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Neoliberal Diet and its Impact on Obesity

Gerardo Otero, Morteza Asadi

Abstract

This paper argues that the risk of exposure to the high-energy components of industrial diet is enhanced with the globalization of neoliberalism. The former is measured through what is called the neoliberal diet risk (NDR) index. Based on in-depth panel data analysis of data from ten countries, the paper concludes that apart from all the health implications of obesity, its strong association with socio-economic determinants suggests that any “solutions” to this issue can hardly be addressed with an individual-focused approach, which is the most prevalent in the literature. Rather, the larger socio-economic determinants must be addressed by a societal agency like the state.

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Introduction

During the historical process of socio-economic transformation, societies observe various degrees of diet risk and food insecurity. Countries with lower income may face inadequate supply of calorie and, therefore, hunger. In higher income societies, people may get more resources to secure food supply. But the problem of diet risk may not be considered as merely a supply side challenge. The entitlement issues (Sen 1980; Sen and Dreze 1984), introduction of neoliberal food regime (Otero 2016), increasing social imbalances and inequalities (Borch and Kjærnes 2013), neoliberal approach to food security (Richards, Kjærnes and Vik 2014), nutritional capabilities (Burchi and De Muro 2015), etc. should be taken into consideration.

Food security can be considered as a challenging issue in not only poor countries, but in the post 1980s it has been a serious concern also in many emerging and higher income countries. The introduction of high-energy components of industrial diet enhanced with the globalization of neoliberalism, could be added to the prevailing risk of diet mostly in industrializing societies.

The purpose of this paper is to explore the effects of new global policies from the 1980s on diet risk. We argue that the risk of exposure to the high-energy components of industrial diet is enhanced with the globalization of neoliberalism. The former is measured through what we call the neoliberal-diet risk index (NDR). It can measure the extent to which each country has seen its NDR vary across time, and how each country compares with other countries.

For this purpose, we use the socio-economic factors of diet risk elements such as food import dependency, globalization, urbanization, female involvement, income distribution and changes in sectoral economic contribution. These factors considered as a global policy package during the last three decades could bring

about drastic changes in the level of food security as well as structural changes in the way of life of societies affected by neoliberalism.

We examine the relationship between neoliberal policy package and diet risk by using data from the Food and Agricultural Organization (FAO), World Health Organization (WHO) and the World Bank for ten countries. These countries are two developed North American countries, six Latin American countries (Brazil, Mexico, Ecuador, Guatemala, Venezuela and Bolivia) and two Middle Eastern countries (Turkey and Iran). The countries concerned are not unique in the level of development and globalization but have more or less been affected by global neoliberal policies in some period of time, despite radical policies adopted to maintain the sovereignty of states. Radical orientations in Venezuela, Bolivia and Iran, and more recently in Turkey, may be considered as a challenging factor for the neoliberal regimes in these countries. On the one hand, the newly elected governments tried to follow more inward looking and more distributive economy policies, and on the other hand, the established institutions and consumer behavior of food regimes as long-standing attitudes may not keep pace with shorter-term electoral orientations.

Review of Literature

There is a rich literature on diet risks and food security since the Malthusian era. Robert Malthus forecasted food and hunger crisis due to imbalance of food supply and overgrowth of population. After a few centuries, even though these two factors still threaten food security, more diversified factors have been observed by social scientists later on. Neo-Malthusian theories have debated and disputed Malthusian theory. They argue that food non-availability is not a result of insufficient food production, but rather a result of inadequate distribution. Another prevalent criticism is that people will develop alternatives to depleted resources and will continue to adapt to their changing availability through the creation of new technologies and processes. The validity of neo-Malthusian theories continues to be *debatable* and it is unclear as to whether overpopulation is a cause of poverty or not. Although no definitive conclusion has yet been drawn regarding how well neo-Malthusian arguments describe the effects of overpopulation, it is an important perspective to understand and consider when investigating the correlation between population and poverty.

The Nobel laureate Amartya Sen (1998), in his book *Hunger and public Action*, analyzed the role of public action in solving the problem of hunger in the modern world. The study made extensive use of the

concepts of entitlements and capabilities, and explores the interaction of nutritional, economic, social and political elements and their influence on hunger and deprivation. Sen and Drèze (1984) contributed to a wide range of policy issues relating to the role of public action in combating hunger and deprivation in the modern world. It deals with the nutritional, economic, social, and political aspects of the problem of world hunger. Topics covered include the characteristics and causal antecedents of famines and endemic deprivation, the interconnections between economic and political factors, the role of social relations and the family, the special problems of women's deprivation, the connection between food consumption and other indicators of living standards, etc.

Burchi and De Muro (2015) provided a comprehensive review of different approaches to analysing food security. It also highlights the added value provided by the capability approach and the human development paradigm. Finally, it proposes a methodology to assess food security through this approach. Comparing social entitlements to food in Australia and Norway, Richards, Kjærnes, and Jostein Vik () argued that decades of policies for intensive agriculture have not alleviated hunger and malnutrition, in both developing and developed nations. To explore the dynamics of food security in developed countries, this paper considered institutional approaches to domestic food security primarily through responses to poverty and welfare entitlements, and, secondarily, through food relief. Australia and Norway, respond to uncertain or insufficient access to food in different ways. Whilst Norway's political agenda on agricultural support, food pricing regulation and universal social security support offers a robust safety net in ensuring entitlements to food, Australia's neoliberal approaches to food security rely on a combination of self-help, charitable and market responses. Despite its extensive food production, Australia appears less capable of ensuring food security for all its inhabitants compared to the highly import-dependent Norway. Borch and Kjærnes (2013) argued that increasing social inequalities and poverty, as well as shifting policy regimes threaten food security in Europe. The social groups at risk of food insecurity as well as legal, economic, practical, social, and psychological constraints hindering access to appropriate and sufficient food.

The Model

Basically, three methods of data analysis are used in this study. Firstly, case studies of individual countries are done using data with five years intervals (1983-2013) and the results are compared. Secondly, a time

series analysis of annual observations is carried out for the same period of time. Thirdly, panel data analysis of all countries is carried out to find a meaningful pattern and determination of NDR.

First of all, for calculating NDR for individual countries, a historical review of the development of their food regime since the 1960s is carried out to show the long- term pattern of supply of main food items before the introduction of the global food regime and the post-neoliberal era by using descriptive time series data. The food items are divided into two groups, new emerging supplies and diminishing traditional supplies, using FAO quantitative data. In the second part, the ten main food items are demonstrated in every selected year, i.e. base year 1983 followed by five year intervals till 2013. In the third part, import dependence of the ten major food supplies are calculated for each country. The Food Import Dependency Ratio (FIDR) is calculated as the ratio of quantity of import of every item (QM) to domestic supply (QDS) of every food item (j).

i.e.

QM_j

$$\text{FIDR} = \frac{\text{QM}_j}{\text{QDS}_j} * 100$$

QDS_j

For calculating import dependence of every individual country, we used geometric mean of import dependencies of ten major food supplies in every selected year and for every country.

In the fourth part, in order to estimate NDR for each selected country and year, we use FIDR and other socio economic variables which are assumed to be influential in diet risk such as urbanization rate, globalization rate, Gini coefficient and female labor participation rate. The NDR is calculated as geometric mean of all above mentioned variables for every country and every selected year. In the next step, the correlation of NDR with obesity as a bio-physical outcome of the neo-liberal food regime is estimated by using Scatter diagram and Pearson correlation method.

