

REVIEW ARTICLE

**OBESITY RELATED RISK FACTORS AND NON -COMMUNICABLE
DISEASES: A SYSTEMATIC REVIEW**

Swastika Roy

Department of Anthropology, Visva-Bharati, Shantiniketan, West Bengal, India.

swastikaroy15@gmail.com

Abstract: *Obesity refers to the presence of excess or abnormal weight of the body due to excess amount of fat in the body. Obesity is a morbid status which predisposes for many important non-communicable diseases causing morbidity, mortality and disability. Overweight and obesity primarily happen either due to excess calorie intake or insufficient physical activity or both. Furthermore, various genetic, behavioural, and environmental factors play a role in its pathogenesis. It was revealed that India has plunged into an obesity epidemic which is marked by sudden increase in average income, resulting in having more money at hand resulting in higher purchasing power and being able to spend more on food. Stress, time crunch and sedentary lifestyle are all added accessories. The focus of the present study was to review the research findings from the available reports on the obesity and non -communicable diseases among children and young male as well as female population of India and World. The findings from this review demonstrated that heart disease and the closely related risk factor of obesity are deeply intertwined with our cultural and evolutionary environment. Through various means, we are conditioned, in developed and developing countries, to consume infinitely, which encourages obesity and cardiovascular disease. The framework of this paper strongly advocates the prevention of obesity related risk factors and NCDs.*

Key words: Obesity, Central obesity, non-Communicable diseases, children, adult population, India, World.

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1. INTRODUCTION

Obesity refers to the presence of excess or abnormal weight of the body due to excess amount of fat in the body. Obesity is a morbid status which predisposes for many important non-communicable diseases causing morbidity, mortality and disability. Any abnormal growth of adipose tissue for the enlargement of the fat cells (hypertrophic obesity) or any kind of increase in the number of the fat cells (hyperplastic obesity) or the combination of both of the condition are termed as ‘obesity’ in human being. A person can be termed as ‘overweight’ for his/her obesity. However, other causes like unusual muscular growth, retention of body

fluid can also lead to obese condition. Calculation of the body mass index (BMI) of a person is used for the numerical expression of obesity.

Overweight and obesity primarily happen either due to excess calorie intake or insufficient physical activity or both. Furthermore, various genetic, behavioural, and environmental factors play a role in its pathogenesis. Childhood obesity is a forerunner of metabolic syndrome, poor physical health, mental disorders, respiratory problems and glucose intolerance, all of which can track into adulthood [1].

Changing socioeconomic parameters along with aggressive industrialisation have augmented the easy availability of processed food and increased the percentage of sedentary behaviour encompassing a wider section of the population both in the developed and developing countries [2]. Industrialisation and enhanced purchasing power have contributed significantly in the remarkable increase in overweight and obesity, especially in adolescents, which in turn enhances the risk of lifestyle related diseases, compounded with medical and social issues [3,4].

Among all the parameters listed as potential risk for deaths, Overweight and obesity occupy fifth position, scoring around 2.8 million deaths of adults annually and globally. According to the report of World Health Organization (WHO, 2013), obesity is the basic cause of the burden for many human disorders, such as 44% for diabetes, 23% for ischemic heart disease and 7- 41% of different types of cancer [5].

In many chronic non communicable diseases obesity is key risk factor, the typical time sequence of emergence of chronic diseases following the increased prevalence of obesity is important in public health planning. The first adverse effects of obesity in population to emerge in transition are hypertension, hyperlipidaemia and glucose intolerance. While coronary heart diseases and long-term complications of obesity, such as renal failure begin to emerge several years later.

Today, the shared socio-environmental factors like affluent lifestyle, junk food, sedentary home environment, vanishing old family traditions (with regard to eating, exercise and outdoor activities) and ready-made food, substantially contribute to obesity. In causation of obesity the varied lifestyle and dietary habits also play an important role. It was revealed that India has ignited an obesity epidemic which is an after effect of sudden increase in income leading to higher purchasing power and being able to spend more on food for the common people. Stress, time crunch and sedentary lifestyle - all added fuel to the fire [6]. According to Sarvottam and Yadav [7], obesity is a global health burden and its prevalence is increasing substantially due to changing lifestyles. Chronic adiposity is associated with metabolic imbalance leading to dyslipidaemia, diabetes, hypertension and cardiovascular diseases (CVD). In anthropological viewpoint, the obesity and risk of heart disease appears like a double-edged sword, as, in case of the developing countries, the rich people gain more weight, while the poor people become thinner for not getting enough quantity of food. Many subjects in these two groups suffered from chronic energy deficiency (CED) and inadequate household food supply [8]. The objective of the present study was to review the research findings from the available studies on the obesity and non-communicable diseases among the people of India and the world.

