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Research Article

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Ecological Determinants of the Happiness Index, Life Expectancy, Incidence and Dietary Patterns in Different Countries

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Abstract

There is a growing interest to the Happiness Index in the world. Purpose of this study is an analysis of the impact of income, UV and latitude on the Happiness Index, incidence and dietary patterns in different countries. Using the Mann-Whitney criterion, it is established that income is 20 times higher in happy countries, and their geographic location is 35 ° to the north of not happy countries ($p = 0.001$). In the happy countries people live 27 years longer, more rarely suffer from cardiovascular diseases, diabetes and asthma ($p = 0.001$), more often suffer from oncological diseases, Alzheimer›s disease and alcoholism ($p = 0.001$). The diet in happy countries contains more animal products and alcoholic beverages ($p = 0.001$). The Happiness Index, life expectancy, frequency of cardiovascular diseases, Alzheimer's disease, breast and prostate cancer, and dietary patterns depend on the Income ($p = 0.001$). The frequency of alcoholism, diabetes, asthma, lung and stomach cancer depend on latitude and UV ($p = 0.001$). The Happiness Index and dietary patterns do not depend on latitude and UV. Income, latitude and UV have irrespective effects on the country performance. The results can be used for disease prevention.

Keywords

Happiness index, Income, Latitude, UV, Life expectancy, Incidence, Dietary patterns

List of Abbreviations

HPI: The Happy Planet Index; GDP: Gross Domestic Product; FAO: Food and Agriculture Organization of the United Nations; HIH: High Index of Happiness; LIH: Low Index of Happiness; BMI: Body Mass Index; BP: Blood Pressure; LPhA: Low Physical Activity; UV: Level of Ultraviolet; PAO: Products of Animal Origin; GV: Grain-Vegetables

Introduction

There is a growing interest in the study of the subjective phenomenon of happiness [1] in the world. The tendency of modern science is a desire for a quantitative expression of the studied society characteristics and a simultaneous appeal to those sides of life that the exact quantitative analysis traditionally ignores [1]. Happiness is one of these society characteristics [1, 2]. For the first time in Bhutan, it was suggested that the Happiness Index, rather than GDP, be given greater importance [3]. The Happiness Index is calculated on many parameters, including income, life expectancy, environment and life satisfaction [4]. In 2006 the happiest countries were Vanuatu, Colombia and Costa Rica, in 2016 it were Denmark, Switzerland and Iceland [2, 5]. It is believed that the human

desire for happiness should serve as a gold standard for the state development [2, 4, 5]. A number of researchers argue about the threshold of GDP, after which the Happiness Index does not grow [5-8].

According to Shmatova and Morev [1], the issue of the connection between happiness and income remains open. There is no information on the incidence and the dietary patterns in countries with different Happiness Index.

It is known that in countries income, latitude, incidence and dietary patterns are interrelated [9, 10]. It makes difficult to determine the independent contribution of income and latitude to the differences in the performance of different countries. Grant WB [10] noted that the types of cancer associated with the level of food consumption are loosely related to latitude. In our work [11], it is shown that in countries with the same income and latitude, but with different rates of breast cancer, the diet with a high proportion of animal products is a cancer risk factor. The purpose of this study is to analyze the independent effects of income, latitude and UV on the Happiness Index, incidence, life expectancy and dietary patterns in countries with different Happiness Index.

Materials and Methods

Studies design is observational [11].

A database of 140 countries with the Happiness Index of 2016 was used for research. Data on incidence rates standardized by age per 100 thousand of population for 140 countries were selected from the GLOBOCAN database for 2008 and WHO for 2005 [12, 13]. Information on life expectancy was selected from the database on the website (World Population Prospects, 2008) [14]. The level of food consumption (53 food products) for each country was selected from the FAO database for 2003-05 [15]. The countries' dietary patterns were presented as a general level of food consumption (g/person/day), and also in the form of 4 blocks as a percentage of the total consumption level: 1- animal products; 2 - grain-vegetables; 3 - fruit-drinks; 4 - alcoholic beverages [11].

The level of consumption of macronutrients was analyzed: Energy, Protein, Fat, Carbohydrate [15]. In order to characterize social conditions in countries, the following indicators were used: GDP (Per capita income) for 2008 and 2016 ($/person/day) [16-18], Indices Happiness Index and Rating of 2016 (World Happiness Report 2016). The geographic location of countries was judged by the latitude and level of ultraviolet (UV) for countries capitals [19]. As the predictors of the Metabolic Syndrome was used the percentage of residents in the country with a body mass index (BMI ≥ 25 kg/m^2), blood cholesterol level (HL ≥ 5.0 mmol/L), blood glucose (GL ≥ 7.0 mmol/L), Blood pressure (BP ≥ 140/90 mmHg) and low physical activity (LPA) (walking < 60 minutes/day) [13].

