

GURU NANAK COLLEGE, SHRI MUKTSAR SAHIB

EFFECTS OF DIET ON CORONARY HEART DISEASES

**A
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Effects of Diet on Coronary Heart Disease-A review

1. Abstract

The present study is undertaken to study prevalence of risk factors of Coronary Heart Disease among adults and to evaluate impact of diet and lifestyle intervention programme on the existing risk factors. This review aims to identify potential targets ,effect of diet on coronary heart disease for preventing CHD and quantifies the magnitude of beneficial effects observed.The dietary data exhibited consumption of sweet beverages, unhealthy fats, reheated oils, salt and Trans fats to decrease and that of whole grains, unpolished dal, fruits, vegetables, and homemade snacks to increase after the intervention.

2. Introduction:-

Coronary heart disease (CHD), also known as ischemic heart disease (IHD),is the leading cause of heart failure in India. According to the first National Heart Failure Registry of India, released in Kerala, June 2020, the rate of dying within 90 days of occurrence of the event of heart failure is 17 per cent, which is quite high when compared to the other non-communicable diseases. The reported findings also draw attention to the fact that the disease burden is more prevalent among people below 65 years of age in India than in other countries. Further, the report highlighted that most of the heart failures, manifested with reduced Ejection Fraction, *i.e.*, reduced pumping function of heart is due to the weakness of the heart muscle. The etiology of heart failure revealed that 73 per cent of it to be caused by CHD, 17.2 per cent by dilated cardiomyopathy and 5.9 per cent by rheumatic heart disease (RHD). Most frequent co-morbid conditions of heart failure are hypertension and diabetes (48.5 per cent and 44.4 per cent, respectively) (Times of India, 2020). Heart disease is the term used for all types of conditions affecting the structure or functions of the heart. Coronary heart disease is also known as Coronary artery disease (obstructive and non-obstructive), Ischemic heart disease, Coronary syndrome-X and Coronary microvascular disease. CHD is caused when the arteries supplying blood to the heart are unable to deliver enough blood to the heart muscles. It is mostly caused by the process of Atherosclerosis *i.e.*, building up of plaque, a waxy substance, under the lining of large coronary arteries. This plaque blocks the blood flow towards heart, partially or totally, and the condition is caused by a disease, injury or lack of oxygen, affecting the function of arteries supplying blood to the heart. Coronary microvascular disease occurs when the tiny blood vessels of heart function abnormally (National Heart, Lung and Blood Institute [NHLBI], 2021). Garcia Covarrubias et al. (2018) defined CHD as a complex pathological that may be defined by an inadequate oxygen supply to the myocardial cells. The coronary vessels involved in atherosclerotic process show lipid accumulation and chronic inflammation. Sometimes the atherosclerotic plaques in epicardial vessels rupture and lead to thrombosis, which may manifest as fatal Myocardial ischemia followed by Myocardial infarction.

Misra et al. (2011) studied the epidemic of diet related non-communicable diseases and its socio-economic burden on the country. He reported that India underwent a 'Nutritional Transition' from 1973-2004, mostly as a product of urbanisation. They reported nutritional trends as given below:

- A 6 per cent increase in calorie intake from fats and 7 per cent decrease in carbohydrate intake.
- An increasing intake of salt, meat and meat products.
- A decreasing intake of coarse cereals, pulses, fruits and vegetables.
- Decline in physical activity.
- Escalation in levels of subclinical inflammation, obesity, atherogenic dyslipidemia, metabolic syndrome, type 2 diabetes and CHD.

The reasons for higher prevalence of CHD in India have been traced to prenatal and perinatal events like, maternal nutritional deprivation. The deficiency in maternal nutrition leads to low birth weight in child. The child who is born having less weight has shown high incidence of NCDs in the early adulthood. The association of low birth weight, which is very common in India, has led to increase in risk factors of CHD like, hypertension, type2 diabetes, etc. These adults also develop CHD in young age and are more susceptible than normal weight adults. The catching up of growth in early childhood makes Indian population vulnerable to obesity and glucose intolerance, thereby make the Indian adults more prone to develop CHD at younger age (Misra et al., 2011).

