

Positive vs Negative Effects of Alternative Diets*

Rosica Popova¹, Bojidar Popov²

¹Medical Faculty – Sofia University “St Kliment Ohridski”, Department of Neurology, Psychiatrics, Physiotherapy and Rehabilitation, Preventive Medicine and Public Health, Medical Faculty, SU “St Kliment Ohridski”, ul. Kozjak 1

Abstract

On the basis of own studies and literature data, the most common alternatives to healthy diets and the subsequent health risk effects are discussed. The experimental studies presented show that in reduced or irregular eating patterns the deficiency of nutrients or their irregular intake activates the systems of absorption of energetic components of food at the expense of the absorption of the structure ones. This can explain the so-called “yo-yo effect” when normal eating habits are resumed. The authors also discuss the “phenomenon of satiety”, characterised by suppression of the systems for hydrolysis and transport of a given nutrient during a period of intensive and prolonged intake. At the same time a deficient intake of a nutrient stimulates the systems for its absorption. On account of this, eating regimens are discussed, where the intake of one nutrient is increased at the expense of another. Such types of diets can cause serious metabolic disorders with harmful health consequences. Different options of vegetarian diets are analysed with emphasis on the risk health effects of the diets with permanent exclusion of animal products. The scientific view on “split diet” is discussed and some principles of its use are explained.

Key words: alternative diets, risk, nutrient

Резюме

На базата на собствени проучвания и литературни данни, се обсъждат най-честите алтернативни на здравословното хранене диети и рисковете за здравето от тяхното прилагане. Представят се собствени експериментални изследвания, маркиращи че при редуцираното и нередовно хранене, дефицитът на нутриенти или неритмичното им приемане, активира системите, усвояващи енергийните съставки от храната за сметка на пластичните. Това обяснява така наречения „йо йо ефект“ след преминаване към обичайното хранене. Обсъжда се и регистрираният от авторите „феномен на насищане“, характеризиращ се с потискане на системите, реализиращи хидролизата и транспорта на даден нутриент, приеман интензивно за по-продължително време. Същевременно дефицитът на някой нутриент, обратно, стимулира системите, свързани с неговото усвояване. По този повод се обсъждат режимите на хранене, при които е повишен приемът на един нутриент за сметка на друг. Това води до съществени метаболитни нарушения със сериозни неблагоприятни последици за здравето. Анализират се различните варианти на вегетарианството, като се акцентира върху рисковете за здравето от перманентното прилагане на хранителни режими с напълно изключване на животинските продукти. От професионална гледна точка се разглежда и така нареченото „разделно хранене“, като се обосновават и някои принципи при неговото прилагане.

Introduction

The main principles of a healthy diet concern the adequate and regular food intake, the balance and diversity of the food. They are:

1. The energy intake should be equal to energy expenditure (EE) to keep energy balance
2. A diet should be balanced in terms of the macronutrient content. That means that proteins should be 10-15 E %, fats – 15-30 E% and carbohydrates – 50-55 E%
3. A diet should be varied in terms of the food products consumed during one week.

* Corresponding author: !E-mail: rosica1702@yahoo.com

² Medical University – Sofia

* The paper was presented at the FOOD-3 Conference, 2017, Sofia, Bulgaria



Хранителна пирамида на Българското научно дружество по хранене и диететика

Fig. 1. Food pyramid for adults with low physical activity (PA)

There are different types of Food pyramids and plates which give advice about the variety and quantity of food intake. The first pyramid (Fig.1) shows the recommended food intake for people with low physical activity who have lower EE – they have to eat more low-calorie food such as fruit, vegetables, low-fat milk and dairy products, low-fat meat and fish, on the other hand they ought to eat less grain products, potatoes, rice, pasta, which are rich in energy, and different foods rich in fats.

The second pyramid (Fig. 2) represents the recommended food intake for adolescents and adults with moderate and high physical activity. They should adhere to both groups of cereals, rice and potatoes together with vegetables and fruits. They need more energy because of the increased energy demands. Of course they need essential protein from meat, fish, eggs and dairy products because of the prevalence of anabolic processes.

