Dietary Fiber and Calorie Intake of Hospitalized Diabetic Patients

Ashwin Meshram[1], Pratibha Chokhi[2], Chittranjan Yadav[3]

[1]Master of Science, Nutrition & Dietetics, Shri Rawatpura Sarkar University, Raipur

[2]Assistant Professor, Shri Rawatpura Sarkar University, Raipur

[3]Senior Clinical Dietitian, Max Healthcare Hospital Nagpur

DOI: https://doi.org/10.51244/IJRSI.2025.120500139

Received: 02 June 2025; Accepted: 06 June 2025; Published: 17 June 2025

ABSTRACT

Background: Managing diabetes effectively hinges on meticulous dietary control, where both fiber intake and overall calorie consumption play pivotal roles. Dietary fiber, a non-digestible carbohydrate, has demonstrated significant benefits in regulating blood glucose levels, improving insulin sensitivity, and promoting satiety. For diabetic patients, these effects are crucial in mitigating hyperglycemia and managing weight. Simultaneously, carefully calibrated daily calorie intake is essential to maintain a healthy weight, which directly impacts insulin resistance and glycemic control. However, determining the optimal balance of fiber and calories for individual diabetic patients remains a complex challenge, necessitating personalized recommendations. This research aims to explore current dietary fiber recommendations and their impact on glycemic control, alongside the significance of tailored daily calorie intake in achieving optimal metabolic outcomes for individuals with diabetes.

Rationale & Objective: This study examined fiber, calorie, and macronutrient intake in hospitalized diabetics, comparing it to 2024 RDA fiber recommendations. It identified imbalances, crucial for targeted nutritional interventions in diabetic patients.

Method: This study enrolled 50 hospitalized diabetic patients (ages 30-90, both male and female) from a Nagpur super specialty center using random sampling. Non-diabetic individuals were excluded. Daily nutrient intake was assessed via 24-hour dietary recall and compared to the RDA 2024 guidelines. Dietary fiber adequacy was evaluated based on recommendations per 1000 kcal.

Results: Diabetic patients significantly exceed required caloric intake (2178 kcal vs. 1816 kcal), with a 362 kcal average excess ($p<0.00001$). Protein intake is deficient (58g vs. 69g, $p<0.00001$), while fat intake is excessive (35g vs. 25g, $p<0.00001$). Fiber intake is alarmingly low (21g vs. 44g, $p<0.00001$). Statistical significance confirms these deviations. Patients consistently overconsume calories and fat, while under consuming protein and fiber, highlighting critical dietary management failures.

Conclusion: Patients exhibit significant nutrient imbalances, consuming excess calories and fat while lacking protein and fiber. Caloric intake surpasses recommendations by 362 kcal, indicating poor dietary control. Protein is deficient by 10.73g, and fat intake exceeds guidelines by 40%. A severe fiber deficit exists, with consumption at only half the recommended level. Compounding these issues, a large proportion of patients are over 60 and overweight or obese, emphasizing the urgent need for improved dietary management.

Keywords: Dietary Fiber, RDA, Diabetes, macro nutrients

INTRODUCTION

Diabetes mellitus, a chronic metabolic disorder, necessitates meticulous dietary management to optimize glycemic control and mitigate complications. Hospitalization often disrupts routine dietary habits, posing challenges for maintaining recommended nutritional intake, particularly concerning dietary fiber and calorie

consumption. Dietary fiber, known for its role in slowing glucose absorption and improving insulin sensitivity, is crucial for diabetic patients. Conversely, excessive calorie intake can exacerbate hyperglycemia and contribute to weight gain, further complicating diabetes management.

Studies have consistently demonstrated the beneficial effects of adequate dietary fiber on glycemic control in diabetic populations. Fiber's ability to increase satiety, delay gastric emptying, and modulate gut microbiota contributes to improved postprandial glucose levels and reduced insulin requirements [**Reynolds, A. et.al**.]. However, hospitalized diabetic patients may face limitations in accessing fiber-rich foods due to hospital food services or altered appetites. Simultaneously, calorie intake during hospitalization can be influenced by various factors, including stress, medications, and altered metabolic states, potentially leading to either over- or under-consumption [**Stratton, R. J. et.al**.].

Maintaining appropriate calorie intake is fundamental for achieving weight management goals and optimizing glycemic control in diabetic patients. Calorie restriction, when necessary, has been shown to improve insulin sensitivity and reduce HbA1c levels [**Lim, E. L. et. al.**]. Therefore, understanding the dietary fiber and calorie intake patterns of hospitalized diabetic patients is essential for developing targeted nutritional interventions. This research aims to assess the current dietary fiber and calorie consumption of hospitalized diabetic patients, identify potential nutritional deficiencies or excesses, and provide insights for improving nutritional care during hospitalization.

LITERATURE REVIEW

Kikuchi, R., et al. (2024) conducted a study on Dietary Fiber and Quality of Life in Type 2 Diabetes this research studied the Relationship between diabetes diet-related quality of life and dietary fiber intake among people with type 2 diabetes. This study shows a connection between higher dietary fiber intake and improved diet related quality of life in type 2 diabetic patients.

American Diabetes Association. (2022) published Standards of medical care in diabetes, and found that these standards recommend individualized medical nutrition therapy for diabetes, including appropriate fiber intake and calorie goals, which are crucial for hospitalized patients.

