

Research Article

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Analysis of the Burden of Cardiovascular Morbidity in Countries with High and Low Levels of Daily Food Consumption

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Abstract

Obesity, like a pandemic, is taking over the world and is a risk factor for many non-communicable chronic diseases (NCD).

Purpose: To evaluate the effect of total daily food consumption (TDC) in different countries on predictors of metabolic syndrome (MS) and the burden of cardiovascular disease in men and women.

Methods and Results: a comparative Mann-Whitney U-criterion analysis of two groups of countries (25 countries per group) with maximum and minimum TDC was performed. It was established:

1. Group 1 countries compared to Group 2 had 5 times higher TDC ($p \leq 0.0001$) and 7-18 times higher levels of 7 product groups in TDC ($p \leq 0.0001$). The percentages of the 7 product groups in TDC differed between two groups. In Group 1 AP was 12% higher, AB was 8% higher ($p \leq 0.0001$). In Group 2 CV was 28% higher ($p \leq 0.0001$) and F was 2% higher ($p \leq 0.02$).

2. All indicators of the 7 predictors of metabolic syndrome (MS) for men and women were 1.5 to 5-fold higher in the 1st group than in the 2nd group ($p \leq 0.001$). The gradient of MS predictors between the 1st and the 2nd group was greater in men than in women.

3. The burden of total cardiovascular morbidity was 2.0 times lower in men ($p \leq 0.007$) and 4 times lower in women ($p \leq 0.0001$) in group 1 than in group 2. In men, the burden of individual types of cardiovascular diseases (Hypertensive heart disease, Coronary heart disease, Cerebrovascular heart disease, Rheumatoid heart disease, and Inflammatory heart disease) was statistically significantly lower in both men and women in Group 1 compared to Group 2 ($p \leq 0.001$). Thus, the burden of all types of cardiovascular diseases in men and women was higher in Group 2. There were definite gender differences in all types of cardiovascular diseases. Moreover, gender differences were clearly visible in Group 1, but practically absent in Group 2.

Conclusion: TDC is a risk factor for MS disorders and the burden of cardiovascular disease in men and women.

Abbreviations: Food consumption levels; Nutritional structure; Predictors of the Metabolic Syndrome; Burden of cardiovascular diseases

Abbreviations: AB: Alcoholic Drinks; AP: Animal Products; BMI: Body Mass Index, BP: Blood Pressure; C: Cancer; CD: Communicable Maternal Perinatal Diseases; Chol: Blood Cholesterol; CL: Consumption of Selected Foods; D: Disease; EEI: Ecological Efficiency Index; 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; M: Male; NCD: Non Communicable Diseases; P: Person; CV: Cereals and Vegetables; RE: Rating Educations; TDC: Total Daily Consumption; UV: Ultraviolet Level

Introduction

Obesity is a risk factor for a number of diseases, including cardiovascular diseases. An endogenous selective estrogen receptor modulator (SERM) hydroxycholesterol (27HC) has been found to be a missing link in the obesity-target organ chain [1]. Hypertension, cardiovascular diseases, stroke, diabetes, heart failure, lung diseases, and obesity have been shown to predispose to increased COVID-19 mortality [2]. Obesity is positively correlated with blood pressure and C-reactive protein HS-CRP [3]. Cardiovascular diseases are the cause of death in patients with nonalcoholic fatty liver disease, which is closely related to insulin resistance, obesity, and diabetes [4]. Since 1948, The Framingham Heart Study has been studying the third generation of participants. These studies put forward two groups of CHD risk factors: non-modifiable and modifiable. Modifiable risk factors: hypertension, hyperlipidemia, diabetes mellitus, obesity, smoking, poor diet, sedentary lifestyle, and stress. Mortality data from 1969 to 2014 concluded that by 2020 the number of cardiovascular diseases will decrease by 21.3% in men and 13.4% in women [5].

