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SUGARS AND NON-TRANSMISSIBLE DISEASES

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Keywords: *sugar, carbohydrates, health, non-communicable diseases.*

Introduction. *Sugars consumed in reasonable quantities play a beneficial role for the human body. However, the type of carbohydrates in the diet (digestible or non-digestible) matters, and in recent decades research has clearly shown that excessive consumption of refined sugar (as such or hidden in various foods) has negative effects on public health.*

Material and methods. *The paper presents a synthesis of official international and national reports, as well as recent bibliographic sources on the occurrence of certain non-communicable diseases (NCDs) as a result of excessive sugar consumption. A focused search of specialized literature sources was conducted using the search engine Google Scholar, PubMed, Research for Life and Medline, starting from the keyword's sugars, health and non-communicable diseases.*

Results. *Excessive consumption of refined sugar contributes to the emergence of various NCDs such as diseases of the circulatory system, type 2 diabetes, obesity, metabolic syndrome or tooth decay. According to the WHO recommendations, in order to reduce the consumption of refined sugar, complex, multisectoral nutritional and public health interventions are needed.*

Conclusions. *In order to prevent NCDs associated with the nutritional factor, especially with excessive consumption of refined sugar, in the Republic of Moldova, it is important to implement cost-effective interventions both socially and economically.*

Cuvinte cheie: *zaharuri, carbohidrați, sănătate, boli netransmisibile.*

ZAHARURILE ŞI BOLILE NETRANSMISIBILE

Introducere. *Zaharurile consumate în cantități raționale au un rol benefic pentru organismul uman. Contează însă tipul de carbohidrați din dietă (digerabili sau nedigerabili), iar în ultimele decenii cercetările au demonstrat în mod evident faptul că un consum exagerat de zahăr rafinat (ca atare sau camuflat în diferite produse alimentare) are efecte negative asupra sănătății populației.*

Material şi metode. *Lucrarea este o sinteză a unor rapoarte oficiale naționale și internaționale, precum și a surselor bibliografice recente privind apariția anumitor boli netransmisibile (BNT), ca rezultat al consumului exagerat de zaharuri. A fost efectuată o cercetare axată pe sursele de literatură de specialitate, folosind motorul de căutare Google Scholar, PubMed, Research for Life și Medline, plecând de la cuvintele-cheie zaharuri, sănătate și boli netransmisibile.*

Rezultate. *Consumul exagerat de zahăr rafinat contribuie la apariția diverselor BNT, cum ar fi: maladiile sistemului circulator, diabetul zaharat de tip 2, obezitatea, sindromul metabolic sau cariile dentare. Conform recomandărilor OMS, în scopul reducerii consumului de zahăr rafinat, sunt necesare intervenții nutriționale și de sănătate publică complexe, multisectoriale.*

Concluzii. *În scopul prevenirii BNT, asociate cu factorul nutrițional, în special cu un consum excesiv de zahăr rafinat, este importantă implementarea în Republica Moldova a intervențiilor cost-eficiente atât sub aspect social, cât și sub aspect economic.*

INTRODUCTION

The notions of sugars have been presented in various documents at international level, by WHO/FAO experts 2003 (1), being divided into "free sugars", "added sugars" and "intrinsic sugars". In the legislation of the medical authorities of various countries, for example, in Great Britain (2), and later (in 2010) by the subgroup of specialists of the WHO for nutrition and health (3) the notion "free sugars" was specified in the following way: " Free sugars are all monosaccharides and disaccharides added to food and beverages by the manufacturer, cook or consumer and sugars naturally present in honey, syrups, fruit juices and fruit juice concentrates". Based on this wording, it can be specified that "added sugars" are monosaccharides and disaccharides, which are added intentionally by the producer, cook or by the consumer herself during the technological process of manufacturing food products, when preparing meals in public catering establishments or in domestic conditions. Most often, sucrose is added, i.e. common sugar, which is included in various recipes for the production and preparation of food. In our republic, the notion of sugars is stipulated in Law no. 279 of 15.12.2017 regarding consumer information on food products (4).

