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Adherence to medical nutrition therapy and its challenges among antenatal women with gestational diabetes mellitus in South India- A sequential explanatory mixed-method study

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Abstract:

BACKGROUND: Globally, one in ten pregnant women have diabetes; out of which, 90% contribute to gestational diabetes mellitus (GDM). Medical Nutrition Therapy (MNT) is the cornerstone for GDM treatment yet adherence to MNT among the masses is not adequately monitored as part of the routine antenatal services. The study aimed to estimate the proportion of adherence to MNT and determine the factors related to adherence among antenatal women with GDM. This study also explores the facilitators, barriers, and possible suggestions for improving adherence.

MATERIALS AND METHODS: This facility-based sequential explanatory mixed-method study was conducted among 341 antenatal women with GDM at, Puducherry. The study was conducted in 2021. Dietary adherence was evaluated using Perceived Dietary Adherence Questionnaire and based on the scores obtained they were selected for in-depth interviews to explore the facilitators and barriers. Collected data were analysed by Chi-square test using STATA version 16.

RESULTS: Out of 341 participants, the proportion of participants adherent to MNT was 135 (39.6%) with 95% CI of 34%–44%. The predictors for poor adherence were unemployment (PR: 0.65; 95%CI: 0.48–0.88) and good adherence was antenatal women in the 2nd trimester (PR: 1.541; 95%CI: 1.18–2.025). Barrier to non-adherence were financial crisis, lack of awareness of the need for MNT, and joint family pressure.

CONCLUSIONS: About two-thirds of antenatal women with GDM are non-adherent to MNT. Unemployment and period of gestation were found to be their determinants. Appropriate action has to be implemented for improving the adherence rate.

Keywords:

Gestational diabetes mellitus (GDM), medical nutrition therapy (MNT), perceived dietary adherence questionnaire (PDAQ)

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Introduction

“Gestational diabetes mellitus (GDM) is defined as impaired glucose tolerance with onset or first recognition during pregnancy”.^[1] In India alone, GDM complicates 4 million pregnancies every year.^[2] According to International Diabetes Federation (IDF)

2017, the prevalence of GDM is rising year by year.^[3] Women with GDM are at risk of suffering from adverse outcomes like cesarean section, progression to type 2 diabetes mellitus, and cardiovascular diseases.^[4-9] Infants could be prone to congenital abnormalities and neonatal hypoglycemia.^[6,10]

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Prevalence of GDM ranges from 10% to 53.5% worldwide, with South East Asia region reporting the highest prevalence.^[11-14] Asian ethnicity significantly increases the vulnerability to GDM by 17%. Late marriage, elderly primi, urbanization, eating patterns, and decreased physical activity levels contribute to the recent trend.^[1] A prospective cohort study in Puducherry reported the prevalence of GDM to be 27%.^[15]

Management of GDM includes lifestyle modifications and pharmacological therapy. Pharmacological therapy is initiated if lifestyle modification strategies fail to reach the expected glucose targets on follow-up visits.^[16] Studies have proved that the fasting blood sugar (FBS), 2-hour post prandial blood sugar (PPBS), appropriate weight gain in 3rd trimester, intrapartum, and adverse events were less frequent in the MNT group.^[17]

Despite a high prevalence of GDM and MNT being the cornerstone for GDM treatment, adherence to MNT among the masses is not adequately monitored as part of routine antenatal services. India needs evidence - based research on this topic.

We need to broach the matter by improving awareness among antenatal women with GDM and the medical fraternity. In India, this is one of the very few studies done to estimate adherence to medical nutrition therapy. A perceived dietary adherence questionnaire was used to assess the dietary adherence of participants which was not used in the previous studies. This study aimed to estimate the proportion adherent to Medical Nutrition Therapy and assessed the factors related to adherence. The study also explored the facilitators, barriers of adherence to MNT from the individual, family, and facility level aspects, and also the possible suggestions for improvement.

Materials and Methods

Study design and setting

A sequential explanatory mixed-method design which includes the quantitative phase (cross-sectional analytical study) followed by the qualitative phase (in-depth and key informant interviews)

This hospital-based explanatory mixed-method study was conducted in the Department of Obstetrics and Gynecology (OB&G), Puducherry. The facility has an annual delivery rate of 15,000. It caters to pregnant women from neighboring three states and eight districts. Screening and treatment for GDM are free. GDM in this facility is diagnosed by using the International Association of Diabetes and Pregnancy Study Groups (IADPSG) criteria. The antenatal women with GDM are referred to the dietician who explains

the MNT to them in detail and arranges for a follow-up visit after 2 weeks. The duration of data collection was from July 2020 to December 2020 (six months). Ethical clearance was obtained from the Institutional Ethics Committee (JIP/IEC/2021/156, Date of approval of ethics is 24/05/2021). Written informed consent was obtained from all the participants. Procedures were in accordance with the ethical standards of the Helsinki Declaration of 1975, as revised in 2000.

