

Research Article

Multiple Regression Analysis: Utilization of Antenatal Care and Its Impact on Maternal and Infant Health in Panruti Taluk, Tamil Nadu, India

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Abstract

Introduction: This study investigates the Utilisation of antenatal care and its impact on maternal and infant health in Panruti Taluk, Tamil Nadu, India, from 2013 to 2017. Antenatal care is essential for monitoring pregnancy, detecting complications, and providing necessary health advice and preventive care. **Aim and Objective:** To investigate the pattern of antenatal registration, childbirth and death and causes of infant death in the General Hospital and Primary Health Centres of Panruti taluk, Tamil Nadu, India. **Methodology:** The primary data (questionnaire schedule) was distributed to the pregnant women for health check-ups falling in the age group of 15 to 38 years who came to one government hospitals (229) and 10 primary health centres (10X150=1500), totally (229+1500) 1729 samples were collected by scientifically tested random sampling procedure from this taluk and they were the respondents of this study. This data was entered into SPSS software, and Regression analysis was performed for the interpretation of this study. **Findings:** The findings highlight the importance of educational qualifications, present age, and types of houses in predicting antenatal care utilisation. Additionally, the study examines the relationship between haemoglobin levels and socio-economic conditions, miscarriage, and infant deaths. **Results:** The results show that occupation, educational qualifications, and community are associated with haemoglobin levels, while miscarriage is influenced by present age, age at marriage, and educational qualifications. **Conclusion:** The study concludes that socio-economic and demographic factors play a crucial role in maternal and infant health, haemoglobin levels, miscarriage rates, and infant deaths in Panruti Taluk.

Keywords

Antenatal Care, Maternal Health, Infant Health, Socio-Economic Factors, Demographic Factors, Panruti Taluk, Tamil Nadu, India

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1. Introduction

Antenatal care refers to pregnancy-related healthcare provided by a physician or a health worker in a medical facility or at home. Antenatal care should monitor a pregnancy for signs of complications, detect and treat pre-existing and concurrent problems of pregnancy. It should also provide advice and counselling or preventive care, diet during pregnancy, delivery care, postnatal care and related issues. Antenatal care is necessary for ensuring a healthy mother and baby at the end of gestation. The antenatal period is a time of physical and psychological preparation for birth and parenthood. Becoming a parent is a time of intense learning, both for parents and for those close to them. Hence, this research focuses on the utilisation of antenatal care, quantified by antenatal registration, live and still birth, and causes of maternal and infant death in the Government General Hospital and Primary Health Centres of Panruti taluk.

1.1. Review of Literature

Antenatal care is essential for ensuring safe pregnancies and enhancing maternal and infant health outcomes. In developing countries, access to high-quality reproductive health services is a critical determinant of antenatal care utilization, significantly contributing to improved child survival rates and increased contraceptive use, which helps lower fertility rates [1-3]. Various socio-economic, demographic, and cultural factors influence the utilization of reproductive health services, including women's age, education level, employment status, caste, and autonomy [4-15]. The provision of antenatal care has been shown to positively affect pregnancy outcomes by enabling the early identification of risk factors and complications, such as preterm delivery [16, 17]. Effective management during antenatal care visits addresses emerging issues and can improve overall pregnancy outcomes. Comprehensive screenings during these visits enable healthcare providers to evaluate pregnancy-related risks and provide personalized care, including treatments and educational resources for expectant mothers [18, 19].

The first antenatal care visit holds particular importance as it involves a thorough assessment of gestational age and risk factors [20]. During these consultations, a complete medical history is gathered, covering the current and past pregnancies, any complications, medical and psychiatric conditions, and family histories related to genetic disorders, allergies, and substance use [20]. Physical examinations include general assessments, systemic evaluations, and pregnancy-specific checks like vital signs and fetal health assessments [21]. Essential laboratory screenings, such as syphilis tests, blood type determination, hemoglobin levels, and urine tests for protein and glucose, are conducted to ensure maternal well-being [21].