In the second method of estimating the relationship of socio-economic factors with obesity, time series analysis is used. In this section, we added two more socio-economic variables, namely, the share of service sector (SSS) and the share of income quantile in national income. The expansion of service sector represents the existence of white collar labor force with relatively less physical movements and higher exposure to obesity risk. Secondly, the role of the middle class in diet risk determination is also examined.

In the third method, data for all countries are used in the Panel analysis. Two statistical methods of correlation and regression analysis are used to find out the fundamental relationship of socio-economic factors with obesity. Regression analysis based on the Ordinary Least Square (OLS) method is used to show the causal effects of socio-economic variables on obesity as follows:

$OBE_t = f(NDR_t) + U$, where OBE_t stands for obesity in t period for j country, NDR_t stands for neoliberal diet risk with t lag period as determinant of bio-physical risk, and U is the residual.

Historical Review of the Diet Regime in Selected Countries

The United States

During 1961-2013, the food supply pattern of the United States changed in four major categories, especially after the 1980s. First, sweeteners and sugars contributed as the most important food supply and even (in aggregate terms) exceeded other traditional food items like wheat. Industrial sweeteners also substituted for land-based sugars.

Secondly, we find substitution of industrial oils for natural fat and ghee. The United States is ranked second in global per capita calorie consumption, i.e. an estimated average of 3750 kcal per capita/day as compared to 2250 kcal per capita/day as healthy consumption (FAO 2006). Out of the average total calorie received from food by a person, the share of sugar and sweeteners, industrial oils and wheat products is estimated at about 58 percent in 2013 as compared to 48 percent of the total 2600 kcal per capita/day in 1961.

Thirdly, we find more reliance on the production of white flours, including wheat. Finally, genetically-modified high yield varieties of animal (poultry) and farm products of agro-industrial corporations substituted

for organic and other traditional products. This new model of food production is also followed by many emerging economies to boost food availability for lower income groups in particular, and maintain food security in general.

As far as socio-economic criteria are concerned, comparatively the United States has experienced mild food dependency with an increasing trend, high female labor participation but at a diminishing rate, high rate of globalization with decline trend after 2000, and high level of urbanization at a slowing rate. Gini coefficient in the United States is as high as in developing societies (about 0.4). It increased during the period of 1983-2013 from 0.35 in the base year at a diminishing rate. Obesity in the USA is the highest among the selected countries and is growing at an increasing rate.

2) Canada

Similar development in the food regime can be observed in Canada, except for sweeteners and sugars. Another difference is the declining share of animal products like milk and meats in daily calorie per capita.

The Canadian case as a developed North American country are similar to the USA in socio-economic criteria. But specific differences are observed in higher food dependency and lower inequality due to the welfare state. Female labor participation is occurring at a decreasing rate as observed in the USA too. Obesity figure is as high as in the United States. The diet risk in Canada is the highest among the observed countries (as calculated NDR is shown below).

Latin American Countries

The case of Latin Americans as developing societies is somehow different from the North Americans in the case of structural changes in socio-economic criteria. These countries are categorized as middle income countries and are traditionally suppliers of raw materials to North America. These countries observe the highest income inequality above world average.

1) Mexico

In Mexico we can find a similar pattern of the neoliberal diet regime, including rising share of sweeteners, industrial oils (palm and soya bean oil) and the meatification of daily diet. Maize still remained the dominant food item, but its share in total calorie intake diminished from 1133 kcal per capita/day in 1988 to 987 in 2013.

Mexico is observed to have rapid increase in food dependency, globalization rate, urbanization and an increasing trend in female labor participation rate and obesity. The Gini coefficient, like many Latin American countries, is above world average. Mexico can be categorized as the second highest diet risk country among all the selected cases and as the highest in Latin America.

2) Brazil

In Brazil, sugar remained the dominant source of calorie, although tremendous decline was reported in recent years. The most important emerging food item is soya bean oil. While dominance of the neoliberal diet regime was the characteristic of Brazil's food supply common to the Latin Americans, Brazil's specific food character is diversification of the sources of calorie as compared to other Latin Americans. In recent years, greater diversification of food consumption is observed.

Brazil, as a large emerging country, could maintain greater food sovereignty with just a one per cent dependency ratio. In general, we can categorize Brazil as a relatively more secure food regime. The decreasing rate of inequality and slowing rate of urbanization in recent years were key factors in decreasing diet risk after 1997.

3) Venezuela

Sugar is still the dominant source of calorie in Venezuela, while soya bean oil and palm oil are the fastest growing food items in recent decades. Besides sugar, maize and wheat are the major sources of calorie, which accounted for about half of calorie sources in this country. The concentration in the sources of energy increased in the last two decades, which can bring about more food insecurity.

Venezuela as an oil-based economy and relies more on food import as compared to the non-oil states in Latin America. Rapid urbanization and high inequality (although at decreasing pace) are the two main challenges of diet risk in this country.

4) Bolivia

Bolivia observed a more stable food regime as compared to other emerging Latin American countries. In terms of neoliberal diets, Bolivia is a more isolated society, exposed less to the high-energy components of the industrial diet.

Bolivia is considered a lower middle income economy and has maintained a more inward looking food regime among the Latin American countries. The major diet challenges of Bolivia are rapid urbanization and high income inequality. The recent development, with the distributive approach of the newly elected state, could compensate diet risk. The share of obese in total population has increased at an increasing rate (from 10 percent in the base year to 20 percent) and was slightly higher than world average during the period under study.

5) Ecuador

In Ecuador, tremendous changes were observed in the share of rice and wheat in the total sources of energy after the 1980s. Industrial diets such as palm and soya bean oil substituted traditional fat, but sugar tended to decline in the sources of energy after the 1980s. The country observed mild meatification of the food regime. In general, we can find introduction of neoliberal diet, but at a lower rate as compared to other major Latin Americans.

Ecuador as an OPEC member and lower middle income country, like most of Latin America, has a high rate of urbanization, income inequality and globalization rate. In the last 15 years, more distributive and inward looking approaches were observed in this country. The main challenge for the diet regime is the increasing trend of urbanization. The increase in obesity in the country is also more than the world average.

6) Guatemala

In Guatemala, greater concentration of the sources of energy is reported. Maize is still leading as a traditional source of energy, although its share declined as it was substituted by other industrial foods like sugar. We can find higher concentration of sources of energy in Guatemala as compared to the average for Latin America. In 2013, half the sources of calorie intake were received from maize and sugar.

Guatemala's food import dependency remained low during 1983-2013. The main challenges to diet risk are rapid urbanization, income inequality and the high rate of economic globalization. The total diet risk among others was slightly decreased due to the fall in inequality and decrease in female labor participation. Obesity is increasing at a higher rate than world trend.

The Middle Eastern countries are considered to have highly concentrated food sources of calorie and at the same time to be a lower risk group, although food supply became more risky due to, among other factors, drought and short term security policy.

Turkey

In Turkey, greater concentration of food energy sources is observed as compared to Latin Americans. The share of wheat out of total 3500 kcal per capita/day in 2013 was 37 percent compared to more than 50 percent in the 1990s. Sugar is the second important source of food energy and its share was growing faster than other food items in the early 1960s till the late 1980s. Since the 1980s, new industrial cooking oil including soya beans and palm oil substituted traditional ghee. Turkey has also followed the neoliberal food regime since the 1980s.

