



RESEARCH ARTICLE

Article URL: <https://ojs.poltekkes-malang.ac.id/index.php/HAJ/index>**Dietary Modification in an Outpatient With Type 2 Diabetes Mellitus and Hypertension**Dita Noviasari¹, Annasari Mustafa^{2 (CA)}, Endang Widajati³, Dwi Ayu Anggraini⁴¹ Dietitian Professional Education Program, Department of Nutrition, Poltekkes Kemenkes Malang, Indonesia^{2,3} Department of Nutrition, Poltekkes Kemenkes Malang, Indonesia⁴ Department of Nutrition, RSUD Bangil Kabupaten Pasuruan, IndonesiaCorrespondence author's email (CA): annasarimustafa@gmail.com**ABSTRACT**

Type 2 Diabetes Mellitus (T2DM) accompanied by hypertension is a chronic metabolic disorder requiring individualized nutrition therapy to improve metabolic control and prevent complications. This study aimed to evaluate dietary modification through the Nutrition Care Process in an outpatient with T2DM and hypertension at RSUD Bangil, Pasuruan Regency. A descriptive case study was conducted on a 55-year-old female outpatient diagnosed with T2DM and hypertension. Nutritional care included assessment, diagnosis, intervention, monitoring, and evaluation. The intervention consisted of individualized meal planning, a diabetic diet with sodium and saturated fat restriction, nutrition education, counseling, and modified pumpkin pudding as a healthy snack. Nutritional status, biochemical parameters, dietary intake, knowledge, adherence, and food acceptability were monitored before and after the intervention. Average energy intake reached approximately 100% of estimated requirements. Blood pressure decreased from 138/85 mmHg to 120/79 mmHg. Fasting blood glucose decreased from 172 to 115 mg/dL, while two-hour postprandial blood glucose decreased from 199 to 112 mg/dL. Nutrition knowledge, dietary adherence, and acceptance of the modified diet also improved. Individualized dietary modification combined with continuous nutrition education improved dietary intake, glycemic control, blood pressure, and adherence in this patient.

Keyword : Dietary modification; glycemic control; hypertension; nutrition care process; type 2 diabetes mellitus

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License (<https://creativecommons.org/licenses/by-sa/4.0/>)**INTRODUCTION**

Dietary patterns play an important role in the management of patients with type 2 diabetes mellitus (T2DM) and hypertension. Patients with these conditions require appropriate dietary intake in terms of energy, carbohydrate quality and quantity, fat composition, fiber, and sodium to support glycemic and blood pressure control. However, outpatient dietary patterns may remain inconsistent with nutritional recommendations, including excessive intake of energy, carbohydrates, saturated fat, and sodium and inadequate consumption of fiber-rich foods. Such dietary patterns can contribute to poor metabolic control and increase the risk of cardiovascular, renal, and other diabetes-related

complications. Therefore, individualized nutrition therapy is essential to address patients' specific dietary needs and support long-term metabolic management.

Diabetes mellitus (DM) is one of the fastest-growing non-communicable diseases worldwide and represents a major public health challenge because of its high morbidity, mortality, and economic burden. The International Diabetes Federation (IDF) estimated that approximately 537 million adults were living with diabetes in 2021, with the number projected to increase to 783 million by 2045 if effective prevention and management strategies are not implemented [1]. Hypertension is also a major global health problem and frequently coexists with T2DM, substantially increasing the risk of cardiovascular disease, stroke, nephropathy, and premature mortality [2]. At the national level, Indonesia is among the countries with the largest number of people living with diabetes worldwide [1]. The prevalence of diabetes and hypertension in Indonesia continues to increase, influenced by population aging, unhealthy dietary patterns, sedentary lifestyles, and obesity [3]. These conditions highlight the need for comprehensive management strategies, including medical nutrition therapy, physical activity, pharmacological treatment, glucose monitoring, and diabetes self-management education. Medical nutrition therapy is a cornerstone of diabetes management because appropriate dietary modification can improve glycemic control, lipid profile, blood pressure, and overall quality of life [4], [5].