2. METHOD

Results of the published papers from the last two decades on the obesity and non-communicable diseases in India and the world were studied from online resources by using electronic search engines like Google and PubMed. The key words used for the present review included: obesity, central obesity, cardiovascular disease (CVD), diabetes, yoga-based lifestyle, vegetarian diet, children, men and women (adult), India and World. The review was restricted to English language and demonstrated the prevalence of obesity and other non-communicable diseases.

3. INDIAN PERSPECTIVES

Report from Asia Pacific Cohort Studies Collaboration in 2006, which was conducted on central obesity and risk of cardiovascular disease (CVD) in the Asia Pacific Region [9] demonstrated that increase of one-standard deviation in index is correlated with the increased risk of ischaemic heart disorder for 17% body mass index, 27% waist circumference (WC), 10% hip circumference (HC) and 36% waist-hip ratio (WHpR). This association was observed in all the age groups, sex, and region. None of the four anthropometric indices had a strong association with risk of stroke. The result indicated that measures of central obesity, such as waist circumference and waist-hip ratio have a strong association with the ischaemic heart disease risk in the study population.

The estimated prevalence of Indian adolescent group with overweight or obesity is in the range of 6%-24.5% as compared to 11.3% in Europe and 20.5% in the USA [10, 11, 12]. India has the second largest population of overweight and obese adolescents globally after China [11]

A study in Bengali Hindu male slum dwellers of West Bengal, India in 2009 demonstrated that the association level of body mass index (BMI) and percent body fat (PBF) with central obesity changes according to different ethnic groups [13]. The results pointed out that a great proportion of the body fat (which has its contribution to BMI) is located within the abdomen in these male population. Moreover, if it is assumed that WC reflects more of the fat mass than the muscle mass. Hence it can be proposed that BMI values of these males represent more fat than muscles. In this population, WC may be preferred over other measures of central adiposity in studies dealing with obesity and cardiovascular disease risk factors.

Acharya *et al* demonstrated that in the urban slums of North 24 Parganas district, hypertension was prevalent among 35% males and 33% females [14]. It was observed that high prevalence of NCD (non-communicable disease) risk factors among urban slum dwellers need to be addressed with health promotion programs and strengthening of primary health care system. Prevalence of central obesity was significantly higher among females while compared to males. It was observed there was no significant difference in the overweight, obesity, and central obesity in the two age groups both among males and females. Strengthening and reorientation of the primary health care system is needed to improve availability and accessibility to hypertension screening and treatment.

A study on rural women of Asian Indian origin in 2011 revealed that the lean postmenopausal diabetic women had a significantly higher intake of carbohydrates, proteins, fats, trans fatty acids (TFA) compared to the obese postmenopausal diabetic women [15]. The intake of saturated fat may be a major risk factor for the onset of metabolic syndrome in adult. Such observation indicates that proper management of diet, following dietary guidelines is essential to control the rise of cardiovascular diseases throughout India in future.

In 2005, Hannon *et al.* reported that in the past two decades, obesity had triggered the rise of type 2 diabetes mellitus (T2DM) among children and adolescents [16]. Children and adolescents with T2DM may experience more microvascular and macrovascular complications at younger ages than the individuals who develop diabetes in adulthood, including atherosclerotic cardiovascular disease, stroke, myocardial infarction. In this respect, the health care professionals are advised to perform the appropriate and quick screening of the children at risk for T2DM, with proper diagnosis and disease management as much as possible.

Survey on the childhood obesity and cardiovascular disease by Tracey in 2009 [17] stated that in the paediatrics, obesity and cardiovascular disease are the risk factors for the extremely serious long-term cardiovascular consequences. Childhood obesity has a great influence on risk factors for CVD and the development of atherosclerosis. There were predictions that, by the year 2020, there will be 16% rise in the

heart disease prevalence, 19% death will occur due to different kinds of heart diseases among adults, which are the short-term and long-term consequences of childhood obesity.

Agrawal *et al.* [18] compared the prevalence of obesity and diabetes among the Indian adults, consuming vegetarian and non-vegetarian diets. The study revealed that the body mass index of Indian vegetarians did not differ significantly from the non-vegetarians. On the other hand, the male vegetarians appeared to be significantly uniformly leaner than female vegetarians. These findings confirmed the interdependence of dietary intake and diabetes, which in turn may help in the development of a clue to address the growing burden of overweight, obesity and diabetes in India. In this regard, more detailed and as well as extensive population survey with thorough measures of dietary intake and more appropriate clinical measures of diabetes are necessary to clarify this relationship.

