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Red color foods for heart health: A comprehensive Review

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Red foods and their effect on human health are both helpful and positive. Since they include essential nutrients and phytochemicals that can prevent risk factors for chronic diseases including CVD, diabetes, obesity, certain cancers, inflammation and stroke. Fruits and vegetables play an important role in human health. Natural red pigments found in fruits and vegetables are carotenoids (especially lycopene), anthocyanin and beta cyanine. Lycopene has a variety of beneficial cardiovascular effects, including antioxidant, anti-inflammatory, anti-atherogenic, cardio-protective, anti-platelet, endothelial function enhancement, metabolic profile, and regulation of blood pressure. Results of sweet fruits as wellness promoters, especially antimicrobial, cell strengthening, anti-diabetic, anticancer, hostile to neuro-degeneration, attenuating and cardiovascular effects are described in this study. Strawberries are low energy and delicious foods, also a rich source of vitamin C. In addition to strawberries contain numerous bioactive phytochemicals and vital nutrients. Pomegranate counteracts diabetes, dental disease, male erection, rupture, bacterial contamination, anti-infection obstruction and skin damage caused by shine. A large amount of potassium is found in watermelon, which helps combat heart disease and protects heart health. It typically refers to one of three forms of heart disease prevention when heart experts speak about prevention: secondary, primary and primordial prevention. These measures can prevent a severe stroke or heart attack, stop heart disease progression, and prevent early death. Primary prevention attempts to prevent a person at risk of heart disease from experiencing a first heart attack or stroke that involves surgery or angioplasty, or from developing another type of heart disease.

Keywords: Cardiovascular diseases, Diet, Lycopene, Anthocyanin's, Knowledge, Prevention, Intervention

INTRODUCTION

CVD stays directed to by messiness of the center and veins and combines coronary malady (CHD), vessel upset, fringe course upset, rheumatic coronary malady, and inherent coronary malady. Atherosclerosis is an everlasting challenging illness conveyed about burst or disintegration, which stimulates intense development of platelet-rich thrombus that prevents or blocks the lumen of the blood vessel

halfway and induces CVD clinical occasions, for example, cerebrovascular mishap or insecure angina, myocardial localized necrosis. Conduct hazard factors e.g physical inertia, smoking and undesirable eating schedule for the cause of CVD.

The causes of CVD disease in the heart and blood vessels are coronary heart disease (CHD), cerebrovascular disease, peripheral artery disease, rheumatic heart disease, congenital heart disease, deep vein thrombosis and

pulmonary embolism. Atherosclerosis is a chronic inflammatory condition triggered by erosion or plaque rupture that results in the acute formation of platelet-rich thrombi that obstructs or partially obstructs the arterial lumen, causing CVD clinical events such as myocardial infarction, unstable angina or stroke. (Erdman et al. 2007). For ~80% of CVD, behavioral risk factors such as lack of physical inactivity, smoking and an inappropriate interpretation of diet. Intermediate risk factors for CVD development, including obesity, as well as increased blood pressure, glucose and lipid levels, can quickly result in risk factors for behavior. (2008).

A healthy diet for the heart is always the first step," says Michael Blaha MD, director of clinical research at Johns Hopkins Doctor of heart disease Prevention. "In some patients, we saw a dramatic improvement in cholesterol only through diet." (Masood et al. 2021). These antioxidant-rich fruits, luckily, are just as delicious as they are safe. Fruits and vegetables play an essential role in human health. They contain vital nutrients and phytochemicals that may prevent the chronic disease risk factors, including cardiovascular disease, diabetes, obesity, certain cancers, inflammation, stroke, and septic shock (Steinmetz et al. 1996).

Recently, a 16-year follow-up analysis in the Iowa Women's Health Study found that dietary intakes of several classes of flavonoids, including flavanones and anthocyanidins and certain flavonoid-rich foods were correlated with a decreased risk of death due to cardiovascular disease and chronic heart disease in 34,489 CVD-free postmenopausal women (Mink et al. 2007).