The study was conducted in 4 stages:

Stage 1: Analysis of social indicators, life expectancy, incidence, predictors of the Metabolic Syndrome and Dietary Patterns of 2 samples of countries (30 countries each) with a high and low Happiness Index in 2016 (list of countries 1 a, b).

Stage 2: Analysis of independent influence of income on the indicators of 2 groups of countries with different Happiness Index, selected from 140 countries (30 countries each), with statistically the same level of UV and latitude ($p = 0.1$), but different income ($p = 0.01$) (list of countries 2 a, b).

Stage 3: Analysis of the independent influence of UV and latitude on the performance of 2 groups of countries with different Happiness Index, selected from 140 countries (30 countries each), with a statistically identical income ($p = 0.1$), but with different UV and latitudes ($p = 0.01$) (list of countries 3 a, b).

Stage 4: Analysis of the performance of 2 groups of countries with different Happiness Index, selected from 140 countries (30 countries each), with a statistically identical income ($p = 0.1$), UV ($p = 0.1$), and latitudes ($p = 0.1$) (list of countries 4 a, b).

The statistical analysis of the comparative country samples was carried out using the nonparametric Mann-Whitney-Wilcoxon U-test for independent samples, since some of the country sample indicators were not normally distributed. The central trend in the distribution of data in the sample was represented by the Median. The variance of the data in the samples was estimated using the Interquartile range between the first and third quartiles, that is, between the 25th and 75th percentiles [20]. The level of statistical significance (p) was 0.05, with the Bonferroni correction ($p = 0.001$). To estimate the reliability of research results, the number of countries in the sample varied from 20 to 35. The 10th version of StatSoft was used to analyze the data.

Results

Analysis of the incidence, life expectancy and dietary patterns in countries with a high and low Happiness index

It was found that in countries with a high Happiness Index (HHI), in comparison with those with a low Happiness Index (LHI), in 2008 the income was 20 times, and in 2016 it was 40 times higher ($p = 0.001$) (Table 1), (List of countries 1 a, b).

Countries with HHI are located in high latitudes with low UV levels (47 ° and 2033 J/m^2). Countries with LHI are located in low latitudes with high UV levels (12 ° and 5160 J/m^2) ($p = 0.001$). Indices of Happiness, Environmental Efficiency, Prosperity and Health in countries with HHI are 2-5 times higher than in countries with LHI ($p = 0.001$). In countries with HHI, the total incidence is 4 times lower, and life expectancy is 25 years longer than in LHI countries ($p = 0.001$). In countries with HHI, the incidence of breast, prostate, lung and stomach cancer is 2-6 times higher than in countries with LHI ($p = 0.001$). In countries with HHI, the rates of Alzheimer's disease, alcoholism and suicide are 1.5 to 4 times higher ($p = 0.001$), the incidence of diabetes, asthma and cardiovascular diseases is 2 times lower ($p = 0.001$).

In countries with HHI, the percentage of people with body mass index (BMI) > 25, cholesterol level > 5.0, glucose > 7.0, BP > 140/90 and low physical activity (LPA) is 1.5-3 times higher ($p = 0.003$).

Table 1: Comparative analysis of indicators of 2 groups of countries with high and low happiness index.

