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THE DIABETES BURDEN IN INDIA AND THE NUTRITIONAL PROMISE OF MILLETS IN ITS PREVENTION AND CONTROL

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ABSTRACT

India is witnessing a significant rise in the prevalence of diabetes mellitus, particularly type 2 diabetes, across various age groups and genders. This surge is accompanied by an increase in diabetes-related complications, including cardiovascular diseases, neuropathy, nephropathy, and retinopathy, which contribute to heightened morbidity and mortality. Many researchers have highlighted the potential role of millets, a group of small-seeded grains, in the prevention and management of diabetes and its complications. Millets are rich in dietary fiber, have a low glycemic index, and contain bioactive compounds that may aid in glucose metabolism and insulin sensitivity. This review is an attempt to review findings from national and international studies to provide a comprehensive understanding of diabetes prevalence across different demographics in India, the common complications associated with the disease, and the role of millets in its prevention and management.

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1. INTRODUCTION

Diabetes mellitus has emerged as a major health concern in India, with a marked increase in prevalence over the past few decades. Factors such as urbanization, sedentary lifestyles, and dietary transitions have contributed to this rise. The complications arising from uncontrolled diabetes further exacerbate the health challenges, leading to increased healthcare costs and reduced quality of life. Amidst this scenario, traditional dietary components like millets are gaining attention for their potential therapeutic benefits in diabetes management. This review aims to synthesize existing literature on the prevalence of diabetes across various age groups and genders in India, the associated complications, and the role of millets in prevention and management.

1.1. PREVALENCE OF DIABETES IN INDIA ACROSS AGE GROUPS AND GENDERS

The prevalence of diabetes in India has shown a consistent upward trend over the past few decades. According to the Global Burden of Disease Study, the crude prevalence of diabetes in adults aged 20 years or older increased from 5.5% in 1990 to 7.7% in 2016. The age-specific prevalence of diabetes in India increased with increasing age in both

1990 and 2016. The divergence between the prevalence in 1990 and 2016 started in young adults, becoming statistically significant for men at 50–54 years (from 10.1% in 1990 to 13.6% in 2016) and for women at 55–59 years (from 10.4% in 1990 to 13.5% in 2016) and remained significant in all older age groups.

Regional disparities exist, with southern states like Tamil Nadu and Kerala, and union territories like Delhi and Goa, reporting higher prevalence rates. Urban areas tend to have higher prevalence compared to rural regions, attributed to lifestyle differences and dietary patterns (Atre,2018; Anjna et al. 2017).

1.2. PREVALENCE OF ETIOLOGY OF COMPLICATIONS ASSOCIATED WITH DIABETES

Diabetes is associated with a range of complications that significantly impact the quality of life and increase healthcare costs. Microvascular complications such as retinopathy, nephropathy, and neuropathy are common. For instance, a study in rural Goa reported neuropathy in 60% of diabetic patients, retinopathy in 15.4%, and nephropathy in 8.9%. (Vac et al. 2011) Macrovascular complications, including coronary artery disease (CAD) and peripheral vascular disease (PVD), are also prevalent. Another study found retinopathy in 23.7% of patients, proteinuria in 19.7%, CHD in 11.4%, and PVD in 4.0% (Anjana et al. 2017, Ramachandran et al. 2000).

The causes behind high prevalence of complications in India include delayed diagnosis , approximately half of diabetics in India are undiagnosed until complications appear (WHO SEARO, 2021).

Poor glycemic control, inadequate Screening, lack of Patient Education are some of the important causes of development of diabetic complications. Many patients are unaware of the importance of routine monitoring and lifestyle management., Comorbid Conditions like Hypertension, obesity and dyslipidemia are highly prevalent among Indian diabetics. Access to endocrinologists, podiatrists, and specialized care is severely limited in rural areas. Cost of drugs, diagnostics, and follow-ups prevents many from adhering to treatment protocols (Mohan et al, 2001; Anjana et al, 2017; Atre 2019).

Hence, the causes of these complications are multi factorial, including poor glycemic control, hypertension, dyslipidemia, and genetic predisposition. Lifestyle factors such as physical inactivity and unhealthy diets further exacerbate the risk.

