

Have We Heard the Consumer's Plea? Developing a Diet Chart Using Locally Available Food Items for Type 2 Diabetes Mellitus Patients in Ramanagara District, Karnataka: Nominal Group Technique Approach

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Abstract:

Background: India faces a growing burden of Type 2 Diabetes Mellitus (T2DM). Despite standardized dietary guidelines, poor adherence persists due to misalignment with cultural food preferences and socioeconomic constraints. This study aimed to develop culturally and regionally appropriate diet charts for T2DM patients in Ramanagara district using the Nominal Group Technique (NGT). **Material and Methods:** Eight stratified (by age and gender) patient groups consisting 37 participants were recruited from a medical college hospital and its Urban Health Training Centre. Using the NGT five-step protocol—idea generation, sharing, categorization, ranking, and consensus, the dietary inputs were synthesized into four customized diet charts in consultation with a registered dietician and culturally appropriate diet charts were derived. Data saturation was achieved through systematic consensus-building. Following this, acceptability of the NGT derived diet charts versus standard diet plans were assessed by an independent sample of 30 patients with T2DM via visual analogue scale scoring. **Results:** Four diet charts which were stratified by gender and age incorporating culturally familiar staples and seasonal vegetables were derived using NGT. The NGT-derived diet charts achieved a mean acceptability score of 8.13 vs. 6.50 for standard charts. **Conclusions:** The participatory NGT approach enabled development of culturally aligned, economically feasible, and regionally appropriate diet charts for T2DM patients in Ramanagara, demonstrating higher acceptability and potential for improved adherence.

Key-words: Type 2 Diabetes Mellitus; Diet Therapy; Patient-Centered Care; Nominal Group Technique; South India.

Key Messages:

1. Using NGT helped co-create diet charts that were practical, acceptable, and culturally relevant.
2. Age- and gender-specific diet chart derived through NGT showed higher patient acceptability compared to standard diet chart. However, this conclusion must be viewed with caution due to the limited purposive sampling.

Introduction:

India faces a rapidly escalating Type 2 Diabetes Mellitus (T2DM) burden, affecting over 77 million people ⁽¹⁾. Prevalence is rising in rural populations due to lifestyle changes and dietary transitions ^{(2),(3)}. Shifts from traditional diets to processed foods, coupled with sedentary habits, disproportionately impact socioeconomically diverse and ethnic groups ^{[4],[5],[6],[7]}. Standardised Medical Nutrition Therapy (MNT) often fails in low-resource settings due to cultural, economic, and accessibility barriers ^{(5),(6),(8),(9),(10),(11),(12)}. The Nominal Group Technique (NGT) can be used for culturally relevant, locally feasible diet planning ^{[13],[14],[15]}. However, its use in designing diet charts in India has been infrequent. This study aims at applying NGT to develop a region-specific diet chart for T2DM in Ramanagara, Karnataka ^{[16],[17]}, thereby documenting its utility in designing culturally appropriate diet charts.

Material and Methods:

Study Design and Participant Recruitment

This mixed methods study employed the Nominal Group Technique (NGT) to identify dietary preferences, commonly consumed foods, and perceived barriers among adult patients with Type 2 Diabetes Mellitus (T2DM) in Ramanagara district, Karnataka. NGT was chosen for its ability to generate structured, participant-driven consensus in a short time frame and to ensure all voices are equally represented in group settings ^[18,19]. Thirty-seven patients aged ≥ 18 years with a confirmed diagnosis of T2DM were recruited purposively from the outpatient departments of a medical college hospital and its affiliated Urban Health Training Centre in Kanakapura (table 1). The recruitment strategy aimed to capture diversity in age, gender, and socioeconomic background while ensuring that participants were familiar with local food systems and dietary practices. Those with acute illness or cognitive impairment were excluded to maintain discussion quality. All sessions were facilitated by third year undergraduate medical students trained in NGT.

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Stratification and Session Conduct

To account for demographic differences in dietary patterns, participants were stratified into four groups by age and gender:

1. Males aged 18–59 years (three NGT sessions)

2. Females aged 18–59 years (two NGT sessions)
3. Males aged ≥ 60 years (two NGT sessions)
4. Females aged ≥ 60 years (one NGT session)

In total, eight NGT sessions were held, each including 5–10 participants to maintain an optimal group size for balanced contributions and effective discussion ⁽²⁰⁾.

