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Overweight and Obesity: Correlates and Temporal Trends in Global Context

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ABSTRACT

This work attempts to highlight the global magnitude of the obesity and examining the evolutionary perspective with focus on the correlates and temporal trend. It is based on a wide literature survey following PRISMA. The data on country wise prevalence was obtained after systematic review of over 500 articles and websites on the prevalence of obesity. A total of 301 entries/data points were found for 84 countries. Regression analysis was computed for 177 countries based on prediction made by WHO to identify the correlates. To find out the regional variation, data on height and weight of two different national surveys at an interval of 35 years from India were used. The highest prevalence of obesity was found in Tonga (65.5±13.3%) and Cook Island (61.6±5.9%) followed by Middle Eastern countries: Saudi Arabia, United Arab Emirates, Iraq, and countries of American continent, namely Paraguay, Argentina and USA. The lowest prevalence was reported in Vietnam (0.5±0.2%) and African countries of Mali, Ghana, and Tanzania. Out of 7 billion population of the world, about 1.5 billion are already overweight or obese and this number is constantly increasing. The regression analyses indicate that obesity is higher in those countries where HDI and life expectancy are higher. No doubt, obesity is now a pandemic as underdeveloped region are also in the grip of the problem; but positive regression of female obesity and life expectancy ($r^2=0.040$, $\beta=0.275$ $p>0.009$) indicate its evolutionary significance as adaptive strategy of surviving, as long as it is not morbid. Any biological or cultural trait that enhances the ability of survival and reproduction become inheritable. In this view, obesity can also be considered as a measure of biological adaptation to a particular ecological setting. But, its association with multiple chronic disorders is now a great challenge for public health and being designated as global pandemic.

Key words: *BMI, HDI, obesity, overweight, obesogenic environment, life expectancy.*

INTRODUCTION

Obesity is a condition of excessive accumulation of body fat, usually caused by the consumption of more calories than the body can use, and; it may cause different kinds of morbidity (WHO, 2015). A person with body weight at least 20% higher than normal is considered obese (Shrivastava, 2009). The excess calories are stored as fat, or adipose tissue. So we can say obesity is a problem of energy balance, calories-in versus calories-out. The Green Revolution (1930-60) alleviated the problem of starvation to some extent. As a result of Green revolution, the agriculture production was increased to sustenance the growing population which had crossed the mark of 7 billion; however, that has led to the problem of obesity.

The advancement in medical science and technology has controlled the traditional health problems resulting in the reduction of mortality rates and successive increment in life expectancy. However, such achievement may be reversed due to newly arising epidemic of overweight, obesity, and metabolic syndromes.

Initially, Obesity itself was considered as a medical condition and not a disease; but in 2013, the American Heart Association declared it as a disease (Jansen et al. 2013) that constitutes a major risk factor for developing chronic illnesses such as diabetes, stroke, cardiovascular disease, kidney failure, cancers, etc. Furthermore, excess bodyweight is an important risk factor for morbidity and mortality, causing nearly 3 million deaths every year worldwide (Ezzati et al. 2002, Ni Mhurchu et al. 2004 and Finucane et al. 2011). Obesity may also lead to metabolic syndrome and multiple chronic conditions, whose impact on the health care system is a worldwide concern (Bloom et.al. 2011 and Yach et.al. 2004).

Body mass index (BMI) is currently the most widely used measurement for nutritional assessment as well as diagnosis and mass screening of overweight and obese individuals. BMI is calculated as the ratio of weight (in Kg) to height (in m^2). According to World Health Organization (WHO) nutritional status of an individual can be broadly categorized based on the value of his BMI namely: underweight (BMI<18.5), normal (18.5<BMI<25) overweight (25<BMI<30), and obese (BMI>30).

Due to varied magnitude of the problem, obesity has been studied world-widely (Jooste et al. 1988, Dhurandhar and Kulkarni, 1992, Dhurandhar et al. 1993, Berrios et al. 1997, Cameron et al. 2000, Filozof et al. 2001, Misra et.al. 2001, Puoane et al. 2002, Gupta et. al. 2003, Lissau et

al. 2004, Baskin et al. 2005). National, sub-national, and multicenter and even regional micro level studies have shown that adiposity, as measured by BMI, has increased in recent decades in many populations (Ogden, et al. 2004, Evans et al. 2001, Monterio et al. 2007, Nguyen et al. 2007). According to an estimate, in the year 2008, globally, 1.46 billion adults were overweight and 502 million adults were obese (Finucane et al. 2011). On the basis of published work, Lobstein et al. (2004) had estimated that a total of 170 million children (aged <18 years) globally were either overweight or obese. They analyzed the reports and papers published after 1980 and made prediction for 2010.

Although, obesity is typically thought of as a problem of the developed countries, its prevalence has also increased in developing nations (Finucane et al. 2011); while, there are some studies focused on global aspect of the problem (e.g. Finucane et al. 2011 and Wang et al. 2011 and others), still there is a need for understanding the problem from micro and macro perspectives. At micro level, individual clinical studies may provide immediate solutions to a limited set of participants. However, macro level studies can be more beneficial for finding the common determinants prevalent in other populations, regions, or countries.

Industrial revolution around the globe has made tremendous impact on human culture, health and life. Improvement in human health, life expectancy, economic conditions and knowledge is measured as human development index (HDI). Every country is assessed by international organizations like World Bank on how much human development they have achieved.

This paper offers an attempt to understand the correlation of obesity with HDI, life expectancy and mortality globally. More specifically, it is investigated, whether human development has any correlation with the problem of obesity or whether the levels of fertility and mortality like dynamics of population and its structure have any impacts on the emerging problem of obesity. In this way, the present review will provide illustrated information on obesity prevalence as well as its correlates. Such studies are helpful for policy making and targeting the problem at national or international levels.

MATERIAL AND METHODS

The analysis involved three major steps: (1) identification of data sources, accessing and extracting data, and computing body mass index; (2) classification of populations as per level of nutrition; and (3) statistical analysis to estimate the prevalence of obesity by country and sex.

Data on obesity prevalence were obtained from a wide literature survey following PRISMA (Preferred reporting items for systematic reviews and meta-analyses) statement (Maher et al. 2009) and using search engines of PubMed as well as Google Scholar. Primary keywords used included: obesity, overweight and global obesity prevalence; whereas, the secondary keywords were the name of countries. After reviewing the abstracts of over 500 articles and websites; 234 relevant sources were selected, out of which, 167 were excluded based on small sample size and regional survey. From the remaining 67, a total of 22 were found methodologically comprehensive, and some of those contained multi-country studies that were considered for computation of prevalence of obesity by country and sex. All in all, a total of 301 entries/data points were found for 84 countries, out of which about 15% were based on survey conducted during 1960-1995, and the remaining 85% were done during 1996-2007. Further, 45% of studies were conducted after year 2000. Highest numbers of entries were collected for South Africa (24) followed by USA (13), Malaysia (13) and India (12). Countries like Bolivia, Haiti, Ghana, Guatemala, Honduras and Mali were represented by single studies. In addition, 49 countries were represented by double entries. Most of the observations were based on large-scale sample survey, which had coverage of country rather than a population or region of particular countries. To find out the correlates of obesity around the globe, the projection by World Health Organization (WHO) for 177 countries for year 2010 was also obtained from their website (WHO 2005).