Reynolds, A., et.al. (2019). Conducted a study to find out The Importance of Dietary Fiber in Glycemic Control; entitled **"**Carbohydrate in the management of diabetes: a systematic review and meta-analysis." This meta-analysis highlights the significant role of dietary fiber in improving glycemic control in diabetic individuals, emphasizing its effects on glucose absorption and insulin sensitivity.

Evert, A. B. et al. (2019) conducted a study on Nutrition therapy recommendations for the management of adults with diabetes, and found that this study goes over carbohydrate counting, which is important for calorie control in diabetic patients.

Reynolds, A. N., et al. (2019) conducted a study on "Dietary fibre and whole grains in diabetes management". And found that This research indicates that higher intakes of dietary fibre is linked to a reduced risk of premature mortality in adults with diabetes.

Evert, A. B. et.al. (2019) conducted a study on Nutrition therapy recommendations for the management of adults with diabetes, and found that this study goes over carbohydrate counting, which is important for calorie control in diabetic patients.

Franz, M. J. et al. (2017) conducted a review on medical nutrition therapy for diabetes mellitus, and found that this review emphasizes the importance of consistent carbohydrate intake and the role of fiber in blood glucose management for diabetic patients.

American Diabetes Association. (2014). Conducted a study on Medical Nutrition Therapy in Hospitalized Diabetes: to develop guidelines for diabetic patients. This guideline gives direction for medical nutritional therapy within hospital settings, emphasizing the importance of calorie control, and carbohydrate consistency.

Gustavsson, B. et al. (2012) conducted a study on Nutritional risk and nutritional status in patients with diabetes mellitus in a hospital setting, and found that hospitalized diabetic patients are often at risk for malnutrition, impacting their overall calorie and nutrient intake, including fiber.

Lim, S. L. et al. (2012) conducted a study on Malnutrition and its impact on the quality of life in hospitalized patients, and found that inadequate calorie and nutrient intake, often associated with low fiber, can negatively impact recovery and quality of life for hospitalized patients, including those with diabetes.

Lim, E. L., et. al. (2011). Conducted a study focusing on Calorie Restriction and Glycemic Control: Reversal of type 2 diabetes: normalization of hepatic triglyceride content and beta-cell function in subjects with non-alcoholic fatty liver disease. This research showcases the positive impact of calorie restriction on reversing type 2 diabetes, emphasizing its role in normalizing hepatic triglyceride content and beta-cell function.

Powers, M. A. et al. (2010) conducted a study on Diabetes care in the hospital: standards of medical care, and found that this study outlines the importance of appropriate nutrition delivery in the hospital, including considerations for fiber and calorie provision for diabetic patients.

Leeds, A. R. (2009) conducted a review on Dietary fibre guidelines, and found that this review highlights the general recommendations for dietary fiber intake, which are often challenging to meet in a hospital setting for all patients, including those with diabetes.

Charney, P. (2008) conducted a review on The role of fiber in the management of diabetes, and found that this review discusses the benefits of dietary fiber in glycemic control and satiety, emphasizing its importance in the dietary management of hospitalized diabetic patients.

Williams, P. (2005) conducted a review on Nutritional care of hospital patients, and found that this review goes over the challenges that hospital food service has in providing adequate nutrition to patients, which often impacts fiber and calorie intake.

Stratton, R. J. et.al. (2003) conducted a study on Disease-related malnutrition and This resource gives information on general caloric needs of hospitalized patients, and how malnutrition can affect those needs.

McLaren, S. M. et al. (2002) conducted a study on Dietetic patient satisfaction with hospital food, and found that patient satisfaction with food can influence actual intake, potentially affecting both calorie and fiber consumption in hospitalized diabetic patients.

Howarth, N. C., et al. (2001) reviewed "Dietary fiber and weight regulation". And found that this review covers how dietary fiber affects satiety, which is important for calorie control.

Chandalia, M., et. al. (2000) studied Dietary Fiber and Lipid Profile Improvement, Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. This study demonstrates that increased dietary fiber, particularly soluble fiber, improves lipid profiles in type 2 diabetes patients, reducing cardiovascular risk.

METHODOLOGY

A total of 50 subjects were carefully recruited for the study, a number deemed sufficient to ensure a diverse yet manageable representation of the hospitalized population. The inclusion criteria were precisely defined to guarantee the relevance and applicability of the study's findings. Participants were required to be:

1. both male and female, ensuring gender diversity;
2. within the age range of 20 to 70 years, covering a significant adult demographic;
3. hospitalized in ward, HDU, or ICU categories, as previously mentioned, to reflect varied clinical states;
4. receiving either oral or tube feeding, confirming their active nutritional intake;
5. capable of providing documented informed consent, upholding ethical research standards; and
6. willing to participate voluntarily, ensuring genuine engagement.

