

Review Paper

# Consequences of Obesity and Cardiovascular Risk

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## ABSTRACT

Obesity is a complex multi-factorial disease. It is known to be an independent risk factor for serious health conditions, including hypertension, type 2 diabetes, and cardiovascular disease. Obesity rates have increased in all ages and both sexes irrespective of geographical locality, ethnicity or socio-economic status. People are becoming obese younger, morbid obesity is increasing and the full health implications are only beginning to be seen. This is expected to rise further in next 20-30 years. To study the overview of obesity and its relation to cardiovascular risks. In this review paper secondary information produced by different authors, researchers from website like PubMed, lancet, Google scholar has been used. Obesity is a chronic metabolic disorder associated with CVD and increased morbidity and mortality. Globally, more than 1.9 billion adults are overweight and 650 million are obese. In India, more than 135 million individuals were affected by obesity. Obesity results into various health problems which are having direct link too cardiovascular disease (CVDs). Obesity emerged as a major public health threat for all strata of the society worldwide.

## HIGHLIGHTS

- ① Obesity isn't just a cosmetic concern that increases the risk of other diseases and health problems such as heart diseases, diabetes, high blood pressure, strokes, pre-mature deaths and mental illness such as depression and anxiety.
- ① Several factors play a role in gaining and retaining excess weight. These includes diet, lack of exercise, environmental factors and genetics.
- ① Recently the WHO had estimated the worldwide obesity has nearly tripled since 1975. In India, 135 million people are obese, as per the Indian Journal of Community Medicine.
- ① According to fifth round of NFHS 6.5% of women and 4.05 of men aged 15-49 are obese.
- ① Excess weight can lead to fatty material building up in arteries. If the arteries that carry blood to heart get damaged and clogged, it can lead to a heart-diseases. Reducing calories and practicing healthier eating habits are vital to overcoming obesity.

**Keywords:** Obesity, BMI, Coronary-heart diseases, Obesity Prevalence, Cardiovascular risk

Obesity, define as an excess of body -fat mass, is a known epidemic that can have very serious consequences like increased risk of morbidity and reduce life expectancy (Cercato and Fonseca, 2019). The burden of obesity and its related conditions on health care provision will only increase in the coming decades. There is a strong co relation between obesity and a number of risk factor for coronary artery disease (CAD) including hypertension,

dyslipidaemia and insulin resistance (Krauss *et al.* 2014). According to WHO, overweight or obesity are defined as abnormal or excessive fat accumulation that present a risk to health (WHO). From 1975 to 2014, global rates of

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obesity increased from 3.2% to 10.8% in man and from 6.4% to 14.9% in women (Kinlen *et al.* 2018). In 2010, more than a quarter of English male population was classified as obese with body mass index > 30 kg/m<sup>2</sup> (NHS, 2012). In England the numbers of overweight and obese adults from 36% to 62% between 1980 to 2013. If trends continue, it is estimated that by 2025, 18% of men and 21% of women worldwide will be obese (NRF 1975 to 2014, Lancet, 2016). A number of studies have reported that with each surge in weight, there is an increase in the risk of coronary heart disease, type 2 diabetes, cancers (endometrial, breast and colon), hypertension, stroke, sleep apnea, respiratory problems, osteoarthritis and gynaecological problems (menstrual irregularities and infertility) (CDC, 2012, 2013).

It is measured through the body mass index (BMI), a simple index of weight height relationship that indicated amount of body fat used to classify overweight and obesity in adults. Other indices, such as waist and hip circumferences, measure different aspects of body composition and fat distribution which have independent and often opposite effects on cardiovascular disease risk factors (Ellulu *et al.* 2014). The World Health Organization (WHO) classifies obesity based on BMI as follows: underweight (<18.5 kg/m<sup>2</sup>), normal range (18.5-24.99kg/m<sup>2</sup>) overweight (25-29.99kg/ m<sup>2</sup>) Obese class 1 (30-34,34.99 kg/m<sup>2</sup>), obese class 2 (35-39.99 kg/m<sup>2</sup>) and Obese class 3 (less than or equal to 40 kg/m<sup>2</sup>). If BMI value is between 35 and 39.9 health experts consider this to be grade 2 obesity on that the risk of heart attacks and strokes is much higher than average (WHO). The advantage of BMI are that it is simple to access and is the most widely used measure in population-based studies. (Romero *et al.* 2008).

