SURVEY STUDY

STAR (Survey for ManagemenT of DiAbetes with FibeR-rich Nutrition Drink): A Pan India Survey to Understand the Physician and Patient Perspective Regarding the Role of Dietary Fiber Supplement in the Management of Type 2 Diabetes

SANJAY KALRA*, NITIN KAPOOR†, SAPTARSHI BHATTACHARYA‡, SAMBIT DAS#, NEETA DESHPANDE¥, SUNIL KUMAR KOTA£, SHEHLA SHAIKH§

ABSTRACT

Objectives: The aim of the STAR survey was to understand the physicians' knowledge, attitude and perception regarding the role of nutritional dietary fiber supplements in the daily management of type 2 diabetes mellitus (T2DM). It also aimed to compare the changes in glycemic parameters as well as energy and satiety levels between patients taking a high-fiber supplement and those not taking a fiber supplement. **Methods:** Two cross-sectional pan-India surveys were conducted. The first was among 152 physicians who had >5 years of experience in treating patients with T2DM and treated >50 patients with T2DM per month. A self-administered paper-based questionnaire was used for the survey. The other survey was conducted among 3,042 patients with T2DM who were receiving treatment with antidiabetics. These patients were further categorized into the Horlicks Diabetes Plus (HDP) group, which consisted of 1,524 patients who had consumed the HDP fiber supplement for a minimum of 3 months and the non-HDP group, which included 1,518 patients who had never consumed HDP. **Results:** Almost all physicians prescribed fiber-rich nutritional supplements to their patients with T2DM and believed that dietary fiber has an important role in managing glycated hemoglobin (HbA1c) values, healthy weight and cholesterol levels. Among the main benefits of HDP seen by physicians were improvement in satiety levels and increase in physical activity, reduction in HbA1c, fasting and postprandial glucose, and reduction in dose and/or number of hypoglycemic medications. All physicians recommended that it was important to increase awareness among patients as well as doctors regarding the benefits of HDP in patients with T2DM. Patients in the HDP group reported a mean decrease of 0.72 in their HbA1c value which was statistically significant at 3 months (8.04 at baseline to 7.32 at 3 months). In contrast, the non-HDP group showed a non-statistically significant decrease of 0.61 in HbA1c from a baseline value of 8.15. Furthermore, patients reported a significant decrease in weight of 3 kg in 3 months from baseline value of 72.11 kg to 69.11 kg. This reduction in weight was observed in 82% patients in the HDP group, while the non-HDP group showed an insignificant weight reduction from a baseline value of 72.14 kg to 71.46 kg in 3 months. About 83% of patients reported feeling full for longer periods of time and 92.62% reported feeling more energetic after starting HDP. The compliance and satisfaction rates with HDP were 96% and 75%, respectively. **Conclusion:** A high-fiber supplement taken along with patients' existing antidiabetic treatment plan has the potential to decrease glycemic parameters and weight while increase the satiety and energy levels among patients with T2DM. However, these results need to be evaluated further with long-term clinical studies conducted in the real world.

Keywords: Dietary fiber, type 2 diabetes, high-fiber supplement, glycemic outcomes, satiety, physical energy

*Dept. of Endocrinology, Bharti Hospital and BRIDE, Karnal, Haryana, India
†Professor of Endocrinology, Dept. of Endocrine, Diabetes and Metabolism, Christian Medical College, Vellore, Tamil Nadu, India
‡Senior Consultant, Dept. of Endocrinology, Indraprastha Apollo Hospitals, Delhi, India
#Professor, Dept. of Endocrinology, KIMS, Bhubaneswar, Odisha, India
¥Consultant Diabetologist and Bariatric Physician, Belgaum Diabetes Centre, Belgaum, Karnataka, India
£Consultant Endocrinologist, Diabetes and Endocare Clinic, Berhampur, Odisha, India
§Dept. of Endocrinology, Saifee Hospital, Mumbai, Maharashtra, India
Address for correspondence
Dr Sanjay Kalra
Dept. of Endocrinology, Bharti Hospital and BRIDE, Karnal, Haryana, India
E-mail: brideknl@gmail.com

In 2021, globally, an estimated 537 million adults aged 20 to 79 years had diabetes, most of which was type 2 diabetes (T2DM).[1] According to the 2021 International Diabetes Federation (IDF) report, India had the second largest number of adults with diabetes in the world (74.2 million). Further, it was estimated that by 2045, there will be approximately 124.9 million patients with diabetes aged 20 to 79 years in India.[2] The "Asian Indian Phenotype" has higher rates of central obesity and