The exclusion criteria were: Patients who were terminally ill, requiring mechanical ventilation, nil per oral (NPO)

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

or nil by mouth, receiving palliative care, admitted solely for day care or emergency services, receiving high inotropic support or other contra indicatory medications, or unable to provide positive voluntary consent were systematically excluded from the study. The study employed a suite of non-invasive tools and techniques to gather data. Primarily, the personal interview method was extensively utilized. This direct, one-on-one approach facilitated the collection of nuanced information regarding patients' dietary intake, their established dietary practices, and critically, their existing **calorie to fiber intake ratio**. A detailed **diet recall** method was specifically employed during these interviews to accurately capture comprehensive information on daily dietary intake. structured questionnaires were meticulously designed and administered. Based on the collected dietary intake data, **total carbohydrate calculations** were performed, offering a quantitative measure of carbohydrate consumption. Importantly, **dietary fibers were expressed in terms of raw salad and cooked vegetables**, providing a practical and relatable measure for both data collection and counseling.

Upon completion of data collection, the gathered information was subjected to rigorous statistical analysis to derive meaningful and actionable insights. Descriptive statistics were extensively employed to analyze data.

DATA ANALYSIS AND INTERPRETATION

Table 1: Age and gender wise distribution of diabetic patients participated in study

Age group	FEMALE	MALE	Grand Total	%
30-60	10	6	16	31.37
60-90	13	22	35	68.63
Grand Total	23	28	51	100.00

This table presents the distribution of diabetic patients by age and gender. The majority (68.63%) fall in the 60-90 age range, while 31.37% belong to the 30-60 age group. More males (22) than females (13) are in the older group, while the younger group has more females (10) than males (6).

Graph 1: Age Group Distribution

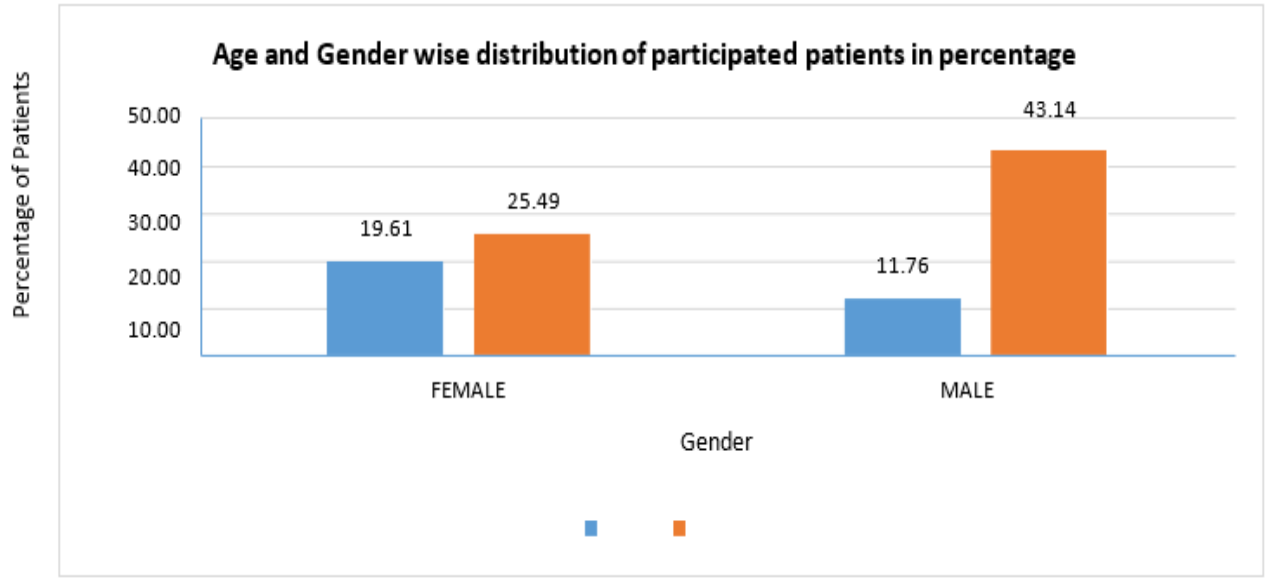


Table 2: Weight Status Distribution

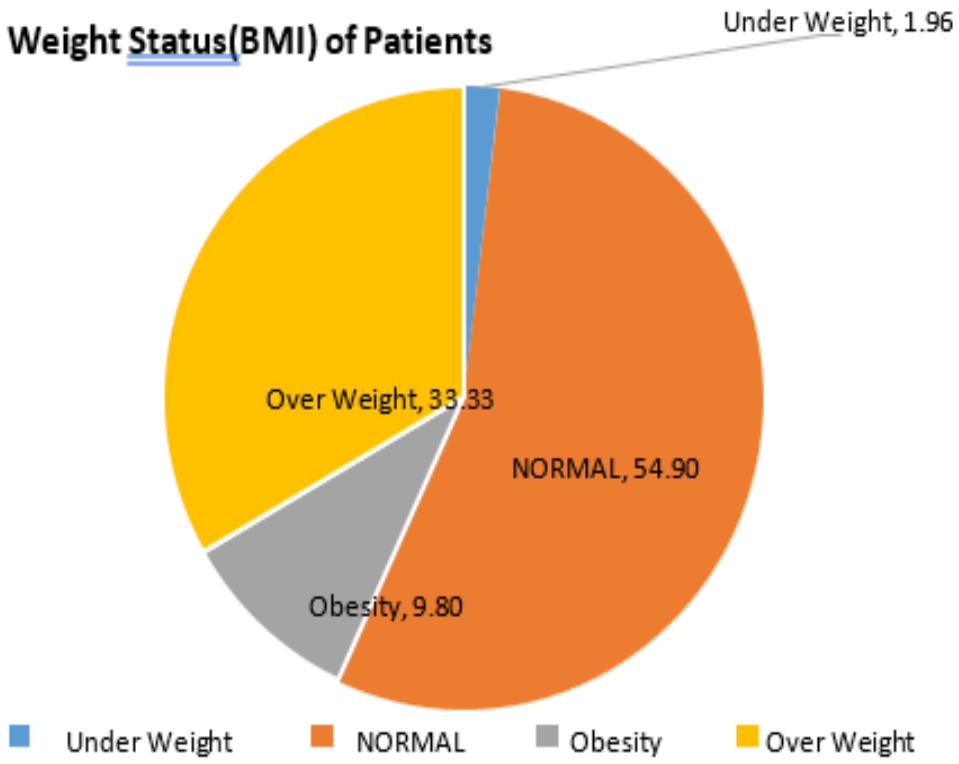
Weight Status	Grand Total	%
Normal	28	54.90

