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Fiber Gap in the Daily Diet of Indian Population: A Narrative Review

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ABSTRACT

Dietary fiber (DF) is made up of lignin, which is an intrinsic component of plants but cannot be broken down by the body. Consuming DF improves insulin sensitivity, controls the release of specific gut hormones, and has an impact on a number of metabolic and inflammatory indicators linked to metabolic syndrome. Despite several recommendations by experts for emphasizing increasing fiber intake many population groups continue to consume less fiber on a daily average basis than advised which may cause the emergence of various chronic disease conditions. The objective of this study was to understand dietary fiber consumption in the Indian population and to identify the role of awareness and knowledge about dietary fiber for better health outcomes. A narrative review of the current literature was performed. We used PubMed and Google Scholar for this purpose and reviewed all potential and relevant articles written in English, with no restrictions on the date of publication. As per this paper, numerous scientific studies support the many and various health advantages of dietary fiber and the hazards of a diet low in fiber. Also, it was observed that the disparity between knowledge and attitude toward the intake of dietary fiber could limit its health benefits and thus better knowledge and awareness about dietary fiber could be determinants of healthy eating behavior in the Indian Population. However, further intervention studies should be carried out to disseminate information on the emotional, cognitive, and sensory aspects of food choices in order to close the gap between nutrition knowledge and the adoption of healthy high-fiber diets.

Key Words: *Dietary fiber, Fiber knowledge, Fiber intake, Fiber recommendations, Fiber in an Indian diet*

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INTRODUCTION:

Dietary fiber, according to epidemiologic research, is important for preventing obesity, type 2 diabetes, cancer, and cardiovascular disease (CVD).[1] Regular consumption of dietary fiber, especially those derived from cereal sources, may benefit health in a variety of ways, including lowering cholesterol levels, regulating weight, improving glucose metabolism, lowering blood pressure, and reducing chronic inflammation.[2]However, many population groups continue to consume less fiber on a daily average than is advised. This pattern of DF use may be harmful to your health. One of the major reasons for reducing fiber intake is attributed to the cost of wholegrains which is believed to be higher than that of their refined counterparts, and the availability of cereal items that are a good source of fiber is thought to be limited. [1, 3]

Aim and Objective: To understand dietary fiber consumption in the Indian population and to identify the role of awareness and knowledge about dietary fiber for better health outcomes and healthy living.

Methods: We performed a narrative review of the current literature. We used PubMed and Google Scholar for this purpose. The search terms were 'dietary fiber intake' in combination with 'fiber gap in diet', and 'knowledge, and perception of fiber intake'. We identified almost 1,447,689 articles by literature search. However, we excluded duplicated articles, not relevant articles, and articles with only abstracts and titles. We reviewed all potential and relevant articles written in English, with no restrictions on the date of publication.

The rationale for the study:

Human health and food habits are closely related. In 2000, Hu and colleagues identified two major dietary patterns, which are the Prudent diet and Western diets. [4] The prudent diet is seen as healthful and is characterized by higher intakes of fish, poultry, whole grains, legumes, vegetables, and fruit. The Western diet is characterized by a high intake of red meat, fat, and refined carbs in comparison to the Prudent diet. Due in part to the lack of dietary fiber in the Western diet, the Western diet raises the risk of non-communicable diseases, particularly gastrointestinal and metabolic disorders.

Defining Dietary Fiber:

According to the widely accepted definition derived from Codex Alimentarius Alinorm in 2009, dietary fiber is considered an edible carbohydrate polymer with three or more monomeric units that are resistant to endogenous digestive enzymes and thus are neither hydrolyzed nor absorbed in the small intestine. [5]

The reduced intake of dietary fiber in the Indian population

In India, a traditional meal consisted primarily of plant-based foods to meet daily macronutrients, micronutrients, and fiber needs, such as grains (cereals, millets), pulses, local seasonal vegetables, and fruits. Although fiber has always been the most crucial element of Indian diets, its advantages have typically been underestimated. In addition, the demand for and consumption of canned, packaged, ready-to-eat (RTE), and processed food has increased due to urbanization. Traditionally prepared foods are increasingly being replaced by easily accessible processed foods. Also, with increasing awareness, a lot of consumers have become aware that they are being deprived of some food compounds, that may be of immense importance to health. [6,7]

