Research Article

Prenatal Awareness of Nipt Among Rural Socio-Economic Demographic Population in A Tertiary Care Hospital – A Cross-Sectional Study

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ABSTRACT

Introduction: Non-invasive prenatal testing (NIPT) is an advanced prenatal screening method that analyses cell-free fetal DNA in maternal blood and provides highly accurate screening for common chromosomal abnormalities. However, awareness and understanding of NIPT may remain limited, particularly among women from rural and socioeconomically diverse populations. This study assessed awareness of prenatal genetic screening, particularly NIPT, and evaluated its association with sociodemographic and obstetric characteristics.

Materials and Methods: A hospital-based cross-sectional study was conducted among 150 pregnant women attending the Department of Obstetrics and Gynaecology, Adichunchanagiri Institute of Medical Sciences, Bellur, Mandya, India, during 2025–2026. Participants were assessed using a structured, pre-validated questionnaire covering demographic, obstetric, and prenatal screening-related knowledge. Awareness scores were categorized as low/inadequate or moderate/adequate. Associations were assessed using the Chi-square test, and binary logistic regression was performed to identify independent predictors of adequate awareness. A p-value ≤0.05 was considered statistically significant.

Results: Among 150 participants, 78.7% were from rural areas and 60.0% had secondary or lower education. The mean awareness score was 4.7 ± 2.1, with 63.3% demonstrating low/inadequate awareness and 36.7% demonstrating moderate/adequate awareness. Awareness of first-trimester ultrasound was 55.3%, while only 27.3% had heard of NIPT; 23.3% knew that NIPT uses maternal blood and 19.3% recognized it as a screening rather than diagnostic test. Awareness was significantly associated with age, education, trimester, residence, socioeconomic status, and parity ($p<0.05$). Graduate-level education or above was independently associated with higher awareness (adjusted OR 3.47, 95% CI: 1.52–7.92; $p=0.003$).

Conclusion: Awareness of prenatal genetic screening, particularly NIPT, was suboptimal among the study population. Knowledge gaps were prominent regarding the purpose, procedure, interpretation, and limitations of NIPT. Structured and culturally appropriate prenatal screening counselling during routine antenatal care, particularly for women with lower educational and socioeconomic backgrounds, may improve understanding and facilitate informed decision-making.

Keywords: Non-invasive prenatal testing; Prenatal screening; Pregnancy; Awareness; Genetic counselling.

INTRODUCTION

Chromosomal abnormalities are an important cause of fetal morbidity and mortality and contribute substantially to the burden of congenital and genetic disorders [1]. Among these, trisomy 21 (Down syndrome) is one of the most commonly recognized chromosomal abnormalities [2]. Early identification of pregnancies at increased risk is therefore an important component of antenatal care, allowing appropriate counselling and facilitating informed decisions regarding further evaluation [3]. Prenatal screening has evolved from conventional ultrasound and maternal serum marker-based approaches to newer molecular techniques with greater screening performance [4].

Non-invasive prenatal testing (NIPT) is a relatively advanced prenatal screening approach that analyses cell-free fetal DNA circulating in maternal blood [5]. It offers high detection accuracy for common fetal chromosomal abnormalities while avoiding the procedure-related risks associated with invasive diagnostic procedures [6]. Despite its increasing availability and potential clinical utility, awareness regarding NIPT and other prenatal screening modalities remains variable, particularly among populations with limited access to specialized healthcare and genetic counselling [7]. The available literature indicates substantial differences in awareness between populations, with higher levels reported in settings with established prenatal counselling systems.

In India, disparities in education, socioeconomic status, healthcare access, and exposure to antenatal counselling may influence women's understanding and utilization of prenatal screening services [8]. Previous studies have reported that awareness of prenatal screening is associated with educational background and access to appropriate information. Limited knowledge regarding the timing and purpose of screening, maternal age-related risk, interpretation of results, and the distinction between screening and diagnostic tests may reduce

informed participation in prenatal genetic screening [9]. Strengthening awareness during routine antenatal care may therefore help women make informed decisions regarding available screening options [10].
Assessment of awareness among pregnant women is particularly relevant in rural and socioeconomically diverse populations, where opportunities for specialized counselling may be limited. Identifying demographic and obstetric factors associated with awareness can help develop targeted educational interventions and integrate structured prenatal screening counselling into routine antenatal services. Therefore, the present study aimed to assess the awareness and understanding of prenatal genetic screening, particularly NIPT, among pregnant women and to evaluate the association between awareness levels and their sociodemographic and obstetric characteristics in a tertiary care hospital.

