

REVIEW ARTICLE

ROLE OF PHYSICAL INACTIVITY AND HIGH BODY MASS INDEX IN THE CAUSATION AND PRIMARY PREVENTION OF NON-COMMUNICABLE DISEASES

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ABSTRACT

Non-communicable diseases are responsible for 71% of all deaths that occur across the globe each year. Physical inactivity and high body mass index are the major modifiable risk factors that play a key role in the causation and prevention of non-communicable diseases. This review aimed to comprehend the current literature on physical inactivity, high body mass index and their association with non-communicable diseases. A literature search was conducted for research articles and meta-analyses available on PubMed, Web of Science, and Google Scholar for the last ten years. Findings from the selected studies were used to determine the role played by physical inactivity and high body mass index in the causation of non-communicable diseases. According to the research, obesity has been labelled a pandemic and the majority of the world's population live a sedentary lifestyle with physical paucity. Lack of physical activity is responsible for approximately 1.6 million deaths annually, whereas the prevalence of multimorbidity is 1.5 times higher in obese than those with normal weight. Obesity and physical inactivity are strong determinants of cardiovascular disease, diabetes mellitus, and may induce carcinogenesis besides other physical and mental health issues. Lack of awareness about these risk factors, time and financial constraints, poverty, illiteracy, and unhealthy dietary practices are some of the factors that further increase the incidence of disease burden. Effective interventions related to diet and exercise are necessary if rates of non-communicable diseases are to be reduced through changing lifestyle practices.

Keywords: *Non-communicable diseases, physical inactivity, high BMI, unhealthy lifestyle practices, obesity, sedentary lifestyle*

INTRODUCTION

Despite global efforts and determinations, chronic noncommunicable diseases (NCDs) remain the major public health concerns that hover over the future of the health and wellbeing of the people worldwide. NCDs are responsible for 71% of all deaths that occur across the globe each year which is equivalent to 41 million people¹. Annually, more than 15 million people die from one of the NCDs between the ages of 30 and 69 years, 85% of these untimely deaths happen in low- and middle-income countries². Considering all age groups 77% of all NCD cases, occur in low- and middle-income countries. According to WHO, cardiovascular diseases account for most of the mortality due to NCD (17.9 million people) annually, cancer (9.3 million), followed by respiratory diseases (4.1 million) and diabetes (1.5 million). Physical paucity, smoking, harmful use of alcohol, and unhealthy dietary practices, are the major modifiable risk factors for NCD. Therefore, the key principles to reduce the morbidity and mortality caused by NCDs are modification of lifestyle practices, early detection through mass

screening, and timely management of NCDs at initial stages.

This unseen epidemic of NCDs is an ignored public health concern and in turn, affected the socio-economic development of many countries. The burden is mounting, and with the current novel coronavirus pandemic, people already having comorbidities like diabetes, cardiovascular disease, and obesity are becoming severely ill with an increased risk of fatal disease outcomes and the mortality rate has increased manifold³. NCDs are chronic ailments that may be caused by a combination of genetic, physiological, environmental, and behavioural reasons. People of all age groups, regions, and countries can be affected by these chronic diseases. Older age groups are more vulnerable, but research shows that more than 15 million of all deaths attributed to NCDs happen between the ages of 30 and 69 years. All ages are susceptible to the risk factors contributing to NCDs, whether from unhealthy dietary practices, sedentary lifestyle, exposure to smoking or due to excessive alcohol consumption.

The major determinants include urbanization, supermarket growth, unhealthy lifestyles, and an ageing population⁴. An unhealthy diet and lack of physical activity may lead to hypertension and metabolic disorders such as diabetes, dyslipidemia, obesity and thus reduces life expectancy. These metabolic risk factors can lead to cardiovascular disease, the leading NCD in terms of premature deaths. Unfortunately, the majority of the world's population does not follow the recommended pattern of physical activity and healthy diet, and hence raising concerns^{5,6}.

This scoping review aims to highlight the association of the two modifiable behavioural risk factors, physical inactivity and high BMI in the regulation of morbidity and mortality caused by NCDs.

METHODS

For this scoping review, several published research papers were appraised and the verdicts were abridged. A literature search was conducted for research articles and meta-analyses available on PubMed, Web of Science, and Google Scholar using the search terms non-communicable disease, physical activity, physical inactivity, overweight, obesity, and high body mass index. Published research papers for the last ten years were initially selected and skimmed. However, most of the analytical findings included in the review are from studies published in the last five years. All the articles reviewed were in English language. A critical analysis of these studies was performed to determine the role played by physical inactivity and high BMI in the causation and prevention of NCDs.

