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The Health Benefits of Vegetables; Preventive Implications for Chronic Non-Communicable Diseases

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Abstract

Low vegetable consumption correlates to an increase in the prevalence of noncommunicable diseases (NCDs) such as obesity, cardiovascular disease, and cancer, which are the leading causes of mortality worldwide. As a result, the purpose of this review was to consolidate present evidence on the health benefits of vegetable consumption and their potential action of mechanism in NCDs prevention. Low vegetable consumption is related to socio-economics, psychological concerns, culture, environment, social support and vegetable practice. Vegetables contain an antihistamine, anti-inflammatory, diuretic, and notably antioxidant qualities, and they have been shown to help prevent and cure NCDs, cancer, and heart disease. Vegetables are the best providers of vitamin A, a nutrient that is essential for many metabolic processes in the body. In addition to being an antioxidant, veggies include folate and potassium, which are proven to prevent birth abnormalities, cancer, and heart disease. Several nations have created a broad strategic effort for the prevention and management of NCDs and their related risk factors. In order to accomplish the strategic plan's goals successfully and efficiently, a greater knowledge of the burden of dietary risk factors and their contribution to NCDs is necessary.

Keywords: vegetables, consumption, chronic diseases, prevention, constraints

1. Introduction

Malnutrition is the highest percentage in South Asia (33%) and Sub-Saharan Africa (21%) specifically, which is responsible for 60% of the 10.9 million deaths annually among children under five years [1]. In addition to influencing health and wellbeing, malnutrition causes physical and mental damage, resulting in poor educational outcomes and negatively affecting their adult lives [2], suppressing the body's immune system, risk of non-infectious and transmissible diseases, reduction of productivity, and other negative social and economic consequences for individuals, households, societies, and nations [3]. About 805 million people are estimated to be chronically undernourished in 2012–2014, down more than 100 million over the last decade and 209 million lower than in 1990–1992 [4].

Consuming a diverse range of foods that provide all of the nutrients required to sustain life is essential for a healthy human diet [5]. Vegetables, in particular, could help prevent NCDs [6] and control micronutrient deficiencies in resource-poor communities [7–10]. Since vegetables are rich in vitamins, minerals, dietary fiber, and low in calories, they are required for the normal functioning of the human body [11]. Sufficient intake of vegetables has been related epidemiologically to a reduced risk of many non-communicable diseases [12–16].

Micronutrient deficiencies linked with malnutrition are the most common nutritional deficiencies in the world, causing significant developmental difficulties, and they are a key indication of poor nutrition and health [17]. Low birth weight, sex, age, rural residency, infectious illness, malnutrition, poor wealth status, and household food insecurity were all linked to it [18]. Iron, vitamin A, zinc, and iodine are critical micronutrients for children's growth, development, and survival, making them critical in terms of global public health [19]. Both iron deficiency anemia and iodine deficiency diseases have been shown to impair cognitive development in children, resulting in reduced educational attainment and, as a result, a detrimental influence on economic growth [20]. Vitamin A deficiency also affects immune function and leads to an increased risk of morbidity [21]. Zinc deficiency may lead to growth failure and impaired immune function [22]. Both vitamin A and zinc deficiencies increase the risk of mortality in children. Children under five years of age are particularly vulnerable to micronutrient deficiencies due to the relatively high requirements of micronutrients for rapid growth and development [23]. Micronutrient deficiencies are currently being addressed by strengthening nutrition information systems, monitoring, and evaluating mechanisms [24] that conceptualize optimal nutrient intake using a variety of foods across and within food groups [25]. Lately, the governments of developing countries have sought to promote diversification of production and exports away from traditional commodities in order to accelerate economic growth, expand employment opportunities, and reduce rural poverty. Market-oriented production could allow households to increase their income by producing output with higher returns on land and labor and using the income generated from sales to purchase goods for consumption [26].

