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Research Article

Suboptimal Nutrition and Risk Factors for NCDs

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Abstract

Methods and Results: Mann-Whitney U test.

Objective: The impact of suboptimal nutrition on NCD risk factors was examined.

Methods and Results: Mann-Whitney U test, since some of the study samples were not normally distributed. The studies were conducted on 4 groups of countries with 15 countries in each group. In group 1 there was optimal nutrition -100%. In groups 2, 3 and 4 of countries there was suboptimal nutrition - 80%, 70% and 60%. The Total Energy of the countries was used as the initial parameter. As a result of the research, it was established that as suboptimal nutrition decreased in groups of countries from group 1 to group 4, there was a SS change in the ratio of % Carbohydrates, Proteins and Fats. The % of carbohydrates increased towards the 4th group of countries, the % of Proteins and Fats decreased towards the 4th group of countries. Moreover, the ratio of Proteins to Fats increased in the 4th group of countries. This SS process was repeated with the Energy, Protein and Fats of animal products included in the Total Energy. In the daily level of products from the 1st group of countries to the 4th SS group, the share of animal products, fruits and alcoholic beverages decreased and the share of grains and vegetables increased. Predictors of MS also underwent SS rearrangements. Obesity and Cholesterol ≥ 5.0 (mmol/L) lost 85%. Hyperglycemia ≥ 7.0 (mmol/L) lost only 30%. Low physical activity turned into high activity in groups 3 and 4 of countries. Burden of NCDs (type 2 diabetes, hypertensive, ischemic, cerebrovascular heart disease, COPD, digestive diseases and 7 types more often SS increased by 2-3 times to group 4 countries. In groups 2, 3 and 4 of SS countries, the quality and life expectancy decreased.

Conclusions: Research results indicate the high adaptive capacity of the human nutrition system. The influence of risk factors on NCDs has not been identified.

Keywords: Suboptimal Nutrition; Quality of Life; Metabolic Syndrome; NCD Risk Factors; Levels of Consumption of Foods; Alcoholic Beverages; Nutrients; Diet Patterns

Abbreviations

AB: Alcoholic Beverage; AP: Animal Products; BMI: Body Mass Index; BP: Blood Pressure; CD: Communicable, Maternal; Perinatal Diseases; Chol: Blood Cholesterol; FAO: Food and Agriculture Organization of the United Nations; COPD: Chronic Obstructive Pulmonary Disease; FS: Fruits and Sweeteners; GDP: Domestic Gross Product; Glu: Blood Glucose; HPI: Happiness Index; IHD: Index of Human Development; LPA: Low Physical Activity; NCD: Noncommunicable Diseases; CV: Cereals And Vegetables; SS - Statistically Significant; TCL: Total Daily Consumption; UV: Ultraviolet Level; SS and SIS: Statistically Significant and Statistically Insignificant

Introduction

Cancer and other non-communicable diseases (NCDs) are now widely recognized as a threat to global development. The latest UN High-Level Meeting on NCDs confirmed this observation and highlighted the slow progress towards achieving the 2011 Political Declaration on the Prevention of NCDs [1].

The mortality rate from cerebrovascular diseases in China reached 149.5 per 100,000 in 2018, ranking as the third leading cause of death [2].

The world's population is aging faster than in the past. This demographic transition will impact every aspect of society. In May 2020, the UN General Assembly declared 2021–2030 the Decade of Healthy Aging. Elderly people are an asset to society [3].

Researchers have documented a high prevalence of several NCDs and risk factors among Iranian adults. The prevalence of diabetes, hypertension, obesity and central obesity was 8.7%, 26.6%, 22.3%. 24.5% and 53.6% respectively. The prevalence of hypertriglyceridemia and hypercholesterolemia was 36.4% and 42.9%, respectively. Prevalence rates were higher among women and urban residents [4].

The medical, research and general community is unable to effect significantly decreased rates of central obesity and related type II diabetes mellitus (TIIDM), cardiovascular disease (CVD) and cancer. All conditions seem to be linked by the concept of the metabolic syndrome (MetS), but the underlying causes are not known. MetS markers may have been mistaken for causes, thus many treatments are destined to be suboptimal. The current paper aims to critique current paradigms, give explanations for their persistence, and to return to first principles in an attempt to determine and clarify likely causes of MetS and obesity related comorbidities [5].

The underlying unifying theory is that the proportionately large and energy-intensive human brain may trigger coadaptive mechanisms that conserve energy for the brain. A "dual system" is proposed. (1) Enlarged, complex cortico-limbico-the striatal system increases food energy by developing strong neural self-organizations of the reward/motivation pathway to acquire high-energy food, and (2) the nuclear factor-erythroid 2-related factor 2 (NRF2) cellular defense system enhances antioxidant, antitoxic, and regenerative activity through the use of plant chemicals. In people who eat a nutritious diet, the NRF2 system has become very energy efficient [6].

Public opinion on NCD prevention in the peer-reviewed literature is examined through cross-sectional surveys. Qualitative methods can provide detailed information for the implementation of advanced NCD prevention strategies [7].

NCDs are a major public health problem in Nepal and are becoming more dangerous than infectious diseases. However, the fight against NCDs has not received the attention it deserves from government and scientists. Simple prevention measures at the population and individual level have not been implemented effectively [8].

The Lajes population in Brazil is prone to NCDs. A significant proportion is made up of hypertension (33.78%), overweight (33.46%), obese (23.46%) and abdominal obesity (43.81%). Women have a higher prevalence of protective factors compared to men. Among women, less than 30.0% are physically inactive and 45. 9% are smokers [9].

It has been established that visceral adipose tissue is a highly informative biomarker for predicting nutritional status disorders and the risk of developing metabolic disorders dependent on eating behavior [10].

NCDs are caused by several preventable risk factors that are widespread: tobacco use, unhealthy diets, physical inactivity and harmful use of alcohol. Key strategies for the prevention and control of NCDs are reducing exposure to risk factors through health promotion, primary prevention and early diagnosis. Addressing NCDs requires a paradigm shift: from tackling each NCD to collectively tackling a group of diseases in an integrated manner. Healthcare based on the principles of universal access and social justice. To reverse the growing burden of NCDs in Southeast Asia, high level of commitment and multi-sectoral action required [11].