Phase 1: Quantitative part Study participants

Antenatal women diagnosed with GDM seeking care in tertiary care hospital, Puducherry. Only women who were on MNT for a minimum duration of two weeks and above were included.

Sample size and sampling technique

Using OpenEpi version 3.01, a study conducted in Zimbabwe reported the adherence rate to diet therapy was 66.8%.^[18] Assuming the same prevalence, absolute precision of 5%, and 95% confidence interval (CI), the calculated sample size was 341. Universal sampling was done to include the eligible participants.

Study procedure

Socio-demographic details were obtained through semi-structured data collection proforma. Details on obstetric complications, biochemical parameters, and anthropometric details were extracted from individual hospital case sheets. To assess the food intake over a period of 7 days, the perceived dietary adherence questionnaire (PDAQ) was used. PDAQ is a nine-item questioners which was developed in 2015 by Ghada Asaad *et al.*^[19] to measure patient perceptions of their dietary adherence. The questionnaire was based on the Canadian Food Guide and CDA Nutrition Therapy recommendations. The questionnaire was modified to suit our setting. The change made in the questionnaire was that the examples of food items given were purely Indian based whereas the original questionnaire had food items that suits the Canadian population. The broad items of the questionnaire are overall adherence to the MNT plan, recommended fruits and vegetable servings, consumption of low glycemic index food, food high in sugar, food high in fiber content, appropriate carbohydrate spacing (3 meal and 3 snacks), appropriate healthy oil consumption and food high in fat. The questionnaire was reviewed by experts and pretested among a group of participants.

The questions are phrased as "In the last seven days, how many days did you consume food high in fiber, high in low-glycemic foods...?" A high score for questions reflects good adherence for all except for questions on sugar intake and fat intake, where a high score reflects poor

adherence. The minimum score is 0, and the maximum score is 63. A person is said to be adherent if she scores 36 and above (i.e. Patients were classified to be adherent if they followed healthy diet for at least 4 days in a week based on previous study by Ayele *et al.*^[20]). At the end of each interview, the participant's scores were revealed to them and non-adherent women were advised accordingly.

Phase II: Qualitative component

Study participants

Based on the quantitative assessment of adherence, five adherent and five non-adherent participants were selected for in-depth interviews, and a panel of health care professionals consisting of a dietician, obstetrician, postgraduate resident, and nursing officers was selected for key-informant interviews.

Sampling technique

Participants were selected based on the purposive sampling (maximum variation sampling) technique and health care workers were selected based on their availability in the clinic [Figure 1].

Study procedure

Ten in-depth interviews and five key informant interviews among health care workers were carried out till the point of theoretical saturation. Interviews were conducted in places convenient to participants. Data collection was done using a semi-structured pre-tested interview guide. The guides were developed by review of the literature and expert opinion. After obtaining written informed consent, interviews were audio recorded. At the end of the interview, the key points were debriefed to the participants for validation.

Statistical analysis

Quantitative

Data was captured using Epicollect5 software. Data analysis was done using STATA version 16 (StataCorp. Texas, United States). Continuous variables were summarized as mean/SD and median/IQR based on normality of distribution following the thumb rule. All categorical variables were

summarized as proportions. The number of antenatal women with GDM adherent to MNT was summarized in proportion (95% CI). Association of socio-demographic and clinic characteristics with adherence to MNT was assessed using the Chi-square test, and an unadjusted prevalence ratio with 95% CI was calculated. A *p* value < 0.05 was considered statistically significant.

Qualitative

The audio recordings were transcribed in verbatim format. Basic content analysis was done. Both inductive and deductive coding was done. Similar codes were clubbed into categories and themes. Statements were the unit of analysis. Thematic analysis of facilitators, barriers, and suggestions was done and a conceptual framework was developed.

Results

In this mixed—method study, data collected from a total of 341 eligible participants with GDM on MNT were included for quantitative analysis. The mean age of the study participants was 28.7 years. About 23.4% were graduates. Around 12.3% of participants were employed. About 58.9% of participants were from rural areas and 19.6% of participants were from nuclear families. About 278 participants were in their third trimester. About 35.8% of participants were on MNT alone. About 22% of participants had controlled fasting blood glucose levels and 16.4% had controlled postprandial blood glucose levels [Table 1].

Out of 341 participants, the number of antenatal women with GDM adherent to MNT was 135 participants (40%) with 95% CI: 34%–44%. The median score for sugar intake was 7 days i.e., majority of participants did not consume foods high in sugar for all 7 days and the median score was 1 day for appropriate oil consumption [Table 2].

