

Protective Impact of Fruits and Vegetable Intake on Cardiovascular Risk Factors-A Review

HARMEET KAUR¹, BANI TAMBER AERI²

ABSTRACT

Consumption of fruits and vegetables is essential for maintaining good health and the longevity, as they are rich in vitamins, minerals, dietary fiber, and phytochemicals. High consumption of fruit and vegetable prevents several non-communicable and chronic diseases such as cardiovascular diseases, hypertension, diabetes, gastrointestinal diseases, and obesity. Despite these positive benefits associated with high intake of fruits and vegetables, the World Health Organisation (WHO) estimates 6.7 million deaths worldwide attributable to inadequate fruit and vegetable consumption in 2010. An inadequate intake of fruit and vegetables is considered to be a cause for around 11% of Ischaemic Heart Disease (IHD) deaths, 9% of stroke deaths and about 14% of gastrointestinal cancer deaths. Further it is stated to be among the top ten risk factors for mortality globally. The present review paper is an attempt to highlight the protective impact of fruit and vegetable intake on cardiovascular risk factors.

Keywords: Diabetes, Dyslipidemia, Hypertension, India, Non-communicable diseases

INTRODUCTION

Social organisation and economic development have been historically related to the health status and disease profile of human societies. There is a shift in the disease pattern from infectious diseases and nutritional deficiencies towards degenerative disease that includes chronic diseases such as Cardiovascular Disease (CVD), cancer, and diabetes. This shift has been entitled as "the epidemiologic transition" [1]. From the past few decades, Non-Communicable Diseases (NCDs) have emerged out to be a global health concern concerning both developed and developing nations. According to the World Health Organisation (WHO) [2] by 2020, NCDs will account for 80% of the global burden of disease; NCDs burden will increase by 17% globally. NCDs account for 60% (that is approximately 5.87 million deaths) of the total deaths in India. In the South-East Asian region, India shares more than 66% of the total deaths that are attributed to NCDs [3].

Country profile data by WHO reveals that of all the four major NCDs CVD (coronary heart disease, stroke, and hypertension) contribute to 24% of all NCD deaths followed by chronic respiratory disease (11%), cancers (6%) and diabetes (2%). This rising shift towards NCDs has been a result of industrialisation and urbanisation which has resulted in the massive lifestyle change moving onto sedentary activity and unhealthy dietary pattern [4].

Tobacco use, physical inactivity, unhealthy diet and the harmful use of alcohol are the four distinct behaviours that are associated and are linked with NCDs. These behaviours further lead to metabolic and physiological changes like hyperglycaemia, hyperlipidemia, raised blood pressure, and overweight/obesity. Globally, in terms of mortality, 13%, 9%, 6%, 6%, and 5% of the deaths are attributed to raised blood pressure, tobacco use, raised blood glucose, physical inactivity, and overweight/obesity respectively [5].

Literature Search Strategy

Relevant articles were identified by searching the PubMed, Science Direct, Google Scholar, NCBI, and Medline databases. Research articles including cross-sectional, interventional, longitudinal studies, and reviews were selected. Keywords such as "fruit and vegetable", "cardiovascular risk factors", "fruit intake", "vegetable intake", etc., were used in the search strategy.

Studies considered for inclusion in this review were full-text articles and abstracts that examined the impact of fruit and vegetable intake on cardiovascular risk factors like obesity, hypertension, diabetes, etc. Articles which were not in English were translated and then used for the present review. Studies that examined the association of fruits and vegetable intake with disorders other than cardiovascular risk factors (like sleep apnea, COPD, etc.) were excluded.

