ORIGINAL ARTICLE

Awareness about Community Management of Hyperglycemia during Pregnancy among Medical Undergraduates in Western Uttarakhand

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ABSTRACT

Background: All women with hyperglycemia in pregnancy (HIP) require optimal care. With western Uttarakhand alone recording a HIP prevalence of 9.7%, the successful implementation of HIP guidelines pan-India at primary healthcare level becomes paramount. **Aim and objective**: The present cross-sectional study aimed to assess the baseline awareness of medical undergraduates regarding HIP management protocols assuming higher their knowledge better the successful implementation of these guidelines within the community. **Methodology**: A descriptive study was carried out among 309 medical undergraduates at a private teaching institute in Uttarakhand. Data was collected using a self-administered, pre-tested questionnaire. Based on individual knowledge scores, participants were subdivided into: good (score≥24), moderate (score 12-24), and poor (score<12) knowledge categories. Data were analyzed using Statistical Package for Social Sciences. **Results**: Most subjects (92.2%) reported reading Indian textbooks on obstetrics; despite this, only 3.6% of subjects had good awareness of the protocols. Sub-domain analysis showed while 90.0% of respondents had a fair understanding of the disease basics, more than two-thirds lagged in recollecting its standard diagnostic and management protocols including the role of health workers. **Conclusion**: Most medical undergraduates have overall poor-to-moderate awareness of HIP management especially the diagnostic and management protocols including the role of health workers.

KEYWORDS

Knowledge, Cognitive, Gestational diabetes, Technical Guidelines, South Asia

INTRODUCTION

All women with hyperglycemia in pregnancy (HIP) - be it gestational diabetes mellitus (GDM) or overt DM - require optimal antenatal care for there is an elevated risk of adverse perinatal outcomes.(1) In addition, following delivery, such a woman and her baby have a higher lifetime risk of developing obesity and

cardiovascular diseases (CVD) compared to euglycemic women; thus, needing postpartum care and subsequent follow-up.(2) She may also need a planned approach to conception for a medication review and intensive DM management.(1) The International Diabetes Federation 2021 estimated 21.1 million global live births borne by HIP women; the majority (80.3%) manifesting as GDM while the remaining as overt DM.(1)

India reports a pooled GDM prevalence of 8.9% (95% confidence interval (CI) 7.1–11.1)(3) with western Uttarakhand recording an overall HIP prevalence of 9.7% (95% CI: 8.1-11.5%) in 2023(4); 95.8% were GDM, and 4.2% overt DIP (4.2%) (4). Considering the risk of early-onset CVD and DM,(5,6) the Government of India (GoI) released indigenous guidelines that mandated universal HIP screening in all Indian pregnant women.(7) Later in February 2018, the GoI added technical aspects(8) for effective service delivery within the population. (**Box 1.1**-**1.3)** enlists key points on the HIP screening and management protocols in India at the primary healthcare level including the roles of the community healthcare physician (namely, the medical officer (MO)) and other frontline workers [viz., auxiliary nurse midwives (ANM), and accredited social health activists (ASHA)]. However, the real success of these strategies depends on the knowledge and involvement of primary healthcare providers.(9) Previous studies have shown healthcare workers and antenatal women had inadequate knowledge about the disease and related preliminary management guidelines.(10-12) As a likely outcome of poor knowledge, more than three-fourths of pregnant women in western Uttarakhand were never screened for HIP despite its burden.(4) Among those screened, the majority availed of services from secondary healthcare facilities. Few even had to bear expenses at private set-ups with a very handful being tested free of cost in the community by ANM; findings that altogether reflect poor service utilization by the native beneficiaries of western Uttarakhand.(4)

Box 1.1: Screening Guidelines for HIP at the Primary Healthcare Level in India [7,8]

Mandatory universal screening of all pregnant women as a part of essential obstetric services

- The only diagnostic test – 2 h 75 g OGTT – is employed in a non-fasting state, irrespective of her last meal timings
- Blood glucose values are measured from the fingertip (capillary) using a plasma-calibrated hand-held glucometer that shows results instantly
- Those exceeding the cut-off value of 140 mg/dL are identified as HIP positive (the diagnostic criterion employed here is: Diabetes in Pregnancy Study Group India (DIPSI))

Timing of Testing:

- Single, shortly at first antenatal contact (Rationale: unlike GDM which usually manifests during late pregnancies, DIP commonly presents in the first trimester itself. Therefore, to rule out all forms of HIP, testing at first antenatal contact is recommended).
- If results are negative (blood glucose value below 140 mg/dL), OGTT is repeated at 24–28 gestation weeks ensuring a minimum gap of four weeks.

