Short-Term High Fiber, Diabetes-Specific Enteral Nutrition in an Elderly Patient with Type 2 Diabetes Mellitus: A Case Report

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ABSTRACT

Introduction: High-fiber diabetes-specific formulas (DSFs) are designed to support glycemic control in patients with type 2 diabetes mellitus (T2DM), particularly those requiring nutritional support. Despite their potential benefits, evidence regarding their short-term effects on blood glucose levels and insulin requirements remains limited. This case report explores the impact of an oral DSF on glycemic control in an elderly patient with T2DM over a four-day inpatient period. **Case:** A 70-year-old overweight woman (BMI 24.6 kg/m²) was hospitalized due to uncontrolled hyperglycemia (HbA1c 10.6%, fasting glucose 469 mg/dL) with poor oral intake (< 50% of needs) secondary to nausea and vomiting. A standardized DSF was administered orally alongside a diabetic soft diet for 4 days. DSF was introduced at 150 mL three times daily and titrated to 200 mL twice daily, contributing to a total intake of approximately 1,500 kcal/day. Insulin doses (10 IU regular insulin three times a day) remained unchanged. Monitoring included daily fasting glucose and clinical tolerance. Fasting blood glucose decreased from 469 mg/dL on day 1 to 260 mg/dL by day 4. The patient showed improved oral intake (up to 75% of caloric needs) and better appetite without gastrointestinal complaints. No hypoglycemia episodes or insulin dose adjustments were necessary. **Discussion**: During the four-day observation period, fasting blood glucose decreased progressively from 469 mg/dL to 260 mg/dL without modification of insulin dosage. Oral intake improved to approximately 75% of estimated needs, and no hypoglycemic episodes or gastrointestinal intolerance were observed. The improvement in glycemic trends occurred alongside structured nutritional support and consistent insulin therapy. **Conclusion:** Short-term administration of a high-fiber DSF improved glycemic trends and nutritional intake in an elderly T2DM patient without adverse effects. DSF can be an effective adjunct in individualized medical nutrition therapy to support glycemic stabilization during hospitalization.

Keywords: Case report, diabetes-specific formula, glycemic control, oral nutritional supplement, type 2 diabetes mellitus.

ABSTRAK

Pendahuluan: Formula khusus diabetes (*diabetes-specific formula*/DSF) tinggi serat dirancang untuk mendukung pengendalian glikemik pasien diabetes melitus tipe 2 (T2DM), khususnya yang memerlukan dukungan nutrisi. Meskipun berpotensi bermanfaat, bukti efek jangka pendek DSF terhadap kadar glukosa darah dan kebutuhan insulin masih terbatas. Laporan kasus ini mengkaji dampak pemberian DSF oral terhadap pengendalian glikemik pada pasien lanjut usia dengan T2DM selama periode rawat inap empat hari. **Kasus:** Wanita berusia 70 tahun dengan status gizi *overweight* (IMT 24,6 kg/m²) dirawat karena hiperglikemia tidak terkontrol (HbA1c 10,6%, glukosa puasa 469 mg/dL) serta asupan makan buruk (< 50% kebutuhan) akibat mual dan muntah. Formula khusus diabetes yang terstandar diberikan secara oral bersama diet lunak diabetes selama 4 hari. DSF diberikan mulai dari 150 mL sebanyak 3 kali sehari dan ditingkatkan menjadi 200 mL sebanyak 2 kali sehari, dengan total asupan sekitar 1.500 kkal/hari. Dosis *insulin* (*insulin* regular 10 IU 3 kali sehari) tidak diubah. Pemantauan meliputi glukosa puasa harian dan toleransi klinis. Kadar glukosa puasa menurun dari 469 mg/dL pada hari ke-1 menjadi 260 mg/dL pada hari ke-4. Asupan makan meningkat (hingga 75% kebutuhan kalori) dan nafsu makan membaik tanpa keluhan saluran cerna. Tidak terdapat kejadian hipoglikemia ataupun perubahan dosis *insulin*. **Pembahasan**: Selama periode observasi 4 hari, kadar glukosa darah puasa menurun secara bertahap dari 469 mg/dL menjadi 260 mg/dL tanpa adanya perubahan dosis *insulin*. Asupan oral meningkat hingga sekitar 75% dari kebutuhan yang diperkirakan, dan tidak ditemukan kejadian hipoglikemia ataupun intoleransi gastrointestinal. Perbaikan tren glikemik tersebut terjadi bersamaan dengan pemberian dukungan nutrisi terstruktur serta terapi *insulin* yang konsisten. **Simpulan:** Pemberian jangka pendek formula khusus diabetes tinggi serat berkontribusi terhadap perbaikan tren glikemik dan asupan nutrisi pada pasien lanjut usia dengan T2DM tanpa efek samping. DSF dapat efektif sebagai terapi gizi medik individual untuk mendukung stabilisasi glikemik selama perawatan di rumah sakit. **Yustina Rossa Simatupang, Andrean Wangsa, Anastu Regita Nareswara, Melinda Setiyaningrum, Dendy Daffa Anugrah Putra. Nutrisi Enteral Jangka Pendek Tinggi Serat, Khusus Diabetes pada Pasien Lanjut Usia dengan Diabetes Melitus Tipe 2 — Laporan Kasus.**

Kata Kunci: Laporan kasus, formula khusus diabetes, pengendalian glikemik, suplemen nutrisi oral, diabetes melitus tipe 2.