DISCUSSION

Fruit and Vegetable Consumption and CVDs

Adequate intake of fruits and vegetables in the diet is considered to be an important component for the prevention of chronic diseases and related risk factors. Recently, there has been increasing evidence that relates to the consumption of fruit and vegetable to decreased the mortality, which includes CVDs and cancers in particular. Low consumption of fruits and vegetables is associated with increased NCD risk and poor health. 2.8% (1.7 million) deaths are related to low consumption of fruit and vegetables globally. Low fruit and vegetable intake are among the top 10 risk factors contributing to attributable mortality, according to evidence presented in the World Health Report 2003 [6]. Around 9% of stroke deaths, 11% of IHD and 14% of gastrointestinal cancer deaths are estimated to be caused by the insufficient intake of fruits and vegetables worldwide [6]. Bazzano LA et al., examined the relationship between fruit and vegetable intake and the risk of CVD [7]. The study results showed an inverse association between fruit and vegetable intake with the risk of CVD and all-cause mortality in the general US population. In the prospective cohort study with >20 year of follow-up on US adults, it was observed that higher quantity, but not variety, in fruit and vegetable consumption was associated with a lower risk of CHD. The inverse association with total quantity was independent of established dietary and non-dietary CVD risk factors [8].

Results of the study conducted by Yu D et al., suggest that a higher intake of fruits may be associated with lower risk of incident CHD in Chinese adults, particularly women [9]. It was seen that with each 80 gm/d increase in total fruit and vegetable consumption a 6% decrease in CHD incidence was observed; which was primarily driven by fruit intake although, in men, the link between fruit or vegetable intake and reduced risk of CHD was less evident. A similar trend was seen in another study conducted on Japanese adults where

in men there was no significant association between mortality from CVD and fruit intake; however, vegetable intake reduced the risk of CVD. Higher intake of vegetables was associated with reduced risk of death from CVD for women [10].

Nikolic M et al., reported that the benefit of fruit or vegetable consumption is increased proportionally by the number of servings consumed [11]. There was a 60% lower risk of developing CHD for those who had fruit consumption of ≥ 5 items/day in comparison to those in the lowest tertile, compared to subjects who did not consume vegetables. The results highlight that the consumption of fruits and vegetables seemed to provide significant protection against CHD.

Eating fruit and vegetables has an influence on physiological processes which can reduce the risk factors of a wide range of chronic diseases. The positive effects include improving the lipoprotein profile, reducing hypertension and atherosclerosis, and lowering elevated homocysteine level.

FAO/WHO expert consultation reported in the year 2003 on diet, nutrition and prevention of chronic disease. They have set population nutrient goals and recommends intake of a minimum of 400 gm of fruits and vegetables per day for the prevention of chronic diseases such as heart diseases, cancer, diabetes and obesity, specifying that the tubers, e.g., potatoes, cassava, should not be included in fruits and vegetables [12]. Consumption of five or more servings of fruits and vegetables per day is recommended to reduce the risk of CVD through the beneficial combinations of micronutrients, antioxidants, phytochemicals, and fiber in these foods. Indian dietary guidelines recommend an average daily consumption of 300gm for vegetables (portion size=100 gm). The vegetables include (green leafy vegetables=50 gm, other vegetables=200 gm, roots and tubers=50 gm) and 100 gm of fruit [13].

Estimated Consumption of Fruits and Vegetables

The current fruit and vegetable intake varies considerably around the world ranging from as high as 450 gm/day in Western Europe to an intake of 100 gm/day in less developed countries [14]. A 77.6% of men and 78.4% of women from the 52 mainly low- and middle-income countries consumed less than the minimum recommendations (that is, five daily servings of fruits and vegetables) [15].

In India, low consumption of fruits and vegetable intake has been highlighted in the NFHS-3 survey [16] stating that only 40% of women, compared with 47% of men, consume fruits weekly. Among the urban populations of Chennai and Jaipur, the average consumption of fruits and vegetable is reported as 265 gm/day and less than three servings by 72.6% respondents respectively [17]. NSSO data revealed that in India the diet pattern is skewed towards cereals, and fruits and vegetables account for only 9% of the total calorie intake [18].

According to recent data by ICRIER [19], the highest average intake of 4.35 servings per day is reported in Chennai while lowest average intake of 2.81 servings per day is reported in Kolkata depicting the interstate variation in the consumption of fruit and vegetables.

