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EXPLORATORY ANALYSIS OF NUTRITIONAL SECURITY IN THE REPUBLIC OF MOLDOVA

Scientific Speciality: 253.04 Food Security

Summary of the doctor habilitat thesis
in engineering sciences

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The public defense will take place on the **27 of June 2024, at 9.00**, in the Meeting of the Commission for public defense at the Technical University of Moldova, 9/9 Studentilor str., academic building nr. 5, lecture hall 5-1, MD-2045.

The doctoral thesis and summary can be consulted at the Technical University of Moldova library and on the ANACEC website (www.anacec.md).

The summary was sent on the 27 of May 2024**.**

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CUPRINS

CONCEPTUAL LANDMARKS OF THE RESEARCH

Actuality and importance of the topic addressed. Global food security and nutrition continue to be at the top of the development agenda. In an era of fiscal responsibility, global investment in nutrition is one of the most cost-effective public health approaches. The World Bank, in 2024, included food and nutrition security among the eight global challenges that must be addressed at scale and mobilized $45 billion in resources to address the issues and protect livelihoods worldwide, surpassing its initial commitment of $30 billion, announced in May 2022 (Andree et al., 2024). To improve nutrition, United Nations agencies have made efforts to improve the nutritional level of populations, especially in developing countries (Mahal et al., 2023). The American Heart Association recently called for updating US food policies and programs to promote equity in nutrition security and reduce nutrition-related health disparities. The American College of Physicians has declared a national imperative to "eliminate food and nutrition insecurity and recognize the fundamental right of adequate access to healthy food." The Academy of Nutrition and Dietetics has strongly supported national policies addressing nutrition security, health equity, and diet-related disease prevention (Holben and Marshall, 2017; Poblacion et al., 2022).

Approaching nutrition security through a health equity lens is critical. People experiencing food insecurity are at greater risk of poor nutrition and diet-related conditions. A World Bank study estimated that the global cost of undernutrition, in terms of lost productivity and human capital, was US$3.5 trillion/year, and nutritional security can lead to reduced healthcare costs by preventing diet-related diseases. This, in turn, reduces the burden on health systems. The share of "out-of-pocket expenses" (OOPE) in total health expenses is approximately 47%. In the annual FAO report on the state of food security in the world (2023), the Republic of Moldova is positioned with a moderate or severe food insecurity rate of 23.5%. About 90% of all deaths registered annually in the Republic of Moldova are due to non-communicable diseases, of which diseases of the circulatory system (CVD), cancers, diabetes and respiratory diseases are responsible for about four out of

ten cases of primary disability and about 80% of mortality. Most of the data, at the country level, based on which various indicators of food and nutritional security are estimated, belong to international organizations. A national nutrition security analysis can help address nutrition disparities to achieve national and global health goals.

The purpose of the research is to realize an exhaustive exploratory analysis of nutritional security in the Republic of Moldova and develop indicators and tools for assessing FNS at the national level to ensure public health and well-being.

Objective 1. Retrospective analysis of nutritional security in the world and the Republic of Moldova and the identification of actions and strategies to ensure it.

Objective 2. Development of the national Healthy Food Basket, aligned with the Nutritional criteria of a Healthy Diet:

- Estimation of the nutritional quality of the current Minimum Consumption Food Basket in the Republic of Moldova ($MCFB_{MD}$);
- Development of a national Healthy Food Basket (HFB_{MD}), aligned to the Nutritional Criteria for Diet Evaluation, in accordance with the Healthy Diet Basket standard.

Objective 3. Quantifying the economic accessibility of food baskets by applying standardized methods and indicators.

Objective 4. Development of nutritional security assessment models through the lens of public policies:

- Development of a multidimensional model for evaluating Nutritional Security through the lens of national public policies;
- Development of a model for assessing the level of support for people with gluten consumption disorders.

Objective 5. Development of a diet- and individual-centred nutritional assessment app and software:

- Development of the Health Nutrition Assistant (HN Assistant) application for evaluating the nutritional quality of food and

the degree of fulfilment of nutrient requirements concerning dietary reference values;

- Development of software for nutritional assessment of people with special nutritional needs.

Research hypotheses:

1) National nutritional policies are deficient in many dimensions of nutritional security, and most existing policies are not aligned with the goals of promoting healthy diets.
2) The Minimum Food Basket existing in the Republic of Moldova does not align with the criteria of a healthy diet (according to FAO and WHO standards), and the accessibility of the basket could indicate a higher poverty threshold than is officially stated.
3) The development of a national Healthy Food Basket, as a determinant of food and nutritional security, is conditioned by the general balance of food groups, intended to ensure the adequacy of macro- and micronutrients and long-term health.

Scientific novelty and originality. For the first time in the Republic of Moldova, nutritional security was addressed through the FAO-Healthy Diet Basket indicator, and a national HFB was developed to align with the nutritional criteria of a healthy diet. HFB affordability was calculated by applying the International Poverty Line (IPL) and the International Food Poverty Line (IFPL) indicator. Nutritional security was assessed through five categories of national public policies.

The results obtained contribute to the solution of a significant scientific problem. An exhaustive analysis of nutritional security at the national level was carried out through the lens of standardized indicators. The Minimum Consumption Food Basket was evaluated according to FAO standards. The Healthy Food Basket was developed by applying a Healthy Diet Basket indicator. The accessibility of $MCFB_{MD}$ and HFB_{MD} was calculated, and results were obtained regarding the number of people in the Republic of Moldova living below the absolute poverty line.

Two models have been developed to assess nutritional security through the lens of national public policies: The general multidimensional model (including 33 items), developed by applying Healthy Diet for a Healthy Life standards and a holistic approach; Model for evaluating the level of assistance of people with special nutritional needs. An application to assess the nutritional quality of food and nutritional software for nutrition students has been developed.

The theoretical significance consists in the scientific argumentation of the non-compliance of the MCFB, existing in the Republic of Moldova, with the Criteria of a Healthy Food Basket and that it can be qualified as a Basket with an Adequate Intake of Nutrients (as defined by FAO).

Empirical and argued evidence was brought concerning the correspondence of the national CAS_{MD} options, developed with the qualification of Healthy Food Basket, by adapting the basket to the national anthropometric peculiarities and validating it through the food security indicator - the Mean Adequacy Ratio.

The determinants of the nutritional security assessment model were outlined and argued through the lens of national public policies by applying the Healthy Diet for Healthy Life model. The block diagrams of the SNUTM application and software were discussed, and the parameters and biomarkers included were justified.

Application value: The developed HFB_{MD} directly affects the size of the indexation of certain social payments and can be applied at different levels of governance, serving as an indicator to measure the official poverty line of a country, as well as to inform and manage social health policies. The Health Nutrition Assistant (HN Assistant) app assesses the nutritional quality of foods. It will facilitate consumers in making informed and conscious dietary decisions and encouraging a healthy lifestyle. The SNUTM Software will enable nutrition students to better learn the concepts and the principles of nutrition, to more effectively manage the nutritional therapy of people with special dietary needs.

Approval of scientific results: about 26 scientific conferences, including International Conference on Nanotechnologies and Biomedical Engineering, ICNBME 2023; the 3-rd international Conference on Food and Nutrition: Hungary, August 25, 2022 (plenary presentation); International Conference on Gastronomy, Food and Nutrition, 2022, Turkey, Antalya; International Scientific Conference „Women in research: destinies, contributions, perspectives", 9th edition, Iași - Chişinău - Lviv, 8-9 February 2024; International Conference Modern Technologies in the Food Industry, UTM, Chisinau, October 20-22, 2022 (plenary presentation); Scientific Conference Yesterday's cultural heritage - implications for the development of tomorrow's sustainable society, Chisinau, February 9-10, 2023, 7th edition (plenary presentation); International Scientific Symposium "Modern Trends in Higher Agricultural Education", UTM. October 5-6, 2023 (plenary presentation) etc.

Publications on the subject of the thesis: The obtained results are reflected in 38 scientific works, including a monograph, a chapter in the monograph, 13 scientific articles – in journals from the databases indexed in Web of Science and Scopus, 12 articles – in other foreign journals recognized, 11 articles - in those from the National Register of professional journals, 10 invention patents, 36 articles - in collections and summaries at national and international scientific events.

Volume and structure of the thesis: The thesis contains Introduction, six chapters, Conclusions and Recommendations, 212 pages of basic text, bibliography of 358 titles, 39 tables and 61 figures.

1. GLOBAL SYNDEMIC OF MALNUTRITION - DETERMINANT OF NUTRITIONAL INSECURITY

Food and nutrition security (FNS) remains one of humanity's critical challenges, being included by the World Bank in the eight priority global challenges. FAO and WHO report, including the European Health Information Gateway Portal, highlight worrying trends, such as high rates

of food insecurity and the significant presence of overweight and obesity among adults and children in the Republic of Moldova. Despite progress in certain areas, such as the promotion of exclusive breastfeeding, the Republic of Moldova still faces significant challenges in reaching key targets on nutrition, anemia and food-related NCDs (Siminiuc and Țurcanu, 2022; Țurcanu and Siminiuc, 2023a). Also, at the national level, there are significant gaps in the assessment and monitoring of nutritional security. The lack of a responsible entity and the fragmentation of information on nutritional risk factors represent significant challenges in public health management. Nutritional policies in the Republic of Moldova are at an early stage, with uncertain progress in reducing malnutrition and ensuring adequate nutrient intake (Siminiuc and Țurcanu, 2022; Țurcanu and Siminiuc, 2023a). The coordination and implementation of these policies remain weak, and the responsibilities between institutions - are unclear. Existing strategies and programs do not fully cover the nutrition dimension, and reforms and realignments to international standards and the SDGs are needed.

It becomes imperative to conduct more comprehensive and consistent surveys for a more accurate assessment of food security at the individual and household levels, including availability, access and utilization dimensions. A comprehensive and coordinated approach is needed to develop reliable and relevant indicator sets for measuring and monitoring FNS at the national level.

2. RESEARCH METHODOLOGY

The methods used in the SAN analysis, evaluation and monitoring process must be robust, transparent and adapted to the specific context of each country. The summary of the methods applied to achieve the research objectives is presented in Table 1.

Table 1. Research methods applied in the realization of the thesis and the chapters where they are found

Used methods	No. of the chapter	Source
Empirical research methods (observation, comparison, measurement, etc.)	C. 1 and C. 3	(European Food Safety Authority (EFSA), 2017; Saturated fatty acid and trans-fatty acid intake for adults and children, 2023).5/27/2024 11:42:00 AM
Evaluation of the Minimum Consumption Food Basket according to FAO standards	C. 3	(Herforth et al., 2022; Siminiuc and Țurcanu, 2024a, 2024b)
FNS Indicator - Mean Adequacy Ratio (MAR)	C. 3	(Herforth et al., 2022; Vermeulen et al., 2023)
Development of the Healthy Food Basket based on the FAO Healthy Diet Basket (HDB) standard (developed by the author and fully described in chapter 3)	C. 3	(Herforth et al., 2022)
Estimation of the nutritional and energy quality of the cost of the Healthy Food Basket (HFB_{FAO})	C. 3	(Bai et al., 2022, 2021; Herforth et al., 2022)
Cost and accessibility of the Food Basket	C. 4	
Development of the Health Nutrition Assistant app	C. 5	(Herforth et al., 2022; López et al., 2017)**5/27/2024 11:42:00 AM**
International Poverty Line Indicator (IPL)	C.4	(Bai et al., 2021; FAO, 2023; World Bank, n.d.)**5/27/2024 11:42:00 AM**
International Comparison Program – Food Prices for Nutrition	C.4	(Bai et al., 2022; Herforth et al., 2022)
Identification and calculation of dietary reference values	C. 3 and C. 5	(European Food Safety Autority, 2024; Gibson and Cooke, 2017; Gibson, 2005)

Global Food Security Index	C. 5	(The Economist Intelligence Unit, 2019; The Economist Group, 2022)
Evaluation of Nutritional Security through the Public Policy Indicator, based on the Healthy Diet for a Healthy Life program (a model developed by the author)	C. 5	(PEN EU, 2019; Pescud et al., 2018)
The model for assessing the level of assistance for people with special nutritional needs through the lens of public policies (model adapted and created by the author)	C. 5	(Blomhoff et al., 2023; European Food Safety Authority, 2024; Fanzo, 2023; Pollard, 2003; The State of Food Security and Nutrition in the World 2022, 2022; The State of Food Security and Nutrition in the World 2023, 2023; WHO and Ministerul Sănătății al Republicii Moldova, 2021)
Application development (developed on the specialized server http://shiny.io/, R language) and nutritional assessment software (through the information system based on the Embarcadero RAD Studio Alexandria Edition platform) and the systemic approach to the Nutrition Assistance Process (a system developed by the author)	C. 6	(Țurcanu and Siminiuc, 2023b)5/27/2024 11:42:00 AM

3. HEALTHY FOOD BASKET - A CRITICAL COMPONENT OF FOOD AND NUTRITION SECURITY

A food basket can be defined as a Healthy Food Basket (HFB) if it provides a balance between food groups and satisfies a set of dietary recommendations aimed at ensuring nutrient adequacy and long-term health (Cost and affordability of healthy diets across and within countries, 2020; FAO, 2023). The need to develop an HFB started from the

hypothesis that MCFB, existing in the Republic of Moldova, does not align with the criteria of a healthy diet FAO and WHO, and the development of an HFB is imposed as a national interest priority.

To confirm or deny the hypothesis, two objectives were set: Estimation of the nutritional quality of MCFB by applying the Nutritional Criteria for Diet Evaluation and development of a HFB_{MD} based on the Healthy Diet Basket standard (Figure 1).

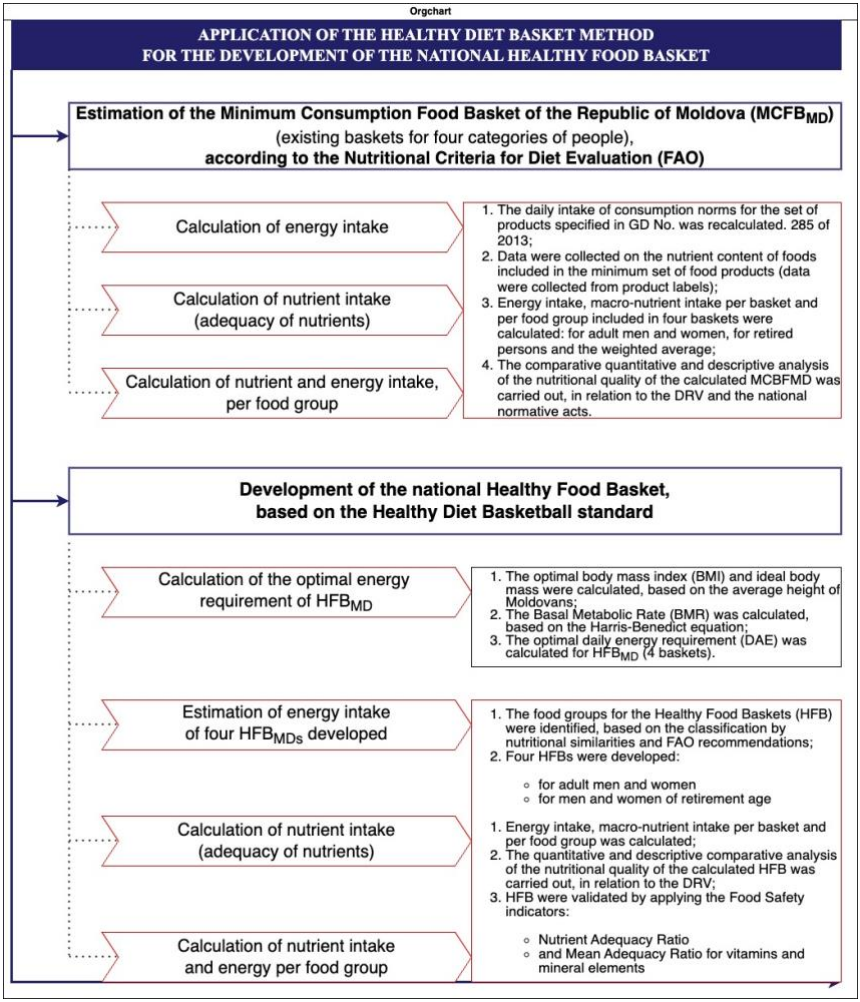

Figure 1. Research design. Development of the Food Basket of the Republic of Moldova

Source: Fully developed by the author

The MCFB options (existing) in the Republic of Moldova include minimum sets of food products, determined based on the minimum physiological norms (in energy and nutrients) of different socio-demographic groups, approved by WHO recommendations (Biroul Național de Statistică, n.d.). The size of the basket directly affects the indexation of various social payments such as pensions, maternity benefits, child benefits, disability and unemployment benefits (Platforma informativă Dzen.ru, 2023).

