GÜSBD 2023; 12(2): 719 - 726 | **Gümüşhane Üniversitesi Sağlık Bilimleri Dergisi** | **Araştırma Makalesi**
GUJHS 2023; 12(2): 719 - 726 | Gümüşhane University Journal of Health Sciences | Original Article

Investigation of Microflora-Mediated Effect of Nutrition Frequency and Food Choice on General Affective State

Genel Duygu Durumuna Beslenme Sıklığının ve Besin Seçiminin Mikroflora Aracılı Etkisinin İncelenmesi

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ABSTRACT

We investigated the changes in the gut microbiota depending on the type and frequency of use of carbohydrate, which is the main element in our diet, and the relationship of these changes with mood. Thus, we aimed to intervene in mood disorders, which are seen in approximately 6.2% of the population in our country, by improving the type and frequency of use of carbohydrates, which make up 60% of the daily diet. In the study, 197 young adults between the ages of 18-45; Questions were asked to determine the number and times of meals during the day, the basic nutrients that make up their meals, the foods they chose in case of mood changes they noticed, the types of carbohydrates they consumed and the frequency of consumption, and the data were collected in the digital environment. To increase the possibility of accurate and reliable data collection; The ideal number of questions was determined as 30 and the Cronbach Alpha coefficient was calculated as (0.78). SPSS 26 statistical program was used to determine the data and $p<0.05$ was considered statistically significant. Prolonged meal breaks, foods perceived as rewards, and moreover, consumption of foods that can be defined as "vain foods" whose content is far from benefit have been detected. Keeping the breaks between meals short, using nutrition not for "prolonged hunger", but for "hunger" and staying away from foods that can be defined as " vain foods" that contain no benefit, will bring us closer to mental and physical well-being.

Keywords: Food selection, Frequency of feding, Microflora, Mood, Protective nutrition

ÖZ

Beslenmemizdeki ana öğe olan karbohidrat tür ve kullanım sıklığına bağlı, bağırsak mikrobiyotası değişimleri ve bu değişimlerin duygu durumu ile ilişkisini araştırdık. Böylece ülkemizde her yıl nüfusun yaklaşık %6,2' sinde görülen duygu durum bozukluklarına, günlük beslenmenin %60'ını oluşturan karbohidratların tür ve kullanım sıklığını iyileştirerek müdahale etmeyi hedefledik. Çalışmada 18-45 yaş arası 197 genç erişkine; gün içi öğün sayısı ve vakitleri, öğünlerini oluşturan temel besinleri, fark ettikleri duygu durumu değişikliklerinde seçtikleri besinleri, tükettikleri karbohidrat türleri ve tüketim sıklıklarını tespit edebilecek sorular yöneltildi ve veriler dijital ortamda toplandı. Doğru ve güvenilir veri toplama olasılığını artırmak için; ideal soru sayısı 30 olarak belirlendi ve Cronbach Alpha katsayısı (0,78) olarak hesaplandı. Bu çalışmada verilerin tespitinde SPSS 26 istatistik programı kullanıldı ve $p<0,05$ istatistiksel olarak anlamlı kabul edildi. Uzamış öğün araları, ödül olarak algılanan besinler ve dahası içeriği faydadan uzak "boşuna besinler" olarak tanımlanabilecek besinlerin tüketimi bulgulanmıştır. Öğün aralarını kısa tutmak ve beslenmeyi "uzamış açlıklar" için değil "açlık" için kullanmak ve içeriği faydadan uzak "boşuna besinler" olarak tanımlanabilecek besinlerden uzak durmak bizi zihinsel ve bedensel iyilik haline daha çok yaklaştıracaktır.

Anahtar Kelimeler: Besin seçimi, Beslenme sıklığı, Duygu durumu, Koruyucu beslenme, Mikroflora

İstanbul Esenyurt Üniversitesi Etik Kurulu'nun 12.01.2021 tarihli 2021/01-10 No'lu toplantısında Karar Sayı no: E-12483425-199-262 ile etik onay alınmıştır.

