

## Role of Serotonin on Appetite in First Year Medical Students

D.D. Musmade<sup>1</sup>, Vivek Nalgirkar<sup>2\*</sup>, Jeevan Satav<sup>3</sup>, Prathamesh Chaudhari<sup>3</sup>, Pradyumna Tembhekar<sup>3</sup><sup>1</sup>Ph.D Scholar, Dept. of Physiology, Dr. D.Y.Patil Medical College, Nerul, Navi Mumbai, India<sup>2</sup>Prof. and Head, Dept. of Physiology, Dr. D.Y.Patil Medical College, Nerul, Navi Mumbai, India<sup>3</sup>Medical Student, Dept. of Physiology, Dr. D.Y.Patil Medical College, Nerul, Navi Mumbai, India

\*Corresponding author: Vivek Nalgirkar

| Received: 14.02.2019 | Accepted: 23.02.2019 | Published: 28.02.2019

DOI: [10.21276/sjams.2019.7.2.73](https://doi.org/10.21276/sjams.2019.7.2.73)

### Abstract

### Original Research Article

Appetite is the desire to obtain and consume food. It is documented that serotonin plays a pivotal role in mood regulation and has been studied in appetite and eating desire. The present study was performed to evaluate the relationship between serotonin levels and appetite among first year medical students. The study revealed that a relationship does indeed exist between serotonin levels and choice of food, regular eating and overall feeling of well being. This study hopes that further clinical implications may be done in cases of eating disorders by monitoring and treating serotonin deficiency in these patients.

**Keywords:** Appetite, Medical Students, Serotonin.

**Copyright © 2019:** This is an open-access article distributed under the terms of the Creative Commons Attribution license which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use (NonCommercial, or CC-BY-NC) provided the original author and source are credited.

## INTRODUCTION

Appetite, defined as the motivational drive to obtain food, is regulated by a complex neurocircuitry which integrates a variety of interoceptive signals to gauge nutritional state and guide appropriate levels of food-seeking [1].

A variety of studies have been conducted to ascertain the relationship between serotonin and appetite. The neurotransmitter, serotonin (5-HT), synthesized in the brain, plays an important role in mood alleviation, satiety, and sleep regulation. Although certain fruits and vegetables are rich in 5-HT, it is not easily accessible to the CNS due to blood brain barrier. However the serotonin precursor, tryptophan, can readily pass through the blood brain barrier. Tryptophan is converted to 5-HT by tryptophan hydroxylase and 5-HTP decarboxylase, respectively, in the presence of pyridoxal phosphate, derived from vitamin B6. Hence diets poor in tryptophan may induce depression as this essential amino acid is not naturally abundant even in protein-rich foods. Tryptophan-rich diet is important in patients susceptible to depression such as certain females during pre and postmenstrual phase, post-traumatic stress disorder, chronic pain, cancer, epilepsy, Parkinson's disease, Alzheimer's disease, schizophrenia, and drug addiction. Carbohydrate-rich diet triggers insulin response to enhance the bioavailability of tryptophan in the CNS which is responsible for increased craving of carbohydrate diets. Although serotonin reuptake

inhibitors (SSRIs) are prescribed to obese patients with depressive symptoms, these agents are incapable of precisely regulating the CNS serotonin and may cause life-threatening adverse effects in the presence of monoamine oxidase inhibitors. However, CNS serotonin synthesis can be controlled by proper intake of tryptophan-rich diet [2].

In dietary decision making, there is abundant evidence implicating serotonin in regulation of appetite and caloric intake. However, it is unclear whether these effects on caloric intake reflect purely homeostatic mechanisms, or whether there are also cognitive mechanisms at play. If there are cognitive mechanisms involved, then this would have potential implications for designing treatments for obesity; for example, serotonin drugs may be more effective if combined with cognitive interventions [3,4] A study in 1975, reported that individuals treated with anti anxiety medications had a reported change in their appetite and satiety levels as compared to control population. This study heralded a new frontier in role of serotonin in diet control and obesity [5].