2.1 RISK FACTORS OF CORONARY HEART DISEASES

The risk factors of a disease are the underlying factors contributing towards the development of any particular disease *e.g.* tobacco abuse, which is a major risk factor of CHD. The risk factors of coronary heart disease are categorized in two: the nonmodifiable and the modifiable. The non-modifiable risk factors cannot be changed with any of the prevention or treatment technique. The modifiable risk factors can be changed or modified with prevention and treatment techniques.

Non-modifiable risk factors: age, gender and family history.

Modifiable risk factors: obesity, dyslipidemia, diabetes, hypertension, unhealthy diet, tobacco smoking, harmful use of alcohol, lack of physical activity and psychological stress.

2.2 Effects of Unhealthy diet

The unhealthy diet refers to the diet that is poor in quality in terms of excessive fat in the diet, less consumption of fruits and vegetables, high in calories, high in sugar or salt, consumption of trans fats, frequently eating outside, binge eating, etc. The traditional Indian methods of food preparation indicate high use of saturated fats, trans fats, overcooking, and excess use of salt and sugar. Indian's preference for ready to eat, processed foods, bakery products rich in trans fat and sodium has put Indians on high risk for CHD. Green et al. (2016) reviewed Indian dietary patterns characterised by consumption of high sweet products and snacks, which are harmful as they are high in energy, fat and contain trans fats. The vegetarian pattern was found to be still prevalent among Indians but use of dairy, meat and eggs has increased. Further, they concluded that the unhealthy eating habits, fasting and feasting habits of Indians multiply the risk of CHD.

2.3 Diet and lifestyle intervention

Ambrose and Najafi (2018) while proposing preventive strategies for coronary heart disease emphasised on early detection. They also described healthy diet/ lifestyle as backbone of any preventive strategy for CHD. The early diagnosis of hypertension could be a preventive approach for consequent cardiac events. They suggested screening at early age for hypertension, health education for consequences of the disease, self monitoring and self care as the preventive approach to decrease the burden of disease and associated risk factors.

Devries et al. (2017) emphasized the importance of nutrition education by quoting that nutritional work is actually interventional cardiology. According to him nutrition has not been utilized fully and frequently to control CHD, which is a simple goal to achieve. He also remarked on lack of nutrition education in physicians, as well. In a study involving 930 surveys on cardiologists, physicians and medical students, he reported that 90 per cent of the cardiologists never received any nutrition education during their training or fellowship. Only 20 per cent of the cardiologists adopted nutrition related healthy behaviour of consuming 5 or more servings of fruits and vegetables per day. He admitted that imparting nutritional knowledge to the patients is the most difficult step in nutrition intervention. Thus, it is a nutrition educator's job to design better programme for effective spread of nutritional knowledge and lifestyle modifications.

Reddy (2013) suggested that cardio protective diet, based on principles of CHD, should be an integral part of nutrition lifestyle counselling for prevention and treatment of the disease. He proposed inclusion of fruits and vegetables (400 to 600 grams per day), small quantity of nuts, fish (2-3 times in a week), 75 per cent of fat intake from PUFA/MUFA, less than 25% of daily fat intake having saturated fatty acids, less than 5 g of salt per day and restricted use of sugar. He also emphasized the importance of economic, cultural and local availability factors to be considered while making dietary suggestions.

3. Literature Review for Effects of Diet

Sharma et al. (2020) reported that the diets in India are unhealthy and an average of 10 per cent of total calorie intake, in both rural and urban households, comes from processed foods. Urban rich consume more than 30 per cent calorie in form of processed foods. They defined processed food as bakery products, biscuits breads, *suji*, refined flour, beverages (hot and cold) and outside meals. The outside meals included snacks, sweets, *namkeen*, chips, pickles, jams, sauces, icecreams, biscuits, chocolates *etc.* considering they normally have a high amount of processed flour, sugar, salt, saturated fat and have been allied to various NCDs and obesity. *Vanaspati ghee* consumption in India has risen by 51 per cent between 1993 and 2012, in home cooking, restaurants, street foods and processed foods. According to them high income group families of Western India consumed high calorie diet having more of Palm oil, which contains saturated fats, and is a main ingredient in manufacturing *vanaspati ghee*.