Obesity in the United States has become synonymous with heart disease, diabetes, and early death [6]. Inflammation plays a major role in the development of atherosclerotic cardiovascular diseases [7]. Understanding the relationship between diet, stress, mood, and behavior can contribute to the treatment of mental disorders associated with stress and obesity [8]. A contradiction has been found between COVID-19 and vascular diseases and hypertension in sub-Saharan Africa [9]. Heart failure is a complex heterogeneous disease for which pathophysiological understanding remains limited and specific prevention and treatment strategies are lacking [10]. Aging is a major risk factor for many chronic diseases. The exact mechanisms underlying the aging process are not fully elucidated. However, there is increasing evidence that several pathways, such as insulin-like growth factor, autophagy, and nuclear factor play a crucial role in the regulation of aging [11]. Risk factors for COVID-19 with adverse outcomes include obesity, diabetes mellitus, cardiovascular disease, and hyperinsulinemia [12]. About 30% of the U.S. population has hypertension. Hypertension risk factors can be largely controlled by the DASH diet [12]. Obesity is associated with a significant etiologic risk factor for type 2 diabetes, hypertension, cancer, and coronary heart disease. The increase in these diseases has been dramatic, especially in the last 20 years [13]. Obesity negatively affects immune function and the body's defense against external factors [14]. Intermittent fasting can have an effect through multiple pathways, including reducing oxidative stress, optimizing circadian rhythms and ketogenesis [15]. Insulin resistance is defined as an impaired biological response to insulin stimulation of target tissues, primarily liver, muscle, and adipose tissue. Insulin resistance impairs glucose utilization [16].

Inflammation is a protective reaction activated in response to harmful stimuli by inflammasomes, which are thought to

be sensors and receptors of the innate immune system [17]. Obesity is associated with chronic low-grade inflammation and immune dysregulation [18]. COVID-19 infection can lead to hyperinflammatory response through excessive cytokine release — “cytokine storm”. Coronary microvascular dysfunction plays a pathogenetic role in cardiac and systemic microvascular angina [19]. Thus, obesity turns out to be a risk factor for many chronic diseases that lead to aging and reduced life expectancy. Purpose: To evaluate the effect of total daily food consumption (TDC) in different countries of the world on predictors of Metabolic Syndrome (MS) and the burden of cardiovascular diseases in men and women.

Material and Method

Research design

Observation statistical analysis

For the purpose of this work, a database of the total burden of NCDs and cardiovascular diseases (ICD-10 codes), was generated for 25 countries with the maximum daily food consumption rate (TDC) — group 1, and 25 countries with the minimum food consumption rate (TDC) — group 2 countries. Disease burden of disease (DALY) data for men and women (all ages) in 25 countries, standardized by sex and age per 100,000 population, were selected from the 2004 GBD database [20]. A number of indicators were used to characterize “quality of life” (QOL) in countries: per capita income or gross domestic product (GDP) in 2008 (US dollars per person per day) [21]; geographical location of countries by latitude and the level of ultraviolet radiation in the capital (UV) (J/m² 2004) [22]; life expectancy for men (LE) [23]; access to good health care, clean water and clean air [24]; Index of Happiness (IH), or the Internal Gross Happiness in 2016 [25]. Body Mass Index (BMI) ≥ 25 kg / m² and ≥ 30 kg / m² have been studied as predictors of metabolic syndrome (MSP) — 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 $\geq 140/90$ mmHg); with low physical activity (LPA) ≤ 60 min/day walking [26]. Daily Food Consumption Level (TDC) (g / person / day) (47 types of products) for each country was selected from the FAO database for 2003-2005 [27] (Figure 1).

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); 5 — vegetable oils (VO); 6 — fish (F). The composition of macro-elements was also analyzed [27].

Statistical analysis of the study results was 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 was represented by the median. 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. 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 were performed using Stat Soft software.

Result

Analysis of the quality of life in countries with high and low levels of food consumption

Economic-geographic and socio-demographic characteristics of the countries

In the 1st group per capita income in 2000 and 2016 was 22 times higher than in the 2nd group ($p \leq 0.0001$) (Table 1). Group 1 was 40° north of Group 2 ($p \leq 0.0001$). In Group 1 UV level was 2 times lower than in Group 2 ($p \leq 0.0001$). Life expectancy (LE) for men and women was 1.6 times higher in Group 1 ($p \leq 0.0001$).