Unemployed were 35% less adherent to MNT as compared to employed with 95% CI of 0.48–0.88 (*p*-value of 0.013). Antenatal women in the second trimester were 1.54 times more adherent to MNT as compared to the third trimester with 95% CI of 1.18–2.02 (*p*-value < 0.05) [Table 3]. Out of 135 adherent participants, 22.2% of participants had controlled fasting blood glucose levels and 18.5% had controlled postprandial blood glucose level. There is no significant association between biochemical parameters and proportion of adherence to diet. Adherent participants had 1.02 times higher prevalence of controlled FBS level with a 95% CI: 0.68–1.52. Adherent participants had 1.09 times higher prevalence of controlled PPBS level with a 95% CI: 0.68–1.73. Qualitative analysis was based on the participant's adherence to diet (quantitative findings), they were selected to explore the best practices and barriers for non-adherence. For the in-depth interviews, the age group of the participants ranged from

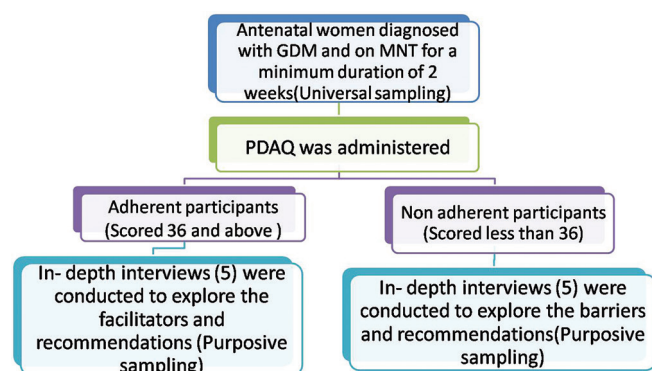


Figure 1: Flowchart for methodology

Table 1: Socio-demographic and clinical characteristics of antenatal women with GDM on MNT in South India (N=341)

Socio-demographic and clinical variables	Frequency (n)	Percentage
Age in years (Mean, SD)	28.7 (4.4)	
Educational status [#]		
Professional	9	2.6
Graduate	80	23.4
High School	210	61.6
Middle School	24	7.0
Primary School	18	5.4
Occupational status		
Unemployed/Homemaker	299	87.7
Employed	42	12.3
Residence		
Rural	201	58.9
Urban	140	41.1
Religion		
Hindu	311	91.2
Christian	16	4.7
Muslim	14	4.1
Socio-economic status ^{##} :		
I. Upper class (Rs. 7770 and above)	165	48.4
II. Upper middle class (Rs. 3809-7769)	68	19.9
III. Middle class (Rs. 2253-3808)	65	19.1
IV. Lower middle class (Rs. 1166-2252)	41	12.0
V. Lower class (<Rs. 1166)	2	0.6
Type of family		
Joint Family	268	78.6
Nuclear Family	67	19.6
Three Generation Family	6	1.8
Comorbidities		
No comorbidities	306	89.7
Hypertension	20	5.9
Hypothyroidism	12	3.5
Others*	3	0.9
Number of living children		
0	197	57.8
1	131	38.4
≥2	13	3.8
Period of gestation		
2nd trimester	63	18.5
3rd trimester	278	81.5
Obstetric complications		
Nil	227	66.6
High risk mothers**	92	27.0
Preeclampsia	14	4.1
Anemia (<11.0gm/dl)	5	1.5
High risk mothers and anemic	3	0.9
Anthropometric characteristics	Mean	SD
Pre-pregnancy BMI	24.5	2.05
Bio chemical parameters	Mean	SD
Fasting blood glucose level (mg/dl)	100.90	18.72
2 h Post prandial blood glucose level (mg/dl)	154.39	37.37
Duration on MNT (weeks) (Median, IQR)		8 (2-18)
	n	%
Treatment regimen		
MNT alone	122	35.8

Contd...

Table 1: Contd...

Socio-demographic and clinical variables	Frequency (n)	Percentage
MNT and Oral hypoglycemic agents	156	45.7
MNT and Insulin	63	18.5
	<i>n</i>	<i>%</i>
Controlled glycemic status		
Fasting blood glucose level	75	22
Post Prandial blood glucose level	56	16.4

*Educational status was measured by Kuppuswamy scale. **Socio-economic status is expressed using B.G.Prasadscale. *Others include epilepsy and cardiovascular diseases **High risk mothers are those greater than 30 years of age

Table 2: Perceived Dietary Adherence Questionnaire (PDAQ) score domain wise among antenatal women with Gestational Diabetes Mellitus on MNT in South India (N=341)