The importance of carbohydrates in nutrition, including sugars, is generally beneficial, serving many roles. First of all, glucose is the fuel for cell activity, constituting the main source of energy (burning 1 g yields 4 kcal). The brain does not survive without glucose for about the same length of time as it does without oxygen. In addition to the role in the functioning of the central nervous system, glucose is necessary for muscle activity, heart, internal organs. In hypoxia states and when muscle fibres contract with high intensity, the tissues need glucose because it contains more oxygen in its structure compared to carbon atoms. Glucose is very important for liver cells, which are extremely demanding in various metabolic reactions. When liver glycogen stores decrease, liver tissue becomes extremely vulnerable to the action of toxic substances. It can also be mentioned the special role of glucose in the process of detoxification of toxins, penetrated the human body.

At the same time, it should be kept in mind that sugars are welcome when they are consumed in adequate amounts, and excessive consumption can harm the health.

The purpose of the work: the paper presents a synthesis of specialized literature on the issue of the negative influence of excessive consumption of refined sugar on health, also elucidating effective public health interventions to reduce sugar consumption and prevent NCDs.

MATERIAL AND METHODS

In order to achieve the objective, a focused research of specialized literature sources was carried out, using the Google Scholar search engine and the PubMed, Research for Life and Medline databases. Article selection criteria included the keywords: “sugars”, “health”, “non-communicable diseases”. After a thorough analysis of the titles, original articles were selected, which contained relevant information about the role of excessive consumption of sugars on the health of consumers, but also official documents of a normative nature, as well as effective public health interventions "best buys" to reduce the influence of risk factors. As exclusion criteria were articles on the importance of carbohydrates for the human body, in general, including the beneficial role of sugars in moderate amounts, but also the beneficial role of different components of carbohydrates, such as, for example, dietary fibre. From the total number of sources, 54 were selected.

RESULTS

If we refer to the history of European civilizations, sugar can be considered a relatively new product, unlike the history of sugar in other geographical areas. Before the mid-20th century, carbohydrates were considered primarily a source of energy, and nutritional recommendations suggested that carbohydrates should contribute to the energy deficit remaining after taking into account the recommended intakes of fat and protein. From the mid-1950s, papers appeared linking increased sugar (mainly sucrose) to tooth decay, and in the 1960s was promoted the view that sugar was a major cause of obesity, type 2 diabetes and cardiovascular diseases (5, 6). After these papers appeared, epidemiological reseasches and investigations on laboratory animals confirmed the negative effect on the health of excessive sugar consumption (7). Moreover, the authors were able to induce diabetes in la-

boratory animals fed various sugars in excess. In the modern period, both in our republic and in many countries of the world, there is an exaggerated consumption of sweet foods, a fact that leads to the appearance of NCDs, which are very widespread today in the world. By the sudden increase in the level of sugar in the blood, the process of mobilization of reserve fats slows down, which, in turn, contributes to the appearance of dyslipidemias with the well-known consequences (atherosclerosis, myocardial infarction, etc.). Also, excessive consumption of refined sugar can cause tooth decay, but also malnutrition, because it does not contain other nutrients necessary for the human body.

In 2020, the WHO (8) found that NCDs remained the leading cause of premature death globally. Each year over 41 million people die from NCDs, the main causes being cardiovascular diseases, cancer, diabetes and chronic respiratory diseases, which account for more than 70% of all deaths worldwide, with NCDs also having a crippling economic impact. According to the same document, in the Republic of Moldova the share of NCDs in the mortality structure reaches 90% (8).

The premature mortality rate attributed to the four main NCDs (cardiovascular diseases, type 2 diabetes, cancer, chronic lung diseases) between 1985 and 2016 was higher in the Republic of Moldova compared to the WHO European Region, the mortality curve being from 2010 close to the indicator of the Commonwealth of Independent States (CIS) (fig.1). According to data from the Department of Health Data Management of the National Public Health Agency, an increase in the mortality rate was observed from 594.39 cases per 100,000 populations in 2016 to 619.8 cases per 100,000 in 2020.

