes are repeated with such beatlike regularity (the period is 24 hours) that the processes are referred to as being rhythmic. Rhythms have now been described for literally thousands of organisms.

Just before the birth of Aristotle, the first written account appeared on what today we call biological rhythms; an early amateur naturalist had observed that certain plants (legumes) stand with their leaves folded to the sides of their stems at night and raise them as if in a pagan gesture-to the sun in the morning (Figure 1-1). Day after day, throughout their entire lives, they repeat this monotonous pattern.(2)

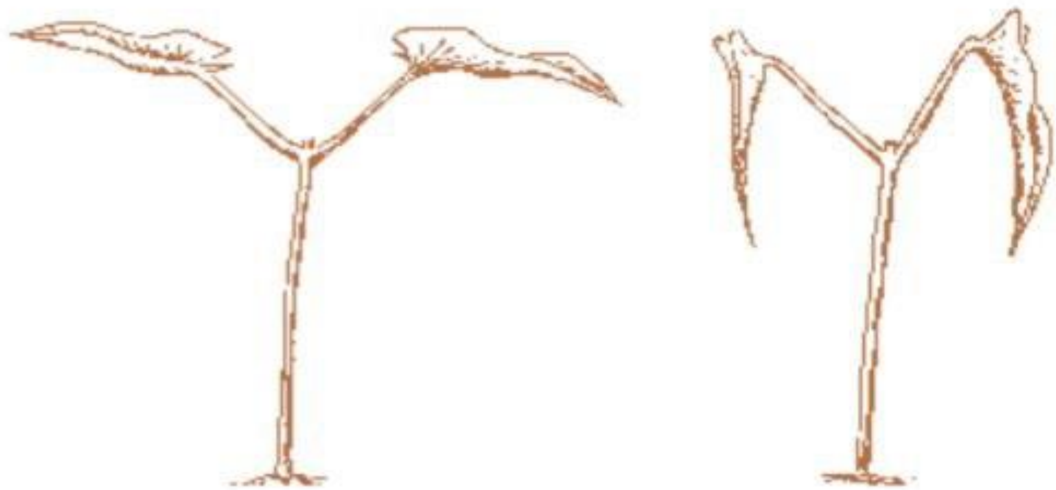

**Fig 1-1 Bean seedlings with the leaves in the raised, daytime; and lowered, nighttime positions-the extremes of the sleep-movement rhythm.**

This unusual plant property-active movement-is brought about by a tiny package of specialized cells located eccentric ally at the base of each leaf. These cells periodically Inflate with water and lift the leaf in a way analo- gous in principle to the hydraulic piston that lifts the scoup on a bulldozer, About 2400 years after this observation an inquisitive scien- tist studied these leaf movements in the laboratory and found to his surprise that even when he deprived the plants of all ob- vious information about the time of day (he maintained them in constant darkness and at a relatively constant temperature) that the up-and-down "sleep movements" of the leaves con- tinued in near synchrony with their feral companions outside in the garden (Figure 1-2). This discovery clearly demonstrated that these organisms had some mysterious means of keeping time; they were described as possessing biological clocks. With this conclusion, the field of biological chronometry was born.

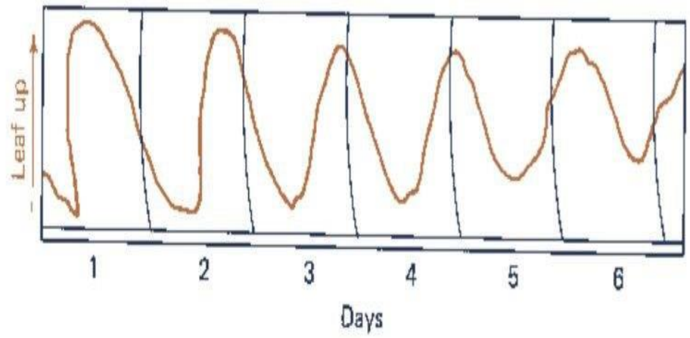


**Fig 1-2 Circadian sleep-movement rhythm in the bean seed- ling.[2]**

In continuous dim illumination (signified by the open horizontal bar subtending the abscissa) and constant temperature. The parallel curved reference lines are 24 hours apart, emphasizing the fact that at this light intensity, the period of the rhythm was approximately 27 hours.[2]

We and just about every living thing on the planet-ani- mals, plants, algae, bacteria have a biological clock that was first set ticking more than three billion years ago.[1]

Most organisms on the planet have such a clock, which is entrained by light and anticipates as well as adapts to external demands to promote organismal fitness.

In mammals, the core molecular clock that is present in each cell is comprised of an autoregulatory transcriptional/translational feedback loop (5–7) that is reset daily by the master clock located in the hypothalamic suprachiasmatic nucleus (SCN) (8, 9). [3]

The rhythms that are a consequence and a necessity for living on a rotating planet are time markers. Through these internal timing processes, organisms have adapted to maximise their chances of reproduction in a temporal environment that changes daily with unfailing regularity.[1]

Although circadian rhythms are anchored genetically, they are synchronized by (entrained) and maintain certain phase relationships to external (exogenous) factors, especially the sleep portion of the light-dark schedule. These rhythms will persist with a period different from 24 h when external time cues are suppressed or removed, such as during complete social isolation or in constant light or darkness.[4]

## CIRCADIAN RHYTHMS

Circadian rhythms are physical, mental and behavioral changes that follow a roughly 24-hour cycle, responding primarily to light and darkness in an organism's environment.