Questionnaire Variable	Median score	IQR
In the last 7 days, how many days have you followed the diet plan prescribed to you?	4	3-5
In the last 7 days, how many days did you eat the correct quantity of fruits and vegetables as prescribed to you?	3	3-4
In the last 7 days, how many days did you eat foods such as dried beans, barley, lentils, low fat dairy products, Chana Dal, brown rice, egg, paneer?	2	2-3
In the last 7 days, how many days did you eat food high in sugar, such as cakes, cookies, biscuits, desserts, sweets such as laddoo, jalebi, rasgulla etc.?	7	7-7
In the last 7 days, how many days did you eat food high in fibre such as oats, ragi, broken wheat, whole pulses like whole Bengal gram, green gram, soya, Greens, and vegetables?	3	2-3
In the last 7 days, how many days did you space carbohydrates evenly throughout the day?	5	3-5
In the last 7 days, how many days did you eat food high in omega-3 fats such as eggs, fish, walnut, soyabean, greens, chia seeds?	2	2-3
In the last 7 days, how many days did you consume oil appropriately (5 teaspoons) per day?	1	1-2
In the last 7 days, how many days did you eat food high in fat (such as high fat dairy products, fatty meat, fried food or deep Fried food)?	7	6-7

25 to 32 years. Four participants were above 30 years. All health care professionals who participated in the study had a work experience of more than five years and their ages ranged from 27 to 35 years. Three overarching themes emerged from in-depth interviews and key informant interviews and were further categorized into subthemes like individual, family, and facility level aspects and categories. [Figure 2] Codes and statements are listed in Table 4.

Theme 1: Facilitators for adherence to medical nutrition therapy

Well-educated and financially sound participants found it easy to adhere to the diet. The majority of the adherent mothers stated that their mothers-in-law were concerned about their glucose control and hence they constantly kept a check on their diet. Spousal support was one of the major facilitators. Most participants felt that the demonstration of servings by the dieticians made it easy to adhere to a diet.

“I’m working as a teacher in a government school hence I could afford to eat healthy foods.” (26 year antenatal women adherent to MNT)

“My mother in law used to prepare lunch by following the diet plan. She used to pack lunch box for me especially keerai,

sundal was there almost every day...” (30 year, school teacher, adherent to MNT)

“My husband browsed for diet related information on different websites and found some healthy recipes.” (27 year, homemaker, adherent to MNT)

“Diet doctor frequently visited me when I was admitted in the hospital. She monitored my diet and gave regular advice which helped me to follow the diet even after I was discharged.” (29 year, home-maker, adherent to MNT)

Theme 2: Barriers for adherence to medical nutrition therapy

The majority of participants reported that only one person earns in their families. Therefore, they consume only what they can afford and cannot split and eat their meals. Most of the participants stated that they found it difficult to manage their time as they were busy with their household chores. Staying in a joint family was a major concern reported by the participants as they had to cook food according to the preferences of family members. Majority reported lack of spousal support as their major concern. Obstetricians felt that there was lack of co-ordination with dieticians. They also stated that they do not have any in-depth knowledge about MNT.

Table 3: Association of socio demographic and clinical characteristics with proportion of adherence among antenatal women with GDM on MNT in South India (N=341)

Socio-demographic and clinical variables	Total (n)	Proportion of adherence		Unadjusted PR (95%CI)	p*
		Yes n (%)	No n (%)		
Age group (in years)					
<30	215	84 (39.1)	131 (60.9)	0.97 (0.74-1.26)	0.798
≥30	126	51 (40.5)	75 (59.5)	1	
Educational status					
Class 1-10	107	41 (38.3)	66 (61.6)	1.01 (0.71-1.45)	0.574
Higher Secondary School	145	60 (41.4)	85 (58.6)	1.09 (0.78-1.52)	
Graduate and above	90	34 (37.7)	56 (62.2)	1	
Occupation					
Unemployed/homemaker	299	111 (37.1)	188 (62.9)	0.65 (0.48-0.88)	0.013
Employed	42	24 (57.1)	18 (42.9)	1	
Residence					
Rural	201	76 (37.8)	125 (62.2)	0.90 (0.69-1.17)	0.421
Urban	140	59 (42.1)	81 (57.9)	1	
Religion					
Hindu	311	123 (39.5)	188 (60.5)	1.06 (0.55-2.02)	0.955
Christian	16	6 (37.5)	10 (62.5)	0.88 (0.36-2.10)	
Muslim	14	6 (42.9)	8 (57.1)	1	
Socio-economic status					
I. Upperclass Rs. 3809 and above	288	111 (38.5)	177 (61.5)	0.85 (0.61-1.18)	0.356
II. Others (Rs. 3808 and below)	53	24 (45.3)	29 (54.7)	1	
Number of family members					
≤5	312	126 (40.4)	186 (59.6)	1.30 (0.74-2.28)	0.325
>5	29	9 (31)	20 (69)	1	
Type of family					
Joint family and three generation family	274	108 (39.4)	166 (60.6)	0.98 (0.71-1.36)	0.895
Nuclear family	67	27 (40.3)	40 (59.7)	1	
Comorbidities					
No comorbidities	306	120 (39.2)	186 (60.8)	0.59 (0.26-1.32)	0.927
Hypertension	20	9 (45.0)	11 (55.0)	0.68 (0.26-1.72)	
Hypothyroidism	12	4 (33.3)	8 (66.7)	0.5 (0.16-1.55)	
Others*	3	2 (66.7)	1 (33.3)	1	
Presence of living children					
≤1	328	133 (40.5)	195 (59.5)	2.63 (0.73-9.49)	0.069
>1	13	2 (15.4)	11 (84.6)	1	
Obstetric complications					
None	227	90 (39.6)	137 (60.4)	1.19 (0.23-5.94)	0.516
High risk mother	92	33 (35.9)	59 (64.1)	1.08 (0.21-5.46)	
Preeclampsia	14	8 (57.1)	6 (42.9)	1.71 (0.32-9.05)	
Anemia	5	3 (60.0)	2 (40.0)	1.8 (0.31-10.39)	
Both high risk mother and anemic	3	1 (33.3)	2 (66.7)	1	
Period of gestation					
2 nd trimester	63	35 (55.6)	28 (44.4)	1.54 (1.18-2.025)	0.004
3 rd trimester	278	100 (36.0)	178 (64.0)	1	
Treatment regimen					
MNT and tablet	156	61 (39.1)	95 (60.9)	0.88 (0.63-1.23)	0.664
MNT alone	122	46 (37.7)	76 (62.3)	0.85 (0.59-1.21)	
MNT and insulin	63	28 (44.4)	35 (55.6)	1	