Anthocyanins are water-soluble colorants that are suitable for phenolic blends. Shades in glycosylated structures. Anthocyanin, responsible for shades of red, purple and blue, is found in soil products. Berries, currants, grapes, and some tropical natural foods are high in anthocyanins (Khoo et al. 2017). Carotenoids (lycopene), anthocyanins and betacyanins are common red shades establish in bottom-grown foods. They need useful cell strengthening properties in anticipation of malignant growth and vascular disease. Specialized medical examinations indicate that increased the use of anthocyanin decreases risk of vas deferens, the most commonly known cause of death in men and women's through increasing anthocyanin absorption and describing their metabolic and, in particular, disorders, in order to eventually assess their use for the production of CVD/counteraction

insurance. (Leong et al. 2018). It is a strong limit to cell reward and offers a number of medical blessings, such as decreasing the risk of heart failure and some types of tumors, increasing scaffold stability, and protecting against age related macular degeneration, a significant cause of irreversible visual capabilities. disorder among adults (Gul et al. 2015).

ASCVD risk and healthy dietary patterns

Every year, patients are attacked for launching a new book on "miracle" diets, which claims to promote health, weight loss and reduce the risk of illness. While there is limited scientific evidence for these foods, there are a number of dietary supplements have been shown to control the risk of many chronic diseases and including coronary heart disease. Doctors need to understand each character. Healthy food choices are the basis for validating published health recommendations from the new diet. Evidence based balanced dietary habits are moderately rich in fruits and vegetables, whole grains, legumes and nuts, while some can include small amounts of lean meat, low-fat dairy products and liquid vegetable oils (including poultry and seafood). In these diets, saturated, Trans and solid fats, sodium, added sugar and refined grains are also poor. (Maki et al. 2014).

Potential heart health benefits of red color foods

Strawberries:

Strawberries are tasty foods that are low in energy and are a recognized source of vitamin C. In addition to basic nutrients, some bioactive phytochemicals are present in strawberries.



Figure:1

Table 1: Clinical Guideline for Specific Dietary Habits, Foods and Nutrients

Food Item and Nutrition	Level of Evidence Available and Included in This Paper	Recommendations for Patients
Dietary trend with added fats, eggs, organ and processed meats, fried foods, and sugar-sweetened drinks (Southern diet pattern)	Prospective studies	Avoid
Dietary cholesterol	RCTs and future research along with meta-analyses	Limit
Canola oil	RCT meta-analyses suggest lipid change, but no prospective studies or RCTs for CVD outcomes	In moderation
Coconut oil	Meta-analyses of RCT and observational findings on toxic effects on lipids. No prospective study or RCTs for CVD results	Avoid
Sunflower oil	No prospective study or RCTs for CVD results	In moderation
Olive oil	RCTs that support enhanced CVD results	In moderation
Palm oil	RCTs and observational studies that indicate worsened effects of CVD	Avoid
Antioxidant-rich fruits and vegetables	RCTs and observational studies that show improved CVD results and improved blood lipid performance	Frequent
Antioxidant supplements	Prospective and retrospective studies and RCTs suggest possible harm	Avoid
Nuts	RCT and broad prospective and meta-analysis studies that display enhanced results of CVD	In moderation
Green leafy vegetables	Large meta-analyses and observational studies of different proportions, and a large prospective analysis	Frequent
Protein from plant sources	Broad studies of observational and prospective	Frequent
Gluten-containing foods	Studies of observation and RCTs	Avoid if sensitive or allergic

CVD = cardiovascular disease, RCT = randomized controlled trial.

Table 2: Potential heart health benefits of red color foods

Red colored food sources	Phytonutrients	Heart Health benefits
Strawberries , Tomatoes, Pomegranate, Beets, Red apples, Raspberries, Cherries, Cranberries and red peppers, Oranges,	Lycopene, Flavones, Anthocyanin's, Carotenoids,	Lowers blood pressure, Protects from oxidative damage, Reduces inflammation, Improves lipid markers,

This study focused on phenolic compounds present in many foods and beverages based on plants, for example fruits, vegetables, tea, red wine, and forms a comprehensive and heterogeneous community of secondary metabolites of plants. Two large classes of plant phenols found in food are flavonoids and phenolic acids. Flavonols, anthocyanins, catechins hydroxycinnamic acids, hydroxybenzoic acids and their polymeric derivatives (tannins), including elagitanins and proanthocyanidins are the major subclasses of flavonoids and phenolic acids contained in berries (Macheix et al. 1990).