Our biological clocks drive our circadian rhythms. These internal clocks are groupings of interacting molecules in cells throughout the body. A "master clock" in the brain coordinates all the body clocks so that they are in synch.The study of Circadian rhythms is termed chronobiology.[5]

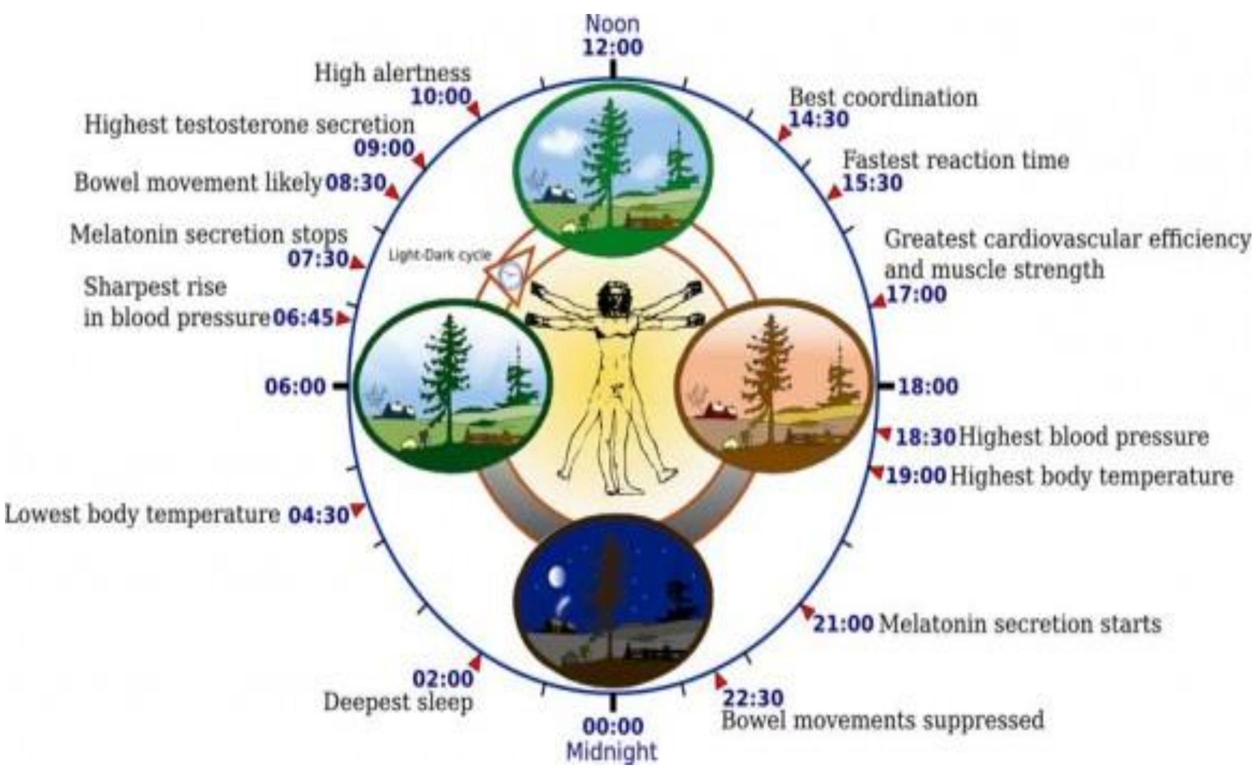


**Fig. 2: Human circadian rhythms.[5]**

Cues such as sunlight, food, sound, and temperature, called zeitgebers, attune circadian rhythms to external conditions, coordinating basic cellular functions to match the environment and maintain homeostasis. A large body of evidence now links an increasing number of known circadian disruptors or zeitgebers, including sleep/wake patterns, dietary timing, and caloric intake, to adverse outcomes in humans. A comprehensive look at evidence from both human and animal studies exploring the relationship between circadian gene expression and metabolic health is lacking. Consequently, we lack a clear mechanistic understanding necessary for future prevention, treatment, and control of metabolic health–related diseases, including diabetes, cancer, and cardiovascular diseases, the leading causes of death and disability across the globe.[(6)]

At a cellular level, core clock genes (CCGs) direct the daily oscil latory expression of thousands of clock output genes (COGs) (Figure 3). This complex system regulates a myriad of physiological pro cesses, synchronizing them to match diurnal needs (7).