The Prosperity Rank and Happiness Index in Group 1 were 4.9 and 1.2 times higher than in Group 2, ($p \leq 0.0001$) and ($p \leq 0.021$) respectively. The Human Development Index (HDI)

and Environmental Performance Index (EPI) were 2 times higher in Group 1 ($p \leq 0.0001$). However, the ranks of corruption and peacefulness were 4 and 3 times higher in Group 2 ($p \leq 0.0001$). In Group 1 there was 3 times higher access to health care ($p \leq 0.0001$), 8 times higher access to clean water ($p \leq 0.0001$), and significantly higher access to clean air ($p \leq 0.0001$).

Levels of food consumption

Group 1 had 5 times higher total daily food consumption (TDC) ($p \leq 0.0001$) (Table 1). Group 1 had 7 times higher consumption of animal products (AP) ($p \leq 0.0001$), 3 times higher consumption of cereals and vegetables (CV) ($p \leq 0.0001$), 11 times higher consumption of fruits and sweeteners (FS) ($p \leq 0.0001$), 18 times higher consumption of alcoholic beverages (AB) ($p \leq 0.0001$), 16 times higher consumption of vegetable oils (VO) ($p \leq 0.0001$) and 3 times higher consumption of fish (F) ($p \leq 0.001$). Thus, the maximum differences between Group 1 and Group 2 were in the consumption of alcoholic beverages and vegetable oils. However, the percentages in terms of the levels of consumption of individual products differed significantly between Group 1 and Group 2. Thus, Group 1 had on average a 2-fold higher percentage of consumption of animal products, fruits and sweeteners, alcoholic beverages, and vegetable oils ($p \leq 0.0001$). Group 2 had a higher percentage of consumption of grains and vegetables and a higher level of fish consumption, ($p \leq 0.0001$) and ($p \leq 0.03$), respectively (Figure 2).

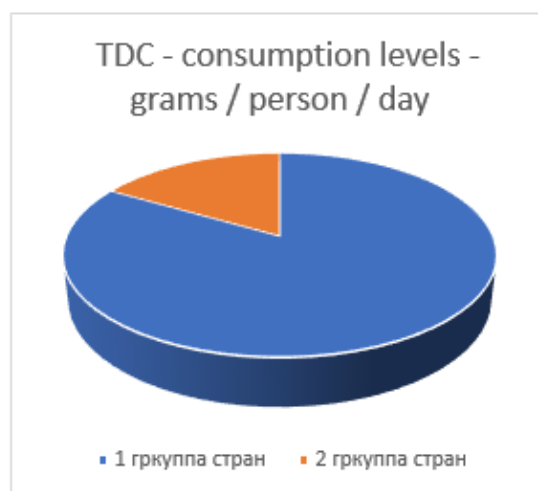


Figure 1: TDC in 1 and 2 country groups.

Table 1: Comparative analysis of quality of life and dietary patterns, including nutrients in groups 1 and 2 of countries differing in TDC levels (Manna Whitney U-criterion).

Variable	U	Z	p-value	Median 1	Quartile 1	Median 2	Quartile 2
The quality of life							
Per capita income (GDP) \$ 2000)	4,00	5,98	0,00000	24942	18553	1012	681
Per capita income (GDP) \$ 2016)	4,00	5,98	0,00000	37901	19365	1720	695
lat°	-	6,05	0,00000	50	12	7	8
UV J/m204	-	- 6,05	0,00000	1812	898	5265	399