To explain the regional trend, data on India population were obtained. Anthropometric data of two consecutive surveys at an interval of 35 years across the country was analyzed. The first survey, named Anthropometric Survey, was conducted between 1965 and 1970; whereas the second survey, known as National Family Health Survey (NFHS-3) was conducted in 2005, had wide coverage and nationally representative sample of 109,041 households, 124,385 women of age 15-49, and 74,369 men of age 15-54. It covered 99% of the population living in 29 states of India (IIPS, 2007).

Information on HDI, life expectancy, population structure, and indicators of fertility and mortality were gathered from Census Reports, World Fact Sheet, Data Sheet of Population Reference Bureau (PRB), and Human Development Report (PRB 2011, 2016 and Gautam 2012, Gautam et al. 2015, UNDP 2015).

The aggregate data was entered into two different excel worksheets, where it was filtered and cross checked for any error or discrepancies. Only the data from reliable sources (peer-

reviewed publications and official surveys) were included in the present study. For statistical analysis, all data was transferred to SPSS (Statistical Package for Social Sciences), and various statistical measures such as central tendency, deviation, t-test, F-value, regression and correlation were used.

RESULTS AND DISCUSSION

Country-based average prevalence of overweight and obesity for 1960-2007 is presented in Table 1. The highest prevalence was found for Tonga Island (65.5±13.3 %) followed by Cook Island (61.6±5.9%), Nauru Island (58.1±3.4%), Samoa (55.6±15.1%), which are situated in South Pacific Ocean. After these Island countries, the next highest prevalence was reported in Middle Eastern countries of Saudi Arabia, United Arab Emirates (UAE), and Iraq. They were followed by some North and South American countries of Paraguay, Argentina, and United States of America (USA). The lowest prevalence of obesity was reported for south Asian country of Vietnam (0.5±0.2%) and African countries of Mali (0.8%), Ghana (0.9%), and Tanzania (2.1%). A summary of the prevalence of overweight and obesity (% of population) of 84 countries are presented in Figure 1. The two bars for the countries indicating separate prevalence of overweight and obesity. It should be noted that for those countries where no information on the prevalence of overweight population was available, two equal sized bars are used in Figure 1. The average values indicate that females (19%) are significantly more obese than males (13%) (Independent t-test: $t=-3.4$ at 229 df, $P<0.001$, with F value 4.6).

For further illustration, a country-wise comparative bar diagram was constructed (Figure 2). Here, each country can be placed in one of the following groups: (1) the prevalence of male and female obesity is relatively the same (<1.5% difference), (2) the prevalence of male obesity is 1.5% or higher than that of females, and (3) the prevalence of female obesity is 1.5% or higher than that of males. Most of the developed countries (UNDP 2015 and PRB 2016) belong to group 1. These countries are Canada, Spain, Germany, United Kingdom, Japan, Singapore, New Zealand, France, Croatia, Cyprus, Ireland, Norway, Denmark, Ireland and Portugal. In the second group, there are some developing countries such as Greece, Israel, Iraq, Hungary and India have between 5-25% higher prevalence of obesity in male. There is a long list of countries in the third group. Some of them having 10-22% higher prevalence of female obesity; these countries are: Samoa, Seychelles, South Africa, Swaziland, Tonga, Saudi Arabia, Fiji, Zimbabwe, Iceland, United Arab Emirates, Azerbaijan, Paraguay, Syria, Bulgaria and

Mexico. The error bar diagram in Figure 3 further illustrates that the difference in obesity prevalence between men and women is significant.

Here, simply question arises about why women have higher prevalence of obesity than men around the globe? Why women have higher body fat as compared to male? This can be explained by the function of fat in human body. In most of mammals, the layer of fat serves as an insulation to protect them from cold. However in humans, the same fat is used as energy reserve (Brown and Konner, 1987). The answer lies in our evolutionary history. 95-99% of human history (pre-historic period) was as foragers (hunter-gatherer). Recently (6-10 thousands year ago), we have shifted from forager to food producer, with the advent of agriculture, followed by industrialization. The forager stage of human evolutionary history was the state of food scarcity. Hence, higher fat deposition among females is an adaptive strategy to provide energy for nursing and fetus (Brown and Konner, 1987).

The review of worldwide data on obesity indicates that it has taken the form of global pandemic and it continues to increase day by day in different country, region, and ethnic groups. In order to quantify the temporal trend of such increase, a scattered plot diagram was drawn (Fig. 4). The results indicate positive trend of obesity during 1980 to 2010 (β-410.80+0.21, r^2=0.01). Detailed studies from different countries show that there is a progressive increase in obesity rates within each country, but at very different rates.

In order to gain a deeper understanding for a specific temporal trend of obesity, we also analyzed two surveys among the Indian population that were conducted 35 years apart. The first survey was conducted during early 1970s, whereas the second survey was conducted during 2005-06. In both surveys, height and weight among the adult male population were recorded. The first survey was conducted in a limited region (Map 1) and on males only, hence for comparison, only these regions were considered. The findings presented in Figure 5 indicate that during last 4 decades the prevalence of obesity has increased significantly in almost all the Indian states. During 1970, the states like Meghalaya and Jharkhand did not have obesity rather they were struggling with undernutrition; However, such states gradually stepping towards being obese. Further, five of the states that had a sum of overweight and obesity less than 5% then, in 1970's, now they have more than 15% obese population. The highest prevalence of obesity (30%) was recorded for the state of Punjab.

In the year 2005, the WHO made the last global projection of obesity for year 2002, 2005 and 2010. The analysis of WHO's projection of obesity for all countries have shown increasing trend of obesity. Merely in 3-5 years, there was an expected increment in the prevalence of obese population in New Zealand (8%), USA (7%), Mongolia (6.6%), Chile (7.5%), Bolivia (4.7%), Guatemala (4.8%), Jamaica (2.6%) (WHO 2005). Alike global variations, the prevalence of obesity also varies within the countries. For example, in Indian, states of Punjab (30.3% males, 37.5% females), Kerala (24.3% males, 34% females) and Goa (20.8% males, 27% females) have higher prevalence of obesity comparing to states of Bihar, Jharkhand, and Orissa have low prevalence (IIPS, 2005-2006). One explanation may be that Kerala and Goa are coastal states at south-west Indian peninsula. They have comparatively higher HDI (0.790 and 0.779). The state of Punjab in northern part of the country is known for its rich diet and excelling in agricultural and dairy production. Easy accessibility and affordability of food along with automation of agriculture and other industries may be the leading cause of obesity in these states. Cultural presumptions may be another reason, as the fatty people are still considered prosperous rather than unhealthy and unwell.