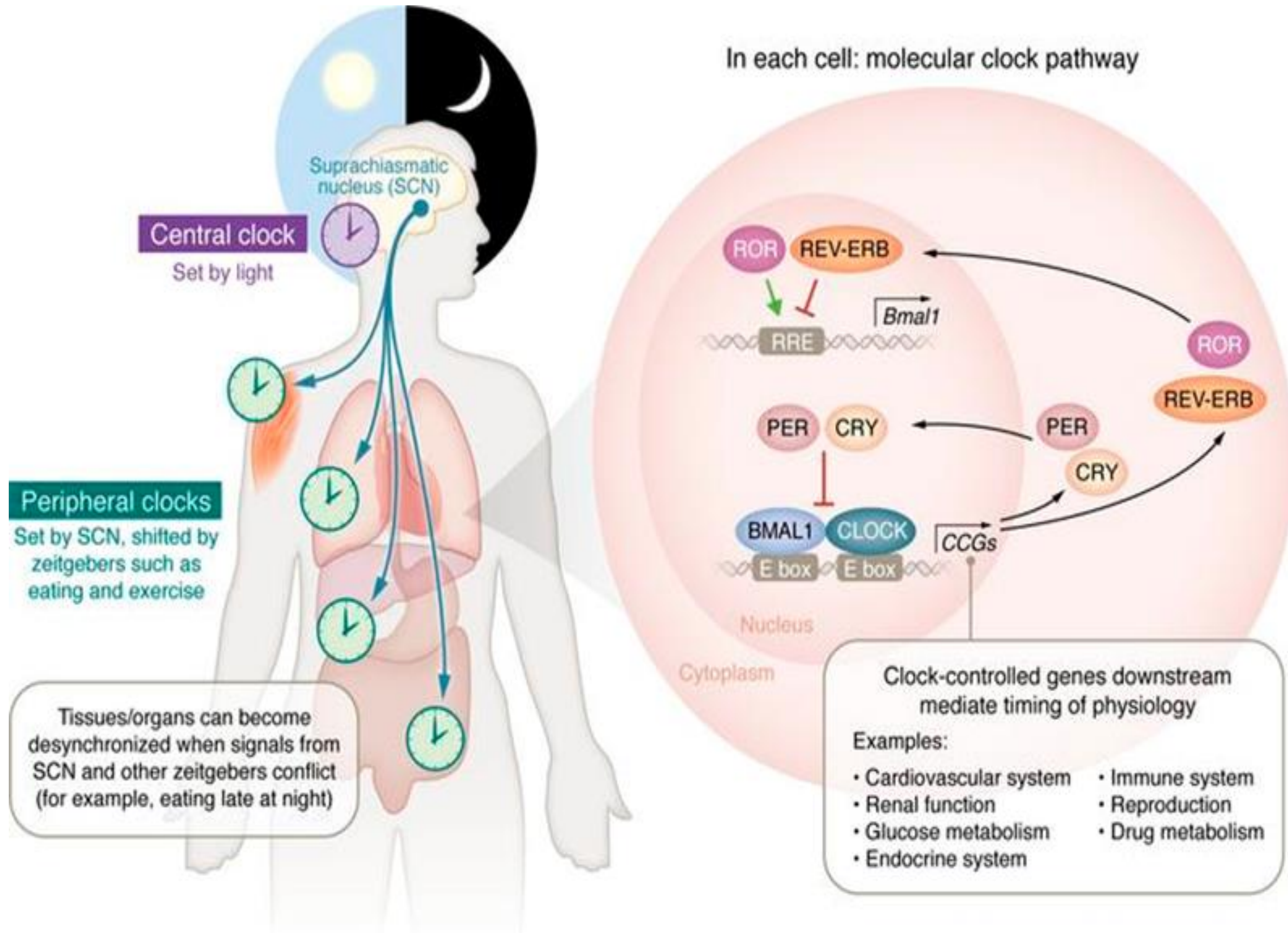


**Fig 3. Circadian control of molecular core clock gene signaling and physiologic regulation.**[(7)]

The central, peripheral, and molecular clocks and the physiolog ical processes under circadian control. The circadian clock (purple) in the suprachiasmatic nucleus (SCN) of the brain sets peripheral clocks in individual organs and tissue types (light green) via signals including circulating hormones, metabolites, the sympathetic nervous system, and body temperature. Within the cells of the SCN and each organ/tissue type, each cell contains transcription-translation feedback loops, the molecular clocks that drive circadian rhythms. These molecular clocks regulate the transcription of thousands of CCGs and direct the daily oscillatory expression of thousands of COGs and additional transcription factors that mediate the timing of myriad physiological processes as represented in the molecular clock pathway within cells.[(7)]

## Four Timely Facts regarding Our Biological Clocks

1**. They're Incredible Intricate**: Biological clocks consist of genes and proteins that operate in a feedback loop. Clock genes have particular instructions for creating clock proteins, whose levels increases and decreases during a regular cyclic pattern. This pattern successively regulates the activity of the genes.

**2. Each organism has them—from alga to zebras:** several clock genes and proteins are similar across species, permitting researchers to form vital findings regarding human circadian processes by learning the clock elements of organisms like fruit flies, bread mould and plants.

**3. Whether or not we're awake or asleep, our clocks keep ticking:** whereas they could get temporarily thrown off by changes in light-weight or temperature, our clocks sometimes will reset themselves.

**4. Nearly everything regarding however our body works is tied to biological clocks:** Our clocks influence alertness, hunger, metabolism, fertility, mood and alternative physiological conditions. For this reason, clock dysfunction is related to varied disorders, which includes insomnia, depression, and diabetes. Even drug efficacious has been coupled to our clocks: Studies have shown that some medicine can be more practical if given earlier within the day.(8)

In modern society, humans have become less constrained by nature's day/night cycles, and circadian rhythms are pushed and pulled by inconsistent zeitgebers. These circadian disruptors include artificial light, continual food availability, ever-changing work and social demands on sleep/wake timing, and, more recently, diet .

where circadian dis ruption occurs as a result of an individual's shifting or shortening of sleep on weekdays, followed by additional sleep on weekends . (9)

When organisms are exposed to circadian disruptors, many biological systems and feedback loops meant to anticipate and regulate diurnal homeostasis can become misaligned through pre viously described feedback loops at the molecular and cellular lev els. Over time, this dysregulation may negatively affect organs and tissues such that catabolic and anabolic processes are out of sync, leading to pathological consequences. For example, aberrant timing of zeitgebers, such as eating during the inactive phase, may induce (a) a generalized environmental desynchrony where the systemic clock is out of phase with external cues such as food timing or (b) an "internal" circadian desynchrony of peripheral clocks (e.g., liver, pancreas) and the central clock, both scenarios with the potential to reduce the efficiency of energy metabolism, leading to weight gain (e.g., see refs. [10–17] and downstream effects on other metabolic pathways. Thus, through regulatory feedback mechanisms, expo sure to circadian disruptors may contribute to the development of human disease or inflict adverse health outcomes via inappropriate phase relationships between the internal tissue clock and environ mental cues [18–21] .Despite relatively rapid rates of behavioral reentrainment (e.g., sleep patterns) following disruption, internal organs reentrain at different rates, adding additional complexity to the potential impact of circadian desynchrony on human health and disease [22–25]. This latter point may be particularly relevant for humans with inconsistent periods of active/inactive cycles over the long term (e.g., shift workers alternating between day and night shifts). Such individuals may rarely reach a state where systemic or tissue clocks are in sync with their external environment, especially energy consumption. Circadian disruption has been studied as a contributor to the development of the constellation of metabolic health–related pathologies, including obesity, diabetes, and metabolic syndrome (MetS), a cluster of indicators including abdominal obesity, high blood pressure, high blood sugar, high serum triglycerides, and low serum high-density lipoprotein (HDL) cholesterol. [26]

clock dysfunction is associated with various disorders, including insomnia, diabetes and depression. Even drug efficacy has been linked to our clocks: Studies have shown that some drugs might be more effective if given earlier in the day.[8]

## SIX Hormones That Can Affect Your Sleep

Our hormones are answerable for variety of changes that occurs in our body – they assist us to grow, to breed, they regulate our appetite and that they also manage our sleep. It"s hardly stunning then that completely different hormones will have an effect on our sleep patterns in several ways.

### 1. Oestrogen

Oestrogen may be found in both men and women. It"s usually related to reproductive health, taking major and crucial part in menstrual cycle; but, oestrogen also performs a range of completely different functions.