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INTRODUCTION

Diabetes mellitus (DM) is a chronic and major global public health challenge, with prevalence reaching epidemic proportions in both developed and developing nations. The International Diabetes Federation projects a 51% increase in diabetes incidence by 2045, underscoring the urgent need to address this growing burden.[1] Risk factors for type 2 diabetes mellitus (T2DM) development include physical inactivity and unbalanced nutrition with high glycemic index foods and low dietary fiber intake.[2] In developing countries, projections suggest a 69% surge in affected adults compared to a 20% rise in developed nations by 2030.[2]

Indonesia's diabetes burden continues to rise. The 2023 SKI report estimates a doctor-diagnosed prevalence of 1.7% in the general population (n = 877,531) and a laboratory-confirmed prevalence of 11.7% among individuals aged ≥ 15 years (n = 19,159), suggesting that around 4.1% of adults remain undiagnosed. Roughly one-third of all cases were detected through testing but unreported by physicians. Among diagnosed cases, 50.2% are type 2 DM, 16.9% type 1, and 2.6% gestational, while 30.3% were unsure of their diabetes type. Prevalence of type 2 DM peaks at 52.5% in those aged 65–74, 51.8% in 55–64, and 50.8% in those ≥75. Trend analysis combining RISKESDAS (2013–2018) and SKI (2023) data shows that adult prevalence rose from 14.2% to 15.3%, diagnosed cases from 19.0% to 28.3%, treatment rates from 10.7% to 22.4%, and glycemic control among treated individuals from 5.8% to 9.1%. These figures reflect a growing epidemic and persistent gaps in detection, treatment, and disease management.[3]

The burden of diabetes is particularly pronounced in elderly populations, with approximately 25% of individuals over 65 years affected by T2DM.[4] This prevalence is expected to increase dramatically in coming decades due to increased population longevity.[4] Elderly diabetic patients (DPs) face unique challenges that extend beyond standard diabetes complications, including higher mortality rates, reduced functional status, and increased risk of institutionalization.[5] Mortality risk increases fourfold when diabetes coexists with conditions like stroke or myocardial infarction, with affected individuals compared to those without these comorbidities.[6]

Nutritional status plays a critical role in diabetes management for elderly patients. Glycemic targets for elderly DPs should be individualized based on frailty status, with traditional targets often being too tight for frail older individuals.[7] Frailty, a concerning aspect of elderly diabetes, increases vulnerability to stressors and complications, creating a potentially vicious cycle as diabetes contributes to frailty, and frailty complicates diabetes management.[8]

Medical nutrition therapy (MNT) stands as one of the foundational pillars in the management of T2DM.[9] The American Diabetes Association (ADA) emphasizes that dietary approaches for diabetics should be personalized, highlighting the importance of collaborative nutrition planning between patients and healthcare providers.[8] Nutritional therapy and education have been shown to improve glycemic control, body weight, and cardiovascular risk factors in patients with T2DM.[8]

Carbohydrate quality is increasingly recognized as a key factor in managing cardiometabolic risk in diabetes. Specifically, dietary approaches emphasizing low-glycemic index (GI) carbohydrates, such as those rich in slowly digestible starch (SDS), have been associated with statistically significant reductions in postprandial glycemic response in patients with T2DM, including a 12% decrease in total glycemic exposure (tAUC$_{0-120}$min) and a 14% reduction in peak glycemic value ($p < 0.001$).[1] Dietary fiber plays a critical role in diabetes management, with high intake (25 g/day for women and 38 g/day for men) associated with a 20%–30% reduced risk of developing T2DM,[8] as recommended by the American Diabetes Association at 25 g/day for women and 38 g/day for men.[8] High-fiber diets have been shown to improve glycemic control. In a landmark randomized crossover trial, a high-fiber diet (50 g total; 25 g soluble fiber) significantly lowered daily preprandial glucose concentrations by 13 mg/dL (95% CI: -24 to -1; $p = 0.04$), reduced 24-hour glucose and insulin area under the curve by 10% ($p = 0.02$) and 12% ($p = 0.05$), respectively, and improved lipid profiles; including a 6.7% reduction in total cholesterol ($p = 0.02$) and a 10.2% drop in triglycerides ($p = 0.02$) compared to a moderate-fiber ADA diet.[10]

For elderly DPs, nutritional management requires special consideration, as nutritional status may decline with age due to anorexia, food access problems, and dietary restrictions.[8,11] In these patients, nutritional therapy may need to shift focus from treating obesity/metabolic syndrome to preventing frailty, with emphasis on optimal energy intake, sufficient protein and vitamin consumption, and healthy dietary patterns.[8,11] The evidence strongly supports the integration of tailored nutritional therapy as an essential component of comprehensive diabetes management across different age groups and clinical contexts.[1] DSFs represent a specialized approach to nutritional therapy for DPs who require nutritional support. These formulas feature macro- and micronutrient ingredients specifically designed to manage malnutrition, dysglycemia, and other cardiometabolic risk factors.[12] DSFs are designed to improve glycemic control, particularly postprandial glucose levels, by including slowly digested, low-glycemic carbohydrates, increased protein, monounsaturated and polyunsaturated fatty acids, fiber, and essential micronutrients, all in palatable, calorie-controlled portions.[12,13]