3.1. Estimation of the adequacy of energy and nutritional intake to $MCFB_{MD}$ options

The application of the Nutritional Evaluation Criteria for the Diet (CNED) is necessary to estimate the quality of baskets. It involves measurements according to three parameters: energy adequacy, nutritional adequacy, and energy and nutritional adequacy by food groups.

Estimation of adequacy of energy and nutrient intake. The research started with the analysis of the energy intake for four existing options of MCFB: for adults (men and women), pensioners and the weighted average, according to the classification in GD No. 285 (Guvernul Republicii Moldova, 2013, p. 285) (Table 2). To estimate the energy and nutritional adequacy of MCFB, the values obtained from the calculations were compared with the values for the same basket options specified in the GD, with the Dietary Reference Values (DRV) and with the FAO recommendations (European Food Safety Authority (EFSA), 2017; *The State of Food Security and Nutrition in the World 2023*, 2023). The calculated energy values of $MCBF_{MD}$ are close to the values established by GD for the same socio-demographic categories of the population: the calculated $MCBF_{MD}$ presents values between 1986.5...2776.5 kcal/day, and in $MCBF_{HG}$, the values are between 2122.9 …2807.8 kcal/day (Table 2).

Table 2. Daily share of energy and nutrients of $MCFB_{MD}$ verso DRV, FAO recommendations and values stipulated in GD No. 285

Nutrients of interest	U.M.	Calculated MFCB				DRV (EFSA)		FAO	MFC_{GD}			
		m	w	p	w.a.	w	m	Inter-vals	m	w	p	w.a.
		%	%	%	%	%		%	%	%	%	%
Proteins, total	% E	12,9	12,2	12,3	12,7	10…20		10-35	13,4	13,2	13,1	13,2
Animal proteins	% E	4,2	3,6	3,6	4,1				5,2	5,2	5,1	5,6
Total fat	% E	28,9	28,7	27,3	29,3	20…35		20-35	30,6	30,3	30,2	31,1
Carbohy-drates, total	% E	58,3	59	60,5	58,0	45…60		45-65	55,2	55,6	55,6	55,0
Fibre	g/d	36,5	28,9	24,9	29,4	23,1…27,0			n.s.	n.s.	n.s.	n.s.
E (MJ x 1,6)	Kcal	2777	2293	1986	2330	1839…2149	2269…2675	2330	2808	2369	2096	2400

Source: Made by the author. Values for CAMCMD – obtained from own calculations; VDR and FAO values:(*Carbohydrate intake for adults and children*, 2023; *The State of Food Security and Nutrition in the World 2023*, 2023; Committee on the Dietary Reference Intakes for Energy et al., 2023; European Food Safety Authority (EFSA), 2017; FAO, 2018; Guvernul Republicii Moldova, 2013, p. 285; WHO, 2023).

DRV- dietary reference values, n.s. – not specified; m - men; w – woman; p - pensioners, w.a. - weighted average

The calculated MCBF comes with a higher intake of energy from carbohydrates (58.0...60.5 %) compared to the $MCBF_{HG}$, where the proportion of carbohydrates is 55.0...55.6 %. The actual calculated values of protein and lipid weight in CAMC MD are, on average, 0.7% and 1.9% lower than the values specified in GD, in contrast to carbohydrate weight, which is 3.5% higher. The values were compared with reference standards for an exhaustive picture and for informed further action. Calculated energy intake from protein and fat in all $MCBF_{MD}$ options was determined to be within the ranges recommended by FAO and DRV (European Food Safety Authority (EFSA), 2017) (Table 2).

Total fat intake > 35% of energy may be compatible with well-being and average body weight, depending on dietary patterns and physical activity levels. The panel proposes to set the lower limit of the reference daily intake range for adults at 20% of energy and an upper limit of 35% of energy (European Food Safety Authority (EFSA), 2017).

The daily energy share of carbohydrates (58.0%...60.5%) is at the upper end of the DRV ranges (45-60), except for the value in MCFB MDp, which exceeds the DRV by 0.5% but falls within the FAO recommendations (45...65 %), without exception. Based on the risk of developing chronic metabolic diseases and dental caries, the EFSA panel concluded that the intake of added and free sugars should be as low as possible in the context of a nutritionally adequate diet (EFSA Panel on Nutrition, Novel Foods and Food Allergens (NDA) et al., 2022). EFSA (2022) found moderate evidence for a causal relationship between higher *ad libitum* intake of added and free sugars and the risk of obesity and dyslipidaemia. The effect on body weight appears to be mediated mainly by changes in energy intake (EFSA Panel on Nutrition, Novel Foods and Food Allergens (NDA) et al., 2022; Hjelmesæth and Sjöberg, 2022).

The fibre intake in the $MCFB_{MD}$ options is between 28.9 and 36.5 g/day for adults, and the weighted average and 24.9 g/day fibre - for people of retirement age. These values exceed the EFSA recommendation of 25 g/day but are similar to the WHO and Nordic Nutrition Recommendations (NNR) (Blomhoff et al., 2023; Siminiuc and Țurcanu,

2024b). Research and calculations made regarding the estimation of macro-nutrient content and determinations about their energy weight suggest an energetic and nutritional adequacy of the four existing $MCFB_{MD}$ options.

3.2. Estimation of the adequacy of energy and nutritional intake of $MCFB_{MD}$ options by food groups

To assess whether MCFB options qualify as HFB, they were evaluated for adequate energy and nutrient intake by food group.

Estimation of protein intake adequacy. According to the calculations obtained, in all $MCBF_{MD,}$ *Bread and bakery products* provide the highest protein intake, with values between 32.4 and 43.5 g/day, far exceeding the intake of the same nutrient from the *Meat and meat products* group (10,7... 19.6 g/day), from *Fish and fish products* (3.9...5.8 g/day) and the *Milk and dairy products* group (2.8...3, 1 g/day). The results obtained are explained by the consumption norms of the first group, which vary in the range of values 349.8 ... 461.6 g/day, depending on the socio-demographic group of the basket. The share of proteins from *Milk and dairy products* varies between 2.8 and 3.1g/day (Tabel 3). The number of items taken into account for the estimation of energy and nutrient intake for the *Bread and bakery products* group was the largest: it included 151 products, ensuring the data's robustness. The nutritional quality of bakery products sold in the Republic of Moldova was investigated in a separate study, and the results were used in that research (Siminiuc et al., 2024; Siminiuc and Țurcanu, 2024b; Țurcanu, 2023).

Table 3. Daily protein (P) and lipid (L) intake of $MCBF_{MD}$ by product groups

Calculated parameters	*n*	$MCFB_{MDm}$		$MCFB_{MDw}$		$MCFB_{MDpm}$		$MCFB_{MDw.a.}$	
		P, g	L, g	P, g	L, g	P, g	L, g	P, g	L, g
Bread and bakery products									
AVERAGE		6,2	1,3	5,2	1,1	4,6	1,0	5,0	1,0
STDEV.S		6,3	1,9	5,2	1,5	4,3	1,3	5,2	1,0
TOTAL	168	43,5	9,1	36,5	7,5	32,4	6,9	35,2	7,2
Meat and meat products									
AVERAGE		2,8	2,8	1,9	2,1	1,5	1,7	2,2	2,3
STDEV.S		3,4	2,5	1,7	1,7	1,3	1,3	2,3	1,6
TOTAL	15	19,6	19,7	13,0	14,8	10,7	11,9	15,5	15,8
Milk and dairy products									
AVERAGE		2,2	2,1	2,3	1,9	2,2	1,6	2,3	1,9
STDEV.S		1,9	1,3	1,6	0,7	1,7	0,6	1,7	0,8
TOTAL	11	2,9	2,4	3,1	2,3	2,8	2,0	3,1	2,4
Eggs	2	0,4	0,3	0,3	0,2	0,2	0,1	0,3	0,3
Fish and fish products									
AVERAGE		2,9	0,6	2,0	0,5	1,9	0,5	2,2	0,5
STDEV.S		1,1	0,0	0,3	0,1	0,3	0,1	0,7	0,1
TOTAL	5	5,8	1,3	3,9	0,9	3,9	0,9	4,3	1,0

Continued, Table 3

Calculated parameters	*n*	$MCFB_{MDm}$		$MCFB_{MDw}$		$MCFB_{MDpm}$		$MCFB_{MDw.a.}$	
		P, g	L, g	P, g	L, g	P, g	L, g	P, g	L, g
Sugar and confectionery (in sugar equivalent)									
AVERAGE		0,2	1,1	0,1	1,0	0,1	0,6	0,1	0,9
STDEV.S		0,2	1,5	0,2	1,4	0,1	0,7	0,1	1,2
TOTAL	4	0,5	3,2	0,4	2,9	0,3	1,7	0,4	2,6
Fats									
AVERAGE		0,1	9,9	0,1	8,4	0,1	7,2	0,1	8,3
STDEV.S		0,1	13,2	0,1	11,3	0,1	10,1	0,1	11,1
TOTAL	7	0,4	39,4	0,3	33,7	0,2	28,8	0,3	33,4
Potatoes	1	7,6	1,5	6,2	1,2	5,4	1,1	6,3	1,3
Vegetables									
AVERAGE		0,5	0,1	0,3	0,0	0,3	0,0	0,4	0,1
STDEV.S		0,4	0,1	0,3	0,0	0,3	0,0	0,3	0,0
TOTAL	10	5,0	0,7	3,5	0,5	3,2	0,4	3,9	0,5
Curcubitaceae	2	0,1	0,1	0,0	0,0	0,0	0,0	0,1	0,0
Fruits, berries and fruit products									
AVERAGE		0,2	0,5	0,1	0,3	0,1	0,3	0,1	0,1
STDEV.S		0,2	0,9	0,1	0,5	0,1	0,6	0,1	0,1
TOTAL	6	3,5	11,3	2,8	9,1	1,9	6,3	3,2	10,4

Source: Fully developed by the author, following the collection of nutritional information, the compilation of the nutrient list and the calculation; Consumption norms - taken from: (Guvernul Republicii Moldova, 2013, p. 285) ; MCFB - minimum consumption food basket; n- No. of items; m - men; w – woman; p - pensioners, w.a. - weighted average

Estimation of the adequacy of lipid intake. Fat intake in all $MCBF_{MDs}$ was calculated to be within the range of 73.2...89.9 g/day in adult men and women, and the weighted average, but is considerably lower in pensioners – 60.2 g/day (Table 3).

According to the results obtained, the total intake of fats in all baskets varies between 28.9...39.4% and is primarily due to the *Fat* group, which provides between 7.2 and 9.9 g/day, with standard deviations from 10.1…13.2 g/day. A lower intake of lipids follows the group *Meat and meat products* (11.9...19.7 g/day) due to the daily amounts of this group of products, between 60.2...107.5 g/day: total fat intake in this group is 11.9...19.7 g/day, with a mean of 1.7...2.8 g/day and standard deviations between 1.3 ...2.5 g/day. *Bread and bakery products,* as well as *Meat and meat products,* owe their intake (6.9...9.1 g/day) to the large share they represent in all $MCBF_{MD}$ (Table 3). At the lowest observed intake of total fat (20% of total energy) in European countries, no obvious signs of deficiencies or adverse effects on blood lipids were observed (European Food Safety Authority (EFSA), 2017).

Estimating the adequacy of carbohydrate intake. The calculations made during the research showed that the intake of carbohydrates in all $MCBF_{MD}$ options was between 300.1 and 404.6 g. The *Bread and bakery products* group provides $MCBF_{MD}$ with 209.1...267.6 g/day, followed by the *Potato* group (43.8...62.2 g/day), *Sugar* (23.8...36 .5 g/day) and *Vegetables* (13.2...21.4 g/day). These three product groups cover baskets with 276.7...366.3 g of carbohydrates. Added sugar in $MCBF_{MD}$ (included in the Sugar and confectionery group) varies between 19.7 and 29.6 grams. Although the consumption of Fruits constitutes 59.8...107.5 g/day, they come with an intake to $MCBF_{MD}$ of only 6.5...11.7 g/day of carbohydrates. Only the $MCFB_{MD}$ for men includes an amount of fruit and vegetables that exceeds the minimum threshold of 400 g/day recommended by the FAO for a healthy diet. For women and elderly people, including the weighted average, these values are below the limit (Table 4).

Table 4. Daily carbohydrate (CH), fibre (F) and energy (E) intake of $MCBF_{MD}$ by product groups

Product groups	*n*	$MCFB_{MD\ m}$			$MCFB_{MD\ w}$			$MCFB_{MD\ pm}$			$MCFB_{MD\ wa}$		
		HC,g	F, g	E, kcal	CH, g	F, g	E, kcal	CH,g	F, g	E, kcal	CH,g	F, g	E, kcal
Bread and bakery products													
AVERAGE		38,2	3,0	189,5	32,6	2,5	161,1	29,9	2,2	146,8	31,1	2,4	154,0
STDEV.S		41,3	3,7	205,5	34,9	3,0	172,7	29,1	2,5	143,7	31,1	2,4	154,0
TOTAL	168	267,6	21,3	1326,3	228,4	17,5	1127,4	209,1	15,4	1027,6	218,0	16,9	1077,8
Meat and meat products													
AVERAGE		0,2	0,0	37,4	0,2	0,0	27,2	0,1	0,0	21,9	0,2		
STDEV.S		0,2	0,0	33,1	0,2	0,0	19,6	0,1	0,0	15,1	0,2		
TOTAL	15	1,5	0,0	261,6	1,2	0,1	190,1	0,9	0,0	153,1	1,5	0,1	210,5
Milk and dairy products													
AVERAGE		0,6	0,0	30,2	0,8	0,0	29,3	1,2	0,0	28,4	0,8	0,0	29,6
STDEV.S		0,7	0,0	13,2	1,3	0,0	6,8	2,2	0,0	14,5	1,2	0,0	8,6
TOTAL	11	1,7	0,0	40,4	2,1	0,0	41,7	2,2	0,0	38,1	2,1	0,0	41,7
Eggs	2	0,0	0,0	4,6	0,0	0,0	2,8	0,0	0,0	2,0	0,0	0,0	3,9
Fish and fish products													
AVERAGE		0,0	0,0	17,3	0,0	0,0	12,0	0,0	0,0	11,8	0,0	0,0	13,1
STDEV.S		0,0	0,0	4,2	0,0	0,0	0,1	0,0	0,0	0,1	0,0	0,0	2,5
TOTAL	5	0,0	0,0	34,6	0,0	0,0	24,0	0,0	0,0	23,6	0,0	0,0	26,2
Sugar and confectionery (in sugar equivalent)													
AVERAGE		12,2	0,1	58,8	10,4	0,1	50,8	7,9	0,1	37,3	10,6	0,1	50,7
STDEV.S		15,2	0,1	55,4	12,5	0,1	44,8	10,2	0,1	36,8	13,4	0,1	48,2
TOTAL	4	36,5	0,2	176,3	31,1	0,2	152,3	23,8	0,2	112,0	31,8	0,2	152,2

Continued, Table 3

Product groups	*n*	$MCFB_{MDm}$			$MCFB_{MDw}$			$MCFB_{MDpm}$			$MCFB_{MDwa}$		
		CH,g	F, g	E, kcal	CH, g	F, g	E, kcal	CH,g	F, g	E, kcal	CH,g	F, g	E, kcal
Fats													
AVERAGE		0,0	0,0	89,1	0,0	0,0	76,1	0,0	0,0	65,1	0,0	0,0	75,5
STDEV.S		0,0	0,0	118,3	0,0	0,0	101,0	0,0	0,0	90,7	0,0	0,0	99,9
TOTAL	7	0,1	0,1	356,5	0,0	0,1	304,4	0,0	0,0	260,6	0,1	0,1	301,8
Potatoes	1	62,2	5,3	293,1	50,7	4,4	238,9	43,8	3,8	206,3	51,4	4,4	242,1
Vegetables													
AVERAGE		2,1	0,6	10,8	1,4	0,4	7,5	1,3	0,4	6,8	1,6	0,5	8,3
STDEV.S		1,7	0,5	8,6	1,3	0,4	6,7	1,1	0,3	5,8	1,3	0,4	6,8
TOTAL	10	21,4	6,3	112,3	14,6	4,2	76,5	13,2	3,8	69,2	16,4	4,8	86,2
Curcubitaceae	2	1,9	0,2	8,4	0,7	0,1	3,1	0,6	0,1	2,5	1,1	0,1	5,0
Fruits, berries and fruit products													
AVERAGE		2,0	0,4	13,2	1,6	0,3	9,3	1,1	0,2	7,7	2,2	0,4	10,0
STDEV.S		2,2	0,3	11,1	1,6	0,3	6,9	1,0	0,2	6,4	2,1	0,3	9,5
TOTAL	6	11,7	3,0	162,4	9,5	2,4	131,6	6,5	1,7	90,4	10,8	2,8	150,0

Source: Fully developed by the author, following the collection of nutritional information, the compilation of the nutrient list and the calculation; Consumption norms - taken from: (Guvernul Republicii Moldova, 2013, p. 285); MCFB - minimum consumption food basket

Food baskets ensure an intake of 15.4...21.3 g/day of fibre from *Bread and bakery products*, 3.8...6.3 g/day from *Vegetables*, 3.8...5.3 g/day from *Potatoes* and 1.7…3.0 g/day of *Fruits*. The European Food Safety Authority Group recommends an adult's daily fibre intake of 25g (EFSA Panel on Dietetic Products, Nutrition, and Allergies (NDA), 2010; European Union Law, 2011). Food and Drug Administration (FDA) - has raised the dose from 25 to 28 g/day of fibre for every 2000 kcal, and other organizations recommend even up to 35 g/day of fibre (European Commission, 2021) (Table 4).