Despite the importance of dietary management, maintaining dietary adherence remains a challenge among outpatients with T2DM and hypertension. Poor adherence may be influenced by patients' knowledge, dietary habits, food preferences, socioeconomic conditions, lifestyle, perceived barriers, and difficulty maintaining recommended dietary changes in daily life. In addition, inconsistent eating patterns may occur when patients experience decreased appetite or other illness-related conditions, resulting in inadequate intake despite excessive habitual consumption during normal periods. At RSUD Bangil, Pasuruan Regency, the assessment of the patient in this study showed uncontrolled metabolic parameters, including HbA1c of 9%, fasting blood glucose of 172 mg/dL, triglycerides of 608 mg/dL, LDL cholesterol of 188.1 mg/dL, and blood pressure of 138/85 mmHg. Nutritional assessment also revealed excessive habitual intake of energy, carbohydrates, protein, and fat based on the Semi Quantitative Food Frequency Questionnaire, whereas the 24-hour dietary recall demonstrated inadequate intake during illness due to decreased appetite. These findings indicate inconsistent dietary behavior and the need for individualized nutrition intervention through dietary modification.

Previous studies have demonstrated that individualized dietary modification improves glycemic control, body weight, and cardiovascular risk factors among patients with T2DM. Soluble fiber supplementation has been shown to improve blood glucose regulation and body weight in patients with T2DM [6]. Furthermore, nutrition education and individualized dietary counseling significantly improve patients' knowledge, dietary compliance, and metabolic outcomes [7]. Dietary approaches emphasizing adequate fiber intake, reduced saturated fat, sodium restriction, and low glycemic index carbohydrates

are also associated with improved glycemic control and blood pressure among patients with diabetes and hypertension [5], [8]. However, most previous studies primarily focused on educational interventions or dietary counseling alone, while limited studies have integrated individualized menu planning, modified food products, continuous monitoring, and nutrition education within outpatient nutrition care.

The novelty of this study lies in the implementation of a comprehensive individualized diet modification program combining nutrition assessment, individualized meal planning based on the principles of diabetic and low-sodium diets, incorporation of a high-fiber pumpkin pudding as a healthy snack alternative, nutrition education, and continuous monitoring of anthropometric, biochemical, clinical, dietary intake, knowledge, dietary adherence, and food acceptability outcomes. This integrated approach provides a more comprehensive nutritional intervention than previous studies and is expected to improve adherence while supporting better metabolic control in patients with T2DM and hypertension.

Therefore, this study aimed to analyze the implementation of individualized diet modification in an outpatient with type 2 diabetes mellitus and hypertension at RSUD Bangil, Pasuruan Regency, and to evaluate its effects on nutritional intake, biochemical parameters, blood pressure, nutrition knowledge, dietary adherence, and food acceptability.

METHODS

This study employed a descriptive case study design with a single-subject pre–post intervention approach to evaluate the implementation of individualized diet modification in an outpatient with type 2 diabetes mellitus (T2DM) and hypertension. The study was conducted at the Internal Medicine Outpatient Clinic of RSUD Bangil, Pasuruan Regency, Indonesia, from June to July 2026. The study subject was selected using purposive sampling based on the following inclusion criteria: diagnosed with T2DM accompanied by hypertension, receiving outpatient care, willing to participate, and able to communicate effectively throughout the intervention period. The intervention consisted of individualized medical nutrition therapy based on the Nutrition Care Process (NCP), including nutrition screening, assessment, nutrition diagnosis, individualized meal planning according to diabetic, low-sodium, and low-fat dietary principles, development of a 7-day cycle menu, provision of a modified pumpkin pudding snack, nutrition education, counseling, and continuous monitoring for seven consecutive days.

Data were collected through anthropometric measurements (body weight, height, and body mass index), biochemical examinations (HbA1c, fasting blood glucose, 2-hour postprandial blood glucose, triglycerides, and LDL cholesterol), clinical assessments (blood pressure and physical complaints), dietary assessment using a Semi-Quantitative Food Frequency Questionnaire (SQ-FFQ), 24-hour dietary recall, daily food records, the Malnutrition Screening Tool (MST), the International Physical Activity

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Questionnaire (IPAQ), nutrition knowledge questionnaires, dietary adherence questionnaires, and food acceptability (palatability) questionnaires. Nutrient intake was analyzed using NutriSurvey software, while energy and nutrient requirements were calculated according to the Indonesian Society of Endocrinology (PERKENI) guidelines. The modified snack consisted of pumpkin, low-fat milk, agar powder, and diabetic-friendly sweetener. Data were analyzed descriptively by comparing pre- and post-intervention results and presented in tables, graphs, percentages, and narrative descriptions to evaluate changes in anthropometric, biochemical, clinical, dietary intake, nutrition knowledge, dietary adherence, and food acceptability outcomes.