increased visceral fat, which are the main causes of insulin resistance (IR).[3] Among Indian patients with diabetes, about 69% fail to achieve the target level of glycated hemoglobin (HbA1c).[4] Lifestyle modification is central to the prevention and management of T2DM.[5] The American Diabetes Association (ADA), Research Society for the Study of Diabetes in India (RSSDI) and Indian Council of Medical Research (ICMR) clinical practice guidelines emphasize diet modification as a first-line therapy for treating T2DM and provide recommendations for daily nutritional needs. Weight loss[6-8] reduces blood glucose besides improving major risk factors of cardiac disease like blood pressure and lipids (cholesterol, triglycerides and low-density lipoproteins [LDL]).[9,10] Weight loss is also important because within 6 years from diagnosis, >80% of patients with T2DM can achieve remission by losing >15 kg of body weight;[11,12] however, this likelihood is lower with increased time since diagnosis.[5] Dietary fiber reduces the risk of obesity and in turn T2DM,[13] because excessive calorie intake leading to obesity is one of the strongest predictors for T2DM.[14,15] Therefore, any nutritional intervention that results in modest weight loss reduces IR.[16] Unhealthy diets are often lacking in fiber-rich foods.[17] The ADA recommends that fiber intake in patients with diabetes should be about 14 g fiber/1,000 kcal daily, or about 25 g/day for women and 38 g/day for men.[18] The Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes (EASD) has also recommended that dietary fiber intake should be at least 35 g/day (4 g/1,000 Kj). The group also recommends fiber-enriched foods and supplements when adequate intake cannot be obtained from diet alone.[5] RSSDI recommends a fiber intake of 25 to 40 g/day for Indians.[7]

Dietary fiber can be classified as soluble or insoluble according to its solubility in water. Soluble dietary fiber forms a gel-like substance in the gastrointestinal (GI) tract thereby increasing the viscosity of GI contents. This prolongs the transit time, digestion and absorption of GI contents.[13] Moreover, high-fiber diets have lower calories for the same portion size.[13] Moreover, foods high in fiber need more chewing before swallowing. This slows down the rate of food consumption and leads to feelings of satiety due to the release of gut hormones.[19,20] Soluble dietary fiber has been specifically linked to increased feelings of satiety and a reduced overall energy intake;[21] it also increases the duration for which satiety signals are released.[22] The viscous gel formed by the fiber acts as a diffusion barrier,[23] reducing the rate at which glucose is absorbed into the bloodstream, and thus decreases postprandial blood glucose levels.[24]

Despite dietary recommendations, people consume inadequate amounts or incorrect type of dietary fiber.[3] A study that compared the Indian diet with EAT-Lancet reference diet, reported that Indian diets were unhealthy across all states and income categories. Moreover, the fiber intake was found to be much lower than the recommended level in women (15-30 g/d) across all income groups.[25]

We conducted the STAR survey among physicians treating patients with diabetes as well as among patients with diabetes. The objective of the physicians' survey was to obtain an understanding of their knowledge, attitude and perception regarding the role of nutritional dietary fiber supplements in the daily management of T2DM. The objectives of the patients' survey were to compare the changes in glycemic parameters as well as energy and satiety levels between patients taking a high-fiber supplement and those not taking a fiber supplement.

METHODS

Design and Participants

To achieve the study objectives, two cross-sectional pan-India surveys were conducted between March 2023 and May 2023. A convenient sample of 152 physicians who had ≥5 years of experience in treating patients with T2DM, treated ≥50 patients with T2DM per month, and provided their written consent to participate were enrolled in the survey. A self-administered paper-based questionnaire was shared with them for completion. The quantitative survey consisted of 26 questions (median time to completion 10 minutes) which included multiple choice, short answers using free text, yes/no and 7-point Likert response scales. The survey questions were designed to understand their knowledge, attitude and perception regarding the role of nutritional dietary fiber supplements in the daily management of T2DM. More specifically, the survey included questions to understand the segment of patients with T2DM who would benefit the most from consumption of dietary fiber supplement such as Horlicks Diabetes Plus (HDP), the recommended dose/quantity of HDP along with the preferred medium of consumption and the observed benefits of consuming HDP with respect to parameters such as reduction in HbA1c, improvement in physical energy and improvement in satiety levels in patients with T2DM.

The other survey was conducted among 3,042 patients with T2DM in the outpatient clinics of participating doctors. Each participating doctor recommended a total of 20 patients from his/her practice for the survey. Of the 20 patients that (s) he recommended, 10 patients were consuming HDP as their primary source of dietary fiber supplement for a minimum of 3 months while the remaining 10 were not consuming HDP. However, all patients were receiving pharmacological treatment for diabetes. The criteria were, age ≥18 years, diagnosis of T2DM ≥12 months before participation, ongoing treatment for T2DM with oral antidiabetics and/or insulin and provision of written informed consent. These patients were further categorized into the HDP group, in which the patients had consumed the HDP supplements for a minimum of 3 months and the non-HDP group in which the patients had never consumed HDP. Based on whether the patient consumed HDP or not, they were provided different self-administered paper-based questionnaires each consisting of about 40 questions (median time to completion 30 minutes) and included multiple choice, short answers using free text, yes/no and 5-point Likert response scales. Both patient surveys included questions regarding sociodemographic and clinical characteristics, diet and lifestyle, their knowledge regarding the role of dietary fiber in the management of T2DM, their consumption of fiber or fiber supplements – type and quantity, their energy levels while performing day-to-day physical activities, and their satiety levels. In addition to the above questions, patients were requested to provide their current HbA1c, fasting glucose, postprandial glucose values and recall values for these parameters prior to consuming HDP to the best of their ability. Patients in the HDP group were also asked to rate their current physical energy and satiety levels after starting HDP. Lastly, for patients in the HDP group, the survey also asked questions with respect to compliance and level of satisfaction with HDP. All responses were kept anonymous, and the identity of the sponsor of the survey was not revealed to the respondents. Participation in the survey was voluntary and respondents had an option to exit the survey at any point. Institutional Review Board approval was not required because this was considered a market research study.