From the total food groups included in the $MCFB_{MD}$ of adults (men and women), the group *Bread and bakery products* have priority in terms of quantitative intake and constitute about 389.3...461.6 g/day (25%), followed by the *Potato* group - with 311.0...381.7 g/day (20%). Taken together, these two starchy groups cover 45% (700.3...843.3 g/day) of all the products in the basket, which, in turn, generate 1366.2...1619.4 kcal/day (59.6% of the basket's total energy) (Figures 2 and 3). $MCFB_{MD}$ options include 227.8...332.7 g/d of vegetables and 97.6...135.8 g/d of fruit. The energy intake of *Fruits* and *Vegetables* is only 283.1 kcal/day for men and 211.2 kcal/day for women (Figures 2 and 3). The *Meat and meat products* group comes with a quantitative intake of 107.5 g/day for men, about 34 g/day more, compared to 73 g/day of $MCFB_{MDW}$. This group of products provides between 190.1 and 261.6 kcal/day of the total daily energy (8.3...9.4%). *Fish and fish products* provide 24.0...34.6 kcal/day (1.0...1.2% of total energy). The *Fat* group constitutes 35.6...42.7 g/day (of both animal and plant origin), the equivalent of 304.4...365.5 kcal/day, ensuring 12.8% of the daily energy intake of men and 13.3% of the daily energy intake of women. From the point of view of the daily energy weight, this type of food is placed after *Bread and bakery products*. $MCFB_{MD}$ also includes 41.4...35.8 g/day of *Sugar and confectionery* (in sugar equivalent), which in turn generates 152.3...176.3 kcal (6 .6...6.3% of the total VE of $MCFB_{MD}$) (Figures 2 and 3).

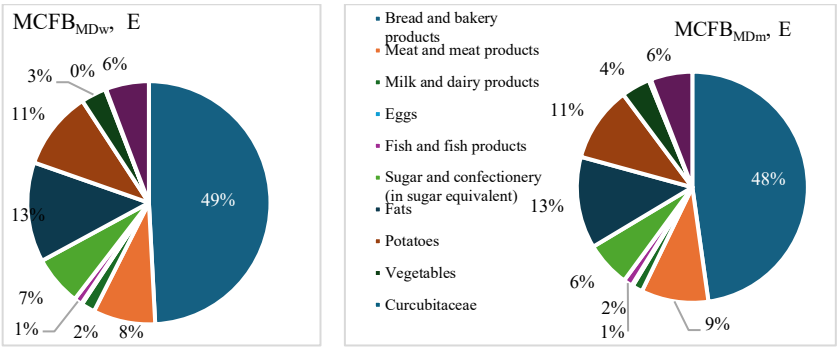

Figure 2. Daily energy share of food groups of MCBF$_{MDw}$ and MCBF$_{MDm}$, %

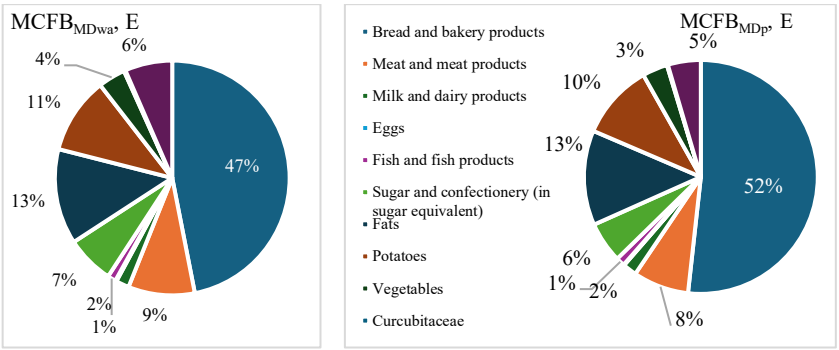

Figure 3. Daily energy share of food groups of MCBF$_{MDp}$ and MCBF$_{MDwa}$, %

Source: Made entirely by the author based on his calculations and estimates
MCFB - Minimum Consumption Food Basket; HFB - Healthy Food Basket; m – men; w-women; pm – pensioner men; wa - weighted average; E - energy

The quantitative intake of the food group *Milk and dairy products* is very close to both women and men, as well as to the weighted average of the MCFB$_{MD}$, oscillating between 375.5 and 378.7 g/day. Although, quantitatively, this food group is the third after Potatoes, the energy intake is relatively low - about 40.4...41.7 kcal/day (1.5...1.8 % E) (Figures 2 and 3).

The quantitative distribution of food groups included in the $MCFB_{MD}$ of retirees is similar to the basket for working-age adults, but the energy share in these groups differs slightly. Thus, *Bread and bakery products* have a greater weight, exceeding half of the basket's total energy (51.8% E). The energy share in Grăsimi is 13.1%, equal to that of $MCBF_{MDw}$. *Meat and meat products* provide about 7.7% of total calories (lower value, compared to the same intake for women) (Figures 2 and 3).

The existing $MCBF_{MD}$ options have considered a diversity of foods. Still, the distribution of these foods by product groups does not take into account nutritional similarities, which is not aligned with international standards and food baskets of other countries (Grosso and Di Cesare, 2021; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2020). The $MCBF_{MD}$ also includes food groups with little or no nutritional density incompatible with a healthy diet. The obtained results demonstrate that the evaluated $MCFB_{MD}$ options ensure energy and nutritional adequacy but do not ensure an adequate distribution of food groups. Accordingly, MCFBs cannot be qualified as Healthy Food Baskets, which justifies the necessity and importance of developing a national HFB.

3.3. Development of the national Healthy Diet Basket by applying the Healthy Diet Basket standard

To develop a national Healthy Food Basket (HFB) for adults (men and women) and people of retirement age (men and women), adapted to national particularities but also aligned with the nutritional criteria for diet evaluation and following the recommendations WHO and FAO, calculated the optimal energy and dietary requirements of a national healthy food basket (HFB_{MD}), corresponding to an ideal BMI (Table 5).

Table 5. The optimal daily energy requirement of HFB_{MD} options to be developed

Person categories		**Q-coefficient (is unchangeable)**						**PAL Sedentary**	**PAL Moderate**	**PAL Active**	**PAL Very activ**	**BMI**	**BMR**	**E**
	Age		**Body mass**		**Height**			**Physical activity level (PAL)**						
Examples	years	Q	kg	Q	meters	Q	Q	1,4	1,6	1,8	2,0	kg/m^2	kcal	kcal
Adult women	45	2,31	57,7	7,38	1,63	607	43	1,4	1,6	1,8	2	21,7	1354	2167
Adult men	45	5,08	66,5	9,56	1,75	573	260	1,4	1,6	1,8	2	21,7	1670	2672
Average (men &women)														2419
Women (pensioners)	70	2,31	57,7	7,38	1,63	607	43	1,4	1,6	1,8	2	21,7	1297	2074
Men (pensioners)	70	5,08	66,5	9,56	1,75	573	260	1,4	1,6	1,8	2	21,7	1543	2469
Average (retirement age men and women)														2272
Weighted average														2345
1 MJ = 238.83 kcal														

Source: Made entirely by the author, based on his own calculations and estimates; Q – fixed numerical coefficients, included in the Harris–Benedict Equations (H–B); PAL- physical activity level; BMI – body mass index; ER – energy requirement; BMR - Basal Metabolic Rate; E-energy

The need for proteins was calculated, starting from the recommendations (EFSA, NNR), that they provide 10-20% of the daily food ration and a lipid intake of about 30% of the energy ration. Carbohydrate energy intake was calculated as the difference between energy from protein and lipids (Table 6).

Table 6. Optimal nutrient requirements and their energy share for HFB_{MD} options

Nutriment	U.M.	HFB_{MDm}	HFB_{MDw}	HFB_{MDpm}	HFB_{MDpw}
Protein	%	15	15	15	15
	g	100,12	81,3	92,6	77,6
	kcal	400,5	325,5	370,5	310,5
Fats	%	30	30	30	30
	g	89,0	72,3	82,3	69,0
	kcal	801,0	651	741	621
Carbohydrates	%	55	55	55	55
	g	367,1	298,4	339,6	284,6
	kcal	1468,5	1193,5	1358,5	1138,5
Energy	kcal	2672	2167	2469	2074
Energy, approximate values	kcal	**2670**	**2170**	**2470**	**2070**

Source: Made entirely by the author based on his calculations; HFB - Healthy Food Basket

3.3.1. Assessment of CAS on energy and nutrient adequacy

Development of HFB.

The FAO Healthy Diet Basket (HDB) indicator supported the development of HFB options. For each of the seven food groups, mean nutrient values were calculated. For each group of products, the consumption norms of the products were identified and distributed in such a way that, in the end, they ensured the optimal energy requirement, calculated according to the H-B equation, as well as the nutrient requirement, calculated according to the DRV (Figure 4).

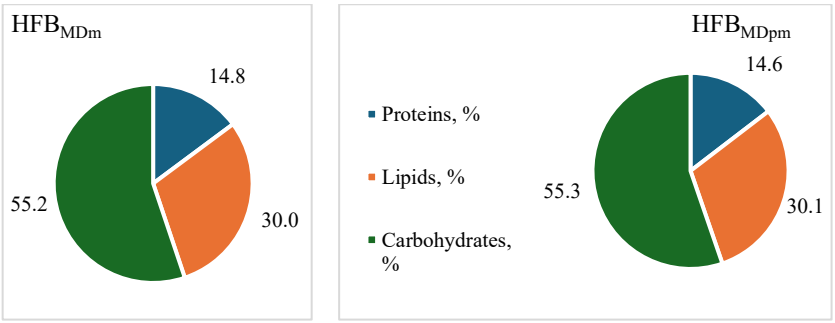

Figure 4. The energy share of nutrients in HFB$_{MDm}$ and HFB$_{MDpm}$, % of the daily energy ration

Source: Made entirely by the author based on his calculations; HFB - Healthy Food Basket; m-men; pm-pensioner men

According to calculations, HFB$_{MDm}$ provides a protein intake of 99 g/day, constituting 14.8% of the basket's daily energy ration (2670 kcal). According to dietary studies, average protein intake in European countries varies between 67 and 114 g/day in adult men and 59 to 102 g/day in women, or about 12 to 20 % of total energy intake (E%) for both sexes (Dekker et al., 2022; Ellinger et al., 2024; Fouillet et al., 2023).

89 g of lipids provide 30% of the basket's daily energy, and carbohydrates - 368 g complete the basket with 55.2% of the energy. The EFSA and WHO recommendations do not distinguish between the weight of nutrients for older people and adults. However, HFB$_{MDpm}$ requires a lower energy intake (200 kcal) compared to the basket for adult men, which provides 2470 kcal/day. Although the intake of energy and nutrients, respectively, is lower, the share of nutrients is similar in both baskets: 14.6% energy from proteins (90.2 g/day), 30.1% energy from lipids (82.7 g) and 55.3% energy from carbohydrates (341.3 g/day). The distribution of energy from nutrients aligns with the calculations made in research to identify the optimal HFB$_{MD}$ options (from the point of view of nutrient and energy intake) and with WHO and VDR recommendations. Two other baskets

developed are HFB_{MD} for adult women and women of retirement age, for which energy intake from nutrients was also calculated (Figure 5).

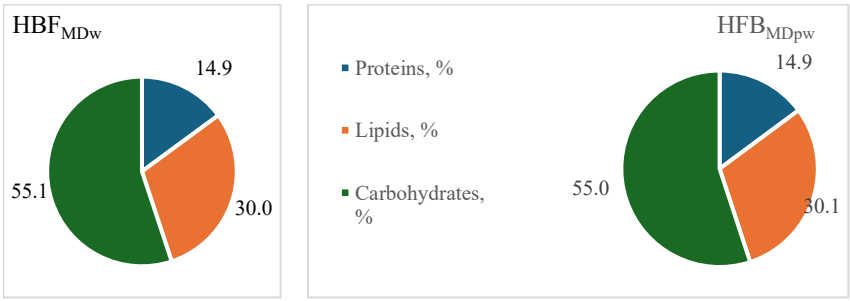

Figure 5. The energy share of nutrients from HFB_{MDw} and HFB_{MDpw}, % of the daily energy ration

Source: Made entirely by the author based on his calculations and estimates; HFB - Healthy Food Basket; w-women; pw-pensioners women

An optimal adequacy of the distribution of energy from nutrients was achieved by juggling with the consumption norms and following the recommendations with reference to a balanced diet. Thus, HFB_{MDw} provides 2170 kcal/day (in strict accordance with the calculations made), which comes from 80.9 g of proteins (14.9% energy), 72.3 g of lipids (30% energy) and 288.8 g of carbohydrates (55.1% energy). The exact ratio is observed at HFB_{MDpw}.

3.3.2. Estimating adequacy of energy and nutrient intake by food group

Nutrients alone do not explain the relationship between food and health, as food has many non-nutritive components, including but not limited to fibre, phytochemicals, the food matrix and interactions between them. Model HFB_{FAOs} have been developed from dietary guidelines, designed to show approximate proportionality of food groups by volume, similar to how foods appear on a plate and are intended to guide stakeholders in developing their HFBs. In all four HFB_{MDs} (adult men and women and men and women of retirement

age), the following conditions were met: the *Sugar and confectionery* group was not included; cooked sausages and meat semi-finished products were excluded from the *Meat and meat products* group, due to their lack of nutritional benefits; margarine was excluded from the *Fats* group, due to the content of trans fats; the *Potato* group, which in GD No. 285 were as a separate group, it was transferred to the *Starchy* group; The *Curcubitaceae* group was excluded, because these products are only found seasonally in the trade and are not representative of a national diet; *Legumes,* from the *Bread and bakery products* group (of $MCFB_{MD}$), formed a separate group, together with nuts; The group *Milk and dairy products* was included in the HFB options as a separate group. Figures 6 and 7 show the energy share of the food groups in the HFB_{MD} options.