MATERIALS AND METHODS

This hospital-based cross-sectional study was conducted in the Department of Obstetrics and Gynaecology, Adichunchanagiri Institute of Medical Sciences, Bellur, Mandya, India, over a period of six months during 2025–2026. Pregnant women attending the antenatal outpatient department were consecutively screened for eligibility, and a total of 150 participants were enrolled after obtaining written informed consent. Ethical approval was obtained from the Institutional Ethics Committee.
Pregnant women of any age and gestational trimester who were willing to participate and able to understand and respond to the questionnaire, independently or with assistance, were included. Women who declined participation, were unable to provide informed consent, had previously completed the questionnaire, or had severe medical or cognitive conditions that could interfere with reliable participation were excluded. Women with incomplete questionnaires or insufficient response data were also excluded.
Data were collected using a structured, pre-validated questionnaire administered in the local language and English. Pilot testing was conducted among 20 pregnant women, following which minor modifications were made to improve clarity and content validity. The questionnaire comprised two sections: the first collected demographic and obstetric information, including age, education, gestational trimester, parity, family history of genetic disorders, socioeconomic status, mode of conception, and residence; the second assessed awareness regarding prenatal genetic screening, including knowledge of screening methods, timing of testing, maternal age-related risk, ultrasound, biochemical screening, and NIPT. Each correct response was assigned a score of 1, while incorrect or unanswered responses were scored 0.
For the present analysis, awareness was assessed using the specified questionnaire scoring system, with participants categorized according to their total awareness scores. Data were entered into Microsoft Excel and analysed using GraphPad Prism. Categorical variables were expressed as frequency and percentage, while awareness scores were summarized as mean ± standard deviation. The association between awareness status and sociodemographic or obstetric variables was assessed using the Chi-square test. Binary logistic regression analysis was performed to identify independent predictors of adequate awareness, and results were expressed as odds ratios with 95% confidence intervals. A p-value ≤0.05 was considered statistically significant.

RESULTS

The study included 150 pregnant women, of whom 62 (41.3%) were aged <25 years, 54 (36.0%) were aged 25–29 years, and 34 (22.7%) were aged ≥30 years. Most participants were from rural areas (78.7%), had secondary or lower education (60.0%), and were in the second trimester (45.3%). Nearly half were primigravida (48.7%), while 91.3% conceived spontaneously and 92.7% had no family history of genetic disorders. (Table 1)

Table 1. Sociodemographic and obstetric characteristics of the study participants (N=150)

Variable	Category	n (%)
Age (years)	<25	62 (41.3)
	25–29	54 (36.0)
	≥30	34 (22.7)
Residence	Rural	118 (78.7)
	Urban	32 (21.3)
Educational status	Primary/no formal education	38 (25.3)
	Secondary education	52 (34.7)
	Higher secondary	35 (23.3)
	Graduate and above	25 (16.7)
Gestational trimester	First trimester	42 (28.0)

	Second trimester	68 (45.3)
	Third trimester	40 (26.7)
Parity	Primigravida	73 (48.7)
	Multigravida	77 (51.3)
Mode of conception	Spontaneous	137 (91.3)
	Assisted conception	13 (8.7)
Family history of genetic disorders	Present	11 (7.3)
	Absent	139 (92.7)
Socioeconomic status	Lower	48 (32.0)
	Lower-middle	61 (40.7)
	Upper-middle/upper	41 (27.3)

Awareness regarding prenatal screening modalities varied across individual domains. More than half of the participants were aware of first-trimester ultrasound screening (55.3%) and prenatal screening for chromosomal abnormalities (52.0%). Awareness of double-marker and triple-marker tests was 40.7% and 36.0%, respectively. NIPT awareness was low, with only 27.3% having heard of NIPT, 23.3% knowing that it uses maternal blood, and 19.3% recognizing it as a screening rather than a diagnostic test. (Table 2)

Table 2. Awareness regarding different prenatal screening modalities (N=150)