Beside inter and intra national variations in the prevalence of obesity, there are variations on the basis of ethnic origin, occupation and level of education. People of particular ethnic origin may be more prone to obesity because of their genetic makeups. Similarly, some regions have more obesogenic environment, which can lead to higher prevalence of the problem. Of course, culture and eating habit directly contribute to the issue, which is also associated with occupation, education and awareness.

It is further a matter of concern that in countries, like India, obesity has reached to an epidemic proportion. Urban population is experiencing high rates of obesity, as their work often demands less physical exertion. In that respect, even rural areas are not immune, due to the increased mechanization of farming leading to reduced physical activity. Furthermore, Indians are genetically susceptible to weight accumulation especially around the waist. Recently, scientists have identified a single nucleotide polymorphism (SNP) near *MC4R* gene, named rs12970134, which was found to be associated with obesity and waist circumference (Loos, 2008). Once an individual develops obesity, it is difficult and costly to reverse the process and there are tremendous challenges for them to maintain a healthy body weight (Bray et. al. 1998).

There is a great need to identify the most efficient and cost-effective approaches to tackle the obesity problem worldwide.

To find the correlates of obesity, bivariate regression analysis was computed in SPSS for 177 countries, based on projection of obesity prevalence for the year 2010. The prevalence of obesity projection was considered as dependent variable on Human Development Index (HDI), Crude Birth Rate (CBR), Crude Death Rate (CDR), percentage of population in age group 15-64 years; life expectancy, mean body mass index (BMI) and percentage of overweight population, which were taken as independent variables. The findings are presented in the Table 2. It is apparent that three variables namely— HDI, percentages of population in age group 15-64 and life expectancy (Figure 6) have positive and significant regression on obesity prevalence; whereas fertility and mortality indicators have negative regression. The CBR have negative and significant regression, whereas the mortality indicator (CDR) has negative but insignificant regression.

It can be derived from the regression analysis that the prevalence of obesity is higher among those countries where human development index is higher, but fertility and mortality is low. The human development index is a composite index of health (life expectancy), wealth (GDP) and knowledge (education). The index value is higher for countries where life expectancy and GDP are higher and they have better educational attainment. The positive regression (r) confirms that the prosperous countries have higher prevalence of obesity. The negative beta (β) value of regression with fertility and mortality further indicates that in these countries, the good medical health care system lead to reduced level of fertility and mortality and extended life expectancy.

As the advancement in medical science and patient care has improved globally, underdeveloped countries are gradually coming forward to improve their overall HDI. Organizations like WHO and World Bank are helping them to improve their socio-economic conditions and medical care. Hence, a boom in obesity prevalence can be expected. Increasing obesity prevalence will further increase disorders like diabetes, cardio-vascular diseases, metabolic syndromes and multiple chronic disorders. This changing pattern of morbidity and epidemiological transition are the result of changes in life style throughout the history. The roots of the obesity do not only lie in the excess of body fat or bodyweight, but it has evolutionary and cross-cultural dimensions. The evolutionary success of *Homo sapiens* can be best understood by

reference to operation of natural selection. Human biology and culture are the product of adaptation to environmental constraints. Any biological or cultural trait that enhances the ability of survival and reproduction become common. In this view, obesity can also be considered as a measure of biological adaptation to a particular ecological setting, such as cold climate and northern latitude. However, at the same time, it is not restricted to a particular climate; rather, it is universal, although the prevalence is still higher as per ecological and socio-economic settings of individuals and populations. At the molecular level, the gene and DNA are regulatory factors, while at the individual level; the eating behavior is the main contributor, whereas at the population level, the genetic makeup, geo-climatic condition as well as socio-economic conditions are prevailing determinants of the problem.

The evolutionary and historical experiences of drought followed by starvations played an important role in the natural selection of species by micro evolution of some genes which can enable individuals to efficiently collect and process food. In this process, fat is stored during periods of food abundance in order to be used during food shortage (feast and famine). Such genes are called *Thrifty* genes. Hence, Thrifty Genotypic hypothesis further supports increasing prevalence of obesity.

Conclusion

In the course of evolutionary history of humans, a higher level of fatness was an adaptive strategy to survive during starvation. However, this adaptive strategy, which was once an important mechanism of survival, existence and perpetuation of the species (*Homo sapiens*) has now led into a global pandemic due to its association with fatal diseases such as diabetes, hypertension, cardio-vascular-diseases, and cancers. Obesity is not simply a disease of developed societies any more, since underdeveloped region are also gradually in the grip of the problem, when they have access to enough food. Higher prevalence of obesity found in females in most of countries is a part of the normal species sexual dimorphism in *Homo sapiens* (Brown and Konner, 1987). In perspective of evolutionary history, it was an adaptive strategy, as the food scarcity has been a very common feature of human ecology in our evolutionary past, and females with greater fat accumulation are buffered from periodic scarcity, providing energy for nursing and fetuses (Brown and Konner, 1987). The positive regression of female obesity and life expectancy lead to inference that it still has adaptive role and a mechanism of surviving strategy,

as long as it stays within some limits. The problem aggravates with increasing age and multiple chronic disorders associated with obesity.

Out of 7 billion population of the world about 1.5 billion are already overweight or obese and this number is constantly increasing. The developed countries with higher HDI and life expectancy have higher prevalence of obesity. In those countries, the mortality rate is comparatively low as evident from regression analysis. However, it may also reverse due to obesity and associated multi-chronic disorders. There are two major determinant of the obesity: one is genetics, which cannot be stipulated in larger sense, and the second one is obesogenic environment that can be managed to minimize the problem. However, that requires mass awareness and education across the globe. There is a great need for more drastic national and international policies to combat the problem. Ultimately, the obesity is preventable.

Conflict of interest

Authors jointly declare that they do not have any conflict of interest.