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

Obesity	5	9.80
Over Weight	17	33.33
Under Weight	1	1.96
Grand Total	51	100.00

This table categorizes patients based on weight status (Normal, Overweight, Obese, Underweight). The majority (54.90%) have a normal weight, while 33.33% are overweight. Only 9.80% are classified as obese, and one male patient (1.96%) is underweight.

Graph 2: Weight Status Distribution



The majority (54.9%) are classified as **NORMAL** weight. However, a significant portion is either **Over Weight (33.33%)** or **Obese (9.80%)**. There's also a very small, unlabeled segment (blue sliver) likely representing another category, possibly "Underweight. "In summary, over 43% of the population shown is overweight or obese.

Table 3: Caloric Intake Analysis

Calories	**Required Calorie**	**Actual Calorie Intake**	**Calorie Difference(+)**	**T Value**	**P Value**
N	51	51	51	-20.55	< .00001
MEAN	1815.86	2178.04	362.18		
SD	106.24	67.44	124.00		

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

MAX	2000	2321.5	566.5		
MIN	1620	2001	27.5		

The required calorie intake for diabetic patients averages **1815.86 kcal**, while the actual intake is significantly higher at **2178.04 kcal**. The average excess calorie intake is **362.18 kcal**, with a maximum excess of **566.5 kcal**. The **t-test** result (**t = -20.55, p < 0.00001**) indicates a statistically significant difference, confirming that patients consume more calories than required.

Graph 3: Caloric Intake Analysis

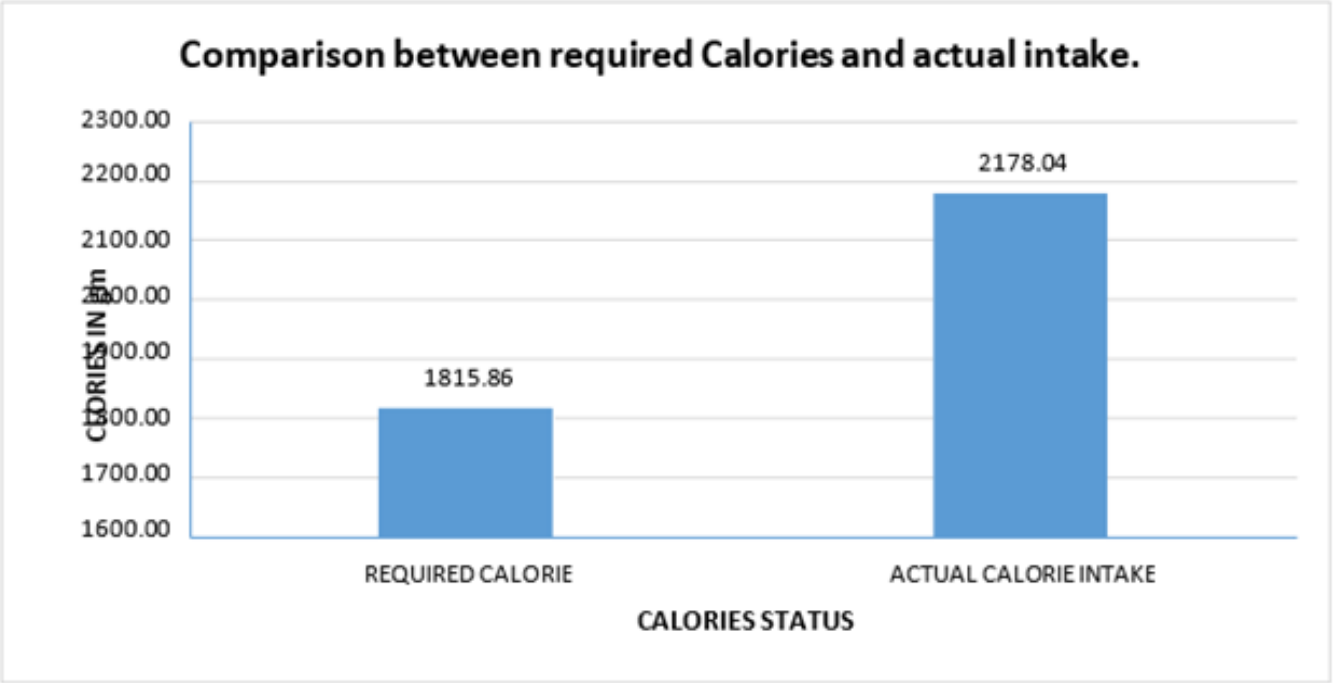


Table 4: Protein Intake Analysis

Protein	**Required Protein**	**Actual Protein Intake**	**Protein Difference (-)**	**T Value**	**P Value**
N	51	51	51	7.50	< .00001
MEAN	69.00	58.27	10.73		
SD	6.41	7.93	8.45		
MAX	85	71	27.6		
MIN	60	40.4	-10.2		