Tomatoes

Lycopene is present in tomatoes watermelon, papaya, red grapefruit, apricot and guava gives a red color to the tomatoes (Kong et al. 2010). For example, the lycopene content increases at the different stages of fruit ripening, there is a steady increase in lycopene content for tomatoes from the switch to the red level (Saini et al. 2017). Watermelon pulp is a rich source of cis-isomeric lycopene. It is abundant in higher concentrations than in tomatoes (Naz et al. 2014) and can also be used to extract lycopene (Oberoi et al., 2017). Lycopene has a number of beneficial cardiovascular properties including antioxidant, anti-inflammatory, cardio-protective effects, antiplatelet effects, anti-atherogenic, endothelial enhancement (blood flow and nitric oxide bioavailability) metabolic profile (by affecting the synthesis of cholesterol), and regulation of blood pressure (Figure 2) (Klipstein et al., 2000).

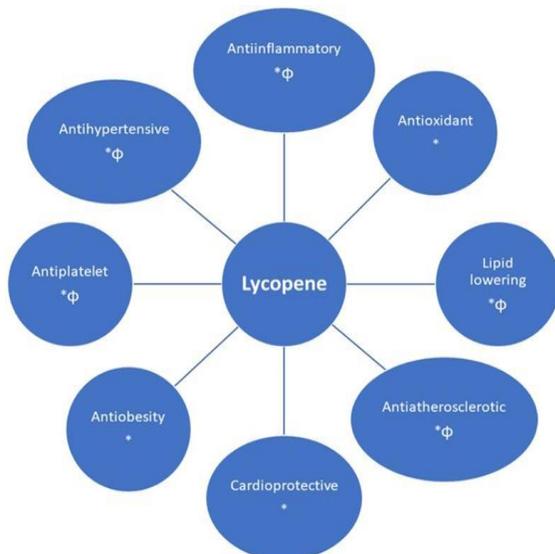


Figure: 2

The correlation among the use of lycopene and the risk of CVD has recently been examined (Mordente et al. 2011) and shows that a small majority of studies have identified an inverse relationship between CVD risk markers and the incidence of CVD (57 percent). High levels of lycopene in adipose tissue and blood associate with a decrease in CVD prevalence (Rissanen TH et al. 2003) and decrease levels are correlated with initial atherosclerosis (Klipstein-Grobusch K et al. 2000) and increased C-reactive protein concentrations (Boosalis MG et al. 1996). The low thickness of the arterial wall correlated with higher body fat concentrations of lycopene implies a low risk of arterial obstruction (Kohlmeier L et al. 1997). The symptoms of inflammation and vascular endothelial dysfunction are inversely linked to serum carotenoids, including lycopene (Hozawa A et al. 2007).

Pomegranate:

One pomegranate contains 1 g of (mostly insoluble) fiber, 12 % of the daily recommended intake of vitamin B6, vitamin C and potassium. Pomegranates are abundant in antioxidants that can minimise the risk of cardiovascular problems, such as heart attacks (Wang et al. 2014). Pomegranates can also help to prevent colon cancer and breast cancer (Mandal et al. 2015). A very generous amount of antioxidants are present in pomegranate juice, which protect brain cells and have anti-cancer effects, considering the many calories it provides (Wolfe et al. 2008). For heart protection and also for treating cancer or inflammation, pomegranate juice is beneficial. It also helps maintain cellular health, which is necessary for individuals who want to maintain their youthful appearance for as long as possible (Wang et al. 2014). Pomegranate juice is considered the healthiest heart. It seems to protect the heart and arteries. Pomegranate peel is also very effective for us. The bark is rich in polyphenols, which show the pharmacological potential of pomegranate caused by the oxidation and preservation activities of ants (Newman et al. 2007). Consuming pomegranate juice can help increase immunity, so it is very beneficial to eliminate toxins from your body. Pomegranate juice is made from antioxidants and consists of high quality vitamins A and C, beneficial for bones and eyesight. It can reduce inflammation in our body and destroy oxidative stress and damage (Adhami et al. 2009).

Pomegranate products are among the most promising food supplements. Although all

pomegranate-derived materials give a larger or smaller amount of pomegranate malignancy results (Seeram et al. 2005).

