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Research Article

Study of Non-Communicable Chronic Diseases Structure and Risk Factors in European and Mediterranean Countries (Population Study)

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Abstract

Goals: Analysis of NDC risk factors in European (EC) and Mediterranean (MC) countries.

Methods and Results: Using the U-Manne-Whitney criterion, it was found that in EC the burden of melanoma (p = 0.0001), colorectal cancer (p = 0.006), Alzheimer's disease (p = 0.0018), Parkinson's disease (p = 0.0276) and alcoholism (p = 0.0001) is higher. In MC, there is a higher burden of hypertension (p = 0.0499), rheumatic heart disease (p = 0.0326), diabetes mellitus (p = 0.007), bipolar disorder (p = 0.0337), and schizophrenia (p = 0.0056). In EC, GDP is 3 times higher than in MC: $38 vs. $14 (p = 0.0001). UV level (latitude analogue) is higher in MC: 2939 J/m2 vs. 1689 J/m2 (p = 0.0001). Quality of life: the ratings of prosperity, education, access to good health care, clean water and air, peacefulness and the Happiness Index is 1.5 times higher in EC (p = 0.0001). Total morbidity, mortality, lifespan (TLL) (p = 0.2), Body Mass Index, Total Daily Food Consumption (TDC), Total Energy, Total Proteins and Lipids (p = 0.4) are equal in EC and MC.

However, in EC, levels of Energy, Proteins and Animal Lipids (AP) are 1.5 times higher than in MC (p = 0.0002). In EC, animal fat consumption is 5 times higher (p = 0.002), and olive oil consumption is 3 times lower (p = 0.01). In EC, nutrition structure consists of 50% of animal products and alcohol (37% AP and 14% AB) (p = 0.004). In MC, these products have the share of 32% (27% AP and 5% AB) (p = 0.004). The share of grains, vegetables and fruits in EC is 49%, and in MC it is 66% (p = 0.002). The diet structure of EC and MC is different in terms of AP and AB consumption. Paired regression analysis found that the independent variable (TDC) has a positive effect on the dependent variable: Alzheimer's disease burden (p = 0.001), and a negative effect on the dependent variables: hypertension and diabetes (p = 0.001). Per unit (1g) increase of the independent variable (TDC) increases the Alzheimer's disease burden by 3.3% and reduces the burden of hypertension by 5.8% and diabetes by 3.8% (-95.0%CL, +95.0%CL).

Conclusion: The different effect of an independent variable (TDC) on dependent variables is probably due to the fact that vectors between NCD gradients in countries have different directions. 53% of NCD are positively associated with GDP, while 47% of NCD are negatively associated. The same NCD risk factor may have negative or positive impact on different types of NCD.

Keywords: *Mediterranean and European Countries; Quality of Life; Metabolic Syndrome; Non-Communicable Chronic Diseases (NCD); Dietary Patterns; Macronutrients; Risk Factors*

Abbreviations

AB: Alcoholic Drinks; AP: Animal Products; BMI: Body Mass Index; BP: Blood Pressure; CD: Communicable Diseases; Chol: Blood Cholesterol; CL: Consumption of Selected Foods; EEI: Ecological Efficiency Index; FAO: Food and Agriculture Organization of the United Nations; FS: Fruits and Sweeteners; GDP: Domestic Gross Product; Glu: Blood Glucose; HPI: Happiness Index; IHD: Index of Human Development; LPA: Low Physical Activity; NCD: Non-Communicable Diseases; CV: Cereals and Vegetables; RE: Rating Educations; TDC: Total Daily Consumption; UV: Ultraviolet Level

Introduction

The World Health Organization (WHO) in 2018 summarized the incidence of communicable (CD) and non-communicable (NCD) diseases from 2000 to 2016 [1,32]. The greatest success has been achieved in combating CD. The incidence of CD [1] decreased twofold from 2000 to 2016 [32]. Success has been achieved in combating NCD [1,2,19,32]. The main 10 risk factors for NCDs have been identified [3]. Many mechanisms of NCD development have been revealed [4-9,11,17,18]. However, it has not yet been possible to defeat NCD [10,28]. There is an increase in NCDs in lower-middle and lower-income countries [10-13,28-31].

Policy, health care, and prevention efforts in many countries have led to a marked decline in alcohol consumption and the burden of alcoholism [14]. However, cancer, cardiovascular, and neurodegenerative diseases continue to increase, not only in low-income countries [5,6,10,15-17]. WHO predicts a significant increase in the NCD burden by 2050 [5,6,15,16]. The growth of the NCD burden in the 21st century is, on the one hand, a result of increased life expectancy [1,18]. On the other hand, NCDs are a threat to longevity [1-5,15,18,19].