NCDs account for the majority of the global disease burden, disproportionately affecting low and lower-middle income countries [27]. According to recent estimates, innovative, cost-effective, and feasible interventions could prevent 82% of NCD-related premature deaths. CVDs, type 2 diabetes, cancer, and chronic obstructive pulmonary disease were the most common NCDs [27]. This rising burden adds to the stress on already overburdened health systems, disproportionately hurting the poorest people and impeding countries' social and economic growth. According to the WHO, Ethiopia's annual mortality rate from NCDs was 34% in 2008 [28]. CVDs accounted for 15% of all deaths, followed by malignancies at 4%, respiratory illness at 4%, diabetes at 2%, injuries at 9%, and other NCDs at 9%, according to the research. Misganaw et al. [29] conducted a study in Addis Abeba that looked at the cause of mortality (51%) due to NCDs. Another study found that among NCDs, cardiovascular disease (CVD) was the leading cause of death (24%), followed by malignant neoplasms (10%), respiratory tract diseases (9%), and diabetes (5%). Furthermore, the study found a substantial increase in mortality from NCDs between the ages of 44 and 74 years, with a large increase in death from NCDs between the ages of 44 and 74 years. Another population-based survey in Jimma, Ethiopia found that the total prevalence of NCDs was 8.9%, with 3.1% for diabetes, 9.3% for hypertension, 3.0% for CVDs, 1.5% for asthma, and 2.7% for mental illness [30].

2. Driving barriers to vegetable consumption

Many of the empirical literature reviews revealed that people consumed few vegetables. Accordingly, the vegetable consumption trend was reported in Ethiopia and Uganda studies with a prevalence of 20 and 12.7%, respectively [31]. There is a variation in household consumption patterns, depending on specific geographical and socio-cultural characteristics. A high percentage of caloric consumption comes from cereals, and per capita intake of calories is relatively higher in rural areas than in urban areas [32, 33]. In Ethiopia, cereals, together with Kocho (Ensete), and vegetables, contribute 85% of the total food intake per person per day [33]. A study conducted in the rural Sima area by Kebebu [34] reported that there was negligible consumption of meat, fish, or vitamin A-containing vegetables. Consumer preferences influence whether or not they consume anything. Poor households have no choice but to rely on cheap sources of energy such as grains and starchy staples until they meet physiological demands to satisfy hunger. Households begin to expand their meals by incorporating animal food sources, dairy products, and vegetables once their fundamental energy demands have been met [35].

Due to several factors, nutrient-dense food crops such as pulses and vegetable types are not consumed [34]. Most published research on the drivers of food demand has always concentrated on the impact of income and prices throughout the world [36, 37], while only a few have looked into the demand features (both economic and noneconomic variables) of healthy foods like vegetables [37–41]. The following variables were found in several systematic studies focused specifically on factors affecting vegetable consumption [37, 39, 42–45]. Biological determinants, such as gender, age and food properties; economic determinants, such as income and price; physical determinants, such as time, cooking skills, accessibility, availability (production) and living area; social determinants, such as marital status, having children, education, family, peers, cultural values, habits and meal patterns and also other social factors (preparation, storage and handling of food). Psychosocial factors at the consumer or individual levels, such as individual taste preferences, consumer awareness, quality consciousness, intra-household decision making power, working status of women, social support, intention, attitudes, beliefs, and traditions, as well as geographical and environmental stage of change, motivation, and knowledge, all interact in a complex manner to shape dietary consumption patterns of an individual and household.

2.1 The physical environment

Lack of time is frequently mentioned as a barrier to vegetable consumption, as well as convenience and knowledge of how to prepare and cook vegetables [46]. According to the FAO, food availability is defined as the availability of sufficient quantities of food of appropriate quality, supplied through domestic production or imports. Accessibility is an important physical factor influencing food choice, reflecting the fact that people's living environments have an impact [39, 47]. The quantity of vegetables consumed by a population can vary depending on where they live. In all 11 nations (Bangladesh, Congo, Ivory Coast, Ecuador, Kenya, Paraguay, Philippines, Tunisia, Ukraine, and Zambia), those residing in urban areas were more likely to have a poor vegetable intake [48]. Overall vegetable intake was greater in urban regions compared to rural ones, according to a meta-analysis of household spending surveys done in 10 Sub-Saharan African nations [49]. Similarly, rural Americans in the United States were less likely than their urban

counterparts to consume the required number of daily vegetable servings [50]. A research done in middle-income nations found no variations in vegetable intake between urban and rural residents [51].