Happiness Rating 2016							
Indicators	**U n-30/30**	**Z**	**p-value**	**Median 1**	**Quartile Range 1**	**Median 2**	**Quartile Range 2**
Social factors							
Happiness Rating	-	- 6.65	0.0001	16.5	17.00	140.5	16.00
Happiness Index 2016	-	6.65	0.0001	6.973	0.633	3.887	0.473
Prosperity Rating	3	- 6.60	0.0001	15.5	25.00	117.5	31.00
Health Rating	10	- 6.51	0.0001	17.5	32.00	118.5	26.00
Ecological efficiency index	13	6.39	0.0001	73.1	19.51	35.4	12.61
Economic and geographical factors							
Of GDP ($)2008	21	6.34	0.0001	36.1	24.80	1.5	1.50
Of GDP ($)2016	4	6.59	0.0001	111.1	97.62	2.3	2.30
UV rad J/m^2 2004	66	- 5.67	0.0001	2032.5	2020.00	5160.0	598.00
lat°	98	5.20	0.0001	46.9	18.50	12.3	12.40
Total morbidity - person/100 thousand standardized by age	8	- 6.53	0.0001	11727	3377	41693	19483
Average life expectancy							
2016 male life expectancy	9	6.51	0.0000	75.8	3.60	51.40	12.60
2016 female life expectancy	9	6.51	0.0000	81.4	2.70	52.40	10.40
The gender difference in life expectancy	75	5.54	0.0001	5.1	1.60	1.00	2.00
Frequency of diseases - person/100 thousand age-standardized population							
Breast cancer	23	6.31	0.0001	82.5	21.70	22.6	8.80
Prostate cancer	36	6.11	0.0001	81.2	44.80	18.0	12.80
Lung cancer	56	5.82	0.0001	34.9	23.40	3.7	3.60
Stomach cancer	188	3.87	0.0001	9.1	3.20	5.0	4.90
Ischemic heart disease	88	- 5.34	0.0001	860.8	270.89	1266.8	387.93
Hypertensive heart disease	69	- 5.63	0.0001	39.8	70.48	159.5	41.39
Cerebrovascular disease	3	- 6.60	0.0001	328.8	165.37	1155.7	304.82
Alzheimer disease	33	6.16	0.0001	268.9	42.21	131.6	10.52
Parkinson disease	228	3.27	0.0011	53.1	30.88	25.3	2.75
Alcohol use disorders	97	5.21	0.0001	840.8	285.70	186.6	248.57
Suicide attempts	172	4.10	0.0001	246.4	109.60	133.0	71.92
Diabetes mellitus disease	116	- 4.93	0.0001	212.5	225.39	578.0	173.36
Asthma disease	134	- 4.66	0.0001	200.5	103.00	383.5	93.0
Metabolic Syndrome							
BMI > 25 (kg/m^2)	19	6.36	0.0001	64.4	8.40	18.4	5.80
Ch > 5.0 (mmol/L)	9	6.51	0.0001	58.1	15.20	20.4	11.30
Glu > 7.0 (mmol/L)	99	5.18	0.0001	10.8	2.60	7.0	1.60
AD > 140/90 (mm/Hg)	305	2.14	0.0321	45.3	6.70	41.3	3.70
Ins act < 60 minutes/day walking	26	4.93	0.0001	40.7	14.10	19.1	12.50
Alcoholic beverages							
Beverages, Alcoholic 2003-05	134	4.67	0.0001	8.5	7.00	0.5	2.00
Wine 2003-05	84	5.32	0.0001	40.0	57.00	0.0	2.00
Beer 2003-05	61	5.75	0.0001	166.5	151.00	10.5	25.00
Dietary patterns							
The general level of consumption (g/person/day)	14	6.44	0.0001	2126.5	508.00	643.0	346.00
Animal products (%)	202	3.66	0.0003	34.5	9.23	24.0	17.41
Grain-vegetables (%)	77	- 5.51	0.0001	37.7	5.43	61.4	16.09
Fruit drinks (%)	85	5.39	0.0001	13.3	4.00	6.6	2.80

Alcoholic beverages (%)	135	4.66	0.0001	11.0	5.49	2.6	5.41
Macronutrients Total Energy 100%							
Energy (kcal/person/day)2003-05	18	6.38	0.0001	3310.0	500.00	2155.0	510.00
Proteins (g/person/day) 2003-05	26	6.27	0.0001	104.0	18.00	54.0	27.00
Fats (g/person/day) 2003-05	20	6.35	0.0001	130.0	49.00	52.5	16.00
Proteins/Fats 2003-05%	125	- 4.80	0.0001	82%	16.00	114%	42.00
Percentage Composition of Energy							
Carbohydrate %	41	- 6.05	0.0001	51.5	9.00	69.5	6.00
Proteins %	164	4.23	0.0001	12.0	2.00	10.0	2.00
Fats %	41	6.05	0.0001	36.0	9.00	20.0	7.00
Nutrients AP				33%		50%	
Energy %	20	6.36	0.0001	30.5	10.00	7.0	6.00
Protein %	6	6.56	0.0001	60.0	12.00	23.5	14.00
Fat %	41	6.05	0.0001	58.0	12.00	23.0	19.00

notes:
BMI - body mass index
Ch is cholesterol
Glu-glucose
Ins act - low physical activity
lat° - latitude

In countries with HHI, the total level of food consumption is 3 times higher (p = 0.001). In countries with HHI the diet includes 34.5% against 22.0% of products of animal origin; 37.7% against 61.4% of grains-vegetables; 13.3% against 6.6% of fruit drinks and 11.0% against 2.6% of alcoholic beverages compared with LHI countries (p = 0.003).

In countries with HHI, consumption of total food Energy, Proteins and Fats is 1.5-3 times higher (p = 0.001), Carbohydrates is 1.4 times lower (p = 0.001), animal nutrients is 3.5 times higher (p = 0.001). Thus, countries with HHI have differences from countries with LHI in terms of income, UV, latitude, social indicators, life expectancy, rates and structure of morbidity, predictors of the metabolic syndrome and dietary patterns.

Influence of income on the Happiness Index, life expectancy, incidence and dietary patterns in countries with the same latitude and UV

It was found that in high-income ($ 34.4) and low income ($ 4.6) countries (p = 0.001), but statistically with the same latitudes and UV (36 °) (p = 0.8), there are differences in the studied parameters (Table 2, List of countries 2 a, b). In high-income countries, the Happiness Index, Prosperity Index, Health Index and Environmental Efficiency Index are 2-3 times higher (p = 0.001), the total incidence is 2 times lower, and life expectancy is 8 years longer (p = 0.001). In high-income countries, the incidence of breast and prostate cancer, Alzheimer's disease is 3 times higher, and the incidence of cardiovascular diseases is 2 times lower (p = 0.001). In countries with high and low incomes, but with the same latitude and UV, the incidence of lung and stomach cancer, asthma, diabetes mellitus; alcoholism and suicide rates are not statistically different (p = 0.9), (Table 2).