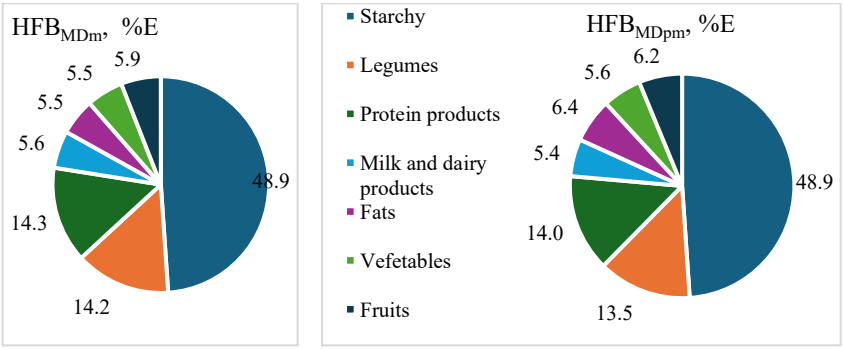

Figure 6. The energy share of the food groups in the HFB_{MDm} and HFB_{MDpm} options, % of the daily energy ration

Source: Made entirely by the author based on his calculations and estimates; HFB-Healthy Food Basket; m-men; pm-pensioner men; E-energy

Starch energy intake in HFB_{MD} (men and retired men) provides exactly 48.9% (1306 kcal/day and 1208 kcal/day, respectively). These values are close to the recommendations from the HFB_{FAO} models, which suggest that this food group provides around 50% of energy. HFB_{MD} of adult women and women of retirement age covers 46.0 ...

46.3% of daily energy. In all four baskets, the quantitative intake of starchy products is between 340.7 and 467 g, which exceeds the FAO recommended amount of 322 g (to ensure 1160 kcal out of 2330 kcal/day total) (Table 3.8). However, even 340.7 and 359 g provide only 1004 and 953 kcal/day, respectively. It follows that the quantitative recommendations of HFB_{FAO} models are not valid for HFB_{MD} and could not be applied, but they could serve as guidelines for the development of diets or HFB. It was estimated that protein (animal) products, in all baskets, constitute 130...160.5 g and provide an energy intake of 383.1...310.3 kcal, equivalent to about 14...15 % of daily energy (Figures 6 and 7).

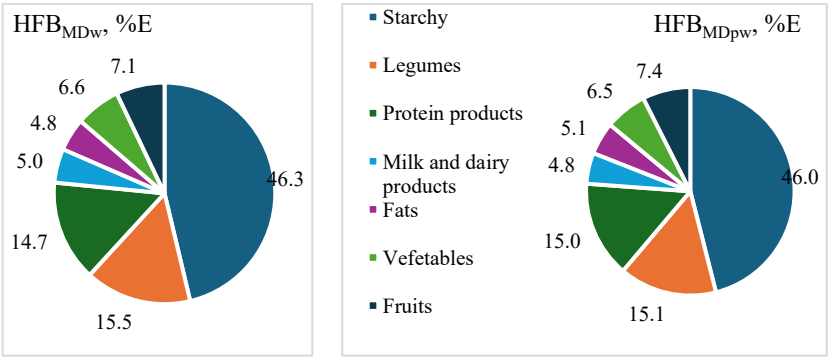

Figure 7. The energy share of the food groups in the HFB_{MDw} and HFB_{MDpw} options, % of the daily energy ration

Source: Made entirely by the author based on his calculations and estimates
MCFB - Minimum Consumption Food Basket; HFB - Healthy Food Basket; w-women; pw-pensioner women; E-energy

This percentage distribution falls within the optimal (calculated) required intake (Table 6) and reports on the suitability and alignment of the HFB_{MD} options developed to the HFB_{FAO} and DRV models. The energy provided by *Legumes and nuts*, with values between 14.2% and 13.5% (380 and 322 kcal) in all baskets, exceeds the values recommended by FAO (of 10...12%), except for HFB_{MDm}, which reached the recommended amount of 80 g of legumes/day (although

they have a higher basket energy intake compared to the FAO basket) (Figure 6 and 7). Even the smallest amount of *Legumes and Nuts*, about 66 g (from HFB_{MDpw}), provides 322 kcal, which exceeds the energy intake recommended in the FAO models. The WHO dietary recommendations state that a healthy diet should include legumes and nuts, suggesting that they are necessary to ensure a balanced diet (WHO, 2018). The Global Burden of Disease Study identified "low legume" and low "nut and seed" dietary patterns as risk factors associated with excess morbidity and mortality (Afshin et al., 2019), and the EAT-Lancet diet emphasizes their inclusion in daily food rations (Willett et al., 2019). These claims justify the inclusion of legumes and nuts as a separate group. In most geographic areas, legumes, nuts, and seeds are accessible, widely consumed, and almost always included in diets at minimal cost. In the Republic of Moldova, this group of products is still, to some extent, associated with the diet of people with low incomes or with diet during religious fasting periods (Chirsanova et al., 2021). Nuts are rich in fat. However, nuts have not been included in the *Fats* and *Oils* group because they have different culinary uses. Thus, nuts were included in the *Legumes and nuts* group, where these foods are commonly found as placed in most dietary guidelines and as they are in food diversity score rankings (Herforth et al., 2022; Pourghaderi et al., 2023).

It was calculated that the energy intake of the *Milk and dairy products* group provides between 4.8...5.6 % E (104.6...149.4 kcal/day) for all baskets. Those values are practically twice as low compared to the recommendations of the HFB_{FAO} models, which suggest that about 228 kcal/day should come from *Milk and dairy* products. Dairy products are considered a food group with relatively high costs (FAO et al., 2020). Including dairy products in a global standard when other foods could be used instead would overestimate the actual cost of a healthy diet in some regions. In the HFB_{MD} options, the *Milk and dairy products* group is included as a separate group. The decision is justified by the fact that this group is the most consumed

in Moldova, reaching annual values of around 230 L/year (in milk equivalent), practically exceeding twice the consumption of vegetables and berries and the consumption of bread and bakery products (BNS, 2023). The energy intake from the *Fruit* group was between 5.9 and 7.4% in all four baskets developed and analyzed, equivalent to 154...148 kcal, due to the 320...330 g of products included in baskets. The included values exceed the values recommended by FAO by about 30 g, but they are slightly below the energy intake limit recommended by FAO for this group (the recommended energy intake from Fruits is 160 kcal). The energy intake from vegetables was 5.5...6.5%, corresponding to 135.2...146.0 kcal/day from 350...380 g of products. The recommended amounts for this group are 270...400 g, or 110 kcal/day. Therefore, the WHO identified the minimum threshold of 400 g/d as a feasible minimum level that would provide significant health benefits for all adults, including the elderly, and children from 10 years of age, but noted that 600 g/d is preferred (WHO, 2023).

3.4. Application of the Mean Adequacy Ratio Indicator to validate the nutritional adequacy of the developed HFB_{MD} options

Most nutrient-based indicators describe the degree to which diets or foods conform to a standard (Food Guidelines or Dietary Reference Values, etc.) (Cowan et al., 2023). Accordingly, dietary assessment tools should be selected taking into account the relative validity of different methodologies, respondent–researcher burden, and resources required for implementation (Mahal et al., 2023). Mean Adequacy Ratio (MAR) is part of the indicators used to assess individual nutrient intake on the quality dimension. This index quantifies the overall nutritional adequacy of a population based on an individual's diet, using the current recommended intake for a nutrient group of interest. Although there are several versions of this index,

MAR has gained popularity and is now increasingly used as a summary indicator of nutrient adequacy (Akter et al., 2021; Beydoun et al., 2018; Lepicard et al., 2017). MAR is positively associated with other indices of diet quality, particularly those that estimate diversity but also assess dietary adequacy and food group ratio (Eldridge et al., 2019; Jun et al., 2019). To calculate the MAR, the PRI values were applied, and the following actions were performed: A systematic review of the literature was carried out concerning the terms and DRV for the nutrients of interest from the most updated and scientifically argued reviews; Each product included in the four HFB_{MD} was compiled with micronutrient content (Институт Питания РАМН. Под ред. И.М. Скурихина ... and Skurichin, 2002); Nutrient Adequacy Ratio (NAR) and MAR were calculated for vitamins and minerals from each HFB_{MD} option (Tables 7 and 8).

Vitamins. To estimate the MAR by micronutrient content in each HFB_{MD}, ten micronutrients (four vitamins and six mineral elements) were identified (Table 7).

Mineral elements. The estimation, through mathematical calculations, of the MAR of the content of mineral elements in each HFB_{MD} focused on the micronutrients sodium (Na), potassium (K), calcium (Ca), magnesium (Mg), phosphorus (F) and iron (Fe) (Table 8).

Table 7. The Nutrient Adequacy Ratio (vitamin) calculated for each developed HFB_{MD}

Vitamine	DRV criteria	m.u.	DRV		The calculated vitamin requirement for HFB_{MD}				Calculated NAR values for HFB_{MD}			
			HFB MDm	HFB MDw	HFB MDpm	HFB MDpw	HFB MDm	HFB MDw	HFB MDm	HFB MDw	HFB MDpm	HFB MDpw
Thiamins (B_1)	PRI = AI	mg/day	**0,88**	**1,99**	5,3	4,3	4,9	1,10	1,08	1,10	1,07	1,10
		mg/MJ	0,11	0,24	-	-	-	-	-	-	-	-
Riboflavin (B_2)	PRI = AI	mg/day	**1,6**		1,6	1,6	1,6	1,6	4,16	3,43	3,78	3,30
Niacin (B_3) or PP	PRI = AI	mg E/1000 kcal	**6,6**		17,6	14,3	16,3	13,7	1,03	1,06	1,03	1,05
		E/MJ	1,6									
Vitamin C	PRI = AI	mg zi	**110**	**95**	110,0	95,0	110,0	95,0	1,93	2,16	1,84	2,09
NE- niacină echivalent												
RE- retinol echivalent												
The calculations were made according to the maximum intervals												

Sources: Developed by author based on own calculations and DVR estimates taken from: (Blomhoff et al., 2023; EFSA Panel on Nutrition, Novel Foods and Food Allergens (NDA) et al., 2022); NAR - Nutrient Adequacy Ratio; HFB - healthy food basket; w - women; m - men; pm – pensioners men; pw – pensioners women; DRV - dietary reference values; PRI - Population Reference Intake (meets the nutritional requirements of about 97 - 98% of healthy individuals); AI - adequate intake

Table 8. The Nutrient Adequacy Ratio (mineral elements) calculated for each developed HFB_{MD}

Mineral elements	u.m.	DRV criteria	VDR		The calculated mineral elements requirement for HFB_{MD}				Calculated NAR values for HFB_{MD}			
			HFB MDm	HFB MDpm	HFB MDpw	HFB MDpm	HFB MDpw	HFB MDpm	HFB MDpw	HFB MDpm	HFB MDpw	CAS MDfp
Sodium	mg/day	AI	1500		679	566	633	540	0,5	0,4	0,4	0,4
Potasium	mg/day	$AI_{RN} = AI_{EFSA}$	3500		3889	3440	3600	3300	1,1	1,0	1,0	0,9
Calcium	mg/day	$RI_{RN} = PRI_{EFSA}$	950		702	598	645	569	0,7	0,6	0,7	0,6
Magnesium	mg/day	$AI_{RN} = AI_{EFSA}$	350	300	573	484	526	462	1,6	1,6	1,5	1,5
Phosphorus	mg/day	$AI_{RN} = AI_{EFSA}$	520		1799	1488	1643	1415	3,5	2,9	3,2	2,7
Iron	mg/day	$AI_{RN} = AI_{EFSA}$	9	15	29,5	24,7	27,2	23,5	3,3	1,5	1,7	1,5

Sources: Developed by author based on own calculations and DVR estimates taken from: (Blomhoff et al., 2023); HFB - healthy food basket; w - women; m - men; pm – pensioners men; pw – pensioners women; DRV - dietary reference values; NAR - Nutrient Adequacy Ratio; PRI - Population Reference Intake (meets the nutritional requirements of about 97 - 98% of healthy individuals); AI - adequate intake; RI – recommended intake

The Mean Adequacy Ratio (MAR) indicator reflects the ratio between the intake of 10 micronutrients from each of the four HFB_{MD} and the DRV for the micronutrient of interest (Table 9).

Table 9. Mean Adequacy Ratio for validation of the nutritional quality of developed HFB_{MD}

Micronutrients	**HFB MDm**	**HFB MDw**	**HFB MDpm**	**HFB MDpw**	***1HFB$_{FAO}$ / DRV $_{EFSA}$**	***2HFB$_{FAO}$ / VDR$_{EFSA}$**
Thiamins (B_1)	1,00	1,00	1,00	1,00	0,98	0,96
Riboflavin (B_2)	1,00	1,00	1,00	1,00	0,92	0,88
Niacin (B_3)or PP	1,00	1,00	1,00	1,00	0,92	0,89
Vitamin C	1,00	1,00	1,00	1,00	0,90	0,77
Sodium	0,45	0,38	0,42	0,36	-	
Potasium	1,00	0,98	1,00	0,94	-	
Calcium	0,74	0,63	0,68	0,60	0,68	0,63
Magnesium	1,00	1,00	1,00	1,00	0,97	0,96
Phosphorus	1,00	1,00	1,00	1,00	1,00	1,00
Iron	1,00	1,00	1,00	1,00	0,67	0,64
MAR	**0,92**	**0,90**	**0,91**	**0,89**	**0,90**	**0,87**

*Sources: Developed by the author based on his own calculations; *DVR HFB_{FAO} - taken from: (European Food Safety Authority (EFSA), 2017; Herforth et al., 2022; The State of Food Security and Nutrition in the World 2020, 2020).*

Thus, the MAR $_{(10\ micro\text{-}nutrients)}$ gravitates close to 1 (range 0.89 ... 0.92), which demonstrates an excellent suitability of the developed baskets, providing empirical and argued evidence to propose the developed HFB_{MD} as optimized alternatives to existing HFB_{MD} (reviewed in the first part of the chapter) that meet the requirements for what is internationally considered a healthy diet.

4. COST AND ACCESSIBILITY OF THE HEALTHY FOOD BASKET

For the first time, the term Cost and Affordability of a Healthy Diet (CAHD), as a critical component of food security, was included in the State of Food and Nutrition Security in the World report (The State of Food Security and Nutrition in the World 2021, 2021).

The idea of that research started from the hypothesis that the national food system does not ensure access to healthy food, especially for people with low incomes, and the poverty threshold could be more pronounced than it is officially stated. To test the hypothesis, the indicators based on CNED were taken into account, and the cost and affordability of $MCBF_{MD}$ and HFB_{MD} options were calculated (Figure 8):

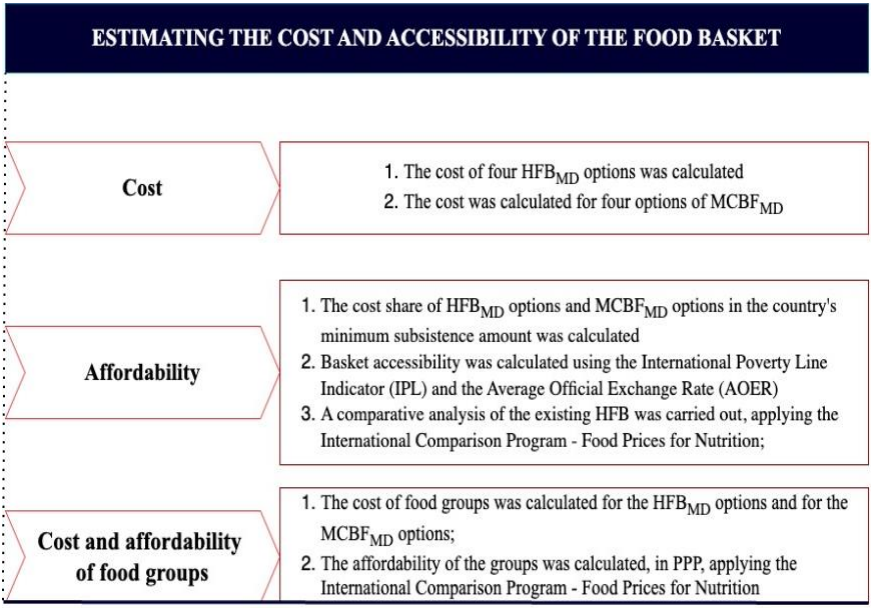

Figure 8. Research design. Estimating food basket cost and accessibility

Source: Entirely designed and developed by the author
HFB - healthy food basket; MCFB - minimum consumption food basket

4.1. Food basket cost and accessibility

It was calculated that the cost of the $MCFB_{MD}$ options falls within the range of 1486...1786 MDL/month, and the cost of the HFB_{MD} options – is within the range of 1978...2346.6 MDL/month. Although several foods considered nutritionally unrobust were excluded from the HFB_{MD},

regrouping foods, increasing fruit and vegetable intake, and reducing starchy intake contributed to increased costs for all basket options compared to the existing $MVFB_{MD}$ by approx. 18.4 ... 24.1 MDL/day (with 734.4 ... 560.6 MDL/month).