**When do issues occur?** As you progress through life, your levels of oestrogen will fluctuate, significantly during menstrual cycle if you"re women. However, as you approach menopause, your levels of this hormone will plummet that brings a range of tell-tale symptoms, like irregular periods, hot flushes, mood swings and muscle and joint pain.[27]

### 2. Progesterone

Progesterone is best called a female sex hormone – its name is virtually derived from „promoting gestation." It helps to sustain the liner of your uterus just in case of pregnancy, that is why women experiences high progestogen levels when ovulating, before they eventually decline. Progestogen is additionally important for healthy brain performance generally being classed as a neurosteroid. It has natural anti-anxiety. When do issues occur? When progestogen levels begin to fall, either due to menstruation or menopause, it will cause problems with your sleep. If you suffer from low progestogen levels throughout menses, it will sometimes hint that your levels of oestrogen are much higher, during which you'll begin to experience symptoms like mood swings, fluid retention and cramping.[27]

### 3. Testosterone

It is also known as male sex hormone. Testosterone isn‟t simply exclusive to men it also plays a vital role in feminine health too. In each sex, testosterone works to support reproductive health and in men, it conjointly helps to control muscle and bone mass too.[28]

**When do issues occur?** Men don‟t usually experience a steep fall in testosterone. Instead, it step by step declines over a period of years. Low levels of testosterone will be related to sleep issues. For example, testosterone levels usually fluctuate throughout the day and it‟s been shown that levels are at their highest throughout rapid eye movement sleep.[29]

## 4. Cortisol and Melatonin

These 2 hormones on this list have a lot of direct impact on your sleep cycle, and that they are thus interlinked that it's not possible to say one without another. Cortisol and Melatonin are the 2 main hormones that regulate your sleep pattern. Cortisol is usually called a „stress hormone‟ and it‟s made by adrenal glands. It helps to control your metabolism and reduces inflammation and, once it's discharged, it raises your glucose levels and blood pressure level. As a part of circadian rhythm, in early hours of morning the levels of cortisol are elevated which helps which helps you feel refreshed and as the day progresses, your levels of cortisol can step by step decline as a lot of melatonin is discharged within the hours before you go to bed. Melatonin, or the sleep hormone, is produced by pineal gland and works with cortisol. Once your optic nerves discover natural light decreasing, they're going to send a message to your neural structure, which is able to the trigger the discharge of melatonin to assist you relax and feel drowsy in preparation for sleep. Usually when cortisol levels increases the melatonin decreases and vice versa.

**What happens once this balance is interrupted?** Finally, few devices will suppress your production of melatonin. Melatonin is sometimes made as a response to an absence of natural light. Night-time encourages you to sleep however, if your optic nerves discover light waves that are just like ultraviolent light, it will trick your hypothalamus into believing that it‟s still daylight outside, and thus you ought to be awake. Sadly, most computers, televisions, tablets and sensible phones emit a blue lightweight wave that has this specific effect thus, binging on Netflix or trawling through social media on your sensible phone before bed will result in insomnia!.

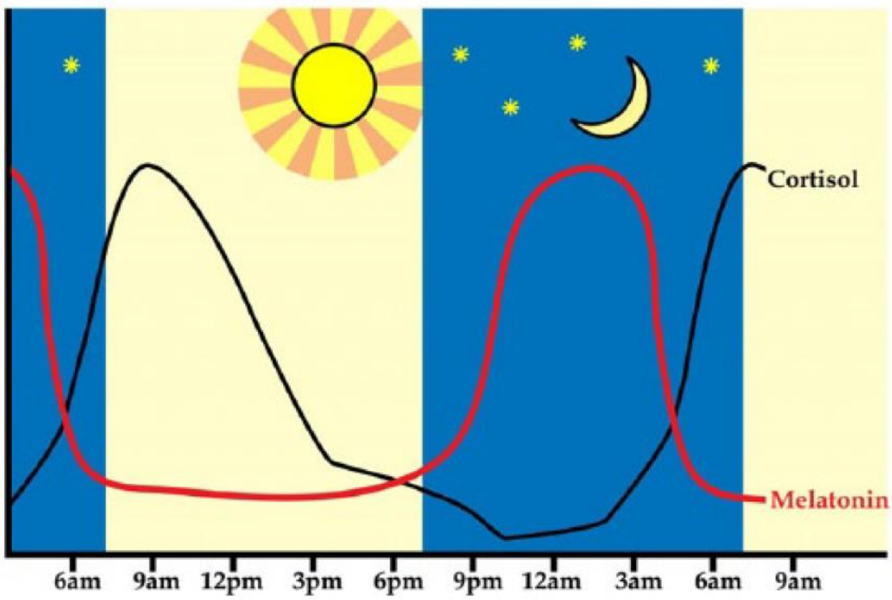


**Fig 5. The circadian-driven hormones cortisol and melatonin occur out of phase.[31]**

## 5 . Thyroid

Your Thyroid gland is located just under the larynx and produces 2 hormones, triiodothyronine and thyroxin. These 2 hormones facilitate to control your metabolic rate, digestive function and brain development thus, within the grand theme of things; they‟re each pretty vital, particularly when it comes to your mood.

**When do issues occur?** Problems tend to occur with your thyroid once your thyroid gland is either too active (hyperthyroidism) or not active enough (hypothyroidism). Both of these conditions have a list of side effects and both are connected to poor sleep. If you suffer from Hyperthyroidism you'll begin to show symptoms of nervousness or irritability and bouts of sweating and heart palpitations. Hypothyroidism suffers from sleep apnoea.[30]

Circadian rhythm disruptions are a major hallmark of mood disorders. Dampened and phase-shifted temperature, activity, and hormonal rhythms are frequently reported in major depressive disorder (MDD) and bipolar disorder .Studies link both environmental and genetic circadian rhythm disruptions with mood disorders. Disrupting circadian rhythms by shift work or jet lag can worsen or cause mood symptoms. Furthermore, seasonal changes in day length can affect mood . In terms of genetic disruptions, many circadian genes have been associated with mood disorders . Since treatments that directly target the circadian system are used as therapies for mood disorders (e.g., light and dark therapies, agomelatine, social rhythm therapy, and sleep phase advance), correcting circadian disruptions may stabilize a mood .

