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Comparative Analysis of Economic, Geographic, Social and Nutritional Risk Factors 4 Types of Non-Communicable Chronic Diseases (Melanoma, Multiple Sclerosis, Diabetes Mellitus and Hypertensive Heart Disease) in the Mediterranean and Caribbean Countries (Population Study)

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Abstract

Background and targets: In 2016, 40.5 million (71%) of the 56.9 million deaths worldwide were due to NCDs [1]. In the Caribbean, NCDs in 2010 outpaced those in North and South America [2]. Male death rate from NCDs is higher than female death rate [1, 2]. This fact served as the basis for comparative studies on nutritional risk factors for NCDs in men in the Caribbean (CC) and Mediterranean (MC) countries. MC are a globally recognized reference for good nutrition and low incidence of NCDs [3].

The impact of nutritional patterns on the burden of melanoma, multiple sclerosis, hypertensive heart disease and diabetes mellitus in men in the Mediterranean (MC) and Caribbean (CC) countries was researched.

Methods: Data on the NCD (DALY) burden in men in MC and CC were obtained from [GBD 2004]. Information on food consumption levels in countries was obtained from FAO [FAO-HQfao.org] for 2003-05. U-Manna-Whitney and multiple linear regression analysis were used to analyze differences in nutrition structure and NCD burden in MC and CC. Using the U-Manna-Whitney Criterion, we evaluated the incidence of the most important NCDs in MC and CC. Regression analysis evaluated the impact of risk factors (independent variables) on DALY for 4 types of NCDs (dependent variables). The independent variables in the first stage of the analysis were 4 food structure fractions: animal products (AP); vegetables (CV); fruits (FS); and alcoholic beverages (AB). Dependent variables were the burden of melanoma, multiple sclerosis, hypertensive heart disease, and diabetes mellitus as the diseases with the highest frequency of 63 NCDs in MC and CC. In the second stage of regression analysis, predictions of the effect of increase on the of risk factors (independent variables) on DALY for 4 types of NCDs (dependent variables) were evaluated.

Results: The total NCD burden in MC was 1.3 times lower than in CC ($p = 0.006$). Total daily food consumption (TDC) as well as animal products fraction (AP) in MC was 1.5 times higher than in CC ($p = 0.0002$). The share of CV (vegetables) in MC was 1.9 times higher than in CC ($p = 0.001$). The share of FS (fruits) in MC was 1.2 times higher than in CC ($p = 0.3$). The share of AB (alcohol) in MC was 2.5 times higher than in CC ($p = 0.009$).

The burden of melanoma and multiple sclerosis in MC was 2 times higher than in CC ($p = 0.002$). In CC the burden of diabetes and hypertensive heart disease was 2.5 times higher ($p = 0.001$). In MC, there were 1.5-2 times higher than in CC: BMI ($p = 0.03$), blood cholesterol ($p = 0.0002$), and blood pressure ($p = 0.002$).

As a result of multiple regression analysis, it was found that the nutrition structure fractions AP and AB, as well as GDP have the largest influence on the dependent variable (DALY). The coefficients R1 were 0.812, 0.723 and 0.819 respectively (p = 0.001). This meant that the independent variables AP, AB and GDP could determine up to 70% of the volatility of the dependent variable R2: 0.66, 0.52, 0.67 respectively. Per unit increase in AP, CV, AB, GDP and UV independent variables affected 4 types of DALY. Thus, an increase in AP by 1 g was accompanied by an increase in DALY for multiple sclerosis by 0.1% (p = 0.000) (± 95% CL). An increase in AB by 1 g reduced DALY for hypertonic disease by 0.3%, but increased DALY for melanoma by 0.5% (p = 0.001) (± 95% CL). An increase in CV by 1 g reduced DALY for diabetes by 0.1% (p = 0.001) (± 95% CL). An increase per unit of independent variable GDP ($1) was accompanied by 0.01% increase in DALY for multiple sclerosis and 0.3% decrease in DALY for hypertension (p = 0.001) (± 95% CL). An increase per unit of independent variable UV (1J/m2) reduced DALY for melanoma by 0.5% and increased DALY for diabetes by 0.3% (p = 0.001) (± 95% CL).