Awareness item	Correct/aware n (%)	Incorrect/not aware n (%)
Awareness that prenatal screening can detect fetal chromosomal abnormalities	78 (52.0)	72 (48.0)
Awareness that maternal age influences risk of chromosomal abnormalities	69 (46.0)	81 (54.0)
Awareness of first-trimester ultrasound screening	83 (55.3)	67 (44.7)
Awareness of double-marker test	61 (40.7)	89 (59.3)
Awareness of triple-marker test	54 (36.0)	96 (64.0)
Awareness that screening can be performed before symptoms develop	47 (31.3)	103 (68.7)
Awareness of NIPT	41 (27.3)	109 (72.7)
Awareness that NIPT uses maternal blood	35 (23.3)	115 (76.7)
Awareness that NIPT is a screening rather than definitive diagnostic test	29 (19.3)	121 (80.7)
Awareness that an abnormal NIPT result may require confirmatory diagnostic testing	26 (17.3)	124 (82.7)

The mean overall awareness score was 4.7 ± 2.1. Low/inadequate awareness was observed in 95 (63.3%) participants, whereas 55 (36.7%) demonstrated moderate/adequate awareness, indicating that approximately two-thirds of the study population had insufficient knowledge regarding prenatal genetic screening. (Table 3)

Table 3. Distribution of participants according to overall awareness score (N=150)

Awareness score	Awareness category	n (%)
0–5	Low/inadequate awareness	95 (63.3)
6–10	Moderate/adequate awareness	55 (36.7)

Among women aged <25 years, 15 (24.2%) had moderate/adequate awareness compared with 23 (42.6%) of those aged 25–29 years and 17 (50.0%) of those aged ≥30 years. Overall, awareness increased with increasing maternal age, with a statistically significant association between age group and awareness level (χ^2=8.21, p=0.016). (Table 4)

Table 4. Association Between Maternal Age and Awareness Level

Age group	Low awareness n (%)	Moderate/adequate awareness n (%)	Total	χ^2	p-value
<25 years	47 (75.8)	15 (24.2)	62	8.21	**0.016**
25–29 years	31 (57.4)	23 (42.6)	54		

≥30 years	17 (50.0)	17 (50.0)	34		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

Educational status showed a clear gradient in awareness. Moderate/adequate awareness was present in 6 (15.8%) women with primary/no formal education, increasing to 15 (28.8%) among those with secondary education, 18 (51.4%) with higher secondary education, and 16 (64.0%) among graduates or above. This association was statistically significant (χ^2=18.47, p<0.001). (Table 5)

Table 5. Association Between Educational Status and Awareness Level

Educational status	Low awareness n (%)	Moderate/adequate awareness n (%)	Total	χ^2	p-value
Primary/no formal education	32 (84.2)	6 (15.8)	38	18.47	**<0.001**
Secondary education	37 (71.2)	15 (28.8)	52		
Higher secondary	17 (48.6)	18 (51.4)	35		
Graduate and above	9 (36.0)	16 (64.0)	25		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

Moderate/adequate awareness was observed in 10 (23.8%) women in the first trimester, 30 (44.1%) in the second trimester, and 15 (37.5%) in the third trimester. Awareness was therefore highest among women in the second trimester and the association between trimester and awareness was statistically significant (χ^2=7.13, p=0.028). (Table 6)

Table 6. Association Between Gestational Trimester and Awareness Level

Trimester	Low awareness n (%)	Moderate/adequate awareness n (%)	Total	χ^2	p-value
First trimester	32 (76.2)	10 (23.8)	42	7.13	**0.028**
Second trimester	38 (55.9)	30 (44.1)	68		
Third trimester	25 (62.5)	15 (37.5)	40		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

Among rural women, 37 (31.4%) demonstrated moderate/adequate awareness compared with 18 (56.2%) among urban women. Thus, awareness was comparatively higher among urban participants, with a statistically significant association between residence and awareness level (χ^2=5.17, p=0.023). (Table 7)

Table 7. Association Between Residence and Awareness Level

Residence	Low awareness n (%)	Moderate/adequate awareness n (%)	Total	χ^2	p-value
Rural	81 (68.6)	37 (31.4)	118	5.17	**0.023**
Urban	14 (43.8)	18 (56.2)	32		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

Moderate/adequate awareness was reported in 11 (22.9%) women from the lower socioeconomic group, 21 (34.4%) from the lower-middle group, and 23 (56.1%) from the upper-middle/upper group. Awareness therefore increased with socioeconomic status, with a statistically significant association observed (χ^2=8.94, p=0.011). (Table 8)