*The test of statistical significance used is Chi-square test

“My husband is a daily wage labourer and earns very little money. So I cannot afford to split meals and eat six times a day...” (28 year, homemaker, non-adherent to MNT)

“I used to go home very late after work so I eat whatever is there in the fridge. No time to prepare food according to the diet plan...” (27 year old, IT professional, non-adherent to MNT)

Table 4: Thematic analysis (Themes, codes, and statements) of facilitators, barriers, and suggestions for improving adherence to MNT obtained through in-depth and key informant interviews

GLOBAL THEME: Adherence to MNT	Theme 1: Facilitators	Theme 2: Barriers	Theme 3: Suggestions for improvement
SUB THEME: INDIVIDUAL ASPECTS	<p>a) History of fetal loss <i>"I had an abortion last time so was scared for this baby. So I strictly followed the diet."</i> (Statement by a 28 year old, working in a private company, GDM adherent to the diet plan)</p> <p>b) Late motherhood <i>"I am pregnant after 7 years of marriage. So I'm extremely careful about the baby. Hence I strictly followed the diet."</i> (Statement by a 34 year old, school teacher, GDM adherent to the diet plan)</p> <p>c) Holds a professional/medical degree <i>I'm a BSC nursing graduate, hence I have a knowledge on MNT. So it was easy for me to follow."</i> (Statement by a 27 year old, staff nurse in government hospital, GDM adherent to the diet plan)</p> <p>d) Diet conscious <i>"I was on paleo diet before my pregnancy. Hence it was easy for me to follow a diet plan."</i> (Statement by a 28 year old, working in a private company, GDM adherent to the diet plan)</p> <p>e) Maintenance of food records <i>"I maintained a food diary and wrote food items that I eat in this week. During my visit to the dietician, I showed her the diary."</i> (Statement by a 34 year old, school teacher, GDM adherent to the diet plan)</p> <p>f) Use of online tools for calorie estimation <i>"I was told to take 1800 calories daily. So I used the online app for calculating calories. It was really useful."</i> (Statement by a 28 year old, working in a private company, GDM adherent to the diet plan)</p>	<p>a) Lack of proper knowledge <i>"I don't have diabetes. I initially had high sugar levels after that it became normal and I didn't continue the treatment."</i> (Statement by a 30 year old, homemaker, GDM non-adherent to the diet plan)</p> <p>b) Lack of understanding on the benefits of diet control & concerned about baby's health <i>"My husband couldn't understand about the diet control. In fact he questioned me how the child will be healthy if you don't eat a lot."</i> (Statement by a 29 year old, homemaker, GDM non-adherent to the diet plan) <i>"My husband overfed me as he was concerned about the weight of the baby."</i> (Statement by a 28 year old, homemaker, GDM non-adherent to the diet plan)</p> <p>c) Busy with household chores and children's work <i>"I get busy with children's work. Getting them ready for school and their homework. In this I have no time to prepare food according to my diet."</i> (Statement by a 27 year old, working in a private company, GDM non-adherent to the diet plan)</p> <p>d) Difficulty in overcoming temptation to avoid sweets <i>"I always have the urge to eat sweets. At family functions, I get tempted and don't follow the diet and I eat a few sweets."</i> (Statement by a 30 year old, homemaker, GDM non-adherent to the diet plan)</p> <p>e) Morning sickness <i>"I used to vomit in the morning because of which I used to skip breakfast and I felt scared to eat anything."</i> (Statement by a 29 year old, working in a private company, GDM non-adherent to the diet plan)</p> <p>f) Wrong information from peers <i>"I heard that sugar levels can be reduced by tablets than why to follow strict diet as my friend told diet does not have much effect on sugar levels."</i> (Statement by a 26 year old, working in a private company, GDM non-adherent to the diet plan)</p>	<p>a) Food records can be maintained <i>"We can encourage them to maintain food records and we can check them on their next visit."</i> (Statement given by a staff nurse, 8 years of experience)</p> <p>b) Make frequent visits to the dietician <i>"I would suggest the patients to clear their doubts and make frequent visits to us if need arises."</i> (Statement by dietician, 11 years of experience)</p> <p>c) Explain the complications of GDM properly <i>"We should inform them properly to control sugar levels and tell them the importance of sugar control. We should properly explain the complications of diabetes during pregnancy."</i> (Statement given by a staff nurse, 8 years of experience)</p>