Raising consumer awareness for diversifying their food choices can motivate them to adopt healthier diets. They defined diverse diet as a healthy plant based diet in which 8 per cent calories come from fruits and vegetables.

They reported that most Indians except from rich households do not consume enough amount of fruits. The average calorie intake per person in rich households, of both rural and urban areas, is >3000 kcal per day, which is more than 20 per cent higher than recommended intake.

Another study demonstrated a positive correlation in body fat and consumption of ultra processed foods like, sugar-sweetened beverages and soft drinks. Consumption of processed foods increases the chance of obesity to 32 per cent. Nardocci et al. (2019) concluded that a lower consumption of ultra processed food products and replacing them with homemade meals is linked to improvement in quality of diet.

Kaur et al. (2016) studied middle class Northern Indian population and inferred that consistent quality, time and labour saving, long shelf life and replication of traditional recipes have been motivating factors in adoption of the ready-to-cook foods.

Huh et al. (2017) observed that high triglyceride level, high diastolic blood pressure and high fasting blood sugars have been linked to the subjects frequently consuming processed cereals like noodles, processed meats, carbonated beverages, sweets and confectionery items. The packaged foods have been found to have high fat content, high sugars, high sodium and less fibre as compared to the same preparations made at home. He stressed upon the fact that homemade preparations are much more healthy and rich in micronutrients than their processed and packaged counterparts.

Shrinivasan and Shende (2015) indicated on adoption of processed food is equally increasing in non working women *i.e.* the homemakers. The ease of preparation is appreciated equally by working and non working women. Out of all participants, 80 per cent of women used processed food due to unavailability of fresh ingredients. The other most important factor behind increase of processed foods is lack of knowledge of preparation method. About 70 per cent of women said that they used processed foods because they lack knowledge of preparation method. Few other variables like sensory appeal, price, mood, health issues and familiarity with foods also favour the adoption of processed food in working and non working women equally.

A study carried out by Kaur and Singh (2014) on use of processed foods in Punjabi population, especially consumption of the breakfast cereals revealed an interesting finding that is, if the price of the RTE food increases for a particular product, the Punjabi population starts searching for another option or brand providing cheaper breakfast cereals, instead of returning to the traditional foods.

This observation is important in context to the prevention approaches suggesting increase of taxation and making unhealthy foods expensive, may not ensure customers' return to homemade meals.

Reddy (2013) reported progressive increase in eating of dairy products, sugars, and oil as well as, diet rich in saturated fats and trans fats. Diet's link to development of cardiac arrhythmias, a predictor of sudden cardiac death, has been established. The dietary pattern is associated with the metabolic syndrome (combination of central obesity, high blood pressure, dyslipidemia and glucose intolerance) and has an effect on natural progression of CHD starting as endothelial dysfunction, elevation of the inflammatory markers like, C-reactive protein and increase in thickness of the arterial walls. These changes then manifest as fat deposition, plaque accumulation, plaque instability and thrombosis and then ultimately clinical CHD.

Reddy (2013) studied the evidences of relationship of dietary fats and CHD, through animal studies, observational studies, clinical trials and metabolic studies on human population. He stated that the dietary fats affect the blood lipid levels and become a cause for atherogenesis, thrombosis and endothelial dysfunction and pave way to inflammatory changes.

Recently, the role of dietary fats on the blood pressure levels has been documented. The cholesterol in blood comes from two sources *viz.* dietary intake and endogenous synthesis. The dietary sources of the cholesterol are dairy fats and meat, which are responsible for rise in the plasma cholesterol levels. This rise is observed as increase in both LDL and HDL rise. But adverse levels of total cholesterol, LDL and HDL are seen in people having more dietary cholesterol intake. The upper permissible limit of cholesterol in diet is 300 mg per day in healthy individual but not more than 200 mg per day in CHD patients. It is also proved that endogenous synthesis is sufficient for physiological needs and there is no need of dietary intake of cholesterol. Thus, it is advisable to keep dietary cholesterol as low as possible by keeping a check on dietary fat and meat and limiting egg yolk intake.