To mitigate issues like anemia, pre-eclampsia, and neonatal tetanus, pregnant women typically receive supplements such

as ferrous sulphate, calcium, folic acid, and tetanus toxoid vaccinations [22]. The World Health Organization recommends that pregnant women have their first antenatal care contact within the first 12 weeks of gestation, followed by scheduled visits at 20, 26, 30, 34, 36, 38, and 40 weeks. This protocol, consisting of at least eight contacts, aims to reduce prenatal mortality and improve care experiences for women [23]. Antenatal care, together with family planning, skilled delivery services, and emergency obstetric care, is a vital component of healthcare that seeks to enhance maternal and newborn health [24].

Research has identified inadequate antenatal care as a significant risk factor for maternal morbidity and mortality, underscoring the need for health policymakers to understand the factors affecting timely and appropriate antenatal care utilization [23, 24]. Improved antenatal care usage is associated with greater involvement in other maternal health services, including institutional deliveries and support during labor and the postnatal period. In this background this present study exhibits the utilisation of antenatal care and its impact on maternal and infant health in Panruti Taluk. Therefore, this study explores the most dominating factors that are responsible for the utilization of antenatal care of pregnant women in Panruti taluk.

1.2. Study Area

Panruti Taluk is selected as a study area, and it occupies an area of 498.25 km². It is in the Cuddalore district of Tamil Nadu, one of the 10 Taluks of the Cuddalore district. There are 88 Panchayat villages. This taluk extends latitudinally 79°25'44" N to 79°41'11" N and longitudinally 11°37'31" E to 11°52'20" E. This study area has 98,171 households, a population of 4,13,639, of which 2,07,946 are male and 2,05,693 are female. The literacy rate of Panruti Taluk is 66.5 per cent, out of which 74.0 per cent of males are literate and 58.92 per cent of females are literate. Out of the total population, 67.56 per cent live in urban areas and 32.44 per cent live in rural areas.

1.3. Aim and Objective

To investigate the pattern of antenatal registration, child-birth and death, and causes of infant death in the General Hospital and Primary Health Centres of Panruti taluk, Tamil Nadu, India.

1.4. Methodology

The primary data (questionnaire schedule) was distributed to the pregnant women for health check-ups falling in the age group of 15 to 38 years who came to one government hospitals (229) and 10 primary health centres (10X150=1500), totally (229+1500) 1729 samples were collected by scientific

ically tested random sampling procedure from this taluk and they were the respondents of this study. This data was entered into SPSS software, and Regression analysis was performed for the interpretation of this study. Hence, this research focuses on antenatal registration, live and still births, and causes of maternal and infant deaths in government hospitals and primary health centres. In addition, this study examines socio-economic and demographic factors influencing antenatal care utilisation, haemoglobin levels, miscarriage rates, and infant deaths.

2. Finding

2.1. Antenatal Registration

During the years 2013 to 2017, 40,287 pregnant women

were registered for antenatal care in the government general hospital and primary health centres of Panruti taluk (Figure 1). As a result, the highest percentage of women was registered at the Panruti government general hospital (24.0%). Likewise, the moderate percentage of pregnant women was recorded in Oraiur (10.6%) and Kadampuliyur (10.5%), Nellikuppam (8.2%), Veeraperumalnallur (7.9%), Panruti (7.8%) and Perperiyankuppam (7.8%) primary health centres (Figures 1-2). The low percentage of women was witnessed in Melpattampakkam (7.5%), Marungur (7.3%), Melkumaramangalam (5.2%) and Keel Arungunam (3.3%) primary health centres. However, the antenatal registration was 21.9 (2013), 20.1 (2014), 18.5 (2015), 18.6 (2016) and 20.8 (2017) per cent. Therefore, the trend of pregnant women registration was decreasing till 2015 and increasing from 2016.