Furthermore, 42% of households did not produce any of the common vegetables, respectively. It explained that while their own production of vegetables was significantly better in rural areas, their market availability was significantly better in urban areas [52]. Furthermore, Tadesse [35] conducted an analysis of changes in food consumption patterns in urban Ethiopia, which confirms that urban household consumption has begun to shift away from staple food grains and toward high-value food products. The relative availability of vegetables has decreased in most countries and is still well below the recommended level in both developed and developing countries [53]. The proportion of households who reported having cultivated vegetables in their gardens even once over the year is considered negligible [52]. In a study of Dutch adults, Kamphuis et al. [54] discovered that the availability of a wide range of vegetables throughout the year was positively related to vegetable consumption [39], especially among individuals with higher socioeconomic levels. Previous research in high income nations found that the season had an influence on vegetable intake. Indeed, decreased vegetable consumption was related to the winter season [43]. The seasonal availability of several vegetables limits their use in low-income SubSaharan African nations [49]. According to studies, having a vegetable garden and eating veggies has a beneficial link. As a consequence, people with at least one family member engaged in a community garden program were more likely to consume more vegetables, according to research performed in the United States [55].

The proportion of households that produce adequate vegetables in their gardens is negligible [52, 56]. Home gardening is increasingly being used as a strategy for improving food quality, reducing food insecurity, saving money, and building a more sustainable food system because it provides immediate access to fresh food for households [57, 58]. The study in Ethiopia found that the majority of vegetable producers' households have been found to be more food secure than their nonproducing counterparts [52, 56, 59]. A study also indicates that home gardens benefit households by providing better access to a diversity of plant and animal food items, leading to an overall increase in dietary intake [60] and improving the bioavailability/absorption of essential nutrients [61]. More recently, a study conducted amongst US older adults suggested that compared to non-gardeners, gardeners were more likely to consume vegetables [62]. According to central statistics agency (CSA) [63], the total area under vegetables is about 12,576 hectares, which is insignificant as compared to other food crops; vegetables constitute 2.7% of the total area of all crops. Production decisions are partly determined by consumption needs, and that consumption partly depends on production opportunities [33, 49]. Vegetables are highly perishable, so the cost of getting them to or from the market will be high for households in remote rural areas [49, 64]. Thus, the consumption of some vegetables may be constrained by whether or not they can be grown by the household. Access to water, seeds, and information on horticultural production methods may limit both production and consumption of vegetables [33, 49]. Information from the FAO [24] statistical database suggests that the total supply of fruit and vegetables available is 173 kg per person per year, which divided into 111.6 kg of vegetables.

2.2 Psychosocial aspects

2.2.1 Consciousness, desire, beliefs and attitudes, phases of change, and purpose

A review of studies on the psychosocial predictors of vegetable consumption among adults, primarily conducted in Europe and the United States, found that

self-efficacy (also known as perceived behavioral control, which refers to people's perception of their ability to perform a given behavior) was the strongest predictor of vegetable intake [39]. Other characteristics, including obstacles, attitudes and beliefs, stage of change, and intention, according to research, might also influence vegetable intake, but to a lesser extent. Nonetheless, this was less consistent among trials [45]. Recent studies, one on obese Canadian adults [65] and one on US students [66], found that perceived behavioral control was a major predictor of intention to consume vegetables. Furthermore, research of US males and immigrants found that reduced perceived obstacles as well as an advanced stage of transformation were related to increased vegetable intake [67]. The majority of these psychosocial elements are often employed in psychosocial models such as the Social Cognitive Theory, the Health Belief Model, the TransTheoretical Model, and the Theory of Planned Behavior [42]. The goal of such models is to forecast either the intention to consume vegetables or the intake of vegetables. Ajzen's Theory of Planned Behavior is one of the most often utilized models (1991).

2.2.2 Sensory properties and preference

Taste is a key impact on food choice, and individual preferences typically determine consumer decisions about what they eat. In a study of older Irish individuals, Appleton et al. [68] found that higher vegetable consumption was related to a higher liking for vegetables in a study of older Irish individuals. A similar finding was reached in young adults in the United States [69]. In a systematic review, Pollard et al. [44] published data from two studies focused on the connection between flavor and vegetable intake, one performed in the Netherlands and one in the United States.