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Geliş Tarihi / Received: 02.10.2022
Kabul Tarihi/Accepted: 15.06.2023

INTRODUCTION

Microbiota bacteria are effective not only in intestinal health, but also in the mental health of individuals. Neuroscience researchers have called this process the psychobiotic revolution. Nutritional psychiatry; It has taken its place as a different discipline in overcoming mental health problems with psychobiotics.[1]

The fact that individual differences in mental diseases can be explained by microbiota changes has supported the studies in this field. Attention was drawn to the importance of microbiota in the treatment follow-up and response in the stages of the symptoms of the disease, and in the susceptibility to the disease in the prophylactic stage.[2, 3]

In many preclinical studies, it has been reported that the gut microbiota is effective in anxiety-related behaviors and depression-like behaviors develop when the microbiota is interfered with specific probiotics and/or certain groups of antibiotics.[4-8] But can mood disorders be prevented or treated with dietary changes? The answer to this question still remains unclear.

Healthy diet recommendations include complex carbohydrates and fermented foods such as kefir, yoghurt and boza. Foods to avoid include artificial sweeteners, emulsifiers, and highly processed foods. It has been suggested that in diets consisting of high lipid and carbohydrate foods, the intestinal microbiota changes negatively and increases intestinal permeability and initiates inflammation, thus creating a risk factor for depression.[9]

Complex carbohydrate consumption, particularly fiber content, is an important determinant in the design of microbiota components. It supports the production of short-chain fatty acids (SCFAs) in metabolism and makes the anti-inflammatory effect dominant in the colon. Dietary fibers; It is a very important substrate for bacterial fermentation resulting in acetate, propionate and butyrate.[10] Thus, while the proliferation of beneficial fermented bacteria is increased, the proliferation of undesirable bacteria in the microbiota is inhibited.[11, 12] According to the results of prospective studies with high sample numbers; This pattern has been held responsible for the prevalence of mood disorders in societies where the Western diet pattern is established. In addition, in longitudinal studies; sweetened beverages, fried foods, processed meats, refined grains, biscuits, etc. snacks, pastries have been associated with an increased risk of microflora-mediated mood disorders.[13, 14]

In addition, the Japanese diet (fruit, soy products, vegetables, green tea), the Mediterranean diet, and other healthy diets containing high amounts of olive oil, fish, fruit, vegetables, nuts, legumes, poultry, dairy products, raw meat, mood was inversely associated with the risk of disorders.[13, 14] The increased consumption of sugar-added foods in the diet is associated with increased rates of mood disorders; It has been determined that foods with high fiber content, fruits and vegetables consumed with pulp are positively correlated with decreased rates of mood disorders.[15]

According to the results of a randomized study in adults; Healthy eating practices are effective in preventing attacks related to mood disorders, and it has been statistically stated that this practice reduces symptoms by 40-50%.[16]

According to the findings of the studies conducted by the researchers; Nutrition is very effective in the formation and continuity of the intestinal microbiota. Therefore, in our study; how many times the participants were fed during the day, in which part of the day the nutrition was distributed; The types of carbohydrates they consume in their diet and whether these types support microflora, the effects of all these parameters on the general mood were investigated and the data were evaluated statistically. Thus, microflora-mediated intervention was aimed by improving the type and frequency of use of carbohydrates, which make up 60% of the

daily diet, for mood disorders, which are seen in approximately 6.2% of the population in our country every year.

MATERIAL AND METHOD

Ethical Aspect of Research

The "Ethics Committee Approval" of the study, numbered E-12483425-199-262, dated 12.01.2021, was obtained from the Istanbul Esenyurt University Ethics Committee.

Research Location, Time and Sample Selection

This study was conducted between 22-29 January 2022 with online access. Only healthy volunteers in the specified age range, who did not have any metabolic, psychiatric and neurodegenerative disease and who had not undergone any surgical intervention in the last 3 months were included in the study. "Informed Volunteer Consent Form" approval was obtained from the people participating in the study, and participants who did not meet these criteria were not included in the study.