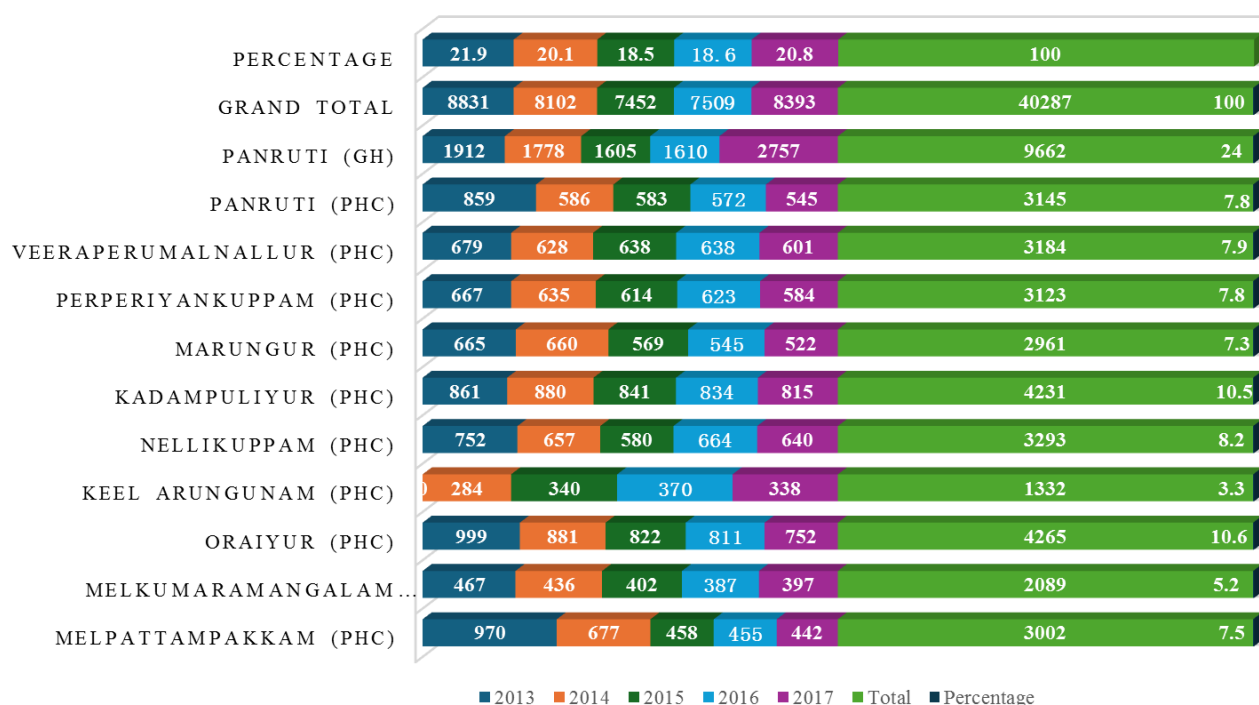


Figure 1. Antenatal registration-panruti taluk.

2.2. Child (Live) Birth

In Panruti taluk, 28,511 live births were recorded between the years 2013 and 2017 in different healthcare centres. The high percentage of live births (Figure 2) was registered in Oraiur (13.5%) and Kadampuliyur (12.6%). The moderate percentage of childbirth was noticed in three primary health centres, namely Nellikuppam (10.1%), Veeraperumalnallur (9.7%) and Perperiyankuppam (9.4%). Similarly, the low percentage of childbirth was recorded in Marungur (9.1%), Melpattampakkam (9.0%), Panruti (8.7%), Panruti government hospital (6.9%), Melkumaramangalam (6.8%) and Keel

Arungunam (4.1%) health centres. Like antenatal registration of women, the live birth was also decreasing with increasing years, noticeably 21.7, 21.5, 19.6, 18.9 and 18.2 per cent in the years 2013, 2014, 2015, 2016 and 2017, respectively.

2.3. Child Stillbirth

During the sample year (2013-2017), 251 stillbirths were recorded in Panruti taluk. The very high percentage of still births was registered in Oraiur (23.1%) primary health centre (Figure 3). The high percentage of stillbirths was observed in Veeraperumalnallur (12.0%) and Melpattampakkam (10.0%) primary health centres. The moderate stillbirths were noticed

in the primary health centres of Melkumaramangalam (9.2%), Nellikuppam (8.8%), Kadampuliyur (8.0%), Perperiyankuppam (8.0%), Marungur (7.6%) and Panruti government hospital (6.4%). The low percentage of stillbirths was traced in Keel Arungunam (4.0%) and Panruti (3.4%) primary health

centres. The stillbirth percentage was fluctuating in every sample year. In the year 2014, the stillbirth rate was very high (25.1%) in the year 2014 and very low (13.5%) stillbirths were registered in the year 2016.