The economic impact of diabetes is substantial, with diabetes imposing a large and growing burden on healthcare systems globally.[14] In this context, the use of DSFs may have particular relevance. A retrospective analysis of hospitalized DPs found that those receiving DSFs had significantly shorter hospital stays and incurred approximately $2,586 less in hospital costs per tube-fed patient compared to those receiving standard nutrition formulas ($p < 0.001$).[15]

Malnutrition is widespread among elderly DPs, affecting approximately 21.2% of hospitalized older diabetics.[14] This population may particularly benefit from DSFs as they help improve glycemic control while addressing nutritional deficits.[16] Given their combined clinical and economic benefits,

DSFs offer a practical option for managing diabetic patients with nutritional challenges across various care settings.

CASE

A 70-year-old woman with type 2 diabetes mellitus was admitted to RSUD Serpong Utara. At admission, subcutaneous regular insulin therapy at a dose of 10 IU was initiated, administered 3 times daily. The patient was classified as overweight, with a body mass index (BMI) of 24.6 kg/m², and demonstrated poorly controlled hyperglycemia, as indicated by a hemoglobin A1c (HbA1c) level of 10.6%. She also experienced nausea and vomiting, with oral intake estimated at less than 50% of her usual dietary consumption for 5 days prior to hospital admission. Her mobility was limited, though she was able to go to the toilet independently. Overall activity was also restricted, and she spent most of her time lying.

After obtaining informed consent, the patient was enrolled in an observational study. The observation period spanned 4 days, from April 26 to 29, 2025. Nutritional assessments and blood samples were collected at baseline and once during the four-day observation period. From the first to the fourth day of hospitalization, the patient received medical nutrition therapy using a high-fiber, diabetes-specific formula (DSF).

Table 1 presents the calculated values of energy, protein, fat, carbohydrate, and fiber content of the diabetes-specific formula (DSF), based on information provided on the nutrition facts panel. The calculations were performed using NutriSurvey 2007 software (www.nutrisurvey.de), with serving volumes of 150 mL and 200 mL, corresponding to the nutritional therapy administered during the hospitalization period.

Nutritional requirements were calculated based on the PERKENI guidelines.[17] The subject presented with a body weight of 63 kg and a height of 160 cm, resulting in a body mass index (BMI) of 24.6 kg/m², categorized as overweight. The ideal body weight (IBW) was estimated to be 54 kg, with an adjusted body weight (ABW) of 57.6 kg used for further calculations. The estimation of nutritional needs in overweight individuals, as outlined by PERKENI, considers both the nutritional status and the individual's level of physical activity.

Table 2 illustrates the classification of caloric requirements according to the PERKENI guidelines,[17] which categorize nutritional needs based on nutritional status. The recommended energy intake for each category is determined by multiplying a specific caloric value with the individual's body weight. According to the nutritional guidelines issued by PERKENI (Perkumpulan Endokrinologi Indonesia),[17] when the actual body weight (ABW) exceeds 120% of the ideal body weight (IBW), calculations should be based on the IBW. In this case, the ABW is 117% of the IBW; therefore, the ABW of 63 kg was used for estimating nutritional requirements. Using an activity factor of 25 kcal/kg, the total energy requirement was calculated to be 1,575 kcal/day, rounded to 1,500 kcal/day. The macronutrient distribution consisted of protein 49 g (13% of total energy), fat 42 g (25%), and carbohydrates 232 g (62%), following the PERKENI recommendations.

An initial energy intake of 1,100 kcal was provided based on observed intake and patient complaints of nausea and reduced appetite. On the first day, a stepwise nutritional intervention was implemented, beginning with an estimated 1,100 kcal, consisting of approximately 650 kcal/day from a soft-texture diabetic (DM) diet, supplemented with enteral nutrition in the form of DSF formula (3 servings of 150 mL each) administered at 09:00, 15:00, and 21:00 Western Indonesian Time (WIB). On the following day, clinical observations indicated improvement, and the patient reported good tolerance to the milk-based formula. Consequently, the nutritionist adjusted the intervention to meet the patient's full estimated energy requirement of 1,500 kcal/day, comprising 1,100 kcal from a soft DM diet and 2 servings of DSF formula (200 mL each) provided at 09:00 and 15:00 Western Indonesian Time (WIB). A graphical representation of food acceptability, including basal metabolic rate (BMR) and actual energy intake, is presented in **Figure 1**.

Table 1. Composition of DSF for diabetic patients on enteral nutrition (EN) therapy.

	Day 1 (150 mL/35 g)	Day 2, 3, 4 (200 mL/46 g)
Energy (Kcal)	146	200
Carbohydrate (g)	22.5	30
Protein (g)	5.8	7.7
Fats (g)	4	5.4
Dietary Fiber (g)	4	7
Vitamins and Minerals	Vitamin A, Vitamin C, Vitamin D, Vitamin E, Vitamin B1, Vitamin B2, Vitamin B3, Vitamin B5, Vitamin B6, Vitamin B9, Vitamin B12, Biotin, Potassium, Calcium, Iron, Phosphorus, Magnesium, Zinc, Iodine, Chromium.	