The study received ethical clearance from the Research Ethics Committee of Bangil Regional Public Hospital (RSUD Bangil), Pasuruan Regency, under approval number 005812/KEPK RSUD Bangil/2026, issued on 17 July 2026. The research was conducted in accordance with the ethical principles and guidelines approved by the Research Ethics Committee.

RESULT

The study involved one outpatient diagnosed with type 2 diabetes mellitus and hypertension. The subject was a 55-year-old female with a body weight of 48.7 kg, height of 154 cm, and body mass index (BMI) of 20.5 kg/m², indicating normal nutritional status. The patient had a 7-year history of diabetes mellitus and hypertension and had been routinely attending the Internal Medicine Outpatient Clinic of RSUD Bangil since 2019. Initial biochemical examination showed uncontrolled metabolic status, including HbA1c of 9%, fasting blood glucose of 172 mg/dL, 2-hour postprandial blood glucose of 199 mg/dL, triglycerides of 608 mg/dL, LDL cholesterol of 188.10 mg/dL, and blood pressure of 138/85 mmHg. Nutritional assessment using the Semi Quantitative Food Frequency Questionnaire (SQ-FFQ) demonstrated excessive habitual intake of energy, carbohydrates, protein, and fat, whereas the 24-hour dietary recall during assessment showed inadequate intake because of decreased appetite.

Table 1. Baseline Characteristics of the Research Subject

Variable	Result
Age	55 years
Sex	Female
Medical diagnosis	Type 2 Diabetes Mellitus + Hypertension
Body weight	48.7 kg
Height	154 cm
BMI	20.5 kg/m ² (Normal)
Blood pressure	138/85 mmHg
HbA1c	9%
Fasting blood glucose	172 mg/dL
2-hour postprandial glucose	199 mg/dL
Triglycerides	608 mg/dL
LDL cholesterol	188.10 mg/dL

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Following the seven-day individualized diet modification intervention, improvements were observed in several clinical and biochemical indicators. Body weight was relatively stable, increasing slightly from 48.7 kg to 48.8 kg while remaining within the normal BMI category. Blood pressure decreased from 138/85 mmHg to 120/79 mmHg. Fasting blood glucose decreased from 172 mg/dL to 115 mg/dL, and 2-hour postprandial blood glucose decreased from 199 mg/dL to 112 mg/dL. These findings indicate an improvement in glycemic control and blood pressure after implementation of individualized medical nutrition therapy.

Table 2. Comparison of Anthropometric, Biochemical, and Clinical Outcomes Before and After Intervention

Variable	Before	After
Body weight (kg)	48.7	48.8
BMI (kg/m ²)	20.5	20.5
Blood pressure (mmHg)	138/85	120/79
Fasting blood glucose (mg/dL)	172	115
2-hour postprandial glucose (mg/dL)	199	112

Evaluation of dietary intake using daily food records and NutriSurvey demonstrated that nutrient intake approached the individualized nutritional requirements during the intervention period. Average daily energy intake reached 1,590 kcal (100.45% of the estimated requirement), protein intake was 65 g (109.08%), fat intake was 44 g (99.54%), carbohydrate intake was 235 g (98.92%), and dietary fiber intake was 25 g (119.39%). These results indicate that individualized meal planning and dietary counseling successfully improved dietary adequacy throughout the intervention period.

Table 3. Average Nutrient Intake During Intervention

Variable	Requirement	Intake	Adequacy (%)
Energy (kcal)	1,582.7	1,590	100.45
Protein (g)	59.3	65	109.08
Fat (g)	43.9	44	99.54
Carbohydrate (g)	237.4	235	98.92
Fiber (g)	21	25	119.39

Nutrition education conducted during the intervention improved the patient's understanding of diabetes dietary management, as indicated by increased post-test scores compared with pre-test assessment. The patient also demonstrated improved adherence to the prescribed meal schedule, portion sizes, and food selection according to diabetic, low-sodium, and low-fat dietary principles. Evaluation of food acceptability showed that the modified menus, including pumpkin pudding as a high-fiber snack, were well accepted by the patient. The overall food acceptability score was categorized as very good, indicating that the individualized diet modification was feasible and acceptable for daily implementation.