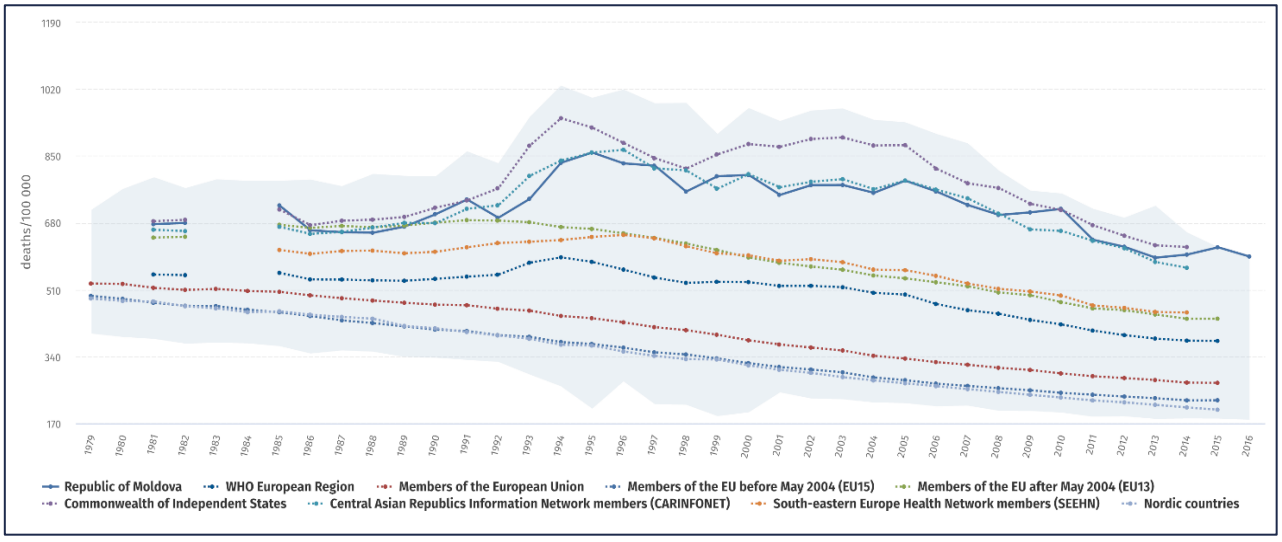

Figure 1. Premature mortality rate attributed to the four main NCDs (cardiovascular diseases, type 2 diabetes, cancer, chronic lung diseases), in the WHO European Region and the Republic of Moldova, years 1979–2015, per 100,000 people (9).

Irrational diet – determining factor of NCDs

Irrational nutrition is one of the main determinants of NCDs leading to premature death and disability. Globally, in 2017, food hazards were responsible for 11 million deaths, representing 22% of all deaths in the adult population and 255 million disability-adjusted life years (DALYs), of which 15% are attributed to adults under the age of 70. It should be noted that cardiovascular diseases account for the majority of food-related deaths with 10 million deaths and 207 million DALYs (10).

According to IHME (Institute of Health Metrics and Evaluation) data in the Republic of Moldova, in 2019, compared to 1990, health risks determined by the nutritional factor, as a component of behavioral risks, dropped from first place to second (after high blood pressure) in the ranking of attributable risk factors for DALYs, including both sexes and all ages. Nutritional risk factors (including increased sugars, salt and *trans* - fats in processed foods) accounted for 15.7% of total

DALYs in 1990, increasing to 19% in 2019 (IHME, 2019) (9).

Systematic review of the influence of behavioral risk factors, including unhealthy diet (high consumption of fat, salt, sugar and processed foods) in low-income and lower-middle-income countries, demonstrates that socio-economic status influences risky eating behavior (11).

Sugars induce an increase in the overall energy density of foods and can greatly increase the energy intake of food rations (12).

The imbalance of the food ration, caused by the surplus of sugar, can also contribute to the appearance of some forms of cancer, in particular, against a background of inflammatory syndrom (13).