2.2.3 Cultural and social support

The diet is based on locally available produce and local agricultural practices; it goes beyond that to the extent that food habits are culturally defined. Food preferences are, in turn, strongly determined by culture and tradition because, generally, what is acceptable as food is dictated to a large extent by cultural norms. A study based on dietary habits learned during childhood seems to be predictive of vegetable intakes in adulthood [54]. Therefore, individuals who ate a lot of vegetables during their childhood usually remain good consumers in adulthood. Social support was significantly associated with vegetable intake [39, 45, 70]. Moreover, there is a misconception among most of the population that the monotonous diet is adequate and superior to vegetables [33, 35, 52]. Eating at fast food restaurants was related to eating significantly less vegetables [71]. Similarly, a study conducted among young Australian adults reported that subjects eating takeaway food at least twice a week were less likely to meet the dietary recommendations for vegetables [72]. Several research studies on children and teenagers found that meal habits, particularly dining together as a family and viewing TV during meals, were associated with vegetable consumption [73, 74]. These studies found that viewing television while eating was linked with lower vegetable intakes in both children and adolescents, but dining together as a family was associated with higher vegetable consumption [75].

The World Health Survey 2002–2003 conducted among adults reported that gender-specific worldwide prevalence of low vegetable consumption, mainly in low and middle-income countries, showed that 78.0% (77.6% of men and 78.4% of women) consumed less than the minimum recommended five daily servings of vegetables. Indeed, in five countries (Comoros, Dominican Republic, Guatemala, Morocco, and Paraguay), women consume fewer vegetables than men, whereas in the remaining ten countries (Czech Republic, Estonia, Hungary, Slovakia, Slovenia, Spain, Swaziland,

Ukraine, Uruguay, and Vietnam), women consume more vegetables than men [48]. Hall et al. [48] found that Men's low vegetable intake ranged from 36.6% (Ghana) to 99.2% (Pakistan), whereas women's consumption ranged from 38.0% (Ghana) to 99.3% (Pakistan) [48].

But many studies specifically indicate that women consume more vegetables than men [44]. Furthermore, most studies investigating the relationship between vegetable consumption and age conclude that the amount of vegetables consumed increases with age [50, 76], and in Canada among adults [65]. On the contrary, in Iran, Esteghamati et al. [51] reported that older adults were more likely to be low consumers. In Canada, a national representative survey reported that middle-aged adults consumed fewer vegetables compared to younger and older adults [77].

Low vegetable consumption was associated with age and tended to increase with age and a decrease in prevalence from the 40–49 year age to the 50–59 year age. The oldest age stratum had a higher risk of eating fewer vegetables compared to younger adults in 26 countries, compared to one or more younger age groups in all countries. But in Brazil and Uruguay, the youngest age group has a higher risk of low vegetable consumption [48]. But in Nigeria, demand for vegetables is higher among households with younger members, compared to households with older members [78]. The World Health Organization Survey reported that Ethiopian women (64.1%) had a higher risk of low vegetables than men (57.7%) [48]. Women are more concerned about a healthy diet and more often classify foods according to the assumed nutrient content than men, i.e. the share of products of vegetable origin is higher in women's diets [79]. The European Journal of Public Health published a survey report on gender differences in the consumption of meat and vegetables from Western European countries such as Finland and the Baltic countries, showing that men ate meat more often while women ate vegetables [79]. Other studies done in diverse circumstances found that women eat more vegetables than males in Europe [76, 80–82], Iran [51], Canada [77], and the United States [50].

2.3 Economic access and the household's income

Households' ability to purchase food depends on the households' income and the price of food. Regardless of the source of food, households must have the means to acquire appropriate foods, and economic access therefore refers to the affordability of food for the consumer. In some of the lowest income countries, households may spend as much as 60% of their income on food, versus 15% or less for households in high-income countries [49, 64]. A meta analysis of 52 mainly low- and middle-income countries showed that the prevalence of low vegetable consumption decreased with increasing income. The poorest community had the highest prevalence of low vegetable consumption, whereas the richest community had the lowest prevalence [48] (Burundi, Ethiopia, Ghana, Guinea, Kenya, Malawi, Mozambique, Rwanda, Tanzania, and Uganda). From the study in sub-Saharan Africa, researchers investigated a positive trend of increasing consumption of vegetables as gross domestic product per capita goes up, even if the trend is not fully linear [49].