Fruit and Vegetable Intake and Selected CVD Risk Factors

Obesity

Obesity is an increasingly prevalent metabolic disorder affecting the developing world. Globally, one in six adults is obese and in terms of mortality rates, overweight or obesity accounts for nearly 2.8 million deaths [20]. In a study conducted on women to examine trends in the prevalence of overweight-obesity and underweight among women of reproductive age in three South Asian countries it was reported that between 1998-2006, across India as a whole, the prevalence of overweight/obesity among women aged 15-49 years increased substantially, from 10.6 to 14.8% [21].

An essential aspect of fruit consumption in relation to obesity is the impact of fruit on satiety. In a 12-year prospective cohort study among middle-aged women, an inverse association between the increase of intake of fruits and vegetables over time and risk of obesity or weight gain was reported [22]. In another intervention study conducted by Sartorelli DS et al., it was found that an increased intake of 100 gm/day of fruits and vegetables resulted in a weight loss of 300 gm and 500 gm respectively during a nutritional counseling program during six months of follow-up attended by 80 overweight Brazilian adults [23].

Increase in the intake of fruits, vegetables, and low-fat dairy, as part of a calorie controlled diet, helps both achieve and maintain weight loss. All of these dietary components contribute to a reduction of total daily kcal intake. Fruits and vegetables, an important component of healthy weight loss programs provide few calories, but considerable amounts of fiber, vitamins, and minerals [24]. An effective approach for managing body weight while controlling hunger can be attained by decreasing dietary energy density by reducing the intake of fat and combining it with increasing fruit and vegetable intake [25].

Hypertension

High blood pressure is quantitatively the most important, modifiable risk factor for premature CVD, being more common than diabetes, dyslipidemia and cigarette smoking which are the other major risk factors. Globally, it accounts for 47% of all IHD and 54% of all stroke events. It is the most prevalent risk factor in India according to 2011 NCD country profile [26]. A total of 7.5 million deaths, that are about 12.8% of the total deaths are estimated to be caused by raised blood pressure. This accounts for 3.7% (57 million) of the total disability-adjusted life years [27].

Meta-analysis of studies conducted by Li B et al., revealed that the consumption of fruit and vegetables may reduce hypertension risk [28]. In the studies carried out in Asia, a significant inverse association was reported between hypertension and consumption of fruits vegetables. Increased consumption of fruits and vegetables is therefore recommended for the primary prevention of hypertension. An inverse association of blood pressure levels with a high intake of fruits and vegetables is reported in a Mediterranean population with elevated consumption of fat [29]. Results of a 7-year blood pressure follow-up study of middle-aged employed men revealed that a less of an increase in systolic and diastolic blood pressure was related to higher intakes of vegetables and of fruits over time, independent of age, weight at each year, and intake of other foods [30]. The modest beneficial effect on hypertension is seen through improvement in the body weight regulation by higher consumption of fruits and vegetables as a part of a healthy dietary pattern [31].

Diabetes

WHO in 2007 define diabetes as having fasting plasma glucose value of ≥ 7.0 mmol/L (126 mg/dL). Impaired glucose tolerance and impaired fasting glycaemia are risk categories for future development of diabetes and CVD. The proportionate incidence for cardiovascular morbidity and mortality in adults with diabetes ranges from 2 to 5 in women and 1 to 3 in men in comparison to those without diabetes [32]. For each CVD risk factor present, the prevalence of diabetes for all the age groups is estimated to be 4.4% in 2030 which was 2.8% in 2000 depicting a projected steep rise from 171 million in 2000 to 366 million in 2030 [33].

Numerous studies highlight the interrelationship between the reduced risk of developing type 2 diabetes with a higher intake of fruits and vegetables. In a data analysed from 11 different US states with a follow-up of 18 years by Bazzano LA et al., it was reported that there was no significant association between total fruit and vegetable consumption with risk of diabetes while the lower risk of diabetes was associated with fruit consumption [7]. Muraki I et al., reported that increased consumption of fruit juice is related with a

higher risk of developing type 2 diabetes while the consumption of whole fruits, particularly apples, grapes, and blueberries is related to lower risk significantly in the US adults in the data from three prospective cohort studies [34].