Box 1.2: Management Guidelines for HIP at Primary Healthcare Level in India (7,8)

For newly identified HIP women:

Antepartum care:

- First the woman is initiated on medical nutrition therapy (MNT) along with physical activity.
- This is followed by 2 h postprandial blood sugar (PPBS) testing two weeks later.
- 2-hour PPBS level is maintained below 120 mg/dL. If 2-h PPBS exceeds 120 mg/dL and above, medical therapy is added to MNT. Metformin (oral antidiabetic drug) or insulin therapy (subcutaneous injection) is the accepted medical management.
- After initiating medical therapy, glycemic status is monitored with both fasting and 2 h PPBS levels.
- To monitor abnormal fetal growth, estimate amniotic fluid, etc., ultrasonography is also recommended thrice during the antenatal period to rule out complications viz., congenital malformations, large-for-gestational fetus, polyhydramnios, placental abnormalities, etc.

Intrapartum care:

- As pregnancy with HIP is associated with delayed fetal lung maturity risk, routine delivery before 39 weeks is not recommended
- Universal institutional delivery is promoted and vaginal delivery is preferred; caesarian section is performed only under obstetric conditions or when estimated fetal weight is above 4 kgs (fetal macrosomia)

Postnatal care:

- All babies born to HIP mothers are evaluated for immediate neonatal hypoglycemia (NHG) within the first hour of birth and at 4-hour intervals till four stable readings of glucose values are achieved (≥45 mg/dL).
- Using a heel-prick blood sample (capillary), blood glucose values are measured using a hand-held glucometer (cut-off for NHG diagnosis: <45 mg/dL).
- In case, blood sugar falls <20 mg/dL, the infant is referred to a higher center where a pediatrician is available.
- Exclusive breastfeeding is promoted preferably by direct breastfeeding.

Postpartum care:

- The NCD program in India (NPCDCS) endorses women with HIP.
- HIP mother is counseled about postpartum follow-up testing at six weeks by 75 g OGTT (fasting and 2 h PPBS) to rule out overt DM during the postpartum phase (recommended fasting value <100 mg/dL and 2 h PPBS values <140 mg/dL).
- These are later linked to NCD clinics for regular annual follow-up screening for Type II DM following delivery at various existing platforms, namely, NCD clinic, postpartum care clinic, and pediatric setups as per programmatic protocols.

Preconception care:

- Counseling is offered to all HIP mothers to ensure desired FBS (<100 mg/dL) and 2-h PPBS levels (<140 mg/dL) before conceiving again.

Box 1.3: Roles of Primary Care Physicians and Frontline Workers in Managing HIP in Rural India [7,8]

Functions of ASHA:

- To line lists all antenatal women in the village
- To generate awareness to create demand for GDM testing in a community
- To mobilize all antenatal clients on a specific day (VHND/ANC OPD day) for testing and follow-up

Functions of ANM:

- To perform OGTT on each registered pregnant woman
- To record the results in her mother-child protection (MCP) card
- To paste red sticker onto MCP cards of all newly identified GDM-positive women
- To perform OGTT on each registered pregnant woman
- To record the results in the ANC register and mother-child protection (MCP) card, and paste red sticker onto MCP cards of all newly identified GDM women for follow-up management
- To counsel for MNT, physical activity,
- To conduct delivery of those controlled on MNT, and refer those uncontrolled on MNT and needing medical management therapy
- To prioritize home visits for left-out pregnant women for OGTT testing
- On a negative test, counsel for the second test

Functions of Primary care physician

- To counsel and perform OGTT testing; counsel for MNT, physical activity, and follow-up schedule on the same day of diagnosis
- To assess for MNT compliance on those uncontrolled on MNT
- To initiate medical therapy after ensuring adherence to MNT, and refer those uncontrolled on medical therapy/with complications to a higher center for specialist care
- To conduct delivery of those controlled on medical therapy
- To monitor the blood sugars of newborns to identify hypoglycemia, and manage it appropriately
- To encourage early breastfeeding and assess the condition of the mother before discharge.
- To counsel for postpartum family planning, and follow-up for OGTT at 6 weeks postpartum
- To maintain records, monitors, and follow-up