Abbreviations: DSF = Diabetes-specific formula; EN = Eternal nutrition; Kcal = Kilocalories; g = gram; Carb = Carbohydrate.
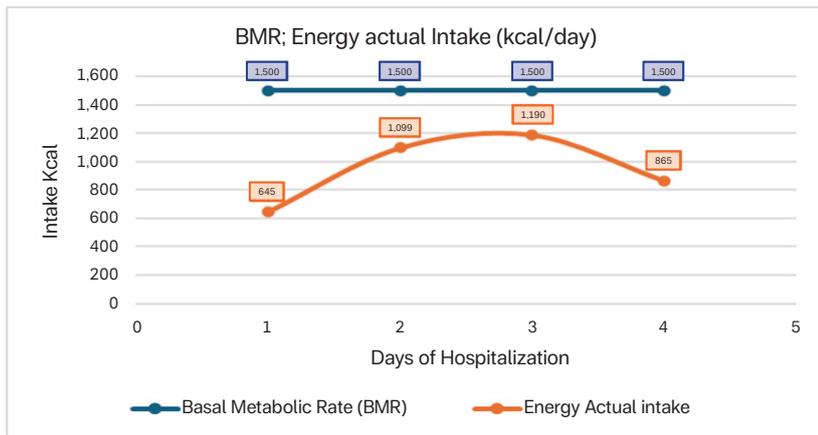
Table 2. Nutritional status for each energy requirement.[17]

Nutritional Status (kg/m²)	Energy Requirement (Kcal/kgBW) *
Underweight	30–35
Normal	25–30
Overweight/Obesity	20–25

* PERKENI (Perkumpulan Endokrinologi Indonesia)
Keterangan: Kcal: Kilocalorie; BW: Body weight.

Figure 1. Comparison between BMR[17] and EAI during hospitalization.
Abbreviations: BMR: Basal metabolic rate; EAI: Energy actual intake.

Figure 1 depicts the comparison between the patient's calculated basal metabolic rate (BMR) and her actual daily energy intake over 4 days of hospitalization. The BMR, estimated at 1,500 kcal/day based on individual anthropometric parameters, remained constant and served as the target for minimum daily caloric requirements to support basal physiological functions.

On day 1, actual energy intake was significantly below the BMR, totaling 645 kcal, due to poor oral intake associated with nausea and vomiting. Energy intake improved on day 2 (1,099 kcal) and peaked on day 3 (1,190 kcal) following the initiation of diabetes-specific enteral nutrition and improved tolerance. On day 4, the recorded intake dropped to

865 kcal. However, this lower value reflects only a partial day's intake, as the patient was discharged from the hospital at midday and therefore did not receive a full day of nutritional support. Overall, while energy intake increased during hospitalization, it remained below the estimated BMR each day, highlighting the challenges of meeting caloric needs in acutely ill elderly patients with type 2 diabetes.

Figure 2 presents the daily progression of fasting blood glucose (FBG) and random blood glucose (RBG) levels concerning diabetes-specific formula (DSF) administration and insulin therapy over 4 days of hospitalization. The left Y-axis represents blood glucose levels (mg/dL) and DSF
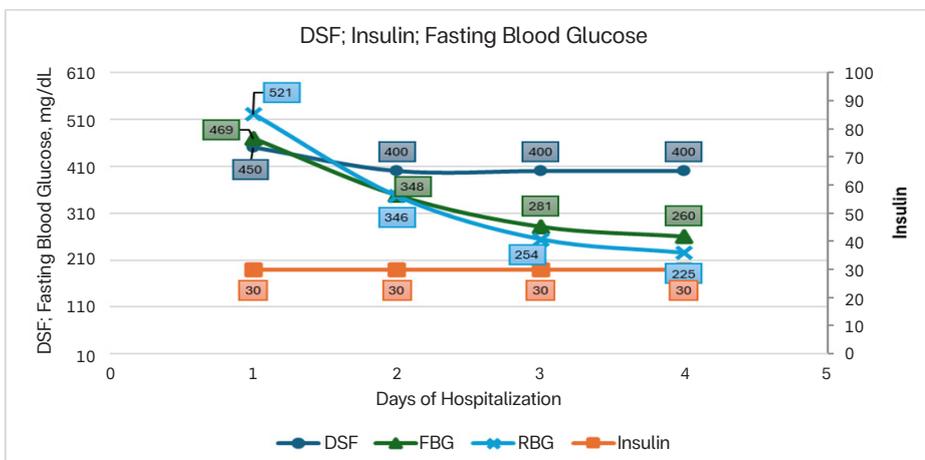
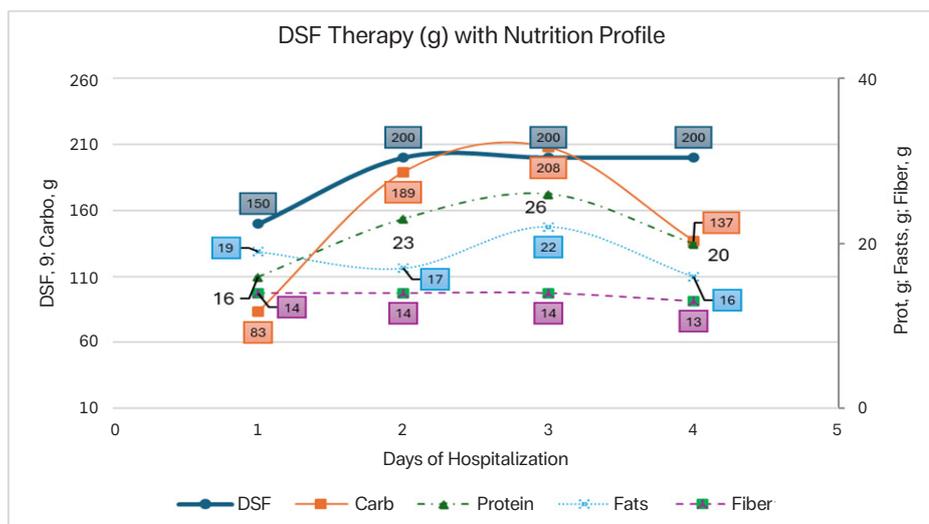volume (mL), while the right Y-axis indicates total daily insulin dosage (IU).