**Table 1:** WHO adult BMI classification (6 may 2010)

Classification	BMI (kg/m <sup>2</sup> )
Underweight	<18.5
Normal Weight	18.5-24.9
Overweight	25.0-29.9
Obese Class	1 30.0-34.9
Obese Class	11 35.0-39.9
Obese Class 111	≥40

The worldwide prevalence rates of overweight and obesity have approximately doubled since 1980 to an extent that over one-third of the world’s population is now classified as overweight or obese. Kelly *et al.* estimated that 57.8% of the world population will be overweight or obese by the year 2030 if the current trends continue (Kelly *et al.* 2008). Globally, the proportion of individuals with a BMI> or equal to 25kg/m<sup>2</sup> increased between 1980 and 2015 in men and from 8.9% to 14.8% in women. The rise in the prevalence of overweight and obesity was greatest between 1992 and 2002, and was always greater in women than in men throughout this period: a pattern of diminishing sex differences in recent years was evident for overweight, but sex differences in obesity remained remarkably constant overtime. The non-communicable diseases (NCD) risk factor collaboration estimated that by 2025, the prevalence of obesity will reach 18% in men and 21% in women (NCD-RisC. 2016).

In India Serial National Surveys have demonstrated an increasing trend in the prevalence of obesity (NFHS 2 and 3). India is a developing country which is in a transitional state of under nutrition due to poverty and obesity due to the industrialization and rapid urbanization .Obesity affects more than 135 million individuals in India. Previously, different studies were reported which after using different methodologies and cut off points for defining obesity that created complications in comparison (Rajeev *et al.* 2018). The prevalence of obesity in India is varying from rural to urban and state-wise also which is due to various factor from 1998 to 2015, it was observed that the prevalence of obesity is threefold increase in Andhra Pradesh which is due to changes in dietary pattern and lifestyle variables (Kumar *et al.* 2016).

### Disease Pathogenesis

The pathogenesis of obesity is influenced by the balance between calories consumed and energy expenditure followed by the reset of body weight (Zhang, 2014). However, this is not as simple as an equation, and there are secondary processes that contribute to this complex condition.

In addition to diet environmental and behavioral factors enhance the risk for obesity. Obesity pathogenesis is not only about how excess body fat is acquired, but also about how this excess is biologically assimilated (Nazim *et al.* 2018). Genetic factors and age are also parameters that can modulate the phenotypic expression of obesity. (Vassallo *et al.* 2007). A high body mass index (BMI) is significantly associated with myocardial infarction, coronary insufficiency, and sudden death; the association seems strongest with sudden deaths (Paul *et al.* 2002). Using the criteria established by Cholesterol Education Panel National (NCEP), the metabolic syndrome is defined as three or more of the following: (1) waist circumference for men greater than 102 cm and for women greater than 88 cm; (2) fasting triglycerides of 150 mg/dL or greater ( $\geq 1.7$  mmol/l); (3) high density lipoprotein (HDL) cholesterol less than 40 mg/dL (1.0 mmol/L). Presently, the “metabolic syndrome” is a working definition only, and it remains unclear as to whether the five components provide equal risk to the development of cardiovascular disease events. (NCEP, 2001) Obesity related medical problem affect very huge problem affect very huge number which exceed 115 million individuals according to WHO in developing countries. These disorders according to WHO will be the number one death cause among needy population by 2030 (WHO, 2011).