Conclusion: It was found that the NCD burden in MC is 1.3 times lower than in CC. However, food consumption levels, both overall and fractionally, in MC are higher than in CC. It was shown that the same risk factors (nutrition structure fractions AP, CV, AB) as well as economic and geographic factors (GDP and UV) could in some cases increase DALY NCD, in other cases had a downward effect on DALY. We assume that in NCD risk factor targets, some vectors of cross-country DALY gradients (40-50%) out of 63 NCD types are associated with unmodifiable factor UV (or latitude), or with modifiable factor GDP either positively or negatively.

This manifest itself in positive or negative correlation between DALY and risk factors in multiple regression analysis. Thus, melanoma and multiple sclerosis are positively associated with AP, AB and GDP. However, DALY for diabetes and hypertension are negatively associated with AB and GDP. Further research is required to investigate in detail the vector structure of cross-country gradients of NCDs and their correlation with risk factors.

Keywords

Mediterranean and Caribbean countries, Metabolic syndrome, Non-communicable chronic diseases (NCD), Nutrition structure, Animal products, Cross-country gradients NCD

Abbreviations

GDP: Gross Domestic Product; **UV:** Ultraviolet level; **FAO:** Food and Agriculture Organization of the United Nations; **NCD:** Non-Communicable Diseases; **HPI:** Happiness Index; **IHD:** Index of Human Development; **EEI:** Ecological Efficiency Index; **DALY:** Disability-Adjusted Life Years; **AP:** Animal Products; **CV:** Cereals and Vegetables; **FS:** Fruits and Sweeteners; **AB:** Alcoholic Drinks; **TDC:** Total Daily Consumption; **E:** Energy; **P:** Proteins; **F:** Fats; **BMI:** Body Mass Index; **Chol:** Blood Cholesterol; **Glu:** Blood Glucose; **BP:** Increased Blood Pressure with Pharmacological Correction; **LPA:** Low Physical Activity; **MC:** Mediterranean Countries; **CC:** Caribbean Countries; **R1:** Correlation Coefficient; **R2:** Determination Coefficient; **b^*:** Regression Equation Coefficients; **b:** Regression Equation Coefficients; **DV1:** Dependent Variable; **DV2:** Predicted Dependent Variable; **%:** Forecast Effect

Introduction

Since the second half of the twentieth century, the world has seen a decline in fertility and an increase in life expectancy [4, 5]. The result of this transition is a change in the age structure of the world population and an increase in the proportion of older generations. At the same time, threats to longevity are increasing in the form of non-communicable chronic diseases (NCDs), to which mankind lives up thanks to economic development and the absence of global wars [4-9]. By 2050, WHO predicts the growth of all types of NCDs, regardless of the level of economic development of countries [9, 10].

In this regard, the 2018 UN declaration set a target to reduce NCDs by two third by 2030 in order to achieve sustainable development [1]. The rate of increase in NCDs indicates the non-genetic nature of the disorders caused by NCD risk factors. In 2000, WHO announced the main risk factors for NCDs [11]. Overweight, obesity, hyperlipidemia, glucose tolerance, high blood pressure, low physical activity, predominance of animal products in diets, excessive consumption of salt and saturated fatty acids, and excessive consumption of alcohol and tobacco have been recognized as the main risk factors for NCDs [12, 13].

Over the past 30 years, successful prevention has reduced mortality from cardiovascular diseases in developed countries. However, in middle- and low-income countries cardiovascular diseases continue to grow. The main threats to longevity in the world are cancer, cardiovascular, neurodegenerative, respiratory diseases and diabetes mellitus [9, 10, 14]. To date, many mechanisms of risk factors' influence on immunity and predisposition to NCDs have been studied [15].

It turned out that predisposition to NCDs could be a consequence of intrauterine development disorders and could be inherited by the epigenetic mechanism without structural DNA damage [16-18]. To reduce food risk factors, a planetary diet with extremely low consumption of animal products has been proposed [19]. Methods of bariatric surgery to reduce excess body weight have been developed and successfully applied [20]. An abnormal increase in NCDs has been observed in some countries. Thus, the review [2] reported that in the Caribbean countries the growth of NCDs from 2000 to 2015 was ahead of the Americas.