Objective of the Study

To conduct a comparative burden (DALY) analysis of 10 out of 60 NCDs in 20 European (EC) and 20 Mediterranean (MC) countries. Evaluate the risk factors for NCDs: quality of life (QL), nutritional structure and metabolic syndrome predictors (MSP).

Materials and Methods

Research design

Observation statistical analysis. For the purposes of this work, the database of burden of disease (44 DALY) NCD for 20 European countries and 20 Mediterranean countries (ICD-10 codes) was used.

Burden of disease (DALY) data for men with NCDs (all ages) in 40 countries, standardized by sex and age per 100,000 of population, selected from the 2004 GBD database [20]. The countries were divided into 2 groups: 1 - European countries (EC), 2 - Mediterranean countries (MC). A number of indicators were used to characterize "quality of life" (QOL) in countries: per capita income or gross domestic product (GDP) in 2008 and 2016 (US dollars per person per day) [21]; geographical location of countries by latitude and the level of ultraviolet radiation in the capital (UV) (J/m^2 2004) [22]; life expectancy for men (LE) [23]; access to a good health care, clean water and clean air [24]; Index of Happiness (IH), or the Internal Gross Happiness in 2016 [25]. As predictors of metabolic syndrome (MSP) have been studied Body Mass Index (BMI) ≥ 25 kg/m^2 and ≥ 30 kg/m^2 (the percentage of men in the country with overweight and obesity); and 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); with low physical activity (LPA) ≤ 60 min/day walking [26]. Daily Food Consumption Levels (TDC) (g/person/day) (47 types of products) for each country selected from the FAO database for 2003 - 2005 [27].

The nutrition structure (NS) of the countries is presented in the form of 4 blocks in absolute and in percentage of NS: 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 also analyzed [27].

Statistical analysis of the study results performed using Mann-Whitney-Wilcoxon U-criterion and Multiple Linear Regression Analysis for Independent Samples (MRA). U is the numerical value of the Mann-Whitney Criterion. The central trend in data distribution in the sample 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 and MSP. The independent variables were NS fractions (AP, CV, FS, AB).

The quality of the regression model was estimated using correlation coefficient (R1), determination coefficient (R^2), 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) $p \leq 0.01$ - error probability 1%; (2) $p \leq 0.05$ - error probability 5%.

All calculations performed using StatSoft software (version 13).

Research Results

Analysis of the quality of life in EC and MC

Per capita income (GDP) in 2008 and 2016 in EC was 2.5 and 4 times higher than in MC ($p = 0.0001$). EC are located 15° north of MC ($p = 0.0001$). EC have an ultraviolet level (UV) on 1250 J/m^2 lower ($p = 0.0001$) than in MC. EC and MC are located in close time zones: 15° and 19° east longitude ($p = 0.12$) (Table 1). Total morbidity (DALY) and mortality (Death) in EC did not differ from MC ($p = 0.17$) and ($p = 0.36$) respectively.

In EC, quality of life indexes and rankings are 1.5 times higher than in MC: prosperity ($p = 0,000$), education ($p = 0,000$), HDI ($p = 0,000$), environment ($p = 0,000$), health care ($p = 0,026$), clean water ($p = 0,017$), clean air ($p = 0,003$), peacefulness ($p = 0,000$) and happiness ($p = 0,000$). The male and female longevity in EC and MC did not statistically differ ($p = 0.3$). Thus, in the early 21st century, EC were more successful than MC. The GDP growth rate in EC by 2016 was 1.5 times faster than in MC ($p = 0.000$).

The burden of NCDs in EC and MC

In EC, compared to MC, the burden of colorectal cancer and melanoma is 1.5 - 2 times higher ($p = 0.000$), the burden of Alzheimer's disease is 1.5 times higher ($p = 0.002$), the burden of Parkinson's disease is 2 times higher ($p = 0.027$), and the burden of alcoholism is 3 times higher ($p = 0.000$) (Table 1).

In MC compared to EC, the burden of diabetes is 1.5 times higher ($p = 0.007$), the burden of hypertensive heart disease is 1.4 times higher ($p = 0.050$), the burden of rheumatic heart disease is 4 times higher ($p = 0.033$), the burden of bipolar disorders is 1.3 times higher ($p = 0.034$), the burden of schizophrenia is 1.4 times higher ($p = 0.006$) (Table 1). Thus, there are statistically significant differences in the burden of 10 types of NCDs selected from 60 NCDs (GBD 2004) [20].