The required protein intake is **69.00 g**, but the actual intake is **58.27 g**, showing a deficit of **10.73 g** on average. The difference is statistically significant (**t = 7.50, p < 0.00001**), suggesting that most patients do not meet their protein requirements.

On average, the **actual protein intake (58.27g) was significantly lower than the required protein (69.00g)**, resulting in an average deficit of 10.73g. The extremely low **P-value (<0.00001)** and high **t-value (7.50)** indicate this difference is **statistically highly significant**, meaning it's highly unlikely to be due to chance. While most individuals consumed less protein than required, some (MIN -10.2) even had a surplus, indicating variability.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

Graph 4: Protein Intake Analysis

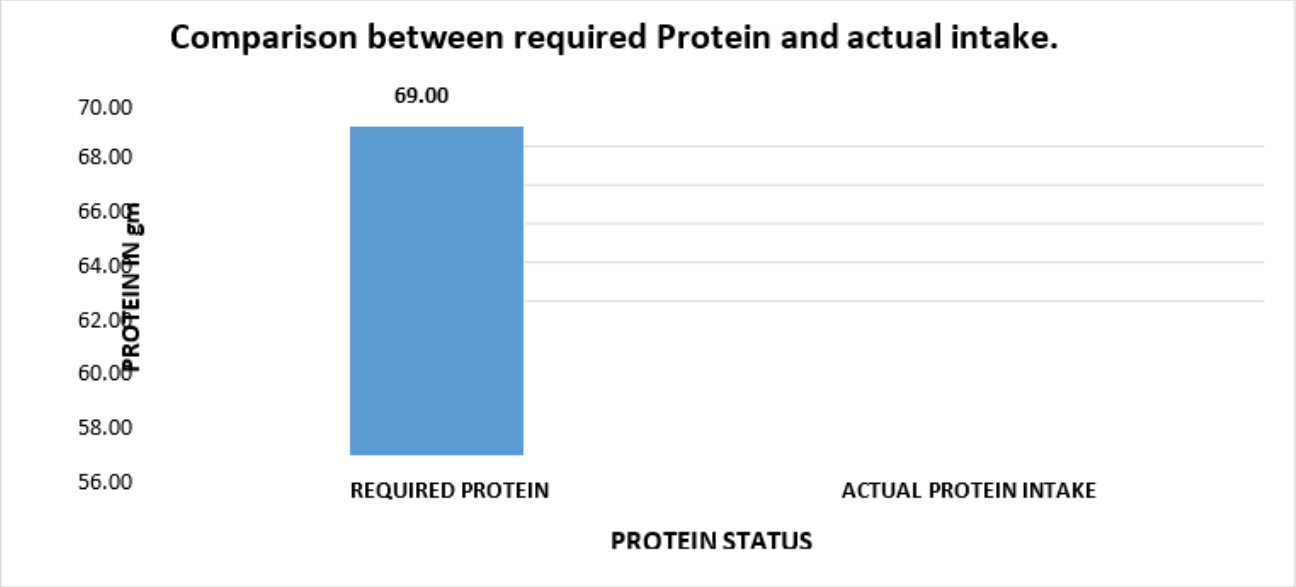


Table 5: Fat Intake Analysis

Fat	Required Fat	Actual Fat Intake	Fat Difference (+)	T Value	P Value
N	51	51	51	-20.15	< .00001
MEAN	25.00	35.06	10.06		
SD	0.00	3.57	3.57		
MAX	25	45.8	20.8		
MIN	25	30	5		

The required fat intake is **25.00 g**, but actual intake is **35.06 g**, leading to an excess of **10.06 g**. The difference is statistically significant (**t = -20.15, p < 0.00001**), indicating that patients consume significantly more fat than recommended.

 N **(Sample Size):** For all measurements (Required Fat, Actual Fat Intake, and Fat Difference), there are 51 participants included in the analysis.

 Required **Fat:**

- **MEAN:** On average, the individuals in the study required 25.00 grams of fat.
- **SD (Standard Deviation):** The standard deviation is 0.00, which is unusual. This indicates that the **required fat intake was exactly 25 grams for every single one of the 51 individuals**. This is likely a standard recommendation being applied across the board.
- **MAX:** The maximum required fat was 25 grams.
- **MIN:** The minimum required fat was 25 grams.

 Actual **Fat Intake:**

- **MEAN:** The actual average fat consumed by the individuals was 35.06 grams. This is notably higher than the required amount.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

- **SD:** The actual intake showed some variability (SD = 3.57 grams), meaning there was some spread in how much fat individuals actually consumed.
- **MAX:** The highest actual fat intake recorded was 45.8 grams.
- **MIN:** The lowest actual fat intake was 30 grams.