In high-income countries, there are 1.5 times more people with a BMI > 25, a cholesterol level > 5.0, and an LPA (p = 0.02).

In high-income countries, the overall level of food consumption, as well as the percentage in the diet of animal products, fruit drinks and alcoholic beverages, is 1.5 to 3 times higher than in low-income countries (p = 0.01). The percentage of grains and vegetables in low-income countries is 1.5-2 times higher than in high-income countries (p = 0.001). Levels of strong alcohol consumption (g/person/day) in countries with high and low income are not statistically different (p = 0.2). Consumption of wine and beer is 8 times higher in high-income countries (p = 0.003).

In high-income countries, the consumption of total Energy, Proteins and Fats is 1.5 times higher, Carbohydrates is 1.5 times lower (p = 0.001). Consumption of Energy and animal Proteins is 1.5 times higher in high-income countries (p = 0.006).

Thus, the social indicators, life expectancy, the incidence of breast and prostate cancer, cardiovascular diseases, Alzheimer's disease, the predictors of the metabolic syndrome, the level of food consumption and the dietary patterns depend on income in countries with the same latitude and UV. The incidence of lung and stomach cancer, asthma, diabetes; alcoholism and suicide rates, and strong alcohol consumption do not depend on income.

The influence of the UV and latitude on the Happiness Index, life expectancy, incidence and the dietary pattern in countries with the same income

It was found that in countries in high latitudes and with low UV levels (50 ° and 1798 J/m^2), by contrast with countries in low latitudes and with high UV levels (33 ° and 3579 J/m^2) (p = 0.001), but with the same income (22.7 $) (p = 0.1), Indices of Happiness, Prosperity, Health, and Environmental

Table 2: Comparative analysis of indicators of 2 groups of high and low income countries located in the same geographical conditions.

Indicators	U n-30/30	Z	p-value	Median 1	Quartile Range 1	Median2	Quartile Range 2
Social factors							
Happiness Rating	67	- 5.66	0.0001	22.0	33.00	94.0	39.00
Happiness Index 2016	67	5.66	0.0001	6.752	1.183	5.097	0.885
Prosperity Rating	53	- 5.86	0.0001	27.0	33.00	82.0	30.00
Health Rating	71	- 5.60	0.0001	23.0	35.00	78.5	31.00
Ecological efficiency index	74	5.47	0.0001	72.4	18.04	48.1	16.56
Economic and geographical factors							
Of GDP ($)2008	6	6.56	0.0001	35.1	18.90	5.0	4.00
Of GDP ($)2016	7	6.54	0.0001	93.0	74.99	9.3	8.37
UV rad J/m^2 2004	412	- 0.55	0.5793	2744.5	3197.00	3212.5	1772.00
lat°	433	0.25	0.8016	36.6	31.00	37.1	15.30
Total morbidity - person/100 thousand standardized by age	92	- 5.29	0.0001	11674.0	5234.13	22385.3	9204.01
Average life expectancy							
Male life expectancy	115	4.95	0.0000	75.8	2.90	67.4	10.60
Female life expectancy	116	4.93	0.0000	80.9	4.50	73.4	13.20
The gender difference in life expectancy	447	-0.04	0.9705	6.10		6.00	
Frequency of diseases - person/100 thousand age-standardized population							
Breast cancer	147	4.47	0.0001	71.8	43.80	31.2	17.20
Prostate cancer	96	5.23	0.0001	59.0	66.70	10.3	13.60
Lung cancer	434	0.23	0.8187	33.0	28.80	28.3	31.70
Stomach cancer	320	- 1.92	0.0546	8.4	4.00	15.1	17.80
Ischemic heart disease	125	- 4.80	0.0001	879.0	381.13	1942.7	1828.56
Hypertensive heart disease	227	- 3.29	0.0010	44.8	114.08	163.6	268.70
Cerebrovascular disease	50	- 5.91	0.0001	346.3	143.47	1142.3	593.49
Alzheimer disease	179	4.00	0.0001	264.0	81.23	174.1	45.42
Alcohol use disorders	372	1.15	0.2519	672.2	608.60	359.6	672.89
Suicide attempts	422	0.41	0.6843	8.6	7.65	9.5	9.14
Diabetes mellitus disease	438	- 0.17	0.8650	296.8	481.03	295.7	184.96
Asthma disease	394	0.82	0.4119	203.0	161.00	186.5	147.00
Metabolic Syndrome							
BMI > 25 (kg/m^2)	123	4.83	0.0001	63.9	9.70	45.0	29.70
Ch > 5.0 (mmol/L)	77	5.51	0.0001	55.9	16.20	35.6	11.90
Glu > 7.0 (mmol/L)	320	1.92	0.0546	10.8	1.90	10.1	2.60
AD > 140/90 (mm/Hg)	429	0.31	0.7562	43.9	8.50	41.3	12.80
Ins act < 60 minutes/day walking	103	2.99	0.0028	45.1	15.20	30.7	14.40
Alcoholic beverages							
Beverages, Alcoholic 2003-05	371	1.16	0.2458	7.0	9.00	5.0	12.00
Wine 2003-05	252	2.93	0.0034	27.0	57.00	3.5	13.00
Beer 2003-05	152	4.41	0.0001	149.5	160.00	18.0	55.00
Dietary patterns							
The general level of consumption (g/person/day)	279	2.53	0.0115	2149.5	858.00	1661.0	598.00
Animal products (%)	288	2.39	0.0170	34.2	5.10	30.5	13.54
Grain-vegetables (%)	117	- 4.92	0.0001	40.5	10.64	58.1	19.60
Fruit drinks (%)	139	4.60	0.0001	12.8	3.00	6.9	4.50
Alcoholic beverages (%)	190	3.84	0.0001	10.1	8.35	2.0	5.25
Macronutrients Total Energy 100%							