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Table 1: Country wise prevalence of overweight and obesity

S.No	Country	Continent	% Overweight (BMI= 25-29.9)		% Obesity (BMI >30)		Total (Overweight + Obesity BMI≥ 25)		Reference*
			Mean	SD	Mean	SD	Mean	SD	
1	Argentina	S America	34.1	6.9	27.0	2.1	61.0	8.9	1
2	Australia	Oceania	39.1	12.9	21.9	2.7	41.4	22.2	2,3
3	Austria	Europe	5.3	0.7			5.3	0.7	4
4	Azerbaijan	Asia			11.4	9.2	11.4	9.2	3
5	Belgium (Flemish)	Europe	4.7	1.1			4.7	1.1	4
6	Bolivia	S America	26.2		7.6		33.8		1
7	Bosnia and Herzegovina	Europe			20.9	6.2	20.9	6.2	3
8	Brazil	S America	27.5	3.1	10.2	2.6	26.7	14.5	1
9	Bulgaria	Europe			17.2	8.3	17.2	8.3	1,3
10	Canada	N America	33.0	2.7	14.9	5.5	40.6	11.2	5
11	Chile	S America			20.7	4.2	20.7	4.2	1,3
12	China	Asia			2.9	0.7	2.9	0.7	3
13	Colombia	S America	31.4		11.5	4.4	22.0	16.6	1,3
14	Cook Islands	Oceania			61.6	5.9	61.6	5.9	3
15	Croatia	Europe			22.2	0.8	22.2	0.8	
16	Cuba	Caribbean			9.9	2.7	9.9	2.7	3
17	Cyprus	Asia			12.4	0.8	12.4	0.8	3
18	Czech Republic	Europe	3.2	1.1	15.0	1.8	7.1	6.2	3,4
19	Denmark	Europe	3.5	2.1	11.4	0.6	6.2	4.4	3,4
20	Dominican Republic	Caribbean	23.5	4.3	10.5	2.8	34.0	7.0	1
21	Eritrea	Africa			2.9	0.8	2.9	0.8	3
22	Estonia	Europe			15.7	1.1	15.7	1.1	3
23	Fiji	Oceania			18.1	11.7	18.1	11.7	3
24	Finland	Europe	5.7	0.9	15.0	1.4	8.8	4.9	4
25	France	Europe	3.6	0.7	16.9	1.1	8.0	6.9	4
26	Germany	Europe	4.6	0.9	20.8	0.4	10.0	8.4	4
27	Ghana	Africa			0.9		0.9		6
28	Greece	Europe	7.6	2.8	22.1	5.5	12.4	8.2	4
29	Guatemala	N America	26.2		8.0		34.2		1
30	Guyana	S America			20.6	8.9	20.6	8.9	3
31	Haiti	Caribbean	8.9		2.6		11.5		1
32	Honduras	N America	23.8		7.8		31.6		1

33	Hungary	Europe			17.7	0.8	17.7	0.8	3
34	Iceland	Europe			12.4	0.1	12.4	0.1	3
35	India	Asia	11.9	8.0	10.3	12.6	16.2	12.1	7-11
36	Indonesia	Asia			2.4	1.8	2.4	1.8	3
37	Iran	Asia			14.2	7.1	14.2	7.1	3
38	Iraq	Asia			32.2	8.5	32.2	8.5	3
39	Ireland	Europe	5.3	1.9	13.0	1.4	7.9	4.3	4
40	Israel	Asia	5.3	1.5	22.6	4.0	11.1	9.2	3,4
41	Italy	Europe			8.2	1.1	8.2	1.1	3
42	Japan	Asia	21.2	4.7	3.0	0.5	13.6	12.3	3
43	Latvia	Europe			15.2	4.1	15.2	4.1	3
44	Lithuania	Europe	1.8	0.8	19.9	1.0	7.9	9.4	3,4
45	Malaysia	Asia	21.4	2.8	7.2	4.3	25.3	6.6	12
46	Mali	Africa			0.8		0.8		6
47	Malta	Europe			23.2	2.6	23.2	2.6	3
48	Mauritius	Africa			10.0	7.1	10.0	7.1	13
49	Mexico	N America	40.3	4.5	24.7	8.0	44.8	18.4	3
50	Mongolia	Asia			9.9	3.7	9.9	3.7	3
51	Nauru	Oceania			58.1	3.4	58.1	3.4	3
52	Netherlands	Europe			11.1	1.2	11.1	1.2	3
53	New Zealand	Europe			22.6	0.9	22.6	0.9	3
54	Norway	Europe			6.2	0.4	6.2	0.4	3
55	Oman	Asia			20.3	5.0	20.3	5.0	3
56	Paraguay	S America	38.9	3.9	29.3	9.1	68.2	5.2	1
57	Peru	S America	37.9	5.9	11.5	7.2	21.9	18.9	1
58	Philippines	Asia	16.9	2.8	3.3	1.6	20.2	4.5	12
59	Poland	Europe			17.8	3.0	17.8	3.0	3
60	Portugal	Europe	5.9	2.1	14.2	1.1	8.7	4.6	4
61	Romania	Europe			8.6	1.3	8.6	1.3	3
62	Russian Federation	Asia			16.0	5.9	16.0	5.9	3
63	Samoa	Oceania			55.6	15.1	55.6	15.1	3
64	Saudi Arabia	Asia			35.2	12.4	35.2	12.4	3
65	Seychelles	Africa			25.1	14.3	25.1	14.3	3
66	Singapore	Asia	24.5	5.9	6.4	0.8	18.7	13.9	12
67	Slovakia	Europe	3.3	1.5	14.3	1.1	7.0	5.8	4
68	Slovenia	Europe			15.2	1.9	15.2	1.9	3
69	South Africa	Africa	25.8	4.5	20.3	12.5	31.0	17.3	3, 14-19

70	Spain	Europe			13.3	0.4	13.3	0.4	3
71	Swaziland	Africa			13.5	13.6	13.5	13.6	3
72	Sweden	Europe	4.0	0.6	12.5	2.1	6.8	4.5	4
73	Switzerland	Europe			7.7	0.3	7.7	0.3	3
74	Syrian Arab Republic	Asia			21.6	8.6	21.6	8.6	3
75	Tanzania	Africa			2.1	2.1	2.1	2.1	20
76	Thailand	Asia	23.5	9.5	6.7	4.8	15.1	11.4	12
77	Tonga	Oceania			65.5	13.3	65.5	13.3	3
78	United Arab Emirates	Asia			32.8	10.1	32.8	10.1	3
79	United Kingdom	Europe			22.7		22.7		3
80	USA	N America	19.6	10.0	26.1	5.5	28.6	14.8	1, 4, 21-22
81	Uzbekistan	Asia			6.3	1.2	6.3	1.2	3
82	Vanuatu	Oceania			19.8	7.6	19.8	7.6	3
83	Viet Nam	Asia			0.5	0.2	0.5	0.2	3
84	Zimbabwe	Africa			11.7	11.0	11.7	11.0	3
	Average		16.1	12.4	16.3	12.5	19.8	16.5	
	Female		15.4	11.2	19.2	13.7	21.8	16.9	
	Male		14.7	13.4	13.6	10.8	16.2	14.9	
	Min		**1.8**	**0.6**	**0.5**	**0.1**	**0.5**	**0.1**	
	Max		**40.3**	**12.9**	**65.5**	**15.1**	**68.2**	**22.2**	