Beet root:

Beetroot contains primarily pigments called betalain. A family of derivative betalamic acids consisting of betacyanine, betaxanthines and a number of phenolic compounds (Pitalua et al. 2010). A large amount of biologically accessible antioxidants is present in beetroot juice (Wootton-Beard et al. 2011) potassium, magnesium, folic acid, iron, zinc, calcium, phosphorus, sodium, niacin, biotin, B6 and soluble fibre, as well as many other health-promoting compounds. Moreover, the consumption of beetroot juice provides a more sustainable approach to the consumption of whole vegetables. There has been particular concern in beetroot juice because it is a good source of many polyphenolic compounds (Kaur and Kapoor et al. 2002; Pitalua et al. 2010).

Watermelon:

Watermelon is a good source of complex carbohydrates, proteins, fiber, and vitamin C, vitamin A and B. In addition, it also has potassium among other vital minerals like calcium, iron, magnesium and phosphorus. Enzymes, natural sugars and organic acids are also included (Maheshwari S. K et al. 2015).

Eating watermelon also improves heart condition. In watermelon, there is a considerable amount of potassium that helps to prevent heart disease and maintain heart health. It also includes the amino acids citrulline and arginine that help to maintain arteries, blood flow, and overall cardiovascular function. A research conducted by Purdue Lycopene, Bet University and the University of Kentucky in the Journal of Nutritional Biochemistry found that citrulline present in this fruit enhances cardiovascular health. It also has vitamin C and carotene that involves reducing cholesterol and prevents several heart attacks. Adopt a diet rich in antioxidants and low in fat and cholesterol to keep a healthy heart. Watermelon satisfies all these specifications. (Niaz R. S et al. 2014).

Red Apple:

After bananas, the apple is the world's second most eaten fruit. In latest decades, epidemiological studies have shown that the consumption of apples correlates with a decrease in CVD incidence. Apple provides antioxidants

including vitamin C and healthy nutritional polyphenols and is a big source of fiber. In particular, due to the cholesterol-lowering effect of apple polyphenols, the most bioactive compounds concentrated in fruit peeling, the low incidence of CVD is correlated with apple intake (Christensen J. et al. 2010).

A medium-sized apple gives 13-20% of the daily fibre requirement of a person, 9-11% of the daily vitamin C requirement of a person, 4% of the daily potassium requirement of a person. Fiber which can reduce the risk, tends to help regulate blood pressure. Vit C is an antioxidant that, together with other antioxidants, can play a role in the protection of some aspects of heart health. Vitamin C can activate the immune system as well and can help protect the body from diseases and infections. Potassium relaxes blood vessels and decreases the risk of high blood pressure and heart attacks (Gonzalez J et al. 2015).

Cranberries and red peppers:

A substantial decrease in LDL cholesterol (bad cholesterol) and enhanced HDL cholesterol has been shown to occur in blueberries. In one study, after drinking three glasses of blueberry juice a day, the HDL of participants increased by an average of 10 percent - an improvement that correlates to a 40 percent reduction in heart disease (Kruse-Elliott K et al. 2005).

In the same study, the average antioxidant levels of subjects after three servings of juice a day increased by up to 121 percent. A reduced risk of cancer, ageing, Alzheimer's and several other disorders, as well as cardiovascular disease is correlated with high concentrations of antioxidants. Blueberries also boost blood circulation, so people with atherosclerosis will benefit from them (clogging of the arteries). In comparison to 19 other popular fruits, cranberries have the highest amount of antioxidant phenols and the highest potential to remove free radicals of all! The blueberries were followed by apples, red grapes, strawberries, pineapples, bananas, peaches, limes, orange, pears and grapefruits. (Lamoureaux T et al. 2005)

Red meat and risk of cardiovascular diseases:

A dietary risk factor for CVD is known to be the intake of red meat. The risk of eating red meat was mainly linked to saturated fat and cholesterol content. This has contributed to the common proposal to decrease consumption of meat and prefer lean meat (McGuire S et al. 2011). However, there is growing evidence to challenge

this view. It has been shown that the daily consumption of saturated fats are associated with the occurrence of CVD if it is accustomed for the general basic diet and carbohydrate intake. Other substances used during the production and storage of red meat, including sodium or other additives, may be responsible for most of the risk. (Micha et al. 2010).