RESULT

The review findings showed that NCDs affect millions of people worldwide and are a major health concern across the globe. Recent epidemiological research revealed that two interrelated and key controllable risk factors for NCDs are lack of physical activity and high BMI, including overweight and obesity. From the review of literature, it has been found that obesity affecting all ages, has become a global health issue and the majority of the world's population live a sedentary lifestyle. Both these risk factors are strongly associated with cardiovascular disease, diabetes, and have potential carcinogenic effects. Besides these, neurological, musculoskeletal, and mental health issues may arise in obese people. Adipokines and insulin resistance are identified as the underlying mechanism for tissue damage caused by obesity. Physical activity may reduce the risk of NCDs by controlling BMI, waist circumference, systolic hypertension, and hypercholesterolemia.

DISCUSSION

Physical Activity and Non-Communicable Disease Burden

Physical activity plays a fundamental role in the primary prevention of NCD². It has been reported by WHO that physical paucity is responsible for approximately 1.6 million deaths annually. In the modern age, physical activity is accredited as a dynamic approach to longevity by attaining good health. It improves the quality of life by reducing the risk of various NCDs⁷. It includes exercise as well as other recreational activities such as playing, swimming, cycling, gardening, etc. WHO recommends for the younger age group (5-17), at least 60 minutes of moderate to vigorous physical activity daily. This can include play, games, sports, chores, recreation, and physical education. Healthy adults should perform at least 150-300 minutes of moderate physical activity throughout the week or perform at least 75-150 minutes of vigorous aerobic physical activity throughout the week or an equivalent combination of both moderate and vigorous⁸. This can include swimming, cycling, work, or household chores. Elderly aged 65 and above should perform at least 150 minutes of moderate aerobic physical activity throughout a week or perform at least 75 minutes of vigorous aerobic physical activity throughout the week or an equivalent combination of moderate and vigorous activity⁹.

Physical activity improves overall functional health. It reduces the risk of cardiovascular diseases, diabetes, and cancer⁵. It also helps in mood elevation, reduces stress, and prevents depression¹⁰. It keeps a balance between energy consumption and energy expenditure and thus helps in weight regulation¹¹. It has been reported that people who are engaged in physical activity several times higher than the recommended minimum level have a significant reduction in the risk of cardiovascular disease, diabetes and malignancies of the breast and colon¹². Physical activity may have a positive impact on various risk factors of NCDs such as body mass index, waist circumference, systolic hypertension, and hypercholesterolemia¹³.

Gender differences have been found for physical activity from the data collected for 142 countries. Women were found to be more inactive when compared to their counterparts¹⁴. Similar results have been gathered by another study conducted in Brazil but it added that most of these differences were due to occupational physical activity which has a minimum role in reducing the risk of NCD mortality than other domains of physical activity². Lack of awareness among youth especially females regarding the association between physical activity and NCDs is one of the several reasons for the increasing incidence of disease burden, whereas

other factors are time and financial restraints, lack of interest and low self-esteem, illiteracy and poverty¹⁵.

Hallal et al presented in a report, data from 122 countries for the physical activity engagement of adults aged 15 and above and found one-third (31.1%) of the adults physically inactive, which is significant. The most afflicted countries were southeast Asia, the eastern Mediterranean region, and the Americas. They also found that physical inactivity raises with age, more prevalent in women, and high-income strata or countries¹⁶.

Obesity and Non-Communicable Disease Burden
Increased Body Mass Index (BMI) including overweight (BMI greater than or equal to 25 kg/m²) and obesity (BMI greater than or equal to 30 kg/m²) is the second leading metabolic risk factor after hypertension for NCDs and imposes adverse health consequences throughout the life course¹⁷. Besides health hazards, it is associated with a huge social and economic burden. High BMI besides other metabolic risk factors like high total cholesterol and diabetes is the leading risk factor for cardiovascular disease, the most common of the NCDs and the leading cause of death worldwide¹⁸. In addition to cardiovascular disease, obesity has a strong association with osteoarthritis, which is a major cause of disability in adults worldwide^{19,20}.

The socio-demographic factors which are directly associated with both overweight and central obesity are age, marital status, level of education, whereas behavioral factors causing weight disorders include dietary practices such as consumption of junk food, increased sodium intake, inadequate consumption of fruits and vegetables, and lack of physical activity²¹. Obesity is found to be associated with physical paucity and sedentary lifestyle, especially in women who are not engaged in physical activity, rendering them more vulnerable to future disability²². A rising trend has been found of overweight and childhood obesity among children and adolescents in many high-income countries as well as in some parts of Asia and Brazil^{23,24}. According to a report, "Health Effects of Overweight and Obesity in 195 Countries over 25 Years"²⁵, childhood obesity is increasing at a higher rate when compared to the rate of increase in adult obesity. Approximately two-thirds of the people living in lower- and middle-income countries are obese²⁶. A study determined an association between obesity and prevalence of NCDs in six of these countries including China, India, Ghana, South Africa, Mexico, and Russia, and revealed that the prevalence of NCD multimorbidity in these countries is 1.5 times higher in obese than those with normal weight²⁷. Another study including more than 1.5million participants from Asia, Australia, New Zealand, Europe, and North America reported

that all-cause mortality was minimal at BMI 20.0-25.0 kg/m² and increased significantly throughout the overweight as well as underweight range. The risk was higher in young adults than the older population and more in men than women²⁸. The prevalence of diabetes and hypertension in Brazilian women who were overweight and obese during childbearing age was found to be higher²⁹. Therefore, early interventions in lifestyle are highly recommended to reduce the NCD risk factors to improve maternal and neonatal outcomes and also in the prevention of NCDs.