Statistical Analyses

Data was analyzed using descriptive analyses such as frequencies for categorical variables and mean (standard deviation [SD]) for continuous variables to summarize responses from the physician and patient surveys. For surveys obtained from patients, a within and between group comparisons were conducted. For the HDP group, a within group comparison using the paired *t*-test to estimate the mean change in weight, HbA1c, fasting glucose and postprandial glucose values from before starting HDP (baseline values) to after starting HDP. Furthermore, a between group comparison (HDP group vs. non-HDP group) was conducted using an independent *t*-test to compare the mean difference in weight, HbA1c, fasting glucose and postprandial glucose values between the two groups. A type 1 error level of 5% ($p < 0.05$) was established for inferential analyses. Statistical Package for Social Sciences (SPSS) for Windows version 10.0 (SPSS Inc., Chicago) was used for the analyses.

RESULTS

Physician Survey

Of the 152 doctors who participated in the survey, 41% were diabetologists, 54% were general practitioners and 5% were endocrinologists. The mean duration of experience was 20 years. Almost all the physicians prescribed fiber-rich nutritional supplements to their patients with T2DM, and believed that dietary fiber has an important role in managing HbA1c values, healthy weight and cholesterol levels. Though most physicians (77%) recommend consuming 30-45 g of fiber/day, most of their patients (about 71%) consume <15 g of fiber daily. This is mainly due to the lack of awareness about the benefits of fiber in managing T2DM. Most patients lack knowledge regarding food items and nutritional supplements rich in fiber. Hence, awareness regarding the role of fiber and fiber-rich supplements in managing diabetes among patients needs to be increased.

Opinion about role of HDP in management of diabetes: Recommended dose and observed benefits

Physicians reported that they recommend HDP to about 50% of patients with T2DM, 35% of patients with overweight and 40% of patients with obesity. They recommend consuming 15-30 g of HDP to patients with T2DM with HbA1c <8% and 15-45 g to patients with HbA1c >8%. For patients with overweight and obesity, they recommend 30-45 g of HDP on a regular basis. Based on the patients' body mass index (BMI) and preference, about 57% of physicians recommend consuming HDP with milk, while 43% recommend consuming it with water. When asked about the top three benefits of HDP in their experience, about 98% of physicians reported improvement in satiety levels and increase in physical activity to be the topmost benefit, followed by reduction in HbA1c, fasting

glucose and postprandial glucose (91%) and reduction in dose and/or number of hypoglycemic medications (75%) after consuming HDP for 3 to 6 months. Lastly, physicians reported that most of their patients (96%) were compliant and consumed HDP on a regular basis. Among those who did not consume HDP regularly or discontinued, added financial burden was one of the main reasons followed by no change in their clinical parameters or energy levels after initiating HDP. All participating physicians recommended that it was important to increase awareness among patients as well as doctors regarding the benefits of HDP in patients with T2DM through social media, educational campaigns, counseling programs and other channels.

Patient Survey

There were 1,524 patients in the non-HDP group and 1,518 patients in the HDP group. The mean age of patients was 55.64 years and 56.3 years, respectively, and almost 57% were male. More than 70% of the patients were overweight or obesity. The baseline demographic and clinical characteristics are shown in Table 1.

Glycemic outcomes at 3 months

A statistically significant reduction of 0.72 in HbA1c was observed at 3 months from baseline in the HDP group. The decrease in HbA1c at 3 months was 0.61 in the non-HDP group; however, this was not statistically significant. A significant decrease in weight of 3 kg in 3 months from baseline was observed in 82% patients in the HDP group, while no significant weight reduction was reported in the non-HDP group (Table 2).

Change in satiety and physical energy levels

A total of 83% patients in the HDP group reported feeling full for longer periods of time after starting HDP vs. only 42% patients in the non-HDP group feeling full. There was a 25% and 23% increase in number of patients who reported feeling satisfied and full after a meal, respectively from baseline to 3 months in the HDP group (Table 3). Similarly, about 93% patients in the HDP group reported improvement in energy levels after starting HDP and 67% patients reported moderate to high increase in energy levels post consumption of HDP at 3 months. In contrast, 85% patients reported feeling fatigued and tired in the non-HDP group (Table 3).