Brunner et al. (2010) stated that the term convenience food is as an umbrella term for all types commercially pre-prepared foods, which include packaged foods. These foods are highly processed and have high content of additives, sugar, salt and trans fats. The list is endless like biscuits, bread, snacks, frozen RTE food, breakfast cereals, carbonated drinks, sugar-sweetened beverages etc. The demand for these convenience foods in Indian market is increasing day by day.

Bazzano et al. (2013) found an inverse relationship between protein intake and blood pressure levels. They also concluded that protein replacement of fat in isocaloric diets results in blood pressure reduction.

Celnik et al. (2012) related the use of more RTE foods in comparison to homemade meals as unhealthy eating habit. These RTE or convenience foods are characteristically high in calories, sugar, salt, total fat, both saturated fats and trans fats, preservatives, unnatural colorants and artificial flavours and particularly lack in micro nutrients. The shift from homemade traditional foods to the RTE or convenience foods is the reason behind increased incidence of global obesity and growing NCDs.

Wales (2009) analysed consumer behaviour and listed reasons for consumer's incline towards processed/ convenience foods as ease of preparation, timesaving and effort saving. He also concluded that consumer selection of convenience food is increasing because of increasing stress levels and social pressures. He pointed that the tiresome process of planning, purchasing, long preparation time, cooking process and waste disposal involved in preparation of homemade meals has led to increase in use of processed food ingredients in home cooking as well. Using the convenience ingredients is also, as harmful as, eating meals outside home. even e-cigarettes are involved in increasing risk of CHD.

3. Methodology

Coronary Heart Disease (CHD) is a highly prevalent non-communicable disease originating from the atherosclerotic plaque. The alteration related to the plaque start quite early in the life. The fatty streak formations have been studied to be forming as early as adolescence. The actual disease is diagnosed very late when the complications and the complexities of the disease already set in. The CHD event is resultant of independent play and interdependent play of many risk factors (Reddy, 2013). The modest elevation in these risk factors is the reason for severe consequences and can manifest in form of severe chronic disease, which is sometimes fatal. The disease continuum needs to be intervened by the control of risk factors in very beginning (Chrysant, 2011). Initially thought to be a disease of affluence it now prevails in low and middle income countries, as well. The treatments for the disease are very pricey. So, the prevention approach is suggested for the countrymen of India, as it is cost-effective and improves the overall quality of life. In this study, an effort has been made to elucidate the prevalence of risk factors of CHD and study the role of diet and lifestyle changes in prevention of the disease.

Nutritional anthropometry is the measurement of human body at various stage and levels of nutritional status (Bamji & Reddy, 2003). The physiological changes reflected in the form of morphological variation are the basis of this branch of nutrition. Three main applications of anthropometry are to know the customary body size of population, approximation of body composition and the fat distribution within the body, and involves standardization thereof (Luepkar, 2001). The anthropometric data used for studies includes height and weight measurements and girth measurement of hip and waist. On the basis of these measurements, BMI and WHR were calculated.

Height (cm)

Height is a product of the genetic endowment and the environmental conditions. The environmental conditions like, nutrition and morbidity decide the realisation of the genetic potential (Bamji & Reddy, 2003). As per Jalali et al. (2005) subjects' height independently affects the myocardial infarction incidence in younger males. The equipment used for height measurement was heightometer,

which was fixed at a height of 2 meter on plain wall. It was ensured that the floor area was even and not rough. The subject was asked to remove his shoes, stand with both feet parallel to each other, and back of head, heel, shoulders, buttock touching the wall. His arms were made to hang sideways naturally, and head was put comfortably erect. The heightometer was then lowered, to touch the crown of head in the center. The heightometer was kept at right angle to the wall and height was measured to the nearest 0.5 cm. Each reading was repeated till two similar consecutive readings were obtained to ensure accurate measurement.

Body weight (kg)

Bamji (2003) emphasized the reliability of weight as a quantifying assay for the nutritional status of an individual. The weight is an important parameter, which correlates with the fat accrual in form of obesity. It is a responsive measure (Venkatalakshmi & Peramma, 2000). A calibrated weighing machine with sensitivity of 500g was used. The subject was made to stand erect at the centre of the machine, barefoot, looking straight, not touching anything and wearing minimum clothing while taking measurement. Before each measurement, scale was checked for zero. Each reading was repeated till two same consecutive readings were obtained (Bamji, 2003).