Comparative analysis of metabolic syndrome predictors in EC and MC

There are no statistical differences in the number of men with overweight and obesity in EC and MC ($p = 0.42$). However, in EC and MC, there are more than 60% men with overweight and over 20% with obesity (Table 1). In EC, there are 1.5 times more men with hyperlipidemia ≥ 5.0 (mmol/L) ($p = 0.001$) and 2 times more men with hyperlipidemia ≥ 6.2 (mmol/L) ($p = 0.001$). In EC and MC, the proportion of men with hyperglycemia, high blood pressure and low physical activity is more than 30% and there are no statistically differences between EC and MC. Thus, it is possible to judge about the difference between metabolic syndrome disorders in EC and MC by high level of hyperlipidemia in EC.

Analysis of nutrition structure in EC and MC

Daily food consumption levels (TDC) in EC and MC did not statistically differ (p = 0.6) and were 2192 ± 215 and 2097 ± 448 g/person/day. However, the size of product blocks was different (Table 1). In EC blocks of animal products (AP), fruit and sweeteners (FS), alcoholic beverages (AB), and fish products (FP) were 1.5 - 3 times larger than in MC (p = 0.01). Blocks of plant products (CV) (p = 0,000) and vegetable oils (VO) (p = 0,002) were 1.5 to 2 times bigger in MC than in EC. Therefore, the percentage of AP, CV, FS, FP, VO blocks in EC and MC nutrition structure was different (Table 1).

In EC, the sum of AP and AB blocks in nutrition structure is 50%. In MC, the sum of AP and AB blocks is 32%. In MC, the sum of CV and FS is 68%. In EC, the sum of CV and FS is 49%. The difference between EC and MC in consumption of individual products is noted. People in EC consumed 1.6 times more meat products (p = 0.003), 1.5 times more dairy products (p = 0.002), 5 times more animal fats (p = 0.002), 1.3 times more fruits (p = 0.004) and sweet drinks (p = 0.005); 2 times more strong alcohol (p = 0.0004) and 4 times more wine (p = 0.05) and beer (p = 0.0001). Consumption of whole grains in MC is 1.4 times higher than in EC (p = 0.02), green vegetables and fresh fruits is 1.3 times higher (p = 0.003).

Thus, despite the same TDC, the diet structure in the EC and MC was statistically significantly different.

Analysis of consumption of total macronutrients in EC and MC

As a result of the studies, it was found that the level of total energy in EC and MC did not statistically differ: 3395 ± 360 and 3235 ± 430 (kcal/person/day) (p = 0.099). There was no statistical difference between EC and MC in terms of the level of total Proteins (12 ± 2% and 12 ± 2%) (p = 0.39) and total Lipids (36 ± 5% and 30 ± 11%) (p = 0.81) that make up the total Energy.

However, the level of total Carbohydrates in MC was statistically significant higher by 7% than in EC (52 ± 5% and 59 ± 13%) (p = 0.05) (Table 1). It has been established that in EC the diversification of the macronutrients (p = 0,006) is 10% higher on the average than in MC (Table 1).

Variable	U (n-20/20)	Z	p-value	Median 1	Quartile 1	Median 2	Quartile 2
Quality of life							
GDP $ person/day2008	55,50	3,90	0,0001	38	18	14	23
GDP $ person/day2016	55,00	3,91	0,0001	116	98	29	54
lat°	12,00	5,07	0,0000	52	8	37	9
UV rad J/m^2 2004	9,00	- 5,15	0,0000	1689	217	2939	1120
lon°	141,50	- 1,57	0,1167	15	16	19	18
Rank Korrup. 2016	26,00	- 4,69	0,0000	15	27	73	56
DALY	149,00	- 1,37	0,1719	11727	3653	16398	6247
Death	166,00	- 0,91	0,3648	646	340	912	359
Prosperity Rating	34,00	- 4,48	0,0000	15	20	73	54
Rating Educations	53,00	- 3,96	0,0001	18	23	58	51
HPI 2016	56,00	3,88	0,0001	7	1	5	1