Awareness about benefits of consuming a high-fiber diet

Overall, 85% of patients in the HDP group were aware about the benefits of consuming a high-fiber diet for managing diabetes vs. 67.45% in the non-HDP group. In the non-HDP group, 91.14% of patients were inclined to take high-fiber supplements when prescribed by a doctor after explaining their health benefits.

Table 1. Baseline Characteristics of Patients

Parameters	Non-HDP group	HDP group
Total (N)	1,524	1,518
Mean age (years)	55.64	56.30
Male, n (%)	861 (56.49)	855 (56.32)
Female, n (%)	661 (43.37)	657 (43.28)
Family history of diabetes, n (%)	1,022 (67)	1,039 (68.44)
HDL, n (%)		
<30	495 (32.48)	531 (34.98)
30-59	879 (57.67)	854 (56.25)
≥60	137 (8.98)	112 (7.37)
Duration of T2DM, n (%)		
≤5 years	618 (40.55)	565 (37.22)
6-10 years	487 (31.95)	545 (35.90)
11-15 years	235 (15.41)	234 (15.41)
16-20 years	101 (6.62)	86 (5.66)
>20 years	79 (5.18)	79 (5.20)
Blood pressure, mmHg, (mean)		
Systolic	137	135
Diastolic	87	85
HbA1c, mean (SD)	8.15 (1.79)	8.04 (1.32)
Weight, mean (SD)	72.14 (13.08)	72.11 (12.25)
BMI (kg/m²), n (%)		
Mean	27.43	27.32
Normal weight (18.5-24.9)	438 (28.74)	426 (28.06)
Overweight (25-29.9)	685 (44.94)	758 (49.93)
Obesity (≥30)	355 (23.29)	309 (20.35)
PPG (mg/dL), n (%)		
Mean	204	206
Normal (≤140)	211 (13.84)	199 (13.10)
Prediabetic (≥141-≤200)	686 (45.01)	650 (42.81)
People with diabetes (≥201)	621 (40.74)	657 (43.28)
FPG (mg/dL), n (%)		
<125	280 (18.37)	216 (14.22)
125-199	881 (57.80)	921 (60.67)
200-299	299 (19.61)	332 (21.87)
≥300	46 (3.01)	46 (3.03)

HDL = High-density lipoprotein; T2DM = Type 2 diabetes mellitus; HbA1c = Glycated hemoglobin; SD = Standard deviation; BMI = Body mass index; PPG = Postprandial glucose; FPG = Fasting plasma glucose.

Table 2. Outcomes at 3 Months

Parameters	Non-HDP group			HDP group		
	Baseline	At 3 months		Baseline	At 3 months	
BMI (kg/m²), n (%)						
Mean	27.43	27.19		27.32	26.20	
Normal weight (18.5-24.9)	438 (28.74)	472 (30.97)		426 (28.06)	570 (37.54)	
Overweight (25-29.9)	685 (44.94)	663 (43.50)		758 (49.93)	659 (43.41)	
Obesity (≥30)	355 (23.29)	327 (21.45)		309 (20.35)	228 (15.01)	
PPG (mg/dL), n (%)						
Mean	204	181		206	153	
Normal (≤140)	211 (13.84)	423 (27.75)		199 (13.10)	528 (34.78)	
Prediabetic (≥141-≤200)	686 (45.01)	666 (43.70)		650 (42.81)	681 (44.86)	
Diabetic (≥201)	621 (40.74)	428 (28.08)		657 (43.28)	300 (19.76)	
FPG (mg/dL), n (%)						
<125	280 (18.37)	473 (31.03)		216 (14.22)	631 (41.56)	
125-199	881 (57.80)	731 (47.96)		921 (60.67)	732 (48.22)	
200-299	299 (19.61)	172 (11.28)		332 (21.87)	133 (8.76)	
≥300	46 (3.01)	31 (2.03)		46 (3.03)	12 (0.79)	
			P value			**P value**
HbA1c, mean (SD)	8.15 (1.79)	7.54 (1.50)	0.031	8.04 (1.32)	7.32 (1.08)	<0.001
Weight, mean (SD)	72.14 (13.08)	71.46 (12.30)	0.056	72.11 (12.25)	69.11 (11.71)	<0.001

Table 3. Changes in Satiety and Physical Energy Levels at 3 Months Reported by HDP Patients