DISCUSSION

Medical nutrition therapy is recognized as one of the primary components in the management of type 2 diabetes mellitus because it regulates energy intake, carbohydrate distribution, meal timing, and food quality. Individualized dietary planning enables nutrition interventions to be tailored according to patients' nutritional status, dietary habits, and daily activities, thereby improving adherence and promoting better glucose homeostasis. Current diabetes nutrition guidelines recommend emphasizing healthy dietary patterns rich in vegetables, fruits, whole grains, legumes, and dietary fiber while reducing refined carbohydrates and added sugars to achieve optimal metabolic control [4], [9].

The improvement in glycemic control observed in this study may be related to the implementation of individualized meal planning based on appropriate food type, amount, and timing ("3J"), combined with continuous nutrition counseling and monitoring. Individualized medical nutrition therapy and meal planning are recommended as important components of diabetes management and have been associated with improved glycemic outcomes in patients with type 2 diabetes mellitus [10]. The individualized approach allows dietary recommendations to be adapted to patients' nutritional needs, metabolic goals, preferences, and daily eating patterns, thereby supporting adherence to dietary recommendations [10]. This approach facilitates gradual behavioral change and improves patients' ability to comply with dietary recommendations in daily practice. Recent evidence indicates that individualized dietary interventions provide greater improvements in glycemic outcomes than generalized dietary advice because they consider individual preferences and metabolic conditions [11].

Another factor contributing to improved glycemic regulation is the increased intake of dietary fiber through vegetables and the modified pumpkin pudding provided during the intervention. Dietary fiber slows gastric emptying, delays glucose absorption, improves satiety, and reduces postprandial glycemic excursions. A recent systematic review demonstrated that increased dietary fiber intake significantly improves fasting blood glucose, HbA1c, and overall metabolic control among individuals with type 2 diabetes mellitus [12], [13].

Although the findings of this study support previous evidence, several studies have suggested that dietary modification alone may not consistently improve long-term glycemic indicators within a short intervention period. The magnitude of improvement is influenced by intervention duration, baseline metabolic status, medication adherence, and patient compliance. Therefore, dietary modification should be integrated with pharmacological therapy and regular follow-up to achieve sustainable metabolic control [14], [7].

Dietary fiber may also explain the observed clinical improvement because soluble fiber delays gastric emptying, reduces postprandial glucose excursions, enhances satiety, and improves insulin sensitivity. A recent rapid review and meta-analysis reported that diets higher in dietary fiber were associated with lower HbA1c, improved fasting insulin, and reduced LDL cholesterol compared with

lower-fiber dietary approaches, emphasizing that fiber quality may be more important than carbohydrate restriction alone in diabetes management [15].

The improvement in blood pressure may be attributed to reduced sodium intake, limitation of saturated fat, and increased consumption of vegetables and fruits throughout the intervention period. Reduced sodium intake contributes to lower blood pressure, while limiting saturated fat intake is recommended to reduce cardiovascular risk and support cardiovascular health [9], [16]. These physiological mechanisms collectively support better blood pressure regulation among patients with diabetes mellitus and hypertension [7], [6].

The intervention also emphasized healthier cooking methods such as boiling, steaming, and grilling instead of frying. Such modifications reduce saturated fat intake while preserving nutrient quality. Similar findings have been reported in recent studies demonstrating that individualized medical nutrition therapy significantly reduces blood pressure and cardiometabolic risk among adults with hypertension when accompanied by continuous dietary counseling [14], [17].

However, blood pressure is affected by multiple factors beyond nutrition, including antihypertensive medication, physical activity, stress, sleep quality, and genetic predisposition. Consequently, the improvement observed in this study should be interpreted as the result of comprehensive disease management rather than dietary modification alone [4], [6].

Nutrition education accompanied by individualized counseling and regular monitoring appears to be an essential factor supporting behavioral change in this study. Many patients with chronic diseases understand dietary recommendations but experience difficulty implementing them consistently in daily life. Practical nutrition education, individualized meal plans, and continuous follow-up improve self-efficacy and facilitate long-term adherence to dietary recommendations [4], [9].