Rating of peacefulness	26,00	- 4,50	0,0000	15	18	65	83
index of human development	70,00	3,50	0,0005	1	0	1	0
EEI Ecological efficiency index	42,00	4,14	0,0000	77	4	60	16
Male life expectancy	161,00	1,04	0,2977	76	3	74	6
Female life expectancy	136,50	1,70	0,0884	81	3	80	6
Expenses (%) for health care	128,00	1,93	0,0531	9	4	7	3
Access to the street. medicine 1990	103,50	2,23	0,0255	100	0	98	14
Access to clean water1990	80,50	2,38	0,0175	100	0	97	16
Air pollution for children under 5 years old 2004	84,00	- 2,96	0,0030	0	1	3	39
Noncommunicable diseases NCD							
Colon and rectum cancers	98,00	2,75	0,0060	270	83	168	220
Melanoma and other skin cancers	55,50	3,90	0,0001	50	32	26	39
Diabetes mellitus	100,00	- 2,69	0,0071	207	77	281	120
Hypertensive heart disease	127,00	- 1,96	0,0499	90	86	122	549
Rheumatic heartdalyrates	120,50	- 2,14	0,0326	14	22	54	87
Alzheimer and other dementias	84,00	3,12	0,0018	296	62	190	93
Parkinson disease	118,00	2,20	0,0275	70	32	44	38
Alcohol use disorders	43,00	4,23	0,0000	981	529	348	488
Bipolar disorder	121,00	- 2,12	0,0337	167	5	208	31
Schizophrenia	97,00	- 2,77	0,0056	167	5	237	78
Metabolic Syndrome Predictors							
BMI ≥ 25 (kg/m^2)	163,00	0,99	0,3235	63	6	61	8
BMI ≥ 30 (kg/m^2)	176,00	0,64	0,5250	23	5	22	6
Chol ≥ 5.0 (mmol/L)	53,00	3,96	0,0001	63	8	47	22
Chol ≥ 6.2 (mmol/L)	52,50	3,98	0,0001	20	6	12	10
Glu ≥ 7.0 (mmol/L)	174,50	- 0,68	0,4989	11	3	11	2
BP ≥ 140/90 (mm Hg)	108,00	2,48	0,0133	50	5	45	10
LPA ≤ 60 minutes/day walking	109,00	- 0,92	0,3566	34	22	35	22

Dietary pattern							
TCL g/person/day	128,50	1,92	0,0548	2192	215	2097	448
AP amount	85,00	3,10	0,0020	799	188	619	350
GV amount	49,00	-4,07	0,0000	798	139	1143	296
FS amount	101,50	2,65	0,0080	278	112	226	116
AB amount	36,00	4,42	0,0000	294	119	101	184
Fish amount	112,00	2,37	0,0179	55	47	31	34
Oil amount	87,50	-3,03	0,0024	16	9	30	22
Percentage of total daily consumption							
% AP	95,00	2,83	0,0047	36	6	27	12
% GV	33,00	-4,50	0,0000	36	5	55	23
% FS	107,50	2,49	0,0128	13	4	11	3
% AB	38,00	4,37	0,0000	14	6	5	9
% Oil	85,00	-3,10	0,0020	1	1	2	1
% Fish	122,00	2,10	0,0360	2	2	2	2
Macronaturents of products							
Percentage of Total Energy							
Energy (kcal/person/day) 2003-05	138,50	1,65	0,0989	3395	360	3235	430
Carboh%E 2003-05	127,00	-1,96	0,0499	52	5	59	13
Proteins%E 2003-05	167,50	0,87	0,3867	12	2	12	2
Fats%E 2003-05	135,00	1,74	0,0810	36	5	30	11
Macronutrients of animal products (AP)							
AP Energy%2003-05	60,00	3,77	0,0002	31	6	21	17
AP Protein%2003-05	67,00	3,58	0,0003	61	7	50	29
AP Fat%2003-05	63,50	3,68	0,0002	60	5	41	21
Nutrient Diversification							
2003-05 E%	85,50	3,08	0,0020	69	6	62	19
2003-05 P%	99,00	2,72	0,0066	71	6	63	23
2003-05 F%	120,50	2,14	0,0326	96	1	95	5

Table 1: *Comparative analysis of quality of life, noncommunicable diseases, nutritional structure, metabolic syndrome in European and Mediterranean countries (Manna Whitney U-criterion).*

Legend: *AB: Alcoholic Drinks; AP: Animal Products; BMI: Body Mass Index; BP: Blood Pressure; CD: Communicable Diseases; Chol: Blood Cholesterol; CL: Consumption of Selected Foods; EEI: Ecological Efficiency Index; FAO: Food and Agriculture Organization of the United Nations; 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; RE: Rating Educations; TCL: Total Daily Consumption; UV: Ultraviolet.*

Analysis of animal product macronutrients consumption (AP) in EC and MC

It was found that in EC the share of AP in Energy was 1.5 times higher than in MC: 31 ± 6% vs. 21 ± 17% of the total Energy (p = 0.0002). The AP protein level in EC was 1.2 times higher than in MC: 61 ± .7% vs. 50 ± 29% (p = 0.0005). The level of AP lipids in EC was 1.5 times higher than in MC: 60 ± 5% vs. 41 ± 21% (p = 0.0002).

It may be concluded that the main difference between the composition of macronutrients in EC and MC is the higher content of AP macronutrients and the higher level of diversification of macronutrients in EC in comparison with MC.