Statistical Evaluation of Data

The research is a descriptive study and the data were collected in digital environment. To increase the possibility of accurate and reliable data collection; The ideal number of questions was determined as 30 and the Cronbach Alpha coefficient was calculated as (0.78). SPSS 26 program was used for statistical analysis of the data in the study. Independent sample t-test was used for paired group comparisons, and one-way ANOVA test was used for multi-group comparisons. Bonferroni and Tukey tests were performed for the correlation of significant groups and $p<0.05$ was considered statistically significant.

RESULTS AND DISCUSSION

The data of 3 out of 197 participants who submitted data to our study were not used due to exclusion criteria. Of the participants whose data cannot be used; One of them declared the diagnosis of type-1 diabetes, one of them type-2 diabetes and the other of postpartum depression.

Feeding Frequency

In the first stage of the study, the participants, consisting of healthy volunteers, were asked, “Which hours do you get hungry the most?” was asked. The hunger that the participants felt in the evening due to the extended meal breaks and the morning hunger they felt after the time they spent asleep at night were almost the same. In order to determine whether the hunger is satisfied at a certain time and / or in a single meal, “How many meals a day do you eat?” was asked. In addition, despite the completion of all meals, the number of which they determined by themselves, it was questioned whether they were hungry at abnormal hours, and if so, how many times. “Do you get hungry at night?” the question was also asked to indirectly clarify whether the abnormal hours are during the daytime. It was determined that the time zone that meets the "abnormal hours" is "night time" ($p< 0.037$).

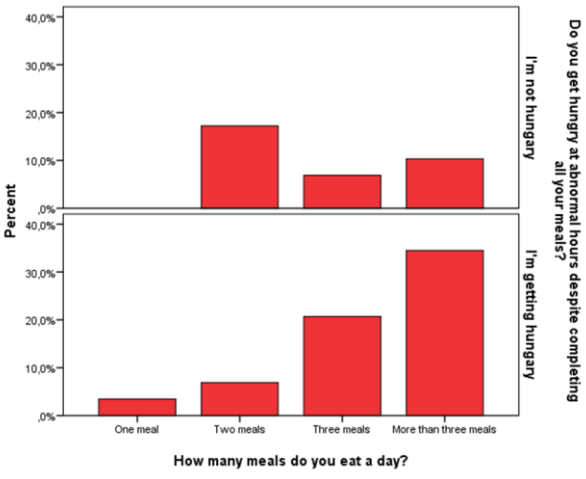

Figure 1. Comparison of The Number of Meals Completed Per Day and The Need for Additional Meals

When the "number of meals" and " the hunger felt despite the completion of all

meals" were compared, those who had 2 meals and those who had more than 3 meals; There is a statistically significant difference in the direction of "I am hungry" between the hunger they feel despite completing their meals (p< 0.36). When looking at the food groups they consume when they are hungry; It has been determined that 80% is not microflora friendly.

Table 1. Microflora Friendly/Unfriendly Foods Consumed by the Participants

Foods that are not microflora friendly	Foods that are microflora friendly
Crackers/Biscuits, Cooked Rice, Chocolate/Wafer, Bread Breadcrumbs/Sandwich, Dessert Types, Rusk, Pasta	Yogurt Fruit Milk

When the "number of meals" is compared with "the hours when hunger is felt the most"; There is a statistically significant difference in p< 0.001 between afternoon and night, and p< 0.037 between evening and night. This difference; It is caused by infrequent meals that are not distributed throughout the day and are compressed into the evening.

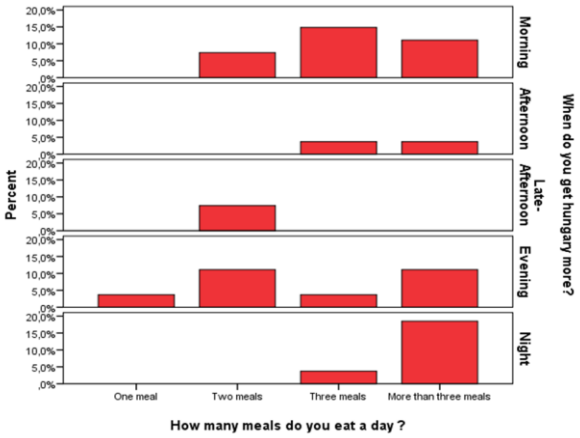

Figure 2. Comparison of the Number of Completed Meals Per Day and the Hungriest Meal

Food Types

In our study, healthy volunteers were asked about foods that are "absolutely consumed in the morning", "not missing in the evening meals" and "consumed continuously during the day". These questions were asked to the participants as open-ended. While the collected data were evaluated with “yes, there is / no, not” in the first step; in the second step, “yes, there is “answers were evaluated whether they were microflora friendly or not.