Objectives

To study the nutritional risk factors of 4 NCDs: melanoma, multiple sclerosis, hypertensive heart disease and diabetes mellitus in 10 Caribbean countries compared to 10 Mediterranean countries with peak levels of animal products.

Materials and Methods

Study design: Observational statistical analysis. A database (from our database of 158 countries) of the burden of disease (DALY) NCD for 10 Mediterranean countries and 10 Caribbean countries (ICD-10 codes) with the maximum level of consumption of animal products (AP) as a fraction of the nutrition structure was created. DALYs are the sum of two indicators: YLL + YLD, where YLL are years of life lost due to premature death and YLD are years of disability due to illness or disability. One DALY is 1 year of life lost. This indicator allows to estimate not only mortality and morbidity, but also the social characteristics of countries and the level of health care.

Data on the burden of disease (DALY) for men (all ages) in 20 countries, standardized by sex and age per 100,000 population, were selected from the 2004 GBD database [13]. Men were preferred due to higher than women's total mortality and shorter life expectancy. Countries were divided into 2 groups: Mediterranean (MC) countries (group 1), and Caribbean (CC) countries (group 2). To characterize the economic, geographic and socio-demographic indicators in the countries, per capita income or gross domestic product (GDP) for 2008 and 2016 (US dollars per person per day) was used [2]; geographic location of countries by latitude (Lat) and the level of ultraviolet radiation in the capital (UV) (J/m2 2004) [21]; life expectancy for men (LE) [22]; access to improved health care, clean water and clean air [23]; the Happiness Index (IH), or Internal Gross Happiness in 2006 [24]. Body Mass Index (BMI) ≥ 25 kg/m^2 and ≥30 kg/m^2 has been studied as predictor of metabolic syndrome (MSP): percentage of men in the country with overweight and obesity; as well as the percentage of men with blood cholesterol (Chol ≥ 5.0 mmol / L) and (≥ 6.2 mmol / L); blood glucose (Glu ≥ 7.0 mmol / L); blood pressure (BP ≥ 140/90 mmHg); low physical activity (≤ 60 min/day walking) [25]. Daily Food Consumption Level (TDC) (g / person / day) (47 types of products) for each country was selected from the FAO database for 2003-2005. [26].

The dietary patters (DP) of the countries is presented in the form of 4 blocks in absolute and percentage of DP: 1 - products of animal origin (AP); 2 - cereals and vegetables (CV); 3 - fruits and sweeteners (FS); 4 - alcoholic beverages (AB). The composition of macronutrients was studied [26].

Statistical analysis of the study results was performed using Mann-Whitney-Wilcoxon U-criterion and Multiple Linear Regression Analysis for Independent Samples (MRA). U was the numerical value of the Mann-Whitney Criterion. The central trend in data distribution in the sample was represented by the Mediana.

The dispersion of data in the samples was estimated by means of the quartile range (QR) between the first and the third quartiles, that is between the 25th and 75th percentiles. The influence of risk factors in the countries on DALY NCD was evaluated by means of the multiple or paired regression analysis. The dependent variables were DALY NCD. The independent variables were DP fractions (AP, CV, FS, AB).

The quality of the regression model was estimated using correlation coefficient (R1), determination coefficient (R2), F-distribution, t-tests for regression coefficients and residues. The residues in all models had normal distribution. The analysis of values and signs of regression equation coefficients b^* and b made it possible to estimate the contribution of predictors to the DALY level, and the use of b coefficients to predict the influence of risk factors on the dependent variable when independent variables change by unit, which are statistically significant related to DALY - dependent variable. The essence of regression analysis was to find the most important factors affecting the dependent variable DALY, a level of statistical significance that reflects the degree of confidence in the conclusion about the differences between indicators of 1 and 2 groups of countries. Two levels of accuracy were assessed: (1) p ≤ 0.01 - error probability 1%; (2) p ≤ 0.05 - error probability 5%.