Diet risk increased tremendously in Turkey after 1998 due to rapid increase in food import dependence and urbanization. The rapid change in the food regime increased the share of obese in the population at a higher rate than the world average.

Iran

Iran, like Turkey, concentrated on wheat as the main source of food energy (in 2013 it was estimated to contribute to 41 percent of the total 3000 kcal pc/day), followed by sugar and soya bean oil (respectively 9 percent and 5.5 percent share of food energy). In Iran, the neoliberal diet regime was introduced at a lower rate in the post-revolutionary isolation era as compared to Latin Americans. The specific characteristic of Iranian diet is the high share of vegetables and nuts as food energy sources and steady dependence on sugar since the early 1960s. Moreover, the genetically modified high yield variety rice and white flour wheat remained unpopular in general.

Iran is considered to have had a low risk food regime during 1983-2003. But afterwards, diet risk increased due to rapid urbanization and more outward looking approaches. In general, Iran is still considered as a low diet risk state due to the distributive approach and low level of female labor participation. As an oil based economy, the main challenge of diet risk is the environmental disaster, particularly shortage of water resources and rapid urbanization.

Food Import Dependency in Selected Countries

Food security of the countries can be considered to be grounded in two major approaches of their governments; outward looking and inward looking strategies. The reliance on any orientation depends on various conflicting factors including the political set up, environmental bottlenecks and techno-economic feasibility of food production. The two approaches may be summarized into the two extremes of traditional self-sufficiency approach and the neo-liberal outward looking approach.

We can observe the two approaches of maintaining food security in Table 1. The majority of sample countries (except Brazil and Bolivia) observed increasing food import dependency during 1983-2013. Mexico and Canada are considered as the most food dependent followed by Guatemala, Venezuela and Turkey. The more inward looking food policies in Iran, Bolivia and Brazil could not be considered as having the same origin. Ideological factor in revolutionary Iran could be an influential factor in pursuing the inward looking strategy of food self-sufficiency as compared to environmental supply feasibility in Brazil.

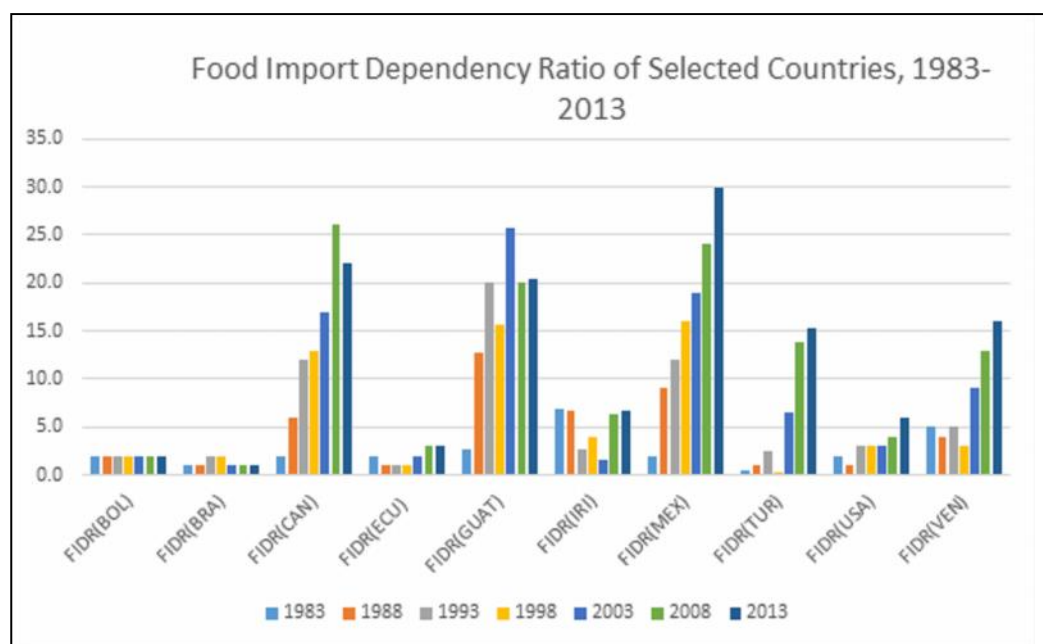
The case of Bolivia as the least developed case can be different in terms of the dominating agrarian base of its economy and the general poverty issues.

Table 1. Food Import Dependence Ratio (FIDR) of Selected Countries, 1983-2013

COUNTRY	1983	1988	1993	1998	2003	2008	2013
FIDR(BOL)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
FIDR(BRA)	1.0	1.0	2.0	2.0	1.0	1.0	1.0
FIDR(CAN)	2.0	6.0	12.0	13.0	17.0	26.0	22.0
FIDR(ECU)	2.0	1.0	1.0	1.0	2.0	3.0	3.0
FIDR(GUAT)	2.6	12.8	20.0	15.6	25.8	20.0	20.5
FIDR(IRI)	6.8	6.7	2.7	4.0	1.6	6.4	6.7
FIDR(MEX)	2	9	12	16	19	24	30
FIDR(TUR)	0.4	1	2.4	0.3	6.5	13.9	15.3
FIDR(USA)	2.00	1.00	3.00	3.00	3.00	4.00	6.00
FIDR(VEN)	5.00	4.00	5.00	3.00	9.00	13.00	16.00

Source: Calculated by the authors

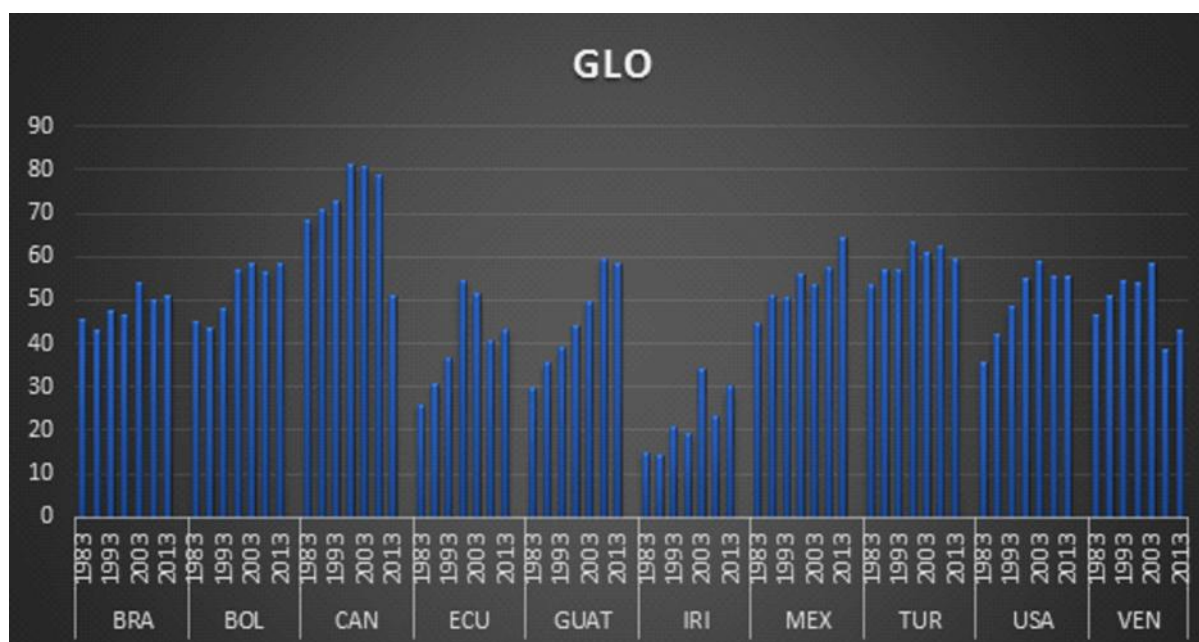
Food Import Dependency Ratio of Selected Countries, 1983-2013



Source: Calculated by the authors

Economic globalization is assumed to be an important determination of neoliberal diet risk. In fact economic globalization as a sub series of general globalization covers socio-economic and political participation in the new world order. Economic globalization expanded in major emerging economies in the post 1983 years. It led to more integration of developing economies to world markets. The impact of economic globalization on the food sector was the introduction of the new diet regime based on industrial high calorie supplies as an alternative to traditional agro-based foods.