***Sources:**

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Table 2: Bivariate linear regression analysis between WHO's projection of Obesity for the year 2010 and Human Development Index and other variables

S. No.	Independent variable	Regression Coefficient				F statistics			**p**
		R	**R^2**	**β**	**SE**	**t**	**F**	**df**	
					For Males				
1	HDI	0.203	0.041	13.159	4.7	2.7	7.5	177	0.007
2	CBR	0.188	0.035	-0.192	0.07	-2.5	6.4	177	0.012
3	CDR	0.071	0.005	-0.227	0.2	-0.9	0.9	177	0.344
4	Population 15-64 yrs (%)	0.152	0.023	0.250	0.125	1.9	3.9	169	0.047
5	Life expectancy (Male)	0.196	0.039	0.233	0.090	2.5	6.7	169	0.010
6	Mean BMI*	0.934	0.873	4.612	0.1	34.7	1208.8	177	0.001
7	Overweight*	0.891	0.793	0.479	0.01	25.9	674.7	177	0.001
					For Females				
1	HDI	0.175	0.031	15.303	6.4	2.3	5.5	177	0.019
2	CBR	0.192	0.037	-0.265	0.1	-2.5	6.7	177	0.010
3	CDR	0.108	0.012	-0.462	0.3	-1.4	2.0	177	0.152
4	Population 15-64 yrs (%)	0.132	0.017	0.286	0.1	1.7	2.9	169	0.087
5	Life expectancy (Male)	0.200	0.040	0.275	0.1	2.6	6.9	169	0.009
6	Mean BMI*	0.983	0.967	5.569	0.07	71.9	5183.2	177	0.001
7	Overweight*	0.937	0.878	0.753	0.02	35.6	1272.0	177	0.001

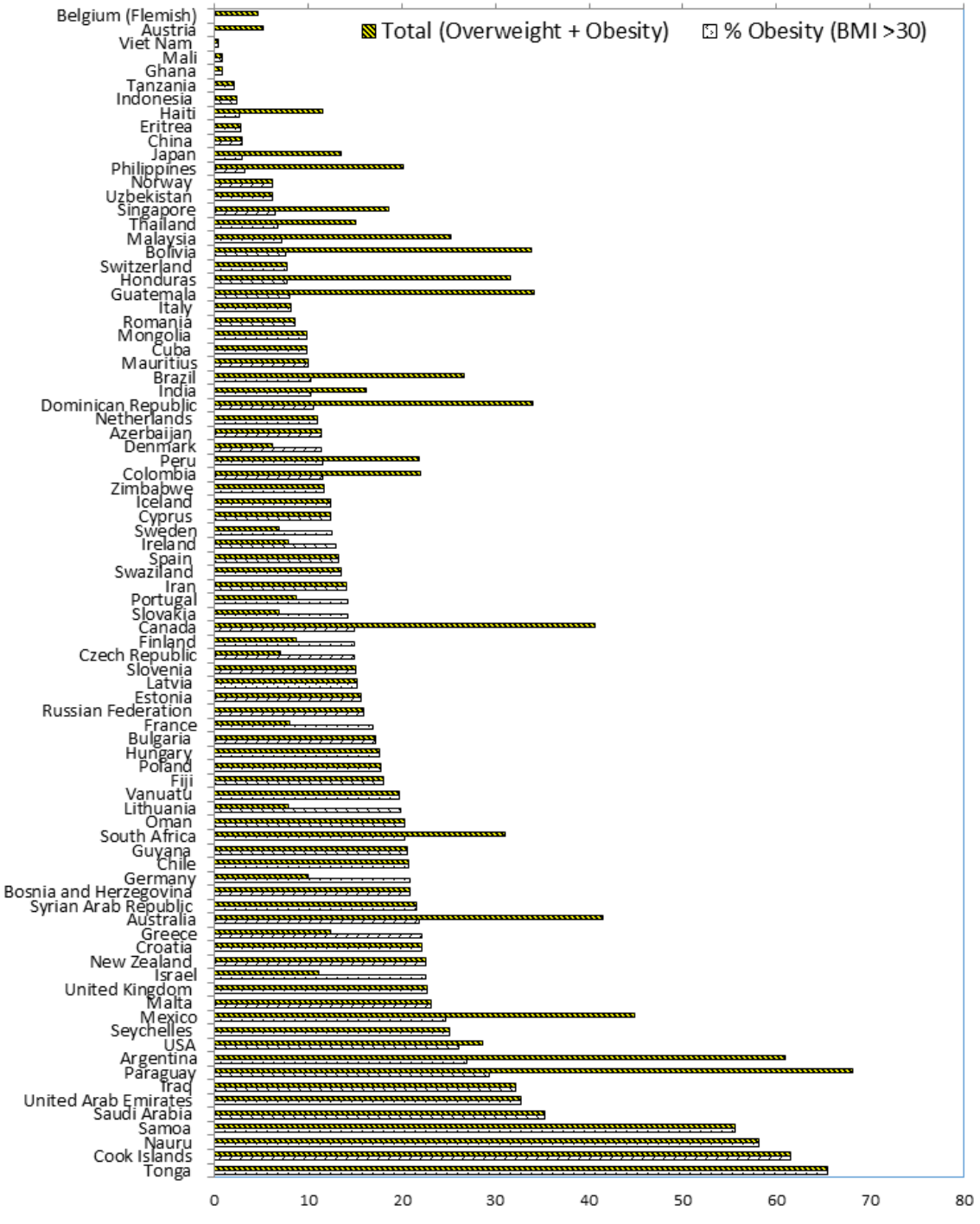


Figure 1. Bar diagram showing the prevalence of obesity per country. Two equal-sized bars are used for those countries where the data for overwight population (25<BMI<30) was not available.