Body mass index (BMI)

Hubbard (2000) provided the evidence for BMI as an indication of nutritional status in adults. Quetelet's formula, was used to calculate BMI from height and weight measurements of the subjects.

$$\text{BMI} = \frac{\text{Weight(kg)}}{\text{Height (m}^2\text{)}}$$

Waist circumference (cm)

Non stretchable measuring tape was used to measure waist circumference. The subject was made to stand comfortably, with feet 25 to 30 cm apart and body weight distributed evenly on both the feet. Measurement of maximum curve of waist starting from midpoint in the horizontal plane between the inferior margins of the subject's last rib to the crest of the ilium was taken without exerting any pressure to the nearest 0.1 cm. Measurements were repeated till two same consecutive readings were obtained (WHO, 1995).

Hip circumference (cm)

Hip circumference was measured with the help of non stretchable tape. The subject was made to stand comfortably, with feet 25 to 30 cm apart and body weight distributed evenly on both the feet. The maximum circumference of hip was measured by placing the measuring tape around the pelvis from the point of the maximum protrusion of the hips/buttocks to the nearest 0.1 cm. The accuracy was assured by repeating the measurements till two same consecutive readings were obtained (WHO, 1995).

Waist to hip ratio (WHR)

This was calculated using the measured values of waist and hip circumferences. WHR is the sturdy forecaster of abdominal obesity (Welborn et al.2003). The cut off values for males above 1.0 point designate abdominal obesity and is correlated to accumulation of visceral fat. WHO (2001) suggested that for the Asian men WHR <0.9 is desirable. The formula used for calculating WHR is-

$$\text{WHR} = \frac{\text{Waist circumference (cm)}}{\text{Hip circumference (cm)}}$$

3.1 Also the dietary habits effects the CHD

The dietary habits included information related to food habits (vegetarian and non-vegetarian), number of meals consumed per day and use of table salt.

4. Summary and Conclusion:-

4.1 Introduction

Coronary Heart disease is the term used for all types of conditions affecting the structure or functions of the heart. Coronary heart disease is also known as Coronary artery disease (obstructive and non-obstructive), Ischemic heart disease, Coronary syndrome-X and Coronary microvascular disease. CHD is caused when the arteries supplying blood to the heart are unable to deliver enough blood to the heart muscles. It is mostly caused by the process of Atherosclerosis *i.e.* building up of plaque, a waxy substance, under the lining of large coronary arteries. This plaque blocks the blood flow towards heart, partially or totally, and the condition is caused by a disease, injury or lack of oxygen, affecting the function of arteries supplying blood to the heart. Coronary

microvascular disease occurs when the tiny blood vessels of heart function abnormally (National Heart, Lung and Blood Institute [NHLBI], 2021).

The Indian population along with the South Asian population is 5 per cent to 10 per cent more at risk of developing CHD at a young age than the young people from other ethnicity who show only 1 to 2 per cent risk. The reason for this is mostly related to genetic factors, lifestyle and environment. Among Asians, 9.7 per cent of males develop first major event *i.e.* a consequence of CHD the Myocardial Infarction under the age of 40 years (Aggarwal et al., 2016).

Dorairaj et al. (2016) pointed that this 'epidemiological transition' from era of communicable diseases to non-communicable and that too, CVD as most prominent cause of death, that has occurred at a fast pace. They also acknowledged the heterogeneous nature of prevalence of cardiovascular risk factors in India. Though, emergence of CVD as major cause of death in all regions of India is established but particular cause of concern is its accelerated build up, premature onset and high case fatality rate. Since 1990 to 2010 there has been 59 per cent increase in premature mortality due to CVD in the country. It has risen from 23.2 million in 1990s to 37 million in 2010.

The 'Epidemiological transition' from era of communicable diseases to non-communicable diseases and CVD becoming prominent cause of death, occurred at a fast pace in Indian population. Particular cause of concern about Indian scenario is its accelerated build up, premature onset and high case fatality rate. Since 1990 to 2010 there is 59 per cent increase in premature mortality due to CVD in the country. It has risen from 23.2 million in 1990s to 37 million in 2010 (Gaziano and Gaziano, 2016).