Results of the EPIC-Norfolk Study signifies that glucose metabolism may be influenced by the intake of fruits and green leafy vegetables and increased consumption of the same may contribute to the prevention of diabetes, independent of Vitamin C or dietary fiber alone [35].

Dyslipidemia/Raised Cholesterol

One of the most prominent risk factors for CVDs is dyslipidemia. High cholesterol attributes to almost one-third of IHD. In both developed and developing nations, it is a major cause of disease burden. An estimated 2.6 million deaths that account for 4.5% of the total deaths and 2% of the Disability Adjusted Life Years (DALYs) is caused by high cholesterol (WHO, 2009). Fruit and vegetables are a rich source of a wide range of antioxidant compounds such as ascorbic acid, carotenoids, and phenolics. These compounds have been shown to effectively scavenge reactive oxygen species and inhibit lipid peroxidation in vitro [36]. In a clinical trial conducted on young adults, it was reported that fruit and vegetable consumption at least 5 serving/d appears to be effective in improving blood lipid profiles in young healthy adults. The supply of antioxidant components naturally found in fruit and vegetables could be benefit in improving oxidative status as well [37].

Fornés NS et al., reported that the intake of fruit and vegetables was inversely correlated with LDL-cholesterol concentrations in men and women [38]. Subjects in the highest fruit and vegetable intake groups had LDL concentrations that were 6-7% lower than those in the lowest fruit and vegetable intake groups [39]. In a randomised control trial on 436 participants, relative to the control diet, the DASH diet resulted in lower total (0.35 mmol/L, or 13.7 mg/dL), LDL- (0.28 mmol/L, or 10.7 mg/dL), and HDL- (0.09 mmol/L, or 3.7 mg/dL) cholesterol concentrations (all $p < 0.0001$), without significant effects on triacylglycerol [40].

CONCLUSION

Research indicates that fruit and vegetables are vital components of a healthy diet and regular consumption of these might facilitate in preventing the large variety of chronic diseases, especially CVDs and its associated risk factors. WHO recommends a daily intake of at least 400 gm/day of fruits and vegetables for the prevention of chronic diseases. Data indicates that insufficient consumption of the same is a recognised risk factor that attributes to a number of diseases. Eating adequate amounts of fruits and vegetables has a beneficial influence on cardiovascular risk factors particularly improving lipid profile, reducing hypertension and weight management. There is a need to further analyse effective interventions and policy approaches to improve the availability and acceptability of fruits and vegetables and to increase their consumption.