Vegetables account for a small proportion of the food share budget, ranging from less than 4.5% in Ethiopia to 15.6% in Rwanda [49]. In studies conducted in several countries, such as Australia [83], Canada [77], Finland [84, 85], France [76], and the United States, higher socioeconomic status was associated with higher vegetable consumption. Several studies have found that those living in higher-income neighborhoods tend to consume more vegetables, while people living in the most disadvantaged regions tend to consume considerably fewer vegetables than people living in the most advantaged areas [86]. Research from the U.S. indicates that those in low-income households are less likely to meet the

U.S. Department of Agriculture guidelines for vegetable consumption [87]. Only Kocho and vegetables cover 55% of the daily intake in the low income group, whereas low (15%) in the high income group. The demand for high-value food items (e.g. meat, milk, vegetables, and fruits) increases with income, which implies that poor households are unlikely to access them [63]. Households with income near to subsistence level consume large quantities of grains and starchy staples and few fruits, vegetables, meat, milk, and milk products.

The most often mentioned impediment to vegetable intake is cost [44, 46]. As a result, the exorbitant cost is mostly related to a person's income or socioeconomic position, which is often based on income, education, and work; hence, income and cost are inextricably intertwined and will not be handled independently. The 2002–2003 World Health Survey discovered a substantial link between vegetable intake and income in 33 of 52 nations. With the exception of Ghana, the number of poor vegetable eaters fell as wealth increased in all of these nations [48]. However, a study conducted on the effect of distance and cost on vegetables Consumption in Rural Texas revealed that neither access nor cost was related to vegetable consumption among white respondents. Among blacks, the cost was also not associated with rural consumption [88]. Only 15% of breastfeeding children aged 6–23 months consumed vitamin A-rich vegetables or foods made from roots and tubers [63]. The consumption patterns are determined by the combination of four main factors: the production level in the community garden, income level, preferences of the household, and market prices. Accessibility and availability are core [39, 49, 89].

2.4 Social

2.4.1 *Children and marital status*

There is a compromise when it comes to marital status and vegetable consumption, with married people being more likely to consume more vegetables. However, this link is less obvious when it comes to having children. Indeed, numerous studies [39, 43, 44] found that being married was linked with higher vegetable intakes than being single in systematic reviews focused on a variety of factors of vegetable consumption. Two European research studies found that married status was a greater predictor of vegetable intake in males than in women [54, 81]. Having children has mixed correlations, according to Kamphuis et al. [43]. Indeed, studies have found a negative relationship between having children and vegetable consumption, i.e. parents consume less vegetables [90]; others have found that this relationship varies depending on ethnicity in the US population; and others conducted in the UK concluded that median vegetable intakes were not significantly different between women who had or did not have children under the age of 16 years [91].

2.4.2 *Food knowledge and skills*

People with a greater level of education consume substantially more veggies. This connection is frequently influenced by income, as more education is generally associated with a larger salary. There is research that suggests a link between education and vegetable intake. Positive associations between vegetable consumption and education have also been reported for Irish adults [81], French adults [76], US adults [50], Finnish adults [92], and Swedish adults [93]. Studies conducted in Canada reported that higher education was associated with purchasing greater amounts of vegetables [94] and with higher intakes of vegetables [77]. A study that looked at the relationship between income and vegetable intake at different levels of education found that Finnish people with low education reported greater

vegetable intakes if their income was higher than individuals with intermediate or high education [85]. A comprehensive analysis of the connection between food consumption and dietary knowledge discovered that consumption of vegetables was positively associated with knowledge among people living in high-income nations [45]. Some studies, the majority of which were conducted in high-income countries, found that a high level of nutrition knowledge, specifically knowledge about the health benefits of high vegetable consumption and knowledge about the associations between diet and diseases, was associated with higher vegetable intakes [45, 67, 95–97]. The only study conducted in low- and middle-income countries discovered the opposite, namely that there was no relationship between diet knowledge and vegetable intake in South African Black adults [98].

