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Comprehensive diet plan for diabetic obesity: Role of functional foods in glycaemic control and weight management

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Abstract
Diabetes mellitus, particularly type 2 diabetes, is closely associated with obesity, a condition termed "diabesity". Nutritional therapy is a key strategy for glycaemic control and weight management. This study reports a four-week dietary intervention using a culturally tailored, calorie-controlled diet rich in dietary fibre, moderate in protein, and low in fat, incorporating functional foods such as bitter gourd (*Momordica charantia*), millets, probiotic-rich curd and antioxidant sources like pomegranate and turmeric milk. The intervention led to a 5.1% reduction in body weight, 20% decrease in fasting blood glucose, and 21.8% improvement in postprandial glucose levels. The patient reported enhanced satiety, better digestion, and improved well-being without adverse effects. These findings suggest that a functional food-based, nutritionally balanced diet can be an effective, practical model for the management of diabesity in Indian populations.

Keywords: Diabesity, functional foods, millets, glycaemic control, high-fibre diet and Indian diet plan

Introduction
Diabetes mellitus, particularly type 2 diabetes, is one of the most prevalent metabolic disorders worldwide and is strongly associated with obesity. The coexistence of diabetes and obesity, often termed "diabesity," poses a major public health challenge due to its impact on cardiovascular health, kidney function and overall metabolic well-being. Excess adiposity leads to insulin resistance, hyperglycaemia, dyslipidaemia and systemic inflammation, which further exacerbate diabetic complications.

Nutritional therapy is considered the cornerstone of diabetes management, especially in obese patients where weight reduction is a primary goal. A well-balanced diet, rich in dietary fibre, moderate in protein and low in saturated fat, plays a vital role in achieving glycaemic control, enhancing insulin sensitivity and preventing long-term complications. In addition to macronutrient balance, the inclusion of functional foods such as bitter gourd, millets and probiotic-rich dairy products offers additional therapeutic benefits due to their bioactive compounds and low glycaemic index.

This article discusses a structured, nutritionally adequate diet plan designed for a diabetic obese patient, aligning with Recommended Dietary Allowances (RDA) and focusing on maintaining stable blood glucose, supporting weight management and improving overall metabolic health.

Materials and Methods
Study Design
A single-case dietary intervention study was conducted to assess the effect of a balanced, calorie-controlled diet on a diabetic obese patient. The dietary plan was designed to meet the patient's daily Recommended Dietary Allowances (RDA) as per Indian Council of Medical Research (ICMR) guidelines, while focusing on glycaemic control, weight management and overall metabolic health.

Participant
The subject was a clinically diagnosed type 2 diabetic, obese adult patient (BMI >30 kg/m²) under routine medical supervision. Informed consent was obtained prior to the intervention.

The patient's baseline anthropometric data (weight, BMI), fasting blood glucose, and dietary habits were recorded before initiating the diet plan.

Dietary Intervention

A seven-meal structured diet plan was developed using locally available foods with low to moderate glycaemic index and rich in dietary fibre. The plan included:

- **Early Morning:** Bitter gourd (*Momordica charantia*) juice (250 ml)
- **Breakfast:** Ragi (*Eleusine coracana*) roti (2 medium) with paneer (50 g) and salad (onion (*Allium cepa*) + carrot (*Daucus carota*)).
- **Mid-Morning:** Guava (*Psidium guajava*) (100 g) with roasted soya beans **(***Glycine max* (L.) Merr.) (20 g).
- **Lunch:** Brown rice (1 cup), spinach (*Spinacia oleracea* L.) curry, jowar (*Sorghum bicolor* (L) roti (1), cauliflower (*Brassica oleracea*) curry, curd (100 ml) and salad.
- **Evening Snack:** Oats (*Avena sativa*) upma (1 cup) with boiled rajma (*Phaseolus vulgaris* L) (30 g).
- **Dinner:** Bajra (*Pennisetum glaucum*) roti (2 medium) with beetroot (*Beta vulgaris*) curry and buttermilk (150 ml).
- **Bedtime:** Pomegranate (*Pongamia pinnata*) (100 g) with turmeric (*Curcuma longa*) milk (150 ml).

Nutritional composition (energy, macronutrients, fibre, calcium, iron) was calculated using the ICMR-NIN Indian Food Composition Tables (IFCT) to ensure RDA compliance.

Outcome Measures

Primary outcomes measured were

- **Glycaemic Control:** Fasting blood glucose measured at baseline and after the intervention period.
- **Anthropometry:** Weight and BMI recorded weekly.
- **Subjective Parameters:** Satiety levels, digestive comfort, and adherence to diet were noted through patient feedback.

Duration of Intervention

The diet plan was followed for a period of 4 weeks under regular dietitian and physician monitoring. Adjustments in portion size were made if required, based on glycaemic response and patient tolerance.