Lack of physical activity, smoking, excess weight, high blood cholesterol and hypertension are independent risk factors for NCDs. The survey results showed that 23.5%-39.5% of respondents go in for sports every day or several times a week. 17.2% - once a month. 9.3% once a year. 10.5% - never play sports.

Adults are less informed about the beneficial effects of physical activity. Respondents assessed the role of physical activity differently: some believed that it controls weight; others prevent the development of various diseases [12].

In 2017, 11 million deaths and 255 million DALYs were attributable to dietary risk factors. High sodium intake, low whole grain intake and low fruit intake were the leading dietary risk factors for mortality and DALYs worldwide.

The study provides a comprehensive picture of the potential impact of suboptimal nutrition on mortality and morbidity from NCDs. The results will support the implementation of evidence-based dietary interventions and provide a platform for annual assessment of their impact on human health [13].

Rats with suboptimal nutrition adapt to moderate Energy restriction by reducing body fat, reducing Energy expenditure, and exercising during the dark period while growth continues and lean body mass is maintained. At higher levels of energy restriction, there is a decrease in height, fat mass, and muscle mass. Moreover, decreases in body fat and physical activity are also reduced during both daylight and dark periods [14].

NCDs have become an important cause of mortality globally. According to a report by the World Health Organization (WHO), NCDs killed 38 million people in 2012 (out of 56 million deaths occurring worldwide). Cardiovascular diseases accounted for the majority of deaths from NCDs (17.5 million), followed by cancer (8,2 million), respiratory diseases (4.0 million) and diabetes mellitus (1.5 million. Worldwide, cardiovascular diseases are the leading cause of death and their prevalence is constantly increasing in both developed and developing countries. Patients with diabetes and insulin resistance are at even greater risk of heart disease vascular diseases. Obesity, high cholesterol, hypertriglyceridemia and high blood pressure are considered major risk factors for diabetic patients suffering from cardiovascular disease [15].

NCDs and chronic respiratory diseases (CRDs) are leading causes of mortality and morbidity worldwide. The most recent data can be found in the 2017 Global Burden of Disease (GBD) study reports. 3.2 million people died from chronic obstructive pulmonary disease (COPD) and 495,000 people died from asthma. COPD was the seventh leading cause of years of life lost (YLL). The number of CRD cases was 62 million, mainly due to asthma (69%) and COPD (29%). COPD accounted for 81.6 million disability-adjusted life years, and asthma accounted for 22.8 million. COPD prevalence at level 9,1% was found in a recent North American population survey [16].

Some evidence suggests that antiretroviral therapy (ART) is a major contributor to hyperglycemia in HIV infection. ART also resulted in increased metabolic dysfunctions, including insulin resistance syndromes, dyslipidemia, and lipodystrophy. Thus, the association between ART and diabetes risk requires careful drug selection and diabetes risk assessment [17].

A better understanding of the role of oxidative stress in obesity and the development of obesity-related NCDs would be a useful approach. This is due to the fact that oxidative stress can be mediated by both external and internal factors, which provides reliable means of preventing metabolic disorders [18].

NCDs kill more than 38 million people every year and are thus a major contributor to the Global Burden of Disease, accounting for 70% of deaths. The majority of these deaths are caused by cardiovascular diseases (CVDs). The risk of NCDs is closely related to exposure to environmental stressors, such as air pollutants, noise exposure, artificial lighting at night, and climate change, including extreme heat, desert storms, and wildfires. In addition to traditional CVD risk factors such as diabetes mellitus, hypertension, smoking, hypercholesterolemia and genetic predisposition, there is growing evidence that environmental physicochemical factors contribute significantly to the high incidence of NCDs. Moreover, urbanization is associated with the accumulation and intensification of these stressors [19].

Purpose of the study

To analyze the impact of suboptimal nutrition in countries around the world on the risk factors and burden of NCDs.

Materials and Methods

Study design: statistical analysis of observations.

For the purposes of this work, 4 groups of countries with 15 countries in each group were formed: 1st group - optimal nutrition - 100%. Group 2 – suboptimal nutrition – 80%. Group 3 - suboptimal nutrition - 70%. 4th - group - suboptimal nutrition - 60%.

The characteristics of countries in group 1 were compared with countries in groups 2, 3 and 4.

From the GBD 2004 Geneva, 2009 database [20], sex- and age-standardized data on the burden of NCDs were selected: cancer, diabetes mellitus, neurodegenerative, cardiovascular and respiratory diseases, liver cirrhosis, nephritis and others.

ICD-10 codes -10-10 (Table 1 - List of countries).

1gr 100% Energy			2gr 80% Energy			3gr 70% Energy			4gr 60% Energy		
Countries	IPC $ 2000	Energy	Countries	IPC $ 2000	Energy	Countries	IPC $ 2000	Energy	Countries	IPC $ 2000	Energy
United States of America	36 450	3 830	Argentina	11810	3 000	Ghana	1791	2 690	Bolivia	3497	2 170
Luxembourg	55 306	3 780	Syrian AR	3497	3 000	Serbia and M	5722	2 690	Djibouti	1678	2 170
Belgium	27 967	3 700	China	2933	2 990	Colombia	6585	2 670	Cambodia	1091	2 160
Greece	19 504	3 690	Chile	9608	2 980	Viet Nam	2100	2 650	Korea DR	3497	2 150
Ireland	30 155	3 680	Bosnia and Herzegovina	4526	2 950	Burkina Faso	829	2 620	Senegal	1512	2 150
Italy	27 006	3 680	Croatia	10747	2 940	Nigeria	2258	2 600	Niger	597	2 140
Austria	29 301	3 650	Barbados	11445	2 930	Honduras	2638	2 590	The Gambia	1237	2 140
Israel	24 942	3 610	Uruguay	10205	2 920	Paraguay	4823	2 590	Malawi	686	2 130
France	26 193	3 590	South Africa	7701	2 900	Mali	1160	2 570	Mozambique	445	2 070
Portugal	18 872	3 590	Belarus	5995	2 890	Guinea	896	2 540	Tajikistan	935	2 070
Canada	29 185	3 560	Mauritius	8780	2 880	Azerbaijan	3534	2 530	Guinea-Bissau	1078	2 050
Malta	19 411	3 540	Malaysia	12928	2 860	El Salvador	5044	2 530	Kenya	1690	2 040
Germany	27 277	3 510	R Moldova	1840	2 840	Côte d'Ivoire	2336	2 520	Zimbabwe	2038	2 040
Romania	5 873	3 470	Guyana	3577	2 830	Thailand	7284	2 490	Togo	1012	2 020
Norway	36 928	3 440	Slovakia	11348	2 830	Georgia	2587	2 480	Liberia	665	2 010

Table 1: List of countries - Country name, IPC, % Energy (kcal / person/day).