Thus, one theory to explain the presence of circadian rhythm disruptions in mood disorders is that disrupted circadian rhythms in the master pacemaker, or suprachiasmatic nucleus (SCN), cause mood disturbances. Alternatively, some studies suggest that light directly impacts other brain regions, independent of the SCN, to control mood .A third viewpoint is that sleep and circadian rhythm changes are a symptom of mood disorders and are not causal.[32]

Everyone knows that everyone needs to sleep at night. Sleeping is as basic a physical need as breathing for everyone. In a person's life, about one third of the time is used for sleep to ensure the normal and stable functions of the body.[33]

## Sleep and metabolism

In human body, every cell produces waste as a byproduct, the Clearance of the waste is a basic problem that each organ has to solve. And Body's lymphatic system which has evolved to meet this need. Except the blood system, there is a second parallel network of vessels that extends throughout the body. It takes up proteins and other waste from the spaces between cells and dumps them into the blood, then the lymphatic system and the blood system work together to remove the waste .But there is one organ that is not covered by the lymphatic system. It is the brain, because the brain tissue is enclosed in a hard skull filled with cells, and there's no room for a second set of blood vessels, like the lymphatic system. Therefore, the brain, the most active organ that produces a lot of waste, must have other ways to efficiently remove waste. Researchers have found that there is a large amount of clear fluid in the brain called Cerebral Spinal Fluid, (CSF). CSF fills the space around the brain, and waste products from brain tissue enter the CSF before they are dumped into the blood. And the most amazing thing is, all this fluid rushing process only happening in the sleeping brain.[34]

At present, it is generally believed that sleep has an important impact on the normal function of the brain, especially the cognitive, learning and memory ability is closely related, even a short sleep deprivation will damage the learning and memory function, make the brain become dull, but also inhibit the metabolism of beta-amyloid proteins to accelerate the onset of Alzheimer's disease. Sleep deprivation can cause electrophysiological and biochemical changes in the central nervous system, resulting in neurotransmitter disorders in the central nervous system, so it is believed that the decline in learning and memory ability. It can also cause behavior abnormalities, emotional loss. Sleep deprivation may be related to the changes in neurotransmitters in the brain after sleep deprivation. This will be associated with the emergence of certain

brain diseases. This paper aims to explore the effects of Sleep on neurotransmitters in order to provide new ideas for clinical diagnosis and treatment. (33)

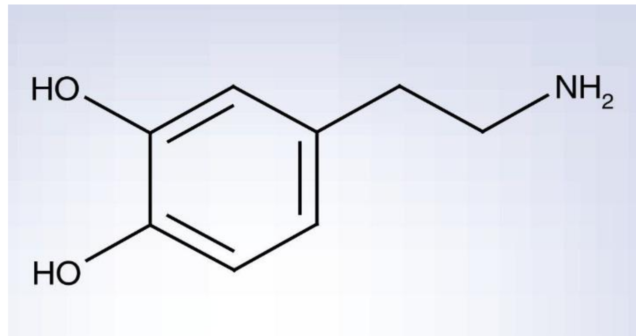


**Figure 6. Dopamine the internal standard**

**Dopamine** is a naturally occurring catecholamine that plays an important role as a neurotransmitter in the CNS and which also has several hormonal functions. It is biosynthesized by the body from its amino acid precursor l-dopa by the action of the enzyme dopa decarboxylase. This mainly takes

place in several areas of the brain, but there also is a peripheral contribution, particularly in the kidneys, where dopamine is produced from circulating l-dopa [35]. In addition, it is likely that dopamine is introduced via the diet, as the consumption of food has been reported to increase its plasma concentrations .

Because of their important role in health and disease, the determination of dopamine and other catecholamines in biological fluids is widespread. (36)

## Tools and Equipment Used:

1. 12 EDTA Tubes (5 mL capacity): Used for blood sample collection and to prevent coagulation.

2. 12 Plain Tubes: Used to store plasma after processing.

3.Butterfly Needles: Used for safe and accurate blood collection.

4.Centrifuge: Used to separate plasma from other blood components.

5.Micropipettes: Used to transfer precise volumes of plasma.

6.Eppendorf Tubes: Used to store the separated plasma.

7.UV-Visible Spectrophotometer: Used to analyze plasma absorbance and determine the concentration of the target compound.

8.Medical Gloves and Personal Protective Equipment (PPE): Used to ensure safety when handling samples.

9.Refrigerator or Freezer (–20°C): Used to preserve plasma samples until analysis.

10.Digital Timer or Timing Application: Used to accurately document sample collection time based on the biological clock.

11.Participant Information Forms: Used to record participant data and sampling times.

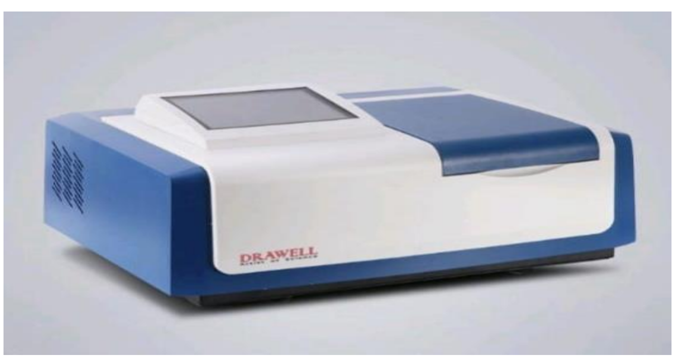


**Fig 7.UV-Visible Spectrophotometer**

**Chemical Materials Used:**

1. Standard Dopamine: Used as a reference to analyze plasma absorbance and determine dopamine concentration in the samples.

2. Distilled Water: Used for diluting solutions, preparing samples, and ensuring measurement purity.

3. 70% Ethanol: Used to disinfect the blood collection site and tools, ensuring volunteer safety and preventing contamination.


**Fig 8.** **Standard Dopamine**

## Methodology

The practical part of the research was conducted in the laboratory using human blood samples and standard solutions, where the following steps were followed:

### 1. Preparation and Analysis of Dopamine Standard

A standard solution of dopamine was prepared at a concentration of 40 mg/mL. The sample was then diluted at a ratio of 1:3 (one part sample and three parts distilled water).