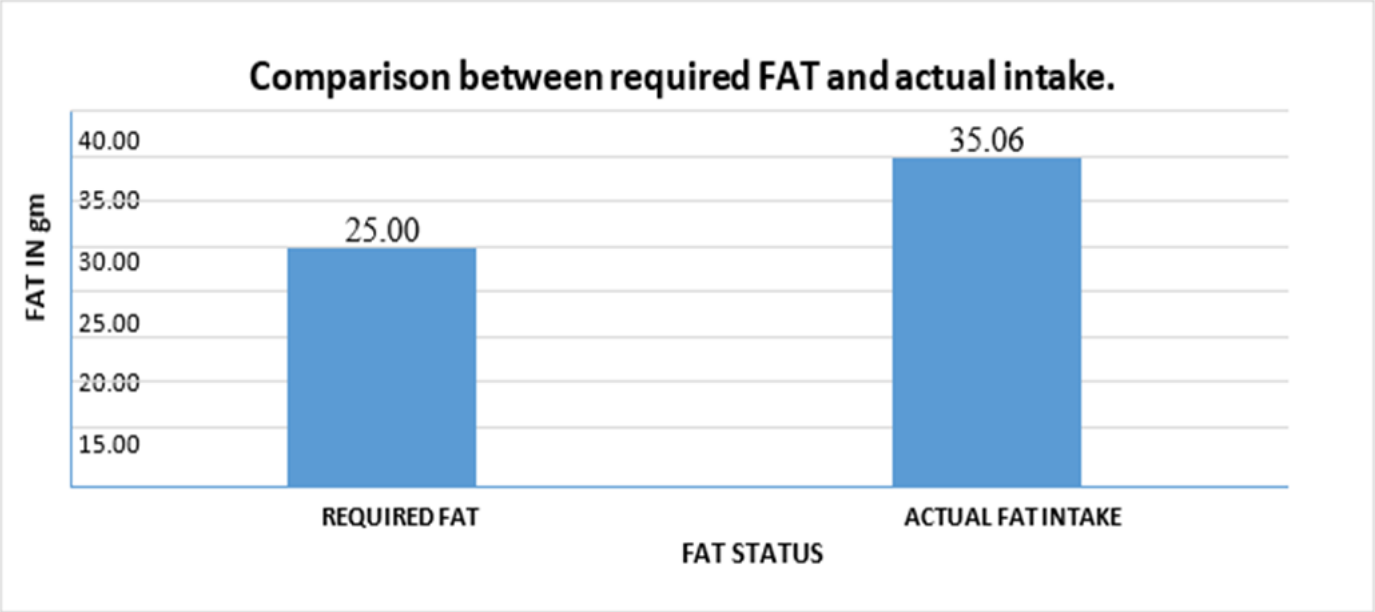
 FAT **DIFFERENCE (+):** This column shows the difference between the actual fat intake and the required fat intake, where a positive value indicates an excess.

- **MEAN:** On average, there was a significant **excess of 10.06 grams** in fat intake. This means, on average, patients consumed 10.06 grams more fat than they needed.
- **SD:** The standard deviation of this difference was 3.57 grams, mirroring the SD of the actual intake, as the required amount was constant.
- **MAX:** The largest fat excess for a single individual was 20.8 grams.
- **MIN:** The smallest fat excess observed was 5 grams, indicating that every individual consumed more fat than required.

 t **Value (-20.15) and P Value (< .00001):** These are statistical measures of significance.

- The extremely large absolute **t-value (-20.15)** (the negative sign simply indicates the direction of the difference, i.e., actual is greater than required) and the very low **P-value (< 0.00001)** indicate that the observed difference between the required fat intake and the actual fat intake is **statistically highly significant**. This means there is overwhelming statistical evidence that the participants, as a group, are consuming significantly more fat than required, and this excess is not due to random chance.

Graph 5: Fat Intake Analysis



Fiber	Required Fiber	Actual Fiber Intake	Fiber Intake Difference (-)	T Value	P Value
N	51	51	51	23.83	< .00001
MEAN	43.56	21.03	22.54		
SD	1.35	6.62	6.71		

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

MAX	46.43	41.5	28.5		
MIN	40.02	16.2	2.4		

Table 6: Fiber Intake Analysis

 N **(Sample Size):** For all measurements (Required Fiber, Actual Fiber Intake, and Fiber Intake Difference), there are 51 participants included in the analysis.

 Required **Fiber:**

- **MEAN:** On average, the individuals in the study required 43.56 grams of fiber.
- **SD (Standard Deviation):** The variability around this mean was quite low, with a standard deviation of 1.35 grams, indicating that most individuals had very similar fiber requirements.
- **MAX:** The maximum required fiber for any individual was 46.43 grams.
- **MIN:** The minimum required fiber for any individual was 40.02 grams.

 Actual **Fiber Intake:**

- **MEAN:** The actual average fiber consumed by the individuals was significantly lower at 21.03 grams.
- **SD:** The actual intake showed more variability (SD = 6.62 grams) compared to the required amounts.
- **MAX:** The highest actual fiber intake recorded was 41.5 grams.
- **MIN:** The lowest actual fiber intake was 16.2 grams.