Contd...

Table 4: Contd...

GLOBAL THEME: Adherence to MNT	Theme 1:Facilitators	Theme 2: Barriers	Theme 3: Suggestions for improvement
SUB-THEME: FAMILY ASPECTS	<p>a) Special effort was taken to get the correct dietary information <i>"My mother-in law discussed with dieticians from a private clinic too about the diet to be followed and the benefits of following the diet."</i> (Statement by a 27 year old, GDM adherent to the diet plan)</p> <p>b) Prepared healthy home recipes <i>"My mother in law used to prepare lunch by following the diet plan. She used to pack lunch box for me especially keerai, sundal was there almost every day ."</i> (Statement by a 30 year old, school teacher by profession, GDM adherent to the diet plan)</p> <p>c) Financially sound family <i>"My family is earning well so it was easy for me to split and eat six times a day."</i> (Statement by a 27 year old, working in a private company, GDM adherent to the diet plan)</p> <p>d) Educated caregiver <i>"My mother is a nurse so she already knew about diet control. So from first day she was very strict with my diet."</i> (Statement by a 25 year old, working in a private company, GDM adherent to the diet plan)</p>	<p>a) Lack of knowledge <i>"My mother- in law couldn't understand about diabetes during pregnancy and also about diet control ."</i> (Statement by a 26 year old, homemaker, GDM non-adherent to the diet plan)</p> <p>b) Cannot cook separately <i>"My mother-in-law told me to eat whatever is made for the entire family. I couldn't cook food based on the diet plan."</i> (Statement by a 24 year old, homemaker, GDM non-adherent to the diet plan)</p> <p>c) Embarrassment:"I live in a joint family and I find it very embarrassing to eat 6 meals a day while others have only 3." (Statement by a 26 year old, homemaker, GDM non-adherent to the diet plan)</p> <p>d) Different food preferences <i>"In a joint family everybody's food preferences are different. So its difficult and tiring to prepare food according to the plan."</i> (Statement by a 26 year old, homemaker, GDM non-adherent to the diet plan)</p>	<p>a) Involvement of husbands/family members in diet sessions <i>"It would be beneficial if we make it mandatory for husbands to attend the diet sessions."</i> (Statement by treating obstetrician, 7 years of experience)</p> <p>b) Provide cash to meet the food expenses <i>"It will be helpful if the people who can't afford six meals a day are brought under some scheme and their food expenses are managed."</i> (Statement by dietician, 11 years of experience)</p>
SUB-THEME: FACILITY LEVEL ASPECTS	<p>a) Demonstration made the diet plan moreunderstandable <i>"They showed me different utensils and their sizes and explained the vegetables and rice quantity."</i>(Statement given by 27 year old, adherent GDM mother)</p> <p>b) Availability of skilled dieticians <i>"We have properly trained dieticians in the hospital and they are ready to clear the queries of patients."</i> (Statement given by obstetrician)</p> <p>c) Frequent ward visits by dieticians <i>"Diet doctor frequently visited me when I was admitted in the hospital. She monitored my diet and gave regular advice which helped me to follow the diet even after I was discharged."</i> (Statement given by 29 year old, adherent GDM mother)</p>	<p>a) Lack of pictures in health education materials <i>"I couldn't understand the serving sizes because it did not contain any pictures. It just had numbers and it was difficult to understand. It could have been better if there were pictures in the materials."</i> (Statement given by a 29 year old, non- adherent GDM)</p> <p>b) Lack of vehicles <i>"The department is very far and we have to walk very long distance. There are no vehicles in the facility to take us to the department."</i> (Statement by 28 year old, non- adherent GDM patient)</p> <p>c) Long waiting period <i>"I came at 9 for my appointment, I met the doctor only at 12 after which I had to go for scan. I couldn't meet the diet doctor during my first visit. I met the diet doctor when I came next time. By the time my sugar levels rose."</i> (Statement by 29 year old, non- adherent GDM patient)</p>	<p>a) Provide pictorial representation in the health education material <i>"The pamphlets that are given after education counselling consists of more numbers. If pictures of appropriate servings could be added, it would be more useful and understandable."</i>(Statement by a staff nurse, 8 years of experience)</p> <p>b) Learning by doing can be followed <i>"They can teach us how to calculate calories and tell us to do it in front of them as this would be more useful rather than just telling you should eat 1800 calories."</i> (Statement given by a 30 year old, non- adherent GDM mother)</p> <p>c) Involve health care providers <i>"We have some knowledge about Medical nutrition therapy but regarding the calories consumption we have no idea. It would be great if we are taught regarding the calories."</i></p>

Contd...