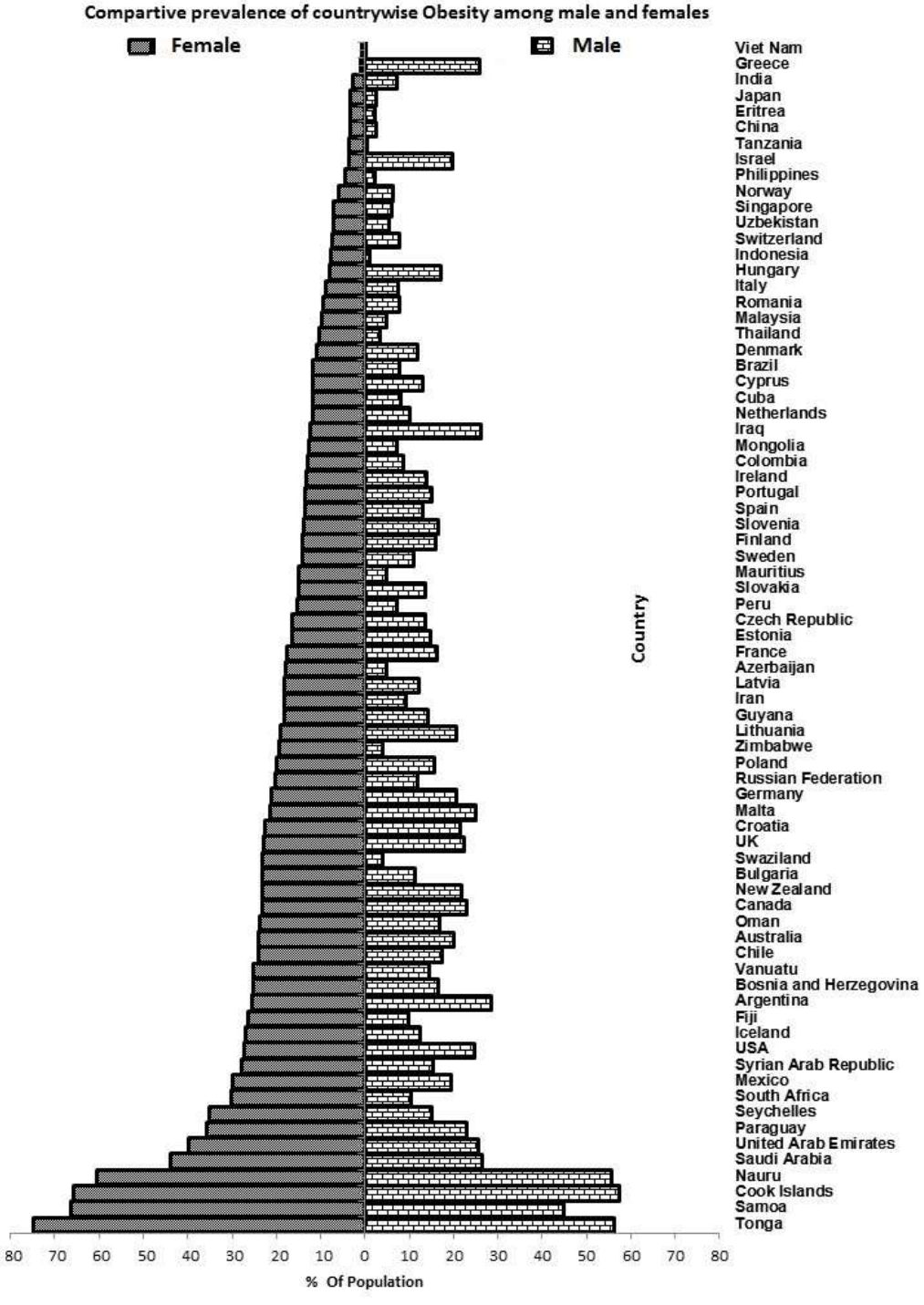


Figure 2. Comparative prevalence of country wise Obesity among male and females

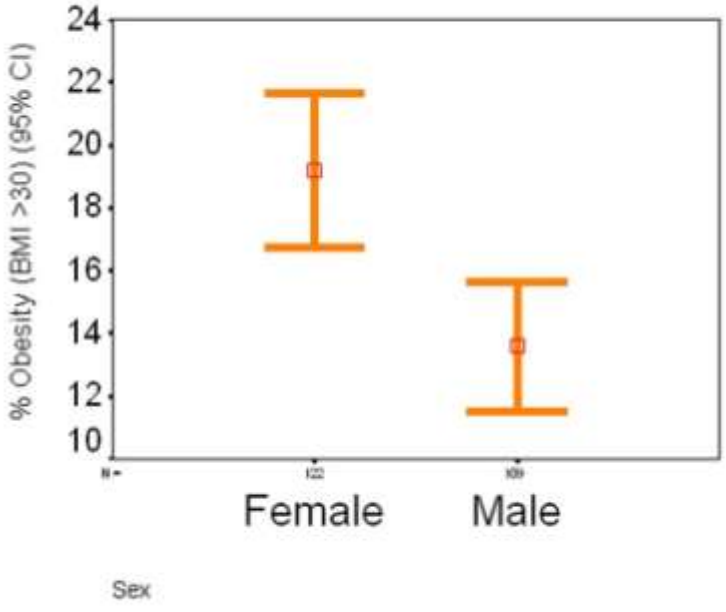
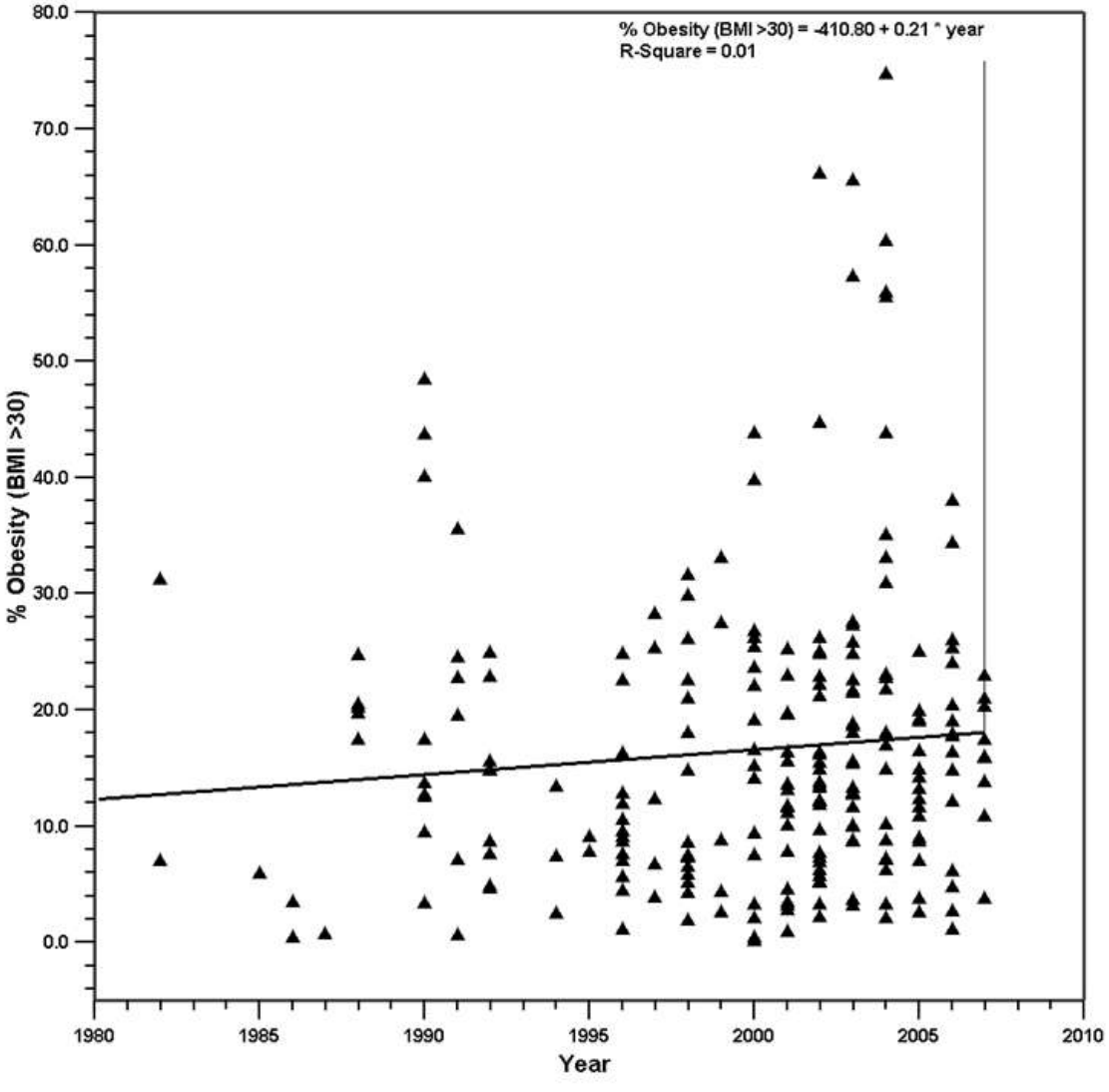