 Fiber **Intake Difference (-):** This column shows the difference between the required and actual fiber intake, where a positive value indicates a deficit.

- **MEAN:** On average, there was a substantial deficit of 22.54 grams in fiber intake. This means, on average, patients consumed 22.54 grams less fiber than they needed.
- **SD:** The standard deviation of this difference was 6.71 grams, showing some variability in how much individuals were falling short.
- **MAX:** The largest fiber deficit for a single individual was 28.5 grams.
- **MIN:** The smallest fiber deficit observed was 2.4 grams, indicating even the best performers were still falling short.

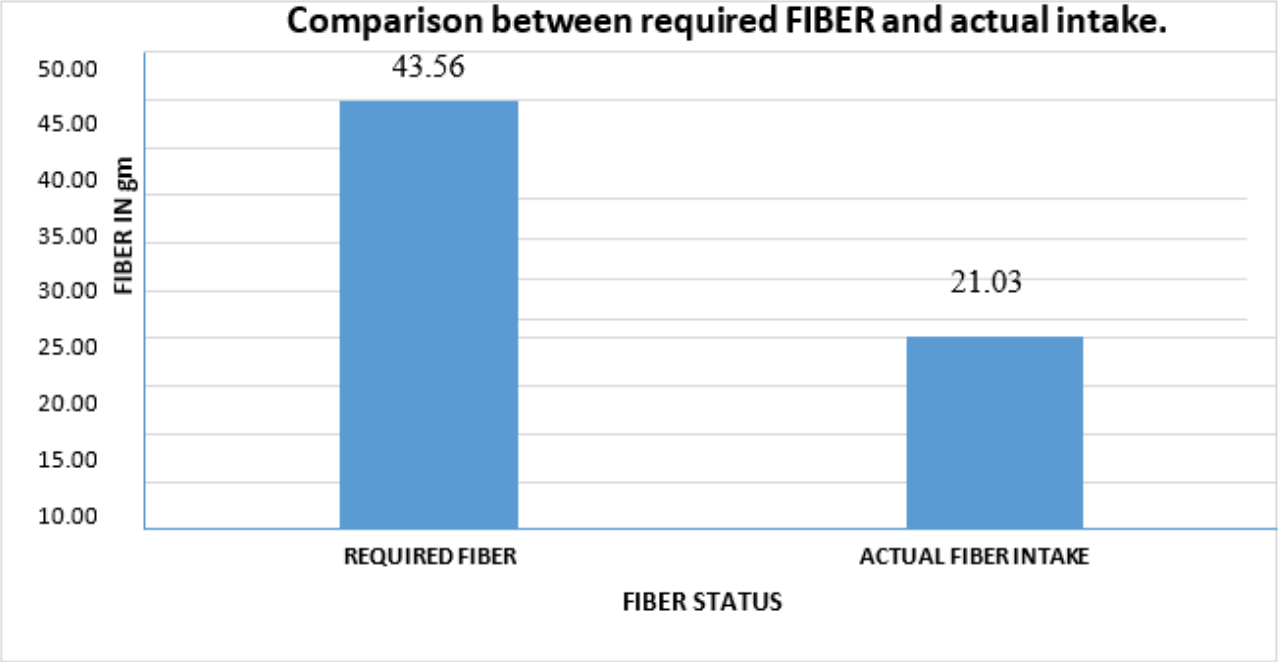
 t **Value (23.83) and P Value (< .00001):** These are statistical measures of significance.

- The very high **t-value (23.83)** and extremely low **P-value (< 0.00001)** indicate that the observed difference between the required fiber intake and the actual fiber intake is **statistically highly significant**. This means there is an overwhelmingly strong statistical evidence that the participants, as a group, are consuming significantly less fiber than required, and this difference is not due to random chance.

Based on calorie intake, the required fiber intake should be **43.56 g**, but the actual intake is **21.03 g**, showing a deficit of **22.54 g**. The difference is statistically significant (**t = 23.83, p < 0.00001**), confirming that diabetic patients fail to meet dietary fiber recommendations.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

Graph 6: Fiber Intake Analysis



CONCLUSION AND RECOMMENDATION

Patients exhibit **significant dietary imbalance**: overconsumption of calories (362.18 kcal excess) and fat (40% above recommendations), alongside critical deficiencies in protein (10.73g less) and fiber (only half of required 43.56g). This creates **substantial health risks**, particularly for the majority of patients who are 60+ and the 43.13% who are overweight/obese, exacerbating chronic disease risks. **Urgent nutritional intervention and education are needed.**

Given severe nutrient imbalances in hospitalized diabetic patients (excess calories/fat, deficient protein/fiber), **urgent research is critical** for targeted nutritional interventions. This requires:

1. **Standardized Dietary Protocol Development:** Design a protocol for hospitalized diabetic patients focusing on increased fiber (aiming for 30-35g/day or as per individual/guideline needs), precise calorie control (addressing 362.18 kcal excess while avoiding undernutrition), and prioritizing protein.

2. **Efficacy Evaluation:** Conduct a prospective study (e.g., RCT) comparing this tailored diet to standard care. Measure glycemic control, weight, lipid profiles, GI health, clinical outcomes (LOS, complications, readmissions), patient satisfaction, and adherence.