Assessment of the impact of risk factors on NCD in EC and MC using paired linear regression analysis

The Paired Linear Regression Analysis (PLRA) found that the independent GDP variable is positively associated with the dependent variables: TDC, Bovine Meat, Animal Fats (p = 0,000). Per unit increase of GDP independent variable ($1) is accompanied by an increase in the dependent variable (DV2): TDC by 2%, Bovine Meat by 3%, Animal fats by 3% (-95.0%CL+95.0%CL) (Table 2).

The independent variable UV had a negative impact on dependent variables (DV1): TDC, Bovine Meat, Animal fats (p = 0,000). Per unit increase of the independent variable UV (1 J/m^2) decreased the dependent variable (DV2): TDC by 0.3%, Bovine Meat by 3.3%, Animal fats by 0.5% (-95.0%CL+95.0%CL) (Table 2).

It has been found that TDC as an independent variable has a positive effect on the dependent variable: Alzheimer's disease burden (p = 0,000). Increasing the independent variable TDC per unit (1g) increased the burden of Alzheimer's disease (DV2) by 3.3% (-95.0%CL+95.0%CL) (Table 2).

The independent variable TDC has a negative impact on the dependent variables: hypertensive heart disease and diabetes mellitus (p = 0,000). Per unit increase of independent variable TDC (1g) was accompanied by a 5.8% reduction of the burden of hypertension and a 3.8% reduction of diabetes mellitus (DV2) (-95.0%CL+95.0%CL), respectively. Per unit increase of the independent variable UV (1 J/m^2) was accompanied by a decrease of the dependent variable TDC (DV2) by 0.3%; Bovine Meat (DV2) by 3.3%; Animal fats (DV2) by 0.5% (-95.0%CL+95.0%CL) (Table 2).

The independent variables UV (R1-0,834), GDP (R1-0,698), TDC (R1-0,676) (p = 0,000) had the greatest influence. The corrected R2 coefficients determined up to 50% of the variability of dependent variables (DV1) (p = 0,000) (Table 2).

Thus, using paired regression analysis, it was found that risk factors in the role of an independent variable could both increase the burden of NDC and reduce the burden of NCD depending on the vector of cross-country gradient.

Modeling the impact on NCD of GDP increase or decrease

As a result of regrouping of EC and MC countries 2 groups of 20 countries were formed. However, the GDP in group 1 does not statistically differ from group 2. As a result, two groups of countries were formed, with GDP in the 1st group $28 ± 23 and $27 ± 24 in the 2nd group (p = 0.82) (Table 3). As a result of the regrouping of EC and MC countries, Group 1 became poorer than EC, and Group 2 became richer than MC. All other indicators of group 1 are statistically the same as those of group 2. It should be noted that none of the initial indicators of each country was changed. The indicators of the two new groups became equal. However, in group 1, the decrease in GDP caused a decrease in the burden of cancer, Alzheimer's disease, Parkinson's disease and alcoholism, but the burden of cardiovascular and diabetes mellitus, bipolar disorders and schizophrenia increased.

Dependent Variable	Independent variable	R^1	R^2	b*	b	F	p-value	DV1	DV2	%
Total Daily Consumption (g)	GDP $	0,698	0,487	0,698	30,395	F(1,16) = 149	0,000	1395	1425	102
Total Daily Consumption (g)	UV rad J/m^2	0,834	0,695	-0,834	-0,387	F(1,16) = 359	0,000	1395	1391	99,7
Bovine Meat (g)	GDP $	0,573	0,329	0,573	1,002	F(1,16) = 77	0,000	30,5	31,5	103
Bovine Meat (g)	UV rad J/m^2	0,469	0,22	-0,470	-0,009	F(1,16) = 44	0,000	31	30	96,7
Fats, Animals (g)	GDP $	0,422	0,178	0,423	0,180	F(1,16) = 34	0,000	6,08	6,26	103
Fats, Animals (g)	UV rad J/m^2	0,529	0,28	-0,529	-0,002	F(1,16) = 61	0,000	6,08	6,05	99,5
Hypertensive heart disease (DALY)	Total Daily Consumption (g)	0,411	0,169	-0,411	-0,127	F(1,16) = 32	0,000	225	212	94,2
Diabetes mellitus (DALY)	Total Daily Consumption (g)	0,501	0,251	-0,501	-0,181	F(1,18) = 53	0,000	469	451	96,2
Alzheimer and other dementias (DALY)	Total Daily Consumption (g)	0,676	0,457	0,676	0,058	F(1,16) = 132	0,000	183	189	103,3