Today's medical undergraduates are tomorrow's primary healthcare providers. For better managerial and leadership skills, these physicians-in-training are expected to reminisce, practice, guide, and supervise subordinates about the correct execution of the above-mentioned guidelines in the community when they go out of their teaching institution for practice. Their level of commitment then will depend on how much they are aware of the issue now including the roles and responsibilities of their own and their subordinates. Awareness of a strategy comes from reading textbooks updated for Indian guidelines, attending lectures, and learning by practice. The National Medical Commission's (NMC) recent move to improvise teaching-learning strategies, introduce competency-based curricula, and exert skill assessment during the compulsory rotatory medical internship (CRMI) of medical undergraduates was welcoming. (13-15)

Thus, considering the high HIP burden in western Uttarakhand and poor utilization of related community services by its beneficiaries in 2023(4), the present cross-sectional study was designed to assess the baseline awareness levels of medical undergraduates regarding the GoI's recommended HIP management protocols studying at a private medical college in the Dehradun district (western Uttarakhand); assuming higher their knowledge better will be the successful implementation of these community guidelines in future.

It is pertinent to highlight here that the present study was planned as the part of situational analysis of HIP in Uttarakhand. In the Phase-I of Prevalence of Gestational Diabetes Mellitus in Rural Dehradun (PGDRD) project (sponsored by the Uttarakhand State Council for Science and Technology, Government of Uttarakhand), the HIP burden and gaps in the utilization of community-related services in rural Dehradun district were identified.(4) Another narrative was published that reviewed the existing gaps within the Reproductive and Child Health (RCH) program for real-time GDM operational guidelines implementation within the state.(16) A situational analysis of this kind was conducted for the first time in the land of Uttarakhand whose findings will assist policymakers in building the capacity of the RCH program in this hilly terrain of India.

MATERIAL & METHODS

Study Design and Participants

A descriptive survey was carried out by the Department of Community Medicine among medical students pursuing an undergraduate course at a private medical teaching institute in Uttarakhand (North India). In line with the NMC guidelines, the institute offers a comprehensive five-and-a-half year-long certified course to medical undergraduates: a four-and-a-half-long learning period, followed by one year of CRMI.(17) The former is subdivided into three phases: pre-clinical (Phase I) followed by para-clinical (Phase II), and lastly clinical phase (Phase III: Part I, Part II, and Electives). In all phases, the clinical exposure is essentially targeted at the primary healthcare level and includes preventive, promotive, and curative healthcare services.(17) Following the launch of competency-based curricula and mandatory skill assessment during CRMI for medical undergraduates, the revised learning format aims to make each student competent enough to diagnose and manage a disease independently in any Indian primary healthcare setting amidst the availability of basic health services. Recognized as the first medical college of Uttarakhand back in 1995, the establishment continues to provide one of its finest infrastructure and facilities, promoting excellence in learning and research.

The study population included all medical undergraduates studying in the clinical phase (Part II) and those undergoing CRMI. A purposive sampling technique was employed, wherein every subject meeting the inclusion criteria was recruited into the study. Assuming an awareness level of 50% among medical undergraduates with a 95% confidence level, 6% absolute error, and a 10% non-response rate, a minimum of 294 subjects were required

to be recruited in the present study. Data was collected offline over 13 months during 2020-22.

Study Variables and Instrument

Data was collected offline using a self-administered, semi-structured, pre-tested questionnaire that inquired about different aspects of HIP diagnostic and management protocols. Each question assessing knowledge was prepared as a multiple-choice question. To gain objectivity within the tool, every knowledge-related question in the tool was assigned a maximum score of one. Sub-scores were then allocated to individual responses such that the total score for every question remained one. Therefore, for every dichotomous variable, the correct response was scored highest as one and the wrong response lowest as zero. In every polychotomous variable where one or multiple responses were expected, individual responses were weighed and graded depending on the number of options provided and their extent of correctness. Thus, each domain had a pre-identified maximum scoring amounting to a total score of 36. Therefore, on a scale of zero to 36, individual knowledge scores so obtained were then categorized and interpreted as follows:

I. ≥24: Good awareness
II. 12-24: Moderate awareness
III. <12: Poor awareness

Domain-specific knowledge scores were also ascertained based on their half-values. Subjects with scores less than or more than equal to the half-value were identified as having poor and good knowledge, respectively. As the tool was prepared referring to the Indian guidelines (face validity), the relevance of the tool was further appraised by the common consensus of the investigators in the absence of any previous similar data (consensus validity).

Data Collection Methodology

Institutional ethical committee clearance (HIMS/RC/2022/51) was obtained before initiating the study. All procedures followed abided by the ethical standards of the committee and with the Helsinki Declaration of 1975. A complete list of presently enrolled medical students in the clinical phase (Part II) and interns was formerly retrieved from records.