The sessions followed a structured **five-step NGT process** ^(13,20):

1. **Silent idea generation** – Participants reflected individually on their personal dietary patterns, frequently eaten foods, challenges faced, and desired additions to their diet. They were asked to provide responses to ten prompts (Supplementary file).
2. **Round-robin sharing** – Each participant shared one response at a time, in rotation, ensuring that every voice was heard equally and conversational dominance was minimised. Responses were recorded verbatim by the facilitator.
3. **Clarification and grouping** – Food items were discussed, clarified, and grouped under thematic categories such as taste preference, affordability, cultural significance, and health-related restrictions. This stage encouraged deeper reflection and brought out community-level insights.
4. **Individual ranking** – Participants independently ranked their top food choices on scoring sheets, enabling quantitative prioritisation of dietary items.
5. **Consensus building** – Final rankings were discussed, and consensus was reached on priority dietary options, ensuring that selected items were both culturally familiar and feasible for regular consumption.

Qualitative reporting followed the COREQ checklist to maintain transparency in research design and analysis. The research team consisted of undergraduate medical students trained in NGT facilitation to minimize interviewer bias. We documented the researcher-participant relationship, the rural primary care setting in Ramanagara, and the purposive sampling strategy used to recruit 30 T2DM patients. Methodological rigor was maintained through standardized prompts across eight sessions, field notes for non-verbal consensus cues, and participant validation, ensuring the final diet chart reflected genuine community preferences rather than researcher imposition. Data adequacy was ensured through repeat NGT sessions, with no substantially new dietary items or themes emerging marking saturation. The thematic grouping generated during the clarification stage was independently validated by two trained researchers with experience in qualitative methods, and discrepancies were resolved through

discussion. To maintain facilitator uniformity across all eight sessions, a standardized protocol was followed and periodic debriefings were conducted.

Ethics approval for the study was obtained from the Institutional Ethics Committee (CDSIMER-IEC), Dr. Chandramma Dayananda Sagar Institute of Medical Education and Research (CDSIMER), Karnataka, India (Study Ref: CDSIMER/MR/0118/IEC/2024). The study was approved in its presented form. Written informed consent was obtained from all participants prior to their participation in the study.⁽²²⁾ The study was conducted in accordance with ethical principles of the declaration of Helsinki.

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Diet Chart Development

The prioritised food items from each NGT session were compiled and analysed by a registered dietician specialising in diabetes care⁽²³⁾. The analysis incorporated Medical Nutrition Therapy (MNT) principles while factoring in local availability, cultural relevance, and economic feasibility^(23,24,25). Nutritional adequacy was cross-checked using existing dietary guidelines for T2DM, with emphasis on balanced macronutrient distribution and glycaemic control^(26,27). Diet charts were then developed for each age and gender subgroup, reflecting the consensus-derived food lists. Special consideration was given to incorporating millet-based options such as ragi, which has shown potential in improving glycaemic control⁽²⁷⁾. The inclusion of affordable, locally sourced foods addressed known barriers to MNT adherence, such as cost constraints and limited food diversity⁽¹²⁾. The NGT-derived diet chart focuses exclusively on a consensus-based list of culturally preferred food items to maximize patient acceptability and adherence within the Ramanagara district. Consequently, specific portion sizes and exact nutritive compositions were omitted at this stage, as these technical parameters can be precisely calculated by a nutritionist once the foundational food choices are finalized.

Assessment of acceptability

To assess subjective acceptability, a purposive pilot sample of 30 in-patients from the general medicine ward of the medical college hospital was selected (table 1). These patients were different from the participants of NGT. These participants were provided with both the NGT-derived diet chart and a conventional dietician-prescribed chart. Using a **Visual Analogue Scale (VAS)** (shown in Figure 1) ranging from 0 to 10, participants rated the acceptability of

each chart. Scores reflected their perception of cultural appropriateness, feasibility, and willingness to adopt the recommended diet. Analyses were conducted by gender and age category to identify patterns in acceptability. Mean scores were calculated for each chart, and differences between the NGT-based and conventional plans were noted.

VISUAL ANALOGUE SCALE (VAS) FOR DIET CHART ACCEPTABILITY

Please look at each diet chart and show how much you like/accept it for your daily use.
Please mark (|) on the line that shows your opinion. *There is no right or wrong answer.*

1. OLD DIET CHART

A horizontal line scale from 0 to 10. At the left end (0) is a sad face icon and the text "Not acceptable at all (0)". At the right end (10) is a happy face icon and the text "Extremely acceptable (10)". The scale is marked with integers from 0 to 10.

