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Prophylactic diet: A treatment for night eating syndrome

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ABSTRACT Night eating syndrome (NES) is an eating disorder that is primarily observed in obese individuals. NES should not be overlooked as it is an important factor contributing to the overall problem of obesity, in addition to its negative effects on quality of life. In regards to managing obesity, NES interferes with the efforts of obese patients to control their weight as well as affecting the long-term outcome of obesity treatments.

Understanding this disorder will contribute to improved treatment strategies, as the current recommended therapies are

accompanied by unpleasant and discouraging side effects. We decided to focus on the serotonin system because understanding the molecular biology of obesity and its associated complications is an essential step towards developing effective therapeutic strategies. Through investigations into the mechanism underlying NES, based on the aforementioned serotonin system, we propose a simple and effective natural treatment for this neglected syndrome.

INTRODUCTION As the molecular and biological aspects of obesity and its associated complications are continually being unraveled, treatments for obesity are being identified, including lifestyle modification, administration of malabsorptive drugs and antidepressant medications, and bariatric surgeries. There are many definitions of obesity, from increases in the quantity of adipose tissue and fat content of adipocytes in the human body to raised body mass index (BMI). The most recent

definition is inappropriate eating habits with an excessive intake of calories that does not correspond to the daily energy expenditure¹. As our understanding of obesity grows, it can be expected that novel treatments for this condition and its associated complications will emerge.

Night eating syndrome (NES) is one of the most prevalent complications of obesity, especially among stressed obese women². The disorder may in turn affect the management of obesity and weight control³. There are controversies regarding the best possible treatment for helping NES sufferers⁴; however, it has been stated that any treatment should be based on the best understanding of the disorder⁶. NES interferes with weight loss regimens, causes morning anorexia (preventing patients from having the most important meal of the day), and leads to distress or depression. Hence, the successful treatment of NES will have multiple benefits for patients.

Night Eating Syndrome NES was first recognized in 1955⁶ and has received its own diagnostic criteria, as follows⁷:

1. Food intake of more than 25% of the daily calories consumed after the last meal in the evening (core criterion)
2. Awakening episodes at night to seek food at least 3 times a week (core criterion)
3. Morning anorexia

As we progressively understand more about the neurological mechanisms of NES, certain medications have been recommended, including selective serotonin reuptake inhibitors (SSRIs) such as the recently introduced sertraline^{4,7-9}, with several other therapeutic strategies such as cognitive behavioral therapy requiring further study. It has been reported that improvements in serotonin function are associated with alleviation of NES symptoms⁴, thus highlighting a promising therapeutic target for treatment of this disorder.

Current methods of treatment (psychotherapy or antidepressant medications), similar to other drug-based therapies, have been effective for some patients to some extent⁴; however, there are accompanying pitfalls. These pitfalls include the high cost of the prescribed medications (like SSRIs), the social stigma attached to the patients who are administered these medications (as SSRIs are referred to as neuropsychiatric medications), and the adverse effects of neurological medications (including nausea, diarrhea, and dry mouth)¹⁰⁻¹³. Therefore, there is a pressing need to develop alternative treatments to minimize the complications associated with the current experimental treatments of NES.

In this manuscript, we aim to describe the neurobiochemistry of the serotonin system and its role in the pathophysiology of NES. We then introduce some nutritional interventions, which may be used in the

treatment, or even prevention, of this prevalent but neglected syndrome⁵.

HYPOTHESIS The notion of serotonin system involvement in NES has emerged with the therapeutic response of the disease to sertraline^{4,7,8}. One study reports dysfunction of the brain serotonin system in NES¹⁴. Using single photon emission computed tomography, the ratio of serotonin uptake of 6 night eaters was compared with that of 9 healthy controls. The results showed that NES sufferers had a higher uptake than healthy controls. On the other hand, it has been shown that SSRIs have therapeutic effects on NES by increasing the synaptic level of serotonin^{3,9}. It has been noted that depression occurs in both obese patients and those with NES^{6,15}, and dysfunction of the serotonin system in the brain has been shown to play a major role in the pathology for depressive symptoms¹⁶. Further, involvement of the serotonin system in depressive disorders has been suggested by findings of reduced plasma levels of tryptophan (a precursor of serotonin), decreased cerebrospinal fluid levels of 5-hydroxy indol acetic acid (the principal metabolite of serotonin in the brain), and decreased platelet serotonin transporter binding in depressed individuals¹⁷⁻¹⁹. Furthermore, post-mortem studies in suicide victims with a variety of psychiatric disorders point to decreased concentrations of serotonin and its metabolites in the brain¹⁷⁻¹⁹. Hence, a similar mechanism is considered to underlie the dysfunction of the

serotonin system in depression, obesity, and NES.