Table 2: *Multiple linear regression analysis (Regression summary for dependent variable).*

Legend: *AB: Alcoholic Drinks; AP: Animal Products; BMI: Body Mass Index; BP: Blood Pressure; CD: Communicable Diseases; Chol: Blood Cholesterol; CL: Consumption of Selected Foods; EEI: Ecological Efficiency Index; FAO: Food and Agriculture Organization of the United Nations; 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; RE: Rating Educations; TCL: Total Daily Consumption; UV: Ultraviolet*

In the 2nd group of countries, in response to GDP growth, cancer and Alzheimer's disease, Parkinson's disease and alcoholism have increased, but the burden of cardiovascular disease and diabetes mellitus, bipolar disorder and schizophrenia have decreased.

Thus, the increase in GDP did not lead to a decrease in all diseases in Group 2. And the decrease in GDP was not accompanied by an increase in NCD burden in the 1st group (Table 3). The model confirmed that the vectors of NCD gradients have different directions.

Variable	U n-20/20	Z	p-value	Median 1	Quartile 2	Median 2	Quartile 2
Quality of life							
GDP $ person/day2008	191,00	0,23	0,82	28	23	27	24
GDP $ person/day2016	191,50	0,22	0,83	50	90	62	89
lat°	157,50	1,14	0,26	47	12	45	17
UV rad J/m^2 2004	160,00	- 1,07	0,29	1932	1006	2231	1483
lon°	163,00	0,99	0,32	19	14	15	18
Expenses (%) for health care	176,00	- 0,64	0,52	9	3	9	4
Access to the street. medicine1990	176,00	- 0,12	0,91	100	4	100	4
access to clean water1990	127,00	- 0,81	0,42	99	15	100	5
air pollution for children under 5 years old 2004	166,50	- 0,65	0,52	0	3	1	19
CCR5 rs333+	104,00	- 0,50	0,62	1	0	1	0
Rank Korrup. 2016	199,00	0,01	0,99	46	54	37	67

Points Korrup. 2016	199,00	- 0,01	0,99	55	33	60	39
DALY	169,00	0,83	0,41	13522	6023	11795	6270
Death	185,00	0,39	0,69	810	407	656	328
Prosperity Rating	196,00	0,09	0,92	36	50	26	60
rating Educations	185,00	- 0,39	0,69	31	33	34	54
HPI 2016	186,00	- 0,37	0,71	5,895	2	6,358	2
Rating of peacefulness	158,00	- 0,63	0,53	40	54	32	58
Index of human development	187,50	0,32	0,75	0,909	0	0,919	0
EEI Ecological efficiency index	161,00	0,80	0,42	74	16	67	25
Male life expectancy	190,50	- 0,24	0,81	75	5	75	4
Female life expectancy	191,00	- 0,23	0,82	81	4	81	4
Noncommunicable diseases NCD							
Colon and rectum cancers	196,00	- 0,09	0,92	190	133	187	130
Melanoma and other skin cancers	180,00	0,53	0,60	42	27	38	53
Diabetes mellitus	156,00	- 1,18	0,24	221	114	238	124
Hypertensive heart disease	178,00	0,58	0,56	57	143	45	60
Rheumatic heartdalyrates	181,00	- 0,50	0,62	15	28	20	33
Alzheimer and other dementias	198,00	- 0,04	0,97	197	63	203	94
Parkinson disease	182,00	0,47	0,64	48	31	47	25
Alcohol use disorders	160,00	1,07	0,29	698	706	651	648
Bipolar disorder	167,50	- 0,87	0,39	187	9	188	18
Schizophrenia	184,50	- 0,41	0,68	194	40	193	43
Metabolic Syndrome Predictors							
BMI ≥ 25 (kg/m^2)	177,50	0,60	0,55	64	6	62	9
BMI ≥ 30 (kg/m^2)	176,50	0,62	0,53	23	5	23	6
Chol ≥ 5.0 (mmol/L)	196,50	- 0,08	0,94	56	15	58	25
Chol ≥ 6.2 (mmol/L)	199,00	- 0,01	0,99	17	8	18	13
Glu ≥ 7.0 (mmol/L)	176,00	0,64	0,52	11	1	11	3
BP ≥ 140/90 (mm Hg)	164,50	0,95	0,34	48	7	46	6
LPA ≤ 60 minutes/day walking	129,50	- 0,22	0,83	38	23	35	19
Dietary pattern							
TCL g/person/day	184,00	- 0,42	0,68	2155	292	2190	293
AP amount	192,50	0,19	0,85	740	254	757	376
GV amount	155,50	- 1,19	0,23	848	299	965	398
FD amount	194,00	0,15	0,88	252	105	260	96