The share of food basket costs in the country's subsistence minimum is intended to determine the share of people who cannot afford a healthy food basket or an energy and nutrient-adequate basket. The share of HFB_{MD} in the minimum subsistence allowance of the Republic of Moldova oscillates in 70.9 ... 90.7%, with higher values for the basket of retired men. The share of $MCFB_{MD}$ in the minimum subsistence amount is slightly lower, with values between 51.4 and 54.0%. The results show that the weight for all the calculated HFB_{MD} options exceeds the limit of 52% (International Food Poverty Line Index, equivalent to $1.12), and the weight for most of the $MCFB_{MD}$ (except for men's baskets) is at the limit from the top of this index (Figure 9).

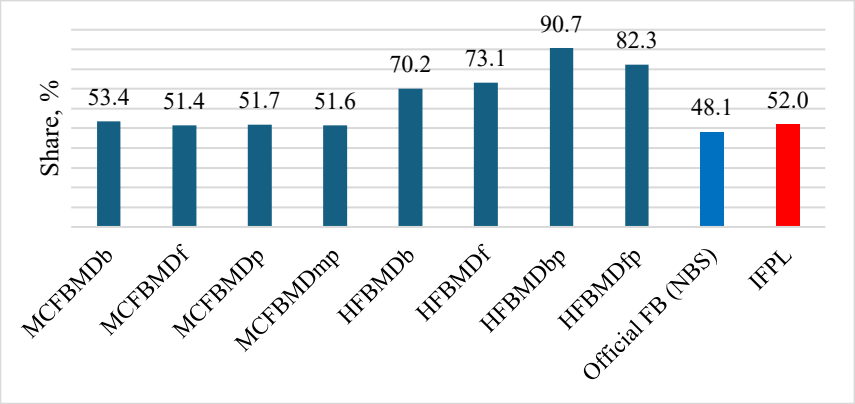

Figure 9. Share of developed HFB_{MD} options and existing $MCBF_{MD}$ of the minimum subsistence amount of the country (averages, year 2023)

Source: Fully developed by the author based on his calculations
FB-Food Baskets; MEB- minimum existence basket; IFPL-International Food Poverty Line; MCFB - Minimum Consumption Food Basket; HFB - Healthy Food Basket; m - men; w-women; pm - pensioner men; pw – pensioner women

This means that, nationally, more than 50% of the population cannot afford an MCFB and 70.2 …90.7% cannot afford a HFB without transferring non-food expenses to food expenses. At the same time, according to the NBS, in 2023, the weight of the food basket, in the amount of the subsistence minimum, was 48.1%, the equivalent of 1383.9 MDL (BNS, 2023), which contradicts the results obtained in the research regarding the number of food baskets from the bare minimum (Figure 10).

The provisional number of the population of the Republic of Moldova with habitual residence on January 1, 2023, was 2.512 million people (BNS, 2023). Of the total population, on average, 1.974 million people nationally (78.59 %) cannot afford healthy diets, and on average, 1.298 (51.69 %) million people cannot afford allows for an adequate diet in terms of energy and macronutrients (Figure 10).

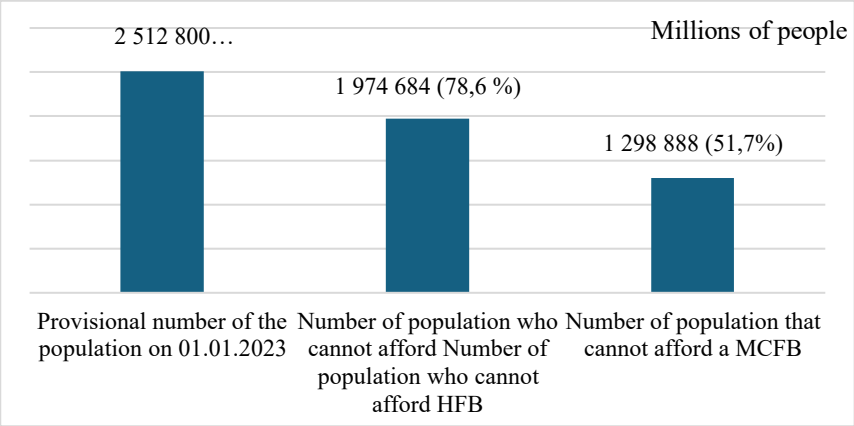

Figure 10. Provisional number of the population, at the national level, that cannot afford HFB and/or MCFB without transferring non-food expenses to food expenses

Source: Fully developed by the author based on his calculations

The International Poverty Line (IPL) indicator is derived from the national poverty lines of some of the world's poorest countries (Kharas and Dooley, 2022) and the comparability of living standards between nations. In September 2022, the poverty line was set from $1.90 to $2.15

(The World Bank, 2023a). For comparison with PIS, the costs of food baskets have been converted into USD, taking into account the Average Official Exchange Rate (AOER) (Callen, 2024) and Purchasing Power Parity (PPP) (OECD, 2001).

For the Republic of Moldova, the PPP in 2023 was 5.688 MDL for 1 USD (BNS). The results showed that the cost of HFB_{MD} options in PPC is between \$11.4 and \$13.6/day, and the cost of $MCBF_{MD}$ is between \$7.2 and \$10.4 per day. The AOER of the Republic of Moldova, in 2023, was 18.16 MDL for 1 USD (average for 01.01.2023 - 31.12.2023) (The World Bank, 2022). The cost of both basket sets, converted through AOER, is lower than those converted to PPP. Thus, the cost of $MCBF_{MD}$ options is 2.3 ... 3.2 USD/day, and the cost of HFB options is 3.6 ... 4.2 USD/day (Figure 11).

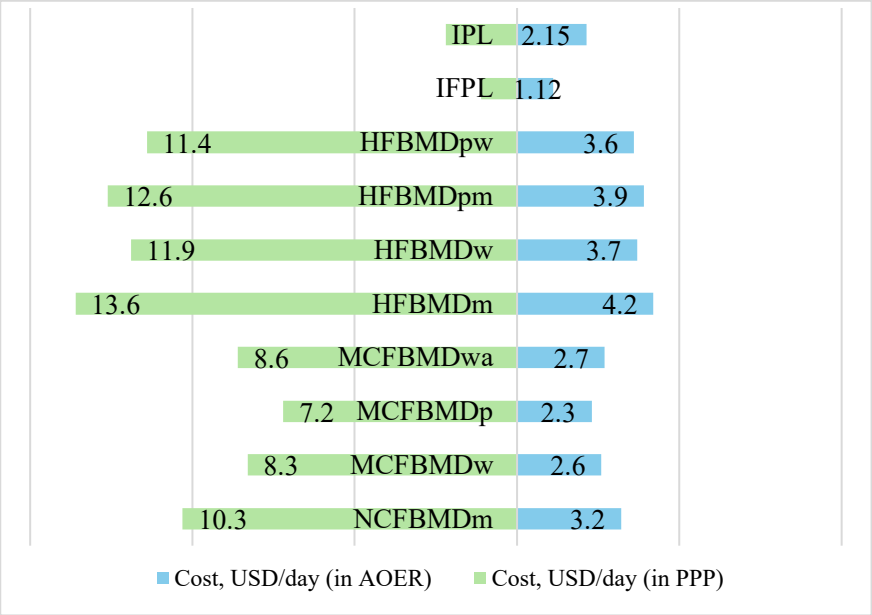

Figure 11. Comparative cost of developed HFBMD, existing MCBFMD options, in AOER and PPP (for the year 2023), USD/day

Sources: Developed by the author based on his calculations; AOER - Average Official Exchange Rate; PPP- Purchasing power parity; IPL - international poverty line; IFPL - international food poverty line

The results obtained confirm the claims of the researchers that healthy food diets are more expensive compared to diets that show adequacy only according to the content of nutrients and energy (Bai et al., 2022, 2021; Herforth et al., 2022; Pourghaderi et al., 2023), as are $MCBF_{MD}$.

Also, the results obtained show that the costs for the sets of HFB_{MD} and $MCBF_{MD}$, converted to PPP or AOER, exceed the IPL indicator values of USD 2.15/day and, significantly, are much higher than the International Food Poverty Line (IFPL) of $1.12/day (52% of IPL). This only confirms the fragility of food and nutritional security at the national level, given that both healthy food baskets and food baskets are adequate in terms of nutrient and energy intake and are not accessible to the majority of the population (Figure 11).

International Comparison Program – Food Prices for Nutrition. Global policies' focus on promoting healthier food choices has increased the need for data on the comparative components and accessibility of nutritious foods (Pourghaderi et al., 2023). For European countries, HFB is the cost of purchasing the least expensive locally available food for a representative person with an energy balance of 2330 kcal/day (World Bank, 2020).

Thus, from the total of European countries presented in the diagram (Figure 12), 2021, Bulgaria's HFB cost was the highest (4.2 USD/day), being close to the HFB_{MDm} cost. In Romania, France and Hungary, the CAS cost was 3.25 ... 3.4 USD/day, in the Russian Federation – 3.68 USD/day, in Spain and Portugal – between 2.65... 2, 88 USD/day. The lowest cost for HFB is attributed to the United Kingdom, at around USD 1.95/day, below the poverty line (Figura 12).

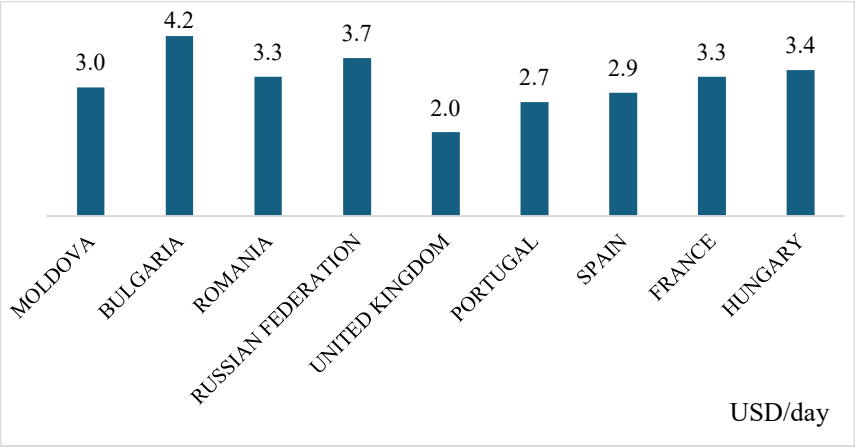

Figure 12. Comparative cost of HFB options of some European countries, in PPP (for the year 2021), USD/day

Sources: Developed by the author based on his calculations; The cost for HFB of European countries for the year 2021 was taken from the Food Prices for Nutrition dataset (The World Bank, 2023b; World Bank, n.d.); IPL - international poverty line

According to the FAOSTAT (FAO) platform, the cost of a healthy diet in the Republic of Moldova in 2021 was USD 3.0/day (in PPP), which represents the lowest cost of HFB, compared to Romania (3. 25 USD in PPP) and the Russian Federation (3.68 USD in PPC). The global average daily cost of a healthy diet in PPP was USD 3.66/day. A synthesis of the cost of countries by income rate showed that in low-income countries, the average price was USD 3.37/day, while in high-income countries, it was slightly higher at USD 3.43 /day (Herforth et al., 2022; *The State of Food Security and Nutrition in the World 2021*, 2021).

The calculations and benchmarking confirm that the costs for most HFBs –nationally and globally – exceed the current international poverty line of $2.15/day, meaning that anyone living on less than $2.15 /day is considered living in extreme poverty (The World Bank, 2023).

4.2. Cost and accessibility by food group, in functional terms of HFB_{MD}

The cost of food groups was calculated for each option developed by $HFB_{MD.}$ The results show that the most expensive groups are fruits, protein products, and l*egumes*. Thus, $HFB_{MD's}$ fruit insurance requires 27.3...31.4% (20.4...21.1 MDL/day) of the total cost of baskets. In HFB_{MD}, *Fruits* are the third group according to the quantitative intake (320…330 g), which explains both the almost identical costs of this group and the higher value (about five times) compared to the $MCBF_{MD}$ options. In $MCBF_{MD}$, fruit intake is 59.8...107.5 g, costing 40.9...58.7 MDL/day (Figures 4.5 and 4.6). *Protein products* require expenses of 20.6 … 21.6% (13.5 and 16.6 MDL/day), which is equivalent to 2.4…2.9 USD in PPP. *Legumes* – of 14.9…16.0% (10.0…12.2 MDL/day), or 1.8…2.1 USD in PPP, of the total budget of HFB_{MD} options (Table 10).

Tabel 10. Share of average costs of food groups in HFB_{MD}, MDL and USD (in PPP)

Food groups	HFB_{MDm}		HFB_{MDw}		HFB_{MDpm}		HFB_{MDpw}	
	MDL/ day	USD /day	MDL/ day	USD /day	MDL/ day	USD /day	MDL/ day	USD /day
Starchy	9,9	1,7	7,6	1,3	9,1	1,6	7,2	1,3
Legumes	12,2	2,1	10,8	1,9	10,6	1,9	10,0	1,8
Animal protein products	16,6	2,9	13,9	2,4	15,0	2,6	13,5	2,4
Milk and dairy products	6,6	1,2	4,7	0,8	5,8	1,0	4,4	0,8
Fats	2,3	0,4	1,6	0,3	2,5	0,4	1,7	0,3
Vegetables	8,6	1,5	8,3	1,5	8,1	1,4	7,9	1,4
Fruits	21,1	3,7	20,4	3,6	20,4	3,6	20,4	3,6
BASKET TOTAL	77,1	13,6	67,4	11,9	71,6	12,6	65,0	11,4

Source: Made entirely by the author based on his own calculations

The expenses for adequate provision of HFB_{MD} with *Vegetables* require 11.1...12.4 % (7.9...8.6 MDL/day) of the total baskets cost. Starch costs 11.1...12.8% (7.2...9.9 MDL/day). The global average cost of

meeting daily energy needs using the most accessible essential starch at each time and place is $0.79/day. The costs for *Milk and dairy products* vary from basket to basket in ranges of 6.7...8.5% (4.4...6.6 MDL/day). The slightest financial implications require *Fats* – about 3.5...2.4%, which requires between 1.6...2.5 MDL/day (Tabel 10). The obtained results allow, at the first stage, a comparative estimate with the results of other research and attest essential differences for some groups, such as, for example, the cost for *Milk and milk products* in all HFB_{MD} options are about three times below the limit of the financial share mentioned by FAO (23%) in its reports.

In general, HFB_{FAO} costs by food groups have the following distribution: Starches -12%, Protein products - 23%, Vegetables - 21% and Fats - 4% (Bai et al., 2021; Herforth et al., 2022). The discrepancies between the values presented by HFB_{MD} and the values of HFB_{FAO} reflected their justification in The quantities of products in all developed HFB_{MD} options differ from the quantitative intakes of the HFB_{FAO} models; The number of product groups differs between the baskets compared; The number of analyzed items differs: HFB_{MD} includes 229 items, and HFB_{FAO} only 1-2 items for each food group (6 groups); The period of data collection differs (HFB_{FAO} values reflect costs in PPP for the year 2017 and 2021, and HFB_{MD} – for the year 2023), as well as the method of data collection.

To ensure research consistency and comparability between the developed HFB_{MD} options and the existing $MCBF_{MD}$, the food group costs of the four existing basket versions ($MCBF_{MD}$) were calculated: *Milk and dairy products* (9.9...10.6 MDL/day), *Meat and meat products* (6.3...10.6 MDL/day), as well as *Bread and bakery products* (6.7 ...9.1 MDL/day) are the most expensive groups in $MCFB_{MD}$. The average cost for *Vegetables* and *Fruits* is between 5.0...8.0 MDL/day and 3.8...6.5 MDL/day, respectively (Table 11).