Excessive sugar consumption is a major contributor to overweight and obesity. The number of young people aged 5–19 years who are overweight and/or obese has increased globally from 11 million in 1975 to 124 million in 2016 (14). A high body mass index (BMI) is estimated to affect at least 4 million of persons each year (15). Emerging from the data of the systematic analysis of 87 behavioral, environmental, occupational and metabolic risk factors in people aged 25+, carried out in 204 countries of the world, between 1990 and 2019, according to the Global Burden of Disease Study, published in 2019 (16), in the Republic of Moldova there was an increase in the consumption of sugar-sweetened beverages in both sexes (18.2 g/day in 1990, compared to 18.6 g/day in 2019), with a predominance in women (19.8 g/day in 1990, compared to 19.9 g/day in 2019), compared to men (16.4 g/day in 1990, compared to 16.9 g/day in 2019) (fig. 2).

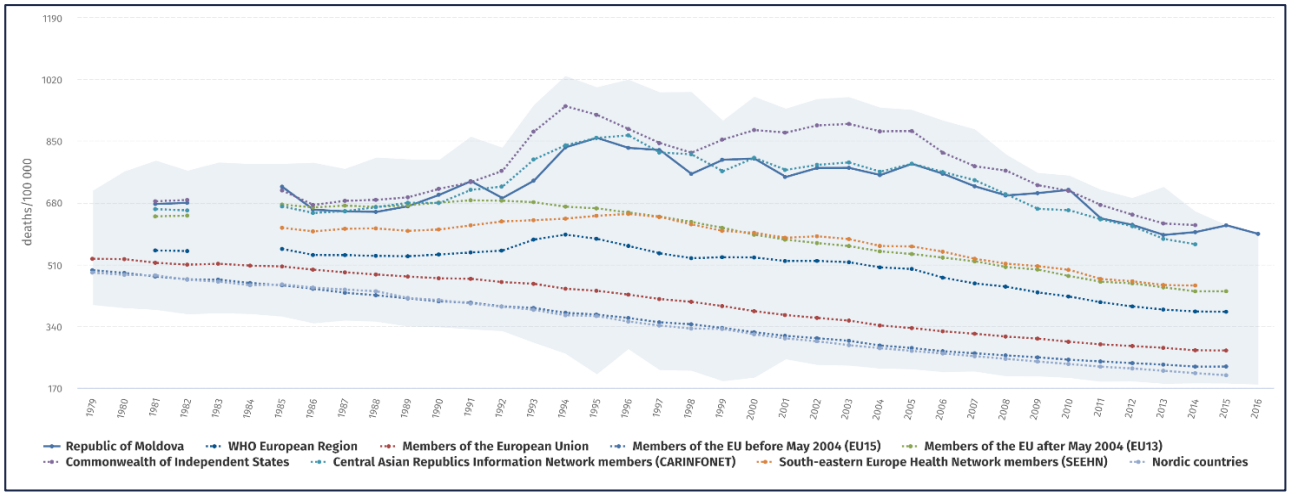

Figure 2. Estimated daily intake of sugar-sweetened beverages, expressed in grams per day (16).

A relatively recent meta-analysis of randomized and cohort studies found that the risk of becoming overweight or obese is 55% higher in people who regularly consume large amounts of sugar-sweetened soft drinks compared to with those who have a small intake of these drinks in their diet (17). Apart from the role of these industrially obtained drinks, it was found that the consumption of various foods, including meals prepared in public catering units or in domestic conditions, in which sugar was intentionally introduced in exaggerated amounts, was also associated with an increase in body mass.

There is a growing concern that overconsumption of sugar-sweetened soft drinks is leading to an increase in overall sugar intake while reducing the intake of healthy, lower-calorie foods, but with greater nutritional value. In this way, the daily food ration becomes unhealthy, and the risk of NCDs increases (18, 19, 20). Thus, maintaining energy balance is essential for maintaining an appropriate body weight and ensuring optimal nutrient intake (21). According to WHO data, the increased content of free sugars in the diet, which leads to its imbalance, is attested in most countries of the world and is one of the main causes of NCDs (22). A recent study from Sweden demonstrates the strong link between

the high content of sugars in the daily diet and the risk of stroke and coronary events (23).