At admission (day 1), the patient exhibited markedly elevated glucose values, with FBG at 469 mg/dL and RBG at 521 mg/dL. Concurrently, DSF intake was initiated at 150 mL, and insulin was administered at 10 IU subcutaneously 3 times daily (accumulated dose 30 IU/day). Over the next 3 days, DSF volume was increased to 200 mL per day, and insulin dosage remained consistent. As shown in the figure, both FBG and RBG levels declined progressively during the observation period. FBG decreased from 469 mg/dL on day 1 to 260 mg/dL on day 4, while RBG dropped from 521 mg/dL to 225 mg/dL over the same interval. DSF intake remained stable at 400 mL/day from day 2 onward. These reductions in glucose levels occurred without any changes in insulin dosage, suggesting a potential adjunctive role of DSF in glycemic management. This figure supports the observed clinical improvement in glycemic control and highlights the potential synergistic effect of consistent insulin therapy combined with structured nutritional support using diabetes-specific enteral nutrition.

Figure 3 illustrates the administration of diabetes-specific formula (DSF) and its corresponding macronutrient contributions—carbohydrates, protein, fats, and fiber—across 4 consecutive days of hospitalization. The left Y-axis represents DSF volume and carbohydrate content (in grams), while the right Y-axis denotes the intake of protein, fats, and fiber (in grams).

On day 1, DSF was initiated at 150 mL, contributing 83 g of carbohydrates, 16 g of protein, 14 g of fats, and 4 g of fiber. On days 2 and 3, the DSF volume increased to 200 mL, resulting in a peak carbohydrate intake of 189 g and 208 g, respectively, accompanied by increased intake of protein (23–26 g), fats (17–22 g), and fiber (6 g consistently). On day 4, DSF volume remained at 200 mL, though carbohydrate content declined to 137 g, while protein, fat, and fiber intakes measured 20 g, 16 g, and 5 g, respectively.

These trends reflect tailored adjustments in medical nutrition therapy aimed at optimizing macronutrient intake during hospitalization.

Figure 2 . Trends in DSF administration, insulin therapy, and blood glucose levels over 4 days of hospitalization.
Abbreviations: DSF: Diabetes-specific formula; FBG: Fasting blood glucose; RBG: Random blood glucose.

Figure 3. DSF administration and associated nutritional profile over 4 days of hospitalization.[17]
Abbreviations: DSF: Diabetes-specific enteral formula; Carbo: Carbohydrates; g: gram.

The increased DSF volume and nutrient delivery on days 2 and 3 aligned with improvements in glycemic control observed over the same period.

Table 3 summarizes the changes in key laboratory parameters observed over a four-day period during which the patient received medical nutrition therapy using a diabetes-specific enteral formula (DSF). A progressive improvement in glycemic control was observed, as evidenced by a reduction in fasting blood glucose (FBG) from 469 mg/dL on day 1 to 260 mg/dL on day 4. Similarly, random blood glucose (RBG) levels decreased from 521 mg/dL to 225 mg/dL over the same period. Hemoglobin A1c (HbA1c), assessed on day 2, was 10.6%, indicating poorly controlled chronic hyperglycemia at baseline.

Other laboratory values remained within acceptable clinical ranges. Hemoglobin (Hb) concentration was measured at 10.3 g/dL on day 1 and showed a slight increase to 11.2 g/dL by day 4. Sodium (Na) levels were stable, increasing marginally from 134 mmol/L on day 1 to 135 mmol/L on day 4. Potassium (K) levels also showed a mild increase from 3.6 mmol/L to 4.0 mmol/L. No electrolyte disturbances or hypoglycemic episodes were noted throughout the intervention period.

These findings suggest that short-term administration of DSF in conjunction with insulin therapy contributed to improved glycemic control without adverse effects on hematological or electrolyte parameters.