Energy (kcal/person/day) 2003-05	189	3.85	0.0001	3195.0	680.00	2805.0	670.00
Proteins (g/person/day) 2003-05	183	3.94	0.0001	102.5	26.00	78.0	20.00
Fats (g/person/day) 2003-05	134	4.66	0.0001	129.5	61.00	69.5	34.00
Percentage composition of Energy							
Carbohydrate %	161	- 4.27	0.0001	52.0	12.00	64.0	9.00
Proteins %	319	1.94	0.0528	12.0	2.00	11.0	1.00
Fats %	151	4.42	0.0001	36.0	12.00	23.5	9.00
Nutrients AP							
Energy %	218	3.42	0.0006	26.0	12.00	18.0	12.00
Protein %	77	5.51	0.0001	56.0	14.00	36.5	16.00
Fat %	413	0.55	0.5844	48.0	19.00	45.0	30.00

notes:
BMI - body mass index
Ch is cholesterol
Glu-glucose
Ins act - low physical activity
lat° - latitude

Table 3: Comparative analysis of indicators of 2 groups of countries, located in high and low latitudes, with the same income.

UV rad - lat°							
Indicators	**U n- 30/30**	**Z**	**p-value**	**Median 1**	**Quartile Range 1**	**Median 2**	**Quartile Range 2**
Social factors							
Happiness Rating	430	- 0.30	0.7675	49.5	60.00	39.0	46.00
Happiness Index 2016	430	0.29	0.7731	6.0	1.60	6.3	1.16
Prosperity Rating	401	- 0.72	0.4688	32.0	46.00	38.5	25.00
Health Rating	384	- 0.98	0.3292	35.5	39.00	36.0	42.00
Ecological efficiency index	363	1.09	0.2750	69.5	23.47	64.9	16.07
Economic and geographical factors							
Of GDP ($)2008	439	- 0.16	0.8708	20.2	26.40	25.5	19.20
Of GDP ($)2016	447	0.04	0.9646	43.2	104.95	51.2	63.50
UV rad J/m² 2004	99	- 5.19	0.0001	1798.0	409.00	3579.0	2313.00
lat°	81	5.46	0.0001	50.5	9.10	33.3	18.60
Total morbidity - person/100 thousand standardized by age	412	0.56	0.5742	15182.3	9528.33	13907.8	7975.45
Average life expectancy							
Male life expectancy	373	- 1.14	0.2550	73.8	7.60	74.3	7.60
Female life expectancy	434	0.23	0.8187	80.1	6.10	78.7	6.50
The gender difference in life expectancy	275	2.58	0.01	6.20		4.30	2.4
Frequency of diseases - person/100 thousand age-standardized population							
Breast cancer	347	1.52	0.1297	56.9	41.00	43.9	36.20
Prostate cancer	362	1.30	0.1932	50.9	60.30	50.0	51.40
Lung cancer	208	3.58	0.0003	44.8	18.40	27.9	25.50
Stomach cancer	289	2.38	0.0173	13.8	12.90	8.9	6.40
Ischemic heart disease	337	1.67	0.0948	1332.3	1425.52	1016.8	409.27
Hypertensive heart disease	401	- 0.72	0.4688	54.6	113.64	85.1	163.19
Cerebrovascular disease	341	1.61	0.1071	660.7	1089.64	468.7	447.21
Alzheimer disease	391	0.87	0.3831	228.3	98.22	216.1	146.24
Parkinson disease	288	2.40	0.0166	45.5	25.72	27.6	29.75
Alcohol use disorders	189	3.86	0.0001	856.0	528.23	449.6	525.48