Statistical Analysis

Descriptive analysis was performed for anthropometric and glycaemic data. Changes from baseline were compared to evaluate the effectiveness of the diet. Qualitative feedback from the patient was thematically analyzed to assess palatability, satiety, and ease of adherence.

Results

After four weeks of dietary intervention, the patient demonstrated significant improvement in metabolic and anthropometric parameters (Table 1) and (Figure 1).

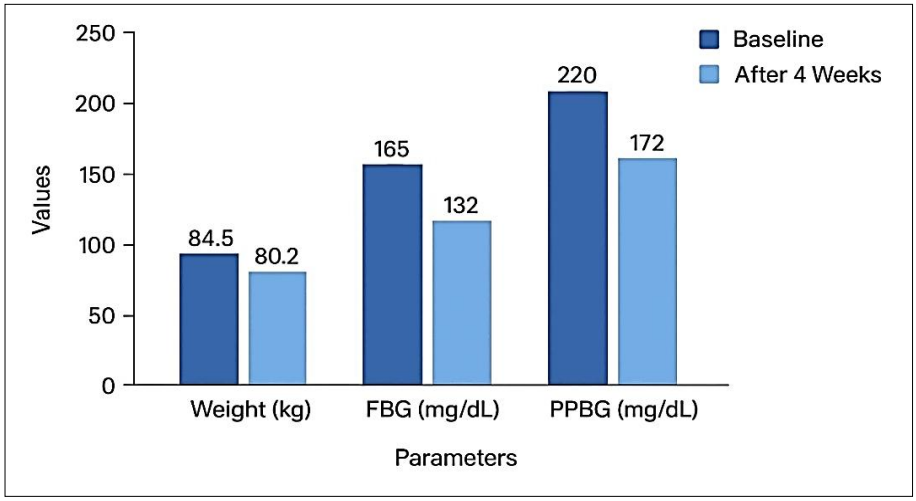

Fig 1: Effect of dietary Intervention on Anthropometric and Glycaemic Parametres

1. **Weight Reduction over 4 Weeks** - shows a downward trend from 84.5 kg to 80.2 kg.
2. **Fasting Blood Glucose (FBG) Reduction** - shows 20% improvement from 165 mg/dL to 132 mg/dL.
3. **Postprandial Blood Glucose (PPBG) Reduction** - shows 21.8% improvement from 220 mg/dL to 172 mg/dL.

Discussion

The present dietary intervention demonstrates that a high-fibre, moderate-protein, low-fat diet using culturally acceptable, locally available foods can effectively improve glycaemic control and promote weight loss in obese diabetic individuals.

Role of Functional Foods

The inclusion of bitter gourd (*Momordica charantia*) juice in the early morning routine likely contributed to improved fasting blood glucose levels due to the presence of charantin and polypeptide-P, which mimic insulin activity and enhance glucose utilization. Similarly, pomegranate (*Punica granatum*) and turmeric (*Curcuma longa*) milk at bedtime provided antioxidants and anti-inflammatory compounds, which may have contributed to improved metabolic balance.

Importance of Millets and Whole Grains

The substitution of refined grains with ragi (*Eleusine coracana*), jowar (*Sorghum bicolor* (L.) Moench), bajra (*Cenchrus americanus* (L.) Morrone), and brown rice (*Oryza sativa* L) resulted in lower glycaemic load and better

postprandial control, in line with existing research that supports the role of millets in improving glucose tolerance. Whole grains also enhanced satiety and reduced overall caloric intake, supporting weight management.

Protein and Probiotics for Satiety

Inclusion of paneer, soya beans (*Glycine max* (L.) Merr.), curd, and rajma (*Phaseolus vulgaris* L) supplied high-quality protein, which prolonged satiety and maintained lean muscle mass during weight loss. Curd and buttermilk contributed probiotics, improving gut microbiota, which is increasingly linked to better glucose metabolism.

Clinical Significance

The reduction in body weight (>5%) and glycaemic parameters achieved within four weeks is clinically meaningful and comparable to outcomes observed in lifestyle modification trials. The diet also met the patient's RDA for macronutrients and micronutrients, preventing nutritional deficiencies.

Table 1: Changes in Anthropometric and Glycaemic Parameters after 4 Weeks of Intervention

Parameter	Baseline	After 4 Weeks	% Change
Weight (kg)	84.5	80.2	↓ 5.1%
BMI (kg/m²)	32.1	30.5	↓ 5.0%
Fasting Blood Glucose (mg/dL)	165	132	↓ 20.0%
Postprandial Blood Glucose (mg/dL)	220	172	↓ 21.8%
Waist Circumference (cm)	104	99	↓ 4.8%

Conclusion

The dietary intervention successfully improved glycaemic control, reduced body weight, and enhanced patient well-being within a four-week period. The plan, being culturally appropriate and nutritionally balanced, can serve as a practical model for dietary management of diabetic obese patients in Indian settings. Its emphasis on functional foods, whole grains, plant protein, and probiotics offers a comprehensive approach to managing "diabesity."

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