Baker and Wardle [80] found that older individuals with higher awareness of the link between vegetables and illnesses ate considerably more vegetables, in both men and women, in a study of older adults in England. Other authors who focused on procedural nutrition knowledge, which is defined as knowledge of how to eat a balanced diet, found that Swiss men who answered correctly consumed more vegetables [99]. Other studies conducted in Africa with low income also showed that the level of education attained and knowledge gained were positively correlated with more consumption of vegetables [15, 49, 100, 101]. In this literature review, it is also recognized that a level of education attained positive associated nutritional value knowledge of vegetables. Knowledge alone will not ensure adequate health intake practice. The appropriate practice of vegetable consumption was, however, not as high as knowledge. The major reasons for this lower proportion of practice as compared to knowledge are the cost of food items and seasonal availability [101]. Knowledge of the nutritional value of vegetables was found to be statistically associated with sex, with females having higher knowledge than their male peers [49, 101]. The only study conducted in low and middle-income countries found the opposite, namely that there was no association between diet knowledge and vegetable intakes in South African Black adults [98].

Furthermore, climate and weather conditions, harvesting and handling techniques, packaging, storage and transportation facilities, market situation, diseases and pests were identified as major causes of post-harvest [111] loss in Dirre Dewa, Ethiopia, with post-harvest losses ranging from 20 to 50% between marketing and consumption [102]. Seid et al. [103] found that the severe postharvest loss and quality deterioration of vegetables mainly occurred during harvesting followed by marketing, transporting and storage [103]. Another study done in Akaki, Ethiopia showed that cabbage post-harvest loss in the supply chain was 58.9% [104]. This might be due to storage/transportation temperature, mechanical damage during transportation, disease infection, poor quality of irrigation water, poor storage mechanisms. In 2015, postharvest loss of vegetables occurred at the retail level (56% for bananas) due to rotting before reaching consumers in Ethiopia [105]. Besides, postharvest loss assessment was conducted in Jimma town, Ethiopia and the result indicated that the postharvest losses of mango and banana were 35.5% and 40.0%, respectively [106].

3. Vegetable nutritional value and health mechanism

Based on the evidence of the role of vegetables in the prevention of many health problems, the FAO and WHO have recommended that people eat at least 240 g of vegetables per person per day, or alternatively, three servings a day. The standard portion size is assumed to be 80 g and the studies reviewed showed that, on average, this is appropriate. Actual portions, on the other hand, tend to be lower for

vegetables and higher for fruits: at least two servings (160 g) of fruits and three servings (240 g) of vegetables, with at least one serving of vegetables involving dark green and leafy or orange vegetables (nutrient-rich vegetables), or approximately 146 kg per capita (per person) per year of fruit and vegetables combined (excluding potatoes and other starchy tubers, cassava, and sugar). This recommendation was based on a dose-response effect, which indicates an increased risk of disease at <200 g/day; yet little benefit >240 g/day. This quantity is believed to provide sufficient micronutrients and to reduce the risk of chronic diseases by ensuring adequate supply, availability and consumption of vegetables around the world [107–109]. Also, they create opportunities for smallholder farmers, a source of a better life for the economy as well as significant for improving feeding behavior for people [24]. Low vegetable intake is the main contributor to micronutrient deficiencies in the developing world, especially in populations with low intakes of nutrient-dense animal source foods such as meat and dairy products, which are expensive for low-income individuals [15, 40].