To characterize the "quality of life" (QL) in countries, a number of indicators were used: Per capita income [21]; Geographical position of countries by latitude and level of ultraviolet radiation in capital cities (UV) (J/m2 2004) [22]. Welfare ratings: education, social capital; corruption, love of peace; Happiness Index, Human Development Index [23].

Environmental Performance Index [24], Life Expectancy (LE) [25]; Access to healthcare, clean water and clean air [26].

The work analyzes predictors of Metabolic syndrome - percentage (%) of men in the country: body mass index (BMI) ≥ 30 kg/m2); Blood cholesterol level (CholL ≥ 6.2 mmol/l); Blood glucose level (Glu. ≥ 7.0 mmol/l); Blood pressure (BP ≥ 140/90 mm Hg); Low physical activity (LPA) ≤ 60 min/day walking [27].

We studied the levels of food consumption (g/person/day) (50 types) and Macrontrients (Energy, Carbohydrates, Proteins, Fats).

Food and Macronutrient consumption data for each country were selected from the FAO database for 2003 - 2005. [28].

The nutritional structure (SN) of countries is presented in the form of 4 blocks in absolute and percentage terms: 1 - products of animal origin (AP); 2 - cereals and vegetables (GV); 3 - fruits and sweeteners (FS); 4 - alcoholic drinks (AB) [28].

Statistical analysis of the results of the study was carried out using the Mann-Whitney-Wilcoxon U-test. U is the numerical value of the Mann-Whitney test.

The central trend in the distribution of data in the sample was represented by the median with quartile range and mean with standard deviation. The variance of the data in the samples was estimated using a quartile range (QR) between the first and third quartiles (between the 25th and 75th percentiles).

The level of statistical significance, reflecting the degree of confidence in the conclusion about the differences in indicators of groups 1 and 2 of countries.

Two levels of accuracy were evaluated: (1) $p \leq 0.01$ - 1% error probability; (2) $p \leq 0.025$ – 2,5% error probability. To assess the significance of the results of the study, the Bonferroni correction was also used, taking into account two hypotheses $p \leq 0.025$ in multiple comparisons.

All calculations were carried out using the STATISTICA program (version 13).

Results

The quality of life - socio-economic status 4 groups of countries

Per Capita Income (IPC) is statistically significant (SS) steadily decreasing by 27 times from 1 group of countries 100% optimal nutrition (ON) to 2-80%, 3-70% and 4 groups - 60% suboptimal nutrition (SN) (Table 2). Ultraviolet radiation (UV) SS increases from group 1 to group 4 countries by 2.5 times. Geographic latitude in the countries studied decreases SS by 4 times from 47° to 13°.

Social characteristics of Well-being (Prosperity, Educations, Index of human development, Social capital, Corruption, Happiness Index) in 4 groups of countries decrease SS on average by 10 times from group 1 to group 4.

From group 1 countries to group 4 SS, access to quality medicine decreases by 3 times. Access to clean water decreases by 9 times SS in countries. Access to clean air decreases by 70 times SS in countries (Table 2). Life expectancy (LE) of SS women decreases from country group 1 to group 4 from 82 years to 55 years, men - from 76 years to 53 years, respectively (Table 2).

Country groups	1 gr. - 100% Energy		2 gr. - 80% Energy		3gr.- 70% Energy		4 gr. - 60% Energy
Variable	Median 1	p≤	Median 2	p≤	Median 3	p≤	Median 4
The quality of life - socio-economic status							
IPC 2000 61,9%	27277	0,0000	8780	0,0000	2587	0,0000	1091
UV rad J/m2 2004	1907	0,0070	3476	0,0001	4931	0,0000	5307
lat°	47	0,0055	34	0,0001	13,2	0,0000	13,3
Prosperity rang	18	0,0001	63	0,0000	90	0,0000	112
Educations rang	24	0,0005	64	0,0000	100	0,0000	109
Index of human development	0,953	0,0000	0,826	0,0000	0,732	0,0000	0,479
Social capital rang	20	0,0021	62	0,0011	95	0,0002	89
Ccorruption rang	23	0,0028	67	0,0000	115	0,0000	126
Peacefulness rang	17	0,0276	60	0,0008	107	0,0021	100
HPI 2016 Index	6,907	0,0099	5,802	0,0002	4,875	0,0001	4,175
Access to the street. medicine1990	100	0,0035	95	0,0000	70	0,0001	54
Access to clean water1990	100	0,0009	85	0,0000	37	0,0000	13
Air pollution for children under 5 years old 2004	0	0,0246	3	0,0001	67	0,0000	178
Female life expectancy	82	0,0000	76	0,0000	71	0,0000	55
Male life expectancy	76	0,0000	71	0,0000	68	0,0000	53
Total Energy							