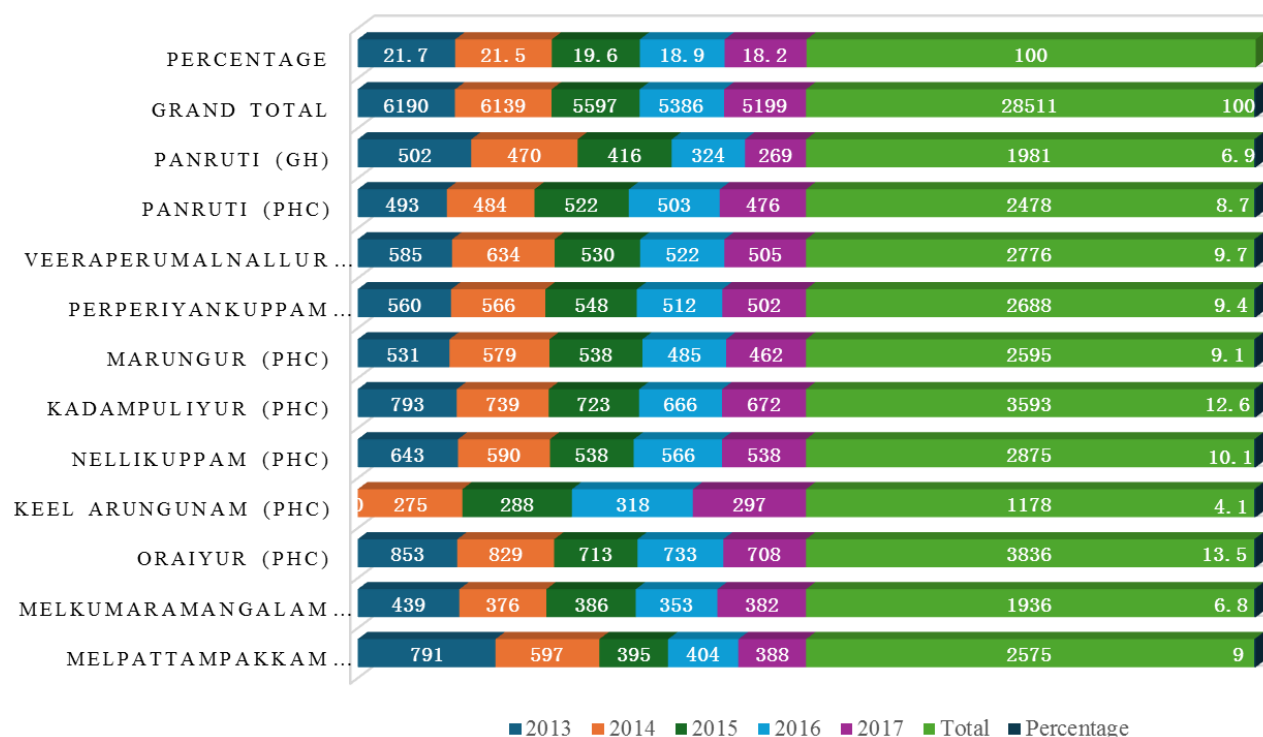


Figure 2. Child Live Birth-Panruti Taluk.