### Obesity and atherosclerosis

Atherosclerosis, the process by which CAD develops is an active process involving many Complex biological mechanism. Normal vasculature can be disrupted in different ways to produce distinct coronary syndromes. Acute coronary syndromes (ACS) develops from an occlusion usually resulting from plaque rupture and thrombus formation. Stable angina often occurs from stable highly fibrous plaques, and these plaques are less prone to rupture and thrombosis and cause stenosis of the arteries (Weintraub *et al.* 2008). Atherosclerotic plaques contain a lipid pool underneath a fibrous cap. The thickness of this cap has been linked to the likelihood of plaque rupture (Seneviratne *et al.* 2013). This fibrous caps are less prone to rupture and can lie dormant for many years. The architecture of individual plaque is not fixed and some lesions can contain a mix of both thick and thin sections of fibrous cap thin fibrous caps with a

large lipid pool have been demonstrated to cause more thrombus formation and resulting ACS (Rathore *et al.* 2012).

### Cardiovascular Risk

It is well known that obesity is an independent risk factor for cardiovascular disease (CVD) and one of the main causes of the increased risk of diseases like dyslipidemia, insulin resistance, high blood pressure, or hypertension, and atherosclerosis both in adults and children (Barroso *et al.* 2017).

### Hypertension

Obese children are approximately three times likelier to have hypertension than non-obese children. In adults, there is a nearly linear relationship between BMI and blood pressure (BP) and weight loss reduces BP in most hypertensive individuals (do Carmo *et al.* 2016).

### Dyslipidemia

The effects of obesity on lipid metabolism include high low density lipoprotein cholesterol, very low-density lipoprotein cholesterol, triglycerides and low levels of the protective high density lipoprotein cholesterol. (Grundy *et al.*).

### Coronary heart disease

One study found that for every 4kg/m<sup>2</sup> increase in BMI there is a 26% increase in odds for coronary heart disease. (Nordestgaard *et al.* 2012). Data from the NHANES study including death information for 2.3 million American adults showed that obesity was associated with significantly increased mortality from both CHD and other forms of CVD (Flegal, 2007). Although BMI may also affect CHD risk though intermediate factors such as hypertension, dyslipidemia and diabetes, recent studies have shown obesity is an independent risk factor (McPherson *et al.* 2015).

### Heart failure

Obesity has been shown to effect the heart as early as in childhood, with obese children having significantly higher left ventricular mass (Maggio *et al.* 2008). The Framingham Heart Study, which followed 6000 adult

subjects without a history of heart failure for a mean of 14 years, found that the risk of heart failure was doubled in obesity. After adjusting for established risk factor, the risk of heart failure increased 5% in men 7% in women for each extra 1kg/m<sup>2</sup> in BMI. A review of 28 studies found that both overweight and obesity are associated with increased risk of heart failure (Aune *et al.* 2016).

However, in people with established heart failure, several studies have observed better outcomes in obese compared with lean individuals (Org E.A. *et al.* 2016). This has been termed the obesity paradox, and proposed explanation have included that obesity is associated with less cardiac cachexia, earlier presentation due to more impaired quality of life, greater metabolic reserves and protective adipokines (Clark *et al.* 2014).

Obese individuals have been shown to be twice as likely to have a stroke, either ischemic or hemorrhagic, than people with a BMI of < 23 (Kurth *et al.* 2002). Even after adjusting for other risk factors, excess weight was still associated with increased risk.

### Cause Consequence

The imbalance increment of energy intake more than energy expenditure is considered the fundamental cause of obesity and overweight. Globally, there has been:

- ❖ The intake of high dense energy foods which involve fats, sugar and salt at the time they poor of essential micronutrients have been increased. (WHO, 2011).
- ❖ Sedentary lifestyle because of forms of work, increased urbanization and changed modes of transportation which mean a little physical action.
- ❖ BMI has been raised due to overweight and obesity that is the major cause for many of non-communicable disease such as (WHO, 2003).
- ❖ Cardiovascular diseases (especially stroke and heart failure) were considered the major cause of death in 2008.
- ❖ Diabetes (especially type 2)
- ❖ Osteoarthritis, which is mean musculoskeletal degenerative disorder affects joints.
- ❖ Cancer like prostate, colon and breast.