Classification, Types, and Sources of Dietary Fibers

DF can be categorized into various groups according to their function in the plant, the type of polysaccharide they are made of, based on their solubility in the gastrointestinal environment, where they are digested, what they produce after being digested, and as per their physiological classification. However, none of them is ideal because the limits cannot be utterly specified. The method for separating dietary components based on their fermentability in an in vitro setting employing an aqueous enzyme solution representative of human digestive enzymes has been the most frequently accepted classification for dietary fiber. Thus, it is most reasonable to divide dietary fiber into two groups: those that are water-insoluble or less fermented, such as cellulose, hemicellulose, and lignin, and those that are water-soluble or well fermented, such as pectin, gums, and mucilages.[8] The classification of dietary fiberon the basis of water solubility and fermentability is presented in Table 1

Table 1: Classification of dietary fiber based on their solubility.[8]

Characteristic	Fiber Component	Food sources
Water insoluble/ Less fermented	Cellulose	Cereals (various brans), fruits, vegetables
	Hemicellulose	Cereal grains, timber, legumes
	Lignin	Woody plants, vegetables, cereals
Water soluble/ Well fermented	Pectin	Fruits skin, vegetables, legumes, apples, potato
	Gums	Leguminous seed plants (guar, locust bean), seaweed extracts (carrageenan, alginates), microbial gums (xanthan, gellan
	Mucilages	Plant extracts (gum acacia, gum karaya, gum tragacanth)

In varying amounts, soluble and insoluble fibers can be found in a variety of food sources, including cereals, nuts, seeds, fruits, vegetables, legumes, and vegetables. Soluble fiber is derived from a range of sources and widely known ones are modified maltodextrins (which reduce blood glucose and promote the growth of healthy bacteria), inulin (from wheat, onions, banana, and chicory or synthesized) a probiotic, and laxative in nature or oligofructose fructooligosaccharides, shown to be associated with inulin or is formed as a by-product of bacterial or fungal action on inulin. Insoluble fiber is composed of the structural components of plant cells. Cereals, seeds, beans, many fruits and vegetables, and bran and whole grain are food sources of insoluble fiber. Insoluble fiber helps to facilitate weight loss and cut back the risk of carcinoma, and cardiovascular disease. Although fibers are present in a wide range of plant-based food sources, consumption is low in many countries.[6]

Vegetables, fruits, whole grains, and whole pulses are where Indian cuisine gets most of its high fiber content. Vegetables can be served separately, with grains or pulses, or in non-vegetarian recipes. They can also be used in salads, as a side dish, in spiced pastes (chutneys), or combined with curd (raita). For later use, some vegetables are dried (such as mint, fenugreek, or moringa leaves) or pickled (such as turnips, carrots, or black carrots). Traditional cooking methods of India such as soaking, sprouting, and fermentation are enriched to enhance the fiber content of grains, pulses, and legumes. When high GI starches (such as rice, potatoes, sweet potatoes, or pasta) are cooked, cooled, and then gently reheated, the RS content rises, reducing the total glycemic reaction. [7]

Prebiotics and their health benefits.

Prebiotics are non-digestible carbohydrates that stimulate the growth of beneficial intestinal bacterial species to promote and maintain a healthy colonic microbiota ecosystem (microbiome) in large part from the fermentation of fiber

to short-chain fatty acids (SCFAs). The sources of prebiotics are significantly influenced by fiber-rich, plant-based dietary patterns. Several traditional Indian preparations and whole-grain products such as cereals, legumes, nuts, seeds, and starchy vegetables provide good prebiotic functions.[7,9]

Healthy dietary patterns, high in non-digestible carbohydrates from whole plant foods have been shown to improve gut health, lower elevated LDL-cholesterol, lower the risk of excessive weight gain and obesity, and lower the risks of cardiovascular disease (CVD), coronary heart disease (CHD), and mortality, lower the risks of several cancers, stroke, and type 2 diabetes, and increase the chances of successful aging.[9]

Evolution of Fiber in our Diet:

High-fiber plant-based diets (50 g total fiber/day) played a key role in the development of the human gastrointestinal tract, cardiometabolic system, and immune system.[9]The advent of plant and animal agriculture some 10,000 years ago caused a permanent environmental shift that had a profound effect on human physiology and health.[10] The evolution in nutrient characteristics of preagricultural wild foods is depicted in the flow chart below:

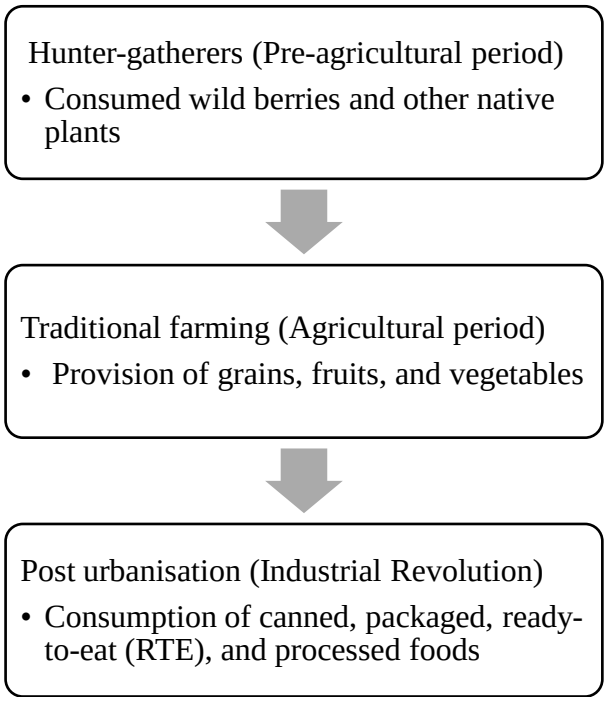

Figure 1: Evolution in nutrient characteristics of preagricultural wild foods.[9,10]

Post urbanization, and mass globalization of Western dietary patterns in the 20th and 21st centuries, traditionally prepared foods are increasingly being replaced by easily accessible processed foods.[10] The amount of fiber in the diet is reduced by several processing techniques, such as grinding grains to produce refined flour and canning fruits and vegetables, among others. [6]

The Western diet is low in fiber, which increases the risk of weight gain, inflammation, chronic diseases, and other health issues. This risk of colonic microbiota dysbiosis is linked to poor immune, cardiometabolic, and energy regulation functions.[9] Only roughly 3 percent of men and 6 percent of women regularly ingest 14 g fiber/1000 kcal, the threshold amount deemed acceptable for optimal health, given the current high prevalence of the Western diet.[9] Although there is research on the DF content of foods accessible in India, Indian diets have the ability to lower the prevalence of a number of risks conditions. [6]

Recommended DF intake:

The amount of fiber is recommended based on energy intake. Fiber intake of 30 g/2000 kcal is considered to be safe as per ICMR-NIN,2020. The USDA's Dietary Guidelines for Americans recommend that fiber intake in the general population, be around about 25 g/d -28g/d for women and 31 to 34 g/d for men. According to the American Diabetes Association, patients with diabetes should consume the same amount of fiber as the general population. No particular suggestions for the optimal DF kinds have been provided, but it is suggested that around 50% of all grains consumed should be whole grains. It has been acknowledged that a fiber intake of >50 g/d is difficult to achieve without the use of DF supplements.[11,12]

The soluble-fiber forms, such as guar gum, glucomannan, xanthan gum, psyllium, pectin, alginate, -glucan concentrates, inulin, and resistant maltodextrin are the most often used DF supplements. A meta-analysis of studies using isolated fiber sources (pectin or guar gum) or fiber-enriched ingredients (oat bran or psyllium) confirmed that

viscous fiber significantly reduces LDL-cholesterol levels whereas no effect of soluble fiber is seen on HDL-cholesterol or triglycerides.[13] Also, in a recent randomized study, it was observed supplementation of inulin and resistant maltodextrin changed the composition of gut microbiota by stimulating the growth of potentially beneficial bacteria and also had a positive impact on blood pressure and glucose metabolism. [14]

Fiber Intake in Different Countries

There is ample proof that fiber is important for maintaining blood sugar levels (low glycaemic index [GI]), triglycerides, and cholesterol levels (binding by fiber components and increased excretion), and regulatory bodies like the FDA have approved health claim labels for many sources of good fiber.[9]The industrialization of Western nations has steadily altered the diet, and fiber intake is minimal. Therefore, the main causes of the loss in fiber consumption were an increase in daily calorie intake, the refining of flours, and a decrease in the consumption of bread high in fiber (such as those made with oat, granola, barley, and wheat). Every nation has unique dietary traits; certain diets, like the Mediterranean and Japanese diets, are seen as healthy, while others, like the Western diet, are heavy in saturated fats, and foods high in sugar and low in fiber are regarded as unhealthy.[15] The average fiber consumption in different countries is mentioned in Table 2.