Comparative data on the trends in the sample countries shows that in most of the observed countries, the rate of economic globalization increased substantially before 2000. After that in the 21st century, majority of our selected countries relied more on domestic supply to avoid vulnerability and fluctuations in the international markets. During the period of 1983-2000, more outward looking strategies were adopted. But after that, as we can see in the following figure, the slope of globalization declined in both developed and developing countries. Inward looking strategies affected the food policy of the countries and contributed to food risk.



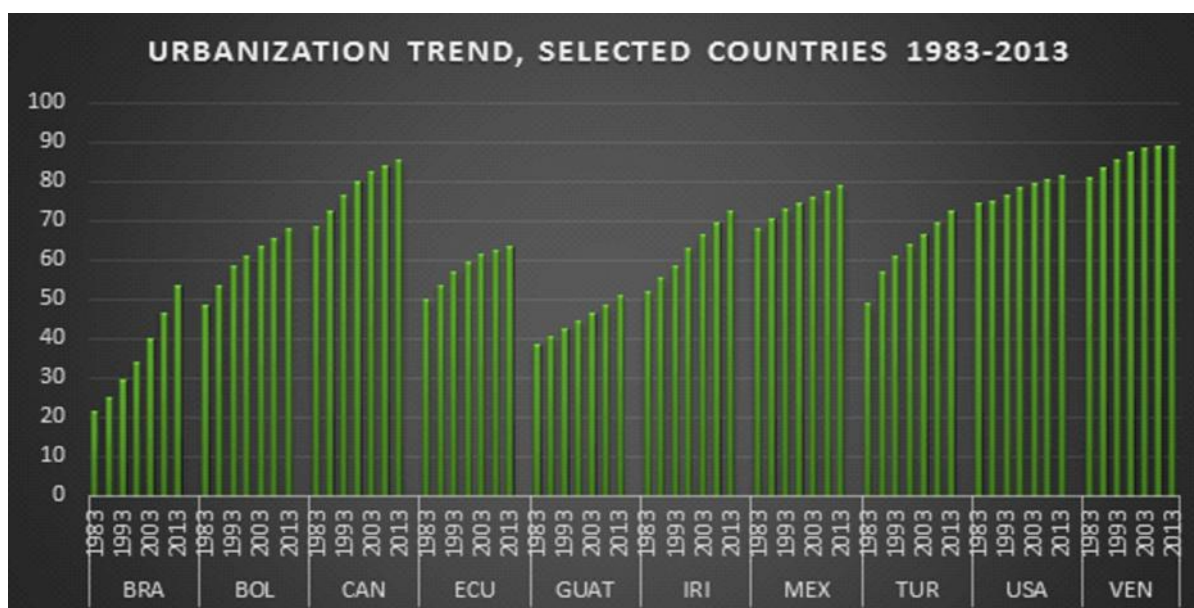
Source: Estimated by co-author Gerardo Otero

Urbanization rate increased at a rapid rate in the sample countries during 1983-2013 as a part of global trends in rural-urban migration. Urbanization, as classified by Ragnar Nurkse (1961), can be of two kinds. It can be due to the push effects or pull effects of migration. The former effects are considered to be due

to the bankruptcy of the agricultural sector, while the pull effects are due to the absorption capacity of the urban sector to create employment opportunities for surplus rural population. Moreover, according to the migration model of Michael Teodoro (1983), the gap between urban wages as compared to rural subsistence wages can be an economic factor for migration. Nurkse's push effects and the comparatively lower earnings of farmers may be an explanation of food insecurity in many developing countries. The rise of more competitive imported industrial-based foods may be considered a challenging factor for local food producers and to have ultimately forced rural-urban migration.

Therefore, urbanization in general can be considered as a diet risk factor by assuming "push effects" as the dominant driver of migration, and secondly, due to the change in the food regime of migrated labor from organic consumption into high calorie food.

In the following diagram, we can observe an increasing level of urbanization in developed and developing countries. But the highest rate and increasing slope is seen in emerging countries (Brazil and Turkey) and Guatemala. The declining slope of urbanization in the rest of the countries among other things, is assumed to be due to declining rural-urban wage gap and the decline in the deterioration of terms of trade against agriculture sectors. Most developed economies (the USA and Canada) tend to have less urbanization rate as compared to emerging and developing economies.



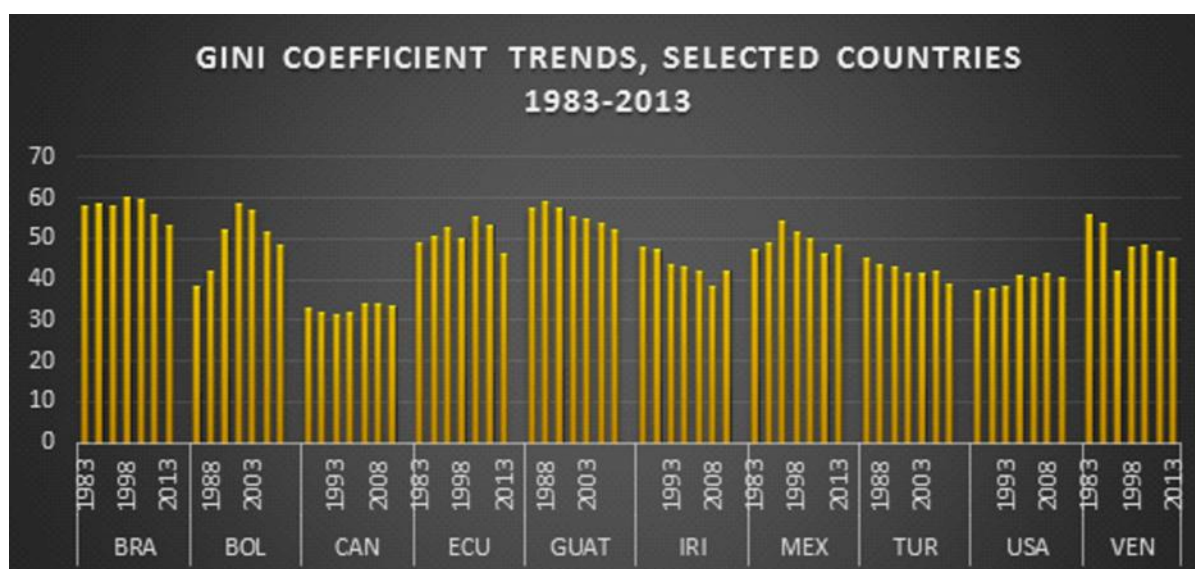
Source: World Bank, World Development Indicators, 2017

Income inequality is assumed to affect diet risk under the following assumptions:

1. The food items are divided into low cost inferior high dense calorie foods and luxury organic foods.
2. Inferior high calorie dense foods at lower cost consumed by poor as compared to luxury expensive organic items.
3. Poor get less leisure time as compared to the rich in order to spend more time for preparing healthy foods.
4. The consumers are assumed to be rational in allocating their income for foods.
5. Decline in Gini Index is an integrated part of sustained economic development, and not a consequence of populist distributive policy.
6. The Gini data is assumed to be reliable and represent real income distribution, not consumption expenditure distribution.