	Baseline	At 3 months	Change from baseline
Satiety levels, n (%)			
Starving, no energy, very weak	17 (1.12)	2 (0.13)	–0.99
Very hungry	45 (2.96)	11 (0.73)	–2.23
Uncomfortably hungry	149 (9.82)	16 (1.06)	–8.76
Hungry, stomach growing	364 (24.0)	23 (1.53)	–22.47
Starting to feel hungry	368 (24.2)	84 (5.57)	–18.63
Satisfied	401 (26.4)	782 (51.89)	25.49
Full	117 (7.71)	467 (30.99)	23.28
Overfull	30 (1.98)	91 (6.04)	4.06
Stuffed	13 (0.86)	22 (1.46)	0.60
Extremely stuffed	3 (0.20)	9 (0.6)	0.40
Missing	11 (0.72)	11 (0.72)	-
Physical energy levels, n (%)			
Not at all energetic	101 (6.65)	7 (0.46)	–6.19
Somewhat energetic	453 (29.8)	98 (6.46)	–23.34
Neutral	589 (38.8)	257 (16.93)	–21.87
Moderate energy	341 (22.5)	901 (64.08)	37.51
High energy	20 (1.32)	105 (6.92)	5.60
Missing	14 (0.92)	140 (9.22)	-

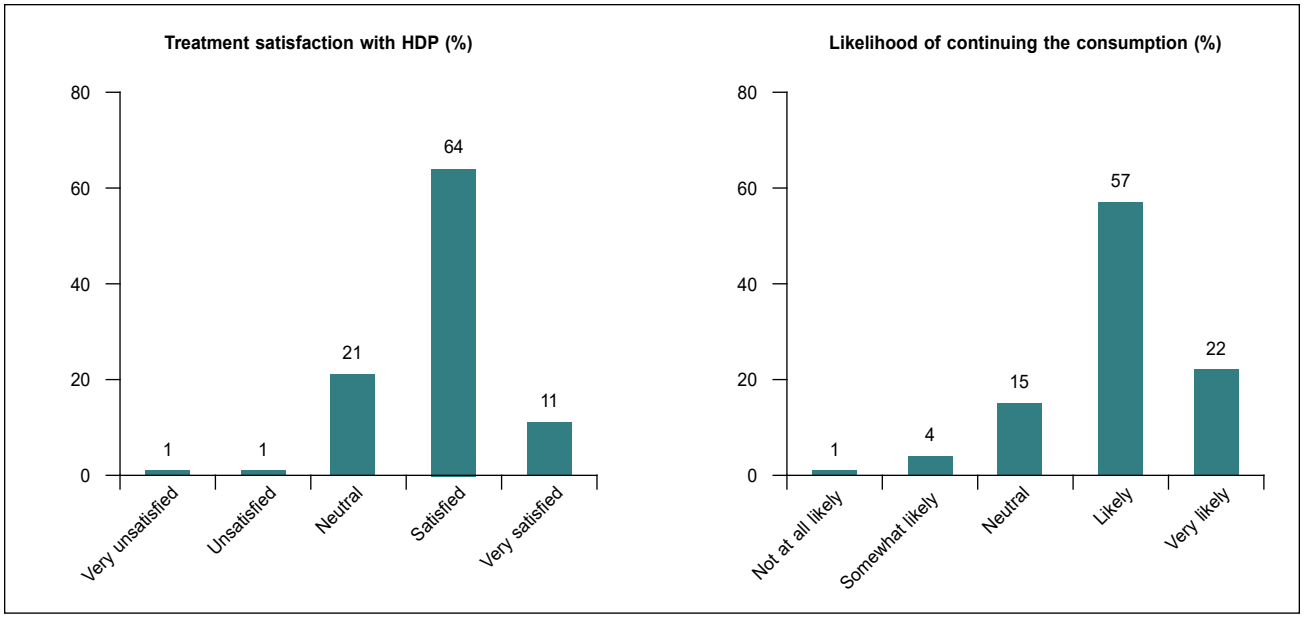

Figure 1. Treatment satisfaction and likelihood, HDP group

Table 4. Consumption of Fiber per Day and Nutritional Supplements in HDP Group

Quantity	n (%)	Frequency	n (%)
1 leveled scoop (<30 g)	634 (41.76)	Once a day	411 (64.82)
		Twice a day	215 (33.91)
		NR	8 (1.26)
2 leveled scoops (30 g)	868 (57.18)	Once a day	742 (85.48)
		Twice a day	121 (13.94)
		NR	5 (0.57)

Satisfaction and likelihood of continuing the consumption of HDP

In the HDP group, 75% of patients were satisfied or very satisfied with the HDP product; nearly 80% of patients reported that they were very likely-likely to continue consuming it and 79% of patients reported high compliance (likely + very likely) with HDP (Fig. 1). About 41.76% of patients consumed <30 g of the HDP product once or twice a day, while 57.18% consumed 30 g once or twice a day (Table 4).

