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Research Article

## White rice with ghee does not increase blood sugar level in type 2 diabetes patients

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### Abstract

**Introduction:** Type 2 diabetes in which India is the second largest globally, characterized by hyperglycemia resulting from defects in insulin action. Rice is the staple food of over half of the world's population, having multiple Nutritional Benefits. **Objective:** To see the effect of white rice with ghee by cooking in an open vessel on blood sugar level in diabetic patients.

**Materials and Methods:** Experimental study with Clinical Trial performed at Vishwaraj Hospital Pune, to correct Blood Sugar Level in type 2 diabetes patients by Nutritional Intervention of White Rice which was cooked in an open vessel with Ghee after Institutional Ethics Committee approval and registered under Clinical Trial Registry of India -CTRI/2022/05/042533. All 103 enrolled participants were provided written information of 'Method of Rice preparation'. During intervention, telephonic follow up had taken every 15th day, till 90 days. After 90 days of intervention, all patients were asked to repeat HBA1C level to compare their previous HBA1C which was done before enrollment.

**Results:** After 3 months of intervention, 86.41% participants had decreased HBA1C level, 13.59% participants had increased HBA1C. Statistical analysis done by Paired t Test which compares the means of two measurements of HBA1C taken from same individual i.e. paired observations, purpose of test is to determine whether there is statistical evidence that the mean difference between paired observations is significantly different from zero.

**Conclusion:** This study concluded that white rice prepared with ghee in an open vessel does not increase blood sugar level in type 2 diabetes patients.

**Keywords:** "blood sugar level", "Diabetes", "ghee", "hba1c level", "type 2 diabetes", "white rice"

## 1. INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both,<sup>1</sup> According to the World Health Organization (WHO),<sup>2</sup> non-communicable diseases (NCDs) accounted for 74% of deaths globally in 2019, out of which, due to diabetes there are 1.6 million deaths, thus becoming the ninth leading cause of death globally. The prevalence of diabetes in India has elevated from 7.1% in 2009 to 8.9% in 2019.

There are four types of DM: type 1, type 2, gestational diabetes and "other specific types" and almost 80% to 90% cases are of type 2 DM thus the most common form of DM, which is highly associated with a family history of diabetes, older age, obesity and lack of exercise,<sup>3</sup> The classic symptoms of diabetes are polyuria, polydipsia and polyphagia, unexplained weight loss, fatigue, restlessness, tingling numbness and body pain,<sup>4</sup>

Complications from diabetes can be classified as Microvascular or Macrovascular. Microvascular complications include neuropathy, nephropathy and retinopathy. Macrovascular complications include cardiovascular disease, stroke, and peripheral vascular disease,<sup>5</sup>

**Dietary Recommendations for diabetes:** Individual nutrients, foods, and dietary patterns have very important role in the prevention and management of type 2 diabetes. Diets rich in whole grains, fruits, vegetables legumes, nuts, low Glycemic Index foods and diet lower in refined grains, sugar-sweetened beverages helps to reduce the risk of diabetes and improve glycemic control in patients with diabetes,<sup>6</sup> The American Diabetes Association reviewed four types diets for their effects on diabetes, the Mediterranean diet, a low-carbohydrate/high-protein diet, a vegan diet and a vegetarian diet,<sup>7</sup>

Rice, *Oryza sativa* belonging to the family *Gramineae* is the second most important cereal crop and staple food for most of the world's population. It is grown over the broad geographical range. The slogan 'Rice is Life' is more suitable for India as this crop plays a vital role in National food security and is a means of livelihood for millions of rural household,<sup>8</sup> High subsidies on rice through the public distribution system and active management of the markets to keep market prices of rice at low levels which encourages people to eat more rice,<sup>9</sup> Thus rice becomes the staple food of over half of the world's population and 90% of Asians,<sup>10</sup>