A nutritional approach has been recommended in the treatment of many conditions, such as chronic liver failure²⁰ and metabolic syndromes²¹. Nutritional intervention has also been suggested either as an adjunct to current treatments or as monotherapy for patients with notable cardiovascular risk factors or mild hypertension²², as well as a way of improving tolerance to cancer treatment²³.

A number of foods, including cottage cheese, soy protein, peanuts, beans, wheat flour, and potato, are considered excellent sources of serotonin and its metabolite precursors²⁴. Some insight into the quantities of serotonin in various types of food can be found in a study by Feldman and Lee²⁵, in which they assessed the serotonin concentrations in 80 types of edibles using a highly specific radioenzymatic assay. In this work, they elucidated that fruits like plantain (the central part containing the seeds), pineapple (the soft edible edge), banana (the central part containing the seeds), kiwi fruit, plums, and tomatoes have high concentrations of serotonin. Nuts belonging to the walnut or hickory family (like butternuts, black walnuts, English walnuts, shagbark hickory nuts, mocker nut hickory nuts, pecans, and sweet pignuts) were also found to contain high serotonin levels. Udenfriend et al. reported that avocado and eggplant contain high concentrations of serotonin²⁶, and another

study demonstrated that tomato and cherry tomato are also rich in this molecule²⁷. Interestingly, some of these carbohydrates aid the entry of tryptophan into the brain by increasing the serum insulin level, which in turn suppresses other amino acids competing with tryptophan to enter the brain^{25,28}; hence, this may lead to an increase in the levels of serotonin precursor.

Based on the aforementioned evidence, we hypothesized that introducing nutritional sources like banana, kiwi, pineapple, and nuts into the daily diet of obese patients, especially those who suffer from NES, could lead to an increase in the serotonin levels in the central nervous system. Such dietary interventions could contribute to the treatment and, to some degree, to the prevention of the disorder by natural means.

EVALUATION OF THE HYPOTHESIS The efficacy and safety of this proposed new treatment as a sole or combination therapy for patients with NES should be evaluated in depth by performing a randomized clinical trial. As the proposed treatment consists chiefly of natural resources, it would appear to be free of major adverse events in patients with NES who are otherwise healthy.

Individuals already diagnosed with NES should be included in such a study. Primary features and patient characteristics along with the severity of NES should be recorded separately for each patient. In addition, the number of episodes of

NES per week, the amount of calories consumed at each episode, and weight gain, weight loss, or weight control (according to the interfering effects of NES) should be recorded.

To assess the efficacy and safety of nutritional intervention, patients should be randomized to either the diet group (treatment based on prophylactic administration of edibles high in serotonin before bedtime) or the medication group (SSRIs); each group would then be followed up at regular intervals for assessment of food-seeking episodes during nocturnal sleep, the amount of calories consumed each night, and the outcome of any weight loss program within a 6-12 month period.

Data could then be compared between the two groups before and after nutritional intervention or medication therapy to determine the benefits and disadvantages of each approach. Patient satisfaction, disadvantages, and cost effectiveness should be taken into account when interpreting the results to secure a global recommendation.

DISCUSSION According to the currently available evidence, we propose that adding natural foods with high concentrations of serotonin and tryptophan (tryptophan is hydroxylated to 5-hydroxytryptophan which is then decarboxylated to 5-hydroxytryptamine and finally to serotonin) to the daily diets of patients with NES could be beneficial in treating the

syndrome and decreasing associated complications.

Current evidence suggests that serotonin plays an important role in sleep regulation and appetite^{24,29}, both of which are impaired in NES. Moreover, obesity and NES are associated with depression, which has a similar underlying mechanism of impairment of the serotonin system¹⁷⁻¹⁹. The suggested fruits and vegetables are rich in vitamins, minerals, and other essential nutrients while lacking harmful dietary agents (saturated fat and high glycemic components), highlighting their value as a dietary treatment for obese patients³⁰ or those with NES⁶. In some cultures, using psychiatric medications is considered a stigma, and patient compliance in taking prescribed medication is an issue^{10,11}. Nutritional therapy is not hampered by such a stigma or compliance issues, and usually has none of the adverse effects that are commonly reported in drug therapy¹⁰⁻¹².