AB amount	176,50	0,62	0,53	242	136	210	287
Fish amount	171,50	- 0,76	0,45	38	31	52	45
Oil amount	198,50	0,03	0,98	20	15	22	21
Percentage of Total Daily Consumption							
% AP	178,00	0,58	0,56	35	10	32	13
% GV	174,00	- 0,69	0,49	40	13	43	26
% FD	180,00	0,53	0,60	12	3	12	4
% AB	163,00	0,99	0,32	11	8	10	12
% Fish	166,00	- 0,91	0,36	2	1	2	2
% Oil	189,50	0,27	0,79	1	1	1	1
Macronaturents of products							
Percentage of total energy							
Energy (kcal/person/day) 2003-05	180,50	- 0,51	0,61	3310	395	3320	425
Carboh%E 2003-05	193,50	- 0,16	0,87	54	9	53	10
Proteins%E 2003-05	170,50	- 0,78	0,43	12	2	12	2
Fats%E 2003-05	189,50	0,27	0,79	35	9	35	9
Macronutrients of animal products (AP)							
AP Energy%2003-05	189,50	0,27	0,79	28	8	29	16
AP Protein%2003-05	192,00	- 0,20	0,84	57	12	58	26
AP Fat%2003-05	172,00	0,74	0,46	58	17	56	28
Nutrient Diversification							
Energy%2003-05	179,00	0,55	0,58	67	11	64	16
Proteins%2003-05	192,00	- 0,20	0,84	68	12	69	19
Fat%2003-05	197,00	- 0,07	0,95	96	3	96	3

Table 3: *Model two groups of countries European and Mediterranean. GDP and latitude of the two groups of countries is statistically the same.*

Legend: *AB: Alcoholic Drinks; AP: Animal Products; BMI: Body Mass Index; BP: Blood Pressure; CD: Communicable Diseases; Chol: Blood Cholesterol; CL: Consumption of Selected Foods; EEI: Ecological Efficiency Index; FAO: Food and Agriculture Organization of the United Nations; 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; RE: Rating Educations; TCL: Total Daily Consumption; UV: Ultraviolet.*

Both models confirm that the vectors of NCD gradients have different directions

To confirm the multidirectional orientation of NCD gradient vectors, we chose from a base of 160 countries 2 groups of 25 countries with maximum and minimum GDP [20]. It was found that in group 1, the total burden of 50 types of CD is 60 times lower than in group

Variable	1 gr 25 cauntry	2 gr25 cauntry
GDP $2008	42	0,9
GDP $ 2016	117	1,9
BMI ≥ 25 (kg/m^2)	63	15
BMI ≥ 30(kg/m^2)	23	3
CD - Ш Infectious diseases DALY/per 100 thousand male population	580	35 745
NCD – Non-communicable diseases DALY/per 100 thousand male population	10 359	10 560
Epilepsy D/per 100 thousand male population	68	275
Alcohol use disorders D/per 100 thousand male population	634	208
Alzheimer and other dementias D/per 100 thousand male population	304	58
Hypertensive heart disease D/per 100 thousand male population	60	104
Ischaemic heart disease D/per 100 thousand male population	1 039	612
Cerebrovascular disease D/per 100 thousand male population	454	591
Diabetes m D/per 100 thousand male population	275	286
TCL g/person/day	2207	536
% AP	35	22
% CV	39	68
% FS	13	7
% AB	12	4

Table 4: *Indicators 2 groups of countries 25 countries in the group with the maximum and minimum of GDP MZ 160 countries.*

Legend: *AB: Alcoholic Drinks; AP: Animal Products; BMI: Body Mass Index; BP: Blood Pressure; CD: Communicable Diseases; Chol: Blood Cholesterol; CL: Consumption of Selected Foods; EEI: Ecological Efficiency Index; FAO: Food and Agriculture Organization of the United Nations; 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; RE: Rating Educations; TCL: Total Daily Consumption; UV: Ultraviolet.*

2: 580 DALY vs. 35,745 DALY. 1 DALY is one year of lost life (Table 4). The total burden of 60 types of NCD in group 1 does not statistically differ from group 2: 10,359 DALY vs. 10,560 DALY. This equality between the two groups of countries that differ by 40 times in GDP could only be achieved with polar NCD gradients. If the total equality is not random, then there is a feedback between some types of NCD. This can be verified with regression analysis. It is interesting how NCD gradients change over time.