lon°	244,00	- 1,32	0,18704	16	17	29	26
Male life expectancy	6,00	5,94	0,00000	76	3	48	10
Female life expectancy	3,00	6,00	0,00000	81	2	52	11
Prosperity Rating	5,00	- 5,96	0,00000	24	28	117	27
Rating Educations	-	- 6,05	0,00000	26	30	120	25
Happiness index HPI2006	193,00	2,31	0,02095	39	7	33	12
Happiness index HPI2016	2,00	5,57	0,00000	6,488	1,192	3,856	0,654
Corruption rating 2016	51,50	- 4,96	0,00000	31	55	123	54
Peacefulness rating	66,00	- 3,84	0,00012	36	51	104	71
Human Development Index IHD	-	6,05	0,00000	0,947	0,073	0,460	0,117
Environmental Performance Index IEE	2,00	5,95	0,00000	74	14	32	11
ASM1990	8,50	5,82	0,00000	100	3	49	18
ACW1990	-	5,86	0,00000	100	5	13	17
Air2004	6,00	- 5,80	0,00000	0	1	226	276
Dietary pfttern (g / person / day)							
TDC g/p/d	-	6,05	0,0000	2291	200	458	172
AP amount	-	6,05	0,0000	800	152	108	54
CV amount	-	6,05	0,0000	919	333	298	109
FS amount	-	6,05	0,0000	270	63	25	21
AB amount	6,00	5,94	0,0000	269	169	15	8
Oil amount	35,00	5,37	0,0000	16	14	1	3
Fish amount	142,50	3,29	0,0010	55	34	18	23
%of TDC g/p/d							
% AP	103,00	4,06	0,0001	34	6	21	14
% CV	48,00	- 5,12	0,0000	39	15	67	16
% FS	109,50	3,93	0,0001	12	2	6	3
% AB	100,50	4,10	0,0000	11	8	3	2
% Oil	150,50	3,13	0,0017	1	1	0	1
% Fish	198,50	- 2,20	0,0277	2	2	4	5
Macronutrients of animal products AP (% of total energy)							
AP Energy %	-	6,05	0,0000	28	5	5	3
AP Protein%	1,00	6,03	0,0000	59	10	17	10
AP Fat%	1,00	6,03	0,0000	58	8	17	12
Fully macronutrients							
Energy k/p/d	-	6,05	0,0000	3440	420	2010	400
% of total energy							
Carboh %E	15,50	- 5,75	0,0000	52	9	72	8
Proteins %E	32,00	5,43	0,0000	13	1	10	1
Fats %E	30,00	5,47	0,0000	36	9	19	7
Diversification of nutrition							
D E%	15,00	5,76	0,0000	67	8	32	13
D P%	39,00	5,30	0,0000	69	7	42	16
D F%	31,00	5,45	0,0000	97	3	84	11

Legend	
Per capita income	(GDP) \$
TDC -	Total Daily Consumption (g / person / day)
AP -	animal products

CV -	cereals and vegetables
FS -	fruits and sweeteners
AB -	- alcoholic drinks
VO -	vegetable oils
F -	Fish

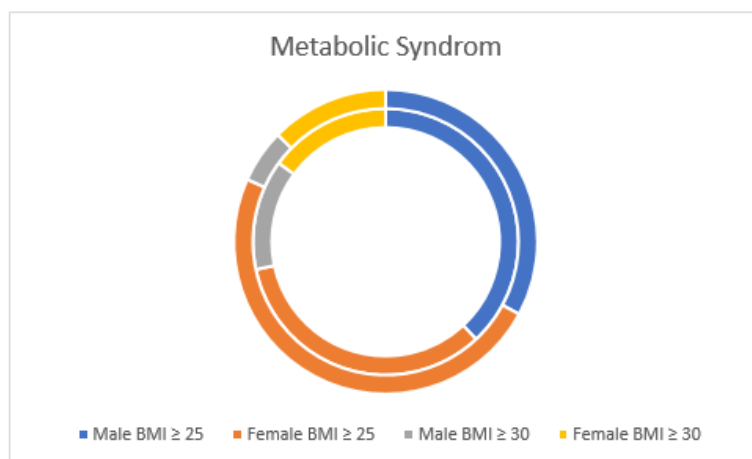


Figure 2: Metabolic syndrome in groups 1 and 2 countries.

Macro and Micronutrients

Group 1 had 4.6 times higher energy levels of animal products (AP) ($p \leq 0.0001$) and 2.5 times higher protein and fat levels of animal products (AP) ($p \leq 0.0001$). Group 1 had 1.7 times higher total energy level ($p \leq 0.0001$), 1.4 times lower total carbohydrate level ($p \leq 0.0001$), 1.3 times higher total protein level ($p \leq 0.0001$), and 1.9 times higher total fat level ($p \leq 0.0001$) than group 2. Group 1 had 5-fold higher levels of micronutrients such as iron of animal products ($p \leq 0.0001$), and 1.2-fold higher levels of vitamin A ($p \leq 0.0001$). Plant iron levels had no statistical differences between Group 1 and Group 2 ($p \leq 0.0001$). Group 1 had on average twice the diversification of total energy, total protein, and total fat compared with Group 2 ($p \leq 0.0001$) (Table 1).