All calculations were performed using StatSoft software (version 12).

Study Results

Comparative analysis of economic, geographic and socio-demographic indicators in the countries

In 2008, the GDP of the Mediterranean countries (MC, 1st group) was 3 times higher than the GDP of the Caribbean countries (CC, 2nd group) (p = 0,031) (Table 1). MC are located 25 ° north of CC (p = 0.0002) and receive 2 times less UV (J/m^2) (p = 0.0002).

The well-being and education ranking in MC is 2 times higher than in CC (p = 0.0376), (p = 0.0002). In MC Human Development Index (HDI) is 1.1 times higher than the in CC (p = 0.0058), and Ecological Efficiency Index (EEI) is 1.3 times higher than the in CC (p = 0.0036). People in MC have 1.1 times higher access to health care (p = 0.0005) and 1.3 times higher access to clean water (p = 0.0011) and clean air than in CC (p = 0.04). Life expectancy (LE) for men in MC is 6 years higher than in CC (p = 0.001). The Happiness Index in CC is slightly lower than in MC (43 *vs.* 56), (p = 0.001). Apparently, MC were more successful than CC in 2004.

Analysis of nutrition structure in the countries

Total daily food consumption (TDC) as well as animal products share (AP) in MC were 1.5 times higher than in CC (p = 0.0002). The share of CV (vegetables) in MC was 1.9 times higher than in CC (p = 0.001). The share of FS (fruits) was 1.2 times higher than in CC (p = 0.3). The share of AB (alcohol) in MC was 2.5 times higher than in CC (p = 0.009).

Thus, people in MC consumed 1.5-2 times more food per day, both in general and in fractions, compared to CC (Table 1).

Macronutrients

In MC, the total Energy level is 1.2 times higher than in CC (p = 0.007). The share of Carbohydrates in MC is 13% lower than in CC (p = 0.0003).

The share of proteins in MC is 2% higher than in CC (p

Table 1: Comparative analysis of the burden of NCDs (DALYs) of quality of life, nutritional structure, metabolic syndrome in Mediterranean and Caribbean countries (Manna Whitney U-criterion) (10 countries in each group).

Variable	U	Z	p-value	Median 1 group	Quartile 1 group	Median 2 group	Quartile 2 group
Economic and geographical indicators							
GDP $ (person/day) 2008	21	2,15	0,0312	30	9	12	6
GDP $ (person/day) 2016	18	2,38	0,0173	66	34	21	24
lat°	-	3,74	0,0002	41	9	17	6
UV rad (J/m²) 2004	-	-3,74	0,0002	2624	834	4891	303
lon°	8	-3,14	0,0017	18	9	80	27
Socio-demographic indicators							
Prosperity Rating	22	-2,08	0,0376	38	25	70	10
Rating Educations	1	-3,67	0,0002	35	26	74	15
HPI 2006	6	-3,29	0,001	43	7	56	11
IHD Index of human development	13	2,76	0,0058	0,932	0,049	0,847	0,084
EEI Ecological efficiency index	11	2,91	0,0036	68	9	54	8
Access to the street. Medicine 1990	0,5	3,49	0,0005	100	0	89	11
Access to clean water 1990	4,5	3,27	0,0011	100	3	78	16
Air pollution for children under 5 years old 2004	19,5	-2,04	0,0412	0	1	7	23
Male life expectancy	6	3,29	0,001	77	2	71	5
Female life expectancy	3	3,52	0,0004	82	3	75	8
All Causes	7	-3,21	0,0013	11224	3214	18062	6622
Dietary patterns							
TDC (g/person/day)	-	3,74	0,0002	2219	229	1446	374
faction TDC							
AP amount	-	3,74	0,0002	763	155	502	171
CV amount	6	3,29	0,001	1028	359	534	136
FS amount	35,5	1,06	0,2899	264	59	229	138
AB amount	15	2,61	0,0091	183	64	74	75
General macronutrients							
Energy (kcal/person/day) 2003-05	13,5	2,72	0,0065	3430	410	2800	340
Composition of total macronutrients (%)							
Carboh %E 2003-05	2	-3,59	0,0003	51	3	64	6
Proteins %E 2003-05	7	3,21	0,0013	13	1	11	1
Fats %E 2003-05	4	3,44	0,0006	37	3	26	4
Macronutrients of animal products							
AP Energy % 2003-05	10	2,99	0,0028	28	4	19	4
AP Protein % 2003-05	17	2,46	0,014	57	9	48	13
AP Fat % 2003-05	39,5	0,76	0,4497	51	21	46	13
Metabolic syndrome							
Male BMI ≥ 25 (kg/m²)	23	2	0,0452	64	7	59	16
Male BMI ≥ 30 (kg/m²)	25	1,85	0,064	25	5	20	10
Male Chol ≥ 5.0 (mmol/L)	4	3,44	0,0006	59	10	33	13