REFERENCES

- [1] Omran AR. The Epidemiologic transition: A theory of the epidemiology of population change. 1971. *The Milbank Q.* 2005;83(4):731-57.
- [2] World Health Organization. Global status report on noncommunicable diseases. Geneva.2014.
- [3] Mote B. A regional epidemiology of India's "NCD"srisk factors" focusing particularly on Maharashtra:A call for "Health promotion" once again. *Int J Med Public Health.* 2016;6(1):26.
- [4] World Health Organization. Non communicable diseases country profiles.2011. <http://www.theworldcounts.com/stories/Causes-of-Non-Communicable-Diseases>.
- [5] World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risks. Geneva.2009.
- [6] World Health Organization. Promoting fruit and vegetable consumption around the world.2018 [online] Available at <http://www.who.int/dietphysicalactivity/fruit/en/index2.html> [Accessed 15 Apr. 2018].
- [7] Bazzano LA, He J, Ogden LG, Loria C, Vupputuri S, Myers L, et al. Dietary intake of folate and risk of stroke in US men and women: NHANES I Epidemiologic Follow-up Study. *National Health and Nutrition Examination Survey. Stroke.* 2008;33(5):1183-88.
- [8] Bhupathiraju SN, Wedick NM, Pan A, Manson JE, Rexrode KM, Willett WC, et al. Quantity and variety in fruit and vegetable intake and risk of coronary heart disease. *The Am J Clin Nutr.* 2013;98(6):1514-23.
- [9] Yu D, Zhang X, Gao Y T, Li H, Yang G, Huang J, et al. Fruit and vegetable intake and risk of CHD: Results from prospective cohort studies of Chinese adults in Shanghai. *The Br J Nutr.* 2013;111(2):353-62.
- [10] Nakamura K, Nagata C, Oba S, Takatsuka N, Shimizu H, et al. Fruit and vegetable intake and mortality from cardiovascular disease are inversely associated in Japanese women but not in men. *J Nutr.* 2008;138(6):1129-34.
- [11] Nikolic M, Nikic D, Petrovic B. Fruit and vegetable intake and the risk for developing coronary heart disease. *Cent Eur J Public Health.* 2008;16(1):17-20.
- [12] Diet, nutrition and the prevention of chronic diseases. Report of a Joint FAO/WHO Expert Consultation. 2003.
- [13] National Institute of Nutrition. (2011). Dietary guidelines for Indians: A manual.
- [14] World Health Organization. (2003). Global Strategy on diet, physical activity, and health. (2003). [pdf]. Available at: http://www.who.int/dietphysicalactivity/media/en/gsfsv_fv.pdf [Accessed 14 May 2018].
- [15] Hall JN, Moore S, Harper SB, Lynch JW. Global variability in fruit and vegetable consumption. *Am J Prev Med.* 2009;36:402-09.
- [16] National Family Health Survey. (2005-06). Mumbai: International Institute for Population Sciences; editor. Calverton, Maryland, USA: ICF Macro2009.
- [17] Radhika G, Sudha V, Sathya R, Ganesan A, Mohan V. Association of fruit and vegetable intake with cardiovascular risk factors in urban south Indians. *Br J Nutr.* 2008;99:398-05.
- [18] National Sample Survey Office (NSSO), Ministry of Statistics and Programme Implementation: Government of India. Household consumption of various goods and services in India: 66th Round (2009-10).2012.
- [19] ICRIER. India's phytonutrient report: Executive summary. 2016. [pdf]. Available at http://icrier.org/pdf/India_Phytonutrient_Report_Ex_summary.pdf (Accessed on 12 July 2018).
- [20] World Health Organization. World Health Statistics 2012[pdf]. Available from: http://www.who.int/gho/publications/world_health_statistics/EN_WHS2012_Full.pdf. [Accessed on 14 July 2018].
- [21] Balarajan Y, Villamor E. Nationally representative surveys show recent increases in the prevalence of overweight and obesity among women of reproductive age in Bangladesh, Nepal, and India. *J Nutr.* 2009;139(11):2139-44.
- [22] He K, Hu FB, Colditz GA, Manson JE, Willett WC, Liu S. Changes in intake of fruits and vegetables in relation to risk of obesity and weight gain among middle-aged women. *Int J Obes Relat Metab Disord.* 2004;28(12):1569-74.
- [23] Sartorelli DS, Franco LJ, Cardoso MA. High intake of fruits and vegetables predicts weight loss in Brazilian overweight adults. *Nutr Res.* 2008;28:233-38.
- [24] Champagne CM, Broyles ST, Moran LD, Cash KC, Levy EJ, Lin P, et al. Dietary intakes associated with successful weight loss and maintenance during the Weight Loss Maintenance Trial. *J Am Diet Assoc.* 2011;111(12):1826-35.
- [25] Ello-Martin JA, Roe LS, Ledikwe JH, Beach AM, Rolls BJ. Dietary energy density in the treatment of obesity: A year-long trial comparing 2 weight-loss diets. *Am J Clin Nutr.* 2007;85(6):1465-77.
- [26] World Health Organization. On-communicable Diseases Country Profiles.2011.
- [27] World Health Organization. A global brief on hypertension: Silent killer, global public health crisis 2013. [online] Available at http://www.who.int/cardiovascular_diseases/publications/global_brief_hypertension/en/ [Accessed September 1, 2018].
- [28] Li B, Li F, Wang L, Zhang D. Fruit, andvegetables consumption and risk of hypertension: A meta-analysis. *J Clin Hypertens (Greenwich).* 2016;18(5):468-76.
- [29] Alonso A, de la Fuente C, Martin-Arnau AM, de Irala J, Martinez JA, Martinez-Gonzalez. Fruit and vegetable consumption is inversely associated with blood pressure in a Mediterranean population with a high vegetable-fat intake: the Seguimiento Universidad de Navarra (SUN) Study. *Br J Nutr.* 2004;92:311-19.
- [30] Miura K, Greenland P, Stamler J, Liu K, Daviglius ML, Nakagawa H. Relation of vegetable, fruit, and meat intake to a 7-year blood pressure change in middle-aged men: the Chicago Western Electric Study. *Am J Epidemiol.* 2004;159:572-80.
- [31] Wang L, Manson JE, Gaziano JM, Buring JE, Sesso HD. Fruit and vegetable intake and the risk of hypertension in middle-aged and older women. *Am J Hypertens.* 2012;25(2):180-89.
- [32] Rivellese AA, Riccardi G, Vaccaro O. Cardiovascular risk in women with diabetes. *Nutr Metab Cardiovasc Dis.* 2010;20:474-80.
- [33] Wild S, Roglic G, Green A, Sicree R, King H. Estimates for the year 2000 and projections for 2030. *Diabetes Care.*2004;27(5):1047-53.
- [34] Muraki I, Imamura F, Manson JE, Hu FB, Willett WC, et al. Fruit consumption and risk of type 2 diabetes: results from three prospective longitudinal cohort studies. *BMJ.* 2013;347:f5001.
- [35] Sargeant LA, Khaw KT, Bingham S, Day NE, Luben RN, Oakes S, et al. Fruit and vegetable intake and population glycosylated haemoglobin levels: the EPIC-Norfolk study. *Eur J Clin Nutr.* 2001;55(5):342-48.
- [36] Vinson JA, Dabbagh YA, Serry MM, Jang JH. Plant flavonoids, especially tea flavonols, are powerful antioxidants using an in vitrooxidation model for heart disease. *J Agric Food Chem.* 1995;43(11):2800-02.
- [37] Suwimol S, Pimpanit L, Apron M, Pichita S, Ratiyaporn S, Wiroj J. Impact of fruit and vegetables on oxidative status and lipid profiles in healthy individuals. *Food and Public Health.* 2012;2(4):113-18.