In real terms, many of the above assumptions may not be fulfilled. People may not necessarily behave rationally (Richard Thaler 2017) in selecting appropriate foods to maximize their utilities. The data published by governments for Gini are biased in many undemocratic developing countries. The middle class' unstable consumption behavior can be a matter of concern in general, and for food consumption in particular.

In the following table, we find that among the selected countries, developing societies tend to have a decreasing trend of income inequality, while in the USA and Canada, Gini indices are rising. The decline in Gini index in Socialist-oriented countries or in those with a populist approach (Venezuela, Bolivia, Iran and Brazil) was stronger than other countries. However, there is no evidence to know the approach of estimating Gini and its effect on changing food regime.

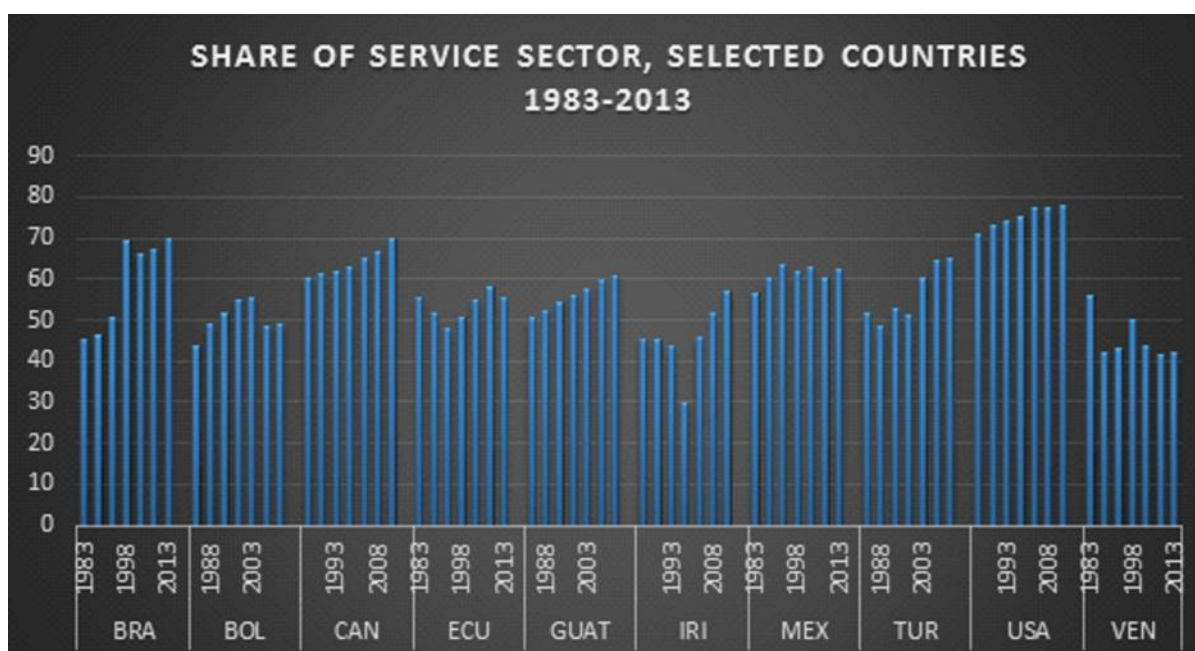


Source: World Bank, World Development Indicators, 2017

Service sector share in GDP may influence diet risk and obesity under the following assumptions:

1. Increase in service sector as a consequence of the shifting of labor from the rural sector to the urban service sector.
2. Service sector is dominated by white collar labor forces as compared to blue collar agrarian labor.
3. The opportunity cost of labor in the service sector is assumed to be higher than that for agricultural labor.

In the following figure, we observe a rise in service sector shares in all the selected countries except in Venezuela and Bolivia after the election of socialist-oriented governments (a challenge to the neoliberal approach to development).



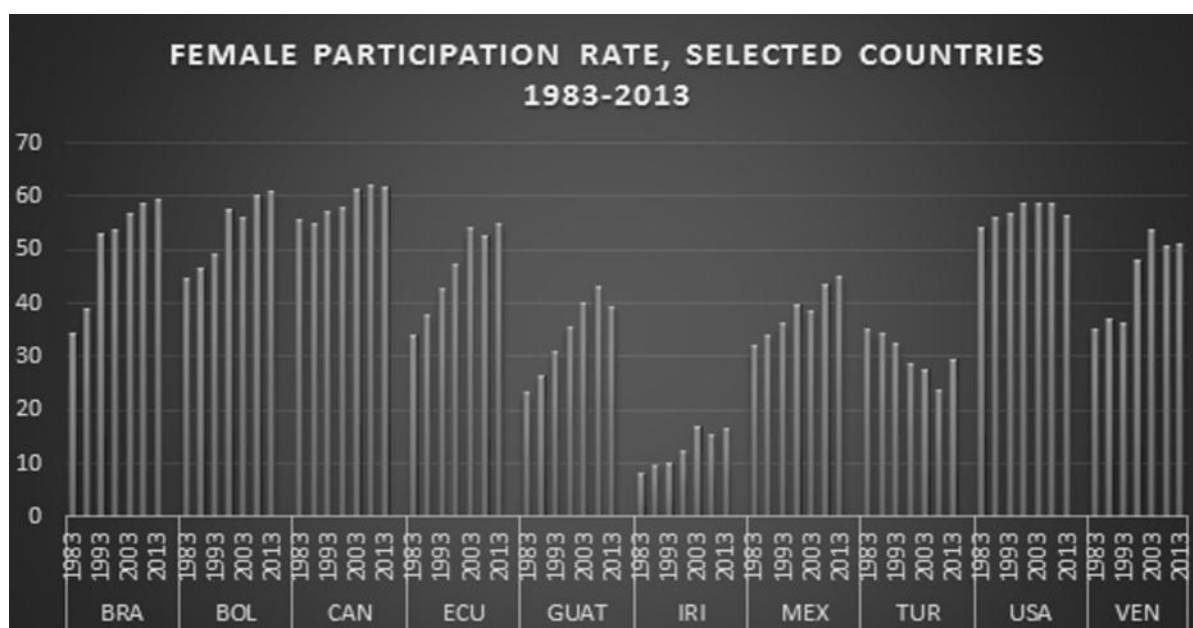
Source: World Bank, World Development Indicators, 2017

Female participation rate may be a contradicting issue in diet risk analysis due to its double-edged role in the process of economic development on the one hand, and on the food regime on the other. In the process of industrialization, women take part in social life. Women's participation may lead to higher diet risk under the following assumptions.

Firstly, the employed female labor force changes their food regime from healthy, traditional home-made food into industrial-based food.