Suicide attempts	199	3.71	0.0002	277.2	131.48	170.7	166.76
Diabetes mellitus disease	186	- 3.90	0.0001	209.0	63.13	397.3	418.72
Asthma disease	218	- 3.43	0.0006	145.5	56.00	225.5	168.00
Metabolic Syndrome							
BMI > 25 (kg/m²)	407	- 0.64	0.5250	63.3	8.30	62.1	10.40
Ch > 5.0 (mmol/L)	319	1.93	0.0537	55.1	17.70	51.4	17.40
Glu > 7.0 (mmol/L)	408	- 0.62	0.5346	10.8	1.90	11.0	2.00
AD > 140/90 (mm/Hg)	161	4.27	0.0001	49.4	6.30	41.8	8.50
Ins act < 60 minutes/day walking	192	- 2.14	0.0321	31.1	19.90	43.6	25.30
Alcoholic beverages							
Beverages, Alcoholic 2003-05	238	3.13	0.0018	14.5	14.00	7.0	10.00
Wine 2003-05	304	2.16	0.0309	27.0	38.00	4.5	56.00
Beer 2003-05	287	2.40	0.0163	185.0	136.00	101.5	154.00
Dietary patterns							
The general level of consumption (g/person/day)	285	2.43	0.0150	2122.5	310.00	1745.0	819.00
Animal products (%)	444	0.09	0.9293	33.8	7.29	33.5	6.78
Grain-vegetables (%)	397	- 0.78	0.4333	42.7	14.46	42.4	14.15
Fruit drinks (%)	434	- 0.23	0.8187	11.2	6.90	11.6	3.00
Alcoholic beverages (%)	342	1.59	0.1120	10.8	8.00	8.4	7.46
Macronutrients Total Energy 100%							
Energy (kcal/person/day) 2003-05	177	1.08	0.2799	3150.0	340.00	3035.0	470.00
Proteins (g/person/day) 2003-05	364	1.26	0.2062	98.5	21.00	91.0	24.00
Fats (g/person/day) 2003-05	372	1.15	0.2488	110.5	41.00	97.5	52.00
Proteins/Fats 2003-05 %	404	- 0.67	0.5011	86%	24.00	87%	26.00
Percentage composition of Energy							
Carbohydrate %	367	- 1.23	0.2198	56.0	9.00	59.0	12.00
Proteins %	404	0.67	0.5011	12.0	2.00	12.0	2.00
Fats %	371	1.16	0.2458	32.5	9.00	28.5	11.00
Nutrients AP							
Energy %	248	2.99	0.0028	27.0	10.00	20.5	12.00
Protein %	379	1.05	0.2939	56.5	12.00	53.0	16.00
Fat %	161	4.27	0.0001	58.0	8.00	42.0	17.00

notes:
BMI - body mass index
Ch is cholesterol
Glu-glucose
Ins act - low physical activity
lat° - latitude

Performance; life expectancy, incidence of breast and prostate cancer, Alzheimer's disease and cardiovascular diseases are not statistically different (p = 0.9) (Table 3), (List of countries 3 a, b).

The gender difference in the life expectancy for northerners is 1.5 times higher than for southerners (p = 0.01). The incidence of lung and stomach cancer, alcoholism and suicide rates are 1.5 times higher in high latitudes with low levels of UV (p = 0.01). The incidence of asthma and diabetes is 1.5-4 times higher in countries in low latitudes with high UV levels (p = 0.01). In countries with low UV levels and in high latitudes, there are 1.5 times more people with a blood pressure > 140/90 (p = 0.02) and fewer people with low physical activity (p = 0.03).

In countries in high latitudes and with low UV levels, food consumption is 1.5 times higher (p = 0.015), consumption of alcoholic beverages is 2-5 times higher (p = 0.03). The percentage composition of the northerners diet is not statistically different from southerners (p = 0.9). The diet of northerners and southerners contains a high proportion of animal products (34%), a low share of grains-vegetables (43%), 11% of fruit drinks and a high level of alcoholic beverages (9%). The consumption of total Energy, Protein and Fat is not statistically different in countries in high and low latitudes (p = 0.3). Consumption of animal nutrients (Energy and Fat) is 1.5 times higher in countries with low UV and in high latitudes (p = 0.002).

Thus, the rate of lung and stomach cancer, alcoholism, suicide, asthma, diabetes mellitus, and also the consumption of alcoholic beverages depend on the UV level and latitudes in countries with the same income. The Happiness Index and dietary patterns do not depend on UV and latitude.

Analysis of the Happiness Index, incidence and dietary patterns in countries with statistically identical income, UV and latitude (p = 0.1)

It was found that in two groups of countries that did not statistically differ in income, UV and latitude (p = 0.1), there were no statistically significant differences in social indicators, life expectancy, incidence, predictors of the metabolic syndrome and dietary patterns (p = 0.1), (Table 4, List of countries 4 a, b).