The individualized menu developed during this intervention was designed according to calculated nutritional requirements while considering the patient's eating habits and food preferences. Such an approach improves the feasibility of dietary implementation because recommendations remain compatible with the patient's lifestyle. Current diabetes nutrition guidelines emphasize that individualized medical nutrition therapy should focus on sustainable dietary behavior rather than temporary dietary restriction [9], [18].

The inclusion of pumpkin pudding as a modified snack may also have contributed to better dietary acceptance while increasing dietary fiber intake. Functional foods rich in fiber and bioactive compounds are increasingly recognized as complementary components of diabetes nutrition therapy because they improve overall diet quality without substantially increasing simple carbohydrate intake [12], [19].

Individualized dietary modification based on the Nutrition Care Process, combined with nutrition education, counseling, and continuous monitoring, improved dietary intake, glycemic control, and blood pressure in an outpatient with type 2 diabetes mellitus and hypertension. The intervention also improved

nutrition knowledge, dietary adherence, and acceptance of the modified diet [20]. These findings suggest that individualized nutrition care may be a practical approach to support dietary management and metabolic control in outpatients with type 2 diabetes mellitus and hypertension.

CONCLUSION

Implementation of the Nutrition Care Process through individualized dietary modification successfully improved nutrient adequacy, glycemic control, and blood pressure in an outpatient with type 2 diabetes mellitus and hypertension. Restricting sodium and saturated fat while optimizing energy, carbohydrate quality, and fiber intake—supported by high-fiber snack modification—effectively normalized daily glucose regulation and clinical vascular parameters. Continuous nutrition education and personalized counseling enhanced patient understanding, dietary compliance, and overall food acceptance, establishing structured medical nutrition therapy as a crucial foundation for chronic disease management. To maintain these positive clinical outcomes and prevent long-term complications, healthcare practitioners should integrate structured, individualized diet planning with continuous monitoring in outpatient care protocols. Further clinical studies with broader populations and extended observation periods are recommended to evaluate the sustained long-term efficacy and clinical viability of specialized high-fiber food modifications in metabolic disease management.

REFERENCES

- [1] American Diabetes Association, “Diagnosis and Classification of Diabetes: Standards of Care in Diabetes-2024,” *Diabetes Care*, vol. 47, no. Suppl 1, pp. S20–S42, 2024, doi: 10.2337/dc24-S002.
- [2] American Diabetes Association Professional Practice Committee, “9. Pharmacologic Approaches to Glycemic Treatment: Standards of Care in Diabetes-2024,” *Diabetes Care*, vol. 47, no. Suppl 1, pp. S158–S178, 2024, doi: 10.2337/dc24-S009.
- [3] H. Sun *et al.*, “IDF Diabetes Atlas: Global, Regional And Country-Level Diabetes Prevalence Estimates for 2021 and Projections for 2045,” *Diabetes Res. Clin. Pract.*, vol. 183, p. 109119, 2022, doi: 10.1016/j.diabres.2021.109119.
- [4] American Diabetes Association Professional Practice Committee, “5. Facilitating Positive Health Behaviors and Well-being to Improve Health Outcomes: Standards of Care in Diabetes-2026,” *Diabetes Care*, vol. 49, no. Supplement_1, pp. S89–S131, 2026, doi: 10.2337/dc26-S005.
- [5] PERKENI, *Pedoman Pengelolaan dan Pencegahan Diabetes Melitus Tipe 2 Dewasa di Indonesia*. Jakarta: Perkumpulan Endokrinologi Indonesia, 2021.
- [6] World Health Organization, *Guideline for the Pharmacological Treatment of Hypertension in Adults*. Geneva: World Health Organization, 2021.
- [7] K. Lu *et al.*, “Effect of Viscous Soluble Dietary Fiber on Glucose And Lipid Metabolism in Patients