In the case of effects of serotonin, it is postulated that agonist agouti related peptide (AGRP) neurons are inhibited via 5-HT<sub>1B</sub> receptors (5-HT<sub>1BRs</sub>) while prohormone pro-opiomelanocortin (POMC) neurons are activated by 5-HT<sub>2C</sub>Rs. AGRP neurons are robustly activated by food deprivation via glutamatergic afferents [4]. The present study was

conducted to ascertain the efficacy of giving a tryptophan rich diet to first year medical students and ascertain any changes in their appetite and eating behavior.

## METHODOLOGY

The present study was a prospective study conducted at Dr. D.Y. Patil medical college, Hospital and Research center, Nerul, Navi Mumbai. In this study participants were first year medical students aged between 18 to 25 years.

Institutional ethical clearance was obtained prior to starting the study. Total number of participants was 20, comprising of 10 male and 10 female participants without any pre morbidities and not on any medications. Daily 30 gms of protein powder was given to participants in morning at the same time for 10 days. Serotonin level of blood was measured before and after completion of 10 days period by using a Serum Enzyme Immunoassay (EIA) method. The effect of serotonin on their appetite and eating habits was assessed before and after study period, using standard questionnaires. The data was analyzed before and after administration by

using SPSS statistical analysis software, in consultation with institutional statistician.

## OBSERVATIONS

The mean age of the study group was 19.95 years all the subjects successfully completed the entire trial within the stipulated study period. The mean serotonin levels were 161.87 ng/ml with a standard deviation of 48.78 before the trial, and mean serotonin levels post administration was 166.65 ng/ml with a standard deviation of 48.54. Males had average level of 145.16 ng/ml pre-administration of protein, while after 10 days, the mean level was 151.05ng/ml, denoting an increase of 5.89ng/ml. Females had a mean level of 178.59 ng/ml pre-administration of protein, while after 10 days; the mean level was 182.26 ng/ml denoting an increase of 3.67 ng/ml.

Analysis of Pre and Post administration of protein powder levels of serotonin revealed a p value < 0.001, denoting that a statistically significant difference in mean serotonin levels among the study group. No statistically significant difference was observed in the values among males and females in terms of mean serotonin levels.

**Table-01: Questionnaire Based responses of subjects**

Parameter	Pre Administration	Post Administration	P Value
Self-health status	Avg (7) Healthy(9) Poor(4)	Avg (5) Healthy(12) Poor(3)	0.410615. (NS)
Junk Food Consumption (Times/week)	1-2 (9) 3-5(10) >5(1)	1-2 (11) 3-5 (8) >5(1)	0.34129. (NS)
Stress Eating	Yes (4) No (16)	Yes (3) No (17)	0.41229. (NS)
Stress loss of Appetite	Yes (15) No (5)	Yes (9) No (11)	0.0124*
Regular Meals (Times/week)	1-2 (4) 3-5 (5) >5 (11)	1-2 (1) 3-5 (5) >5 (14)	0.0154*

(Numbers in Brackets denote subjects)  
(NS- Not Significant)

Questionnaire based responses revealed that 11 (55%) individuals revealed that they were poor or average in health pre administration, while only 8 (40%) subjects revealed the same, post administration of protein powder.

In terms of stress and associated loss of appetite, 6 (30%) individuals reported that they were able to handle stress better and did not have any loss of appetite post administration. Individuals also reported that they were having regular meals after administration of protein powder. Statistically significant p values were revealed in reduced loss of appetite and regular meals per week in the selected study group (table 01).

## DISCUSSION

The present study revealed a relationship between administration of protein and levels of serotonin in otherwise healthy subjects. There was no significant difference in serotonin levels based on age or gender among the selected study population. Though certain differences were observed in terms of overall feeling of health, reduction of junk food intake and reduction of stress eating, no statistically significant difference was visible in these parameters. However the subjects displayed a statistically significant difference in having regular meals per week and in reduction of loss of appetite during work or study. No difference was observed based on age or gender.