3. **Demographic Tailoring:** Adapt interventions for patients aged 60+ and those overweight/obese, considering specific metabolic needs (e.g., fiber types, protein sources, meal timing).

4. **Adherence Barriers/Facilitators:** Investigate factors hindering/aiding adherence (food preferences, culture, taste, education, family support) via qualitative methods.

5. **Cost-Effectiveness Analysis:** Assess economic benefits (reduced medication, complication management, hospital stay).

This research will bridge a critical gap, refining guidelines and improving care for this vulnerable population.

ACKNOWLEDGMENT

The authors gratefully acknowledge the hospital administration for their generous permission and support in

facilitating this research. We extend our sincere appreciation to all study participants for their invaluable voluntary contributions.

Funding Agencies: No funds received or accepted from any agency

Conflict Of Interest: None

REFERENCES

1. American Diabetes Association. (2014). Medical nutrition therapy in hospitalized patients with diabetes. Diabetes Care, 37(Supplement 1), S120-S127.
2. American Diabetes Association. (2022). Standards of medical care in diabetes. Diabetes Care, 45(Supplement 1), S1–S262.
3. Anderson, J. W., & Bridges, S. R. (1988). Dietary fiber content of selected foods. The American Journal of Clinical Nutrition, 47(3 Suppl), 440-447.
4. Chandalia, M., Garg, A., Lutjohann, D., von Bergmann, K., Grundy, S. M., & Brinkley, L. J. (2000). Beneficial effects of high dietary fiber intake in patients with type 2 diabetes mellitus. New England Journal of Medicine, 342(19), 1392-1398.
5. Charney, P. (2008). The role of fiber in the management of diabetes. Journal of the American Dietetic Association, 108(10), 1726–1729.
6. Diabetes care in the hospital: Standards of medical care. Diabetes Care, 33(Supplement 1), S111–S117.
7. Evert, A. B., Boucher, J. L., Cypress, M., Dunbar, S. A., Franz, M. J., Mayer-Davis, E. J., & Yancy, W. S. (2019). Nutrition therapy recommendations for the management of adults with diabetes. Diabetes Care, 42(5), 731-754.
8. Evert, A. B., Dennison, M., Gardner, M. C., Garvey, W. T., Joffe, D., Kulkarni, K., & Peraglie, M. (2019). Nutrition therapy recommendations for the management of adults with diabetes. Diabetes Care, 42(5), 724–732.
9. Franz, M. J., et al. (2017). Lifestyle management: standards of medical care in diabetes—2018. Diabetes Care, 41(Supplement 1), S56–S63.
10. Franz, M. J., Powers, M. A., Leontos, C., Holzmeister, L. A., Kulkarni, K., Monk, A., & Gradwell, E. (2017). Medical nutrition therapy for diabetes mellitus. Diabetes Care, 40(11), 1618–1633.
11. Gustavsson, B., Lundqvist, M., & Hultgren, M. (2012). Nutritional risk and nutritional status in patients with diabetes mellitus in a hospital setting. Journal of Clinical Nursing, 21(11-12), 1640–1649.
12. Howarth, N. C., Saltzman, E., & Roberts, S. B. (2001). Dietary fiber and weight regulation. Nutrition Reviews, 59(5), 129-139.
13. Kikuchi, R., et al. (2024). Relationship between diabetes diet-related quality of life and dietary fiber intake among people with type 2 diabetes: a cross-sectional study. Endocrine Journal, 71(6).
14. Leeds, A. R. (2009). Dietary fibre guidelines. British Journal of Nutrition, 101(S1), S20–S25.
15. Lim, E. L., Hollingsworth, K. G., Aribisala, B. S., Chen, M. J., Mathers, J. C., & Taylor, R. (2011). Reversal of type 2 diabetes: normalization of hepatic triglyceride content and beta-cell function in subjects with non-alcoholic fatty liver disease. Diabetologia, 54(10), 2506-2514.
16. Lim, S. L., Crivelli, M., & McLaughlin, D. (2012). Malnutrition and its impact on the quality of life in hospitalized patients: A review. Clinical Nutrition, 31(2), 162–169.
17. McLaren, S. M., Lord, J. M., & McNally, R. (2002). Dietetic patient satisfaction with hospital food: An exploratory study. Journal of Human Nutrition and Dietetics, 15(1), 13–21.
18. Pastors, J. G., Blaisdell, N., & Daly, A. (2001). Effective nutrition counseling in the management of diabetes. Diabetes Spectrum, 14(3), 136-141.
19. Powers, M. A., Bardsley, J., Cypress, M., Duker, P., Funnell, M. M., Imbus, D., & Vivian, E. (2010).
20. Reynolds, A. N., et al. (2019). Dietary fibre and whole grains in diabetes management: systematic review and meta-analyses. The Lancet, 393(10179), 1641–1652.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XII Issue V May 2025

21. Reynolds, A., Mann, J., Cummings, J., Pomare, E., & Olsson, S. (2019). Carbohydrate in the management of diabetes: a systematic review and meta-analysis. The Lancet, 393(10179), 1641-1652.
22. Stratton, R. J., Green, C. J., & Elia, M. (2003). Disease-related malnutrition: an evidence-based approach to treatment. CABI publishing.
23. Williams, P. (2005). Nutritional care of hospital patients: a review. Clinical Nutrition, 24(1), 1-12.