### Prevalence of Overweight and Obesity by Sex and Age

Globally, a total of 1.9 billion and 609 million adults were estimated to be overweight and obese in 2015, respectively, representing approximately 39% of the world's population. Fig. shows the global prevalence rates of overweight and obesity in 2015, for adult men and women aged >20 years, by age group. The prevalence of obesity was generally higher in women than in men in all age group, with sex differences being maximal between 50 to 65 years old. The rates of both overweight and obesity increased with age from 20 years old onwards, reached their peak between the ages of 50 to 65 years and declined slightly thereafter (Yu Chunget *et al.* 2019).

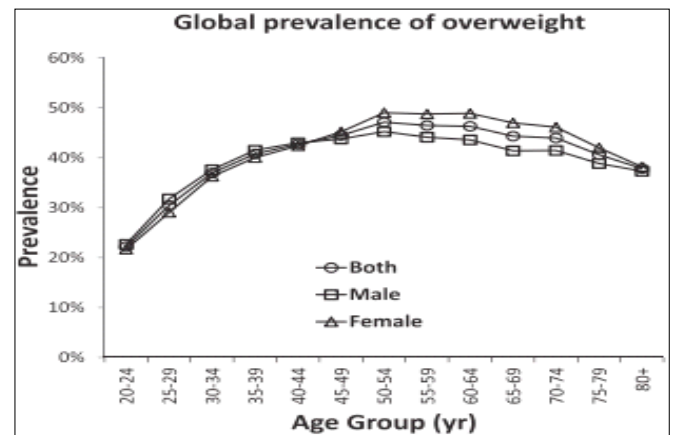


Fig. 1: Global prevalence of overweight in adults N 20 years old by age group and sex (ca. 2015).

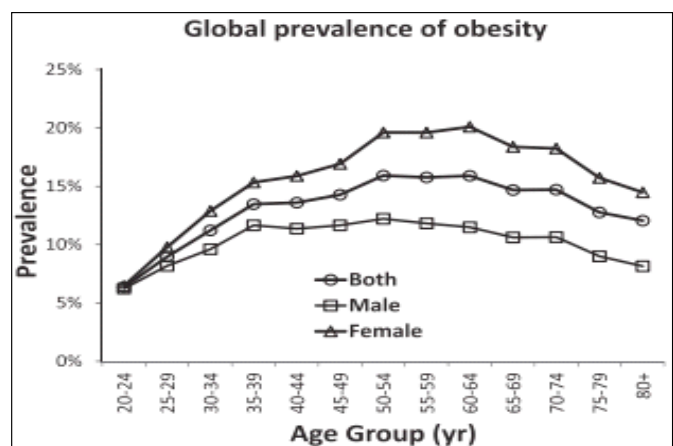


Fig. 2: Global prevalence of obesity in adults N 20 years old by age group and sex (ca. 2015).