The consumption of “water” in the morning meals is statistically significantly higher than the other food items they define as tea/coffee and breakfast items. The "presence" of the food groups "not missing in the evening meals" was declared by the participants with a very high percentage. Considering the content of these nutrients, which are not missing, there is no statistically significant difference between the use of microflora friendly / non-microflora friendly species.

Table 2. Foods That Are Constantly Served at Dinner/During the Day by Participants

Not Microflora Friendly	Microflora Friendly
Dinner	**Dinner**
Rice, Meat (Processed product), Bread	Yogurt, Salad, Water, Vegetables
During the Day	**During the Day**
Bread, Pasta, Meat (processed product), Tea (black tea), Chocolate/Wafer Biscuit/Cracker/Cake/Chips, Coffee (packaged product)	Water, Yogurt

While the participant declared the " presence " of the foods consumed continuously during the day, it was determined that this consumption consisted of foods that were not friendly to microflora at a statistically significant level.

In our study, participants were offered specific foods known as microflora friendly While making these suggestions; types of carbohydrates that are in daily use as much as possible, that do not cause intolerance in general, and that are accessible are preferred. Consumption of raw vegetables as fiber source, consumption of yogurt and boza as pre/probiotic support were questioned.

As the frequency of use of raw vegetables increases, gastrointestinal tract complaints increase. Consumption of yogurt every 2-3 days decreased GIS complaints, while consuming it every other day increased GIS complaints. Comparing the GIS complaints of those who consume boza and those who do not, no significant difference was found. In the classification of GIS complaints, “constipation” received the lowest percentage by the participants, while “gas formation” and “pain” respectively shared the highest percentages. When healthy volunteers "who do not accompany their meals with drinks" are questioned about their "daytime carbonated beverage consumption", almost none of them consume "carbonated beverages neither with meals nor alone during the day" (More than 3 - None, $p< 0.041$). Those who consume beverages in their meals also keep their consumption of carbonated beverages at very low percentages during the day. (None-1, $p< 0.041$).

During the research, the participants' statements about their food choices consist of their answers to open-ended questions, we did not make any food recommendations.

Relationship with General Mood

According to the statements of the participants consisting of healthy volunteers; Eating behavior is interrupted while under psychological-physical “stress”. Even the evolutionary priority of "sweet" taste could not statistically significantly reverse the eating behavior in emotional states that they define as "unhappiness". The “sweet” taste declared by the participants consists mostly of processed carbohydrate products.

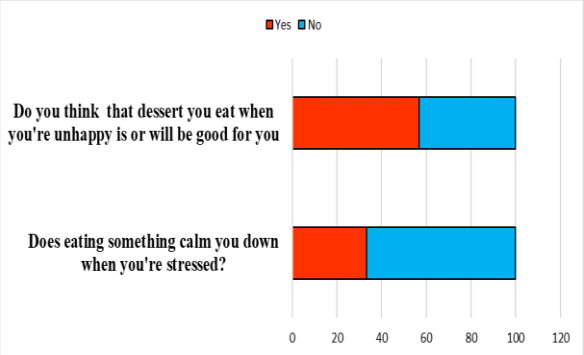

Figure 3. Comparison of Food Consumption and Sweet Taste Consumption in Negative Mood States

In social environments where positive emotions are dominant, it has been determined that eating behavior is active and they are not more microflora friendly when we classify their preferences according to the foods they choose. When alone; while avoiding eating behavior, On the other hand, it was determined that the foods taken in the participants, who were in a very low percentage and continued to be fed, did not have microflora-friendly content.