Obesity is an established risk factor for a broad spectrum of cardiovascular diseases such as coronary artery disease, hypertension, cerebrovascular events, cardiac arrhythmias, and cardiac arrest^{30,31}. It affects the heart directly and causes morphological and physiological cardiac alterations due to increased workload and renders the heart susceptible to ischemia. Cytokines produced by adipocytes and their proinflammatory effects also disturb vascular homeostasis. On the other hand, indirect mechanisms such as insulin resistance, increased blood glucose, dyslipidemia, atherosclerosis, increased peripheral vascular resistance, endothelial dysfunction, hypertension, and a prothrombotic state enhances the risk of morbidity and mortality in obese people³².

High BMI including overweight and obesity are associated with increased incidence of type 1 and type 2 diabetes^{33,34}. The underlying mechanism is insulin resistance which is induced by the accumulation of non-esterified fatty acids, glycerol, cytokines, hormones, and other pro-inflammatory substances in obese people. Besides insulin resistance, insulin-producing cells of the pancreas may also not function properly and this increases the risk significantly³⁵. High BMI and diabetes together or individually are recognized as potential risk factors for some cancers such as liver cancer and endometrial cancer³⁶.

Diet, high BMI, body fat distribution, and physical activity are found to have a significant influence on the risk of certain malignancies. There is strong evidence for an association of obesity with endometrial, gastrointestinal, postmenopausal breast, prostate, and renal cancers. The less common malignancies linked with obesity are some blood cancers, malignant melanoma, and thyroid cancer³⁷. The abnormalities of insulin metabolism and insulin-like growth factor-1 are the major endocrine mechanisms relating to obesity and the risk of cancer, besides others like increased bioavailability of sex-steroid hormones, and other hormones or cytokines secreted by adipocytes known as adipokines, that are pro- or anti-inflammatory in nature. Adipokines such as leptin, resistin, apelin, lipocalin 2 and other inflammatory

markers, may have an association with breast cancer³⁸. The insulin/IGF-1 axis is strongly associated with the risk of pancreatic, hepatic and gallbladder cancer, colorectal and prostate cancer in obese people whereas estrogens and androgens are associated with breast cancer and endometrial cancer among obese women in the postmenopausal period³⁹. Some cancer types are more strongly related to abdominal obesity which is estimated and influenced by waist circumference or waist to hip ratio than generalized obesity as depicted by BMI⁴⁰.

The metabolic imbalances occurring in obesity such as dyslipidemia and inflammation may affect the central and peripheral nervous system⁴¹. Neurological consequences include a cognitive impairment due to morphological and physiological alterations in the frontal lobe and hippocampus, part of the limbic system responsible for the processing of memory as well as dysregulated hypothalamic whole-body energy balance mechanism⁴². Continued consumption of high-fat diet damages hypothalamic areas responsible for energy homeostasis, marked by inflammation and permanent gliosis in the mediobasal hypothalamus, as evidenced by MRI in obese people⁴³. The dysregulation of energy balance by hypothalamic centres due to gliosis further enhances weight gain and obesity. Peripheral polyneuropathy may occur due to obesity-driven alterations in the sensory part of the somatic nervous system⁴⁴. Hence obesity is associated with neuronal damage in many ways.

RECOMMENDATIONS

Primary prevention strategies need to be implemented to regulate this upsurging issue. Fortunately, the resolutions are doable and economically effective⁴⁵. Comprehensive and cohesive investment in the prevention, screening, management and rehabilitation are the prerequisites for controlling NCDs. Considerable health benefits and future drops in healthcare costs can be achieved by population-based prevention strategies including population awareness through proper communication and health information highlighting the significance of healthy eating and physical activity⁴⁶. Implementation of fiscal procedures such as availability of healthy food products rich in fiber at an affordable cost, an increase in the cost of junk food, and restriction of unhealthy food marketing keeping adolescents in focus. Facilitation for the development and easy access to gyms, swimming pools and public parks for adolescents and adults are also important to motivate them in moving them out from their homes and engage in healthy lifestyle practices.

CONCLUSION

As high BMI and lack of physical activity are significantly associated with the prevalence of NCDs, affecting all ages and causing damage to different body systems, hence effective interventions are necessary if rates of NCDs are to be reduced through changing lifestyle practices. A balanced healthy diet, accompanied by at least minimum recommended physical activity, and prohibition from an unhealthy lifestyle are the most promising drivers for primary and secondary prevention of NCDs.

AUTHOR CONTRIBUTIONS

Conceptualization, UAJ; Original draft preparation, UAJ, ZO; Review and editing, UAJ, SAJ. All authors have read and agreed to the published version of the manuscript.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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