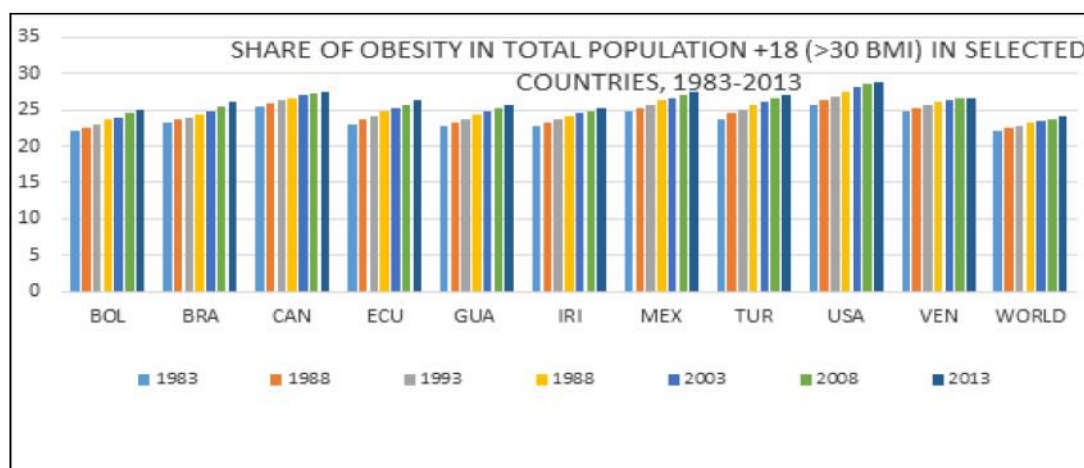
Secondly, their leisure time decreases as compared to the pre-employment phase.

Female participation rate increased over time during 1983-2013. But in the developed societies of North America, we can find a declining tendency in the last two decades.



Source: World Bank, World Development Indicators, 2017

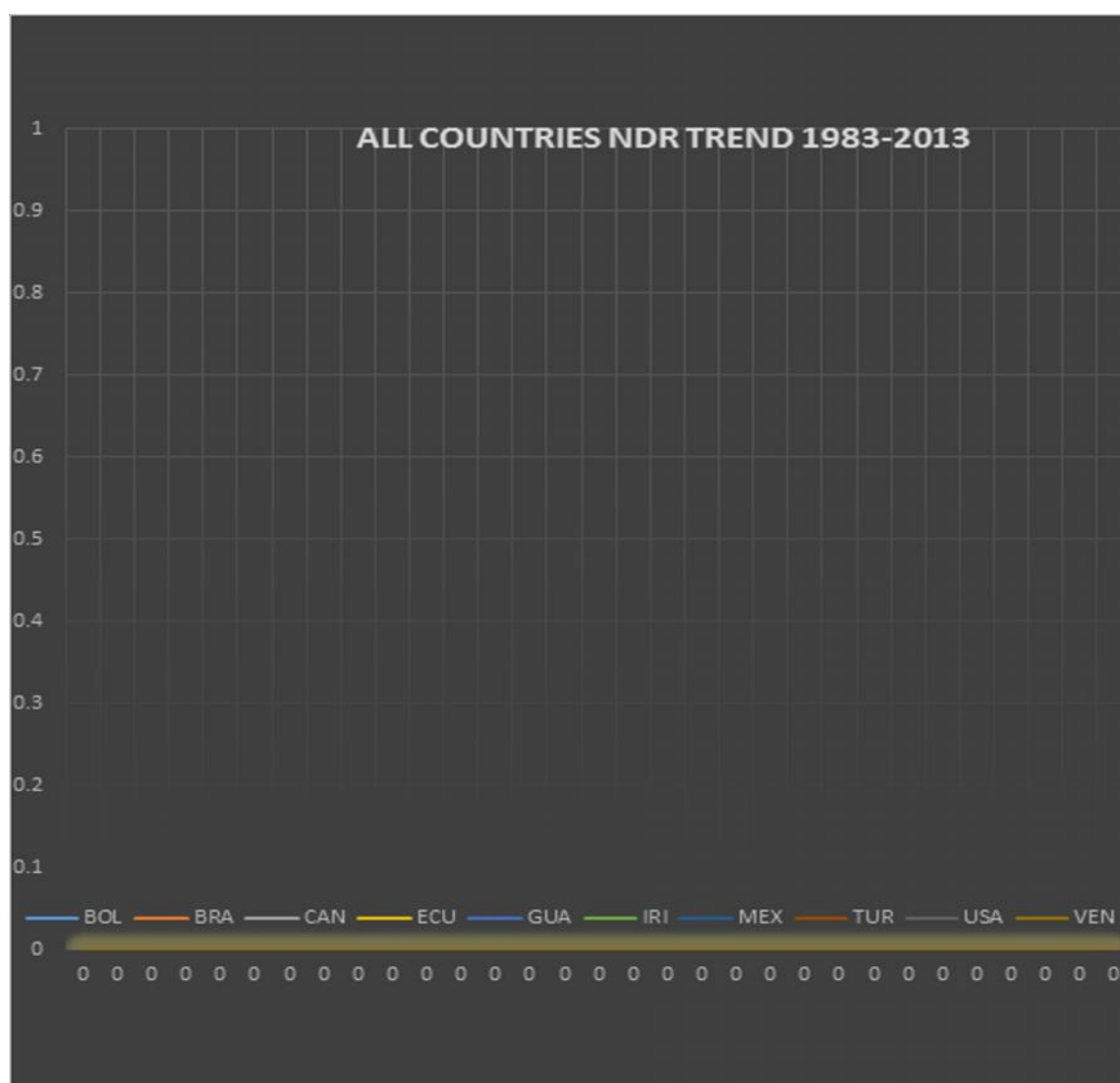
The main objective of this research is to find out whether there is any meaningful relationship of neoliberal diet risk with obesity. People are getting fatter all over the world as is shown in the following table. The introduction of high calorie dense foods, rise of income in developing countries, increase in leisure time, and increase in the share of white collar labor force can all be considered to be key socio-economic factors in increasing obesity. The rate of increase in share of obese population varies across the different countries. This study focuses on the socio-economic determinants of diet risk and obesity, while other factors such as genetic nature and bio-medical factors are assumed as given.



Source: World Health Organization Database, 2017

A Comparative Analysis of NDR in the Selected Countries

The neo-liberal diet risk (NDR) is calculated as the geometric mean of socio-economic factors including food import dependence ratio, economic globalization, urbanization ratio, income inequality and female participation ratio. The following diagram shows that Canada and Mexico are the most risky countries over time after 1983, while Brazil and Iran are the least risky countries. In the case of Mexico and Iran, we find less variance in the NDR as compared to Brazil and Canada. The sharpest jump in NDR is observed in the case of Bolivia after 2009, and the sharpest decline is in the case of Canada after 2008.