On the day of the data collection, subjects reporting to the demonstration room of the study setting were identified. The subject information sheet was handed out to all study subjects and those providing written informed consent to participate were finally enrolled in the study preserving their anonymity. Subjects were then provided the tool to gather the data. In case the student denied or was absent during the session, the next student with an adjacent roll number was recruited till the desired sample was achieved.

Statistical Analysis

Data were entered and analyzed using Statistical Package for the Social Sciences, version 20.0. Results were expressed as proportions for categorical variables. Continuous data were described as mean with standard deviation (SD). The chi-square test or Fisher Exact test was used to compare the proportion in two groups. A P-value <0.05 was considered statistically significant.

RESULTS

A total of 309 medical undergraduates participated in the present study. Out of the total, more than half (50.2%; n=155) were interns while the remaining (49.8%; n=154) were students studying in the clinical phase (Part II). Their mean (±SD) age was 23.4 (±1.1) years with more than half (55.0%; n=170) being females.

Table 1 shows the baseline characteristics of the study participants. Most subjects (92.2%; n=285) reported reading Indian textbooks on Obstetrics and Community Medicine most frequently during their training period. Despite this, only 3.6% (n=11) of subjects had good overall awareness of the disease. Sub-domain analysis showed while 90.0% (n=278) of the respondents had a fair understanding of the disease basics, more than two-thirds lagged in recollecting its standard diagnostic and management protocols including the role of health workers.

Table 1: Baseline Characteristics of Study Participants (N=309)

Variables	Medical Students (N=154); n (%)	Interns (N=155);n (%)	Total (N=309);n (%)	χ2; P-value
Gender				
Male	72 (46.8)	67 (43.2)	139 (45.0)	0.4; 0.533
Female	82 (53.2)	88 (56.8)	170 (55.0)	
Age (in years)				
<25	141 (91.6)	131 (84.5)	272 (88.0)	3.6; 0.057
≥25	13 (8.4)	24 (15.5)	37 (12.0)	
Books referred to during training				
Indian undergraduate textbooks	146 (94.8)	139 (89.7)	285 (92.2)	3.8*; 0.139
Indian post-graduation preparatory notes	5 (3.3)	13 (8.4)	18 (5.9)	
International textbooks	3 (1.9)	3 (1.9)	6 (1.9)	
Awareness level				
Overall				
Poor (<12)	26 (16.9)	23 (14.8)	49 (15.9)	2.8; 0.249
Moderate (12-24)	120 (77.9)	129 (83.2)	249 (80.6)	
Good (≥24)	8 (5.2)	3 (1.9)	11 (3.6)	
Sub-domain specific				
Basic understanding of the disease				
Poor (<4)	20 (13.0)	11 (17.1)	31 (10.0)	3.0; 0.085
Good (≥4)	134 (87.0)	144 (92.9)	278 (90.0)	
Diagnostic protocols				
Poor (<7.5)	108 (71.1)	124 (80.0)	232 (75.1)	4.0; 0.045
Good (≥7.5)	46 (29.9)	31 (20.0)	77 (24.9)	
Disease management guidelines including the role of community health workers				
Poor (<6.5)	109 (70.8)	101 (65.2)	210 (68.0)	1.12; 0.29
Good (≥6.5)	45 (29.2)	54 (34.8)	99 (32.0)	

*Abbreviations: MBBS: Bachelor of Medicine and Bachelor of Surgery (an undergraduate medical training course in India); *Fischer Exact Test*

Basic Medical Knowledge regarding the Disease

As seen in Table 1, 90.0% (n=278) of the respondents understood the disease basics fairly. Table 2 further reflects that at least eight out of every 10 subjects had known that GDM is a public health problem in India (P-value=0.02). At least six out of every 10 subjects had recognized that GDM manifests as impaired glucose tolerance with onset/first recognition during pregnancy only (P-value=0.004). However, only around one-fourth of the subjects were aware that GDM commonly manifests during the second trimester and beyond (P-value=0.003).

Not many were aware of the related complications; out of all, the most frequent complication recalled was macrosomia (P-value=<0.001). Remaining less than one-fourth of the subjects could recall only a few immediate maternal and neonatal complications; the most frequent being congenital malformations (24.6%; n=76). Only a few subjects could recall caesarian delivery, prolonged labor, placental abnormalities, hyperinsulinemia, hyperbilirubinemia, and polycythemia (<2%).