In the first step of the study, the number of meals in the young adult population during the day, the times they prefer their meals, and the times when they frequent or sparse their meals, if any, were tried to be determined. Attention was drawn to the "nutrition-timing" relationship, which is a controllable step of nutrition for everyone with minimal intervention.

According to the distribution of feeding frequency during the day; no statistically significant difference between “morning hunger” and “evening hunger”, the number of meals generally remains at 2 and the distribution of the added meals (3 or more) during the day is after dinner and also mostly at night, reveals the negative course of people's nutrition-timing relationship.

In the studies conducted in this area, attention has yet to be focused on the nutritional content and the time periods in which this content is taken, namely "chrono-nutrition". This effect; It is the primary cause of intestinal microflora changes caused by the content of the food and the processing of this content.

With the "time-restricted nutrition" models recommended in recent studies, the removal of persistent meals in the evening and after; has been reported that increasing BDNF synthesis, which is known to protect from neurodegeneration, and reducing 8-isoprostane, which is considered an oxidative stress biomarker. [17, 18] In the study of Huang et al.; It has been reported that at least two of the three unhealthy eating practices, skipping breakfast, snacking after dinner, or eating dinner shortly before bedtime, are associated with a higher incidence of depressive symptoms. [19]

In another study, chrono-types with "morning eating" activity were compared with chrono-types with "evening eating" activity. “It has been reported that chrono-types with “evening eating” activity generally skip breakfast, consume more food during the day than those with “morning eating” activity, and have a higher risk of major depressive disorder.[20-22]

In the next step of our study, the foods selected and placed in this diet by the participants and the benefit-harm balance in the microflora depending on the content of these nutrients were investigated. Participants declared the nutrients that they do not miss during the day and especially at dinner. When food types are grouped, it has been determined that they generally prefer processed carbohydrate types and these foods are not microflora friendly. As a result, gas formation and pain complaints increased.

It has been reported that proinflammatory and pathogenic bacteria increase in the intestinal microflora of those who consume long-term, processed carbohydrates and lipids in their diet, and the species and numbers of beneficial bacteria decrease.[23] It was emphasized that butyrate synthesis was impaired in the process and the developing inflammatory response increased intestinal permeability and caused bloating. [24]

The effects of diet on intestinal microbiota composition and mental health were investigated by researchers. In adults without mood disorders, higher anxiety and lower fecal Bifidobacterium in women and higher depression scores and lower Lactobacillus in men were associated. In addition, almost all of the healthy volunteers participating in our study did not consume, and an inverse relationship was noted between fruit and dairy products, respectively, and depression and stress scores.[25]

It has been determined that Bacteroides has a lower concentration in people diagnosed with major depression.[26] This table is seen in the microflora of people who consume more refined carbohydrates.[27]

At this stage of the study, prolonged meal breaks, foods perceived as rewards, and moreover, the consumption of foods that can be defined as "waste foods" whose content is far from benefit draws attention. This situation indicates the difference between the nutrition that the participants will eat due to "hunger" and the nutrition they will make by creating persistent meals in a short time in order to experience the same feeling of reward again. This situation brings errors in both timing (number and frequency of meals) and selection of foods in nutrition.

Individuals cannot make the decision to feel hungry, but they can decide whether to satisfy the hunger.[28] In these decision stages, hypothalamic nuclei basically regulate the homeostatic feeding impulse, while cortico-limbic structures control rewarded feeding behaviors.[29, 30]

It has been reported that diets with high levels of refined carbohydrates are effective in reducing the inhibitory effect on dopamine receptors in neuronal activity, thus increasing motivation for food contents defined as delicious.[31] Some researchers have reported that regardless of whether excessive food intake is associated with obesity, it mimics addiction.[32-34]

CONCLUSION AND RECOMMENDATIONS

If the participants in our study continue with this diet when they reach the age of late adulthood, they will have lost their quality of life considerably. Since the nutritional need that is satisfied after long-term hunger causes us to perceive that food as a reward, keeping the intervals between meals short, using nutrition not for "prolonged hunger" but for "hunger" and staying away from foods that can be defined as "futile foods" that are far from beneficial, make each individual mentally and It will bring you closer to bodily well-being.

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