Ahmad *et al.* (2011) investigated the prevalence of Diabetes Mellitus [DM] and its associated risk factors among the adult Kashmiri population (20 years and above) and found that obesity and physical inactivity represent the most important modifiable risk factors for DM. In subjects with pre-diabetes, lifestyle intervention reduced the incidence of DM significantly and cost effectively, justifying the implementation of population-based strategies for identifying and treating high-risk individuals for DM. Less physical activity was also found to be significantly associated with increased susceptibility for DM. Subjects with moderate to light grade physical activity were having a greater number of DM records, as compared to those who performed heavy physical activity.

In 2012, Kalra and Unnikrishnan [20] reported unique features of obesity among Indians, with excess body fat, manifested in abdominal adiposity. Such kind of adiposity is due to the deposition of fat at subcutaneous and intra-abdominal layers, including the ectopic sites like liver, muscle, etc. In Asian Indian subjects, population-wide generalized obesity is escalating and is correlated strongly with increasing cardiovascular risk factors. The rising prevalence of these lifestyle disorders are a cause of concern. In India, these disorders are acting as threatening risk factors for coronary artery diseases (CAD). Premature CAD, along with diabetic disorders jointly attribute to the typical "Asian Indian Phenotype". This morphological nature is characterized by lower level of generalized obesity and higher central body obesity (increased WC and WHR) in terms of BMI. From these findings, it is evident that, for the widely prevalent metabolic syndrome and type-2 diabetes mellitus (T2DM), obesity is a major cause of concern.

Multiple personal, environmental and biological factors can result in high levels of obesity [21]. High energy intake and low energy expenditure, in the absence of other possible contributing medical conditions, are the leading contributing factors to obesity [22]. It was revealed that adequate nutrition and healthy life style behaviour such as physical activity and no alcohol consumption are to be given significant consideration among women of reproductive age for their babies as well as their own health [23].

George *et al.* conducted a survey of cardiovascular risk factors in the school-going children of Delhi [24]. It was found that in the study population, the prevalence of overweight and obesity to be 9.5% and 11.5% respectively. One fifth of the school children had a family history of cardiovascular disease. 25.4% had adequate knowledge regarding cardiovascular risk factors. It was evident that, among school children cardiovascular risk factors are highly prevalent. Importantly, it was observed that, a major percentage of those school children do not have adequate knowledge and clear idea regarding the cardiovascular risk factors. In childhood, school-based interventions are required for cardiovascular risk reduction, by developing basic awareness.

In 2016, Vikram *et al.* [25] demonstrated that in the northern Asian Indian Populations WC had the highest area under ROC metabolic risk factors except hyperinsulinemia in males and metabolic syndrome and pressure of at least one cardiovascular risk factor in females. It was also observed that for metabolic syndrome, WC, followed by WHR to be the better predictor than other measures of adiposity.

Table-1. Obesity related risk factors and non-communicable diseases from Indian Perspective

Authors	Year	Area of Study	Major findings
Asia Pacific Cohort Studies Collaboration [9]	2006	Asia Pacific Region	Strong association between central obesity (measured by WC and WHR) are strongly associated with and risk of ischaemic heart disease in Asia-Pacific population.
Gupta <i>et al.</i> [10]; GBD 2015 Obesity Collaborators [11]; Ogden <i>et al.</i> [12]	2012, 2017, 2016	Indian Adolescent	6-24.5% of Indian adolescent population are overweight or obese. Indian population is the second largest (after China) in the world, in respect to overweight and obesity the among adolescent population.
Acharyya <i>et al.</i> [14]	2014	Urban slums of North 24 Parganas District	High prevalence of NCD (non-communicable disease) risk factors among urban slum dwellers need to be addressed with health promotion programs and strengthening of primary health care. It was reported that, prevalence of central obesity was significantly higher among females while compared to male members of study population.
Agrawal <i>et al.</i> [18]	2014	Adult men and women in India	The study confirmed the interdependence of dietary intake and diabetes, playing a key role in management of obesity problem.
Sahoo <i>et al.</i> [22]	2015	Review on childhood Obesity	High energy intake and low energy expenditure, in the absence of other possible contributing medical conditions, are the leading contributing factors to obesity.
Dunneram and Jeewon [23]	2015	Review on the women of reproductive age	Adequate nutrition and healthy life style behaviours such as physical activity and no alcohol consumption may have significant consideration among the women of reproductive age.
Vikram <i>et al.</i> [25]	2016	Asian Indians in North India	It was found that in the study population, WC had the highest area under ROC metabolic risk factors except hyperinsulinemia in male population. For dyslipidemia, metabolic syndrome or high pressure was among one of the risk factors of CVD in female population. It was recorded that for metabolic syndrome, WC, followed by WHR were the better predictor compared to the other measures of adiposity.