Awareness about Diagnostic Protocols for Hyperglycemia in Pregnancy

As seen in Table 1, three-fourths of the subjects lagged in recollecting disease standard diagnostic protocols (P-value=0.045). Table 3 further illustrates that nearly three-fourths of subjects were aware that 2-h 75 g OGTT is a diagnostic test of choice in India. Around two-thirds had a realization that a prior fasting state is not mandatory for OGTT. About half of the subjects could identify the Diabetes in Pregnancy Study Group of India (DIPSI)

criterion for diagnosis (P-value<0.001), with repeat testing at four weeks following a negative test.

However, only one-third of the subjects had known that the diagnostic test should be universally employed at their very first antenatal contact; the cut-off blood glucose value used for diagnosis is 140 mg/dL (P-value<0.001), without any prior screening (p=0.006). Only one-fourth of subjects knew only a single blood sample (P-value<0.001), preferably capillary (P-value=0.002) is required.

Knowledge of HIP Management Protocols in Primary Healthcare Settings in India

As seen in Table 1, more than two-fourths of the subjects lagged in recollecting the disease standard management protocols including the role of community health workers; Tables 3 and 4 further illustrate the related details.

Antepartum

Nearly two-thirds of the subjects were aware that HIP management involves both medical nutrition therapy and physical activity (P-value=0.009), and requires ultrasonography thrice at different trimesters (P-value=0.005). However, less than half of the respondents knew that metformin and insulin are the accepted drugs for medical management. Less than one-third of the subjects could only identify that both FBS and 2-h PPBS tests are needed for blood glucose monitoring and dose adjustment during follow-up (Table 3).

Intrapartum

Less than two-thirds of subjects were aware that institutional vaginal delivery not before 39 weeks is recommended only in the absence of other perinatal complications (p<0.001) (Table 3).

Postpartum

Less than half of the subjects were aware of mandatory postpartum follow-up OGTT testing at 6 weeks; for which a prior fasting state is required (P-value<0.001). One-fourth of the subjects knew that these mothers were later linked to NCD clinics (P-value=0.102); for annual screening of Type DM by World Health Organization criteria (P-value=0.004) (Table 3).

Table 2: Basic Understanding of Study Subjects on Hyperglycemia in Pregnancy (N=309)

Variables	Medical Students (N=154); n (%)	Interns (N=155);n (%)	Total (N=309);n (%)	χ2; P-value
GDM – a public health problem	116 (75.3)	133 (85.8)	249 (80.6)	5.4; 0.02
Operationally, GDM an IGT	102 (66.2)	106 (68.4)	208 (67.3)	0.2; 0.687
Onset/ first recognition only during pregnancy	104 (67.5)	127 (81.9)	231 (74.8)	8.5; 0.004
Occurs anytime beyond 2nd trimester onwards	56 (36.4)	33 (21.3)	89 (28.8)	8.6; 0.003
Affects both the mother & fetus	141 (91.6)	139 (89.7)	280 (90.6)	0.3; 0.571
Complications				
Immediate – Maternal				
Polyhydramnios	30 (19.5)	26 (16.8)	56 (18.1)	0.4; 0.537
Pre-term delivery	29 (18.8)	24 (15.5)	53 (17.2)	0.61; 0.435
Hypertensive disorders	25 (16.2)	15 (9.7)	40 (12.9)	2.9; 0.086
Intra-uterine growth restriction	17 (11.0)	18 (11.6)	35 (11.3)	0.03; 0.874
Intra-uterine death	10 (6.5)	22 (14.2)	32 (10.4)	4.9; 0.026
Still-birth	17 (11.0)	11 (7.1)	28 (9.1)	1.5; 0.227
Postpartum hemorrhage	11 (7.1)	16 (10.3)	27 (8.7)	1.0; 0.322
Abortion	6 (3.9)	10 (6.5)	16 (5.2)	1.0; 0.311
Antepartum hemorrhage	4 (2.6)	7 (4.5)	11 (3.6)	0.8; 0.363
Immediate – Neonatal				
Macrosomia	122 (79.2)	94 (60.6)	216 (69.9)	12.7; <0.001
Congenital malformations	32 (20.8)	44 (28.4)	76 (24.6)	2.4; 0.12
Shoulder dystocia	51 (33.1)	22 (14.2)	73 (23.6)	15.3; <0.001
Neonatal hypoglycemia	24 (15.6)	39 (25.2)	63 (20.4)	4.4; 0.037
Respiratory distress syndrome	24 (15.6)	17 (11.0)	41 (13.3)	1.4; 0.232

Long-term				
Overt DM	12 (7.8)	34 (21.9)	46 (14.9)	12.2; <0.001
Complications of Overt DM	11 (7.1)	26 (16.8)	37 (12.0)	6.8; 0.009
Obesity	1 (0.6)	11 (7.1)	12 (3.9)	8.6; 0.003
Hypertension	1 (0.6)	7 (4.5)	8 (2.6)	4.6; 0.032