Nutritional treatment has been widely addressed in the published literature^{1,20,23,25,28,30-32}. It has not been confined to metabolic and eating disorders, but also includes other medical conditions such as liver diseases, hypertension, and depression, which are usually treated chiefly by pharmacological regimens^{1,20,22,25,30-31}. In their study, Matsumoto et al. treated a 66-year-old cirrhotic patient with a low glycemic index liquid and demonstrated a significant improvement in insulin sensitivity³¹. Lifestyle modifications including

Table 1. Natural foods and their metabolite content

	FAMILY	FOOD	CONTENT	STUDY
1	Fruits	Plantains Pineapples Bananas Kiwi fruit Plums Avocado Eggplant	Serotonin, Melatonin	Feldman et al. ²⁵ Udenfriend et al. ²⁶ Ly et al. ²⁷
2	Vegetables	Cherry tomato Spinach Chinese cabbage Hot peppers Potato	Serotonin, Tryptophan	Feldman et al. ²⁵ Udenfriend et al. ²⁶ Ly et al. ²⁷ Feldman et al. ²⁵
3	Nuts	Walnut Butternut Peanut Butternuts Black walnuts English walnuts Shagbark hick- ory nuts Mocker nut Hickory nuts Pecans Sweet pignuts	Serotonin, Tryptophan	Feldman et al. ²⁵ Udenfriend et al. ²⁶ Ly et al. ²⁷ Feldman et al. ²⁵
4	Other	Soybeans Pumpkin seeds Parmesan cheese Sesame seeds Cheddar cheese Wheat flour	Serotonin, Tryptophan	Feldman et al. ²⁵ Udenfriend et al. ²⁶ Ly et al. ²⁷ Feldman et al. ²⁵

changes in dietary habits for patients with high cardiovascular risks have been shown to control mild hypertension without any need for pharmacological intervention²². Further, supplementation with omega-3 fatty acids may improve treatment tolerance in cancer patients with malnutrition from the anorexia-cachexia syndrome²³. Even simple diets solely enriched by trace elements and amino acids have improved liver function of patients diagnosed with chronic liver failure²⁰. However, to our knowledge, such approaches have never been studied in a clinical setting nor have they even been considered as a potential alternative by the experts of this field.

The role of serotonin dysfunction in NES has been highlighted by recently introduced drugs for its treatment that act on the pathways of serotonin metabolism. These drugs (such as sertraline) reinforce the serotonin content of the intercellular space of the nervous system, especially the mid-brain, allowing more powerful action of this neuro-intermediate^{13,14,16,17}. The aim of the proposed study is to evaluate whether the function of the serotonin system could be enriched by including these resources in the daily diet of patients with NES and whether this would be effective in controlling the abnormal eating episodes associated with NES. The potential benefits could lead to better management of obesity along with a possible decrease in NES-related distress. Nutritional interventions, when compared with

SSRIs and similar medications for NES, are cheaper and more accessible, and lack the discouraging side effects and stigma associated with these psychiatrically classified drugs, as well as providing other benefits associated with the consumption of natural fruits and vegetables.

Thus, we recommend using edibles with high serotonin levels (for examples, see Table 1) for controlling and even preventing NES. This treatment is hypothesized to be a competitive alternative even if does not exceed the benefits of the widely applied drug treatments. However, further human studies are required to assess our suggestion and its relevance for global application. Although deceptively simple, we are hopeful that this could be a powerful treatment for this complicated disorder.

CONCLUSION We would like to draw the attention of medical societies and physicians involved in the management of patients with eating disorders and obesity to NES, as it is a common, but neglected, syndrome. Changes to the diets of patients to include small amounts of healthy serotonin-containing foods should be recommended, enabling patients to enjoy the benefits of these natural resources. We propose that trying such regimens will help in developing NES treatments as well as help the patients feel cared for. **H**

The authors declare no conflicts of interest.

ABOUT THE AUTHORS Dr. Saeed Shoar is a medical student from Tehran University of

Medical Sciences in Iran who has dedicated his life to research in medical sciences. His interest is surgical research which has produced several trials in cooperation with Professor Zhamak Khorgami (Assistant Professor of Surgery in the same medical school) who has been named his guidance by him. His colleagues, Dr Nasrin Shoar and Dr. Mohammad Naderan, are the best supporting team members who have collaborated with him in over 50 research projects to date. Dr. Saeed Shoar is currently considering regenerative medicine as his future perspective in research. He aims to pursue his specialty training in cardiology and cardiac surgery with special attention to heart regeneration. He believes medicine is going to achieve a successful power to regenerate human organs one day. At that day, we will draw our beauty how we desire!

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