2. NEW DIET CHART

A horizontal line scale from 0 to 10. At the left end (0) is a sad face icon and the text "Not acceptable at all (0)". At the right end (10) is a happy face icon and the text "Extremely acceptable (10)". The scale is marked with integers from 0 to 10.

Note to interviewer: Please read the question and instructions aloud to the participant and assist them in marking (|) on the line.

Figure 1. VAS used to assess old non NGT diet chart and new NGT based diet chart

Table 1: Distribution of NGT participants(N=37) and participants of diet chart acceptability assessment (N=30) by age, gender and duration of diabetes.

NGT participants (N=37)			
Age	Male	Female	Mean Duration of T2DM (years)
18–30 years	0	0	Not available
30–45 years	2	1	6.3
45–60 years	4	11	6.1
> 60 years	13	6	12.1
Total	19	18	8.2

Diet chart acceptability assessment participants (N=30)			
Age	Male	Female	Mean Duration of T2DM (years)
18–30 years	1	1	10.5
30–45 years	1	1	10.5
45–60 years	1	1	10.5
> 60 years	1	1	10.5
Total	4	4	10.5

Age	Male	Female	Mean Duration of T2DM (years)
18–30 years	0	1	1.5
30–45 years	3	1	4.0
45–60 years	8	1	4.8
> 60 years	13	3	6.8
Total	24	6	4.3

Results:

Dietary Preferences & Themes

Across the eight NGT sessions, participants consistently prioritised regionally familiar staples as the core of their daily meals. Items such as ragi mudde (steamed finger millet flour dumplings), chapathi (wheat bread), idli (steamed dumplings made from fermented batter consisting rice and split black gram), dosa (crepes made from fermented batter consisting rice and split black gram), steamed rice, dal (spiced and steamed lentils), sambar (spiced and steamed lentils with cooked vegetable pieces), and a variety of seasonal vegetables were most frequently ranked at the top. These foods were valued not only for their taste and cultural familiarity but also for their accessibility through local markets and home cultivation. Ragi mudde was highlighted for its perceived health benefits, affordability, and long-standing presence in local diets. Diet chart listing food items derives from the NGT is shown in table 2. Alongside preferred items, several **barriers to optimal dietary intake** emerged consistently across sessions:

1. **Financial constraints** – Many participants reported difficulty in purchasing nutrient-rich foods such as fruits, curd, and lean protein sources (e.g., fish, chicken, eggs). Rising prices, seasonal fluctuations, and limited household income often resulted in reduced dietary diversity.
2. **Irregular meal patterns** – Work demands, agricultural labour schedules, extended fasting during religious observances, and caregiving responsibilities often led to skipped meals or poorly timed eating patterns, impacting blood sugar control.
3. **Dietary misconceptions** – Some participants believed that certain substitutes, such as jaggery in place of refined sugar, were inherently healthier, overlooking their similar glycaemic impact. Misunderstandings also persisted around the role of millets, fruits, and dairy in diabetes management.

4. **Lack of cooking support** – Particularly among elderly individuals and those living alone, preparing balanced meals was challenging due to limited physical ability, absence of family support, or reliance on ready-made foods. This was further compounded by the lack of affordable, healthy alternatives in small-town food environments.

Participant quotes:

The following are some illustrative quotes from the study participants which highlight barriers and misconceptions regarding following a diabetes-friendly diet:

“We cannot buy fruits every week—it’s too expensive for the whole family.” (68-year-old male patient).

“We eat what is filling. There’s no way we can buy special foods for diabetes every day.” (44-year-old female patient).

“I live alone and cannot cook different meals just for myself.” 67-year-old female patient

Misconception: “We thought jaggery was good, so we used it in tea instead of sugar.” (52-year-old female patient).

Irregular timing complaint: “I skip breakfast if I have to leave early and just eat whatever is available later.” (72-year-old male patient).

Acceptability of NGT derived diet chart

VAS based assessment of the NGT derived diet chart (versus the conventional dietician prescribed diet available at the hospital) by an independent group of T2DM showed higher mean tabore (8.13) for the NGT derived diet chart (table 2). Table 3 depicts diet chart acceptability assessment by broad age group, gender (N=30).