Abbreviations: DM: Diabetes Mellitus; GDM: Gestational Diabetes Mellitus; IGT: Impaired Glucose Tolerance

Table 3: Knowledge of Diagnostic and Management Guidelines for Hyperglycemia in Pregnancy in Primary Healthcare Settings of India (N=309)

Variables	Medical Students (N=154); n (%)	Interns (N=155); n (%)	Total (N=309); n (%)	χ2; P-value
Diagnosis				
Diagnostic test – 2 h 75g OGTT	117 (76.0)	124 (80.0)	241 (78.0)	0.7; 0.393
Test executed at the earliest/first antenatal contact	53 (34.4)	54 (34.8)	107 (34.6)	0.006; 0.938
Only one blood sample required	54 (35.1)	27 (17.4)	81 (26.2)	12.4; <0.001
Capillary blood sample preferred	19 (12.3)	41 (26.5)	60 (19.4)	9.8; 0.002
Cut-off blood glucose value – 140 mg/dL	79 (51.3)	38 (24.5)	117 (37.9)	23.6; <0.001
Diagnostic criterion – DIPSI	100 (64.9)	69 (44.5)	169 (54.7)	13.0; <0.001
Fasting state not required	108 (70.1)	103 (66.5)	211 (68.3)	0.5; 0.487
2-step screening not needed	70 (45.5)	47 (30.3)	117 (37.9)	7.5; 0.006
Repeat testing after 4 weeks of negative test	82 (53.2)	67 (43.2)	149 (48.2)	3.1; 0.078
Management				
Antepartum Care				
Initial management – both MNT & Physical Activity	96 (62.3)	118 (76.1)	214 (69.3)	6.9; 0.009
Medical therapy – both Metformin and insulin	83 (53.9)	71 (45.8)	154 (49.8)	2.0; 0.155
Follow-up glucose monitoring – both FBS & 2 h PPBS	51 (33.1)	50 (32.3)	101 (32.7)	0.03; 0.872
Ultrasonography – thrice for GDM woman	81 (52.6)	106 (68.4)	187 (60.5)	8.1; 0.005
Intrapartum care				
Institutional vaginal delivery not before 39 weeks	108 (70.1)	78 (50.3)	186 (60.2)	12.6; <0.001
Postpartum Care (to rule out overt DM)				
First follow-up testing (6 weeks post-partum)	88 (57.1)	83 (53.5)	171 (55.3)	0.4; 0.525
2 h 75 g OGTT in the fasting state	4 (2.6)	22 (14.2)	26 (8.4)	13.5; <0.001
Mandatory prior fasting	66 (42.9)	61 (39.4)	127 (41.1)	0.4; 0.532
Diagnostic criterion – WHO	50 (32.5)	28 (18.1)	78 (25.2)	8.5; 0.004
Annual Screening for women linked to NCD clinics after post-partum follow-up testing	35 (22.7)	48 (31.0)	83 (26.9)	2.7; 0.102
Postnatal Care (to diagnose NHG)				
Type of blood sample – Capillary	40 (26.0)	51 (32.9)	91 (29.4)	1.8; 0.182
Minimum number of stable glucose readings – four	3 (1.9)	5 (3.2)	8 (2.6)	0.5; 0.5
Cut-off blood glucose value – 45 mg/dL	13 (8.4)	13 (8.4)	26 (8.4)	0.0; 0.986
Referral blood glucose value for extreme NHG – 20 mg/dL	2 (1.3)	5 (3.2)	7 (2.3)	1.3; 0.255
Exclusive (and direct) breastfeeding – protective role	80 (51.9)	101 (65.2)	181 (58.6)	5.6; 0.018
Pre-conception Care				
Desired FBG level – 100 mg/dL	9 (5.8)	23 (14.8)	32 (10.4)	6.7; 0.009
Desired PPBG level – 140 mg/dL	36 (23.4)	17 (11.0)	53 (17.2)	8.4; 0.004

Abbreviations: DIPSI: Diabetes in Pregnancy Study Group India; DM: Diabetes Mellitus; FBG: Fasting Blood Glucose; MNT: Medical Nutrition Therapy; NHG: Neonatal Hypoglycaemia; OGTT: Oral Glucose Tolerance Test; PPBG: Post Prandial Blood Glucose; WHO: World Health Organization

Postnatal

One-fourth of the subjects knew that capillary blood samples were needed to diagnose NHG. However, a mere eight subjects were aware that a minimum of four stable glucose readings are needed to diagnose NHG; the cut-off blood

glucose value for diagnosing NHG was known to be 8.4% (n=26) of subjects, though the blood glucose value limit of extreme NHG for immediate referral to a higher center was known to only seven subjects (Table 3).