Table 11. Share of average costs of food groups in MCBFMD, MDL and USD (in PPP)

Food groups	$MCFB_{MDm}$		$MCFB_{Mw}$		$MCFB_{MDpm}$		$MCFB_{MDaw}$	
	MDL/ day	USD/ day	MDL/ day	USD/ day	MDL/ day	USD/ day	MDL/ day	USD/ day
Bread and bakery products	9,1	1,6	7,6	1,3	6,7	1,2	7,3	1,3
Meat and meat products	10,6	1,9	7,5	1,3	6,3	1,1	8,6	1,5
Milk and milk products	10,2	1,8	10,5	1,8	9,9	1,7	10,6	1,9
Eggs	0,2	0,0	0,1	0,0	0,1	0,0	0,2	0,0
Fish and fish products	3,2	0,6	2,4	0,4	2,3	0,4	2,5	0,4
Sugar and confection ery	1,4	0,3	1,3	0,2	0,9	0,2	1,2	0,2
Fats	3,1	0,5	2,5	0,4	2,1	0,4	2,7	0,5
Potatoes	4,7	0,8	3,8	0,7	3,3	0,6	3,8	0,7
Vegetables	8,0	1,4	5,5	1,0	5,0	0,9	6,3	1,1
Curcubita ceae	1,6	0,3	0,6	0,1	0,5	0,1	1,0	0,2
Fruits	6,5	1,1	5,5	1,0	3,8	0,7	4,7	0,8
TOTAL	**58,7**	**10,3**	**47,4**	**8,3**	**40,9**	**7,2**	**48,8**	**8,6**

Source: Made entirely by the author based on his calculations

Research findings show that food price elasticity and substitution effects are more significant within food groups than between them and are more remarkable for many (phyto) micronutrient-rich food groups than for staples. As a result, lowering the prices of staples would have a much smaller impact on diet quality than lowering the prices of nutrient-dense foods.

5. ASSESSING NUTRITION SECURITY THROUGH THE LENS OF NATIONAL PUBLIC POLICIES

The objective of the research consists in the development of two models for assessing nutritional security through the lens of national nutritional policies: a general, multidimensional model and a model for assessing the level of assistance of people with special dietary needs (Figure 13):

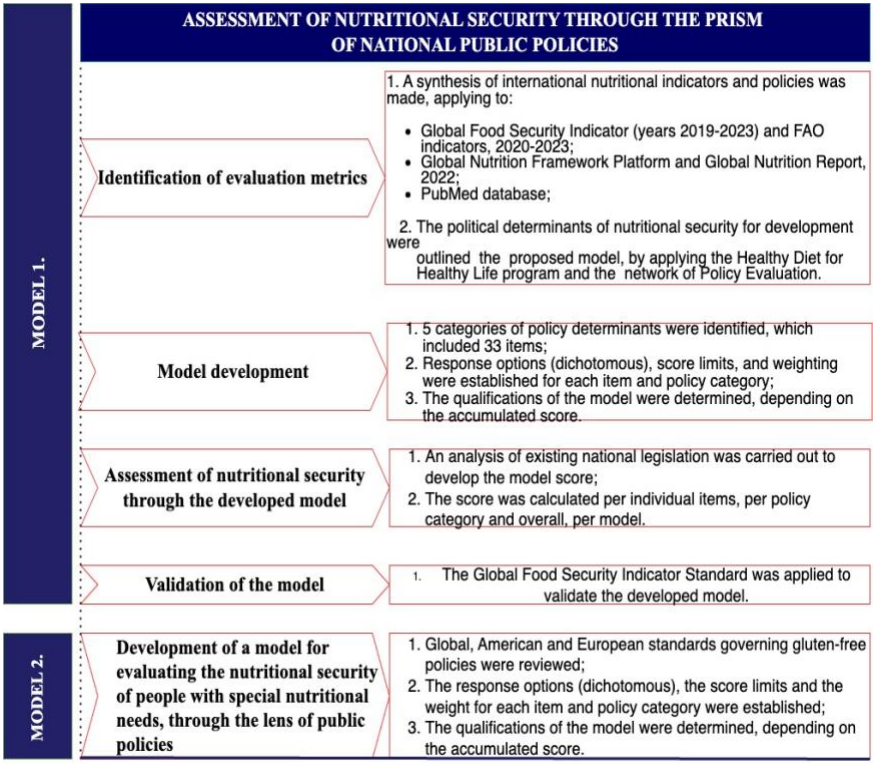

Figure 13. Research design. Evaluation of nutritional security through the lens of national public policies

Source: Entirely designed and developed by the author

In order to achieve this objective, two models were developed to assess nutritional security at the national level through the lens of public policies:

- A general, multifactorial model.
- A model for evaluating the level of assistance of people with special nutritional needs.

Taking into account the complexity of the problem to be addressed, the ambiguity of policy interpretation, but also its importance for achieving the objective, the work algorithm of the research follows the architecture established in Figure 13.

5.1. Development of a multidimensional model of nutritional security assessment based on national policies

The model for assessing nutritional security in the Republic of Moldova through the lens of policies was based on the Healthy Diet for a Healthy Life program and has a general, multifactorial character, without emphasis on nutritional policies focused on children, the elderly or people with special dietary needs. Thirty-three items were validated, which form the model score (Table 12).

Table 12. Nutrition policy categories included in the model and the score assigned to each category

	Policy category	Number of items, n	Maximum score possible	Maximum possible share, %
1.	**Education**	5	5	16,1
2.	**Policy**	11	11	35,5
3.	**Labeling**	5	5	16,1
4.	**Monitoring**	7	7	22,6
5.	**Fiscal**	5	3	9,7
	Total	**33**	**31**	**100**

Source: Fully developed by the author based on his calculations

The model included five sub-categories of policies: education policies, strategic policies, labeling policies, monitoring and fiscal policies. The score of the developed model was calculated by applying the working principle of the GFSI. The model is based on dichotomous response options: Yes = 1 point, No = 0 points.

The score of public policies through the developed multidimensional model. It was found that the Republic of Moldova has numerous institutions involved in food security, but the organizational structure does not fully reflect modern approaches regarding the delimitation of tasks among the authorities concerned. The policy-strategies ensure the greatest coverage of the policies: 11 nutritional policies with strategic directions were included in the model, and of these, six are available at the national level, with the percentage weight of the total score = 19%. Out of five educational and labeling policies, the Republic of Moldova has only two for each category, which constitutes a weight of 6% for each. It was observed that the significant deficiency is reflected in the monitoring policies. The score for this criterion constitutes 6% of the total accumulated score. At the national level, there are major deficiencies in monitoring harmonized or implemented nutritional policies. Of the seven political items concerning monitoring, only two were identified: one regarding monitoring the supplementation of bakery flours with iron and folic acid and another about food consumption, but which is only carried out within some projects, which does not ensure the sustainability of these estimates (Figure 14).

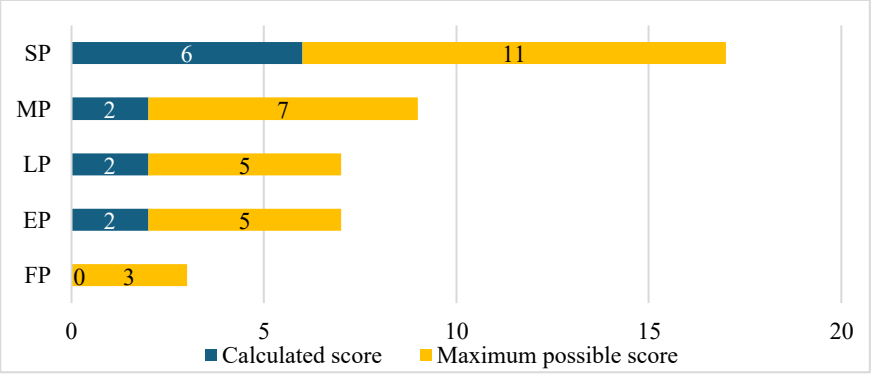

Figure 14. The score assigned per policy subcategory

Source: Developed by the author based on his analysis and calculations; PS – policies-strategies; MP – monitoring policies, LP – labeling policies; EP – educational policies; FP – fiscal policies

A total score = 12 was calculated, constituting a weight of 38.7% of the maximum possible score. The result corresponds to the

qualification of *satisfactory* assurance of the FNS from the perspective of national public policies.

The developed model was validated through an additional assessment, for which the Global Food Security Indicator (GFSI) standard was applied. The GFSI was designed and developed by Economist Impact. It is a country-centered index, and for the evaluation and validation process, only the category of sub-indicators aimed at food quality and safety, including nutritional standards, was taken over and applied. The sub-indicator included four question items. The obtained score was calculated, which showed a result close to the developed multifactorial model = 40%. The results show that national food policies fail to provide good quality evidence on the SAN coverage level, being delimited by either health, agriculture or food safety and less focused on nutrition security.

5.2. Evaluation of the level of assistance for people with GRDs through the lens of public policies in the Republic of Moldova

For the first time in the Republic of Moldova, the level of assistance for people with gluten-related disorders was evaluated based on public policies, according to a composite model developed based on six components-questions (Falcomer et al., 2020; Ortiz-Andrellucchi and Serra-Majem, 2019). The model's score was calculated from the answer options for each question-item and the assigned score: for each positive answer, 1 point was assigned, and for each negative answer – zero points (Table 13).

In the Republic of Moldova, patients diagnosed with celiac disease receive financial allowances approved by the Government, according to the general recommendations for disability, and can benefit, once a year, from rehabilitation services. At the national level, there are significant deficiencies in the design and content of policies and programs governing the food security of people with gluten-related disorders.

Table 13. Evaluation of the level of assistance for people with GRDs in the Republic of Moldova, according to the developed model

	Items used to assess the level of care of people with gluten-related disorders	Answer choices	
		Yes	No
1.	Does the country have regulations regarding packaged industrial food products for people with CD?	1,0	
2.	Does the country have regulations regarding meals and non-packaged foods for people with CD?		0
3.	Is there a specialist healthcare service for celiac patients?	0,5	
4.	Is there a government food allowance and/or financial incentive for CD patients?	1,0	0
5.	Is there a gluten-free certification program for manufactured products intended for people with CD?		0
6.	Does the country have a national CD association?		0

Source: Developed by the author

Thus, the score of the assessment model of the level of assistance of people with GRDs = 2.5, which corresponds to a low level of assistance, ranking lower, according to the level of assistance, compared to other European countries (Figure 15).

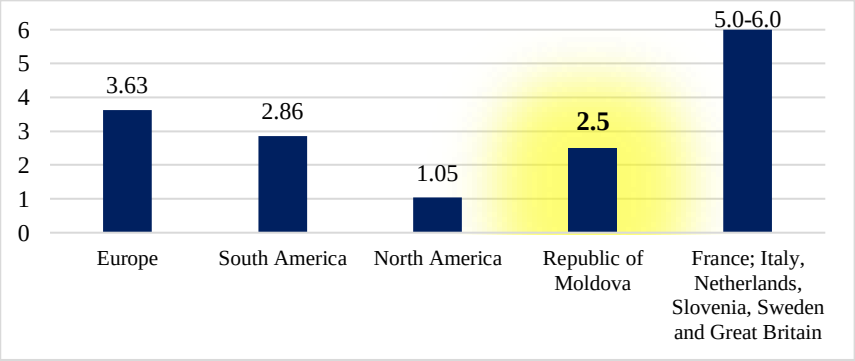

Figure 15. Comparative score of the level of assistance of people with GRDs in the Republic of Moldova and different countries and regions

Source: (Siminiuc and Țurcanu, 2022)

The score reveals a significant risk of food and nutritional insecurity and, respectively, the precarious situation of people with GRDs in the Republic of Moldova.

6. DEVELOPMENT OF A NUTRITION APPLICATION AND SOFTWARE FOR INFORMED FOOD CHOICES

The objective of this research consists in: development of an application for evaluating the nutritional quality of food, which takes into account the qualitative and quantitative intake of nutrients in food; development of software for personalized nutritional assessment, including for people with special dietary needs.

6.1. Development of the Health Nutrition Assistant app

The Health Nutrition Assistant (HN Assistant) application collects user input to make calculations, applying the equations for determining the Body Mass Index (BMI), the Basal Metabolic Rate (BMR), the Daily Energy Need (NED), to calculate the weight of the energy intake (kcal) and macro-/micronutrients of the product of interest from the daily DRV; to come up with a feedback for the consumer. Vitamins and minerals are recommended either in mg/day or in equivalent units (like, for example, vitamin A - in (RE/d), µg) or mg/Mj/kcal (Table 14 and 15).

Table 14. Dietary Reference Values for Micronutrients (vitamins)

Micronutrient		NNR , 2023						EFSA, 2017				
		AR		PRI		AA		NM		AA		PRI
Vitamine	**m.u.**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	**W**	**M**	
Vitamin A	(RE/d), µg	540	630	700	800	-	-	490	570			650-750
Vitamin D	µg/d	7,5	7,5	10	10	-	-	-	-	15	15	-
Vitamin E (a-TE/d)	mg/d	8	9	10	11	-	-	-	-	11	13	-
Vitamin K	µg/d	50	60	-	-	65	75	-	-	70	70	-
Thiamine (B_1)	mg/E	0,65	0,75	0,9	1,1	-	-	0,072	0,072	-	-	0,1
Riboflavin (B_2)	mg/d	1,3	1,3	1,6	1,6	-	-	1,3	1,3	-	-	1,6
Niacin (B_3), mg	mg NE/E	12	15	14	18	-	-	1,3	1,3	-	-	1,6
Pantothenic acid (B_5)	mg/d	4	4	-	-	5	5	-		5	5	1,6
Vitamin B_6	mg/d	1,3	1,5	1,6	1,8	-	-	-	1,5	-	-	1,6-1,7
Biotin (B7)	(µg/d)	32	32	-	-	40	40	-	-	40	40	-
Folate (B_9)	(µg/DFE/d)	250	250	330	330	-	-	250	250	-	-	330
Vitamin (B_{12})	(µg/d)	3,2	3,2	-	-	4	4	-	-	4		-
Vitamin C	mg/d	75	90	95	110	-	-	80	90	-	-	95-10

Source: Developed by the author based on data taken from NNR and EFSA recommendations (Blomhoff et al., 2023; European Food Safety Authority (EFSA), 2017): NE - niacin equivalent; RE - retinol equivalent; DFE - dietary folate equivalents; M – men, W- women; NNR- Nordic Nutritional Recommendations; EFSA - European Food Safety Authority; AI - adequate intake; RI - reference intake; PRI - population reference intake; AR – average requirement

Table 15. Dietary Reference Values for Micronutrients (mineral elements)

Elemente minerale	u.m.	NNR (2023)					EFSA				
		RI		PRI		AI	RI		AI	PRI	
		W	M	W	M	W	M	W	M	W	M
Sodium	g/d	-	-	-	-	1,5	-	-	2		-
Potasium	mg/d	2800		-	-	3500	-	-	-	3500	
Calcium	mg/d	750		950		-	750-860	750-860		950-1000	
Iron	mg/d	9	7	15	9	-	6-7	6		11-16	11
Zinc	mg/d	-	-	-	-	-	6,2-10,2	7,5-12,7	9,4-16,3	300	350
Magnesium	mg/d	240	280	-	-	300	-	-	-	-	-
Iodine	(µg/d)	120		-	-	150	-	-	-	150	
Phosphorus	mg/d	420		-	-	520	-	-	-	550	

Sursa: Dezvoltat de autor în baza datelor preluate din RNN şi a recomandărilor EFSA (Blomhoff et al., 2023; European Food Safety Authority (EFSA), 2017)

M – men, W- women; NNR- Nordic Nutritional Recommendations; EFSA - European Food Safety Authority; AI - adequate intake; RI - reference intake; PRI - population reference intake; AR – average requirement

The Health Nutrition Assistant (HN Assistant) application https://shorturl.at/1ZKHH is developed on the specialized server http://shiny.io/, the R language, which allows the creation of interactive web applications. With Shiny, developers can easily incorporate data visualization techniques such as charts, graphs and interactive dashboards to present nutritional information more attractively and easily understood. These visualizations can help users understand complex nutritional data and make more informed food choices. The convenience and portability of the app further encourage users to engage with it regularly and consistently make healthier choices. The application has an expert system based on rules that use modern concepts and recommendations in the field (for example, from the European Food Safety Authority). The main sections of this application are listed on the left (on a dark background) and include. (Figures 16 and 17): How to use this (current) application; User nutrition assessment; Evaluation of food products; Results; Glossary.