Male Chol ≥ 6.2 (mmol/L)	2	3,59	0,0003	18	7	7	4
Male Glu ≥ 7.0 (mmol/L)	37,5	0,91	0,3643	11	1	10	5
Male BP 2 ≥ 140/90 (mm Hg)	11,5	2,87	0,0041	47	5	42	7
Male Insact ≤ 60 (minutes/day walking)	15	0,08	0,9323	49	30	41	13
NCD Noncommunicable diseases	16	-2,53	0,0113	9178	1939	11712	3066
DALY							
Melanoma and other skin cancers	7	3,21	0,0013	35	18	10	11
Multiple sclerosis	3	3,52	0,0004	29	5	19	3
DALY							
Diabetes mellitus	3	-3,52	0,0004	281	82	577	227
Hypertensive heart disease	8	-3,14	0,0017	38	51	228	213

= 0.001). The share of fat in MC is 11% higher than in CC (p = 0,0006) (Table 1).

Macronutrients of animal products (AP)

In MC, AP share in Energy is 1.5 times higher than in CC (p = 0.003). Consumption of animal proteins in MC was 1.2 times higher than in CC (p = 0.014).

Animal Fats in MC did not statistically differ from CC (p = 0.5) (Table 1).

So, in MC compared to CC, the daily food consumption was 1.5 times higher than in CC, AP products consumption was 1.5 times higher than in CC, and CV and AB products consumption was 2-2.5 times higher than in CC.

In addition, in MC, on average, consumption of both general and animal macronutrients was 1.5-2 times higher than in CC, except for AP fats, whose consumption did not statistically differ (Table 1).

Metabolic syndrome (MS)

The proportion of men with overweight (BMI ≥ 25) in MC was 1.1 times higher than in CC (p = 0.045); men with obesity (BMI ≥ 30) in MC was 1.3 times higher than in CC (p = 0.064), but not significant; with hyperlipidemia (Chol ≥ 5.0) in MC was 1.6 times higher than in CC (p = 0.0006); with hyperlipidemia (Chol ≥ 6.2) was 2.2 times higher in MC than in CC (p = 0.0003); with blood hyperglycemia (Glu ≥ 7.0) in MC was statistically the same as in CC. In MC, the proportion of men with high blood pressure (BP ≥ 140/90) was 1.1 times higher than in CC (p = 0.004); the difference between MC and CC in proportion of men with low physical activity (LPA) was not statistically significant (p = 0.9) (Table 1).

Thus, the share of male population in MC with increased MS characteristics was, on average, 1.4 times higher than in CC.

NCD burden of disease analysis in the countries

The total NCD burden in MC was 1.3 times lower than in in CC (p = 0.006).

The burden of melanoma and multiple sclerosis in MC was 2 times higher than in in CC (p = 0.002). In CC, the burden of diabetes and hypertension was 2.5 to 5 times higher (p = 0.001). (Table 1).

As a result of multiple regression analysis, it was found that the nutrition structure fractions AP and AB, as well as GDP have the largest influence on the dependent variable (DALY). Coefficients R 1 were 0.812, 0.723 and 0.819 respectively (p = 0.001). This meant that the independent variables AP, AB and GDP could determine up to 70% of the volatility of the dependent variable R2: 0.66, 0.52, 0.67 respectively (p = 0.001).