DISCUSSION

The mechanisms through which dietary fiber benefits DPs include delayed gastric emptying, improved postprandial glucose responses, enhanced lipid metabolism, inhibition of digestive enzyme action, and positive modifications to gut microbiota.[8]

Clinical evidence consistently shows that diabetes-specific formulas (DSFs) offer measurable short-term advantages over standard formulas in glycemic control.[16] A systematic review of 23 studies (n = 784) found DSFs reduced postprandial glucose by 1.03 mmol/L, peak glucose by 1.59 mmol/L, and glucose AUC by ~35% ($p < 0.001$).[18] Individual studies also reported insulin reductions of 26%–71%.[17] Another study using continuous glucose monitoring found DSFs lowered glycemic variability (MAGE: 64.6 ± 6.8 vs. 110.6 ± 15.3 mg/dL), mean glucose during feeding (171.1 ± 16.1 vs. 202.1 ± 17.4 mg/dL), and insulin use (7.8 ± 2.3 vs. 10.9 ± 3.3 units/day) compared to standard formulas.[19]

For elderly T2DM patients, who often face nutritional challenges, high-fiber DSFs may help address both glycemic control and nutritional deficits,[16] as diabetes is highly prevalent in this group, and many have insufficient oral intake.[16] Treatment may need to shift from strict metabolic control to frailty prevention, especially in those over 75 or malnourished.[8] The short-term benefits of DSFs extend to critical care settings as well. A prospective randomized study in ICU patients found that compared to standard formulas, DSFs lowered insulin requirements, improved glycemic control, and reduced the incidence

Table 3. Variation in laboratory parameters in a diabetic patient receiving diabetes-specific enteral nutrition (DSF) over 4 days of hospitalization.

	Day 1	Day 2	Day 3	Day 4
FBG (mg/dL)	469	348	281	260
RBG (mg/dL)	521	346	254	225
HbA1C (%)	-	10,6	-	-
Hb (g/dl)	10,3	-	-	11,2
Na (mmol/L)	134	-	-	135
K (mmol/L))	3,6	-	-	4
Blood Pressure (mmHg)	110/70	110/70	120/65	120/70
Triglycerides (mg/dl)	-	-	-	-
Total Cholesterol (mg/dl)	-	-	236	-
LDL (mg/dl)	-	-	159	-
HDL (mg/dl)	-	-	130	-

Abbreviations: FBG = Fasting blood glucose; RBG = Random blood glucose; Hb = Hemoglobin; Na = Sodium; K = Potassium.

of ventilator-associated infections. These findings are further supported by a meta-analysis of 10 RCTs involving 685 critically ill patients, which showed that glycemic-control formulas significantly reduced blood glucose levels by 16.06 mg/dL (95% CI: −23.48 to −8.63; $p < 0.001$), insulin requirements by 7.20 IU/day (95% CI: −13.92 to −0.48; $p = 0.04$), and glycemic variability by 6.85% (95% CI: −13.57 to −0.11; $p = 0.05$) compared to standard formulas.[20]

There is a potential bidirectional relationship where diabetes contributes to frailty development, and frailty, in turn, complicates diabetes management.[8] Beyond traditional complications, sarcopenia, characterized by the loss of skeletal muscle mass, power, and function, has been recognized as a specific diabetes complication in elderly patients that profoundly affects physical and psychosocial health.[4] Malnutrition is common among elderly DPs, affecting approximately 21.2% of hospitalized older diabetics.[14] Hospital-related malnutrition is associated with treatment intolerance, poor prognosis, increased infections, poor wound healing, and longer hospitalizations.[14]

Physical activity remains an essential component of diabetes management in elderly patients. In a meta-analysis cited by the ADA, resistance training increased strength by approximately 50% and reduced HbA1c by 0.57% in adults with T2DM.[21] Resistive activities are generally preferable for frail elderly individuals, while aerobic activities should be prescribed, when possible, with the optimal combination of both modalities. Combined training has been shown to be superior to either modality alone for glycemic control.[21] Moreover, exercise has been shown to be as effective for diabetes management in elderly patients as in younger individuals.[21]

Maintaining optimal glycemic control fundamentally prevents both acute and chronic complications in T2DM patients.[16] This is underscored by compelling evidence demonstrating that even modest improvements in glycemic parameters can translate into substantial clinical benefits. Research has shown that a mere 1% reduction in HbA1c is associated with a 21% reduction in the risk of diabetes-related deaths and a

14% reduction in the incidence of myocardial infarction in T2DM patients.[16] The relationship between hyperglycemia and macrovascular complications is well established. Findings from the UK Prospective Diabetes Study showed that each 1% increase in HbA1c was associated with a 14% higher risk of myocardial infarction (relative risk 1.14; 95% CI: 1.10–1.18; $p < 0.0001$) and a 15% higher risk of diabetes-related death (RR 1.15; 95% CI: 1.10–1.20; $p < 0.0001$), with overall cardiovascular disease risk increasing by approximately 15%–18% per 1% HbA1c rise.[16] This heightened cardiovascular risk is especially concerning given that diabetes can decrease life expectancy by up to 6 years in older adults.[11] The risk multiplies substantially when diabetes coexists with other conditions; DPs with stroke or myocardial infarction face nearly 4 times higher mortality risk compared to those without these conditions.[6]

Evidence from a critically ill DKA (diabetic ketoacidosis) case further supports this approach: a modified hospital-based enteral formula enriched with MUFA and fiber reduced glycemic variability from 61% to 8%–19% (%CoV) while also allowing for a reduction in insulin dose and discharge from the ICU by day 12. Notably, the patient eventually tolerated the formula orally, reinforcing its relevance to nontube-fed diabetic populations.[22] Recent evidence reinforces the benefits of DSFs beyond acute hospital settings. In a 6-month case series of diabetic home-care patients receiving continuous EN with a DSF reported a mean HbA1c reduction of 2.1%, a 17 mg/dL decrease in average blood glucose, and a 32% reduction in daily insulin requirements.[23] Lipid profiles improved markedly, with LDL falling by 67 mg/dL and triglycerides by 140 mg/dL. Glycemic variability progressively stabilized, and no patients required hospitalization, Highlighting the potential of DSFs to maintain metabolic control even in older, comorbid populations receiving long-term enteral support.[23]