This is in concurrence with studies by Blundell and Boureau [6-8], wherein it was stated that that serotonin can facilitate behavioral inhibition as a result of impacting the weighting of health outcomes or goals in value-based choice. The above research revealed that serotonin in the body mediates nutritional input and the feeding drive. Specifically, manipulation of serotonin causes changes in feeding behavior, such as when serotonergic activation leads to selective avoidance of fat in the diet whereas serotonergic activation is modulated by nutritional variables such as the proportion of carbohydrate, the availability of specific macro- nutrient sources, the degree of hydration, and the circadian rhythm[4,8].

The present study is consistent with Miyazaki *et al.*'s hypothesis that serotonin enhances prefrontal regulation of action, most likely through structures such as the medial prefrontal and orbitofrontal cortices, which are involved in value-based decision making[9,10]. The current data demonstrate that this effect of serotonin occurs not only during the regulation of behavior but also during other self-control problems such as intake of junk food and regular meals.

In summary, our results revealed that an increase in serotonin levels may be associated with a decrease in poor appetite choices and an upregulation in health eating and it may shed light on the underlying neurochemical substrates involved in self-control.

## CONCLUSION

Our findings have implications for understanding and treating health conditions such as eating disorders and obesity by undertaking medications aimed at improving food choices and appetite regulation. For example, serotonin enhancing drugs could be given during initial stages of behavior change interventions aiming to change the lifestyle of overweight individuals and obese patients. Similarly, the affected cognitive processes also have important implications for disorders of human decision making such as addiction and impulsive behaviors. A limitation of the study is the small sample size which invites the need for future replications with larger samples and more heterogeneous populations which includes individuals who are healthy as well as obese.

## REFERENCES

1. Lam DD, Garfield AS, Marston OJ, Shaw J, Heisler LK. Brain serotonin system in the coordination of food intake and body weight. *Pharmacology Biochemistry and Behavior*. 2010 Nov 1;97(1):84-91.
2. Shabbir F, Patel A, Mattison C, Bose S, Krishnamohan R, Sweeney E, Sandhu S, Nel W, Rais A, Sandhu R, Ngu N. Effect of diet on serotonergic neurotransmission in depression.

3. Neurochemistry international. 2013 Feb 1;62(3):324-9.
3. Carek PJ, Dickerson LM. Current concepts in the pharmacological management of obesity. *Drugs*. 1999 Jun 1;57(6):883-904.
4. Halford JCG, Harrold JA. 5-HT<sub>2C</sub> Receptor Agonists and the Control of Appetite. In: Joost HG. (eds) *Appetite Control. Handbook of Experimental Pharmacology*, vol 209. Springer, Berlin, Heidelberg. 2012.
5. Herman CP, Polivy J. Anxiety, restraint, and eating behavior. *Journal of abnormal psychology*. 1975 Dec;84(6):666.
6. Halford JC, Harrold JA. 5-HT 2C receptor agonists and the control of appetite. In *Appetite Control 2012* (pp. 349-356). Springer, Berlin, Heidelberg.
7. Blundell JE, Lawton CL, Halford JC. Serotonin, eating behavior, and fat intake. *Obesity research*. 1995 Nov;3(S4):471S-6S.
8. Boureau YL, Dayan P. Opponency revisited: competition and cooperation between dopamine and serotonin. *Neuropsychopharmacology*. 2011 Jan;36(1):74.
9. Miyazaki KW, Miyazaki K, Tanaka KF, Yamanaka A, Takahashi A, Tabuchi S, Doya K. Optogenetic activation of dorsal raphe serotonin neurons enhances patience for future rewards. *Current Biology*. 2014 Sep 8;24(17):2033-40.
10. Miyazaki K, Miyazaki KW, Doya K. The role of serotonin in the regulation of patience and impulsivity. *Molecular neurobiology*. 2012 Apr 1;45(2):213-24.