Figure 3. Error bar diagram showing difference in prevalence of obesity among males and females.


% Obesity (BMI >30) = -410.80 + 0.21 * year
R-Square = 0.01
% Obesity (BMI >30)
Year
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
1980
1985
1990
1995
2000
2005
2010

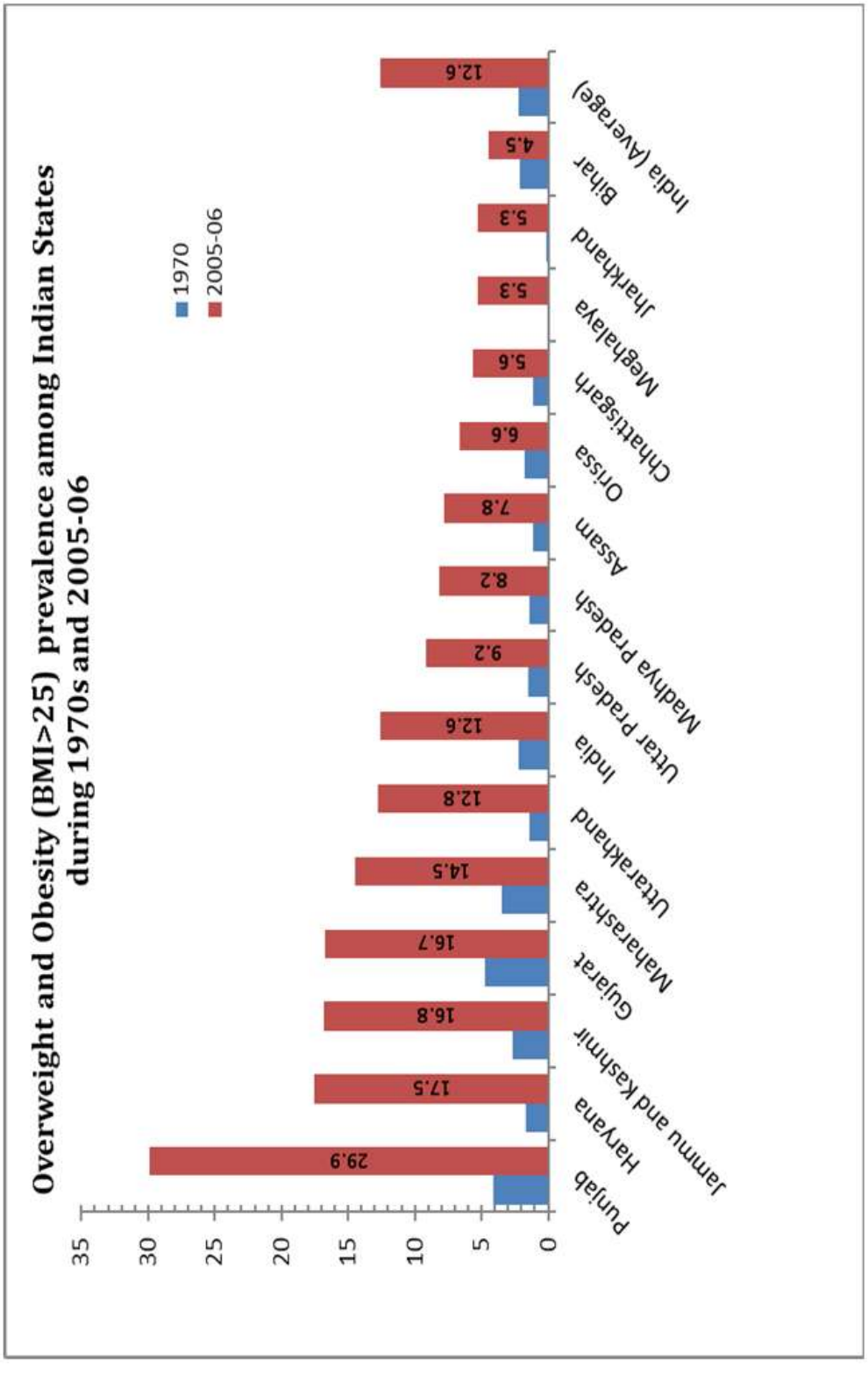


Figure 5. Comparative bar diagram showing significant increment in the overweight and obese population among Indian states.