Beyond cardiovascular complications, poor glycemic control increases the likelihood of microvascular complications such as neuropathy, retinopathy, and chronic kidney disease, which profoundly impair QoL.[11] Additionally, hyperglycemia is associated with a twofold increase in hospitalization

risk and increased mortality risk when overly intensive glucose-lowering strategies are implemented.[11]

Despite guidelines recommending optimal nutrition and protein intake for older diabetics, age-related declines in intake due to anorexia, limited access, poor diet quality, and dietary restrictions require a fundamental shift in nutritional therapy to prevent frailty.[8,11] While glycemic targets should be individualized based on frailty status, many guidelines still suggest HbA1c levels of 53–59 mmol/mol (7%–7.5%), which may be too strict for frail elderly patients.[7]

Nutritional management is essential for achieving glycemic control in patients with T2DM. Current scientific consensus emphasizes that treatment goals should focus on preventing or delaying complications and maintaining quality of life, with effective management of daylong glycemia being central to these outcomes.[1] Lifestyle interventions, particularly nutritional strategies that prioritize dietary quality and appropriate carbohydrate selection, remain safe and practical approaches to improving glucose regulation.[1] For elderly patients experiencing nutritional challenges, addressing both glycemic control and nutritional adequacy becomes paramount. Optimal energy intake, sufficient protein and vitamin consumption, and healthy dietary patterns should be recommended to prevent frailty while maintaining glycemic control.[8,11] A comprehensive approach of nutritional therapy, exercise, glycemic control, and social support is essential to extend healthy life expectancy and maintain QoL in all DPs, particularly in vulnerable elderly populations.[7,11] This balanced approach recognizes that while tight glycemic control remains essential for reducing complications, treatment strategies must be tailored to individual needs, capabilities, and risk profiles to achieve optimal outcomes.[17]

CONCLUSION

Short-term oral supplementation with a high-fiber, diabetes-specific formula (DSF) over 4 days in an elderly patient with type 2 diabetes mellitus (T2DM) and inadequate dietary intake led to a notable improvement in glycemic levels, achieved without

modification of the existing insulin regimen. The intervention was well accepted, without gastrointestinal complications, and resulted in enhanced palatability and dietary intake. These outcomes support the potential role of DSF as a valuable element of personalized medical nutrition therapy for older adults with diabetes, especially in hospitalized individuals facing oral intake challenges.

Authors Contributions
Yustina Rossa Simatupang: Conceptualization; Methodology; Investigation; Data curation; Formal analysis; Project administration; Resources; Supervision; Validation; Visualization; Writing (original draft); Writing (review & editing).

Andrean Wangsa: Conceptualization; Methodology; Investigation; Project administration; Supervision; Writing (original draft); Writing (review & editing).

Anastu Regita Nareswara: Investigation; Project administration, Writing (review & editing).

Melinda Setiyaningrum: Methodology; Investigation; Project administration, Preparation of poster, tables and figures.

Dendy Daffa Anugrah Putra: Writing (review & editing).

Conflict of Interest
The authors declare no conflicts of interest

REFERENCES

1. Goux A, Breyton AE, Meynier A, Lambert-Porcheron S, Sothier M, Van Den Berghe L, et al. Design and validation of a diet rich in slowly digestible starch for type 2 diabetic patients for significant improvement in glycemic profile. Nutrients. 2020;12(8):2404. https://doi.org/10.3390/nu12082404.

2. Nitzke D, Czermainski J, Rosa C, Coghetto C, Fernandes SA, Carteri RB. Increasing dietary fiber intake for type 2 diabetes mellitus management: a systematic review. World J Diabetes. 2024;15(5):1001–10. https://doi.org/10.4239/wjd.v15.i5.100.

3. Badan Kebijakan Pembangunan Kesehatan. Survei kesehatan Indonesia (SKI) 2023 dalam angka. Jakarta: Kementerian Kesehatan Republik Indonesia [Internet]. 2023. Available from: https://www.badankebijakan.kemkes.go.id/ski-2023-dalam-angka/.

4. Izzo A, Massimino E, Riccardi G, Della Pepa G. A narrative review on sarcopenia in type 2 diabetes mellitus: prevalence and associated factors. Nutrients. 2021;13(1):183. https://doi.org/10.3390/nu13010183.

5. Simon MG, Batubara SO. The correlation of food and physical activity with diabetes incidence among older-adult. Indones Nurs J Educ Clin INJEC. 2020;5(2):166. https://dx.doi.org/10.24990/injec.v5i2.286.

6. Di Angelantonio E, Kaptoge S, Wormser D, Willeit P, Butterworth AS, Bansal N, et al. Association of cardiometabolic multimorbidity with mortality. JAMA. 2015;314(1):52. https://doi.org/10.1001/jama.2015.7008.

7. Strain WD, Hope SV, Green A, Kar P, Valabhji J, Sinclair AJ. Type 2 diabetes mellitus in older people: a brief statement of key principles of modern day management including the assessment of frailty. A national collaborative stakeholder initiative. Diabet Med. 2018;35(7):838–45. https://doi.org/10.1111/dme.13644.