After dilution, the absorbance was measured using a UV-Vis spectrophotometer at a specific wavelength. Subsequently, the absorbance was measured by increasing the wavelength in increments of 5 nanometers for each absorbance reading to determine the highest wavelength at which dopamine absorbs.

### 2. Sample Collection

Blood samples were collected from two groups of individuals:

* **Group 1:** Consisted of (8) individuals suffering from a sleep pattern disorder with irregular sleep schedules.

* **Group 2:** Consisted of (4) individuals with a normal and regular sleep pattern.

### 3. Plasma Separation

The tubes were placed in a centrifuge to separate the plasma component from the other blood components.

### 4. Sample Preparation for Analysis

Plasma samples were diluted using distilled water at a ratio of (1) mL of distilled water for every (0.5) mL of separated plasma.

### 5. Absorbance Measurement

A spectrophotometer was used to analyze the samples, where absorbance values were recorded for each sample individually.

### 6. Recording the Results

The values obtained from the spectrophotometer for both groups were documented in preparation for their analysis and comparison to study the effect of sleep disturbance on biochemical indicators related to the biological clock.

## Table between standard dopamine and wavelength.

| A | ɦ | A | ɦ |
|---|---|---|---|
| 1.671 | 300 | 1.651 | 370 |
| 1.662 | 305 | 1.641 | 375 |
| 1.658 | 310 | 1.621 | 380 |
| 1.655 | 315 | 1.615 | 385 |
| 1.671 | 320 | 1.604 | 390 |
| 1.681 | 325 | 1.591 | 395 |
| 1.689 | 330 | 1.593 | 400 |
| 1.665 | 335 | 1.62 | 405 |
| 1.676 | 340 | 1.637 | 410 |
| 1.68 | 345 | 1.651 | 415 |
| 1.663 | 350 | 1.644 | 420 |
| 1.671 | 355 | 1.638 | 425 |
| 1.659 | 360 | 1.625 | 430 |
| 1.66 | 365 | | |

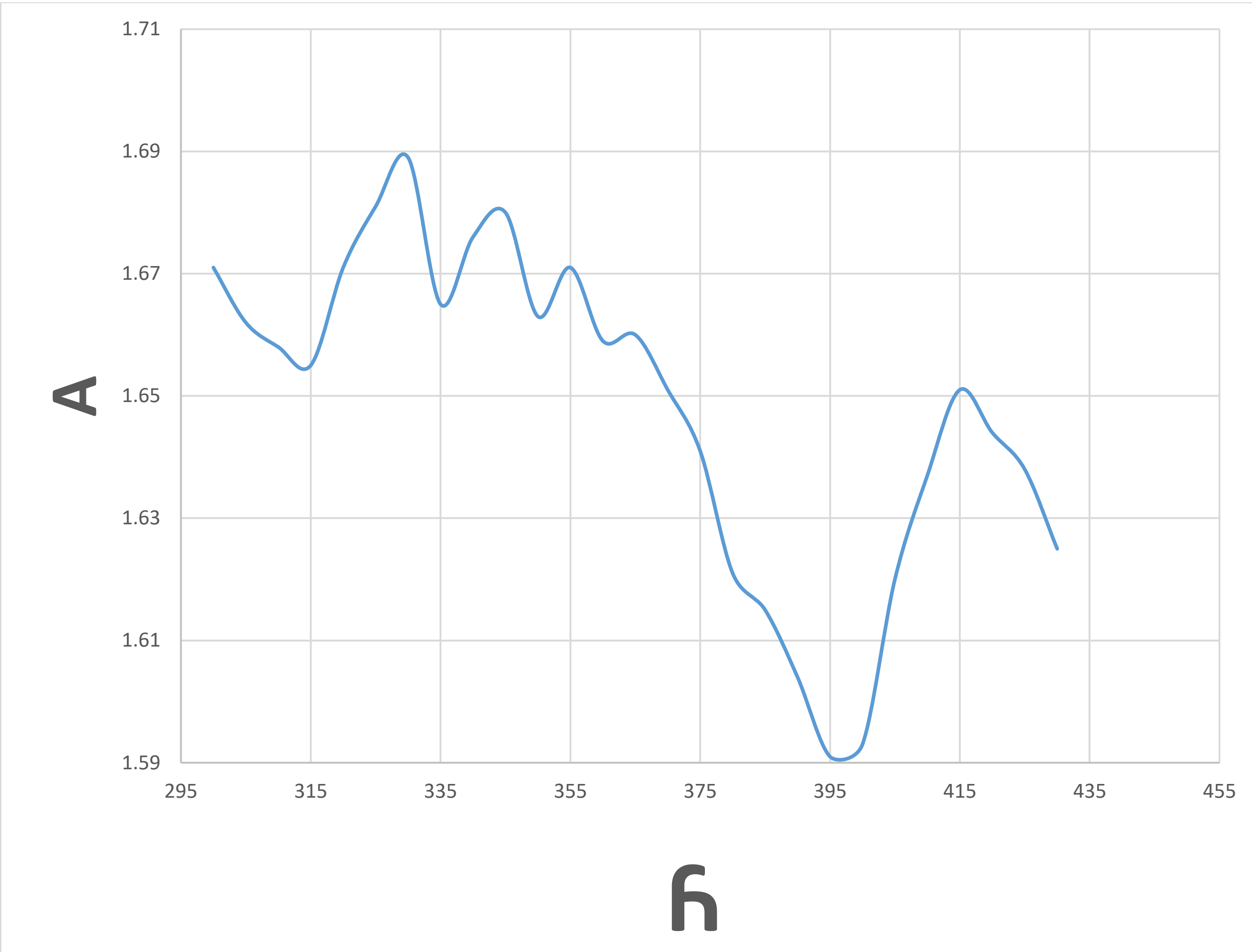


**Fig 9.Graph between standard dopamine and wavelength.**

**A table representing laboratory results for absorbance values for healthy and unhealthy individuals.**

| Healthy people | Unhealthy people |
|---|---|
| A | A |
| 0.692 | 0.508 |
| 0.925 | 0.551 |
| 0.285 | 0.536 |
| 0.462 | 1.990 |
| | 0.939 |
| | 0.562 |
| | 0.63 |
| | 0.617 |

## Calculations

1-The concentration is converted to molarity to find the molar absorption coefficient.