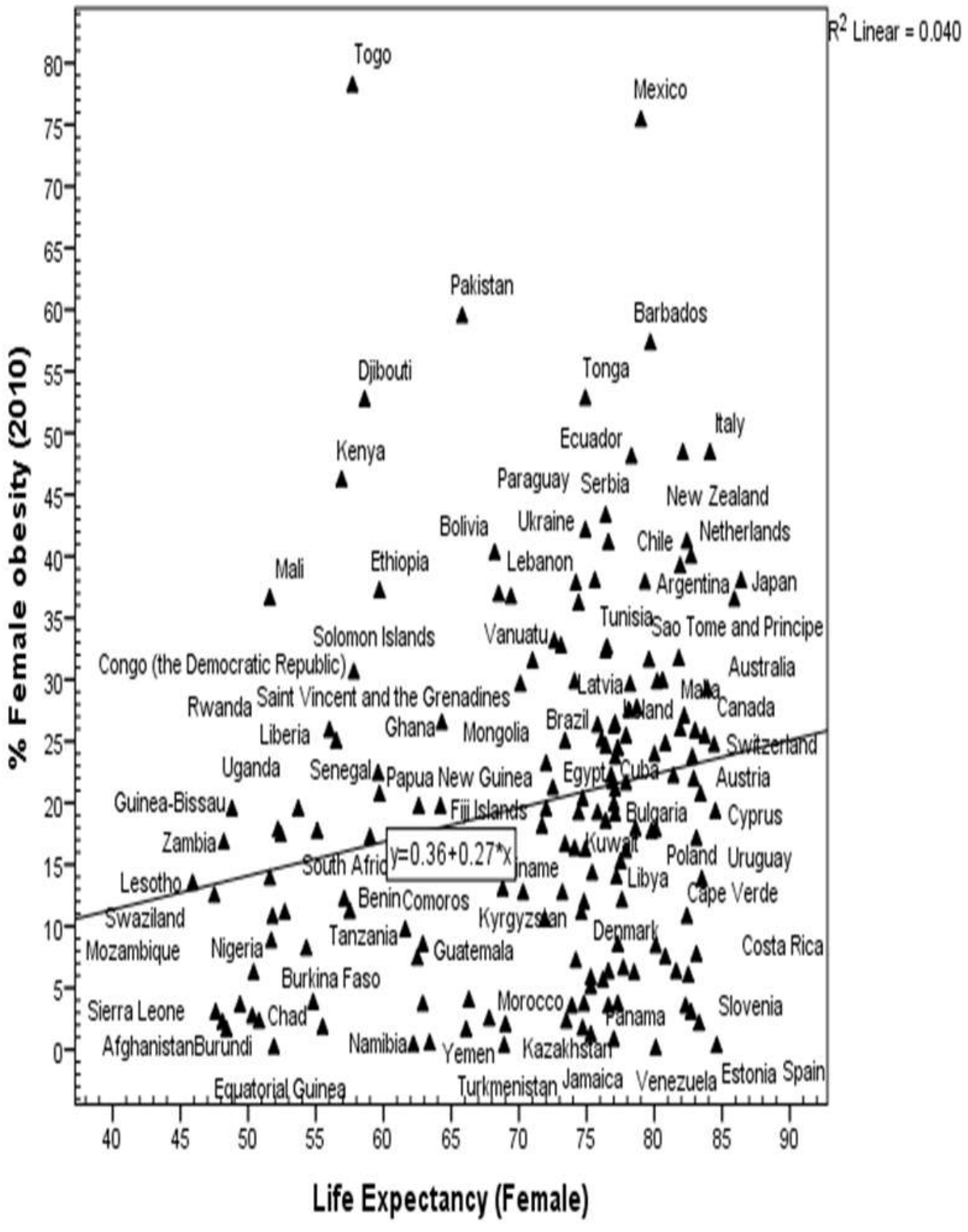
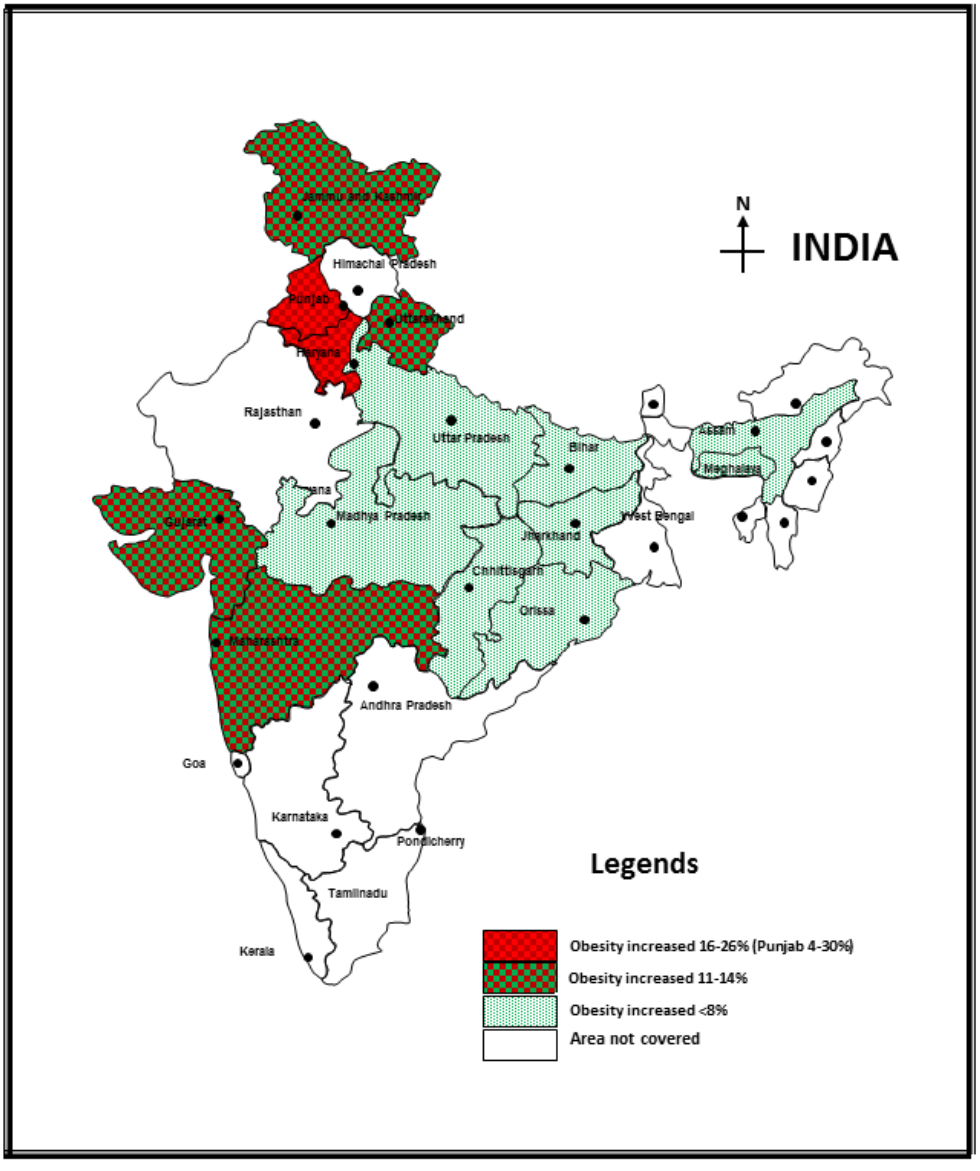


Figure 6. Scattered plot diagram showing positive regression of obesity among females and their life expectancies.



Map 1. Increment of Overweight and Obesity (BMI>25 Kg m^{-2}) among Indian States