Energy (kcal / person / day) 2003-05	3610	0,0000	2920	0,0000	2590	0,0000	2130
Proteins (g/person / day) 2003-05	114	0,0000	80	0,0000	67	0,0000	54
Fats (g/person / day) 2003-05	146	0,0000	88	0,0000	58	0,0000	48
Proteins/Fats 2003-05 %	73	0,0051	99	0,0011	102	0,0045	106
Percentage Composition of Total Energy Macronutrients							
Carboh%E 2003-05	51	0,0000	62	0,0000	69	0,0000	69
Proteins%E 2003-05	12,0	0,0028	11,0	0,0028	10,0	0,0000	10,0
Fats%E 2003-05	38	0,0000	27	0,0000	20	0,0000	21
Percentage composition of Energy from animal products from Total Energy							
AP Energy %2003-05	29	0,0003	21	0,0000	14	0,0000	7
AP Protein%2003-05	60	0,0004	48	0,0000	31	0,0000	19
AP Fat%2003-05	56	0,2134	52	0,0136	38	0,0000	21
Dietary Patterns Daily level of food consumption (g/person/day)							
Total CL	2323	0,0000	1696	0,0000	1086	0,0000	730
Percentage composition of Dietary Patterns							
% AP	33,9	0,2998	31,3	0,1711	29,2	0,0005	19,6
% GV	38,9	0,0114	50,8	0,0019	56,1	0,0000	67,1
% FS	12,4	0,0202	10,6	0,1466	7,6	0,0004	5,8
% AB	10,6	0,0251	7,0	0,0028	4,4	0,0000	2,1
Daily levels of alcoholic beverage consumption (g/person/day) both sexes'							
Beverages, Alcoholic2003-05	9	0,8357	13	0,0488	5	0,0016	2
Wine2003-05	67	0,0062	15	0,0000	1	0,0000	0,000
Beer2003-05	170	0,0055	81	0,0001	42	0,0000	8
AB amount	237	0,0012	118	0,0000	50	0,0000	15
% AB	11	0,0251	7	0,0028	4	0,0000	2
male consumption (l/person/year) 2016	17,2	0,0251	13,9	0,0048	9,3	0,0000	6,0
Tobacco smoking Male Daily Age	29	0,1354	37	0,1073	16	0,0253	16
Diversification of Энергия % 2003-05	69	0,0000	53	0,0000	39	0,0000	32
Predictors of Metabolic Syndrome							
BMI ≥ 25 (kg / m2)	63	0,0225	59	0,0000	27	0,0000	15
Chol. ≥ 5.0 (mmol / L)	63	0,0000	43	0,0000	31	0,0000	22
BMII ≥ 30 (kg / m2)	23	0,0649	21	0,0001	5	0,0000	3
Chol. ≥ 6.2 (mmol / L)	20	0,0001	10	0,0000	6	0,0000	4
Glu. ≥ 7.0 (mmol / L)	10,8	0,8682	10,8	0,0048	7,5	0,0000	7,2
BP ≥ 140/90 (mm Hg)	47	0,9835	46	0,0344	40	0,0279	41
LPA ≤ 60 (minutes / day walking)	40	0,5007	34	0,0093	17	0,0002	15
Death /100 000 человек)	620	0,0101	952	0,0012	1165	0,0001	1832
Burden of NCDs (DALY/100,000 person-years)							
NCD Noncommunicable diseases	9260	0,0000	13065	0,0000	13411	0,0000	14266
Malignant neoplasms							
Mouth and oropharynx cancers	54	0,2998	99	0,5069	77	0,7400	83
Stomach cancer	77	0,0037	141	0,0620	143	0,4807	87

Liver cancer	54	0,4553	61	0,1150	231	0,0005	231
Prostate cancer	109	0,7400	100	0,3837	0,000	0,2455	139
Lymphomas, multiple myeloma	88	0,8035	82	0,4306	0,000	0,0048	145
Leukaemia	79	0,9339	73	0,4068	158	0,0114	48
Other neoplasms	24	0,1150	32	0,1844	43	0,0070	51
Oesophagus cancer	48	1,0000	43	0,1466	36	0,7400	38
Colon and rectum cancers	175	0,2134	162	0,0001	70	0,0000	65
Pancreas cancer	74	0,1711	50	0,0000	27	0,0000	29
Trachea, bronchus, lung cancers	377	0,4553	366	0,0003	177	0,0000	85
Melanoma and other skin cancers	35	0,0114	21	0,0000	11	0,0006	13
Breast cancer	2,5	0,0680	1,2	0,0000	0,000	0,0000	0,000
Bladder cancer	54	0,1150	47	0,2998	0,000	0,8682	54
Neuropsychiatric conditions and Diabetes mellitus							
Alcohol use disorders	746	0,1985	844	0,6482	555	0,0014	158
Alzheimer and other dementias	217	0,0005	163	0,0000	144	0,0000	119
Parkinson disease	54	0,0011	24	0,0000	25	0,0000	24
Diabetes mellitus	263	0,0381	369	0,0025	428	0,0006	431
Cardiovascular diseases							
Hypertensive heart disease	36	0,0007	152	0,0008	152	0,0000	167
Ischaemic heart disease	738	0,0090	1436	0,0028	1255	0,0004	1231
Cerebrovascular disease	325	0,0002	999	0,0006	938	0,0001	1064
Respiratory diseases							
Chronic obstructive pulmonary disease	305	0,7089	321	0,1249	454	0,0019	526
Digestive diseases	445	0,0025	766	0,0008	923	0,0000	1120
Musculoskeletal diseases	345	0,0003	449	0,0000	489	0,0000	466
Cirrhosis of the liver	175	0,0465	252	0,1249	232	0,2998	190
Osteoarthritis	176	0,0042	213	0,0000	276	0,0001	273
Nephritis and nephrosis	37	0,0000	136	0,0000	287	0,0000	316
Peptic ulcer disease	20	0,0070	55	0,0000	86	0,0000	168
Injuries	1518	0,0000	2500	0,0007	3578	0,0000	4300
Nutritional deficiencies (DALY/100 000 человеко-лет)							
Protein-energy malnutrition	2	0,0000	67	0,0000	258	0,0000	511
Vitamin A deficiency	0	0,2211	0	0,0055	1	0,0000	8
Iron-deficiency anaemia	41	0,0000	82	0,0000	166	0,0000	293

Table 2: Quality of life, Dietary Patterns and, Metabolic Syndrome Predictors, Burden of NCDs in countries of groups 1,2,3,4. U - Mann-Whitney.