Table 2: Fiber intake in different countries

Countries	Fiber Consumption
Germany	Women (23g), Men (25g)
France	15-22g
European countries	Women (16-20g), Men (18-24g)
United States	15-16g
China	10-11g
India	15–30 g

According to a 2005–2006 survey, Germany has the greatest average consumption of fiber among Western states, with women taking 23 g and many consuming 25g daily. Other countries lag behind, with average daily intakes of 15 g for women and 20 g for men. Only a century ago, the French enjoyed an abnormally high fiber diet. However, the average daily fiber intake in France is currently between 15 and 22 g, which is less than the recommended amount recommended by a nutritionist.Overall, dietary fiber intake for adults living in European countries was 18–24 g per day for men and 16–20 g per day for women, with grain products (including bread) providing the largest source of dietary fiber.[16] Consumption of fiber is substantially lower in the US. According to observational studies, just around 5% of Americans consume enough fiber,As per the National Health and Nutrition Examination Survey (NHANES) data, the mean daily fiber intake is 16.2 grams which is substantially low that the recommended range defined as 14 g of fiber per 1000 kcal.[15,17]

The Chinese diet has a lower daily intake of fibre, according to a study that compared it to the Mediterranean, Japanese, and American diets. This ancient Chinese diet, which was high in fibre, has changed in recent years due to the growth of the economy into an unbalanced diet typical of contemporary living.[18]

Due to the abundance of unprocessed grains and vegetable products in the Indian diet, it is simple to consume the recommended amount of fiber each day. However, the amount of fiber consumed each day varies based on socioeconomic categories, with women consuming less fiber than men (15–30 g/day) and tribal populations consuming even less fiber (15–19 g/day). DF intakes are often higher in diets based on wheat or millet than in diets based on rice. Cereals constitute around 80% of the fiber in diets consumed in India, especially among low-income groups. Fruits, vegetables, and legumes make constitute the majority of the diets of high-income groups, which means that they include more soluble non-starch polysaccharides (NSP) in the diets of the poor-income group, even though the total NSP content of the two groups' diets may be the same. [6,15]

Knowledge and Perception of Dietary Fiber

Every stage of human life benefits from balanced eating habits and a healthy lifestyle, which may also be helpful in the prevention and treatment of some diseases. Consumers need to understand the fundamental benefits and drawbacks of the food they eat. In a balanced diet, dietary fiber (DF) is one of these components. [3,19]A study was conducted in rural and urban areas of Bangladesh by Ahmed and colleagues which reported the requirement of awareness and consumer education in order to increase DF intake. [20] Recently, a survey was conducted in Croatia which emphasized the importance of nutritional knowledge of healthy foods. The findings from the study reported that the knowledge of fiber intake differs depending on age, gender, education level, and locality of rural versus urban areas.[21]Very similar findings were observed from a study in Romania which demonstrated the vital role of knowledge, information, and community intervention regarding fiber consumption and its role in healthy living.[22] Thus, from the above finding, it could be considered that better knowledge and awareness about dietary fiber could be determinants of healthy eating behaviour

CONCLUSION:

Consumption of dietary fiber has declined, although the intake of sugar and animal protein has increased, and the diversity of microorganisms in the human gut microbiome has decreased. These occurrences may interfere with the microbiome's ability to produce SCFAs and so contribute to the emergence of chronic inflammatory diseases. This finding emphasizes the necessity for us to deliberately include foods with high fiber content in our daily lives. Fiber, now it is termed dietary fiber (DF), has been accorded the scientific importance it deserves. People who consume a lot of dietary fiber have a much lower risk of getting conditions like coronary heart disease, stroke, hypertension, diabetes, obesity, and some gastrointestinal illnesses. Increasing fiber intake decreases serum cholesterol and blood pressure. In both non-diabetics and diabetics, increasing soluble fiber consumption increases glycemia and insulin sensitivity.Thus, increasing dietary fiber in our daily life is essential and must be done promptly and consistently.[19]

Now, to improve our daily intake of dietary fiber it is vital to impart nutritional information. When making food selections, it's crucial to pay attention to fiber content labeling. This food composition information is vital for consumer food choice behavior and may influence the food selection that is beneficial for better health outcomes. [2] Fortification of foods extracted or synthesized with non-digestible carbohydrates or employing them in dietary supplements also constitutes a strategy to increase fiber intake.[23]

Limitation: This is not a systematic review of the literature. Further intervention studies should be carried out to disseminate information on the emotional, cognitive, and sensory aspects of food choices in order to close the gap between nutrition knowledge and the adoption of healthy high-fiber diets.[1]

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