4. Every human should eat regularly during the day – from 3 to 5 times per day with 3 main meals and 2 snacks

Materials and methods:

An alternative diet is a diet which significantly differs from the principles of the healthy diet. The most popular alternative diets are:

1. Hypocaloric (reducing) diet
2. Intermittent fasting
3. Vegetarian diet
4. Raw food diet
5. Imbalanced diet
6. Split diet



Fig. 2. Food pyramid for adolescents and adults with high PA

Results and Discussion:

The hypocaloric diet is a diet when the energy intake is constantly less than the energy expenditure. The energy intake may even be reduced to starving when there is less than 500 kkal per day. The most frequent reason for such deficient energy intake is the attempt to reduce overweight. The carbohydrates and fats are limited essentially and when people starve for more than 10 days substantial disturbances appear in the metabolism, which leads to pathological processes in the body. When the starvation is more than 72 hours, the glycogen levels fall and glucose is derived from gluconeogenesis. Since fatty acids cannot be converted into glucose, this process in the liver depends on the continuing supply of precursor amino acids from the muscles – decreased muscle mass. This pathophysiological mechanism of negative nitrogen balance leads to a decline in the metabolic rate and in the absence of glucose the brain starts utilizing ketones as fuel (Soeters *et al*, 2004).

When different macro- and micronutrient deficiencies are found in the human body, the state is called malnutrition. When the patient is malnourished disturbances appear in the mental, muscle, cardio-vascular, renal, respiratory, gastrointestinal function, in the thermoregulation and the immune system. Specific deficiencies in the vitamin B group (vitamin B12 and thiamine), calcium, and magnesium can lead to anxiety and depression, which can recover with refeeding. The fast loss of body weight is proportional to decreased heart volume, which leads to circulatory failure. Some mineral and electrolyte disorders can cause cardiac arrhythmias. The low food intake decreases the gastric,

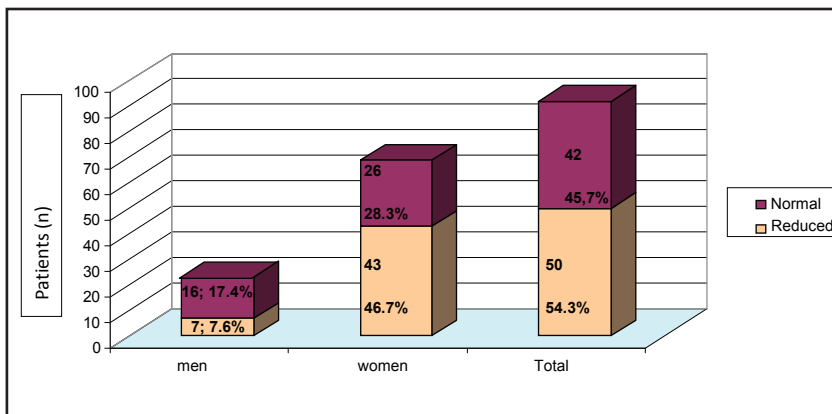


Fig. 3. Muscle function in patients with malnutrition

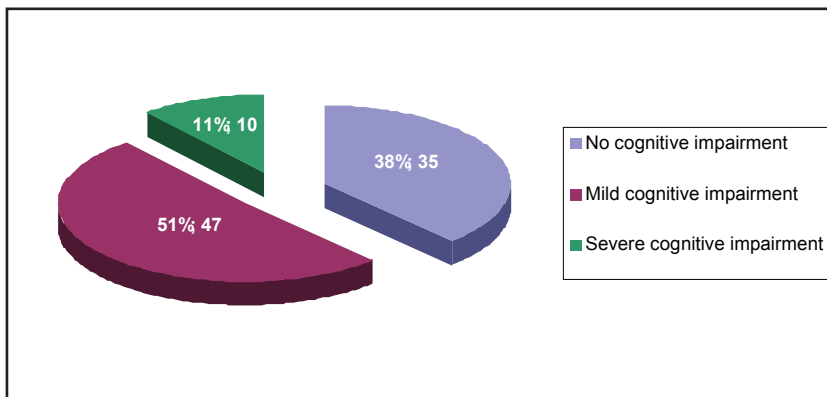


Fig. 4. Cognitive impairment in malnourished patients

biliary and pancreatic secretion, which contributes to malabsorption. The enterocytes and colonocytes which have a rapid turnover during an adequate diet, during malnutrition can be depleted (Barendregt *et al*, 2004).