**Table 1:** Represents the prevalence of obesity in India (1998-2018)

S.No	Author	Year Of Study Reported	State	Age (Yrs)	No. Of Individuals		BMI Criteria for General obesity (kg/m <sup>2</sup> )	Prevalence Of Obesity (%)	
					Male	Female		Male	Female
1	Mishra et al. [8,22]	2018	Rajasthan	25	Urban:57	Urban:92	≥27.5	Rural: 20.78	
2	Ningombam et al. [17]	2018	Manipur	-65 18 -60	Rural:89 258 Liangmai; 263 Mizo	Rural:194 >25	42* Liangmai 51* Mizo	Urban:37.5	
3	Kandpal et al. [5]	2016	Uttarakhand	20 -60	104	184	>25	54.8	57.6
4	NFHS-4 [14]	2015–16	Bihar Goa Haryana Karnataka Madhya Pradesh Meghalaya Tamil Nadu West Bengal Uttarakhand Uttar Pradesh Tripura Telangana Sikkim Rajasthan Puducherry Punjab Odisha Nagaland Mizoram Manipur Maharashtra Lakshadweep Kerala Jharkhand Jammu & Kashmir Himachal Pradesh Gujarat Daman & Diu Dadra & Nagar Haveli Delhi NCT Chhattisgarh Chandigarh Assam Arunachal Pradesh Andhra Pradesh Andaman & Nicobar Island	15 -49	5433 767 3381 3760 9496 1144 4795 2402 1994 12,939 821 1,054 801 5892 610 3027 4209 1440 1617 1747 4455 156 1864 3820 5584 2185 5574 432 206 672 3529 120 3860 1930 1399 411	45,812 1696 21,652 26,291 62,803 9201 28,820 17,668 17,300 97,661 4804 7567 5293 41,965 4012 19,484 33,721 10,790 12,279 13,593 29,460 1070 11,033 29,046 23,800 9929 22,932 1393 796 5914 25,172 746 28,447 14,294 10,428 2811	≥25	12.6 32.6 20 22.1 10.9 12.2 28.2 14.2 17.7 12.5 15.9 24.2 34.8 13.2 37.1 27.8 17.2 14.0 21.0 19.8 23.8 24.6 28.5 11.1 20.5 22.0 19.7 34.2 22.9 24.6 10.2 32.0 12.9 20.6 33.5 38.2	11.7 33.5 21 23.3 13.6 12.2 30.9 19.9 20.4 16.5 16.0 28.1 26.7 14.1 36.7 31.3 16.5 16.2 21.1 26.0 23.4 41.4 32.4 10.3 29.1 28.6 23.7 29.0 19.1 34.9 11.9 41.5 13.2 18.8 33.2 31.8
5	ICMR-INDIAB (Urban & Rural) [18]	2015	Tamil Nadu Maharashtra Jharkhand Chandigarh	≥20	Rural: 2800/state	Urban: 1200/ state	≥25	20.6 15.7 11.5 24.2	28.4 17.6 12.1 38.7
6	Mungreiphy et al. [11]	2011	Tangkhuil Naga	20 -70	257	–	≥25	17.6	
7	NCD risk factor surveillance 2003–2005 [10]	2008	<b>North India</b> -(Delhi) Ballabgarh- (Haryana) <b>South India</b> -Chennai, Tamil Nadu Trivandrum (Kerala) <b>East India</b> -Dibrugarh (Assam) <b>West India</b> - Nagpur (Maharashtra)	15 -64	5103 7990 7847 7537 8365 7661		≥25	23.8* 27.2* 15.9* 15*	
8	Das M & Bose K [2]	2006	West Bengal (Marwaris)	>20	110	110	≥25	44.5	71.8
9	Sidhu & Kaur [21]	2005	Punjab	20 -45	–	1700 (Urban:900; Rural: 800)	≥25	–	Urban: 43.88; Rural: 22.26
10	Shukla et al. [20]	2002	Mumbai	≥35	40,071	59,527	≥25	19	30
11	Yajnik [25]	2002	Pune, Maharashtra	>40	159	162	≥25	1.8	9.8
12	Misra et al. [9]	2001	Delhi NCT (Slum)	>18	170	362	>25	13.3	15.6
13	Zargar [26]	2000	Kashmir Valley	≥40	2496	2587	≥25	7.01	23.69
14	Reddy [19]	1998	Andhra Pradesh	18 -75	456	663	≥25	6.6	10

## Objective

To study the overview of obesity and its relation to cardiovascular risks.

## Methodology

This is a review paper, where information produced by various journals as well as series of database searches using Medline, PubMed, Google scholar were performed using the key words like obesity, acute coronary syndrome, obesity paradox, body mass index, atherosclerosis, cardiovascular risks, etc.