**Nutritional benefits of rice:** Rice has plenty of nutritional and medicinal properties. It is a good source of carbohydrates, contains RS which boosts the growth of beneficial bacteria keeping the bowel healthy, good source of energy, low fat, low salt, absolutely no cholesterol, also good source of thiamine, niacin, iron, riboflavin, and fiber, gluten free, <sup>8</sup>

We have seen till date that substituting brown rice for white rice gives the potential benefit on HbA1C among patients with the metabolic syndrome and an elevated BMI,<sup>11</sup> Addition of pigeon pea to rice, addition of ghee (clarified butter) to rice resulted in low GI and increase in RS content. This also highlights the importance of formulating food combinations of rice with other food that suit diabetics,<sup>12</sup> The size of particle and form of rice also affect the gastro intestinal tract for example, ground rice has higher GI than whole rice, <sup>13</sup>

Analysis of HbA1c in blood measures an individual's average blood sugar levels for the period of previous two to three months. Now HbA1c is recommended as a 'Standard of Care (SOC)' for testing and monitoring diabetes, specifically the type 2 diabetes, <sup>14</sup>

Thus we have seen that rice has many nutritional and medicinal benefits, also consumption of white rice is more common in daily meals, it is easy to digest and cheaper than other cereals and brown rice, many times doctors and dietitian advised diabetic patients not to eat white rice due to starch content and high glycemic index, this study performed to see the effect on blood sugar level of diabetic patients, if we change method of preparation with following object,

**Objective:** To see the effect of white rice with ghee by cooking in an open vessel on blood sugar level in diabetic and pre-diabetic patients.

## 2. MATERIALS AND METHODS

### 2.1. Study Design

Experimental study with clinical trial to correct HbA1C level in type 2 diabetes and pre-diabetic patients by nutritional intervention, of white rice which was cooked in an open vessel with ghee performed at Vishwaraj Hospital, Pune from May 2022 to December 2022. This is the Single arm prospective study.

### 2.2. Ethical approval

Ethical approval was obtained from the Institutional Ethics Committee (Registration number- ECR/1138/Inst/MH/2018/RR-21), the study protocol, consent form and case record form was designed and approved by the Institutional Ethics Committee before the start of the study and all subjects of study group had given written, informed consent.

This study is registered under Clinical Trial Registry of India with Registration Number: CTRI/2022/05/042533.

### 2.3. Selection of samples

110 known cases of type 2 diabetic and pre-diabetic patients were selected by Randomization method both hospitalized and OPD patients in Hospital. Dietary history had taken before enrollment; all these selected participants were eating 1 to 2 bowls of rice once or twice daily that is 30 – 60 gm raw rice before enrollment. All of them were on anti-diabetic medicines, also pre-diabetic patients were newly detected but diabetic patients were having long term diabetes since more than 5 years.

**Dose of Rice:-** 30 gm to 60 gm raw white rice.

**Dose of Ghee:-** 5 ml to 10 ml, that is 1 or 2 teaspoon depends on activity level of patient.

### Method of preparation of white rice:

All patients were provided written and verbal information of method of preparation i.e. how to cook. Patients were asked to cook white rice in an open vessel. Recipe: First put 5-10 ml ghee into vessel, then roast washed rice in ghee for 2-3 minutes, add sufficient amount of water and then cook white rice till it gets cooked completely.

Asked to eat this rice with pulses (dal)/curd/sprouts or only rice as per their taste preference, after taking signature on consent form.

All patients were provided diabetic diet chart according to their dietary habits, activity level on the day of enrollment.

After consuming white rice and ghee together follow up had been taken on 2<sup>nd</sup> day just to check any adverse effect after consumption of white rice and ghee by telephone and after that every 15<sup>th</sup> day telephonic follow up had been taken whether patients were taking recommended dose of white rice, ghee and doing correct method of cooking that is on 15<sup>th</sup>, 30<sup>th</sup>, 45<sup>th</sup>, 60<sup>th</sup>, 75<sup>th</sup> and 90<sup>th</sup> day. After 90 days of this white rice and ghee intervention all patients were asked to repeat HbA1C blood test in Laboratory of Vishwaraj Hospital, Pune, Maharashtra, which is 'National Accreditation Board of testing and calibration laboratory (NABL) Approved Lab'.