1mg /mL=1000 mg/l=1000 ppm

40mg/ml =40*1000 =40000 ppm

M(mol/L)=$\frac{ppm}{M.wt*1000}$

M(mol/L)=$\frac{40000}{153.18*1000}$=0.2612 mol/L

2- Use Beer-Lambert Law to find the absorptivity coefficient

A=E*b*C → E=$\frac{A}{b*c}$

E=$\frac{1.689}{1*0.2612}$=6.4663 L/mol.cm

3- We find a concentration of all absorbance

C=$\frac{A}{E*b}$

Absorbance of healthy individuals:

- Sample number 1

C=$\frac{0.692}{6.4663*1}$=0.10701mol/L

- Sample number 2

  C=$\frac{0.925}{6.4663*1}$=0.1430mol/L

- Sample number 3

  C=$\frac{0.9250.285}{6.4663*1}$=0.04407mol/L

- Sample number 4

$C=\frac{0.462}{6.4663*1}$=0.07144mol/L

**Concentrations for patients**

- Sample number 1

$C=\frac{0.508}{6.4663*1}$=0.0785 mol/L

- Sample number 2

$C=\frac{0.551}{6.4663*1}$=0.0852 mol/L

- Sample number 3

$C=\frac{0.939}{6.4663*1}$=0.1452 mol/L

- Sample number 4

$C=\frac{1.990}{6.4663*1}$=0.3077 mol/L

- Sample number 5

$C=\frac{0.630}{6.4663*1}$=0.0974 mol/L

- Sample number 6

$C=\frac{0.562}{6.4663*1}$=0.0869 mol/L

- Sample number 7

$C=\frac{0.536}{6.4663*1}$=0.08289 mol/L

- Sample number 8

$C=\frac{0.617}{6.4663*1}$=0.09541 mol/L

| Healthy people | |
| --- | --- |
| **A** | **C** |
| **0.692** | **0.10701** |
| **0.925** | **0.143** |
| **0.285** | **0.04407** |
| **0.462** | **0.07144** |
| **Unhealthy people** | |
| **A** | **C** |
| **0.508** | **0.0785** |
| **0.551** | **0.0852** |
| **0.536** | **0.08289** |
| **0.562** | **0.0869** |

**Table between absorbance (A) and concentration (C) in plasma samples of patients and healthy individuals.**

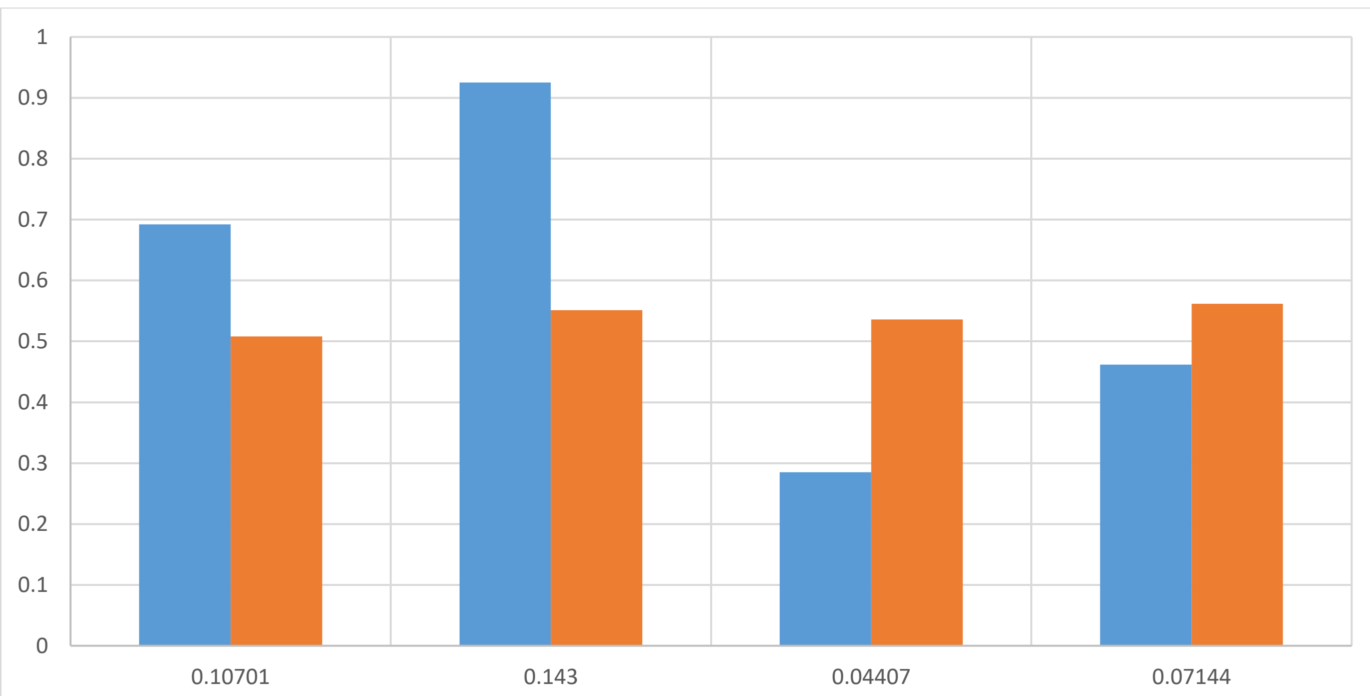


**Fig 10.The relationship between absorbance (A) and concentration (C) in plasma samples from patients and healthy individuals.**

This survey aims to assess some psychological symptoms that you may experience in your daily life. Please answer the following questions honestly.

Name: …………. Age: …... Session:…………

1. Memory Recall

How do you assess your ability to remember daily information ?

- Very good ( )

- Moderate ( )

- Weak ( )

2. Ability to Concentrate

Do you find it difficult to focus on tasks ?

- Yes ( )

- No ( )

3. Lack of Enjoyment

Do you feel a lack of interest in activities you used to enjoy ?