At the same time, the GDP in group 1 is 40 times higher than in group 2. Overweight and obesity in group 1 is 4 and 5 times higher than in group 2. In group 1, the burden of epilepsy is 4 times lower, the burden of hypertension is 2 times lower, the burden of cerebrovascular disease is 1.5 times lower and diabetes mellitus is 1.04 times higher. However, in the 1st group burden of alcoholism was 3 times higher, the burden of Alzheimer's disease was 6 times higher, the burden of coronary heart disease was 1.5 times higher. In the nutrition structure of the 1st group the TDC was 4 times higher, AP was 1.5 times higher, CV was 2 times lower, FS was 2 times higher and AB was 3 times higher.

Thus, with a significant difference in GDP, metabolic syndrome predictors and nutrition structure, the total characteristics of NCD in the 1st group of countries does not differ from the 2nd group of countries, unlike CD.

Discussion

This work provides a comparative analysis of two groups of EC and MC countries. In EC, they have Western lifestyle and high GDP [11]. MC are taken as the generally accepted benchmark for healthy lifestyle and low burden of NCDs [12]. Research has shown that the GDP in MC is twice as low as in EC. The quality of life in MC is 1.5 times lower than in EC. However, the levels of daily food consumption (TDC) and total Energy in EC and MC are statistically the same [11,12].

However, the nutrition structure in EC and MC differed significantly [11,28]. In EC, they consumed by 1.5 times more animal products (AP) and by 3 times more alcoholic beverages (AB) [29]. However, they consumed 1.5 times less plant products (CV) in EC than in MC [30]. The composition of the daily energy in EC and MC was different. The composition of the daily Energy in EC included 1.5 times more macronutrients of animal origin (AP) [11]. The total morbidity and mortality as well as life expectancy in EC and MC did not differ [11].

The burden of the studied NCDs in EC and MC was statistically different. EC had a higher burden of colorectal cancer, melanoma, Alzheimer's and Parkinson's diseases, and alcoholism [11,12,31]. MC had a higher burden of hypertensive heart disease, rheumocarditis, diabetes mellitus, bipolar disorder, and schizophrenia [31,32].

Predictors of metabolic syndrome in EC and MC were equally high, but statistically the same. In EC and MC, over 60% of men had overweight. More than 20% of men in EC and MC had obesity [11]. More than 50% of men in EC and MC had high blood pressure. And more than 35% of men in EC and MC had low physical activity [11]. More than 11% of men in EC and MC had a glucose tolerance. However, there were 24% more men with hyperlipidemia in EC vs. MC (83% vs. 59%) ($p = 0.0001$). In EC, animal fats were consumed by 5 times more than in MC ($p = 0.002$) [29-31]. Olive oil was consumed in MC by 1.5 times more than in EC ($p = 0.002$) [12,30].

Our paired linear regression analysis studies have shown that an increase per unit (1g) in the independent variable TDC (NCD risk factor) leads to an increase in the burden of Alzheimer's disease, but to a decrease in the burden of hypertensive heart disease and diabetes mellitus ($p = 0,000$). An increase per unit ($1) in the independent variable GDP (NCD risk factor) is accompanied by an increase in the level of dependent variables: TDC, Bovine Meat and Animal fats ($p = 0,000$) [31]. Conflicts in the reactions of dependent variables to the same NCD risk factors confirm the fact that country gradients of different NCD types do not have the same direction in the databases.

We can say that cross-country gradients for Alzheimer, Parkinson, alcoholism, melanoma, and colorectal cancer are positively associated with GDP. As GDP increases, the burden of these diseases increases [31]. However, the burden gradients of other diseases, such as cardiovascular disease, bipolar disorder, and schizophrenia, are negatively associated with GDP. As GDP increases, the burden of these diseases decreases [13]. It should be noted that cross-country infectious disease (CD) gradients are unipolar, positively associated with geographic latitude and negatively associated with GDP. In countries with high GDP, the CD burden is low. With low GDP, the CD burden is high. This is the difference between CD and NCD. NCD includes 60 types of diseases. Of these, 53% are positively associated with GDP. 47% of NCD are negatively associated with GDP. All predictors of metabolic syndrome are positively associated with GDP. Moreover, overweight and obesity depend only on GDP and do not depend on geographic latitude [13]. Our model (Table 3) shows that an increase in GDP in countries leads to an increase in cancer and a decrease in cardiovascular disease [11,13]. Decrease in GDP in countries is accompanied by a decrease in oncological diseases and an increase in cardiovascular disease [13].

Conclusion

A study of NCD risk factors and burden in EC and MC has shown that, given the great similarity of TDC, common macronutrients and metabolic syndrome predictors, there are significant differences in NCD burden. We suggest that the differences in NCD burden between EC and MC are based on differences in the diet structure of EC and MC in terms of AP consumption, and also in cross-country NCD gradients. The NCD risk factor problem requires further research [11,13,31].

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