Millets as a Functional Food in the Prevention, Management, and Reversal of Diabetes

Nutritional and Functional Composition of Millets

Millets, a group of small-seeded grasses, have been traditionally consumed in India and are now recognized for their health benefits, particularly in diabetes management. Millets are rich sources of dietary fibre (6-12%) and complex carbohydrates these grains also contain resistant starch. These grains are also contain certain essential amino acids like tryptophan and methionine. Magnesium, zinc, calcium, iron, and B-vitamins are important micronutrients present in these mighty grains. Millets also contain polyphenols and antioxidants , such as ferulic acid, tannins and flavonoids. This unique composition contributes to improved satiety, slower carbohydrate digestion and reduced postprandial blood glucose spikes in diabetics.

2. MECHANISMS OF ACTION OF MILLETS

2.1. LOW GLYCEMIC INDEX (GI) AND SLOW GLUCOSE RELEASE

Millets typically contain a low to medium GI (35–55) as compared to polished white rice (70–75) or refined wheat flour (65). The slow digestion and absorption of carbohydrates from millets leads to a gradual rise in blood glucose levels, helping avoid hyperglycemic spikes. A study by Lakshmi et al. (2017) published in Nutrition Research demonstrated a significant reduction in postprandial glucose levels in T2DM patients consuming foxtail millet versus white rice.

High Fiber and Resistant Starch Content

Dietary fiber and resistant starch in millets delays the gastric emptying thereby reducing overall caloric intake and provide satiety for a longer period of time. The slower digestion also improves insulin sensitivity. These effects collectively contribute to better glycemic control and weight management, a key aspect in diabetes therapy.

2.2. ANTIOXIDANT AND ANTI-INFLAMMATORY EFFECTS

Millets are rich in polyphenolic compounds such as ferulic acid and tannins, which may reduce oxidative stress implicated in β-cell damage. Millet consumption can lower chronic inflammation associated with insulin resistance and complications such as nephropathy and neuropathy (Sharma et al. 2021).

2.3. IMPROVED GUT HEALTH AND SHORT-CHAIN FATTY ACID (SCFA) PRODUCTION

Millets support gut microbiota diversity, leading to increased SCFA production such as butyrate, propionate. These short chain fatty acids can enhance insulin sensitivity, reduce systemic inflammation,improve gut barrier integrity, which is often compromised in diabetics.

Certain preclinical studies and small human trials suggest millet- induced gut modulation supports glycemic control and reduces insulin resistance. Anitha et al. (2021) conducted a meta-analysis across 65 studies, concluding that millet consumption led to reduction in fasting blood glucose by 12% and HbA1c by 0.5–1.2% with improved insulin sensitivity. Antonio et al. 2020 demonstrated that a finger millet-based diet improved lipid profiles and reduced glycemic load in T2DM patients (Narayanan et al 2016).

Incorporating millets into the daily diet can serve as a preventive strategy against diabetes and its complications. Public health initiatives promoting millet consumption, along with awareness campaigns and policy support, can play a crucial role in combating the diabetes epidemic in India.

2.4. IMPACT OF MILLETS ON DIABETIC COMPLICATIONS

Studies have shown that millets can lower LDL cholesterol and triglycerides owing to their high fiber and phytosterol content. Their magnesium and potassium content supports blood pressure regulation, reducing risk of stroke and myocardial infarction.

Low-protein and high-fiber millet diets may slow the progression of kidney damage. Polyphenols in millets reduce oxidative stress in renal tissues. Antioxidants like ferulic acid and quercetin found in millets protect neuronal and retinal cells from glucose-induced oxidative damage. Long-term millet consumption may reduce AGEs (Advanced Glycation End-products), which contribute to microvascular complications. High-fiber millet diets improve satiety hormones like leptin and reduce ghrelin, aiding in weight loss, which is critical in preventing insulin resistance and metabolic syndrome (Fu et al, 2020; Fu et al. 2021, Kim et al. 2018, Shanmugam et al. 2013).

3. CONCLUSION

Millets are not merely an alternative grain but they are a functional food with evidence-backed benefits in diabetes prevention, control, and complication management. Their low glycemic response, nutrient richness, prebiotic potential, and anti-inflammatory properties make them an ideal component of a therapeutic diet in the Indian context. Promoting millet consumption can help mitigate India's growing diabetes epidemic through a natural, sustainable, and culturally acceptable solution.