Accordingly, sufficient intake of vegetables has been related epidemiologically to a reduced risk of many non-communicable diseases [10, 28]. There are mainly three arguments that explain the health benefits of vegetables. Firstly, the large contribution of vegetables to micronutrients (especially provitamin A carotenoids, vitamin C and E, folate, and minerals, such as potassium or magnesium, which are probably involved in beneficial health effects, i.e., a decreased risk of NCDs. Secondly, the protective effect, due to certain antioxidants, such as vitamin C, carotenoids and polyphenols, against NCDs such as cardiovascular diseases, neurodegenerative and metabolic diseases and certain cancers. Five of the ten leading global disease burden risk factors identified by the World Health Report [19] are among the major causes of these diseases: high blood pressure, high cholesterol, obesity, physical inactivity, and insufficient consumption of vegetables. Four factors in the epidemiology of these diseases, such as poor diet and nutrition, physical inactivity, and tobacco and alcohol use, are of devastating importance to public health [10]. Diet and nutrition are recognized as key factors in the promotion and maintenance of good health throughout the entire life course [53]. Dietary behaviors like intakes of diets low in vegetables and high in sodium contribute significantly to the non-communicable disease burden in Ethiopia [110]. Vegetables also contain minerals such as potassium, magnesium, and, less importantly, iron and calcium, which are hard for the body to absorb and use [109]. A cross-sectional study in Gilgel Gibe found that 9% of the population is affected by chronic diseases [111]. The Ethiopian nationwide study reported a strong association between nutritional impairment and the development of chronic diseases such as cardiovascular diseases, cancer, and diabetes [112]. The survey reported the prevalence of chronic disease and its risk factors in the rural Jimma area of Ethiopia and found that the overall prevalence of chronic disease was 8.9%, and 80% of the rural subjects studied had at least one risk factor for chronic disease [111].

Recent research has shown that dietary calcium intake from vegetable consumption aids in bone mass formation in children aged 8–20 years [113–115]. Many studies have found that eating fewer vegetables than recommended is a risk factor for edentulism [114, 115], which is the condition of having lost all of one's natural teeth [116]. Indeed, numerous studies have shown evidence that nonstarchy veggies may lower the incidence of cancers of the mouth, larynx, pharynx, esophagus, and stomach. Furthermore, some foods, such as allium vegetables, may help prevent stomach cancer, and garlic may help prevent colon cancer [25]. A beneficial effect of consumption of vegetable-origin food is based on the presence of nutrients and phytochemicals including energy, fiber, B vitamins, vitamin C, antioxidants, potassium, flavonoids, and other identified and unidentified food compounds that provide

good health for both children and adults. Health benefits include antihistamine, anti-inflammatory, diuretic, and especially antioxidant properties, and they have a proven preventive role in cancer processes [117]. Much research has focused on the possible mechanisms of action of phytochemicals in preventing or treating NCDs, cancer, and heart disease [118, 119]. Phytochemicals treat cancer by neutralizing free radicals, inhibiting enzymes that activate carcinogens, and activating enzymes that detoxify carcinogens. They protect against cancer by blocking or suppressing active carcinogens or tumor promoters from reaching target tissue [118–120]. The blocking actions could include activating enzymes that detoxify carcinogens, trapping carcinogens, or inhibiting cellular events linked to tumor formation. Study findings suggest that phytochemicals have also been promoted for the prevention and treatment of heart disease and may reduce the risk of coronary heart disease by preventing the oxidation of low-density lipoprotein (LDL) cholesterol, reducing the synthesis or absorption of cholesterol, normalizing blood pressure and clotting, and improving arterial elasticity [119, 120]. Some of these phytochemicals, such as phenolic compounds and sulfides, are marked by a broad spectrum of health-promoting functions [121] as cited by Charles et al. [118].

Dietary fiber (from fruits, vegetables, cereals, and pulses) has been shown to delay the absorption of carbohydrates after a meal and thereby decrease the insulinemic response to dietary carbohydrates [118, 119, 122, 123]. Since the water retention capacity of fiber adds bulk to fecal bolus, solidifies feces, aids bowel movements and brings beneficial physiological effects such as improving glucose intolerance, gastrointestinal functioning through keeping water, lowering total and LDL in the blood cholesterol level and prevention of some forms of cancer, especially colon cancer [12, 14–16, 122, 123]. Recent studies have concentrated on a specific kind of oligosaccharide: fructo-oligosaccharides (FOS), which have appealing physiological features such as low caloric values (approximately 2 kcal/gram), sweetness, limited potential for producing caries, and effects similar to those of dietary fiber. It is regarded as a prebiotic due to its ability to modify colon flora by promoting the selective growth of groups or individual species of bacteria that discourage the settlement of pathogenic bacteria. Additionally, FOS fermentation acidifies the environment, thereby reducing carcinogen production [117, 122]. Fiber increases satiety, reduces hunger, and decreases energy intake by reducing the absorption of carbohydrates, thus reducing possible hyperglycemia and serum insulin levels from carbohydrate-rich foods and increasing insulin sensitivity through which they might have a positive effect on preventing one of the risks for type II diabetes, hypertension, and obesity. Because most vegetables are low in energy density, due to high water and low fat content and usually being fiber rich. Given that obesity is perhaps the most potent risk factor in the development of type 2 diabetes, the evidence indicated that the effects of dietary fiber due to its role in weight management were prevented by weight gain [118, 119]. According to the WHO, raising individual vegetable consumption up to the theoretical minimum-risk distribution may lower the global burden of disease for ischaemic heart disease by 30% for men and 31% for women and for ischemic strokes by 18% for men and 19% for women. The possible reduction in illness attributed to an increase in vegetables was 19% for stomach and esophageal cancers, and 19% for gastric cancer. Attributable risk fractions were lower for lung and colorectal cancers, at 12% and 2%, respectively. Overall, it is estimated that up to 2.7 million lives could potentially be saved each year if vegetable consumption were sufficiently increased [107].