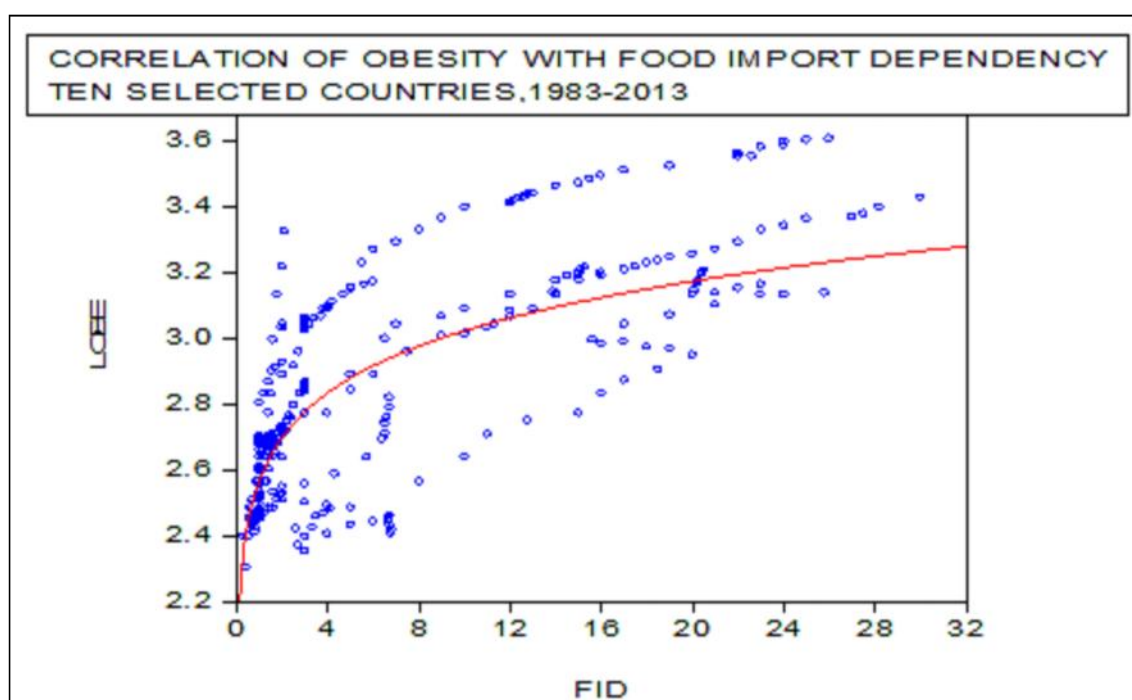
Source: Estimated by the authors

In the diagram, we can see the socio-economic components of NDR during 1983-2013 for all countries in a compressed form. These include the urbanization ratio (URB), food import dependency (FID), globalization ratio (GLO), GINI index (GIN) and the female participation ratio (FPR). The total sum of all risk components can be seen in this diagram. It shows the comparative share and weight of every risk factor in ten countries. For policy makers, it may help to focus on more risky elements and their priority in tackling the food insecurity issue. For Canada as a developed country, urbanization, food import dependency and globalization are main challenges as compared to Brazil (as an emerging economy), for which the major risk is income inequality. In the case of Bolivia as the least developed country in the selected sample, import dependency is not considered as a challenge to diet risk but it faces more threat from globalization than other factors.

Correlation Analysis

In order to find the relationship between obesity and socio-economic factors, we use correlation analysis by applying E-views software. For this purpose, we use panel data analysis by using 310 observations (i.e. 31 years' observations of 10 countries). The scatter diagrams display all coinciding points of different levels of specific socio-economic factors with obesity. We use logarithmic figure to show the relationship of the variables in smaller values. In the table, the correlation of obesity with urbanization ratio is estimated 0.65 for all countries and for the whole period (1983-2013). The correlation score is significant at 95 percent accuracy. Table:2 Correlation Matrix of Obesity with Socio-economic Variables

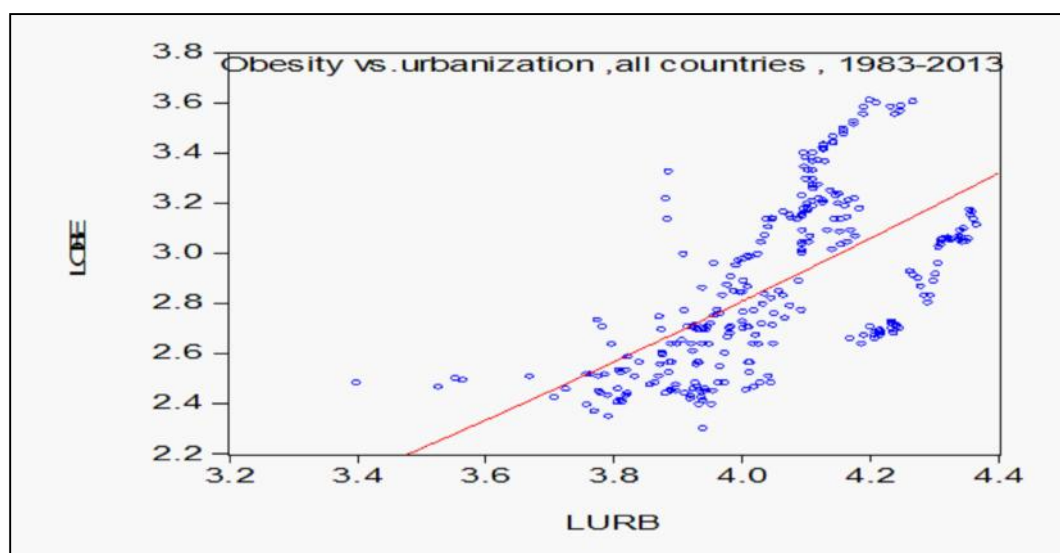
<i>LNDR</i>	<i>LURB</i>	<i>LGIN</i>	<i>LFPR</i>	<i>LFID</i>
<i>0.65021</i>	<i>0.618530</i>	<i>0.435467</i>	<i>0.745736</i>	<i>0.745694</i>



There is high positive correlation (0.75) between obesity and food import dependency (FID). The slope of regression line is diminishing, showing that at higher FID, obesity also increases but at a lower rate.

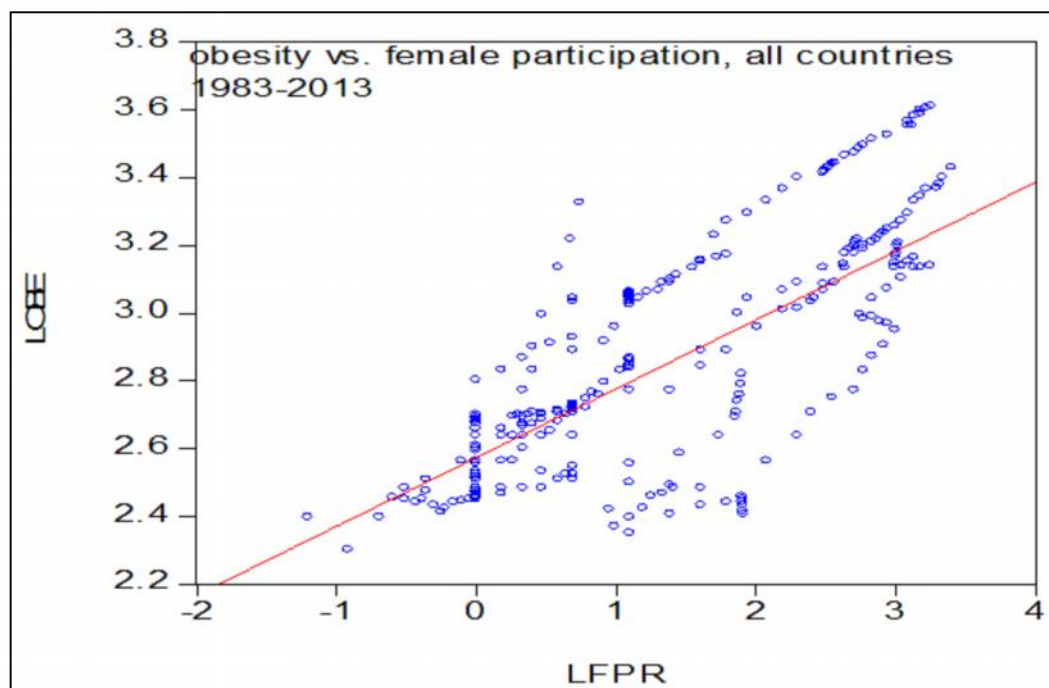
Obesity and Urbanization

Diagram:21



Source: Estimated by the authors

In the diagram 21, the correlation of obesity with urbanization ratio is estimated 0.62 for all countries in the whole period (1983-2013). The statistical significant at 95 percent accuracy is observed for the all variables. It shows a strong correlation between urbanization trend and increase in the obesity in selected countries during 1983-2013. The diminishing slope shows that with an increase in urbanization rate, obesity increases at increasing rate.