Excess of sugar in the daily diet is one of the main causes of tooth decay (26). Although there have been major improvements in the prevention and treatment of dental diseases in recent decades, they still remain highly prevalent globally, causing pain, anxiety, functional limitation (including frequency and low performance in students) and social handicap through tooth loss in mature (27). A meta-analysis of 55 studies reported a clear association between the amount of sugars consumed and the development of dental caries (28). Other recent longitudinal studies have also found a direct link between the amounts of sugar consumed and tooth decay (29, 30). Therefore, the recommendation to reduce the consumption of free sugars throughout life remains very important and beneficial for dental health. It should also be noted that because tooth decay is a cumulative disease, excessive consumption of sugars in childhood leads to an increased prevalence of tooth decay in both children and adults. In the occurrence of dental caries, as well as other NCDs, the frequency of sugar consumption is also important, which increases the total amount of time during which the teeth are exposed to sugars. The process of developing dental caries depends on the retention time of foods and drinks that contain sugars. Foods containing sugars, especially sticky foods such as chocolate candies, sweet biscuits and other sweet confectionery, have a long-lasting retention, leading to a greater degree of exposure of the tooth surface (31). Treatment of dental diseases is expensive, consuming 5–10% of health care budgets in industrialized countries and would exceed the entire financial resource available for child health care in lower-income countries (32). Obviously, any possibility of preventing tooth decay is welcome. In this connection, to prevent tooth decay, among other measures, it is necessary to reduce the consumption of foods and drinks with a high sugar content and, as far as possible, to reduce the amount of sugar in them.

Interventions to reduce excessive consumption of sugars

A systematic review of interventions to reduce obesity in cities, including interventions to reduce sugar consumption, highlights the importance of a series of integrated interventions that combine educational, fiscal, regulatory and environmental approaches in a consistent manner (33).

International organizations and public health experts recommend that, together with the improvement of knowledge about risk factors, their influence on health (educational or literacy interventions) and the degree of awareness for changing the behavior of individuals, premises for changing the environment (context) to promote healthy eating (34).

Of particular importance in the sense of informing the consumer about the content of sugars in industrially obtained foods and sold in their sales objectives, is the nutritional declaration on the product packaging. In our country according to artikel 29 of Law no. 279 of 15.12.2017, the mandatory nutritional declaration, in addition to other information, must contain both the carbohydrate content in general and the sugar content, in particular. At the same time, in order to inform the consumer, the "Health Regulation regarding nutritional and health claims written on food products", approved by the Decision of the Government of the Republic of Moldova no. 196 of 25.03.2011, annex no. 1, and includes 3 positions regarding the sugar content in food:

1)„low sugar content" (5 g sugars per 100 g in the case of solids or 2.5 g sugars per 100 ml in the case of liquids);

2) „without sugars" (the product does not contain more than 0.5g of sugars per 100g or 100ml);

3) „no added sugars".

At the same time, the mentioned document states that if the food product contains sugars naturally, the label should also include the following indication: "Contains sugars naturally". In some economically developed countries, the so-called "traffic light method" of voluntary labeling of food products is used, which provides information to the consumer about the content of sugars, but also of table salt, fats, including trans fats and saturated fatty acids. So, for example, in Great Britain to help consumers choose healthier foods the Food Standards Agency proposed a voluntary labeling based on this method (35). Depending on the content of sugars in food per 100 g, the colors of the labels are provided: (a) green – for low content, which is ≤5.0 g; (b) yel-

low – for medium content, which is from 5.0 to ≤22.5 g and (c) red – for high sugar content, i.e. greater than 22.5 g. For soft drinks depending on the content of sugars in 100 ml the colors are provided: (a) green is ≤2.5 g; (b) yellow is 2.5 to ≤11.25 g and (c) red is >11.25 g.

As mentioned, one of the main sources of sugar, especially for teenagers is soft drinks. For example, according to the information included in the labels on the bottles of "Coca-Cola", 250 ml contains 27 g of sugar. So, when consuming 500 ml of such a drink, the recommended amount of sugars for a day is already exceeded. Increased amounts of sugar are also found in various other soft drinks, and research suggests a strong link between sweetened beverage consumption and sugar intake (36,37,38). In 2012, the WHO established guidelines to protect children everywhere from the impact of aggressive marketing of sweetened beverages (39). To this end, for example, in London, it has even reached a promotion of drinks with lower sugar content. San Marco adopted a voluntary partnership approach to change children's menus by eliminating sugar-sweetened beverages and increasing fruit and vegetable offerings (40).