Vegetables are the most important sources of vitamin A, a nutrient important for several metabolic activities in the body, in addition to its role as antioxidant; vegetables provide folate and potassium that are known to prevent birth defects, cancer, heart disease, hypertension and stroke; vegetables are good sources of minerals such as iron, zinc, calcium, potassium, and phosphorus [124–128]. Although concerns

with respect to the bioavailability of vitamin A from green leafy vegetables have been raised [129, 130], consumption of cooked and pureed green leafy vegetables was shown to have a beneficial effect on improving vitamin A status [131–135]. Based on World Health Organization [27] recommendations suggesting unavailability of dark green leafy vegetables for more than six months in an area as indicative of increased risk to Vitamin A deficient, Inadequate intake of foods containing vitamin A is basically due to lack of access to vitamin A rich foods, which is a function of inadequate production, inadequate availability in the market or inability to purchase the foods.

4. Conclusion

Because of their high quantities of dietary fiber, vitamins, minerals, and phytochemicals, vegetables are included in dietary guidelines. Vegetable intake can protect against a number of serious and expensive NCDs, such as cardiovascular disease, type II diabetes, some cancers, and obesity. Despite the various health advantages of vegetables, impoverished nations frequently fail to reach the 240 g daily requirement for vegetable consumption. Efforts must be increased to promote vegetable consumption and battle cost-effective and preventable noncommunicable diseases. Furthermore, vegetable promotion is more likely to be economically acceptable to governments and the food industry than policies that restrict consumption of unhealthy foods. Despite the fact that the burden of noncommunicable diseases is increasing, health systems and public health policies have mostly focused on infection management and nutritional deficiencies. Low vegetable consumption is related to economics, age, gender, psychological concerns, family members, educational attainment, insufficient nutritional understanding, culture, the environment, social and vegetable practice concerns, according to this review. The presence of nutrients and phytochemicals, such as energy, fiber, B vitamins, vitamin C, vitamin A, antioxidants, potassium, flavonoids, and other recognized and undiscovered dietary components, contributes to the positive effect of vegetable consumption in both children and adults. Phytochemicals fight cancer by neutralizing free radicals, inhibiting enzymes that activate carcinogens, activating enzymes that detoxify carcinogens, and preventing active carcinogens or tumor promoters from reaching the target tissue. Some of these phytochemicals, such as phenolic compounds and sulfides, have a diverse range of health-promoting properties. Vegetables are essential for delaying carbohydrate absorption after a meal and thereby lowering the insulinemic response to dietary carbs. Fiber's water retention capacity adds bulk to fecal bolus, solidifies feces, aids bowel movements, and has beneficial physiological effects such as improving glucose intolerance, gastrointestinal functioning by keeping water, lowering total and LDL in blood cholesterol levels, and preventing some forms of cancer, particularly colon cancer. Fiber promotes satiety. Fiber increases satiety, decreases hunger, and decreases energy intake by reducing carbohydrate absorption, thereby lowering the possibility of hyperglycemia and serum insulin levels from carbohydrate-rich foods and increasing insulin sensitivity, which may have a positive effect on preventing one of the risks for type II diabetes, hypertension, and obesity. As a result, nutrition education through multisectoral approaches should be enhanced to boost vegetable consumption and prevent the incidence of NCDs.

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