Source: Estimated by the authors

The correlation of obesity with female participation rate

It shows a high positive correlation value of 0.74. The increasing slope of the regression line shows that with an increase in the female participation rate at the higher levels, obesity increases but at lower rate. In other words, in the more developed countries urbanization has less effect on obesity as compared with developing countries.

The correlation of obesity with income inequality

There is positive but mild correlation between obesity and income equality. The diminishing slope of the regression line shows that at higher Gini, obesity increases faster. In other words, in Latin American countries with the highest inequality, we expect more obesity rate.

If we substitute Gini with middle income class' share in national income, we get higher correlation. It means obesity is more related to the consumption behavior of the middle class as compared to lower income quintiles. The middle class as white collar labor force usually in the service sector can be an explanation for the higher obesity rate among them. In this case, the correlation between obesity and the share of middle class in national income increased to 0.56. **An examination of correlation analysis of obesity with socio-economic factors in individual countries**

The country study of relationship between obesity and socio economic indicators is displayed in Table 2. The earlier findings of the panel study is examined to test the accuracy of correlation results. As far as the relation of obesity with NDR is concerned, in all cases there is strong correlation except Bolivia (with 0.44 correlation value). The hypothesis of strong correlation of obesity with urbanization ratio also shows the same result (again Bolivia is an exceptional case). In the cases of other factors such as female participation rate, the earlier finding is confirmed, except in Turkey. In the case of globalization, again Bolivia and Venezuela are showing negative correlation. In all countries, there is positive correlation of obesity with the share of service sector. Venezuela and Ecuador are exceptional cases. In the case of food import dependency correlation with obesity, all countries had high correlation except Bolivia, Iran and Brazil. Regarding correlation of obesity with income inequality, we find that Mexico, Canada and Bolivia had strong correlation, but the rest of the selected observations were weak or negative. The later finding support our assumption that the role of Gini in obesity cannot be summarized at the aggregated level. In many sample countries, obesity in the middle class is higher than low income groups (as we observed in the previous section).

ALL COUNTRIES

<i>Correlation of Log Obesity with Log Socio-Economic Factors ,1983-2013</i>							
	<i>LFID</i>	<i>LFPR</i>	<i>LGIN</i>	<i>LGLO</i>	<i>LSSS</i>	<i>LURB</i>	<i>LNDR</i>
<i>LOBEBRA</i>	-0.19	0.91	-0.52	0.75	0.87	1.00	0.73
<i>LOBEBOL</i>	-0.01	0.87	0.68	-0.21	0.58	0.42	0.44
<i>LOBECAN</i>	0.95	0.93	0.70	0.30	0.93	0.99	0.95
<i>LOBE ECU</i>	0.68	0.95	0.24	0.74	0.14	0.98	0.94
<i>LOBE GUAT</i>	0.71	0.95	-0.94	0.99	1.00	1.00	0.93
<i>LOBE IRI</i>	-0.09	0.93	-0.88	0.84	0.48	1.00	0.89
<i>LOBE MEX</i>	0.98	0.92	0.98	0.87	0.40	1.00	0.87
<i>LOBE TUR</i>	0.86	-0.83	-0.91	0.75	0.88	0.99	0.87
<i>LOBE USA</i>	0.89	0.74	-0.07	0.87	0.98	0.99	0.90
<i>LOBE VEN</i>	0.83	0.91	-0.48	-0.24	0.00	0.95	0.87

Source: Estimated by the authors

REGRESSION ANALYSIS

For confirmation of above findings and inquiring about the causal effects of obesity, we can use regression analysis (by using panel data analysis, least square method). We tested three functional relations, namely the impact of NDR on obesity in ordinary values, impact of NDR on obesity in logarithmic values and impact of NDR on obesity in logarithmic values for developing countries (excluding USA and Canada). The results of regression functions analysis are as below:

In the first test, NDR is a causal factor for obesity in ten selected countries during 1983-2013. The result was a positive and significant impact of NDR on obesity. It shows that one percent increase in NDR can add 0.41 percent in obesity for whole countries. The statistical test shows accuracy of result in more than 95 percent.

In the second regression test, the logarithmic values substituted. In this case, again we find a positive and significant impact of NDR on obesity. The impact increased to 0.57. In the third test, by excluding North Americans, the NDR impact on obesity increased to positive 0.75. We conclude that impact of diet risk on obesity is stronger in developing countries than developed societies. It can be explained by the differences in the food regime, higher health care and public expenditure in developed countries.

Dependent Variable: Obesity

Variables	Coefficient	t value
C	12.94701	5.190363
NDR	0.411049	3.306723
AR(1)	0.232867	4.121462
D.W.	F STAT	PROB F
2.148	17.8	0.0

Conclusion

To sum up, in our observation on the impact of Neoliberal Diet Risk (NDR) on obesity, historical observation of change in diet regimes during 1961-2013 in ten selected countries including two from North America, six from Latin America and two from the Middle East shows that all these countries followed a tremendous change in their diet behaviors in spite of their level of development. The countries with a higher globalization rate tend to be a target of greater change in food consumption behavior.

For calculating NDR as a diet risk indicator, we chose the ten largest food items for every country in every year. In the first step, we calculated the import dependency of the major food items. In the second step, the NDR is calculated as geometric mean of all socio-economic indicators including food import dependency, globalization, urbanization, income inequality and female participation. The neoliberal diet as a new model of food regime influenced the supply pattern of the sample countries, including a shift from agro-based foods into industrial diets with dense calorie and less nutrition values. Sweeteners, manufactured oils, white flours and the use of preservatives increased the risk of diets and consequently more obesity among the middle and lower income groups. In order to test the effects of NDR on obesity, we used four methods of qualitative and quantitative analysis in order to cross check the validity of the results: individual country graphical observations; country-wise testing of correlation between NDR and obesity; panel data analysis; and finally a regression analysis. To sum up, the results confirm that in all the tests the hypothesis of the impact of NDR on obesity is valid. For Canada, Ecuador, Guatemala and USA with a higher globalization rate, the impact was higher. The only weak correlation was observed for Bolivia as the least developed in the selected countries.

In the panel data analysis, with 310 observations, all the socio-economic indicators show a positive correlation with obesity. NDR, in general, risk index and food import dependency, female participation ratio, and urbanization show stronger correlation as compared to Gini, the share of service sector and middle class share of income.

The following results obtained using the regression analysis of the causal effect of NDR on the obesity rate of population show that NDR significantly contributed to obesity in all countries, but its effects are stronger in developing countries. Differences in health care quality and the food regime are supposed to be influential factors for the differences in NDR impact.

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