Thus, countries with the same income, UV and latitude do not have statistical differences in the characteristics that are studied in this work.

Discussion

The income of the happiest inhabitants of the Earth in 2008 and in 2016 was 20 and 40 times higher than those of the most unlucky. High levels of food consumption including animal products and alcohol in happy countries are accompanied by the fact that more than 60% of the population of these countries has signs of obesity (BMI more than 25, hypercholesterolemia and low physical activity). Our results confirm the data on the nutritional disorders role in the obesity growth in the world and chronic diseases (CD), predisposition to which is transmitted by epigenetic mechanisms [21-25]. According to our data, in happy countries, unlike countries with LHI, life expectancy is higher; incidence of oncological and neurodegenerative diseases is higher and less often cardiovascular pathologies, diabetes and asthma.

It is shown that the consumption of red meat increases the level of insulin-like growth factor 1 and the risk of chronic

Table 4: Comparative analysis of indicators of 2 groups of countries with the same income and breadth.

indicators	U n-30/30	Z	p-value	Median 1	Quartile Range 1	Median 2	Quartile Range 2
Social factors							
Happiness Rating	372	- 1.15	0.2519	28.0	32.00	35.5	31.00
Happiness Index 2016	373	1.14	0.2550	6.6	1.03	6.4	0.90
Prosperity Rating	396	- 0.80	0.4247	34.0	44.00	37.5	43.00
Health Rating	406	- 0.64	0.5201	35.0	48.00	38.0	45.00
Ecological efficiency index	425	0.14	0.8855	67.4	21.48	62.5	23.07
Economic and geographical factors							
Of GDP ($)2008	423	0.39	0.6952	23.4	26.30	24.1	25.10
Of GDP ($)2016	412	0.55	0.5793	46.6	94.38	50.5	82.79
UV rad J/m^2 2004	401	- 0.72	0.4688	2913.5	2757.00	2938.5	3173.00
lat°	430	0.29	0.7731	36.5	27.50	38.9	33.30
Total morbidity - person/100 thousand standardized by age	430	- 0.29	0.7731	15182.3	10671.71	14381.4	9760.84
Average life expectancy							
Male life expectancy	416	0.50	0.6204	74.6	6.10	73.5	7.70
Female life expectancy	439	0.16	0.8766	79.8	6.00	79.8	6.60
The gender difference in life expectancy				5.2		6.3	
Frequency of diseases - person/100 thousand age-standardized population							
Breast cancer	399	0.75	0.4553	48.3	44.70	44.8	51.50
Prostate cancer	423	0.39	0.6952	51.7	63.70	51.0	48.70
Lung cancer	410	0.58	0.5592	31.4	22.70	34.6	36.20
Stomach cancer	346	- 1.53	0.1260	9.1	7.00	13.4	10.60
Ischemic heart disease	378	1.06	0.2905	1013.7	782.32	863.9	459.93
Hypertensive heart disease	439	- 0.16	0.8766	72.3	222.70	77.7	108.67
Cerebrovascular disease	384	0.97	0.3329	476.1	450.63	395.0	342.29
Alzheimer disease	369	1.19	0.2340	218.9	90.81	209.4	92.39
Parkinson disease	328	1.80	0.0724	33.8	39.24	27.4	31.91
Alcohol use disorders	403	- 0.69	0.4918	833.2	570.34	845.6	704.66
Suicide attempts	403	0.69	0.4918	249.2	126.64	242.6	175.08

Diabetes mellitus disease	436	- 0.20	0.8418	338.2	330.54	355.8	356.23
Asthma disease	364	1.27	0.2036	228.0	161.00	177.5	166.00
Metabolic Syndrome							
BMI > 25 (kg/m^2)	398	0.76	0.4464	63.4	12.50	60.0	16.10
Ch > 5.0 (mmol/L)	401	0.72	0.4688	54.1	17.40	50.6	22.30
Glu > 7.0 (mmol/L)	357	1.37	0.1715	10.9	1.80	10.5	2.70
AD > 140/90 (mm/Hg)	438	0.17	0.8650	43.6	5.50	44.6	10.70
Ins act < 60 minutes/day walking	201	0.48	0.6323	37.6	21.15	37.5	20.60
Alcoholic beverages							
Beverages, Alcoholic 2003-05	424	0.38	0.7062	9.5	9.00	7.0	12.00
Wine 2003-05	411	0.36	0.7216	17.5	49.00	17.0	50.00
Beer 2003-05	373	1.14	0.2550	127.5	161.00	97.5	180.00
Dietary patterns							
The general level of consumption (g/person/day)	440	- 0.14	0.8883	1864.5	720.00	1958.0	824.00
Animal products (%)	396	- 0.79	0.4290	33.5	4.32	34.2	7.07
Grain-vegetables (%)	447	0.04	0.9705	42.4	12.56	41.8	16.74
Fruit drinks (%)	409	- 0.60	0.5493	12.1	4.20	12.6	5.60
Alcoholic beverages (%)	365	1.25	0.2116	10.2	7.76	8.7	7.14
Macronutrients Total Energy 100%							
Energy (kcal/person/day) 2003-05	446	- 0.06	0.9528	3080.0	580.00	3110.0	600.00
Proteins (g/person/day) 2003-05	435	- 0.21	0.8303	91.0	24.00	93.5	34.00
Fats (g/person/day) 2003-05	427	0.33	0.7394	106.0	59.00	90.5	53.00
Proteins/Fats 2003-05 %	413	- 0.55	0.5844	88.0	24.00	87.5	29.00
Percentage composition of Energy							
Carbohydrate %	433	- 0.25	0.8016	58.5	13.00	60.5	13.00
Proteins %	450	-	1.0000	12.0	1.00	12.0	2.00
Fats %	416	0.50	0.6152	30.0	11.00	27.5	12.00
Nutrients AP							
Energy %	406	0.64	0.5201	25.5	12.00	22.5	12.00
Protein %	427	0.33	0.7394	52.5	13.00	52.5	18.00
Fat %	379	1.05	0.2939	56.0	19.00	49.0	17.00