- [38] Fornés NS, Martins IS, Hernan M, Velásquez-Meléndez G, Ascherio A. Food frequency consumption and lipoproteins serum levels in the population of an urban area, Brazil. *Rev Saude Publica*. 2000;34(4):380-87.
- [39] Djoussé L, Arnett DK, Coon H, Province MA, Moore LL, Ellison RC. Fruit and vegetable consumption and LDL cholesterol: The national heart, lung, and blood institute family heart study. *Am J Clin Nutr*. 2004;79:213-17.
- [40] Obarzanek E, Sacks FM, Vollmer WM, Bray GA, Miller ER, Lin PH, et al. Effects on blood lipids of a blood pressure-lowering diet: The Dietary Approaches to Stop Hypertension (DASH) Trial. *Am J Clin Nutr*. 2001;74(1):80-89.

PARTICULARS OF CONTRIBUTORS:

1. PhD Scholar, Department of Food and Nutrition, Institute of Home Economics, University of Delhi, New Delhi, India.
2. Assistant Professor, Department of Food and Nutrition, Institute of Home Economics, University of Delhi, New Delhi, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Bani Tamber Aeri,
Institute of Home Economics, Department of Food and Nutrition, University of Delhi,
F4, Hauz Khas Enclave, New Delhi-110016, India.
E-mail: baniaeri@yahoo.co.in

FINANCIAL OR OTHER COMPETING INTERESTS: None.

Date of Submission: **Feb 22, 2019**

Date of Peer Review: **Mar 11, 2019**

Date of Acceptance: **Apr 01, 2019**

Date of Publishing: **May 01, 2019**