Analysis of predictors of metabolic syndrome in countries with high and low levels of food consumption

In group 1 there were 4 times as many men and 2 times as many women with overweight ($BMI \geq 25$) as in group 2 ($p \leq 0.0001$) (Table 2). In group 1 there were 7 times as many men and 4 times as many women with obesity ($BMI \geq 30$) as in group 2 ($p \leq 0.0001$). In group 1 there were 3.2 times as many men and 2.9 times as many

women with hyperlipidemia (Chol. ≥ 5.0) as in group 2 ($p \leq 0.0001$). In group 1 there were 5.7 times as many men and 5.0 times as many women with hyperlipidemia (Chol. ≥ 6.2) as in group 2 ($p \leq 0.0001$). In group 1 there were 1.6 times as many men and 1.4 times as many women with hyperlipidemia (Chol. ≥ 7.0) as in group 2 ($p \leq 0.0001$) and ($p \leq 0.002$) respectively. In group 1 there were 1.2 times as many men and 1.1 times as many women with high blood pressure (BP $\geq 140/90$) as in group 2 ($p \leq 0.0001$) and ($p \leq 0.004$) respectively. In group 1 there were 2.4 times as many men and 2.2 times as many women with low physical activity (LPA ≤ 60 min) as in group 2 ($p \leq 0.0001$) and ($p \leq 0.007$) respectively. Thus, for all indicators of predictors of metabolic syndrome, the proportion of men in the populations of Group 1 was higher than in Group 2. The proportion of women in Group 1 populations was also higher than in Group 2. But the gradient of MS predictors between countries in groups 1 and 2 was steeper for men than for women. Therefore, the proportion of MS predictors in women was slightly higher in group 2 than in men in group 2 (6 out of 7). We can conclude that the 5-fold difference in TDC between the 1 and 2 groups of countries had a greater effect on MS for men than for women (Table 2).

Table 2: Comparative analysis of MS predictors and the burden of cardiovascular morbidity in groups 1 and 2 of countries with different levels of TDC (Manna Whitney U-criterion).

Variable	U	Z	p-value	Median 1	Quartile 1	Median 2	Quartile 2
TDC g/p/d	-	6,05	0,00000	2291	200	458	172
Metabolic syndrome (predictors) percentage in the population							

Male BMI \geq 25	11,00	5,84	0,00000	62	9	16	9
Female BMI \geq 25	25,00	5,49	0,00000	55	9	24	12
Male BMI \geq 30	13,00	5,80	0,00000	22	6	3	2
Female BMI \geq 30	25,00	5,49	0,00000	24	8	6	5
Male Chol \geq 5.0	1,00	6,03	0,00000	59	13	19	5
Female Chol \geq 5.0	1,00	5,57	0,00000	58	11	20	5
Male Chol \geq 6.2	1,00	6,03	0,00000	17	8	3	1
Female Chol \geq 6.2	1,00	6,03	0,00000	20	8	4	1
Male Glu \geq 7.0	39,50	5,29	0,00000	11	2	7	2
Female Glu \geq 7.0	151,50	6,03	0,00184	10	3	7	2
Male BP \geq 140/90	81,00	4,48	0,00001	48	5	41	3
Female BP \geq 140/90	163,00	- 1,00	0,00384	41	7	38	4
Male LPA \leq 60 min	34,50	3,93	0,00008	36	19	15	12
Female LPA \leq 60 min	72,50	2,89	0,00670	44	25	20	25
Non-communicable diseases (DALY) NCD							
Male NCD Non-communicable diseases	25,00	- 5,57	0,00000	8744	1511	14793	1708
Female NCD Non-communicable diseases	100,00	- 4,11	0,00004	9817	3555	14493	2088
Cardiovascular diseases (DALY)							
Male Cardiovascular diseases	172,00	- 2,72	0,00660	1876	2635	3586	675
Female Cardiovascular diseases	65,00	- 4,79	0,00000	1038	932	3644	645
Male Hypertensive heart disease	105,00	- 4,02	0,00006	40	61	155	27
Female Hypertensive heart disease	33,00	- 5,41	0,00000	30	36	284	36
Male Ischaemic heart disease	233,00	- 1,53	0,12532	990	1156	1278	200
Female Ischaemic heart disease	177,00	- 2,62	0,00881	368	560	792	127
Male Cerebrovascular disease	115,00	- 3,82	0,00013	405	512	1209	242
Female Cerebrovascular disease	52,00	- 5,04	0,00000	336	270	1394	231
Male Rheumatic heart disease	119,00	- 3,74	0,00018	8	12	30	9
Female Rheumatic heart disease	58,00	- 4,93	0,00000	12	14	53	16
Male Inflammatory heart diseases (k)	151,00	- 3,12	0,00179	73	105	205	44
Female Inflammatory heart diseases (k)	16,00	- 5,74	0,00000	35	44	210	37
Legend							
NCD	Non-communicable diseases (DALY)						
DALY -	Disability-adjusted life years						
BMI -	Body Mass Index,						
Chol -	blood cholesterol						
Glu -	blood glucose						
BP -	blood pressure						
LPA -	Low physical activity						