4. WORLD PERSPECTIVES

In a study in 2014 Valentine *et al.* [26] revealed that among University Pharmacy Students, prevalence of overweight and obesity has no gender bias, when considering the BMI index. However, WHR and WC indicated that females were more overweight/ obese compared to male students. Empirical evidence has shown a negative relationship between socio-economic status and obesity among adolescents in developed countries, such as the United States [27], England [28], and Canada [29].

Goran *et al.* [30] observed that, in youth stage of human being, there are several risk factors, which have distinct contribution for developing the type 2 diabetes along with cardiovascular disorders in human. These factors include increased body fat and abdominal fat, which may be especially problematic during the critical period of adolescence.

Tilaki-Hajian and Heidari had studied the prevalence of obesity, central obesity and associated factors in urban population of north Iran [31]. Their result demonstrated that the prevalence rates of obesity and overweight were 18.8% and 34.8% respectively in the study population. The overall prevalence rate of central obesity was 28.3%. The rate of obesity was raised with increasing age. There was an inverse relation of obesity with the high level of education, severe occupational activity, the level of exercise and leisure time activity. Therefore, community-based multiple strategies are required to combat the increasing rate of obesity and its subsequent complications such as diabetes, coronary artery disease, hypertension and osteoarthritis.

Bertsias *et al.* [32] reported that a relatively high proportion of medical students of University of Crete were overweight or obese. In this student population, there was the high prevalence of major CVD risk factors, notably high blood pressure and adverse lipid profile. Determination of the risk for the presence of major CVD risk factors in young adults is of particular importance, as it would allow prompt identification of the persons, who are at high risk for development of clinical CVD, later in life. In this context, obesity indices such as BMI, WC, WHpR and WHtR are all considered useful non-invasive anthropometric measurements to provide information on cardiovascular risks. In both male and females, the obesity indices could only explain between 2.3% and 11.9% of the variance of the CVD risk factor variables. These low percentages are probably a result of the multifactorial nature of these CVD risk factors.

According to Tharkar [33], with the increase of body mass index, the prevalence of cardio-metabolic risk factors like pre-diabetes, diabetes and hypertension also increases. His hypothesis describes that though Indians have lower BMI, they have tendency of increased body fat, around the abdominal portion. This results in the development of central obesity, which causes the increase of insulin resistance leading to the development of diabetes and CVD. The study also revealed that Metabolic Syndrome (MS), constituting the presence of any three, out of five risk factors (e.g., increased blood glucose, hypertension, low HDL cholesterol, high triglycerides and high waist circumference), was present in 21.7% of normal weight, 45.4% of overweight and 60% of obese subjects. For developing coronary heart disease MS is an important risk factor.

Sarvottam and Yadav [7] demonstrated that a reduction in weight may lead to a decrease in inflammation, resulting in CVD risk reduction, and better management of CVD. According their report, the intervention of lifestyle through yoga-based activities has a better prospect to reduce the risk for CVD and its management. This lifestyle intervention is cost-effective and simple to follow with high effectiveness (reduction in weight, obesity-related inflammation and stress).

Among a Chinese population, Zhu *et al.* [34] demonstrated that, waist to height ratio was more efficient than WC to detect the cardiometabolic risk factors, but it was only superior to BMI in case of females. It was also revealed that WHtR–Q was positively correlated with fasting plasma glucose, 2-h postprandial blood glucose and systolic blood pressure. There were also reports that a relatively high prevalence of generalised obesity was 42% having high or very high risk, where 16% of the male were with increased risk, and 12% with high or very high risk [35. 36].

In 2018, Bambra *et al.* [37] revealed that the general health condition is poor in the Northern powerhouse region of UK, leading to productivity gap and high unemployment. According to Mytton *et al.* [38], healthy lifestyles and reduced OR-NCD (OR-obesity related) risk among vulnerable groups promotes preventive strategies in England.