The protein and iron intake is also diminished and this leads to anaemia. Also, the endocrine function is disturbed, especially the thyroidal, suprarenal and pituitary glands. In a study by Popova *et al*, 92 malnourished patients at the Clinic of Metabolic and Endocrine diseases were analysed (Popova and Popova, 2016). Their diagnoses were Anorexia nervosa (19 patients), secondary anorexia with anxiety-depressive syndrome (38 patients) and gastro-intestinal diseases (35 patients). The analysis showed that their energy intake was about 72% less than their daily requirements according to Ordinance 23/2005. The anthropometric measurements showed that 69 % of the whole group had less fat mass than normal. The others had normal weight with significant reduction of their weight over the last 3 months. From the functional exams – 62% had impaired cognitive function (Fig. 4) , 40,2% - restricted pulmonary ventilation, 54,3% - decreased muscle function (Fig. 3). These disorders are connected with the lack of essential nutrients – essential amino acids, PUFA, vitamin D etc.

When determining the Basal metabolic rate

(BMR) - 34% of the patients had reduced BMR and the others had normal BMR but the nutrient utilisation was unbalanced. 17 % had initial cardiac failure and 74% had reduced bone density.

After inclusion of appropriate diet and monitoring of the patients for 2 years, the conclusion was that the patients with anorexia nervosa and secondary anorexia with anxiety-depressive syndrome improved their anthropometric and functional parameters.

Other experimental studies demonstrate that animals without food intake for different periods of time absorb more glucose after refeeding compared to regularly fed animals. (Fig. 5).

That explains the so-called “yo-yo effect” after a normal diet is resumed.

The intermittent diet can be described as a kind of hypocaloric diet – this is very rare food intake, for example once per day, or 3-4 times per week. Another experimental study proves the unhealthy effect of this alternative diet. Animals that consume food regularly were compared with animals that take the same quantity of food but in one meal (Fig. 6).

Glucose absorption again was increased in the second group. The conclusion is that both the hypocaloric and intermittent diets increase energy absorption of diminished food intake.

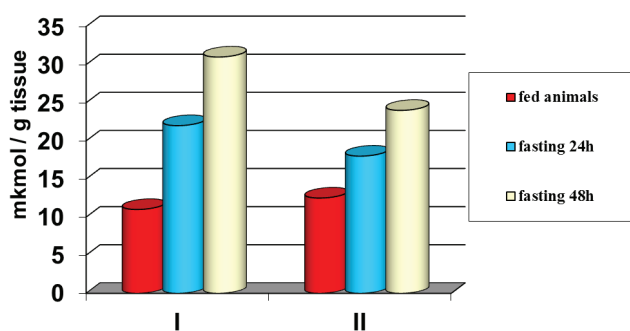


Fig. 5. I - Glucose absorption; II – Maltase activity

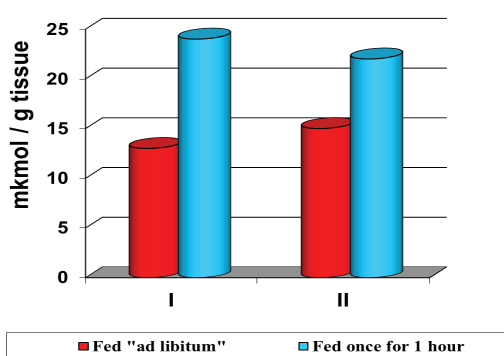


Fig. 6. Glucose absorption

Vegetarianism is divided into Vegans, who are strict vegetarians who consume just plant food, and vegetarians who are several types:

- Lacto vegetarians – they consume plant foods as well as milk and dairy products
- Ovo-lacto vegetarians – they avoid fish and meat
- Pesco vegetarians – they avoid only milk
- Pseudo vegetarians – they avoid only red meat.