IPC: Per Capita Income; ON: Optimal Nutrition; SN: Suboptimal Nutrition; UV: Ultraviolet; LE: Life expectancy; HPI: Happiness Index; Total CL: Total consumption level; % AP: Animal products; % GV: Grains and vegetables; % FS: Fruits and sweeteners; % AB: Alcoholic beverages; BMI: Body Mass Index; Chol: Cholesterol; Glu: Glucose; BP: Blood Pressure; LPA: Low physical activity; SS: Statistically significant; SIS: Statistically insignificant

p≥ 0,025: Statistically insignificant according to Bonferroni correction

Macronutrients

Levels of daily Energy consumption (kcal/person/day) in 4 groups of countries

The level of daily Energy consumption in 4 groups of countries decreased SS from optimal nutrition in the 1st group of countries - 3610 to 2920 in the 2nd group of countries, to 2590 in the 3rd group and to 2130 kcal/person/day) in the 4th group of non-optimal nutrition. On average, from group 1 to group 4 of countries decreased by 500 kcal/person/day (Table 2, Figure 1).

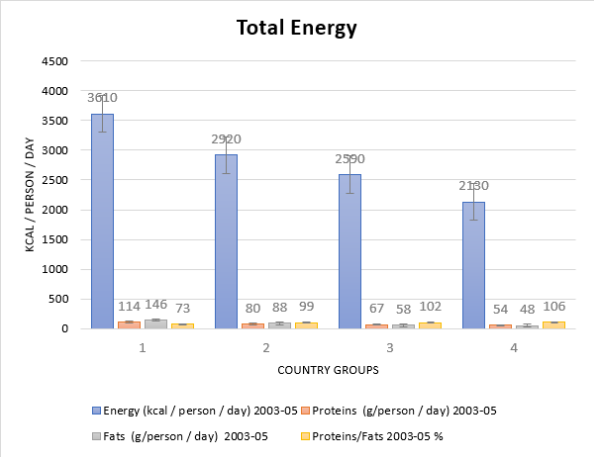

Figure 1: Total Energy

The daily level of protein consumption from the 1st group of countries to the 4th group decreased SS from 114 to 54 (g/person/day), Fat - SS from 146 to 48 (g/person/day). The ratio of Proteins to Fats in the composition of Energy SS increased from group 1 of countries to group 4 from 73% to 106% (Table 2).

Percentage composition of total energy macronutrients

The percentage composition of SS carbohydrates increased uniformly from the 1st group of countries to the 4th group from 51% TO 69%; Protein and Fat levels decreased from 12% to 10% and from 38% to 21%, respectively (Table 2, Figure 2).

Percentage composition of energy from animal products from total energy

The percentage of animal Energy SS decreased from country group 1 to group 4 from 29% to 7%; animal Proteins SS from 60% to 19%; Fat SS from 56% to 21% (Table 2, Figure 3).

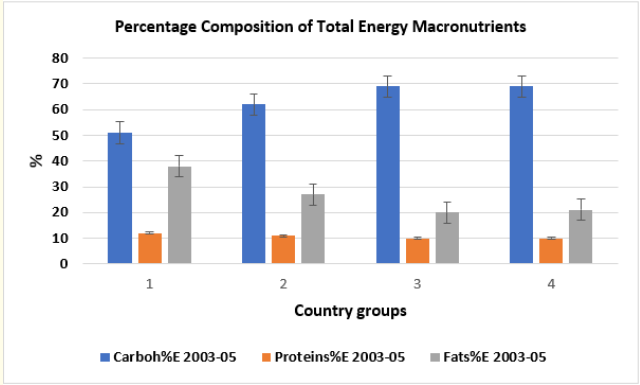

Figure 2: Percentage Composition of Total Energy Macronutrients

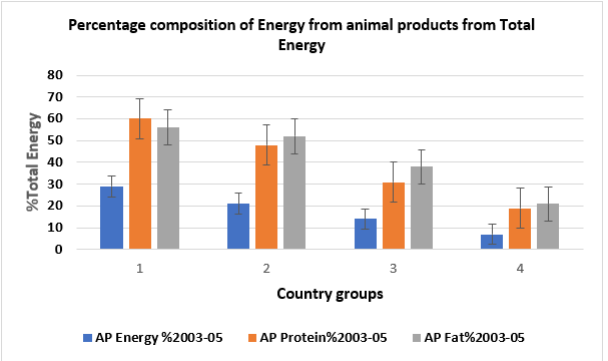

Figure 3: Percentage composition of Energy from animal products from Total Energy

Dietary Patterns

Daily level of food consumption (g/person/day)

Total CL decreased SS from country group 1 to group 4: 2323, 1696, 1086, 730 (g/person/day), respectively (Table 2).

Percentage composition of dietary patterns

% Animal products (AP) decreased statistically insignificantly (SIS) from group 1 of countries to group 4 from 34% to 20%. % Grains and vegetables (GV) SS increased from country group 1 to group 4 from 39% to 67%. % Fruits and sweeteners (FS) SS from countries group 1 to group 4 decreased from 12% to 6%. %Alcoholic beverages (AB) SS from countries group 1 to group 4 decreased from 11% to 2% (Table 2, Figure 4).

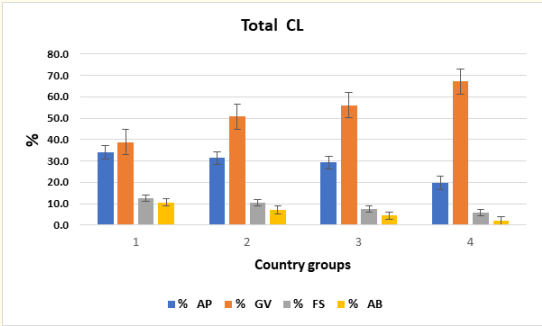

Figure 4: Dietary Patterns Daily level of food consumption.

Daily levels of alcoholic beverage consumption (g/person/day) both sexes

Levels of consumption of alcoholic beverages (Beverages, Alcoholic, Wine, Beer, AB amount) are steadily decreasing more often SS from group 1 to group 4 countries (Table 2). Less SS decreases from group 1 to group 4 countries Tobacco smoking Male Daily Age (Table 2, Figure 5).