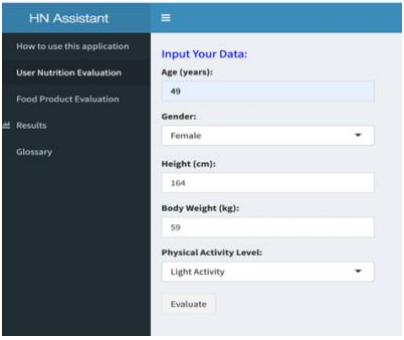

Figure 16. User input data

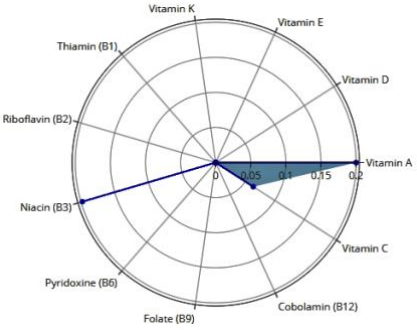

Figure 17. The level of DRV coverage with vitamins per 100 g of product

The application could also link to the nutritional quality data, according to the health claims, warning or promoting the consumer concerning this.

6.2. Software development for nutritional management of consumers

The software (SNUTM - UTM Nutritional System) was developed based on the Embarcadero RAD Studio Alexandria Edition information system with Microsoft SQL Server as the database (Figure 18).

The system has several advantages: performance, with the fastest compiler; the possibility of reusing the components; containing specialized components in database programming; the chance of developing mobile applications; development of web applications; cross-platform use; simplicity and speed of use, etc.

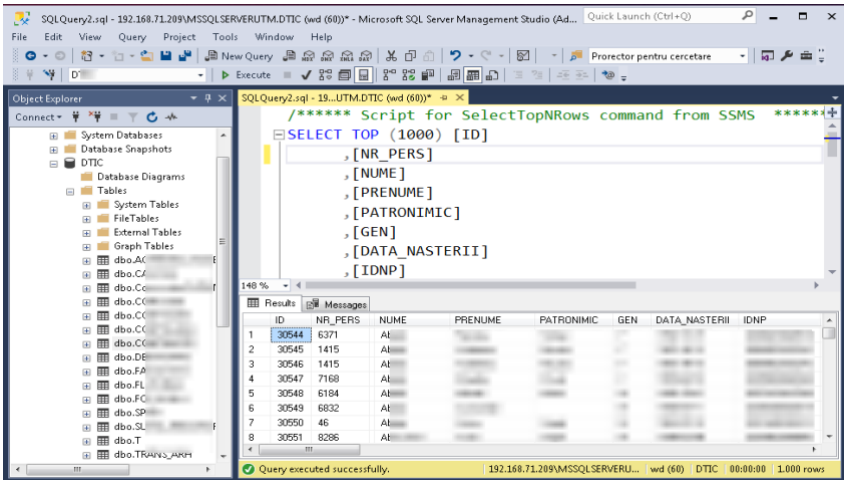

Figura 18. Produsul software SNUTM, elaborat în baza *Microsoft SQL Server*

Sursa: (Țurcanu, 2023; Țurcanu and Siminiuc, 2023b)

The parameters included in the SNUTM system are general and specific, taken from the scientific literature, and include identification and contact information, age, locality, nationality, education level and profession (as an indicator of understanding). The software allows user registration, with the subsequent possibility of him registering consumer-customers. Contact details of the consumer/client's supervising physician

may also be collected, alerting the student-user to the importance of active collaboration between the nutritionist and physician (Doina and Laura, 2015) (Figure 19).

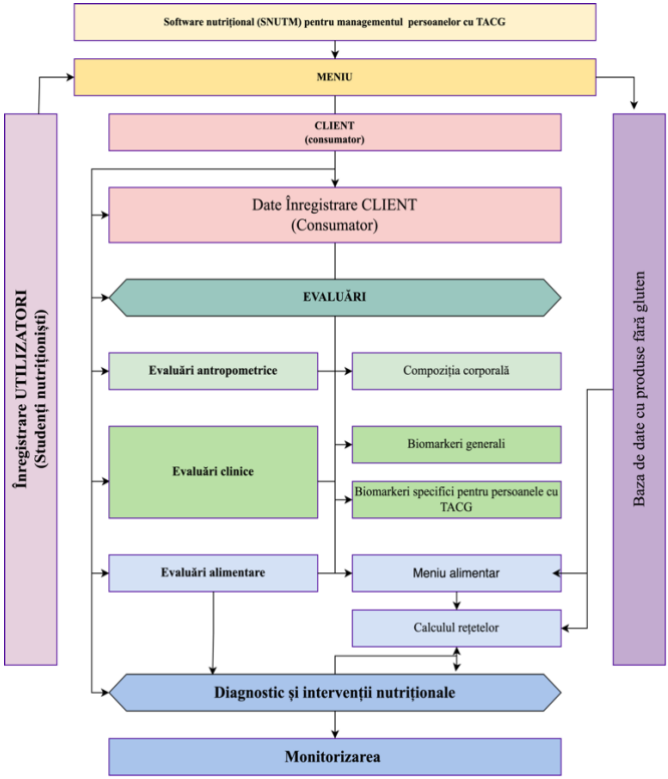

Figure 6.11. SNUTM Nutrition Software Map
Source: (Țurcanu, 2023; Țurcanu and Siminiuc, 2023b)

The clinical evaluation will collect the patient's medical history: general physiological condition, symptoms, allergies, blood pressure, medical diagnosis, personal and hereditary collateral history, and medications. Also here, the user will complete, interviewing the patient, a questionnaire developed and validated by the European Society for

Pediatric Gastroenterology, Hepatology and Nutrition (ESPGHAN) to measure the presence of gastrointestinal symptoms.

General markers and specific ones can be registered, with the possibility of scanning and archiving the results obtained from the analysis sampling laboratories.

GENERAL CONCLUSIONS

The continuing ascendancy of the global nutrition crisis outlines the vulnerability of agri-food systems and societal inequalities, with worrying trends in all forms of malnutrition, from hunger to obesity and the multiple associated chronic diseases. The research carried out highlighted the following aspects regarding nutritional security in the Republic of Moldova:

1. The nutritional profile of the Republic of Moldova, analyzed through the lens of international organizations (European Health Information Gateway Portal and FAO and WHO reports), as well as through the lens of national organizations, highlights high rates of food insecurity, with a significant share of overweight and obesity among adults and children, of anemia and non-communicable diseases related to nutrition, arguing the need for an integrated and sustained approach to improving the nutritional status of the population. The nutritional profile of the Republic of Moldova presents significant deficiencies in the evaluation and monitoring of nutritional security, in the identification of an entity responsible for nutrition and the fragmentation of information regarding risk factors and deficiencies in the systems of care for people with special nutritional needs. The retrospective shows the lack of dietary policies and the inertia of the existing ones (**Siminiuc, R.,** Țurcanu, D., 2024b.; **Siminiuc, R.,** Țurcanu, D., 2021; **Siminiuc, R.,** Țurcanu, D., 2020b).
2. The exploration of nutritional security in the Republic of Moldova was multifactorial, with a significant focus on the cost and accessibility of the food basket and through the lens of national public food policies.

The nutritional quality of four existing Minimum Food Baskets in the Republic of Moldova - $MCFB_{MD}$ (for adult men and women, for pensioners and the weighted average) was estimated, which included the calculation of the energy intake, nutrients and their weight by food groups of the basket. All $MCFB_{MDs}$ provide between 1985.5 and 2776.5 kcal per basket; 12.3 ... 12.9 % of the energy is due to proteins; 27.3...30.9% - lipids; 58.3...60.5% - carbohydrates (**Siminiuc, R.,** Țurcanu, D., 2024a.; **Siminiuc, R.,** Țurcanu, D., 2022).

3. The energy and nutrient intake of $MCFB_{MD}$ aligns with DRV and FAO recommendations, suggesting nutritional adequacy. Still, the energy and nutrient distribution of $MCFB_{MD}$ by product group differs significantly from the HFB_{FAO} patterns and HFB patterns presented in the guidelines and the reports of other countries, which attests that all four $MCFB_{MD}$ options do not meet the Criteria of a Healthy Food Basket and can be qualified as Baskets with Adequate Nutrient Intake (as defined by FAO). This justifies the imperative of developing a National Healthy Food Basket (HFB_{MD}) **(Siminiuc, R.,** Țurcanu, D., 2024b; **Siminiuc, R.,** Țurcanu, D., **Siminiuc, S**., 2024).
4. The FAO Healthy Diet Basket (HDB) indicator was applied to develop four HFB_{MDs} (for adult men and women and men and women of retirement age). The HFB_{MD} options were found to provide 14% of energy intake from protein, 55% from carbohydrates and 31% from fat. Nutrient and energy intake aligns with FAO, EFSA and Nordic Nutrition Recommendations and ensures adequate energy weighting of food groups, aligning with the HFB_{FAO} model and the general recommendations of the Food-Based Dietary Guidelines **(Siminiuc, R.,** Țurcanu, D., 2024b; **Siminiuc, R.,** Țurcanu, D., **Siminiuc, S.,** 2024).
5. The Mean Adequacy Ratio (MAR) indicator was applied to validate the nutritional adequacy of the food baskets and included ten micronutrients (4 vitamins and 6 mineral elements). The MAR index was between 0.89 and 0.92 and demonstrates optimal micronutrient intake and distribution of food groups, providing empirical and argued

evidence to propose developed HFB_{MDs} as optimized alternatives to existing $MCFB_{MDs}$ that satisfy the requirements for what is considered, internationally, a healthy diet. The cost was calculated for the basket set: HFB_{MD} (four basket options), which requires costs of 65.0...77.1 MDL/day and the $MCFB_{MD}$ set (four basket options), which requires lower costs compared to the HFB_{MD} options, with about 18.4...24.1 MDL/day. The share of HFB_{MD} and $MCFB_{MD}$ in the minimum amount of subsistence of the Republic of Moldova demonstrated that 1.986 million people in the Republic of Moldova cannot afford healthy diets, and 1.311 million cannot afford diets adequate in terms of energy and macronutrients without transferring non-food expenses to food expenses (**Siminiuc, R.,** Țurcanu, D., 2024a).

6. The accessibility of HFB_{MD} and $MCFB_{MD}$ was calculated by applying the International Poverty Line indicator. The results showed that the average PPP costs of HFB_{MD} ranged from 11.4 to 13.6 USD/day, and the cost of MCFB ranged from 7.2 to 10.4 USD/day. Costs for HFB_{MD} and $MCFB_{MD}$, converted to PPP and Average Official Exchange Rate, exceed the IPL indicator values of $2.15/day and IFPL of $1.12/day (52% of IPL), confirming the fragility of food and nutrition security nationally.
7. The most expensive food groups of HFB_{MD} are *Fruits* (20.4...21.1 MDL per day), *Protein products* (13.5 and 16.6 MDL per day) and *Legumes* (10.0...12.2 MDL per day), and in $MCFB_{MD}$ the most expensive groups are *Milk and dairy products* (9.9...10.6 MDL per day), *Meat and meat products* (6.3...10.6 MDL per day), followed by bread and bakery products (6.7...9.1 MDL per day). Food price elasticity and substitution effects are greater within food groups than between them, being greater for fruit and vegetables than for other essential product categories.
8. Two models were developed to evaluate nutritional security through the lens of national public policies: a general multidimensional model, which included 33 items, created by applying the Healthy Diet for a Healthy Life standards and the holistic approach; a model for assessing

the level of assistance for people with gluten-related disorders, by using the Falcomer model. At the national level, significant deficiencies were found in the monitoring of nutritional policies, according to the multidimensional model, and the score of the model is = 38.7% (out of 100%), which constitutes a satisfactory level of food and nutritional security, a result validated by applying the standardized indicator Global Index of Food Security (**Siminiuc, R.,** Țurcanu, D., 2023a). A model was developed and used to assess the level of assistance for people with disorders associated with gluten consumption in the Republic of Moldova through the lens of public policies. The model showed a score of 2.5, indicating a low level of support, lower than the average values for the European continent (with 3.63 points) and South America (with 2.86 points) (**Siminiuc, R.,** Țurcanu, D., 2022; **Siminiuc, R.,** Țurcanu, D., 2020a).

9. An application has been developed to assess the nutritional quality of food: Health Nutrition Assistant (HN Assistant), which integrates personal parameters such as body mass index, basal metabolic rate and daily macro- and micronutrient requirements by EFSA standards. The app could facilitate informed and conscious food decision-making and foster transparency and accountability on the part of traders regarding the quality and nutritional composition of food products and could play a significant role in promoting a healthier food environment and encouraging a healthy lifestyle among consumers (Țurcanu, D., **Siminiuc, R.,** 2023a; Țurcanu, D., **Siminiuc, R.; Siminiuc, R.,** Țurcanu, D., 2020a).
10. Personalized nutritional assessment (SNUTM) software has been developed for people with special dietary needs. The software allows us to consider the consumer's history, the results of clinical evaluations, anthropometric parameters and specific biomarkers. The system generates personalized feedback that helps the selection of appropriate solutions for the nutritional management of the consumer (Țurcanu, D., **Siminiuc, R.,** 2023a; Țurcanu, D., **Siminiuc, R.; Siminiuc, R.,** Țurcanu, D., 2020a; **Siminiuc, R.,** Țurcanu, D., 2023b).

RECOMMENDATIONS:

Dietary patterns have been studied extensively in the nutritional epidemiology literature, relating specific foods and the proportionality of different food groups to disease incidence and prevention. The food basket is a tool used by various levels of government and other stakeholders to monitor the cost and accessibility of food. The food basket can serve as an indicator for:

- determine the cost of the food component of the Market Basket Measure, which is used to measure a country's official poverty line;
- monitor the cost of healthy eating at a regional or national level to inform health and social policies;
- to manage health and social policies and to educate and inform about the relationship between poverty and food insecurity;
- developing/updating the national food guide and a more targeted promotion of healthy food guidelines;
- The development of menus for the economically vulnerable population, based on the HFB_{MD}, could be a subject for further investigation, including qualitative studies on the acceptability of the qualitative and quantitative provision of the included foods.

Thus, this basket's size directly affects the indexation of various social payments, such as pensions, maternity benefits, child benefits, the disabled and the unemployed.

This research could promote constructive discussions between specialists in food, nutrition, health and economic analysts (all decision makers in the Republic of Moldova), aiming for cross-sectoral collaboration between various ministries to ensure the right to adequate and healthy food and to reduce social inequalities in society.

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LIST OF PUBLICATIONS
published in the period 2020-2024

1. Monografii naționale (domeniile cercetării și inovării)

1.1. **SIMINIUC R.,** ȚURCANU D. *Provocări și tendințe în dezvoltarea produselor fără gluten*. Ediția nr. 1. Chișinău: editura Kim Art, **2023.** 160 pagini. ISBN 978-9975-3595-3-5. http://repository.utm.md/bitstream/handle/5014/23556/Provocari-tendinte-dezv-produse-fara-gluten-Monografie.pdf?sequence=1&isAllowed=y

1.2. CHIRSANOVA, A., REȘITCA, V., **SIMINIUC, R.,** SUHODOL, N., POPOVICI, C., DESEATNICOVA, O., CAPCANARI, T., GUTIUM, O., COVALIOV, E., GROSU, C., PALADI, D., MIJA, N., COȘCIUG, L., CIUMAC, J. *Produse alimentare inovative.* Monografie colectivă. Ediția nr.1. Chișinău: editura Tehnica UTM, **2021.** 455 p. ISBN 978-9975-45-704-0. DOI: 10.5281/zenodo.5563412

2. Articole în reviste științifice

2.1. ***în reviste din bazele de date Web of Science și SCOPUS*** *(cu indicarea FI)*

2.1.1. **SIMINIUC, R.,** ȚURCANU, D**.** Development of a model for evaluating the nutritional quality of bread and bakery products. *Journal of Food and Nutrition Research,* issue 2, June, *2024. Publicat online* https://www.vup.sk/en/index.php?mainID=2&navID=34&version=2&volume=0&article=2353 **(IF = 1.1)**

2.1.2. CAPCANARI, T., COVALIOV, E., NEGOIȚA, C., **SIMINIUC, R.,** CHIRSANOVA, A., REȘITCA, V., ȚURCANU, D. Hemp Seed Cake Flour as a Source of Proteins, Minerals and Polyphenols and Its Impact on the Nutritional, Sensorial and Technological Quality of Bread. *Foods* **2023**, 12, 4327. https://doi.org/10.3390/foods12234327 **(IF=5.56).**

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2.1.4. **SIMINIUC, R.,** ȚURCANU, D. Impact of Nutritional Diet Therapy on Premenstrual Syndrome. In: *Frontiers in Nutrition*. **2023,** 1079417 https://doi.org/10.3389/fnut.2023.1079417 . **IF = 6,59.**

2.1.5. CAPCANARI, T., COVALIOV, E., CHIRSANOVA, A., POPOVICI, V., RADU, O., **SIMINIUC, R.** Bioactive profile of carob (Ceratonia siliqua L.) cultivated in European and North Africa agrifood sectors. In: *Ukrainian Food Journal.* **2023,** 12 (2): 227-239. DOI: 10.24263/2304-974X-2023-12-2-6 . **IF = 0,12.**

2.1.6. **SIMINIUC, R.,** ȚURCANU, D. Food security of people with celiac disease in the Republic of Moldova through prism of public policies. In: *Frontiers in Public Health*. **2022,** 3639. https://doi.org/10.3389/fpubh.2022.961827 **IF= 6,46**

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2.1.8. CAPCANARI, T., CHIRSANOVA, A., RADU, O., COVALIOV, E., POPOVICI, **V., SIMINIUC, R.** Functional profile of carob beans and pods pulp (Ceratonia Siliqua L.) originated from the Republic of Moldova. In: *Czech Journal of Food Sciences*. **2022,** 40: 465–473. 10.17221/139/2022-CJFS. **IF = 1.3**

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2.1.10. COVALIOV, E., GROSU, C., POPOVICI, V., CAPCANARI, T., **SIMINIUC, R.,** RESITCA, V. Impact of Sea Buckthorn Berries *(Hippophae Rhamnoides)* on Yoghurt Biological Value and Quality. In: *The Annals of the University Dunarea de Jos of Galati. Fascicle VI - Food Technology* . **2021,** 45 (2), 62-76. https://doi.org/https://doi.org/10.35219/foodtechnology.2021.2.05.