Vegans have serious health risks. The animal protein which contains essential amino acids is missing. The deficit of lysine, methionine, tryptophan and histidine is vital. This reflects on the immune system, enzymes and hormones. The liver can be damaged by intoxication. The human body is vulnerable without essential protein especially to the adverse effect of the chemical factors of the environment. The most serious deficit is vit B₁₂, which causes megaloblastic anaemia. There are studies that prove the relation between vit B₁₂ and homocysteine – the lack or decreased vit B₁₂ leads to increased levels of homocysteine, which causes adverse effects on the central nervous system and a higher risk of cardio-vascular diseases (CVD)

(Obersby *et al*, 2013). Vegetarians have a higher risk also of diminished bone density because of reduced or lack of Ca and vit D intake. These nutrients are mainly present in food of animal origin – milk and dairy products, meat, fish. The lack of fish in the diet leads to a low content of the essential omega-3 fatty acids, which increases the risk of thrombogenesis, CVD, mental disorders and ophthalmopathy.

There are also positive effects of the vegan diet, which is due to the low intake of saturated fatty acids and cholesterol, high intake of fibres from the plant foods, and generally the statistics shows that vegetarians live healthier life than omnivores because they abstain from drinking alcohol and smoking and they are more physically active.

The moderate vegetarians are closer to a healthy diet, especially pseudo- and pesco- vegetarians.

The raw food diet has two directions – raw food eaters and strict vegans. The strict vegans have lower health risk because they consume only plant food – fruits, vegetables and nuts. These food products cannot cause food-borne diseases such as bacterial toxic infection or bacterial intoxication. Also, this type of diet is beneficial because of the low calorie intake, high fibre intake, and the quantity of vitamins, minerals and phytochemicals is not decreased by thermal food processing. However, there are negative sides especially related with the small variety of food, the deficiencies of essential proteins, calcium, iron, vit B₁₂, which makes the diet inadequate for a long term. Besides, raw food is less digestible.

Raw food eaters who are not strict vegans eat animal food products which may not be safe. The risk of food poisoning from eating raw or undercooked food is higher. Raw food contains toxic or allergenic substances that are broken down during thermal processing. Also cooking boosts some nutrients such as lycopene and beta-carotene, which have beneficial effects on human health.

An imbalanced diet is when the balance between the basic macronutrients – proteins, fats and carbohydrates - is disturbed. According to one of the principles of the healthy diet, proteins should be 15-20 E %, fats – 15-30 E% and carbohydrates – 50-55 E%. Every variation of that principle leads to an improper ratio between the macronutrients. The most frequent imbalanced diets are:

- High-protein diet
- High-fat diet
- High-carbohydrate diet

A high protein diet is when the protein intake exceeds 20 E% of the daily calorie intake. Usually, it can be around 30 E%, which in a 2000 kkal diet is 150 g of protein. There is no doubt that the high-protein diet helps people to lose weight. The high-protein intake boosts the metabolism, reduces appetite and changes several weight-regulating hormones (Eisenstein *et al*, 2002; Astrup *et al*, 2015). Protein reduces the levels of the hunger hormone ghrelin, while it boosts the appetite reducing hormones GLP-1, peptide YY cholecystokinin. This leads to unintentional reduction of calorie intake and subsequently to losing weight (Leidy *et al.*, 2015).

Usually, during digesting and metabolizing, food burns calories that are called diet-induced thermogenesis. Depending on the type of the nutrient intake it is up to 10 % of the total energy expenditure during the day. Protein has a much higher thermic effect of food (20-30%) compared to carbs (5-10%) and fat (0-3%) (Westerterp, 2004). Therefore, the high protein intake increases the energy expenditure and boosts metabolism. Another positive effect of that diet is keeping the muscle mass in the body, which is metabolically active tissue with increased energy expenditure (Clifton *et al*, 2014).