Table 2: Summary of Diet Charts prepared based on the outcomes of the NGT

Group	Breakfast	Lunch	Snacks	Dinner	Restricted Foods*
Females < 60	Chapathi, Mudde, Sambar, Idli, Dosa	Rice, Dal, Mixed Vegetables, Skimmed Curd, Tomato Bath, Vangi Bath (rice dish with brinjal)	Groundnuts, Flaxseeds, Sprouts, Chithranna(spiced rice with turmeric and lemon),	Millet dish, Boiled Vegetables, Buttermilk, Palya	Red meat, Pickles, full fat dairy

			Uppit(spiced cream of wheat)		
Females ≥ 60	Wheat porridge, Oats, Sesame seeds	Ragi, Leafy Vegetables, Sprouts, Low fat Yoghurt, Chithranna, Ragi rotti	Pumpkin Seeds, Guava, Uppit	Little Millet, Vegetable Soup, Skimmed Milk, Palya	Maida-based items, mango, jackfruit, palm oil
Males < 60	Foxtail Millet Chapathi, Egg white, Idli, Dosa	Bansi Rava, Pulses, Tomato Bath, Ragi mudde	Almonds, Groundnuts, Chithranna, Uppit	Brown Rice, Mixed Veg, Low fat Buttermilk, Palya	Fried seeds, red meat, pickles
Males ≥ 60	Avalakki (spiced beaten rice), Skimmed Milk, Millet chapathi, Flaxseeds	Legumes, Curd, Vangi Bath, Ragi rotti	Apple, Uppit	Wheat based dish, Boiled Vegetables, Palya (spiced cooked vegetables)	Deep-fried foods, full fat milk, mango, sapota.

*Restricted food: Foods to be avoided in patients with Type 2 Diabetes Mellitus.

Table 3: Diet chart acceptability assessment by broad age group, gender (N=30).

Group	n	NGT Chart Score (Mean $\pm$ SD)	Standard Chart Score (Mean $\pm$ SD)	Mean Difference
Overall	30	8.13 $\pm$ 0.96	6.50 $\pm$ 1.15	1.63
Sex				
Males	24	8.17 $\pm$ 0.99	6.46 $\pm$ 1.17	1.71
Females	6	8.00 $\pm$ 0.89	6.67 $\pm$ 1.03	1.33
Age group				
Age ≥ 60 years	16	7.94 $\pm$ 0.93	6.69 $\pm$ 1.14	1.25
Age < 60 years	14	8.36 $\pm$ 0.93	6.29 $\pm$ 1.14	2.07

Discussion:

This study demonstrates that NGT can be used to design culturally appropriate diet charts and addresses an important gap in the provision of contextually relevant dietary management for patients with Type 2 Diabetes Mellitus (T2DM) living in rural Indian settings. Rigidly prescribed diets that overlook these contextual factors risk alienating patients and fostering frustration rather than motivating change. Recognising this, the present study sought to

address these barriers by using the Nominal Group Technique (NGT), a structured and inclusive participatory method that actively engages patients in the process of designing their own dietary plans ^{(13),(21)}.

The NGT process allowed for designing diet charts with incorporation of culturally familiar foods, ensured that affordability was a central consideration, and adapted to the availability of ingredients in local markets—factors that greatly influence the feasibility of dietary advice in rural households ⁽²⁶⁾. By directly involving patients in the decision-making process, the resulting diet charts reflected a realistic balance between medical recommendations and everyday practicality, making them more acceptable and sustainable.

Alignment with Previous Research

The findings of this study are consistent with earlier work in South Asia that has highlighted the benefits of culturally tailored dietary interventions for T2DM ⁽⁶⁾. Evidence suggests that incorporating familiar, traditional foods into dietary recommendations increases adherence, fosters trust in healthcare providers, and leads to better dietary compliance ⁽¹⁵⁾. An Indian study also showed that traditional, locally preferred foods contribute significantly to patient acceptability and willingness to follow long-term dietary changes ⁽¹⁶⁾. Our results reinforce this, as the NGT-derived charts consistently received higher preference ratings compared to conventional dietician-prescribed charts.

Strengths

One of the clear strengths of this work lies in its demonstrated applicability of NGT for creating diet plans that are directly shaped by T2DM patient preferences. Although NGT has been used successfully in various healthcare contexts to reach group consensus ^(18,19), its use for dietary planning in rural Indian settings remains relatively underexplored. The structured process ensured that all voices were heard equally, reducing the influence of more dominant individuals and allowing even quieter participants to share their perspectives ⁽²⁰⁾.

Active patient involvement was another strength. By engaging participants as collaborators rather than passive recipients of advice, the NGT sessions enhanced ownership of the dietary plans. This, in turn, contributed to cultural relevance and dietary customisation, as patients could see their own suggestions reflected in the final recommendations ^(4,16,26,29).