Because eating patterns influence a broad variety of biological pathways and biomarkers that are intermediate, none or much more alternative results can predict health outcomes (including low-density cholesterol levels [LDL-C]) (Elsevier et al. 2012). Proposed systematic techniques for weighing the impact of eating patterns on endpoints of chronic disease primarily based on literature evidence (Kalantarian S et al. 2012). Similarly, the impact of meat intake on cardiovascular risk has not been studied for most other lifestyle cardiovascular risk factors (e.g., salt intake, dietary cholesterol, fruits, vegetables, nuts, whole grains, smoking, physical activity and obesity) (Turesky et al. 2011).

In broad studies, it is difficult to investigate the role of specific foods, both due to the variation in the interpretation and also the variation of the food itself. In comprehensive and long-term studies, therefore, an appropriate amount of each food is difficult to provide. (Which are often necessary when endpoints are cardiovascular results). Wide researches, in fact, generally choose to use more or less limited food categories. There are significant nutritional variations between different types of meat. Latest research shows that there are some major nutritional variations between red and processed meat. Calorie content, specific fats, sodium, iron or additives (such as nitrites) or specific preparation methods are the most significant among these variations in cardiovascular danger (such as commercial cooking at high temperatures) (Le Marchand et al. 2011).

Meat is sometimes categorized as red (e.g. Lamb, pork, beef) or white (e.g., chicken, turkey, rabbit) depending on its fat, cholesterol and iron concentration. It is possible to preserve both red and white meat, usually by the application of high amounts of salt or chemical preservatives (processed meat), or to consume it without these preservatives (unprocessed meat). It is clear that there are many distinct subcategories in the red meat group, too (Micha R et al. 2010).

In order to research the impact on cardiovascular risk, an appropriate classification may be split into two main groups: unprocessed

and preserved-processed fresh meat (Fernández-Jarne et al. 2010).

Red foods and its inflammation

Red color foods are rich in various phytonutrients that can assist in the regulation of anti-inflammatory, immune activities, antioxidant, including ascorbic acid, astaxanthin, lycopene, quercetin and high anthocyanin levels. Chronic inflammation is associated with immune responses that are irregular or dysfunctional, leading to numerous disorders such as neurological defects, heart disease or cancer, diabetes, obesity, lung disease, immunological illnesses and other disorders that are life threatening. (HC et al.2016).

Red foods such as cherries and tomatoes have a high level of vitamin C. Vitamin C (ascorbic acid) is well established for certain immune system impact, and vitamin C concentrations appear to increase in the body under conditions of elevated inflammation. Several studies have yielded results on cells, animals and humans, red foods and their components (Liugan et al. 2019) can help decrease systemic inflammation and strengthen the immune system by decreasing infections by increasing watermelon intake (A. Basu et al. 2018), apples (Hong et al. 2015), cherries (Sharma et al. 2019), (Showiheen et al. 2019), (Minich et al. 2019), blueberries, pomegranate and raspberry.(Nie et al. 2019), (Denis et al. 2016).

Strawberries

Strawberries are a richest source of anti-inflammatory polyphenols, like anthocyanin, that are shown in 14 healthy overweight adults to decrease the increase in mass-induced inflammation and oxidative stress. Specifically, intake of strawberry drinks before the meals (Tsitsimpikou et al. 2014).

One study found that overweight adults with knee arthritis drank a freeze-dried strawberry drink for at least twelve weeks (about 50 gm daily) and was more helpful compared to the control drink in decreasing plasma biomarkers of inflammation and also degenerating collagen (Burton - Freeman et al. 2012).

Strawberry supplementation decreased constant, intermittent and even total pain, leading to research that concluded that strawberries in obese adults had analgesic and anti-inflammatory effects, the condition known as knee osteoarthritis adults who were overweight and consumed a rich mass. in carbohydrates, with moderate fats and

then included strawberries or any drink associated with it in diet drinks with inflammation diminished with strawberries, measured by high sensitivity (Valderas-Martinez et al. 2016).