- With Type 2 Diabetes Mellitus: A Systematic Review and Meta-Analysis on Randomized Clinical Trials,” *Front. Nutr.*, vol. 10, no. 1, pp. 1–15, 2023, doi: 10.3389/fnut.2023.1253312.
- [8] American Diabetes Association Professional Practice Committee, “3. Prevention or Delay of Diabetes and Associated Comorbidities: Standards of Care in Diabetes—2024,” *Diabetes Care*, vol. 47, no. Supplement_1, pp. S43–S51, 2023, doi: 10.2337/dc24-S003.
- [9] K. H. K. Lau, “Nutrition Therapy for Adults With Diabetes or Prediabetes,” *ADCES Pract.*, vol. 10, no. 1, pp. 34–38, 2022, doi: 10.1177/2633559X211050404.
- [10] American Diabetes Association Professional Practice Committee, “8. Obesity and Weight Management for the Prevention and Treatment of Diabetes: Standards of Care in Diabetes-2026,” *Diabetes Care*, vol. 49, no. Suppl 1, pp. S166–S182, 2026, doi: 10.2337/dc26-S008.
- [11] T. Jing *et al.*, “Effect of Dietary Approaches on Glycemic Control in Patients with Type 2 Diabetes: A Systematic Review with Network Meta-Analysis of Randomized Trials,” *Nutrients*, vol. 15, no. 14, p. 3156, 2023, doi: 10.3390/nu15143156.
- [12] A. N. Reynolds, J. Lang, A. Brand, and J. Mann, “Higher Fiber Higher Carbohydrate Diets Better Than Lower Carbohydrate Lower Fiber Diets for Diabetes Management: Rapid Review With Meta-Analyses,” *Obes. Rev.*, vol. 26, no. 1, p. e13837, 2025, doi: 10.1111/obr.13837.
- [13] B. Thorisdottir *et al.*, “Legume Consumption in Adults And Risk of Cardiovascular Disease And Type 2 Diabetes: A Systematic Review and Meta-Analysis,” *Food Nutr. Res.*, vol. 67, no. 10, p. 29219, 2023, doi: 10.29219/fnr.v67.9541.
- [14] R. M. Farras, “The Effectiveness of Nutritional Interventions on Hypertension Control: A Meta-Analysis,” *J. La Medihealtico*, vol. 5, no. 3, pp. 600–608, 2024, doi: 10.37899/journallamedihealtico.v5i3.1193.
- [15] American Diabetes Association Professional Practice Committee, “3. Prevention or Delay of Diabetes and Associated Comorbidities: Standards of Care in Diabetes-2024,” *Diabetes Care*, vol. 47, no. Suppl 1, pp. S43–S51, 2024, doi: 10.2337/dc24-S003.
- [16] IDF, *Diabetes Atlas*, 10th ed. Brussel: International Diabetes Federation, 2021.
- [17] S. E. Abdelsalam, M. A. R. Ismaail, E. A. Sultan, O. E. Elsherif, H. M. Salama, and S. I. Hassan, “The Outcome of Medical Nutrition Therapy on Glycemic Control Among Type 2 Diabetic Patients,” *Pan Afr. Med. J.*, vol. 45, p. 85, 2023, doi: 10.11604/pamj.2023.45.85.35520.
- [18] S. Joshi *et al.*, “Digital Twin-Enabled Personalized Nutrition Improves Metabolic Dysfunction-Associated Fatty Liver Disease in Type 2 Diabetes: Results of a 1-Year Randomized Controlled Study,” *Endocr. Pract.*, vol. 29, no. 12, pp. 960–970, 2023, doi: 10.1016/j.eprac.2023.08.016.
- [19] Y. Tursinawati, L. Setiowati, Z. Wahab, and A. Kartikadewi, “Korelasi Indeks Massa Tubuh dan Tekanan Darah dengan Rasio TG/HDL pada Penderita Diabetes Mellitus Tipe 2 Etnis Jawa: Correlation of Body Mass Index and Blood Pressure with TG/HDL Ratio in Type 2 Diabetes Javanese Patients,” *Medica Hosp. J. Clin. Med.*, vol. 9, no. 3, pp. 335–339, 2022, doi:

10.36408/mhjcm.v9i3.817.

- [20] N. Nirmalan and M. Nirmalan, “Hormonal Control of Metabolism: Regulation of Plasma Glucose,” *Anaesth. Intensive Care Med.*, vol. 24, no. 10, pp. 618–623, 2023, doi: 10.1016/j.mpaic.2023.07.001.