In urban environments, walking is a relatively easy method for successful exercise intervention, which is required in order to reduce the risks for OR-NCDs [39, 40].

In 2020, Bassatne *et al.* [41] reported that hypertension (53%), diabetes (21%), dyslipidemia (31%) and cardiovascular diseases (30%) far exceeded the prevalence of other NCDs in Lebanon. Dean *et al.* [42] demonstrated that to reduce the body weight in women, in addition to the diet and exercise-based interventions, the calorie restriction, as well as physical activities also play an important role.

Table-2: Obesity related risk factors and non-communicable diseases from World Perspective

Authors	Year	Area of Study	Major findings
Valentine <i>et al.</i> [26]	2014	Pharmacy Students in a University of Nigeria	Based on WHR and WC, it was found that more women were overweight or obese compared to men. Among the study population, there was a smaller number of people having overweight, obesity, diabetes and hypertension.
Zhu <i>et al.</i> [34]	2014	China	It was demonstrated that waist to height ratio was more efficient indicator than WC, to identify cardiometabolic risk factors.
Higgins <i>et al.</i> [35]	2019	United Kingdom (UK)	The study reported a relatively high prevalence of generalised obesity (42%) as a high or very high level risk factor.
Sutaria <i>et al.</i> [36]	2019	East London (UK)	It was observed that, 16% of the males had increased obesity risk, whereas 12% of them were having high or very high level risk factors.
Bambra <i>et al.</i> [37]	2018	Northern powerhouse for the UK region	General poorer health conditions resulted into productivity gap and high unemployment.
Mytton <i>et al.</i> [38]	2018	In England	Healthy lifestyles and reducing OR-NCD (OR-obesity related) risk among vulnerable groups promotes preventive measures.

Morris <i>et al.</i> [39]	2019	Among Asian Ethnic group pf women (Bangladeshis) in UK	It was observed that in urban environments, group walking is relatively easy and among the study group, successful exercise intervention was required to reduce their risks for OR-NCDs.
Bassatne <i>et al.</i> [41]	2020	In Lebanon	It was found that hypertension (53%), diabetes (21%), dyslipidaemia (31%) and cardiovascular diseases (30%) far exceeded the prevalence of other NCDs in study population.

5. DISCUSSION AND CONCLUSION

The findings from this review demonstrated that heart disease and the closely related risk factor of obesity are deeply intertwined with our cultural and evolutionary environment. Through various means, we are conditioned, in developed and developing countries, to consume infinitely, which encourage obesity and cardiovascular disease. At the same time, in 2002, Batchelder [8] revealed that the traditional societies offer important clues for ways to prevent and fight heart disease, from new drugs developed through studies of traditional medicine to meditation, relaxation, exercise, and even hydrotherapy. It also noted from another paper that in Indian rural populations, CED is of primary significance rather than obesity or overweight, as is the case in Western populations. Men are particularly at risk for CED since they do most of the hard physical labour in India. Cardiovascular disease (CVD) accounts for a large proportion of all deaths and disability worldwide. In 1990, The Global Burden of Disease (GBD) study recorded 5.2 million deaths due to CVD from industrialized countries and the CVD death count was 9.1 million for the developing countries [15]. In India, a large population of adult men and women, are used to take variants of vegetarian diets such as lacto-vegetarian and lacto-ova vegetarian were associated with at least a 30% lower risk of diabetes. The potential consequences associated with obesity, it is vital for health care professionals to identify children at risk and provide appropriate help as needed. It was revealed that in 2019 this global pandemic led to 5 million deaths due to high body mass index, with cardiovascular diseases and type 2 diabetes as leading causes of deaths [43]. Thakur *et.al* also demonstrated that the prevalence of obesity among COVID-19 patients has been reported to be around 25%; on the other hand, it varied across countries, reaching up to 50% and more in studies including patients from US, Mexico and UK [44]. In 2020, Horton described the COVID-19 pandemic has been called a “syndemic” since influenced by concurrent pandemics, such as the non-communicable diseases pandemic (NCDs) with additional adverse effects exacerbated by disadvantaged social status [45]. More recently, Grosso (2021) reported that being overweight is one of the important causes behind the variable outcomes, which are considered to be the aftereffects of COVID-19 [46].

The framework of this paper strongly encourages the primary prevention of obesity related risk factors and NCDs. Risk factors in parents are associated with childhood obesity and later NCD risk such as unhealthy diet, lack of physical activity and so many other factors. The life course

approach provides the potential to prevent the risk of obesity in children, which affects their growth and physical and mental development.

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