Analysis of the burden of cardiovascular morbidity in countries with high and low TDC

The burden of non-communicable chronic diseases (NCD) was 1.5 times lower in men and 1.7 times lower in women in Group 1 than in Group 2 ($p \leq 0.0001$) (Table 2). The burden of total cardiovascular diseases was 1.9 times lower in men ($p \leq 0.007$) and 3.5 times lower in women ($p \leq 0.0001$) in Group 1 compared with Group 2. The burden of hypertensive heart disease was 3.9 times lower in men ($p \leq 0.0001$) and 9.5 times lower in women ($p \leq 0.0001$) in group 1 compared with group 2. The burden of coronary heart disease was 1.3 times lower in men ($p \leq 0.1$) and 2.2 times lower in women ($p \leq 0.009$) in group 1 compared with group 2. The burden of Cerebrovascular Heart Disease was 3.0 times lower in men ($p \leq 0.0001$) and 4.2 times lower in women ($p \leq 0.0001$) in group 1 compared with group 2. The burden of Rheumatoid Heart Disease was 3.8 times lower in men ($p \leq 0.0001$) and 4.4 times lower in women ($p \leq 0.0001$) in group 1 compared with group 2. The burden of inflammatory heart disease was 2.8 times lower in men ($p \leq 0.002$) and 6.0 times lower in women ($p \leq 0.0001$) in group 1 compared with group 2. In group 1, the burden of disease in all types of cardiovascular disease was on average 2 times higher in men than in women. In group 2 countries, the burden of disease in all types of cardiovascular disease was on average similar in men and women (Table 2). Thus, the burden of all types of cardiovascular disease in men and women is higher in group 2. For all types of cardiovascular diseases, there are pronounced gender differences. Moreover, gender differences are pronounced in Group

1, but practically absent in Group 2.

Discussion

According to the UN, 836 million people in the world were undernourished in 2015. But 500 million people are obese [28]. Due to population growth, food production will increase by 60% by 2050 [28]. This will lead to a significant increase in the burden of four types of diseases: cardiovascular, respiratory, type 2 diabetes, and cancer [28]. A joint meeting of the UN and WHO in 2014 adopted a declaration on the need to reduce the burden of NCD by one third by 2030 [29]. Obesity covers more than 40% of the population in high-income countries. Most studies and reviews in recent years have focused on obesity, its impact on inflammation processes, NCD, life expectancy, and even COVID-19 [30-34, 39,40, 43-48]. The results of our research showed that in 25 high-income countries the maximum total daily food consumption (TDC) was 5 times higher than the minimum level in 25 low-income countries in 2002-05. Quality of life indicators of the 1st group of countries, on average, were 2 times higher than in the 2nd group of countries. But per capita income in Group 1 was 23 times higher than in Group 2. In general, all MS predictors for both men and women were 2-5 times higher in Group 1 compared to Group 2. Moreover, the severity of MS predictors was lower in women than in men. At the same time more than 50% of men and women in the 1st group had overweight (BMI ≥ 25). More than 20% of population in 25 countries of the 1st group had obesity. Hyperlipidemia (Chol. ≥ 5.0) covered 58% of both men and women in Group 1 (Table 3) (Figure 3).