When the protein intake is about 50-60 E% it can lead to some health risks. The first adverse effect is increased levels of uric acid, which can lead to gout. The protein metabolites are excreted through the kidneys, so when protein intake is too high, adverse effects can appear in the kidneys. The high protein intake changes the pH homeostasis in the body as it becomes more acidic and this leads to changes in the calcium turn-over with following osteoporosis. (Manninen, 2004; Pesta and Samuel, 2014).

The high-carbohydrate diets include mainly vegetables and fruits and there is a lack of the essential amino acids and other micronutrients related with strict vegetarianism.

The high-fat diet has been much discussed over the last 30 years because it claims to treat some neurological diseases as epilepsy, Alzheimer's disease, Parkinson's disease, cancer (Gasior *et al*, 2006). The other name of the high-fat diet is ketogenic diet because the high fat content in the diet replaces the carbohydrates (low-carb diet) and the reduction of carbs leads to a different metabolic state called ketosis. At present, a large number of studies have proved that the ketogenic diet protects against seizures in children with difficult-to-treat epilepsy (Hemingway *et al*, 2001; Marsh, 2006).

These studies showed a good response to the diet with a decrease in the number of seizures or even prevention of seizures in children. They are not completely reliable because of the lack of a control group, but the diet may claim to have a disease-modifying activity with improved long-term outcome. Alzheimer's disease patients show improved memory performance after medium-chain triglycerides intake. This is in positive correlation with plasma levels of β -hydroxybutyrate, which is a product of oxidation of the medium-chain triglycerides (Reger *et al*, 2004). There is increasing evidence that the ketogenic diet may also be beneficial as an adjuvant cancer therapy by potentiating the antitumor effect of chemotherapy and radiation therapy (Vidali, 2015). The high-fat diet does have an adverse effect on the cardiovascular system with a vascular damage observed after treatment with ketogenic diet. The serum levels of cholesterol and triglycerides are increased; also, arterial stiffness parameters are higher than the same parameters in the control group (Coppola *et al*, 2014).

A split diet is a diet with separated intake of different foods (compatible and non-compatible foods). The concept does not involve compatibility in terms of their chemical characteristics, but competition of the enzymes and transporters of nutrients during their hydrolysis and absorption. When a big quantity of food is consumed for a short period of time the enzymes cannot be included in the utilization of the whole amount of food and a part of it is not absorbed (Popov and Vasileva, 1998). Also some of the nutrients play the role of inhibitors, others of promoters of nutrient absorption. For example, the absorption of glucose diminishes in the presence of the amino acid glycine, and glycine absorption decreases in the presence of glucose (Fig. 7).

The red column at I is the absorption of glucose and the blue one is the absorption of glucose in the presence of glycine. The second red column

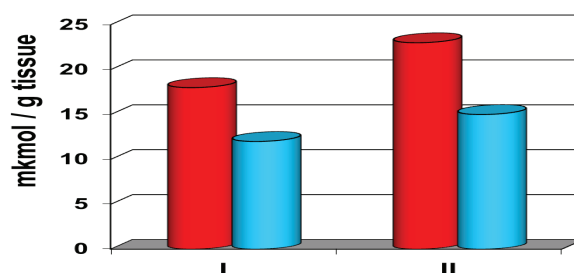


Fig.7. Glycine and glucose absorption

is glycine absorption and the second blue column is the absorption of glycine in the presence of glucose.

Conclusion:

According to these statements, it can be concluded that every diet has both positive and negative effects on human health. Every individual has different susceptibility to a specific diet and if the diet is appropriate or not depends on the spectrum of the consumed foods. The broader the dietary diversity, the more adequately it will fulfil the requirements of the body and the risk of nutrient deficiencies will be the lowest. Undoubtedly, there must be a good balance between overdose and deficiency, which has to be managed by a professional nutritionist.