DISCUSSION

The results of our surveys showed that all physicians were aware of the importance of dietary fiber in managing glycemic parameters, weight and cholesterol and prescribed fiber-rich nutritional supplements to their patients with T2DM. However, they reported a lack of awareness among patients with T2DM about the importance of fiber and that patients consume less than the recommended amount of fiber. In the patients' survey it was found that two-thirds of patients who were not taking HDP supplement were aware about the benefits of high-fiber diet, though this proportion was >90% in those taking the supplement. Patients consuming HDP supplement reported an improvement in HbA1c as well as weight loss 3 months after initiating HDP. In both surveys, increased energy levels and satiety were reported to be the main benefits of consuming HDP. The compliance to HDP was good.

A high-fiber diet is known to reduce total cholesterol and LDL cholesterol.[26] A high intake of soluble dietary fiber above the ADA recommended level, was shown to decrease blood glucose, insulin and serum lipid levels in a study.[27] In another study among urban Indians with T2DM, patients with low consumption of dietary fiber (<29 g/day) had higher prevalence of hypercholesterolemia and higher LDL than patients with median consumption of fibers.[28] One more study among diabetic patients in India showed a significant reduction in serum cholesterol with a high-fiber diet and this was sustained over a prolonged period.[29] In a systematic review, Reynolds et al reported the outcomes of 27 trials about increasing fiber intakes on total cholesterol. Increased fiber intake resulted in reduction of total cholesterol, LDL cholesterol and triglycerides. There were no differences by diabetes type, therapy, risk of bias, fiber type, trial size or trial duration. Similarly, increasing the fiber intake reduced body weight by

a mean of 0.56 kg, BMI by a mean of 0.36 kg/m^2 and waist circumference by a mean of 1.42 cm, despite no recommendations for reduction in calorie intake.[30] Water-soluble fibers are most effective in reducing LDL cholesterol, though they do not considerably affect high-density lipoprotein (HDL) levels.[25]

Studies have also shown a decrease in glycemic parameters with a high-fiber diet. A recent systematic review and meta-analysis of 28 randomized controlled trials (RCTs) assessed the effect of viscous fiber intake in patients with T2DM. There was an absolute decrease of 0.58% in HbA1c and 0.82 mmol/L in fasting blood glucose following a median dose of 13.1 g/day for a median duration of 8 weeks. Patients with higher baseline HbA1c showed greater reductions.[31] Silva et al analyzed 12 RCTs and reported a decrease of 0.52% in HbA1c and 0.55 mmol/L in fasting blood glucose following a high intake of various types of soluble and insoluble dietary fiber.[32] Another meta-analysis of 19 studies reported that the multivariable-adjusted risk of T2DM decreased significantly by 9% for every 10 g/day increase in intake of total dietary fiber.[33] There is a major difference between Asians and Caucasians in the postprandial β-cell response to glucose.[34] T2DM in East Asians is characterized primarily by β-cell dysfunction rather than IR.[35] Dietary fiber reduces carbohydrate absorption in the small intestine[36] and thus prevents a rapid rise of blood glucose levels, which is important in the East Asian population with limited insulin secretion capacity.[37] Indian meals often consist of high-calorie foods that are high in processed carbohydrates and saturated fats. These cause a significant increase in postprandial blood glucose, free fatty acids and triglycerides, leading to higher CVD risk.[38] In a recent study among Indian patients, ingestion of a fiber-rich nutritional supplement containing nutriose and fibersol in the form of a drink, significantly reduced the postprandial blood glucose peak following a high-fat meal in overweight subjects with impaired fasting glucose.[38]

While insoluble fiber is more helpful for colonic health and increasing the stool bulk, viscous fibers have pleiotropic metabolic effects.[39] HDP contains nutriose and fibersol. Nutriose is a wheat fiber dextrin with clinically proven digestive tolerance, while fibersol is a corn fiber dextrin that is digestion resistant, a low-calorie soluble fiber and bulking agent.[38] Fiber intake of >50 g/day is difficult to achieve without the use of dietary fiber supplements.[40] Although it is preferable to meet the daily fiber requirement through food rather than supplement, the use of the latter makes it easier to measure and achieve the goal of daily fiber requirement despite lack of willingness or ability to modify the diet.[41] Moreover, as seen in our survey, most patients were willing to take the supplement if recommended by the physician. Further, the compliance among those prescribed the supplement was very high. Hence, increasing the awareness about the importance of fiber-rich food along with prescription of a fiber-rich supplement, if necessary, might lead to an overall increase in the intake of fiber per day among patients with T2DM.

There were certain limitations to our survey. The first is that the HbA1c and blood glucose values as well as weight were based on patients' recall from memory and the actual reports were not checked as a part of the survey. Hence, there is a likelihood of recall bias, which can lead to an over or under estimation of reported values. Second, the compliance was also self-reported and not actually monitored as this was not a clinical trial. Nevertheless, this is the first survey to assess the subjective and objective outcomes following a high-fiber supplement consumption among Indian patients with T2DM. Findings from this survey can be further evaluated and supported by conducting large multicenter real-world clinical evidence studies pan India.