## DISCUSSION

By reviewing different articles on obesity, it was observed that in past few decades in developing countries, obesity has a rapid increment leading to increased risk of Cardiovascular Diseases (CVD) and its morbidity and mortality consequences. The prevalence of obesity has been increasing since 1981 for both genders. Because of malnutrition even under- or over-nutrition are seen together in developing countries, the double burden of diseases makes the condition more difficult. In low-income countries, obesity is generally higher among middle-aged adults from wealthy and urban environments (especially women); whereas, in high-income countries, obesity affect both sexes and all ages, but is disproportionately greater in disadvantaged groups (Swinburn *et al.* 2011). Female BMI is greater than that of males, except in European countries (Bhurosy *et al.* 2014). Generally, the prevalence of obesity is higher in women than in men in all socio-demographic levels. Lower BMI trends are more prevalent in African and Southern Asian countries. Multiple factors take the responsibility for increasing the NCD'S are rapidly transition of nutrition, sedentary lifestyle and occupation (Ellulu *et al.* 2014). Past and ongoing studies indicate that during last 30 years, there are significant changes in mean body weight, diet, and physical activity taking place along with comorbidities will continue to affect an increasing number of populations in these regions. Lifestyle and environmental factors are acting in a synergistic manner to fuel the obesity epidemic (Bhurosy *et al.* 2014).

In 2010, around 43million children under five were overweight. Once considered a high-income country problem, overweight and obesity are now on the rise in low and middle-income countries, particularly in urban setting. Close to 35 million countries and 8 million in developed countries. The public health agenda of WHO put the obesity in the apex as it avoidable risk factors for many disorders according to reports deal with diet, nutrition and prevention of chronic diseases. These disorders according to WHO will be the number one death cause among needy population by 2030 (Ellulu *et al.* 2014). Overweight and obesity rate have increased considerably during past 35 years to the extent to that more than one third of the world's population is now classified as overweight or obese. Although there is some variability between countries and regions, these trends were relatively uniform worldwide (Chooi *et al.* 2018). The prevalence of Obesity in India is varying from rural to urban and state-wise also, which is due to various factors like age, gender, geographical environment, socioeconomic status, etc. (Ahirwar and Mondal 2019). In India, abdominal obesity is one of the major risk factor for cardiovascular diseases (CVDs). Estimates of obesity prevalence based on WHO, BMI cut-offs may not adequately capture the full scale of the problems. The increase in obesity likely results from a complex interaction between changes in the food environment, physical activity, socio-economic, environmental, and genetic factors. Prevention is a complex issue and requires collective efforts from the government, the scientific and the medical communities, the industry, and various social organizations towards the changing of dietary and lifestyle habits (Chooi *et al.* 2018).

## CONCLUSION

Obesity is a chronic metabolic disorder associated with CVD and increased morbidity and mortality. Obesity may affect atherosclerosis through risk factors like dyslipidemia markers, hypertension, glucose intolerance, inflammatory markers, and the pro-thrombotic state. Both underweight and extremely obese patients (Class 2 and 3) have increased mortality, whereas those in the overweight or obese class 1 category have lower mortality rates. Rather

than focusing on obesity as individuals behavioral chronic state, current scientific evident indicates the consideration of a multidisciplinary approach targeting the intermediate environment of the obese individual to a broader socioeconomic context. Research shows that obesity is associated with increased mortality and numerous complications including diabetes, heart disease, dementia and cancer. The obesity rate seems to have leveled of during the past 10years in several developed countries. For example, the prevalence of obesity in US and UK remained at around 30-34% and 23-24%, respectively, between 2005 and 2015. However, the global obesity rate is still increasing as the trends have accelerated in other regions of the world, where most people live.

Prevention is a complex issue and requires collective efforts from the government, the scientific and the medical communities, the industry, and various social organizations towards the changing of dietary and lifestyle habits. Without more urgent actions, the obesity crisis already overwhelming our health services will also cripple our economy.

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