References

- Astrup, A., A. Raben, N. Geiker. (2015). The role of higher protein diets in weight control and obesity-related comorbidities. *Int. J. Obes.* **39**: 721-726.
- Barendregt, K., P. B. Soeters, S. P. Allison. (2004). Influence of malnutrition on physiological function. In: Sobotka L. *Basics in Clinical Nutrition*. Galen. Prague, pp. 18-31.
- Clifton, P. M., D. Condo, J. B. Keogh (2014). Long term weight maintenance after advice to consume low carbohydrate, higher protein diets - a systematic review and meta-analysis. *Nutr. Metab. Cardiovasc. Dis.* **24**: 224-235.
- Coppola, G., F. Natale, A. Torino, R. Capasso, A. D'Aniello, E. Pironti, E. Santoro, R. Calabro, A. Verrotti (2014). The impact of the ketogenic diet on arterial morphology and endothelial function in children and young adults with epilepsy: A case-control study. *Seizure* **23**: 260-265.
- Eisenstein, J., S. B. Roberts, G. Dallal, E. Saltzman. (2002). High-protein weight-loss diets: are they safe and do they work? A review of the experimental and epidemiologic data. *Nutr. Rev.* **60**: 189-200.
- Gasior, M., M. A. Rogawski, A. L. Hartman (2006). Neuroprotective and disease-modifying effects of the ketogenic diet. *Behav. Pharmacol.* **17**: 431-439.
- Hemingway, C., P. L. Pyzik, J. M. Freeman (2001). Changing physician attitudes toward the ketogenic diet: a "parent-centered" approach to physician education about a medication alternative. *Epilepsy Behav.* **2**(6): 574-578.
- Leidy, H. J., P. M. Clifton, A. Astrup, T. P. Wycherley, M. S. Westerterp-Plantenga, N. D. Luscombe-Marsh, S. C. Woods, R. D. Mattes (2015). The role of protein in weight loss and maintenance. *Am. J. Clin. Nutr.* **101** (Suppl): 1320S-13209S
- Manninen, A.H. (2004): High-protein weight loss diets and purported adverse effects: where is the evidence? *Sports Nutr Rev J* **1**: 45-51
- Marsh, E. B. (2006). The outcome of children with intractable seizures: a 3- to 6-year follow-up of 67 children who remained on the ketogenic diet less than one year. *Epilepsia* **47**(2): 425-30.
- Obersby, D., D.C.Chappell, A. Dunnett, A. A.Tsiami. (2013). Plasma total homocysteine status of vegetarians compared with omnivores: a systematic review and meta-analysis. *Br. J. Nutr.* **109**: 785-794.
- Pesta, D. H., V.T. Samuel (2014). A high-protein diet for reducing body fat: mechanisms and possible caveats. *Nutr. Metab.* **11**: 53-58.
- Popov, B., R. Vasileva (1998). A study on the influence of basic nutrients on glucose and glycine transport in the small intestine. *Folia Medica XXXX*. **3**: 29-34.
- Popova, R., D. Popova (2016). Comparative analysis of the nutritional status of underweight patients and healthy people. In: *Nutrition Science – authoritative present and prestigious future*. Vezni-4, Sofia, pp. 212-217.
- Reger, M. A., S. T. Henderson, C. Hale, B. Cholerton, L. D. Baker, G. S. Watson, K. Hyde, D. Chapman, S. Craft (2004). Effects of beta-hydroxybutyrate on cognition in memory-impaired adults. *Neurobiol. Aging* **25**(3): 311-314.
- Soeters, P. B., K. Barendregt, P. Allison, L. Sobotka. (2004). Simple and stress starvation. In: Sobotka L. *Basics in Clinical Nutrition*. Galen. Prague, pp. 107-113.
- Vidali, S. (2015). Mitochondria: The ketogenic diet—A metabolism-based therapy. *Int. J. Biochem. Cell Biol.* **63**: 55-59.
- Westerterp, K. R. (2004). Diet induced thermogenesis. *Nutr. Metab.* **1**: 1-5.