It should be noted that, when implementing public health interventions, the context (environment) must be analyzed and the commercial interest of the producing industry must be taken into account. For example, New York City tried, but failed, to limit the amount of sugar in sweetened beverages and restrict the consumption of sugary drinks purchased through the federal Supplemental Nutrition Assistance Program, with a state court striking down the regulation a day before it to enter into force (41). At the same time, we must not forget about other foods with a high content of added sugars. In order to reduce the excessive consumption of sugar, it has also been proposed to add additional taxes to the sales prices (42, 43).

There is currently increased interest in developing combined interventions to address individual behavior change together with population-based fiscal policies such as taxes and subsidies to encourage healthier eating patterns. A meta-analysis of 2000-2013 research in the US, Mexico, Brazil and France on the influence of fiscal policy, such as excise taxes on sugar-sweetened beverages, on levels of sugar-sweetened beverage consumption, obesity, overweight and of body mass index (BMI) showed that the fiscal tool has a positive impact on nutrition (44). The meta-analysis demonstrated a negative influence of actual price (-1.299) on consumption, meaning that higher prices are associated with lower demand for these beverages. Four articles included in the meta-analysis indicated cross-price fluctuations, with higher prices for sugar-sweetened beverages being associated with increased demand for alternative beverages such as fruit juice (0.388) and milk (0.129) and a reduced demand for diet drinks (-0.423). Six articles showed that a higher price could also lead to a lower BMI and lower prevalence of overweight and obesity (44).

Mexico's sugar tax reduced sales of sweetened beverages by 5% in the first year, followed by a further reduction of nearly 10% in the second year (45). Several US states have introduced excise taxes on sugar-sweetened beverages, originally intended to raise revenue, but this is now seen as a priority anti-obesity policy. Taxing sugar-sweetened beverages is an effective option because these beverages contribute significantly to energy intake in many population groups (for example, they account for about 7% of all calories consumed in the US and 11% of calories for children and adolescents in this country). they provide little or no nutritional value (46, 47). Furthermore, these beverages are aggressively marketed and easily accessible to all age groups through vending machines, restaurants, schools, cafeterias, and convenience stores, as well as home delivery (48). A recent review concludes that "the evidence accumulated through observational and experimental studies is sufficient to conclude that frequent consumption of sweetened beverages causes weight gain." The link between the intake of sweetened beverages and obesity is well established (49), as is the link between their intake and such conditions as osteoporosis and tooth decay (50).

In the context of what has been exposed in our republic, there is a current need for collaboration between representatives of public health and those from the food industry, public catering and food trade in order to seek a possibility to reduce, of course rationally, the amount of sugars in food products and ready meals. The results of this collaboration can have a beneficial effect on the health of the population in general, but especially for the growing population, contributing to the prevention of NCDs.

The Swiss Agency for Development and Cooperation through the Project "Healthy Life: Reducing the burden of non-communicable diseases" and in collaboration with the National Agency for Public Health (NAPH) supported the development and implementation of the national communication campaign in the field of nutrition with the generic "Choose what you eat" for reduction of excessive sugar consumption (September – October 2021), with its subsequent transposition at the level of districts and pilot communities of the Project. A practical element was the event dedicated to the involvement of the food industry and HoReCa in promoting healthy eating, with the Discussion Panel and communication platform for reducing sugar consumption being organized. In order to realize this Campaign, we collaborated with the educational system for the involvement of the young generation, by organizing the workshop dedicated to the Health Promoting Schools Network (HPSN) and Youth Friendly Health Centers (YFHC) – over 100 participants of the HPSN, heads of the YFHC and specialists in the control of NCDs and health promotion within the territorial subdivisions of NAPH on the topic of reducing sugar consumption for schoolchildren.