HbA1C done by Immuno-Fluorescence Assay method.

#### 2.3.1. Inclusion criteria:-

1. Type 2 diabetic and pre-diabetic patients with HbA1C reports.

#### 2.3.2. Exclusion criteria:-

Patients with any of the following conditions were excluded from the study:

1. Chronic Kidney disease (CKD)
2. Intestinal mal absorption disorders like colitis, Irritable Bowel Syndrome, etc.
3. Those who doesn't like the taste of rice or ghee or both

#### 2.4. Statistical Analysis

##### Statistical tools used:-

The Paired t Test compares the means of two measurements taken from the same individual, object, or related units that is paired observations. The purpose of the test is to determine whether there is statistical evidence that the mean difference between paired observations is significantly different from zero. The Paired t Test is a parametric test.

In this study it's two HbA1C tests before and after nutritional intervention.

## 3. RESULTS AND DISCUSSIONS

For this clinical study total 158 diabetic and pre-diabetic patients were screened at Vishwaraj Hospital, Pune, who were having latest HbA1C reports, but performed on 110 diabetic and pre-diabetic patients after exclusion criteria. All patients were selected by randomized method. All participants were asked to cook white rice with ghee in an open vessel, as per mentioned in 'Method section' under "Method of Preparation" headings.

Out of these 110 enrolled diabetic patients 7 patients did not repeat HbA1C level, so statistical analysis done on 103 diabetic patients. HbA1C blood test has been done before and after nutritional intervention

Values of HBA1C in Vishwaraj Hospital Laboratory are as follows,

➤ Non Diabetic (Normal): < 5.7 %

➤ Pre-diabetes: > or = to 5.7% to < 6.5

➤ Diabetes: > or = to 6.5%

**Results:**

**Frequency Distribution**

**Table 1: Age** The frequency distribution of patients according to age.

Age in years	Frequency	%
30 to 39	23	22.33
40 to 49	26	25.24
50 to 59	32	31.07
60 &Above	22	21.36
Total	103	100.00

**Table 2: Sex** The frequency distribution of patients according to sex.

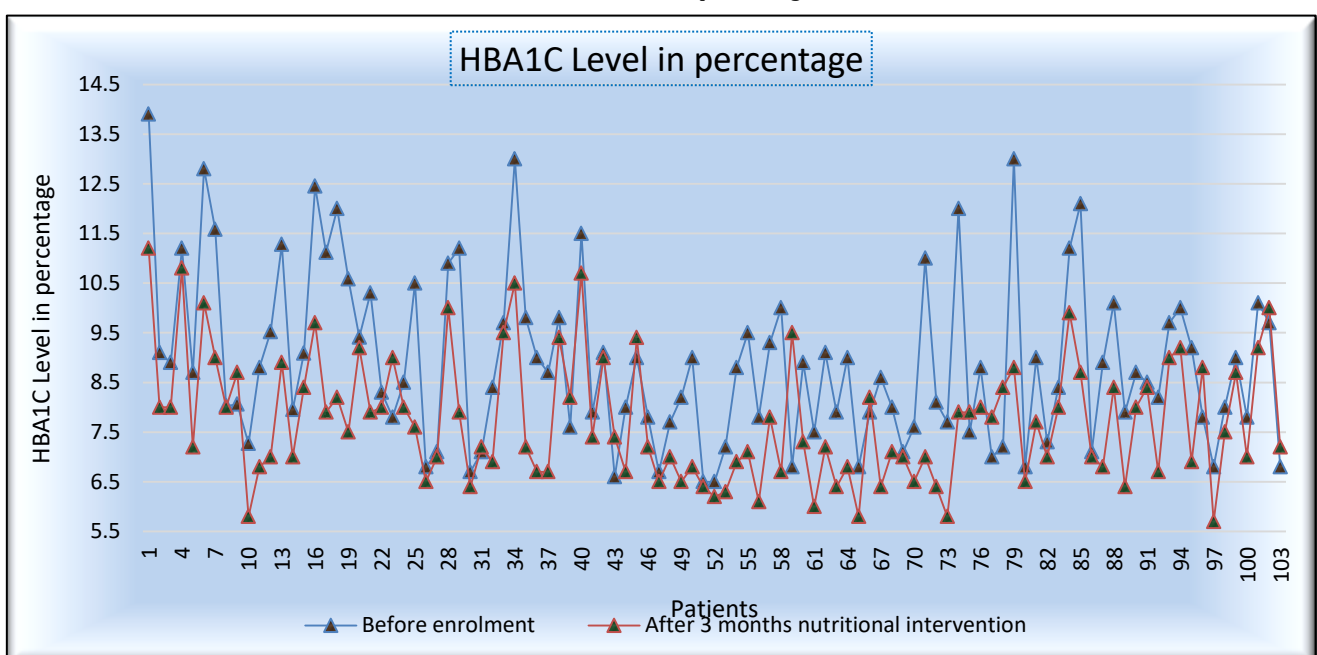
Sex	Frequency	%
Female	48	46.60
Male	55	53.40
Total	103	100.00