Stratifying the NGT sessions by age and gender was also a valuable aspect of the study design. This approach allowed for the identification of distinct needs and priorities within each subgroup. Younger participants often emphasised the importance of foods that support sustained energy for physical labour, while older participants placed more emphasis on foods

that are easy to chew, digest, and prepare. These insights ensured that the final diet charts were sensitive to demographic differences within the patient population.

Finally, using region-specific foods ensured that the diet charts were both affordable and sustainable ⁽²⁷⁾. Locally grown and seasonally available foods were prioritised, reducing reliance on costly, imported items. This addressed one of the most persistent barriers to following MNT in rural, resource-limited settings—cost and accessibility ⁽¹²⁾.

Limitations

While the findings are encouraging, there are some limitations that must be acknowledged. The feedback window for evaluating the diet charts was relatively short, limiting the ability to assess the durability of patient preferences over time. The sample of 30 in-patients who evaluated the NGT derived diet charts was small and were chosen purposively, the generalizability of this finding is greatly limited. Furthermore, the evaluation did not include objective clinical outcome measures, such as glycated haemoglobin (HbA1c), fasting glucose levels, or lipid profiles ⁽²⁸⁾. Without these data, it is not possible to determine whether the increased acceptability of the NGT-derived charts would directly translate into improved metabolic control.

The cultural and dietary context of the Ramanagara district is another factor to consider. The food preferences and availability in this region may differ significantly from those in other parts of India. As a result, while the NGT process itself is adaptable, the specific food items prioritised in this study may not be universally applicable ⁽³⁰⁾. Lastly, the reliance on self-reported information about dietary patterns introduces the possibility of recall bias. The study also did not fully account for comorbidities, such as hypertension or dyslipidaemia, which can influence dietary choices ⁽³¹⁾.

Future directions

Future research should build on these findings by assessing the long-term impact of NGT-derived diet charts on measurable health outcomes in patients with T2DM and other health conditions requiring dietary modifications. It would also be valuable to replicate the study in different rural regions of India to assess the scalability and adaptability of the approach ^(30,31).

Integrating NGT-based planning into primary healthcare services could further enhance its reach. Training healthcare providers, including community health workers, in facilitating NGT sessions could make participatory dietary planning a standard component of diabetes care ⁽³²⁾. This would help ensure that dietary advice is consistently patient-centred, culturally relevant, and grounded in local realities. Finally, future studies could explore ways to refine

the NGT process itself to make it even more efficient and widely accessible, while maintaining the inclusive, consensus-building nature that underpins its success ^(19,32).

Conclusion:

This study demonstrates the value of the Nominal Group Technique (NGT) as an effective participatory approach for developing dietary recommendations that are both culturally relevant and practically feasible for individuals living with Type 2 Diabetes Mellitus (T2DM) in Ramanagara district. By directly involving patients in the decision-making process, the research moved beyond traditional, top-down dietary prescriptions to create diet charts grounded in local realities.

Abbreviations:

T2DM – Type 2 Diabetes Mellitus

NGT – Nominal Group Technique

MNT – Medical Nutrition Therapy

VAS – Visual Analogue Scale

COREQ – Consolidated Criteria for Reporting Qualitative Research

CDSIMER – Chandramma Dayananda Sagar Institute of Medical Education and Research

DSU – Dayananda Sagar University

HbA1c – Glycated Haemoglobin

Ethics approval and consent to participate: Ethics approval for the study was obtained from the Institutional Ethics

Committee (CDSIMER-IEC), Dr. Chandramma Dayananda Sagar Institute of Medical Education and Research (CDSIMER), Karnataka, India (Study Ref:

CDSIMER/MR/0118/IEC/2024). The study was approved in its presented form. Written informed consent was obtained from all participants prior to their participation in the study.

⁽²²⁾. The study was conducted in accordance with ethical principles of the declaration of Helsinki.

Consent for publication: Not applicable

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Authors' contributions: AP, AT, and ASS contributed to the conceptualization and design of the study, data collection, data analysis, and interpretation of findings. SAC provided expert input on medical nutrition therapy, assisted in the development of the diet charts based on the consensus findings, and reviewed the manuscript for nutritional accuracy. ADM supervised the study, provided methodological guidance, contributed to the interpretation of results, and critically reviewed the manuscript for important intellectual content. All authors read,

revised, and approved the final manuscript.

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