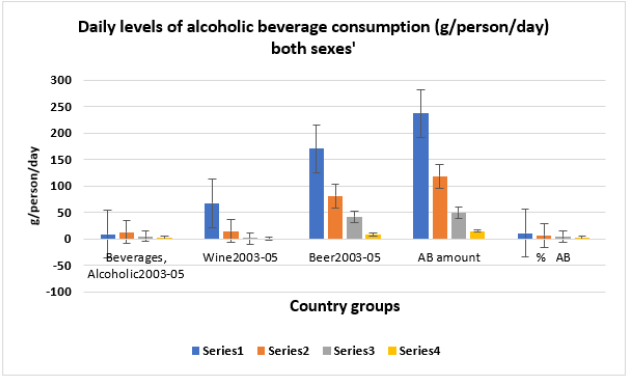

Figure 5: Daily levels of alcoholic beverage consumption (g/person/day) both sexes.

Comparative analysis of metabolic syndrome predictors

- BMI ≥ 25 (kg/m2) SS decreases from 63% to 15% from group 1 to group 4 countries.
- Chol. ≥ 5.0 (mmol/L) SS decreases from 63% to 22% from group 1 to group 4 countries.
- BMII ≥ 30 (kg/m2) SS decreases from 23% to 3% from group 1 to group 4 countries.
- Chol. ≥ 6.2 (mmol/L) SS decreases from 20% to 4% from group 1 to group 4 countries.
- Glu. ≥ 7.0 (mmol/L) SS decreases from 10.8% to 4% from 1st group of countries to 4th group.
- BP ≥ 140/90 (mm Hg) SIS decreases from 47% to 41% from group 1 to group 4 countries.LPA ≤ 60 (minutes/day walking) SS decreases from 40% to 15% from group 1 to group 4 countries, indicating an increase in PA from group 1 of countries to group 4 (Table 2, Figure 6).

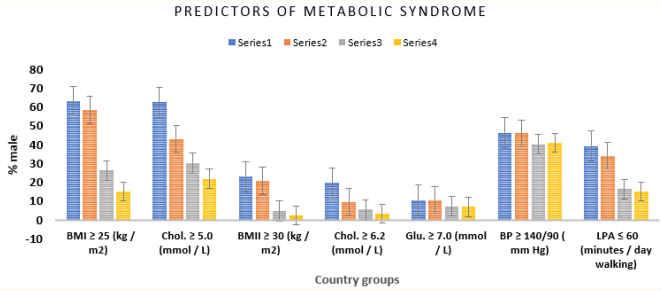

Figure 6: Predictors of Metabolic Syndrome.

An analysis of the burden of NCDs in groups countries 1, 2, 3, 4

Burden of NCDs (DALY/100,000 person-years) increased SS from country group 1 to group 4 from 9200 to 14266 SS.

Malignant neoplasms 1

Mouth and oropharynx cancers SIS from group 1 to group 4 countries there was an increase from 54 to 83 DALYs (Table 2). Stomach cancer growth from 77 to 87 DALYs. Liver cancer growth from 54 to 231 DALYs. Prostate cancer SIS growth from 109 to 139 DALYs. Lymphomas, multiple myeloma increase in SIS from 88 to 145 DALYs. Leukaemia SIS increase from 79 to 158 DALYs. Other neoplasms growth up to 51 DALY, SS, in group 4 of countries (Table 2, Figure 7).

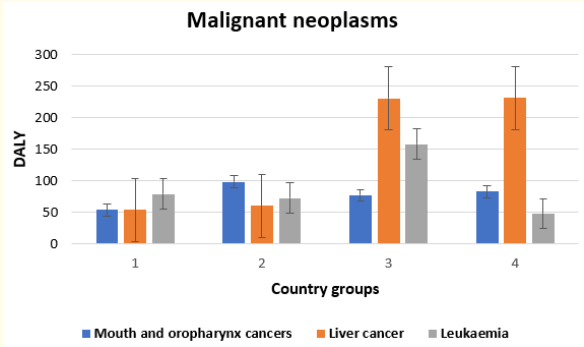

Figure 7: Malignant neoplasms 1

Malignant neoplasms 2

Oesophagus cancer SIS from 48 to 38 DALYs. Colon and rectum cancers reduction in growth from 175 to 65 DALYs, SS in the 3rd and 4th group of countries. Pancreas cancer decrease in growth from 74 to 29 DALYs, in the 3rd and 4th group of SS countries. Trachea, bronchus, lung cancers reduction in growth from 377 to 85 DALYs, in the 3rd and 4th group of SS countries.

Melanoma and other skin cancers SS growth reduction from 35 to 13 DALYs in 2,3,4 groups of countries. Breast cancer SS growth reduction from 2.5 to 0.00 DALY, in 3 and 4 group of countries SS. Bladder cancer SIS, 54 DALYs in 4 groups of countries (Table 2, Figure 8).

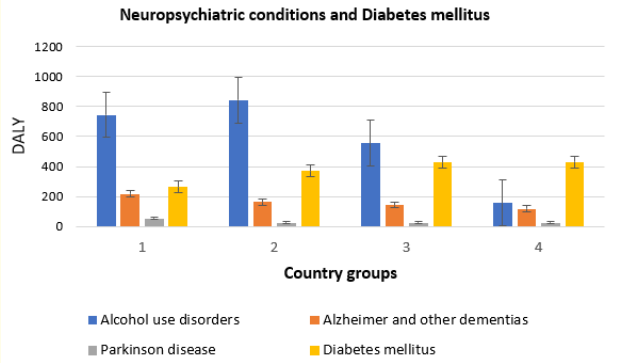

Figure 8: Malignant neoplasms 2.

Endocrine disorders

The median burden of Diabetes mellitus – from the 1st to the 4th group of countries, the burden of Diabetes increased from 263 DALYs to 431 DALYs and was SS in the 3rd and 4th groups of countries (Table 2, Figure 9).