Table 4: Contd...

GLOBAL THEME: Adherence to MNT	Theme 1:Facilitators	Theme 2: Barriers	Theme 3: Suggestions for improvement
	<p>d) Individual attention was given <i>“The dietician explained the diet to us in person. She cleared all our doubts and it was done separately for each patient” (Statement given by 27 year old, adherent GDM mother)</i></p>	<p>d) Lack of co-ordination <i>“We are interested in learning about MNT and doing something to increase patient’s adherence to it. But we are not aware of what to do and who to approach. We are very interested though.”(Statement given by PG resident)</i></p>	<p>(Statement given by a PG resident, 3 years of experience) <i>“If they teach us MNT in depth it would be beneficial as we spend more time with patients in the ward and patients ask us a lot of questions for which we don’t have the proper answers.” (Statement given by staff nurse, 7 years of experience)</i></p> <p>d) Appoint a health care provider to guide patients on MNT <i>“ I would suggest to appoint and train a staff nurse/medical social worker specially to clear the doubts of the patient regarding diet control” (Statement given by a staff nurse, 8 years of experience)</i></p> <p>e) Pay the grass root level workers extra money <i>“The grass root level workers are already working on a number of national health programs and the money they get for the work is very less. They can be trained to give MNT only if they get recognized for it.” (Statement given by a staff nurse, 8 years of experience)</i></p>

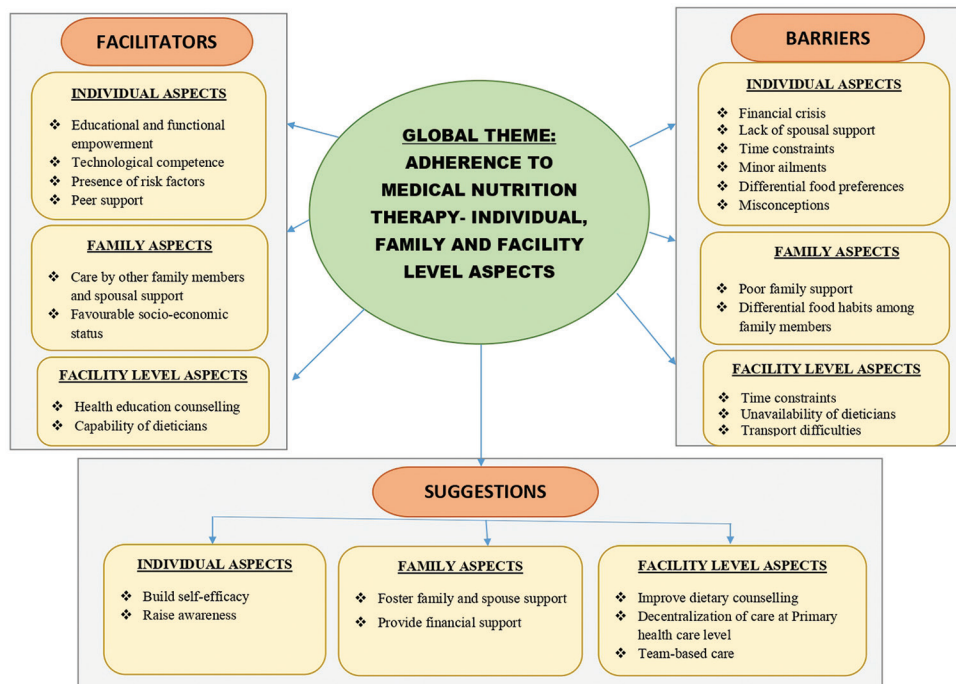


Figure 2: Conceptual framework of thematic analysis of facilitators, barriers and recommendations for adherence to MNT

“I usually prepare foods that my children and husband like. So I have no time to prepare food according to the plan...” (28 year old, home-maker, non-adherent to MNT)

“I live in a joint family and I find it very embarrassing to eat 6 meals a day while others have only 3...” (29 year old, homemaker, non-adherent to MNT)

Theme 3: Suggestions for Improvement

Some participants felt that it would be better if they allowed their husbands to meet dieticians during their antenatal visits. Suggestions to improvise IEC materials were mentioned. Participants stated they had huge respect and trust for Accredited Social Health Activist. It would be useful if ASHA could monitor their dietary adherence and clear their doubts. Health care providers also agreed to this but they stressed that ASHAs should get remuneration for this job as they are already overburdened with other national health programmes.