- Yes ( )

- No ( )

4. Feeling Anxious

Do you often feel anxious or worried ?

- Yes ( )

- No ( )

5. Feeling Sad or Depressed

Do you often feel sad or depressed ?

- Yes ( )

- No ( )

- Sometimes ( )

…………………………………………………………………………………………………………………

Thank you for your participation in this survey. If you have any notes or additional comments, please write them here :

This survey aims to assess some psychological symptoms that you may experience in your daily life. Please answer the following questions honestly.

Name: …………. Age: …..... Session:…………

1. Memory Recall

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- Yes ( )

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4. Feeling Anxious

Do you often feel anxious or worried ?

- Yes ( )

- No ( )

5. Feeling Sad or Depressed

Do you often feel sad or depressed ?

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## Discussion:

In this study, we measured the dopamine levels in the blood of all samples using a known chemical method, but we were not sure whether it had been used previously. This method involves measuring unknown dopamine in terms of dopamine of known concentration. This method includes using a dopamine concentration bottle in it (0.02612mol/L) We measured its lambda max and then applied the Beer-Lambert equation to find the constant and then applied this constant in the equation for the unknown.

Furthermore, In this year and the previous academic year, we learned in the subject of biochemistry that there are many biological molecules that plays a major role in many metabolic processes and other bio-operations. Among these molecules are hormones and enzymes, and these molecules are necessary for the activities of the living organism's body.
Dopamine is a type of monoamine neurotransmitter. It's made in your brain and acts as a chemical messenger, communicating messages between nerve cells in your brain and the rest of your body, Dopamine also acts as a hormone. Dopamine, epinephrine and norepinephrine are the main catecholamines (a label based on having part of the same molecular structure). These hormones are made by your adrenal gland, a small hat-shaped gland located on top of each of your kidneys. Dopamine is also a neurohormone released by the hypothalamus in your brain [37].
The aim of this study is to measure the level of dopamine in the blood of people who stay up late at night, especially after we confirmed that the symptoms of these people are very similar to the symptoms of dopamine deficiency in the body.
However, sample number 4 in the samples of people who stay up late changed the idea of our study. When we asked this person, it became clear that he was eating a lot of proteins, and this led to an increase in the percentage of dopamine in his blood, because dopamine is basically derived from the amino acid tyrosine, and thus proteins increase the percentage of this compound in the blood.
Therefore, the more protein a person consumes, the happier they will feel due to the increase in dopamine in their blood. This is clear from the samples in this study. People who stay up late have more dopamine because they wake up more and eat more different foods, including proteins, which increases the level of dopamine, the happiness hormone, as they describe it.

.Indeed, our results showed that the average dopamine level in the group of late sleepers was 0.738, compared to 0.591 in the group that maintained regular night sleep patterns. Some values in the late-sleep group (e.g., 1.920 and 0.939) were noticeably higher than all values in the regular-sleep group, suggesting that dietary habits—particularly protein intake—may have a more significant influence than previously anticipated.

The best example of the results of this study is that the fasting person's behavior changes in the last hours of fasting and he becomes upset and moody... etc. unless he breaks his fast, everything about him changes. The reason for fasting is that proteins decrease leading to decrease dopamine, and the fasting person changes. As soon as he eats proteins, the happiness hormone increases, and the fasting person becomes happy, unlike how he was before breaking the fast.

Although nighttime sleep disturbances—such as staying up late—can negatively affect dopamine balance, nutritional factors, particularly increased protein intake, may partially mitigate or compensate for this effect. It can therefore be concluded that dopamine levels are not solely influenced by sleep patterns but are also significantly affected by dietary habits. This highlights the importance of considering both nutritional and behavioral factors when studying changes associated with circadian rhythm disruptions.

## Conclusions:

1. In this study, we concluded that the dopamine molecule is very important for the body's comfort and human feelings.
2. The concentration of the dopamine molecule can be measured with high accuracy using the optical method used in this study.
3. There are several factors that affect a person who stays up late at night. This disrupts their biological clock, and dopamine concentration depends on what they eat while staying up late. If they eat protein-free foods, they will become depressed and sad.
4. There is a close direct relationship between the amount of protein consumed and the concentration of the happiness hormone, dopamine.
5. Through the study, we found a strong relationship between proteins and happiness and its hormone, dopamine. Fasting people, or those who go without food for a long period, experience changes in their mood and emotions. This stems from their protein intake, which in turn increases dopamine levels.
6. Dopamine is derived from the amino acid tyrosine, so proteins generally contain abundant amounts of tyrosine, so this hormone increases with increased protein intake.

## Recommendations:

1. We recommend that anyone who is moody, unhappy, or feeling sad drink more milk or eat eggs, as they contain taurine, the happiness hormone dopamine.
2. We recommend regularly measuring dopamine levels, as it is not only the happiness hormone, but also an important neurotransmitter in the brain. Research has not yet uncovered all of its functions.
3. We recommend intensifying studies on dopamine, as doctors believe most diseases are caused by psychological factors, meaning mental health, which is directly or indirectly related to dopamine.
4. We recommend not relying solely on food to obtain dopamine. According to what we've read, there are medications containing dopamine that are given to patients before and after surgery to improve their mood and for other conditions.
5. We recommend checking the function of dopamine, as an excess of it may have an adverse effect on a person.

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29. Sleep: Neurobiology, Medicine, and Society – Blog: A blog offering insights into the relationship between sleep, neurobiology, and medicine, with a focus on the societal implications of sleep-related health.

30. The link you provided, "Sleep Better With Hypothyroidism | Everyday Health," appears to point to an article published on Everyday Health, a trusted source in the field of general health.

31. The link you mentioned points to a graph published on ResearchGate titled:

"The circadian-driven hormones cortisol and melatonin occur out of phase. Cortisol peaks during the waking hours and melatonin peaks during habitual sleep."

32. The article you mentioned, "Circadian Rhythm Disturbances in Mood Disorders: Insights into the Role of the Suprachiasmatic Nucleus," is published in the journal Neural Plasticity and was published on November 5, 2017. The article, by Chelsea A. Vadnie and Colleen A. McClung, is a trusted source in the fields of neurology and psychology.

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