notes:
BMI - body mass index
Ch is cholesterol
Glu-glucose
Ins act - low physical activity
lat° - latitude

diseases [10, 11, 26]. The protective effect for chronic diseases is revealed in unsaturated fatty acids, which are widely used in the Mediterranean and DASH diets [10, 11, 26-28]. We found that income, latitude and UV have an independent effect on the characteristics of countries. Social indicators depend on income, including the Happiness Index, life expectancy, the incidence of breast and prostate cancer, Alzheimer's disease, cardiovascular diseases, and diet patterns. The rates of lung and stomach cancer, alcoholism, suicide, asthma, diabetes as well as levels of consumption of strong alcohol depend on latitude and UV. Happiness Index and diet patterns do not depend on latitude and UV. The dependence of life expectancy on income was established earlier by Chetty et al. and Anisimov et al. [29, 30]. Anisimov et al. [30] have previously shown that the rates of hormone-dependent tumors depend on income, and the rates of the gastrointestinal tract cancer are associated with latitude, which corresponds to our data.

The gender difference in the life expectancy of northerners and southerners that we discovered is also shown by Davis GE and Lowell WE [31]. The dependence of the incidence of lung, stomach cancer, diabetes, asthma, alcoholism, suicide rates on UV and latitude revealed by us indicates the role of insolation, vitamin D3, melatonin and circadian rhythms in the etiology of these diseases [10, 26, 30-32]. Based on our data, we can assume that the risk factor for cardiovascular diseases is the "carbohydrate" diet, which is typical for low-income countries with high incidence of cardiovascular diseases [33].

The risk factor for Alzheimer's disease, breast and prostate cancer is the "protein" diet, with a large proportion of animal products. This connection was previously shown by Grant WB and Radkevich et al. [9-11, 26].

It can be concluded that the differences in diet patterns, incidence, life expectancy and social characteristics in countries with a high and low Happiness Index are due to the modifying effect of income and geographical location [5-11, 26, 27]. It is important that the revenue is a modifiable factor. According to our data, the Happiness Index of 2016 does not have a threshold for the level of income established by the authors for the Happiness Index 2006-2009 [4, 6].

A study of the mechanisms of the environmental factors independent influence on the risks of chronic diseases can contribute to the development of etiotropic prevention and treatment of the global burden of morbidity [33].

Conclusion

Countries with a high and low Happiness Index have differences in social indicators, disease structure and incidence, and dietary patterns. It was established an independent effect of income, latitude and UV on incidence, metabolic syndrome and nutritional status of countries. The results obtained can broaden the concept of the etiology and pathogenesis of diseases associated with income, or with latitude and UV. The results can be useful for developing a strategy for the prevention and diagnosis of chronic diseases for a specific person. A rapid method for assessing the independent influence of environmental risk factors on country indicators is proposed.

Remarks and Limitations

The advantage of the study is the facts of the independent influence of income, latitude and UV on social indicators, the structure and rates of morbidity, metabolic syndrome and the dietary patterns of countries that were established on a large statistical basis.

The drawback of the study is that the revealed patterns and risk factors of diseases are still difficult to apply for a specific person.

Findings

1. Income, UV and latitude are modifying factors of the Happiness Index, Life expectancy, Dietary patterns and Incidence in world countries.

2. Morbidity, income-dependent and nutritional structure (breast and prostate cancer, Alzheimer's disease and cardiovascular), can be reduced due to the fact that income is a modifiable factor.

3. Increasing income can make everyone happy and healthy.

Recommendations

The results can be used to diagnose and prevent chronic diseases and prevent obesity.

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