Per unit increase in AP, CV, AB, GDP and UV independent variables affected DALY NCD. Thus, an increase in AP by 1 g was accompanied by an increase in DALY for multiple sclerosis by 0.1% (± 95% CL). An increase in AB by 1 g reduced DALY for hypertonic disease by 0.3%, but increased DALY for melanoma by 0.5% (p = 0.001) (± 95% CL). An increase in CV by 1 g reduced DALY for diabetes by 0.1% (p = 0.001) (± 95% CL). An increase per unit of independent variable GDP ($1) was accompanied by 0.01% increase in DALY for multiple sclerosis and 0.3% decrease in DALY for hypertension (p = 0.001) (± 95% CL). An increase per unit of independent variable UV ($1J/m^2$) reduced DALY for melanoma by 0.5% and increased DALY for diabetes by 0.3% (p = 0.001) (± 95% CL) (Table 2).

Thus, despite higher risk factors (nutrition structure and metabolic syndrome) in MC (AP, AB and MS), the NCD burden in these countries was 1.3 times lower than in CC (p = 0.006). Multiple regression analysis shows that the same risk factors (AP, AB, GDP, UV) may in some cases increase DALY NCD, but in others have a decreasing effect on DALY.

Discussion

As a result of the research, it was found that in 2004, men's NCDs in MC have 9178 ± 1936 DALY, and in CC have 11712 ± 3066 DALY (p = 0.01). In order to estimate the level of NCDs in these countries, we can compare them with the world data from our database of 158 countries. There are at least 100,000 people in each country of the database. In our database, 3 countries have the median position on NCDs in 2004: Iran, Bosnia and Herzegovina, Serbia and

Table 2: Multiple linear regression analysis. Independent variables: AP, CV, FS, AB, GDP, UV. DALYs -dependent variables.

Dependent variable (DV)	Independent variable (IV)	Regression Summary for Dependent Variable						Dependent variable 1	Dependent variable 2	Forecast effect
	AP, CV, FS, AB	R^1	R^2	b^*	b	F	p-value	DV^1	DV^2	%
Melanoma and other skin cancers	AB	0,611	0,374	0,611	0,008	(1,16) = 93	0,000	19,75	19,84	100,5
Multiple sclerosis	AP	0,812	0,659	0,412	0,011	(3,154 = 99	0,000	20,05	20,07	100,1
Diabetes mellitus	CV	0,457	0,209	-0,271	-0,165	(1,16) = 20	0,000	395,95	395,79	99,9
Hypertensive heart disease	AB	0,379	0,144	-0,379	-0,738	(1,16) = 26	0,000	217,8	217,1	99,7
	GDP, UV									
Melanoma and other skin cancers	UV	0,463	0,214	-0,463	-0,006	(1,16) = 42	0,000	19,75	19,74	99,5
Multiple sclerosis	GDP	0,819	0,67	0,229	0,109	(2,16) = 158	0,000	20,05	20,16	100,5
Diabetes mellitus	UV	0,57	0,325	0,57	0,077	(1,16) = 75	0,000	395,95	396,03	100,3
Hypertensive heart disease	GDP	0,293	0,086	-0,292	-0,437	(1,16) = 15	0,000	217,81	213,43	97,7

R^1: Correlation coefficient; R^2: Determination coefficient; b^*: Regression equation coefficients; b: Regression equation coefficients; DV^1: Dependent Variable; DV^2: Predicted Dependent Variable; IV: Independent Variable (IV); %: Forecast Effect; AP: Animal Products; CV: Cereals and Vegetables; FS: Fruits and Sweeteners; AB: Alcoholic Drinks; GDP: Gross Domestic Product; UV: Ultraviolet; DALY: Disability-Adjusted Life Years

Montenegro - 13000 DALY. 13071 DALY is a middle value in our database. NCD of Kazakhstan, Russian Federation and Angola are the highest in our list - 20 000 DALY. 21333 is the maximum DALY in our list. Italy, Iceland and Japan have the lowest NCD level, 7,000 DALY. 6899 DALY is the minimum value in our database.