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2.1.13. **SIMINIUC, R.,** ȚURCANU, D. Impact of artisanal technologies on the quality indices of the cozonac. In: *Food systems*. 2020**,** 3(3):25-31. https://doi.org/10.21323/2618-9771-2020-3-3-25-31. Indexat Scopus.

2.2. în alte reviste din străinătate recunoscute

2.2.1. **SIMINIUC, R.,** COȘCIUG, L. Influence of Culinary Treatment on Soriz Mineral Elements (Sorghum Oryzoidum). In: *Food and Nutrition Sciences*. **2022,** 13, 78-84. DOI: 10.4236/fns.2022.131008.

2.2.2. **SIMINIUC, R.,** COVALIOV, E., ȚURCANU, D., POJAR, D., REȘITCA, V., CHIRSANOVA, A., CAPCANARI, T. Eating Behavior of Students at the Technical University of Moldova during the Isolation Period. In: *Food and Nutrition Sciences*. 2022, **13**, 108-123. doi: 10.4236/fns.2022.132011.

2.2.3. COVALIOV, E., **SIMINIUC, R**., POPOVICI, V. Walnut paste: a healthy alternative for nutella consumers. In: *The Eurasia Proceedings of Health, Environment and Life Sciences (EPHELS).* **2022,** 7, 28-35. https://doi.org/10.55549/ephels.49

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2.2.5. CAPCANARI, T., CHIRSANOVA, A., COVALIOV, E., **SIMINIUC, R.** Development of Lactose Free Yogurt Technology for Personalized Nutrition. In: *Food and Nutrition Sciences*. **2021, 12**, 1116-1135. doi: 10.4236/fns.2021.1211082.

2.2.6. **SIMINIUC, R.,** ȚURCANU, D. Physico-Chemical and Nutritional Characteristics of Soriz Flour (Sorghum Oryzoidum). In: *Global Journal of Researches in Engineering.* **2021,** 21, (1) Version 1.0, DOI: https://doi.org/10.34257/GJREJVOL21IS1PG1 https://globaljournals.org/GJRE_Volume21/E-Journal_GJRE_(J)_Vol_21_Issue_1.pdf

2.2.7. GROSU, C., **SIMINIUC, R.,** TURCANU, D., COVALIOV E., GUTIUM, O. Walnut Meal Whitening and the Impact of Whitening Factors on Its Quality. In: *Food and Nutrition Sciences*. **2021**, **12**, 1-12. doi: 10.4236/fns.2021.121001.

2.2.8. **SIMINIUC, R.,** ȚURCANU, D., POJAR, D., CUJBA, R., CAZAC, V., GUTIUM, O., GROSU. Cultural and technological retrospectives of the coliva in the Republic of Moldova. In: *Global Journal of Human-Social Science Research.* **2021.** DOI: https://doi.org/10.34257/GJHSSCVOL20IS10PG1.

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2.2.12. ȚURCANU, D., **SIMINIUC, R**., BOSTAN, V. The Impact of the COVID-19 Pandemic on the Use of Digital Technologies in Ensuring the Efficient e-Learning Process at the Technical University of Moldova. In: *Creative Education,* 11, 2116-2132. https://doi.org/10.4236/ce.2020.1110154

2.3. în reviste din Registrul National al revistelor de profil, cu indicarea categoriei

2.3.1. ȚURCANU, D., **SIMINIUC, R.** Software for nutritional assessment of people with gluten-related disorders. In: *Journal of Engineering Science*. 2023, XXX (3). (B+). 10.52326/jes.utm.2023.30(3).12

2.3.2. **SIMINIUC, R.,** ȚURCANU, D. Front-end nutrition labeling and eco-labeling models for public health promotion. *In: Journal of Social Science*. 2023, 6(3). (B+). https://doi.org/10.52326/jss.utm.2023.6(3).06

2.3.3. **SIMINIUC, R.,** ȚURCANU, D. Evaluation of gluten contamination in gluten-free products in the Republic of Moldova. In: *Journal of Engineering Science*. 2022, 29 (3). DOI: 10.52326/jes.utm.2022.29(3).14. (B+).

2.3.4. POPESCU, L., BULGARU, V., **SIMINIUC, R**. Effects of lactose hydrolysis, fermentation conditions and milk type on the quality of lactose-free yoghurt. In: *Journal of Engineering Science.* 2022, 29 (4). https://doi.org/10.52326/jes.utm.2022.29 (4).13. (B+).

2.3.5. **SIMINIUC, R.,** ȚURCANU, D. The impact of the pandemic on the agri-food system. In: *Journal of Social Sciences*. **2022,** 3 (3), 85–94. https://doi.org/10.5281/zenodo.3971973. (B+).

2.3.6. BULGARU, V., POPESCU, L., **SIMINIUC, R.** Lactose intolerance and the importance of lactose-free dairy products in this condition *(Review).*

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2.3.7. GROSU, C., **SIMINIUC, R.,** COVALIOV, E., GUTIUM, O., REȘITCA, V., DESEATNICOVA, O. Qualitative profile of macarons cookies made with walnut meal addition. In: *Akademos. **2021**, 4.* DOI: 10.5281/zenodo.4509356 *(B).*

2.3.8. CHIRSANOVA, A., BOISTEAN, A., CHISELIȚĂ, N., **SIMINIUC, R**. Impact of yeast sediment beta-glucans on the quality of yoghurt. Food systems. Federal Research Center for Food Systems of Russian Academy of Sciences. **2021;** 4(1). p.12-18 DOI: 10.21323/2618-9771- 2021-4-1-12-18 (B+)

2.3.9. **SIMINIUC, R.** The influence of biotechnological strategies on nutritional aspects of bakery products. In: *Journal of Engineering Science.* **2020,** 27 (3), 216-224. DOI:10.5281/zenodo.3949722 https://ibn.idsi.md/vizualizare_articol/110365 *(cat. B+).*

2.3.10. **SIMINIUC, R.;** ȚURCANU, D. The impact of the pandemic on the agri-food system. In: *Journal of Social Sciences.* **2020,** 3 (3), 85 – 94. Doi: 10.5281/zenodo.3971973. https://jss.utm.md/wp-content/uploads/sites/21/2020/09/JSS-3-2020_85-94.pdf . *(cat. C).*

2.3.11. GROSU, C., **SIMINIUC, R.,** COVALIOV, E., GUTIUM, O., REȘITCA, V., DESEATNICOVA, O. Profilul calitativ al biscuiților Macarons fabricați cu adaos de șrot de nucă. In: *Revista de Ştiinţă, Inovare, Cultură şi Artă „Akademos”.* **2020**, 4(59), 11-16. ISSN 1857-0461. DOI: 10.5281/zenodo.4509356 http://repository.utm.md/bitstream/handle/5014/16832/Akademos_2002_N4_p11_16.pdf?sequence=1&isAllowed=y *(cat. B).*

3. **Articole în culegeri ştiinţifice naţionale/internaţionale**

3.1. **culegeri de lucrări ştiinţifice editate peste hotare** (*incluse în BD SCOPUS /WoS)*

3.1.1. **SIMINIUC, R.,** ȚURCANU, D., SIMINIUC, S. (2024). Nutritional Quality of Bread and Bakery Products. In: *The International Conference on Nanotechnologies and Biomedical Engineering. ICNBME 2023.* IFMBE Proceedings, vol 91. Springer, Cham. https://doi.org/10.1007/978-3-031-42775-6_54

3.1.2. ȚURCANU, D., **SIMINIUC, R.,** BOSTAN, V., ȚURCANU, T. (2022). Impact of the Covid-19 Pandemic on the Use of Microsoft 365 and Learning Outcomes at the Technical University of Moldova. In: *the 5th International Conference on Nanotechnologies and Biomedical Engineering.* IFMBE Proceedings, vol 87. Springer, Cham. https://doi.org/10.1007/978-3-030-92328-0_59

4. **Teze ale conferințelor științifice**

4.1. în lucrările conferințelor științifice internaționale (peste hotare)

4.1.1. COVALIOV, E., CAPCANARI, T., CHIRSANOVA, A., POPOVICI, V., **SIMINIUC, R.** Physicochemical characteristics, biological value, and acceptability of quince and sea buckthorn sauces. In: *The 11th International Symposium Euro-Aliment,* 2023, 19-20 October, Galați, Romania. *Pag. 35. Link:* Book of Abstracts_EuroAliment 2023.pdf

4.1.2. CAPCANARI, T., COVALIOV, E., CHIRSANOVA, A., NEGOITA, C., **SIMINIUC, R.** *Cannabis Sativa* L. oil cake technological applications. In: *The 11th International Symposium Euro-Aliment,* 2023, 19-20 October, Galați, Romania. *Pag. 36. Link:* Book of Abstracts_EuroAliment 2023.pdf

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5. Brevete de invenţii şi alte obiecte de proprietate intelectuală, materiale la saloanele de invenţii

5.1. **SIMINIUC, R.,** ȚURCANU, D. Compoziţie pentru obţinerea pâinii fără gluten din făină de soriz şi procedeu de obţinere a acesteia. Hotărâre de acordare a brevetului de invenţie de scurta durată nr.10340 din 2023.10.24 (la Nr. depozit: s 2023 0023)

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6. Lucrări științifico-metodice și didactice

6.1. manuale pentru învățământul universitar (aprobate de consiliul științific /senatul instituției)

6.1.1. CHIRSANOVA, A., REȘITCA, V., CAPCANARI, T., **SIMINIUC R.,** BOIȘTEAN, A. Microbiologie alimentaire. UTM. – Chișinău: MS LOGO, 2022. – 203 p. ISBN 978-9975-3464-7-4. *Coli autor =12,69 (5) (http://cris.utm.md/handle/5014/1782)*

6.2. alte lucrări științifico-metodice și didactice

7.2.2. **SIMINIUC, A.,** CHIRSANOVA, A. REȘITCA, V., COVALIOV, E., ȚURCANU, D. *Exerciții practice pentru dezvoltarea acuității senzoriale. Indicații metodice la disciplina Analiza senzorială a produselor alimentației publice.* Chișinău, Editura „Tehnică – UTM", 2022. 164 p. ISBN: *978-9975-45-807-8. http://repository.utm.md/handle/5014/20552*

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7.2.6. CHIRSANOVA A., BOIȘTEAN, A., **SIMINIUC, R.,** ȚURCANU, D., COVALIOV, E., POPOVICI V., CAPCANARI, T., REȘITCA, V. *Ghid nutrițional pentru adolescenți (băieți). Ediția 1. Ed. Chișinău: editura Kim Art, 2022. 22p. ISBN 978-9975-3595-1-1.* http://repository.utm.md/bitstream/handle/5014/21910/Ghid-nutritional-adolescenti-baieti.pdf?sequence=1&isAllowed=y

7.2.7. COVALIOV, E., CAPCANARI, T., POPOVICI V., **SIMINIUC, R.,** ȚURCANU, D., CHIRSANOVA A., BOIȘTEAN, A., REȘITCA, V. *Ghid nutrițional pentru adolescenți (fete). Ediția 1. Ed. Chișinău: editura Kim Art, 2022. 22p. ISBN 978-9975-3595-2-8.* http://repository.utm.md/bitstream/handle/5014/21912/Ghid-nutritional-adolescenti-fete.pdf?sequence=1&isAllowed=y

ANNOTATION

SIMINIUC Rodica. „Exploratory analysis of nutritional security in the Republic of Moldova”, the post-doctoral thesis in engineering sciences

Scientific Speciality: 253.04 Food Security, Chișinău, 2023.

Structure of the thesis: The thesis contains an Introduction, six chapters, Conclusions and Recommendations, 212 pages of basic text, a bibliography of 358 titles, 39 tables and 61 figures. The obtained results are published in 38 scientific papers.

Keywords: nutritional indicators and metrics, healthy food basket, diet cost and accessibility, nutritional public policies, nutritional and energy balance.

The purpose of the research: realising an exhaustive exploratory analysis of nutritional security in the Republic of Moldova and developing indicators and tools for evaluating Food and Nutritional Security (FNS) at the national level to ensure public health and well-being.

Research objectives: Analysis of Nutritional Security (NS) in the Republic of Moldova; Development of the national Healthy Food Basket (HFB), aligned with the Nutritional Criteria of a Healthy Diet; Quantifying the economic accessibility of HFB options by applying standardized methods and indicators; Development of NS assessment models through the lens of national public policies; Development of a nutritional assessment application and software.

Scientific novelty and originality: For the first time in the Republic of Moldova, nutritional security was addressed through the FAO indicator - Healthy Diet Basket - and a national HFB was developed, aligned with the dietary criteria of a healthy diet. The accessibility of the food basket was calculated by applying the International Poverty Line indicator. Nutritional security was assessed through the lens of national public policies.

Main results: An exhaustive analysis of NS at the national level was carried out through the prism of standardized indicators. The Minimum Consumption Food Basket ($MCFB_{MD}$) was evaluated according to FAO standards. HFB was developed by applying a Healthy Diet Basket indicator. The accessibility of $MCBF_{MD}$ and HFB_{MD} was calculated. Two models have been designed to assess NS through the lens of national public policies. An application for determining the nutritional quality of food and software for nutritional management was developed.

The theoretical significance consists in the scientific argumentation of the non-correspondence of the MCFB, existing in the Republic of Moldova, with the criteria of an HFB. Empirical evidence and arguments were brought with reference to the correspondence of the developed national MCFB options with the qualification of HFB. HFB was validated through the Mean Adequacy Ratio indicator. The determinants of the nutritional security assessment model were argued through the lens of national public policies by applying the Healthy Diet for Healthy Life model. Block diagrams of the SNUTM application and software were discussed and the parameters and biomarkers included were justified.

Application value: The developed HFB_{MD} can be applied as an indicator to measure a country's official poverty line, as well as to inform and manage social health policies. The Health Nutrition Assistant App assesses the nutritional quality of food and will help consumers make informed and conscious dietary decisions. The SNUTM Software focuses on consumer nutritional management.

Implementation of the scientific results: The research results were applied in the preparation of the report for the World Food Program (WFP) "Food System Analysis in the Republic of Moldova", based on the contract Moldova - 122023/50091511, December 2023; Technologies and compositions for gluten-free products (TT project “Bio Production of gluten-free flour and mixes from wholemeal flours enriched with seed protein powder”), implemented at SRL Art-ProEco.

RODICA SIMINIUC

EXPLORATORY ANALYSIS OF NUTRITIONAL SECURITY IN THE REPUBLIC OF MOLDOVA

Scientific Speciality: 253.04 Food Security

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