Misra et al. (2011) while studying the epidemic of diet-related noncommunicable diseases and their socioeconomic burden reported that India underwent a 'Nutritional Transition' during the span of five decades from 1970s, mostly a product of urbanisation. The nutritional trends include a 6 per cent increase in calorie intake from fats and 7 per cent decrease in carbohydrate intake. An increase in consumption of salt and animal based products. A decrease in consumption of cereals (course), pulses, fruits and vegetables. Also a decline in physical activity, escalation in levels of subclinical inflammation, obesity, atherogenic dyslipidemia, metabolic syndrome, type 2 diabetes and CHDs.

4.2 Risk factors of coronary heart diseases

The risk factors of a disease are the underlying factors contributing towards the development of any particular disease *eg.* tobacco abuse, which is a major risk factor of CHD. The risk factors of coronary heart disease are categorized in two: the non-modifiable and the modifiable. The non-modifiable risk factors cannot be changed with any of the prevention or treatment technique. The modifiable risk factors can be changed or modified with prevention and treatment techniques.

4.3 Consequences of coronary heart disease

The CHD, if left untreated leads to many grave problems in future. It confirms its consequence on the cardiac blood vessels, valves, as well as, on the heart muscle. The heart strives to compensate the ill effects of CHD by beating up fast, building up additional muscle or extending to accommodate more amount of blood. These compensations impinge on the heart's functions and over the time result in various consequences as discussed below.

4.4 Prevention of coronary heart disease

The Framingham Heart Study (Mahmood et al., 2014) was pioneer study to establish coronary heart disease risk factors and titled them as 'Factors of Risk'. It was for the first time healthy volunteers were studied for the presence of risk factors of CHD. Many researches after this study worked to establish risk factors of CHD. The knowledge gained from the study of the risk factors has laid the foundation of prevention approaches for CHD.

Reddy (2013) concluded that CHD among all atherosclerotic vascular diseases is multi-factorial in origin. These risk factors operate continuously and may occur simultaneously. The co-existence of many risk factors substantially increases the risk of CHD exponentially. Most of the CHD events are resultant of the modest elevations of multiple risk factors. Primary prevention refers to 'measures applicable to a particular disease or a group of diseases to intercept the cause of disease before they involve in man'. The risk reduction to prevent onset of the specific disease is crux of the concept of primary prevention. It is a mix of alteration of individual behaviour and limiting exposures to risk factors of the disease. Addressing the risk factors and enhancing the individual's capacity to resist the disease is the main strategy to reduce incidence of disease.

4.5 Intervention for prevention of CHD

Rose Paradox explains that it is impossible to prevent the prevalence of disease without targeting the knowledge and prevention strategies towards moderate to low risk population. Providing health education to low to moderate risk population can prevent their movement to high-risk category and then to the diseased category (Thompson, 2016).

Ambrose and Najafi (2018) while proposing preventive strategies for coronary heart disease emphasised on early detection. They also described healthy diet/ lifestyle as backbone of any preventive strategy for CHD. The early diagnosis of hypertension could be a preventive approach for consequent cardiac events. They suggested screening at early age for hypertension, health education for consequences of the disease, self monitoring and self care as the preventive approach to decrease the burden of disease and associated risk factors.

Devries et al. (2017) emphasized the importance of nutrition education by quoting that nutritional work is actually interventional cardiology. According to him nutrition has not been utilized fully and frequently to control CHD, which is a simple goal to achieve. He also remarked on lack of nutrition education in physicians, as well.

Khadka (2012) highlighted striking lack in knowledge about modifiable risk factors in adults, residing in Kathmandu city, Nepal. He suggested that for successful implementation of primordial, primary and secondary prevention of CHD, the possession of knowledge is the basic requisition. As prevention is the key strategy for any nation having very limited resources to combat any epidemic so, to combat CHD, the knowledge of its risk factors among population and its prevention approaches is pivotal.

Conclusion

The study unveiled the presence of risk factors of CHD in adults. The high prevalence of obesity, dyslipidemia, sedentarism, hypertension, unhealthy habits made the subjects vulnerable to development of CHD in future. We have shown the intimate relationship between diet and CHD. Thus the challenge is in promoting healthy dietary habits as well as an active lifestyle as early as possible in young adults.

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