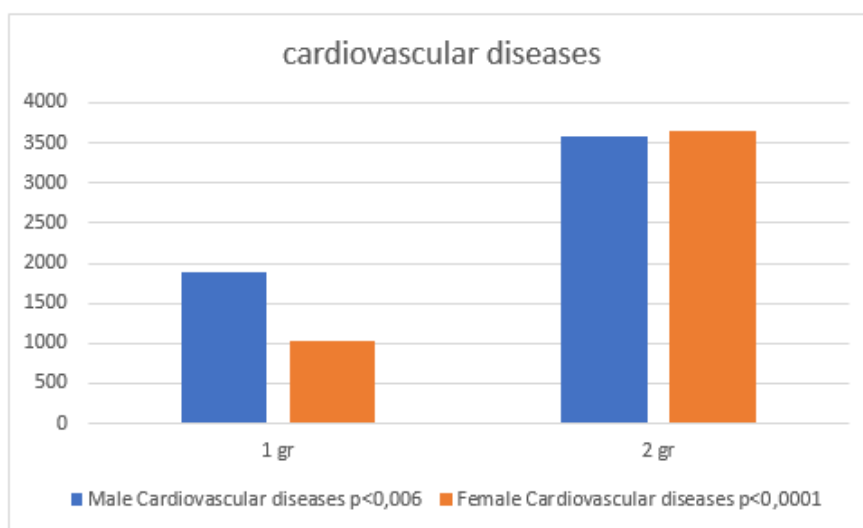


Figure 3: Cardiovascular diseases in groups 1 and 2.

Table 3: Groups of countries 1 and 2.

Countries	1 Groups	2 Groups
TDC g / person / day	2291±200	458±172
1	Luxembourg	Zambia

2	Ireland	Côte d'Ivoire
3	Romania	Ghana
4	Greece	Rwanda
5	Lithuania	Tanzania
6	Malta	Nigeria
7	Spain	Sierra Leone
8	United States of America	The Gambia
9	Belgium	Benin
10	United Kingdom	Haiti
11	Italy	Guinea-Bissau
12	Portugal	Solomon Islands
13	Kazakhstan	Togo
14	The Netherlands	Uganda
15	Denmark	Comoros
16	Kyrgyzstan	Liberia
17	France	Burkina Faso
18	Germany	Mozambique
19	Czech Republic	Central African
20	Israel	Niger
21	Albania	Eritrea
22	Sweden	Burundi
23	Belarus	Ethiopia
24	Estonia	Chad
25	Finland	Congo DR

However, both the overall NCD burden and the overall cardiovascular disease burden were 2-fold higher in men and 4-fold higher in women statistically significantly in group 2 with low TDC, virtually with no overweight (20% vs 60%), obesity (4% vs 23%) and other MS predictor disorders in these low-income countries. Thus, high burden of Cardiovascular diseases (Coronary, Hypertensive, Cerebrovascular, Rheumatoid, and Inflammatory heart disease) is significantly higher in low-income countries with low TDC.

We believe that risk factors for a high burden of Cardiovascular disease were low per capita income, poor access to health care, clean water and clean air, high corruption, aggressiveness, and a low Happiness Index. TDC in these countries was meager (460 gr in group 2 vs. 2290 gr in group 1). The TDC of the 2nd group of countries was at 67% carbohydrate ($p \leq 0.0001$) and only 10% protein and 16% fat ($p \leq 0.0001$). Using linear multiple regression analysis, we found that a decrease in per capita income (independent variable) by \$1 in countries reduced TDC (dependent variable) by 2% ($p \leq 0.0001$) [49]. An increase in UV (independent variable) in countries by 1 J/m, reduces TDC (dependent variable) by 0.3% ($p \leq 0.0001$) [50]. If TDC (independent variable) is increased by 1 J/m, the burden of Hypertensive heart disease (DALY) (dependent variable) is reduced by 5.8% ($p \leq 0.0001$) [50].

Thus, TDC decreases in countries according to decreasing per capita income and approaching the equator. We conclude that the observed changes in the burden of the 5 types of cardiovascular disease as well as the 6 predictors of MS in our study occur not only as a result of a fivefold difference in TDC between groups 1 and 2, but also as a result of differences in the dietary patterns in these countries. The COVID-19 pandemic has revealed new aspects of cardiovascular, premorbid diseases, and obesity that have yet to be studied [2, 9, 12, 35, 38, 41, 42].

Conclusion

There are 1.5-5-fold differences in MS predictors and the burden of cardiovascular diseases with gender differences in men and women in the countries with five times difference in TDC.

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Conflict of Interest

No conflict of interest.

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