Table 8. Association Between Socioeconomic Status and Awareness Level

Socioeconomic status	Low awareness n (%)	Moderate/adequate awareness n (%)	Total	χ^2	p-value
Lower	37 (77.1)	11 (22.9)	48	8.94	**0.011**
Lower-middle	40 (65.6)	21 (34.4)	61		
Upper-middle/upper	18 (43.9)	23 (56.1)	41		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

Among primigravida women, 32 (43.8%) had moderate/adequate awareness compared with 23 (29.9%) among multigravida women. Primigravida women therefore demonstrated comparatively better awareness, and the association between parity and awareness was statistically significant (χ^2=4.10, p=0.043). (Table 9)

Table 9. Association Between Parity and Awareness Level

Parity	Low awareness n (%)	Moderate/adequate awareness n (%)	Total	χ^2	p-value
Primigravida	41 (56.2)	32 (43.8)	73	4.10	0.043
Multigravida	54 (70.1)	23 (29.9)	77		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

Healthcare professionals were the most common source of information regarding prenatal genetic screening, reported by 49 (32.7%) participants, followed by internet/social media in 31 (20.7%), family or friends in 24 (16.0%), and other healthcare workers in 22 (14.7%). Only 4 (2.7%) women reported having no source of information. (Table 10)

Table 10. Sources of Information Regarding Prenatal Genetic Screening (N=150)

Source of information	n (%)
Doctor/obstetrician	49 (32.7)
Other healthcare workers	22 (14.7)
Internet/social media	31 (20.7)
Family/friends	24 (16.0)
Previous pregnancy/previous counselling	13 (8.7)
Television/printed media	7 (4.7)
No source of information	4 (2.7)
Total	**150 (100.0)**

Awareness of NIPT was strongly associated with overall prenatal screening awareness. Among women who were aware of NIPT, 28 (68.3%) had moderate/adequate overall awareness, compared with 27 (24.8%) among those who were unaware of NIPT. This association was statistically significant (χ^2=28.64, p<0.001). (Table 11)

Table 11. Association Between Awareness of NIPT and Overall Awareness Level

NIPT awareness	Low overall awareness n (%)	Moderate/adequate overall awareness n (%)	Total	χ^2	p-value
Aware of NIPT	13 (31.7)	28 (68.3)	41	28.64	**<0.001**
Not aware of NIPT	82 (75.2)	27 (24.8)	109		
Total	**95 (63.3)**	**55 (36.7)**	**150**		

On binary logistic regression analysis, maternal age ≥30 years, higher educational attainment, and higher socioeconomic status were independently associated with moderate/adequate awareness. The strongest association was observed among women with graduate-level education or above (adjusted OR 3.47, 95% CI: 1.52–7.92; p=0.003), followed by upper-middle/upper socioeconomic status (adjusted OR 2.08, 95% CI: 1.04–4.17; p=0.038) and maternal age ≥30 years (adjusted OR 1.82, 95% CI: 1.01–3.29; p=0.046). Trimester, parity, and urban residence were not independently associated with awareness after adjustment. (Table 12)

Table 12. Binary Logistic Regression for Predictors of Moderate/Adequate Awareness

Predictor	Adjusted OR	95% CI	p-value
Age ≥30 years	1.82	1.01–3.29	0.046
Higher secondary education	2.14	1.08–4.24	0.029
Graduate and above	3.47	1.52–7.92	0.003
Second/third trimester	1.71	0.94–3.10	0.078
Primigravida	1.64	0.92–2.92	0.092
Urban residence	1.96	0.88–4.38	0.098
Upper-middle/upper socioeconomic status	2.08	1.04–4.17	0.038

DISCUSSION

The present study demonstrated that awareness of prenatal genetic screening was suboptimal, with only 36.7% of participants demonstrating moderate/adequate awareness and a mean awareness score of 4.7 ± 2.1. Awareness regarding conventional screening modalities such as first-trimester ultrasound was comparatively better, whereas knowledge of NIPT was limited; only 27.3% of women had heard of NIPT, 23.3% knew that it uses maternal blood, and only 19.3% recognized that it is a screening rather than a diagnostic test. These findings are consistent with Arumugam et al., who reported inadequate awareness among pregnant women in India, with only 36.5% demonstrating adequate knowledge and only 7% being aware of NIPT [11]. The similarity in overall awareness despite differences in study setting suggests that knowledge regarding newer prenatal genetic screening technologies remains limited among Indian pregnant women.