CONCLUSION

The results of our survey show a high level of awareness among physicians about the importance of a high-fiber diet in patients with T2DM and recommendations about the same to patients. Patient awareness about the same needs to be increased. Nevertheless, there was a high level of acceptance and compliance to take high-fiber supplements if recommended by physicians. The main benefits of HDP as a fiber supplement were decrease in HbA1c and weight and an increase in satiety and energy levels.

REFERENCES

1. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, et al. IDF Diabetes Atlas: global, regional and country-level diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract. 2022;183:109119.
2. IDF Diabetes Atlas 2022, 10th edition. Available at: https://diabetesatlas.org/2022-reports/. Accessed July 12, 2023.
3. Saboo B, Misra A, Kalra S, Mohan V, Aravind SR, Joshi S, et al; Diabetes India 'Decode Fiber' Expert Consensus Group. Role and importance of high fiber in diabetes management in India. Diabetes Metab Syndr. 2022;16(5):102480.

4. Chadha M, Das AK, Deb P, Gangopadhyay KK, Joshi S, Kesavadev J, et al. Expert opinion: optimum clinical approach to combination-use of SGLT2i + DPP4i in the Indian diabetes setting. Diabetes Ther. 2022;13(5):1097-114.
5. Diabetes and Nutrition Study Group (DNSG) of the European Association for the Study of Diabetes (EASD). Evidence-based European recommendations for the dietary management of diabetes. Diabetologia. 2023;66(6):965-85.
6. Indian Council of Medical Research. ICMR guidelines for management of type 2 diabetes. 2018. Available at: https://main.icmr.nic.in/sites/default/files/guidelines/ICMR_GuidelinesType2diabetes2018_0.pdf. Accessed July 12, 2023.
7. Chawla R, Madhu SV, Makkar BM, Ghosh S, Saboo B, Kalra S; RSSDI-ESI Consensus Group. RSSDI-ESI clinical practice recommendations for the management of type 2 diabetes mellitus 2020. Indian J Endocrinol Metab. 2020;24(1):1-122.
8. Evert AB, Dennison M, Gardner CD, Garvey WT, Lau KHK, MacLeod J, et al. Nutrition therapy for adults with diabetes or prediabetes: a consensus report. Diabetes Care. 2019;42(5):731-54.
9. Haase CL, Lopes S, Olsen AH, Satylganova A, Schnecke V, McEwan P. Weight loss and risk reduction of obesity-related outcomes in 0.5 million people: evidence from a UK primary care database. Int J Obes (Lond). 2021;45(6):1249-58.
10. Wing RR, Lang W, Wadden TA, Safford M, Knowler WC, Bertoni AG, et al; Look AHEAD Research Group. Benefits of modest weight loss in improving cardiovascular risk factors in overweight and obese individuals with type 2 diabetes. Diabetes Care. 2011;34(7):1481-6.
11. Lean ME, Leslie WS, Barnes AC, Brosnahan N, Thom G, McCombie L, et al. Primary care-led weight management for remission of type 2 diabetes (DiRECT): an open-label, cluster-randomised trial. Lancet. 2018;391(10120):541-51.
12. Lean MEJ, Leslie WS, Barnes AC, Brosnahan N, Thom G, McCombie L, et al. Durability of a primary care-led weight-management intervention for remission of type 2 diabetes: 2-year results of the DiRECT open-label, cluster-randomised trial. Lancet Diabetes Endocrinol. 2019;7(5):344-55.
13. Waddell IS, Orfila C. Dietary fiber in the prevention of obesity and obesity-related chronic diseases: from epidemiological evidence to potential molecular mechanisms. Crit Rev Food Sci Nutr. 2022 Apr 26:1-16.
14. Sung KC, Jeong WS, Wild SH, Byrne CD. Combined influence of insulin resistance, overweight/obesity, and fatty liver as risk factors for type 2 diabetes. Diabetes Care. 2012;35(4):717-22.
15. Sivaraman S, Weickert MO. Nutrition and exercise in the treatment of type 2 diabetes mellitus. Hamdan Med J. 2012;5(2):131-44.
16. Nowotny B, Zahiragic L, Bierwagen A, Kabisch S, Groener JB, Nowotny PJ, et al. Low-energy diets differing in fibre, red meat and coffee intake equally improve insulin sensitivity in type 2 diabetes: a randomised feasibility trial. Diabetologia. 2015;58(2):255-64.
17. Chan YM, Aufreiter S, O'Keefe SJ, O'Connor DL. Switching to a fibre-rich and low-fat diet increases colonic folate contents among African Americans. Appl Physiol Nutr Metab. 2019;44(2):127-32.
18. Evert AB, Boucher JL, Cypress M, Dunbar SA, Franz MJ, Mayer-Davis EJ, et al. Nutrition therapy recommendations for the management of adults with diabetes. Diabetes Care. 2014;37(Suppl 1):S120-43.
19. Li J, Zhang N, Hu L, Li Z, Li R, Li C, et al. Improvement in chewing activity reduces energy intake in one meal and modulates plasma gut hormone concentrations in obese and lean young Chinese men. Am J Clin Nutr. 2011;94(3):709-16.
20. Hogenkamp PS, Schiöth HB. Effect of oral processing behaviour on food intake and satiety. Trends Food Sci Technol. 2013;34(1):67-75.
21. Adam CL, Williams PA, Garden KE, Thomson LM, Ross AW. Dose-dependent effects of a soluble dietary fibre (pectin) on food intake, adiposity, gut hypertrophy and gut satiety hormone secretion in rats. PLoS One. 2015;10(1):e0115438.
22. Fiszman S, Varela P. The role of gums in satiety/satiation. A review. Food Hydrocoll. 2013;32(1):147-54.
23. Fabek H, Messerschmidt S, Brulport V, Goff HD. The effect of in vitro digestive processes on the viscosity of dietary fibres and their influence on glucose diffusion. Food Hydrocoll. 2014;35:718-26.
24. Yu K, Ke MY, Li WH, Zhang SQ, Fang XC. The impact of soluble dietary fibre on gastric emptying, postprandial blood glucose and insulin in patients with type 2 diabetes. Asia Pac J Clin Nutr. 2014;23(2):210-8.
25. Slavin J. Fiber and prebiotics: mechanisms and health benefits. Nutrients. 2013;5(4):1417-35.
26. Gulati S, Misra A, Pandey RM. Effects of 3 g of soluble fiber from oats on lipid levels of Asian Indians - a randomized controlled, parallel arm study. Lipids Health Dis. 2017;16(1):71.
27. Chandalia M, Garg A, Lutjohann D, von Bergmann K, Grundy SM, Brinkley LJ. Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. N Engl J Med. 2000;342(19):1392-8.
28. Narayan S, Lakshmipriya N, Vaidya R, Bai MR, Sudha V, Krishnaswamy K, et al. Association of dietary fiber intake with serum total cholesterol and low-density lipoprotein cholesterol levels in urban Asian-Indian adults with type 2 diabetes. Indian J Endocrinol Metab. 2014;18(5):624-30.
29. Viswanathan M, Mohan V. Dietary management of Indian vegetarian diabetics. Nutrition Foundation of India. 1991;12:1-3.