Preconception

Most subjects had very poor or minimal knowledge about it. Only around 10% of the subjects were aware of the correct desired fasting and postprandial blood sugar levels before conception (Table 3).

Roles and Responsibilities of Community Healthcare Workers

As seen in Table 4, only around half of the subjects were aware of the roles and responsibilities of the MO, ASHA, and ANM.

Table 4: Awareness of Roles and Responsibilities of Frontline Health Workers in Disease Management (N=309)

Variables	Medical Students (N=154); n (%)	Interns (N=155); n (%)	Total (N=309); n (%)	χ2; P-value
ASHA				
GDM awareness generation	72 (46.8)	94 (60.6)	166 (53.7)	6.0; 0.014
Line listing of pregnant women	75 (48.7)	80 (51.6)	155 (50.2)	0.3; 0.609
Mobilization of antenatal clients on VHND/ ANC OPD day for testing & follow-up	82 (53.2)	69 (44.5)	151 (48.9)	2.4; 0.125
ANM				
Perform OGTT, identify GDM women, & record results in MCP card, ANC & Follow-up register	84 (54.5)	64 (41.3)	148 (47.9)	5.4; 0.02
Counsel for MNT, physical activity, & follow-up schedule for GDM women	76 (49.4)	60 (38.7)	136 (44.0)	3.6; 0.06
Refer those needing medical management therapy	65 (42.2)	57 (36.8)	122 (39.5)	1.0; 0.329
Prioritize home visits for left-out women	66 (42.9)	42 (27.1)	108 (35.0)	8.4; 0.004
Counsel for 2nd test, if negative	51 (33.1)	36 (23.2)	87 (28.2)	3.7; 0.053
Conducts delivery for those controlled on MNT	46 (29.9)	43 (27.7)	89 (28.8)	0.2; 0.680
Medical Officer				
Counsel & performs OGTT	76 (49.4)	76 (49.0)	152 (49.2)	0.003; 0.955
Counsel for MNT, physical activity, & follow-up schedule for GDM women	86 (55.8)	66 (42.6)	152 (49.2)	5.4; 0.020
Initiate medical therapy, if required, after assessing MNT compliance	94 (61.0)	90 (58.1)	184 (59.5)	0.3; 0.594
Conducts delivery for those well-controlled on medical therapy	90 (58.4)	76 (49.0)	166 (53.7)	2.8; 0.097
Counsel for family planning & OGTT at 6 weeks postpartum	76 (49.4)	88 (56.8)	164 (53.1)	1.7; 0.191
Encourage early breastfeeding & assess maternal condition before discharge	88 (57.1)	84 (54.2)	172 (55.7)	0.3; 0.602
Monitor neonatal blood sugars to identify NHG & manage appropriately	86 (55.8)	68 (43.9)	154 (49.8)	4.4; 0.035
Refer those uncontrolled on medical therapy/ with complications	73 (47.4)	72 (46.5)	145 (46.9)	0.03; 0.867
Maintains records, monitors & follow-up	61 (39.6)	54 (34.8)	115 (37.2)	0.8; 0.386

Abbreviations: ANC: Ante-natal care; GDM: Gestational Diabetes Mellitus; MCP: Mother-child protection MNT: Medical Nutrition Therapy; NHG: Neonatal Hypoglycaemia; OGTT: Oral Glucose Tolerance Test; VHND: Village health and nutrition day

DISCUSSION

The present study assessing the baseline awareness levels of medical undergraduates on HIP management was pertinent in the context of national protocols especially when GDM is adding fuel to the DM epidemic, with

existing literature suggesting overall poor knowledge among healthcare professionals.
Sub-nominal awareness of GDM was comparable to the findings of other studies carried out in Chennai (Tamil Nadu) (9), Kharagpur (West Bengal) (10), and Hooghly district (West Bengal) (11). These findings were, however, in sharp contrast to other cross-sectional studies conducted in Kanchipuram (Tamil Nadu) (18), and Belagavi (Karnataka) (19) wherein the results showed the majority had good-to-average knowledge.
Studies conducted by Halder et al. (11) and Prabhu et al. (18) showed, in line with the present study findings, that only less than half of the subjects were aware that Type II DM can de novo manifest as GDM during pregnancy. However, only a few (17.9%) subjects in Halder et al. study (11) could recall that GDM disappears following the delivery.