"At present, MNT is not being implemented in PHCS as there's no dietician present there. We can train ASHA's & ANM in counselling pregnant woman about the need for MNT..." (Staff nurse with 8 years of experience)

Discussion

Our study reported that about 40% of antenatal women with GDM were adherent to MNT. This is much less than the results of a hospital-based study in Zimbabwe (66.8%) on dietary adherence.^[18] This difference in results may be due to the use of different study tools. This indicates that we will have to work more on the monitoring of dietary adherence among antenatal women with GDM. In the present study, majority of participants reported that they never consumed any food high in sugar in the last 7 days which is really commendable. The participants consumed very few foods high in omega-three fatty acids and low glycemic index which emphasizes that extra attention to these domains is needed during dietary counseling.

Unemployed participants were 35% less adherent to MNT in our study which mentions that financial independency among the participants is a necessity as they will be able to afford to consume the recommended diet and the same was revealed through qualitative findings.

"My husband is the only working member in the family and we find it difficult to meet the expenses..." (Statement by a 30 year old, home-maker, GDM non-adherent to the diet plan)

"I'm working as a teacher in a government school hence I could afford to eat healthy foods..." - (Statement by a 26 year old, school teacher, GDM adherent to the diet plan)

Quantitative findings reported that women in the 2nd trimester had higher odds of being adherent to MNT. This result is consistent with statements from qualitative analysis. Most of the participants in the third trimester mentioned that they were already on a drug regimen and hence they did not follow the recommended diet.

"Some people don't understand the need of diet for sugar control. They think tablets and insulin only play a role in sugar control. We should properly tell them the importance that diet has in sugar control..." (Statement given by a dietician, 11 years of experience)

"I'm already on insulin (high dose) and in the third trimester. Why should I follow diet?" (Statement given by 32 year old, non-adherent to MNT)

Out of 135 adherent participants, the glycemic goal for FBS level and PPBS level was achieved by 33.3% and 18.5% of participants respectively which differed from a study by Gadgil *et al.*,^[21] wherein about 50% of participants had achieved glycemic control among the adherent participants as compared to non-adherent participants. The difference in results could be due to operational definitions and different study tools. The finding was supported by a comment from a participant.

"My blood glucose levels reduced as I followed the diet properly which encouraged me to follow diet strictly..." (Statement by a 26 year old, school teacher, GDM adherent to the diet plan)

The other facilitators identified were previous dietary compliance, previous clinical history, good spousal support, and care by other family members. The facilitators and best practices were not explored in any other study till now. The barriers identified were financial crisis, lack of spouse and family support, time constraint, differential food preferences, misconception about diet plan, lack of awareness which was similar to the findings of a qualitative study by Mukona *et al.*^[22] Apart from these similar findings, new evidence about joint family pressure was found in our study. This finding stresses the importance of educating the family members on the need for MNT. Lack of awareness about GDM was mentioned by majority of participants. Hence, health care professionals must clear the misconceptions of patients and stress that MNT is an integral component irrespective of the medications used.

Our study also elucidated the facilitators, barriers, and suggestions for improvement from health system and facility level aspects. However other studies did not explore the facilitators and barriers from the facility in detail. Suggestions for improvement mentioned in our study was the call for team-based care which was similar to a study by Hirst *et al.*^[23]

In exploring the dietary adherence of general diabetic patients, a study conducted by Mekonnen *et al.*^[24] reported the dietary adherence to be 48.3% which is somewhat similar to our findings. These findings conclude that adherence to MNT has yet not been considered the key component of diabetic care. As people think that tablets

and insulin are sufficient enough to maintain glycemic control and there is no need for dietary care. Empowering patients on healthy food patterns plays a key role in guiding their self-care in partnership with health-care providers as mentioned in a study by Mohebbi B *et al.*^[25]

The study focuses on relatively unexplored area of adherence to MNT. Adoption of mixed-method study design was the major strength of the study as qualitative phase strengthened the findings of the quantitative assessment. The use of a standardized tool to check dietary adherence adds to the strength of the study. The study was prone to recall and social desirability bias as pregnant women either under-reported/over reported their food intake.

We have guidelines in place proposed by the Ministry of Health and Family Welfare- Operational and Technical Guidelines for diagnosis and management of GDM^[1] that has set priorities for the decentralization of GDM care. The roles and responsibilities of the grass root level workers have been explained in detail yet the implementation of the guidelines remains challenging at ground level. Team-based care for GDM identification in community, adequate management, and referral to tertiary centers is of utmost importance and needs to be emphasized.

Conclusion

In our study, majority of antenatal women with GDM had a poor adherence rate to Medical Nutrition therapy. The results stress the need to create and improve awareness of MNT among patients, their family members, and health care provider. It also stresses the need for strengthening the implementation of an effective nutrition program for GDM that can be incorporated from the primary level of care.

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Conflicts of interest

There are no conflicts of interest.

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