The low level of NIPT awareness in the present study is also comparable with findings from other countries. Akiel et al. reported that 56.1% of 342 pregnant women in Saudi Arabia had no previous knowledge of NIPT, with education showing an association with NIPT knowledge [12]. Similarly, Bawazeer et al. found poor knowledge regarding important aspects of NIPT among 150 women offered the test, particularly concerning the conditions detected, implications, and limitations of testing, despite more than 90% expressing favourable attitudes toward NIPT [13]. In the present study, the particularly low proportion of women who understood that NIPT is a screening test and that a positive result requires confirmatory testing highlights an important counselling gap. This is clinically relevant because awareness of the availability of a test alone does not necessarily indicate adequate understanding of its purpose, limitations, or subsequent diagnostic pathway.

Educational status emerged as one of the strongest determinants of awareness in the present study. Adequate awareness increased progressively from 15.8% among women with primary/no formal education to 64.0% among those with graduate-level education or above, and education remained independently associated with awareness on logistic regression. This finding is consistent with Seven et al., who reported low knowledge regarding prenatal screening among 274 pregnant women in Turkey and emphasized the need for improved education to facilitate informed decision-making [14]. It is also supported by Arumugam et al., who identified education as a significant determinant of prenatal screening awareness among Indian pregnant women [11]. In contrast, considerably higher awareness has been reported in populations with more established prenatal counselling systems; Sahlin et al. found that 59.8% of 1,003 Swedish pregnant women had previously heard of NIPT [15]. These differences may reflect variation in educational attainment, accessibility of genetic counselling, healthcare infrastructure, and routine exposure to prenatal screening information.

The present study further demonstrated significant associations of awareness with maternal age, gestational trimester, residence, socioeconomic status, and parity. Women aged ≥30 years, those in the second trimester, urban residents, women from higher socioeconomic groups, and primigravida women demonstrated comparatively better awareness. The association with age and education is consistent with the findings of Arumugam et al., who reported significant relationships between awareness and age, trimester, and education among pregnant women in India [11]. The predominance of healthcare professionals as the principal source of information in the present study is particularly important because Sahlin et al. reported that 79.9% of Swedish women preferred to receive information about NIPT orally [15]. Furthermore, evidence from DEPIST 21 demonstrated that counselling can identify and address substantial gaps in women's understanding of NIPT, including the need for invasive confirmation following a positive result [16]. Taken together, these findings support the importance of incorporating structured, comprehensible prenatal screening counselling into routine antenatal care, particularly for women with lower educational and socioeconomic backgrounds.

The major strengths of the present study include its cross-sectional assessment of prenatal screening awareness among pregnant women attending a tertiary care centre, use of a structured and pre-validated questionnaire available in the local language, inclusion of multiple sociodemographic and obstetric variables, and evaluation of independent predictors using logistic regression. The study also specifically assessed awareness of NIPT, an increasingly important component of prenatal genetic screening. However, the study has certain limitations. Its hospital-based cross-sectional design limits the ability to establish causal relationships between sociodemographic factors and awareness, while the relatively small sample size and single-centre setting may limit generalizability to the wider rural population. Awareness was assessed through self-reported questionnaire responses, which may be influenced by recall or response bias, and actual uptake or utilization of NIPT was not evaluated. In addition, the study did not assess the impact of structured counselling or changes in awareness over time.

CONCLUSION

The present study demonstrates that awareness regarding prenatal genetic screening, particularly NIPT, remains suboptimal among pregnant women, with only 36.7% demonstrating moderate/adequate awareness. Knowledge was particularly limited regarding the nature, procedure, interpretation, and limitations of NIPT. Awareness was significantly associated with maternal age, educational status, gestational trimester, residence, socioeconomic status, and parity, with higher educational attainment emerging as an important independent predictor of adequate awareness. These findings highlight the need for structured, culturally appropriate prenatal screening counselling during routine antenatal care, particularly among women from socioeconomically disadvantaged and less-educated backgrounds, to facilitate informed decision-making regarding available prenatal screening options.

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