8. Tamura Y, Omura T, Toyoshima K, Araki A. Nutrition management in older adults with diabetes: a review on the importance of shifting prevention strategies from metabolic syndrome to frailty. Nutrients. 2020;12(11):3367. https://doi.org/10.3390/nu12113367.

9. Nie Q, Gao H, Li M, Sun Y, Chen H, Zuo S, et al. Not all dietary fibers alleviate type 2 diabetes. Research Square 2020. https://doi.org/10.21203/rs.3.rs-23527/v2.

10. 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. https://doi.org/10.1056/nejm200005113421903.

11. Giraldo Gonzalez GC, Gonzalez Robledo LM, Jaimes Montana IC, Benjumea Salgado AM, Pico Fonseca SM, Arismendi Solano MJ, et al. Nutritional interventions in older persons with type 2 diabetes and frailty: a scoping systematic review. J Cardiovasc Dev Dis. 2024;11(9):289. https://doi.org/10.3390/jcdd11090289.

12. Mechanick JI, Marchetti A, Hegazi R, Hamdy O. Diabetes-specific nutrition formulas in the management of patients with diabetes and cardiometabolic risk. Nutrients. 2020;12(12):3616. https://doi.org/10.3390/nu12123616.

13. Mesejo A, Montejo-Gonzalez JC, Vaquerizo-Alonso C, Lobo-Tamer G, Zabarte-Martinez M, Herrero-Meseguer JI, et al. Diabetes-specific enteral nutrition formula in hyperglycemic, mechanically ventilated, critically ill patients: a prospective, open-label, blind-randomized, multicenter study. Crit Care. 2015;19(1):390. https://doi.org/10.1186/s13054-015-1108-1.

14. Sanz-Paris A, Boj-Carceller D, Lardies-Sanchez B, Perez-Fernandez L, Cruz-Jentoft A. Health-care costs, glycemic control and nutritional status in malnourished older diabetics treated with a hypercaloric diabetes-specific enteral nutritional formula. Nutrients. 2016;8(3):153. https://doi.org/10.3390/nu8030153.

15. Hamdy O, Ernst FR, Baumer D, Mustad V, Partridge J, Hegazi R. Differences in resource utilization between patients with diabetes receiving glycemia-targeted specialized nutrition vs standard nutrition formulas in U.S. hospitals. J Parenter Enter Nutr. 2014;38(2S). https://doi.org/10.1177/0148607114550315.

16. Mesa Garcia MD, Garcia-Rodriguez CE, Rico MDLC, Aguilera CM, Perez-Rodriguez M, Perez-de-la-Cruz AJ, et al. A new fructose-free, resistant-starch type IV-enriched enteral formula improves glycaemic control and cardiovascular risk biomarkers when administered for six weeks to elderly diabetic patients. Nutr Hosp. 2017;34(1):73–80. doi: 10.20960/nh.978.

17. Soelistijo S. Pedoman Pengelolaan dan pencegahan diabetes melitus tipe 2 dewasa di Indonesia 2021. PERKENI [Internet]. 2021[cited 2025 Jul 29]. Available from: https://pbperkeni.or.id/wp-content/uploads/2021/11/22-10-21-Website-Pedoman-Pengelolaan-dan-Pencegahan-DMT2-Ebook.pdf.

18. Elia M, Ceriello A, Laube H, Sinclair AJ, Engfer M, Stratton RJ. Enteral nutritional support and use of diabetes-specific formulas for patients with diabetes: a systematic review and meta-analysis. Diabetes Care. 2005;28(9):2267–79. doi: 10.2337/diacare.28.9.2267.

19. Alish CJ, Garvey WT, Maki KC, Sacks GS, Hustead DS, Hegazi RA, et al. A diabetes-specific enteral formula improves glycemic variability in patients with type 2 diabetes. Diabetes Technol Ther. 2010;12(6):419–25. https://doi.org/10.1089/dia.2009.0185

20. Eckert I, Kumbier MCC, Silva FM, Franzosi OS, De Almeida JC. Association of specialized enteral nutrition with glycemic control and clinical outcomes in critically ill patients: a meta-analysis of randomized controlled trials. Clin Nutr. 2021;40(6):3940–9. https://doi.org/10.1016/j.clnu.2021.04.030.

21. Colberg SR, Sigal RJ, Yardley JE, Riddell MC, Dunstan DW, Dempsey PC, et al. Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. Diabetes Care. 2016;39(11):2065–79. https://doi.org/10.2337/dc16-1728.

22. Anindhita B, Singal AM, Wardhani WI, Manikam NRM, Aditianingsih D. Olive oil and vegetable extract in modified hospital enteral formula improves glycemic variability in critically-ill diabetic ketoacidosis obese patient: a case report. Maj Anest Crit Care. 2024;42(1):56–67. https://doi.org/10.55497/majanestcricar.v42i1.315.

23. Pantanetti P, Cangelosi G, Sguanci M, Morales Palomares S, Nguyen CTT, Morresi G, et al. Glycemic control in diabetic patients receiving a diabetes-specific nutritional enteral formula: a case series in home care settings. Nutrients. 2024;16(16):2602. https://doi.org/10.3390/nu16162602.