Thus, MC are closer to the minimal level of NCDs [3, 27], and CC are closer to countries with median levels of NCDs [28-30]. We can conclude that in 2004, the male population of the Caribbean countries lost 11712 ± 3066 years due to premature death and disability. Moreover, the largest loss was due to hypertension and type 2 diabetes [31-34]. We cannot conclude that the losses in these countries (CC) were due to excessive consumption of food, both in general and in fractions of the food structure. Incidence of these diseases was 2.5 to 5 times higher than in MC [35, 36], where food consumption levels were 1.5 to 3 times higher both in total and in fraction than in CC. Predictors of metabolic syndrome were 1.5-3 times higher in MC. In CC in 2004-2008, the income level was 3 times lower than in MC. In CC, level of health care is lower, access to clean water and clean air is lower, and Ecological Efficiency Index is also lower than in MC. However, CC residents feel happier [24], which is reassuring.

We have shown that cardiovascular diseases depend on income and do not depend on geographic latitude [37]. And diabetes does not depend on income, but depends on geographic latitude [38]. In MC compared to CC the burden of melanoma is 3 times higher, and the burden of multiple sclerosis is 1.5 times higher. These data are quite in line with common views [38]. MC have higher levels of total consumption, consumption of animal products, and alcoholic beverages than CC. In MC, BMI and hyperlipidemia is higher than in CC. MC have higher education level and higher Human Development Index than CC, which are considered as risk factors for cancer. [39].

The WHO report 2018 [40] summarized the development of NCDs since 2000. It was shown that cancer, diabetes mellitus, cardiovascular and respiratory diseases are steadily growing worldwide [39, 40]. The 2011 plans of WHO together with the UN to reduce NCDs by 1/3 by 2030 were reduced to 1/3 in 2011 [1]. If NCDs have been rising steadily for over 50 years, how it is possible to reduce NDC by at least 1/3? We can see that income growth is slower in middle- and low-income countries than in 11-15 high-income countries. Recommendations are made to redistribute the country's budget in favor of health care and prevention of NCDs, especially in sub-Saharan Africa and Eastern Mediterranean countries [39, 40]. A lot of research is devoted to the widespread desire of the world's young people to westernize nutrition and lifestyle [33].

Our multiple regression analysis and prediction studies show that increased income in countries will be accompanied by a decline in cardiovascular diseases, but an increase in cancer incidence. There are studies that show that as far as income increases in low-income countries, the structure of cancer will change. Cancers associated with infections (cervical, stomach, liver cancer) are decreasing, but the incidence of prostate and breast cancer is increasing [40].

Cross-country studies are not intended to uncover mechanisms of NDC development. However, they can illuminate directions for deeper research by other specialists. We see that in WHO [19, 39] databases, NCDs are not homogeneous like infectious diseases. It is likely that NCDs are of 2-3 types, either positively or negatively associated with income and geographic latitude (or UV), due to vectors of cross-country gradients of NCDs. However, there are rare types of NCDs that have steep cross-country DALY gradients such as lymphoma and leukemia. In these NCDs, cross-country vectors of gradients are multipolar. However, at the same time, leukemia and lymphoma correlate neither with income nor with geographical latitude.

Conclusion

It was found that the NCD burden in MC is 1.3 times lower than in CC. However, consumption levels both overall and fractionally in MC is higher than in CC. It is shown that the same risk factors (feed structure fractions AP, CV, AB), as well as economic and geographic factors (GDP and UV) can in some cases increase DALY NCD, but in other cases have a downward effect on DALY. We assume that in NCD risk factor targets, some vectors of cross-country DALY gradients (40-50%) out of 63 NCD types are associated with unmodifiable factor UV (or latitude), or with modifiable factor GDP either positively or negatively.

This manifest itself in positive or negative correlation between DALY and risk factors in multiple regression analysis. Thus, melanoma and multiple sclerosis are positively associated with AP, AB and GDP. However, DALY for diabetes and hypertension are negatively associated with AB and GDP. Further research is required to investigate in detail the vector structure of cross-country gradients of NCDs and their correlation with risk factors.

Conflict of Interest

The authors have no conflict of interest.

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