**Table 3:** The frequency distribution of patients according to HBA1C level in percentage.

HBA1C level in percentage	Before enrolment	%	After 3 months Nutritional Intervention	%
Below 6	0	0.00	4	3.88
6 to 8	36	34.95	58	56.31
8 to 10	43	41.75	34	33.01
10 to 12	16	15.53	7	6.80
12 & Above	8	7.77	0	0.00
Total	103	100.00	103	100.00

**Before Enrolment:** None of the participants were having normal HBA1C level i.e. less than 5.7 %, all patients were having HBA1C level above 6 %.

**But After 3 Months Nutritional Intervention:** 3.88% patients were with HBA1C level in percentage Below 6, also majority 56.31% patients were with HBA1C level in percentage 6 to 8.



**Figure 1:** The HBA1C level in percentage per patient is shown by line graph

The graph clearly shows the overall decrease in HBA1C level in percentage per patient before and after nutritional intervention.

To be exact there is increase in HBA1C level in percentage for 14 patients (13.59%) and there is decrease in HBA1C level in percentage for 89 (86.41%) patients. Thus only 13.59%

patients have increased HBA1C level after nutritional intervention.

#### Test for Comparison of HBA1C level in percentage:

The comparison of HBA1C level in percentage of patients before enrolment and after 3 months 'Nutritional Intervention' is done by paired t test. The results are as follows.

Calculation Tables:

Paired Samples Statistics				
HBA1C Level in percentage	Mean	N	Std. Deviation	Std. Error Mean
Before enrolment	8.90	103	1.69	0.17
After 3 months nutritional intervention	7.74	103	1.25	0.12

Paired Samples Test						
Paired Differences				t	df	P value (2-tailed)
HBA1C Level in percentage	Mean	Std. Deviation	Std. Error Mean			
Before enrolment - After 3 months nutritional intervention	1.16	1.29	0.13	9.17	102	.000

Since p value is less than 0.05, the level of significance; there is significant difference in HBA1C level in percentage of patients before enrolment and after 3 months 'Nutritional Intervention' on an average. The mean values suggest that there is significant decrease in HBA1C Level in percentage of patients after 3 Months 'Nutritional Intervention'.