Thirty-six subjects were subdivided into two classes for type 2 diabetes. Two cups of freeze-dried strawberry beverage (50g) of freeze-dried strawberries were drank by the group receiving treatment, approx. In a controlled trial, fresh strawberries or macronutrients equivalent to 500 g - placebo powder with strawberry flavoring every day for at least six weeks. The supplementation of freeze-dried strawberries decreased the CRP level similar to the base. There was a crossover configuration in which 14 women and ten men were advised to eat a six-week strawberry or placebo drink, accompanied by a six-hour carbohydrate or fat meal with evaluations. (Huang et al. 2016). The response to a high-carbohydrate or fat meal after six weeks of drinking strawberry beverages reported lower chronic inflammation compared to placebo. The intake of strawberries for drinks showed results in the decrease of postprandial concentrations at about six hours. Summarizing strawberries, especially in the form of frozen drinks, seems to reduce the inflammatory response over time.

Tomatoes

Tomatoes have been studied worldwide in a range of categories, from raw tomatoes to tomato juice, and much more, in isolated phytonutrients derived from tomatoes such as lycopene. (Ogura et al. 2016). They have large amounts of vitamin C, flavonoids such as fiestin, and carotenoids such as lycopene. There is also a comment that the alkaloid content of tomatoes is inflammatory for people sensitive to these compounds from different consumer-oriented websites and different organizations.

Even the results of an animal study (Bibi et al. 2018) showed that, when administered individually, both lycopene and tomato powder supplementation were very beneficial and effective in reducing inflammatory and cardiovascular problems with a high-fat diet. In addition, through decreasing phosphorylation levels at the University of Medical Sciences in Tehran, a group of 106 obese and overweight students randomly received either 330 ml of juice, both additional formats helped to decrease, and decrease inflammatory and lipid markers for about twenty days of tomatoes, or water a day. The comparison with the treatment group and initial serum levels in overweight and obese female

participants decreased. Other researches have shown that tomato juices or tomato-based beverages have protective effects on inflammation. In some other tomato juice research, people with metabolic syndrome experienced a substantial increase in inflammation and endothelial function after drinking tomato juice four days in a week for two months comparison with the control subjects. Especially when tomato products have been effective in alleviating oxidative stress caused by post - prandial lipid and affiliated inflammatory response when consumed with high-fat meals (Jacob et al. 2008).

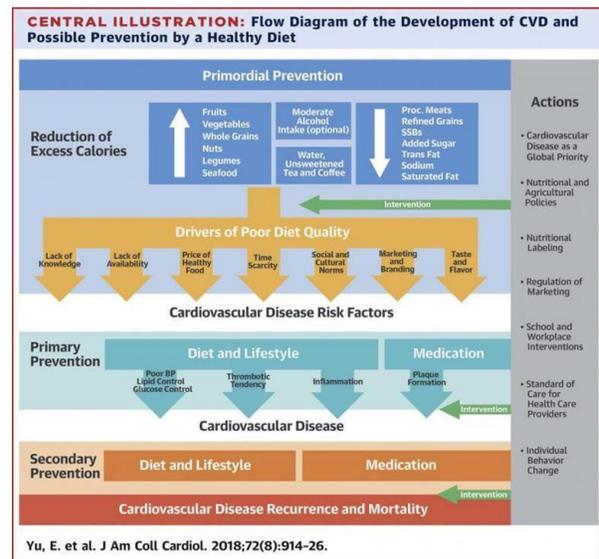


Figure: 3

In order to increasing plasma HDL cholesterol, tomato sauce or tomato sauce with processed olive oil reduces total cholesterol levels, triglyceride levels, other inflammatory cell and serum biomarkers (Riso et al. 2006). Greater changes in the adhesion molecules of plasma and vascular cells were caused by the incorporation of oil to the tomato sauce. Overall, studies have concluded that tomatoes, when included in a meal, can compensate for the inflammatory markers associated with cardio muscle and oxidative stress.

CONCLUSION

Red fruits and vegetables have various effects on the health of the body. These will improve the functioning of the body in addition to helping to fight inflammation. There is a wide range of fruits such as different berries, potatoes, pastas or tomatoes that are linked to the improvement of cardiac health. Furthermore, red wine intake leads

to adverse effects on cardiac health.

CONFLICT OF INTEREST

The authors declared that present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

TT, KR¹ and HBUA originally came up with the idea of the article and wrote the manuscript. IJ, HS, KR², MJ, PK substantially contributed in literature review, drafting and formatting. TK, FI, MA, RS gathered the literature and managed references. SM and MI has critically revised the manuscript and provided supervisory support. All authors read and approved the final version.

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