Neuropsychiatric conditions

Alcohol use disorders - in the 1st group of countries, the burden was equal to 746 DALYs, in the 2nd group 844 DALYs, but SIS, in the 3rd group and 4th group of countries, the SS disease burden decreased to 555 DALYs and SS decreased to 158 DALYs in the 4th group of countries. The burden of Alzheimer and other dementias SS decreased from group 1 countries from 217 DALYs to group 4 countries to 119 DALYs.

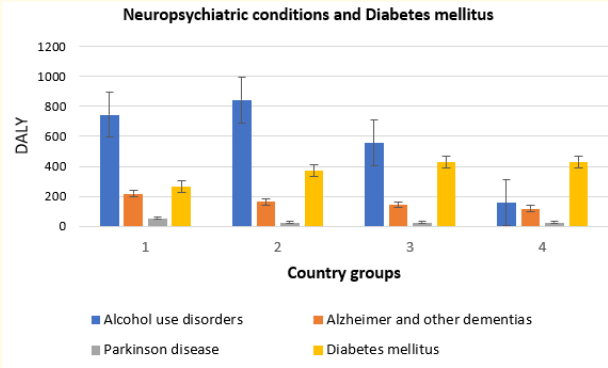

Figure 9: Neuropsychiatric conditions and Diabetes mellitus.

The burden of Parkinson disease SS decreased from group 1 countries from 54 DALYs to 24 DALYs in group 4 countries (Table 2, Figure 9).

Cardiovascular diseases

The burden of Hypertensive heart disease SS increased steadily from group 1 countries from 36 DALYs to 167 DALYs in group 4 countries. The burden of Ischemic heart disease SS increased steadily from group 1 countries from 738 DALYs to 1231 DALYs in group 4 countries. The burden of Cerebrovascular disease SS increased from group 1 countries from 325 DALYs to 1064 DALYs in group 4 countries (Table 2, Figure 10).

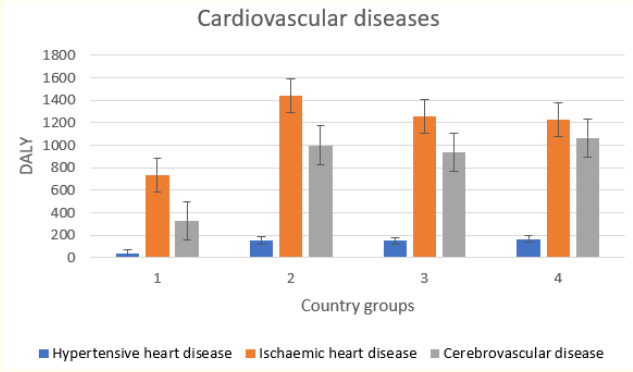

Figure 10: Cardiovascular diseases.

Respiratory diseases

The burden of Chronic obstructive pulmonary disease increased SIS from 305 DALYs in group 1 of countries to 526 DALYs to SS 526 SIS in group 4 of countries (Table 2).

Digestive diseases

The burden of Peptic ulcer disease SS increases from group 1 countries from 20 DALYs to 168 DALYs in group 4 countries. The burden of Cirrhosis of the liver SIS increases slightly from 175 DALYs in group 1 of countries to 190 DALYs in group 4 of countries. The burden of Nephritis and nephrosis SS increases from group 1 countries from 37 DALYs to 316 DALYs in group 4 countries. The burden of Musculoskeletal diseases SS is growing from group 1 countries from 345 DALYs to 466 DALYs in group 4 countries. The burden of Osteoarthritis SS increases from group 1 countries from 176 DALYs in group 1 to 273 DALYs in group 4 countries (Table 2, Figure 11).

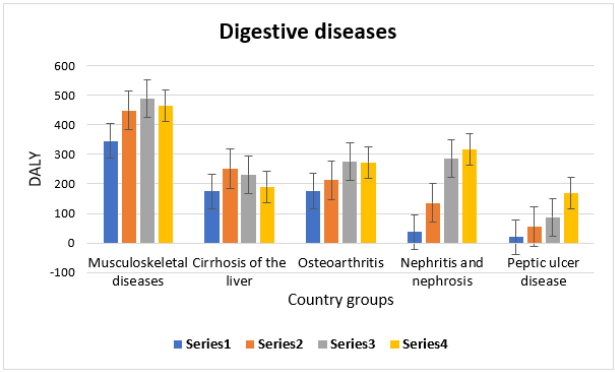

Figure 11: Digestive diseases.

Nutritional deficiencies (DALY/100 000 man-years)

Protein-energy malnutrition SS grows from country group 1 to group 4 from 2 DALYs to 511 DALYs. Vitamin A deficiency SS increases from country group 1 to group 4 from 0 DALY to 8 DALY. Iron-deficiency anemia SS grows from country group 1 to group 4 from 41 DALYs to 293 DALYs (Table 2).

Discussion

By the beginning of the 21st century, it seemed that the world had mastered infectious diseases [20]. The problems of risk factors and burden of NCDs have come to the forefront [1,2,4,8,13]. But the Covid-19 Pandemic arose and has been going on for 4 years. And NCDs, including cancer, CVD, COPD, neurodegenerative diseases and type 2 diabetes, are steadily increasing in countries with high, middle and low income [10-13]. Research over the past 10 years does not show success in the fight against NCDs [1,2,10].

Studies have emerged that question the involvement of Metabolic Syndrome and visceral obesity as risk factors for NCDs [5,6]. Some authors propose developing prevention and treatment not for one type of NCD, but for a group of diseases at once [11]. In accordance with our goal, we investigated the role of suboptimal nutrition on the implementation of risk factors for NCDs, including MS, in countries around the world. In rodent studies, four diets with different calorie levels (100, 80, 70 and 60%) were used [14]. The main rule of these studies was the same percentage composition of macronutrients (Carbohydrates, Proteins and Fats) in the control and experimental groups. In the 4 groups of countries in our study, the calorie content of the diet was 100%, 80%, 70% and 60% of total Energy. But the percentage composition of macronutrients was not constant across the 4 groups of countries.