#### 4. DISCUSSION

Sex effects are present in both Type 1 and Type 2 diabetes. The rates of diabetes for the two sexes are not much different below 25 years. At ages 25 to 34 years, the females are higher by 20%, at ages 35 to 44 years by almost 60%, and at ages from 45 to 64, their rates are almost double those for males,<sup>15</sup> In this study, wide age group is included from 32 years to 75 years with majority 32 patients are from 50 to 59 years age group (Table 1). Females are 48 and males are 55 included in this study (Table 2).

Rice production and consumption are the highest in Asian populations. Rice provides up to 50% of the dietary energy supply and a significant part of the protein intake for about 520 million people living in poverty in Asia. China and India account for approx. 50% of the world's rice consumption. Rice is closely associated with food and nutrition security for a majority of populations living in the developing world,<sup>16</sup> The International GI table shows a wide range of GI for brown rice, from 45 to 87, falling into all the three GI categories (low, <55; medium, >55-69; and high, >70; on a scale of 100 being the GI of glucose), which may be due to the different varieties and different methods of processing. Despite these GI values, brown rice has so many challenges for its practical use. This includes poor consumer acceptance, as it is perceived as being an inferior quality of rice due to its color and sensory properties. Moreover, there are problems associated with short shelf life and longer cooking time,<sup>17</sup> Many studies done to prove which method of preparation of rice is better to reduce its starch content, in 2012 Jain, A., Rao, S., et al. compared different methods of cooking rice for its starch content and concluded that the amylose content of microwaved rice is highest after raw, uncooked rice. Hence, microwave method of cooking rice is the most suitable for diabetic patients as the Glycemic Index (GI) is lowest. Amylose

content in rice is inversely proportional to GI,<sup>18</sup> In this study we asked to cook rice in an open vessel with ghee. Many participants have added some spices like pepper, clove, cumin seeds in rice.

The HbA1c is an accurate and easy-to-administer test with on-the-spot results availability and an effective tool for the diagnosis of diabetes. The prognostic potential of HbA1c lies in its unique ability of assessing retrospective glycemic control in diabetic patients. The ADA has recently recommended HbA1c with a cut-point >6.5% for diagnosing diabetes as an alternative to fasting plasma glucose (FPG >7.0 mmol/L)-based criteria. HbA1c provides a reliable measure of chronic glycemia and correlates well with the risk of long-term diabetes complications, so that it is currently considered the test of choice for monitoring and chronic management of diabetes,<sup>(14)</sup> In this study HBA1C test has been done by Immuno-Fluorescence method in NABL approved laboratory of hospital.

In this study we asked to eat white rice instead of brown rice due to unpalatable taste and heavy to digest brown rice. We did HBA1C test before enrollment and 3 months after Nutritional Intervention of all participants in NABL approved laboratory of hospital, Pune. Statistical analysis done to compare previous and after reports with significance level of 0.05.

Only 13.59 % participants had increased level of HBA1C, otherwise remaining 86.41 % of participants had either similar values or decreased values of HBA1C after nutritional intervention (Table 4). Also none of the participant had HBA1C level below 5.7 % i.e. normal level before enrollment, but after nutritional intervention 4 % participants had HBA1C level below 5.7 %. (Table 3)

We are not trying to prove that white rice cooked with ghee in an open vessel decreases blood sugar level, but if white rice cooked in an open vessel with ghee, it will not increase blood sugar level, which is tried to prove in this study by doing repeat HBA1C level after 3 months.



## 5. CONCLUSION

This study concluded that white rice prepared with ghee in an open vessel does not increase blood sugar level in type 2 diabetes patients, rather this method of preparation helps to lower blood sugar level.

### Clinical Trial Registration Number:

CTRI/2022/05/042533 in the Clinical Trials Registry- India (CTRI)

URL of CTR:

<https://ctri.nic.in/Clinicaltrials/rmaindet.php?trialid=68848&EncHid=27232.65149&modid=1&compid=19>

### Abbreviations

1. DM: Diabetes mellitus
2. GI: Glycemic Index
3. RS: Resistant Starch

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### Conflicts of interest

The authors declare no conflict of interest.

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