30. Reynolds AN, Akerman AP, Mann J. Dietary fibre and whole grains in diabetes management: systematic review and meta-analyses. PLoS Med. 2020;17(3):e1003053.
31. Jovanovski E, Khayyat R, Zurbau A, Komishon A, Mazhar N, Sievenpiper JL, et al. Should viscous fiber supplements be considered in diabetes control? Results from a systematic review and meta-analysis of randomized controlled trials. Diabetes Care. 2019;42(5):755-66.
32. Silva FM, Kramer CK, de Almeida JC, Steemburgo T, Gross JL, Azevedo MJ. Fiber intake and glycemic control in patients with type 2 diabetes mellitus: a systematic review with meta-analysis of randomized controlled trials. Nutr Rev. 2013;71(12):790-801.
33. InterAct Consortium. Dietary fibre and incidence of type 2 diabetes in eight European countries: the EPIC-InterAct Study and a meta-analysis of prospective studies. Diabetologia. 2015;58(7):1394-408.
34. Cho YM. Incretin physiology and pathophysiology from an Asian perspective. J Diabetes Investig. 2015;6(5): 495-507.
35. Yabe D, Seino Y, Fukushima M, Seino S. β cell dysfunction versus insulin resistance in the pathogenesis of type 2 diabetes in East Asians. Curr Diab Rep. 2015;15(6):602.
36. Lattimer JM, Haub MD. Effects of dietary fiber and its components on metabolic health. Nutrients. 2010;2(12): 1266-89.
37. Kimura Y, Yoshida D, Hirakawa Y, Hata J, Honda T, Shibata M, et al. Dietary fiber intake and risk of type 2 diabetes in a general Japanese population: The Hisayama Study. J Diabetes Investig. 2021;12(4):527-36.
38. Bhoite R. Effects of a fiber-rich nutritional supplement on postprandial glycemic response and lipid parameters in overweight adults with and without impaired fasting glucose in India. J Diab Metab. 2020;11(3):841.
39. Vuksan V, Jenkins AL, Rogovik AL, Fairgrieve CD, Jovanovski E, Leiter LA. Viscosity rather than quantity of dietary fibre predicts cholesterol lowering effect in healthy individuals. Br J Nutr. 2011;106(9):1349-52.
40. Papathanasopoulos A, Camilleri M. Dietary fiber supplements: effects in obesity and metabolic syndrome and relationship to gastrointestinal functions. Gastroenterology. 2010;138(1):65-72, e1-2.
41. American Diabetes Association. 9. Cardiovascular disease and risk management: Standards of Medical Care in Diabetes-2018. Diabetes Care. 2018;41(Suppl 1):S86-S104.

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