Carbohydrates increased from 51% to 69%; Proteins decreased from 12% to 10%; Fats decreased from 38% to 21%. At the same time, the ratio of Proteins to Fats increased from the 1st group of countries to the 4th group by 30%. All changes in macronutrients were SS. Macronutrients from animal products those included in the Total Energy SS uniformly decreased from 1 1grtsppv countries to 4 groups. We assume that this is how adaptation to suboptimal nutrition occurred in groups 2, 3 and 4 of countries.

Daily food consumption levels in countries decreased SS from 100% to 30%. The nutritional structure (percentage composition of daily consumption level) reflected the dynamics of macronutrients from group 1 to group 4 of countries. %AP (animal products) decreased from 31% to 20%. %GV (cereals and vegetables) SS increased from 39% to 67%.

% FS (fruit and sweeteners) SS decreased from 12% to 6%. %AB (alcoholic beverages) SS decreased from country group 1 to group 4 from 11% to 2%.

Suboptimal nutrition on average reduces indicators of MS predictors by 3 times.

Obesity and Cholesterol ≥6.2 mmol/L are reduced by 85% in group 4 countries. Overweight and Cholesterol ≥5.0 mmol/L are

reduced by 70% in group 4 countries. Hyperglycemia decreases by only 30% in group 4 countries. From group 1 to group 4 of countries, physical activity increases to 85%.

Obesity in childhood is associated with the presence of risk factors for the development of diseases in the future and with the early development of these diseases. Risk factors for the burden of NCDs among obese children are high [30]. Fat accumulation occurs when dietary energy intake exceeds energy expenditure through physical activity, taking into account metabolic rate.

There is no complete study of what contributes to metabolic rate [31].

Thus, as a result of the three-stage suboptimal nutrition, unfavorable risk factors for NCDs were significantly reduced to a non-hazardous level.

But the burden of 7 types of cancer (*Malignant neoplasms 1)* increased from 1 group of countries to 4 groups of countries.

The burden of type II diabetes from group 1 countries to group 3 SS increased by 2 times. According to some authors, insulin resistance in type II diabetes occurs in the muscles of thin people predisposed to diabetes. According to the authors, this insulin resistance is the cause of the excessive fat accumulation associated with type II diabetes. This early muscle insulin resistance is the etiology of the hyperlipidemia and excess fat accumulation characteristic of type II diabetes [32].

Type II diabetes is a growing epidemic and a leading cause of mortality and morbidity worldwide. Improving quality of life is considered the primary goal of a type 2 diabetes control program. The socioeconomic status (SES) of households in developing and developed countries has a significant impact on the quality of life of patients with type II diabetes [33].

The burden of CV diseases increased 3 times from group 1 to group 4 countries. The burden of COPD increased by 2.5 times SS in group 4 countries. SS the burden of digestive diseases increased from 1st to 4th group of countries and Injuries.

At the same time, the burden of 7 cancers (*Malignant neoplasms 2),* as well as the burden of Alcoholism by 4 times, Alzheimer's and Parkinson's diseases in groups 2, 3 and 4 of SS countries decreased by 2 times.

Our research shows that the quality of life in countries from group 1 to group 4, including life expectancy, is steadily declining. Natural and geographical conditions have a negative impact on the life expectancy of the population. But socio-economic factors have a dominant influence on increasing population longevity [34]. Many researchers believe that Quality of life is an important risk factor for the burden of NCDs. Primary and secondary prevention strategies, such as promoting a safe environment, healthy lifestyles, including proper nutrition, appropriate physical exercise. Quitting smoking and drug and alcohol abuse should lead to significant reductions in medical and social costs [35]. Income is an important determinant of individual living standards and social participation. Data from the German Socio-Economic Group shows that income levels influence a person's health and life expectancy. Stress burden, social comparison reactions and processes, and disease-induced processes of decreased social mobility and social isolation are discussed as possible explanations [36]. Data from the German Socio-Economic Group shows that income levels influence a person's health and life expectancy. Stress burden, social comparison reactions and processes, and disease-induced processes of decreased social mobility and social isolation are discussed as possible explanations [36]. With increasing life expectancy, the desire to maintain good health, functionality and maximum quality of life in old age, for which nutrition plays a critical role, becomes a priority for older people. Although genetic factors are a determining factor in life expectancy. There are several external factors which have a great impact on the quality of life of older people. Diet and nutritional status have a major impact, especially on the prevention and treatment of several NCDs that affect this heterogeneous and vulnerable age group. In developed countries, older people are most affected by malnutrition [37].

Conclusion

The studies were conducted on 4 groups of countries with 15 countries in each group. In group 1 there was optimal nutrition -100%. In groups 2, 3 and 4 of countries there was suboptimal nutrition - 80%, 70% and 60%. The Total Energy of the countries was used as the initial parameter. Comparative nutrition studies of countries were carried out using the Mann-Whitney U test, since

some of the studied samples did not have a normal distribution. As a result of the research, it was established that as suboptimal nutrition decreased in groups of countries from group 1 to group 4, there was a SS change in the ratio of % Carbohydrates, Proteins and Fats. The % of carbohydrates increased towards the 4th group of countries, the % of Proteins and Fats decreased towards the 4th group of countries.

Moreover, the ratio of Proteins to Fats increased in the 4th group of countries. This SS process was repeated with the Energy, Protein and Fats of animal products included in the Total Energy. In the daily level of products from the 1st group of countries to the 4th SS group, the share of animal products, fruits and alcoholic beverages decreased and the share of grains and vegetables increased. Predictors of MS also underwent SS rearrangements. Obesity and Cholesterol ≥ 5.0 (mmol/L) lost 85%. Hyperglycemia ≥ 7.0 (mmol/L) lost only 30%. Low physical activity turned into high activity in groups 3 and 4 of countries.

The burden of NCDs (type 2 diabetes, hypertensive, ischemic, cerebrovascular heart disease, COPD, digestive diseases and 7 types of hormone-independent cancers) more often than SS increased by 2-3 times to the 4th group of countries. In groups 2, 3 and 4 of SS countries, the quality and life expectancy decreased.

The results indicate the high adaptive capacity of the human nutrition system. No influence of risk factors on NCDs was identified.

Conflict of Interest

The authors have no conflict of interest.

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