In conclusion, the integration of millets into daily diets offers a promising, culturally appropriate strategy for the prevention and management of T2DM. Their multifaceted benefits, ranging from glycemic control to modulation of gut microbiota potray their potential as functional foods in combating the diabetes epidemic.

CONFLICT OF INTERESTS

None.

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REFERENCES

Anitha, S., Kane-Potaka, J., Tsusaka, T. W., Botha, R., Rajendran, A., Givens, D. I., & Bhandari, R. (2021). A Systematic Review and Meta-Analysis of the Potential of Millets for Managing and Reducing the Risk of Developing Diabetes Mellitus. Frontiers in Nutrition, 8, 687428. https://doi.org/10.3389/fnut.2021.687428

Atre, S.(2019).The burden of diabetes in India. Lancet Glob Health, Vol 7, Issue4, e418.

Anjana, R. M., Deepa, M., Pradeepa, R., Mahanta, J., Narain, K., Das, H. K., Adhikari, P., Rao, P. V., Saboo, B., Kumar, A., Bhansali, A., John, M., Luaia, R., Reang, T., Ningombam, S., Jampa, L., Budnah, R. O., Elangovan, N., Subashini, R., Venkatesan, U., ICMR–INDIAB Collaborative Study Group (2017). Prevalence of diabetes and prediabetes in 15 states of India: results from the ICMR-INDIAB population-based cross-sectional study. The lancet. Diabetes & endocrinology, 5(8), 585–596. https://doi.org/10.1016/S2213-8587(17)30174-2

Anitha, S., Kane-Potaka, J., Tsusaka, T. W., Tripathi, D., & Upadhyaya, H. D. (2021).Can millet consumption help manage hyperlipidemia and obesity?: A systematic review and meta-analysis. Frontiers in Nutrition, 8, Article 647214. https://doi.org/10.3389/fnut.2021.647214

Antonio, J. P., Sarmento, R. A., & de Almeida, J. C. (2019). Diet Quality and Glycemic Control in Patients with Type 2 Diabetes. Journal of the Academy of Nutrition and Dietetics, 119(4), 652–658. https://doi.org/10.1016/j.jand.2018.11.006.

Banerjee, P & Maitra, S (2020). The Role of Small Millets as Functional Food to Combat Malnutrition in Developing Countries. Indian Journal of Natural Sciences.

Vol.10 ; 60.

Devi, P. B., Vijayabharathi, R., Sathyabama, S., Malleshi, N. G., & Priyadarisini, V.B. (2014). Health benefits of finger millet (Eleusine coracana L.) polyphenols and dietary fiber: a review. Journal of food science and technology, 51(6), 1021–1040. https://doi.org/10.1007/s13197-011-0584-9

India State-Level Disease Burden Initiative Diabetes Collaborators (2018). The increasing burden of diabetes and variations among the states of India: the Global Burden of Disease Study 1990-2016. The Lancet. Global health, 6(12), e1352–e1362. https://doi.org/10.1016/S2214-109X(18)30387-5

Muthamilarasana, M., Shobana, S., & Henry, C. J. (2016). Dietary Interventions for Type 2 Diabetes: How Millet Comes to Help. Frontiers in Plant Science, 7, 1454. https://doi.org/10.3389/fpls.2016.01454

Kam, J., Puranik, S., Yadav, R., Manwaring, H. R., Pierre, S., Srivastava, R. K., & Yadav, R. S. (2016). Dietary Interventions for Type 2 Diabetes: How Millet Comes to Help. Frontiers in plant science, 7, 1454. https://doi.org/10.3389/fpls.2016.01454.

Lakshmi, K. P., & Kaul, M. R. (2017). Comparative study of glycemic index of rice and millets. Nutrition Research, 41, 70–75.