In the present study, not many were aware of the related complications. Compared to the present study, fewer subjects in Halder et al. study (11) were aware of the complications. In the Prabhu et al. (2021) study (18), slightly higher proportions of the subjects knew about the complications including future DM risk in both mother-offspring duets; their major information sources were family members and friends. In the Bhavadharini et al. study (9), Type II DM among adolescents was the most commonly reported long-term consequence.
Comparable to the present study findings, more than 70% of the subjects in the Prabhu et al. (18) study said screening is done during the fasting status; they were aware of the universal screening methodology, and the available treatment modalities if positive. Even the healthcare workers in Ghosha et al. (10) study exhibited average and inconsistent knowledge of the timing of testing. More than 70% recommended high-risk pregnant women undergo testing only.(10) There was an evident knowledge gap in the GDM surveillance, where only 22% of respondents could identify OGTT as the confirmatory test while most (70%) agreed that daily blood glucose level surveillance served as the best monitoring method.(10) In the Bhavidharini et al. (9) study, high proportions of the subjects believed in antenatal GDM screening; though compared to urban areas, most rural women were not aware of screening during the first trimester.

In contrast to the present findings, a high proportion of subjects in the Halder et al. (11) study found that 73.8% knew about universal screening, and 41% were aware of the blood test. However, the protective benefits of breastfeeding against future Type II DM risk were known to less than one-fourth of the subjects only. Also, knowledge regarding its treatment was sub-nominal as seen in the present study.(11) In 2021, another cross-sectional study conducted in a tertiary hospital in Tamil Nadu showed more than half of the pregnant women accepted universal GDM screening; subjects reported acquiring knowledge from friends, medical professionals, family, and neighbors. (20)

Post the launch of competency-based curricula for Indian medical undergraduates (IMUGs) in 2018(13), the NMC visualized that the IMUGs would be able to provide holistic care to their patients by enunciating the competencies learned during their training program. While the initiative was revolutionizing in integrating different disciplines both horizontally and vertically, the focus was primarily on improvising teaching-learning strategies. Textbooks that make up a major part of students' learning were largely ignored. In the present study, while most subjects had been reading Indian textbooks during their training period, the majority had poor-to-moderate information. More than two-thirds lagged in recollecting its standard diagnostic and management protocols including the role of health workers.

Today, despite GDM being part of RCH since 2018, barely any Indian textbook of Community Medicine(21) or even Obstetrics(22) for UGs talks explicitly about it. In addition, standard textbooks that are commonly recommended for undergraduate teaching to qualify in internal university and even nation-level postgraduate entrance exams are mostly authored by international writers highlighting guidelines validated for

non-Asian populations. In such a scenario, how can every Indian medical undergraduate be expected to be well-versed with its indigenous guidelines if the textbooks referred to are not up-to-date meeting the country's needs? The present practice is a matter of grave concern needing attention especially when NMC is aiming to provide high-quality medical professionals pan-India encouraging community health perspective and making their services accessible to all citizens.

Conclusion

The present study showed most medical undergraduates (primary care physicians-in-training) have overall poor-to-moderate awareness of HIP management especially its standard diagnostic and management protocols including the role of health workers.

Limitations

The study has limitations, the most significant being that the authors could ascertain awareness only in the cognitive domain; their psychomotor skills could neither be assessed nor measured.

Recommendations

Interns posted in the study setting were trained in performing 2-h 75 g OGTT on pregnant women, taking capillary blood samples using a hand-held plasma-calibrated glucometer, and identifying HIP women using DIPSI criteria. Making the students/ interns learn by doing will help them master the principles and apply them at every opportunity in the future. Besides, for long-lasting results, medical education must evolve towards developing curricula that mandate medical undergraduates (who wish to practice or pursue higher education within the country) to refer only to those textbooks that are updated to the latest national guidelines already validated for the Indian population. Country-level postgraduate entrance exams including university exams must also assess whether medical undergraduates have a grip on these community guidelines before qualifying them for future practice or higher education. Following implementation, these potential interventions must be tested using relevant research methodology techniques. This evolution will not only expose Indian medical undergraduates to the latest country guidelines right at their desks but will also avoid an overload of information and unnecessary confusion with non-Asian guidelines, reduce the bulk of medical books, and prepare them better to practice in community settings.

Authors Contribution

All authors have contributed equally.

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Conflict of Interest

There are no conflicts of interest.

Declaration of generative AI and AI assisted technologies in the writing process

During the preparation of this work, the authors did not use any AI tool/ service.

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