In addition to the WHO recommendations regarding the amount of carbohydrates for various categories of the population and in various countries of the world, norms of nutrients and energy value are approved, used both by medical institutions and by government authorities for planning purposes. In the regulations existing in various countries, as well as at the international level, concrete sugar regulations are not specified, the total carbohydrate norms in grams being exposed. Despite the fact that there are no recommended daily intakes for the consumption of sugars, the WHO recommends a reduced intake of free sugars throughout life, starting even from childhood. Thus, in the Guide developed by the WHO/FAO expert team on the issue of chronic diseases prevention, the recommendation is stipulated, according to which the energy provided by free sugars must make up less than 10% of the energy value of the daily diet (1). At the same time, the real situation in many countries of the world turned out to be different, the research carried out in 10 countries of the European Union found that the share of energy provided by sugars varied in the range of 15-21% for adults, and for children - between 16-26 % of the energy value of the daily diet (51).

The results of scientific research led to a certain modification of the WHO position on the discussed issue. Thus, two recommendations were introduced in the 2015 WHO guide (52). The previous recommendation, which stipulated reducing the intake of free sugars to less than 10% of the total energy intake, is considered a strict one. At the same time, the WHO suggests a further reduction of the intake of free sugars to below 5% of the total energy intake. This recommendation is conditional, but, according to experts, particularly important in the complex of measures for the prevention of NCDs. These recommendations have been taken up by national governments and professional organizations around the world.

The WHO recommendations are also found in some national documents, for example, in Ministry of Health Order no. 638 of 12.08.2016 "Regarding the implementation of the Recommendations for a healthy diet and adequate physical activity in the educational institutions of the Republic of Moldova" and in Ministry of Health, Labor and Social Protection Order no. 622 of 21.05.2018, which introduced some changes in the previous Order.

Methodical recommendations "Adequate nutrition during preconception, pregnancy and lactation: a healthy start in life" draw attention to the fact that excessive consumption of free sugars increases the risk of obesity, and in pregnant women the risk of pre-eclampsia and premature birth and recommends limited consumption of soft drinks, energy drinks and fruit drinks, including nectars, which are food sources of sugar with low nutrient content, as well as limiting the consumption of sweet products (53).

In the Republic of Moldova, the nutritional targets and indicators monitored at the global/regional level were reflected in the National Program in the field of food and nutrition (NPFN) for the years 2014-2020 (Government Decision no. 730 of 14.09.2014) and which stipulates cost-effective solutions for a healthy nutrition. The objectives stipulated in the NPFN were, however, only partially achieved. A series of nutrition indicators were included in the new project of the Program for the prevention and control of major non-communicable diseases in the

Republic of Moldova.

At the same time, the mentioned WHO recommendations are also current for the entire population of the Republic of Moldova, because if at the end of the Soviet period the average consumption of sugar by a person was very high, then there followed a period with a significant decrease in the consumption of several food groups, including sugar, in recent years there has been a constant increase in its consumption. Thus, according to the "Statistical Yearbooks" reports published by the National Bureau of Statistics, the average annual consumption of sugar by a person in 1990 was 48.9 kg (133.97 g/day), in 2000 – 8.0 kg (21.91 g/day), in 2010 – 16.3 kg (44.65 g/day), and in 2020 – 21.6 kg (59.17 g/day) respectively (53, 54).

CONCLUSIONS

In order to prevent NCDs associated with excessive sugar consumption, in the Republic of Moldova, it is important to implement cost-effective interventions both from a social and economic point of view, such as:

1. Introduction of taxes for products with increased sugar content;
2. Offering subsidies for producers in order to implement recipes with reduced sugar content;
3. Reformulating products to reduce sugar content and introducing changes in the text of food product labels to ensure that consumers are informed about the nutritional content;
4. Increasing the degree of collaboration and openness between the authorities and representatives of the food industry and public food establishments to promote social marketing favorable to public health;
5. Promoting and creating a favorable environment for increasing the consumption of fruits and vegetables;
6. Increasing the literacy level of the population about the importance of healthy eating and offering counseling services in different circumstances (in medical institutions, kindergartens, schools, workplaces, families and communities).

CONFLICT OF INTERESTS

Authors declare no conflict of interests.

ETHICAL APPROVAL

No, the opinion from the ethics committee.

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