Mohan, V., Deepa, M., Deepa, R., Shanthirani, C. S., & Farooq, S. (2001). Prevalence of coronary artery disease and its relationship to lipids in a selected population in South India: The Chennai Urban Population Study (CUPS No. 5). Journal of the American College of Cardiology, 38(3), 682-687. https://doi.org/10.1016/S0735-1097(01)01415-2

Narayanan, J., Sanjeevi, V., Rohini, U., Trueman, P., & Viswanathan, V. (2016). Postprandial glycaemic response of foxtail millet dosa in comparison to a rice dosa in patients with type 2 diabetes. The Indian journal of medical research, 144(5), 712–717. https://doi.org/10.4103/ijmr.IJMR_551_15

Ramachandran, A.; Chamukuttan; Snehalatha ; Kumpatla; Satyavani ; Latha, E ; Sasikala. R & Viswanathan. (2000). Prevalence of Vascular Complications and Their Risk Factors in Type 2 Diabetes. The Journal of the Association of Physicians of India. 47. 1152-6.

Saleh, A. S., Zhang, Q., Chen, J., & Shen, Q. (2013). Millet grains: Nutritional quality, processing, and potential health benefits. Comprehensive Reviews in Food Science and Food Safety, 12(3), 281–295.

FSSAI. (2023). Millets—The Smart Food. Eat Right India Movement.https://www.fssai.gov.in

Shanmugam, S., Krishnaswamy, K., Vasudevan, S., Malleshi, N., Anjana, R. M., Palaniappan, L., & Mohan, V. (2013). Finger millet (Eleusine coracana L.): A review of its nutritional properties, processing, and plausible health benefits. Advances in Food and Nutrition Research, 69, 1–39. https://doi.org/10.1016/B978-0-12-410540-9.00001-6

Kim, Y. A., Keogh, J. B., & Clifton, P. M. (2018). Probiotics, prebiotics, synbiotics and insulin sensitivity. Nutrition Research Reviews, 31(1), 35–51.

Sun, C., Zhao, C., Guven, E., Paoli, P., Simal-Gandara, J., Ramkumar, K., et al. (2020). Dietary polyphenols as antidiabetic agents: Advances and opportunities. Food Frontiers, 1(1), 18–44.

Vaz, N. C., Ferreira, A., Kulkarni, M., Vaz, F. S., & Pinto, N. (2011). Prevalence of diabetic complications in rural goa, India. Indian journal of community medicine : official publication of Indian Association of Preventive & Social Medicine, 36(4), 283–286. https://doi.org/10.4103/0970-0218.91330

Fu, Y., Zhang, F., Liu, Z., Zhao, Q., Xue, Y., & Shen, Q. (2021). Improvement of diabetes-induced metabolic syndrome by millet prolamin is associated with changes in serum metabolomics. Food Bioscience, 44, 101434. https://doi.org/10.1016/j.fbio.2021.101434

Ren, X., Wang, L., Chen, Z., Hou, D., Xue, Y., Diao, X., & Shen, Q. (2021). Foxtail Millet Improves Blood Glucose Metabolism in Diabetic Rats through PI3K/AKT and NF-κB Signaling Pathways Mediated by Gut Microbiota. Nutrients, 13(6), 1837. https://doi.org/10.3390/nu13061837.

Fu, Y., Yin, R., Liu, Z., Niu, Y., Guo, E., Cheng, R., Diao, X., Xue, Y., & Shen, Q. (2020). Hypoglycemic Effect of Prolamin from Cooked Foxtail Millet (Setaria italic) on Streptozotocin-Induced Diabetic Mice. Nutrients, 12(11), 3452. https://doi.org/10.3390/nu12113452

Wan, X.-z., Ai, C., Chen, Y.-h., Gao, X.-x., Zhong, R.-t., Liu, B., Chen, X.-h., & Zhao, C. (2020). Physicochemical characterization of a polysaccharide from green microalga Chlorella pyrenoidosa and its hypolipidemic activity via gut microbiota regulation in rats. Journal of Agricultural and Food Chemistry, 68(5), 1186–1197. https://doi.org/10.1021/acs.jafc.9b06282

Singh, K. Shriya, K &Priyadarshini ,V (2021). Effect of Nutritional Composition and Glycemic Index on Selected Varieties of Rice, Millets and Legumes. International Journal of Pharmaceutical Sciences Review and Research. 70.10.47583/ijpsrr.2021.v70i01.019.

Xiong,Y., Zhang , P., Warner, R D.,& Fang, Z. (2019) Comprehensive Reviews in Food Science and Food Safety . Institute of Food Technologists, 18, 2025-2046. doi: 10.1111/1541-4337.12506