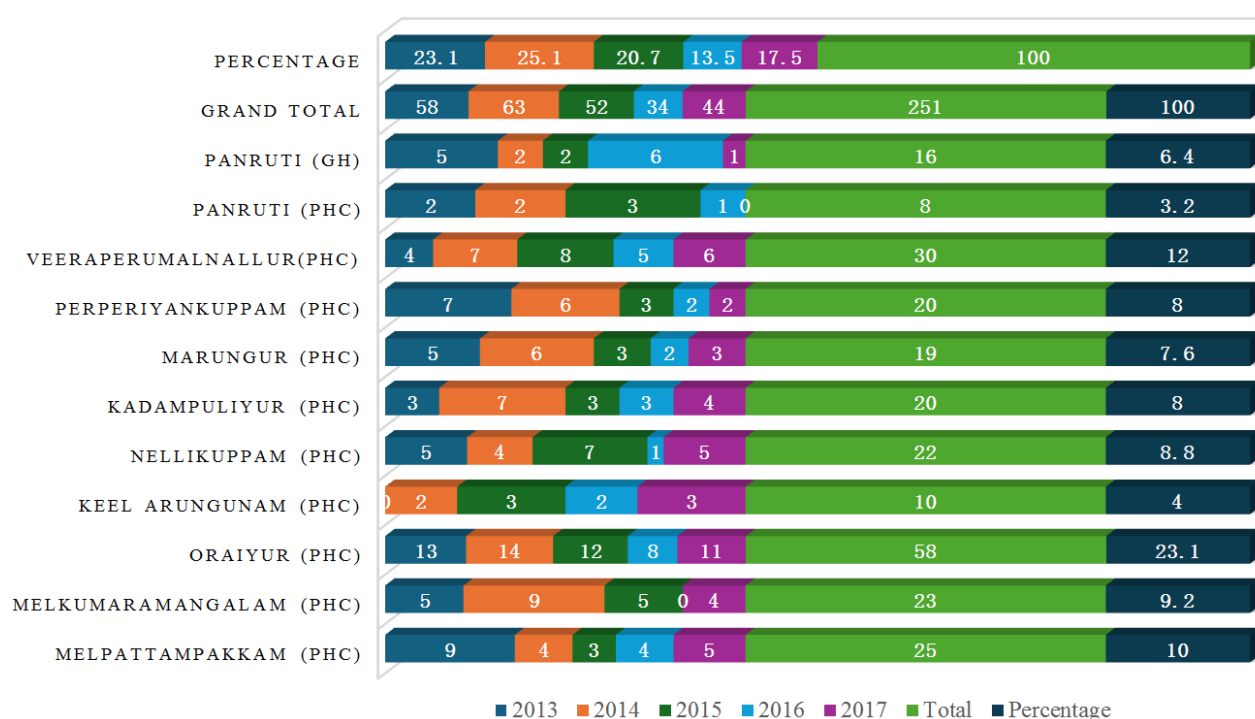


Figure 3. Child Still Birth-Panruti Taluk.

2.4. Causes of Maternal Death

In this taluk, the causes of maternal deaths (2013-2017) are due (Table 1) to Ante partum Eclampsia (1), Cardiac arrest (4), Sepsis (1), Generalized Tonic Clonic Seizure (1), Encephalitis (1), Cerebral Venous Thrombosis (1), Pulmonary Embolism

(1), Pupal Sepsis (1), Disseminated Intra Vascular Coagulation (2) PPH (2), Septic Abortion (1), Nosocomial Sepsis (1), Dengue Shock Syndrome (1), Cardiac Arrest Secondary to sepsis (1) and others 1). There were 19 maternal deaths from 2013 to 2017 in this taluk.

Table 1. Cause of Maternal Death (Year wise Details) - Panruti Taluk.

Sl. No.	Year/Name of the Hospital	2013	2014	2015	2016	2017	Total
1	Melpattampakkam (PHC)	Nil	Nil	Ante partum Eclampsia (1)	Cardiac Arrest (1)	Sepsis (1)	3
2	Melkumaraman-galam (PHC)	Nil	Generalized Tonic Clonic Seizure (1)	Nil	Nil	Nil	1
3	Oraiur (PHC)	Cardiac arrest (1)	Encephalitis (1)	Nil	Nil	Nil	2
4	Keel Arungunam (PHC)	Nil	Cerebral Venous Thrombosis (1)	Nil	Nil	Nil	1
5	Nellikuppam (PHC)	Nil	Nil	Pulmonary Embolism (1)	Nil	Pupal Sepsis (1)	2
6	Kadampuliyur (PHC)	Nil	Nil	Disseminated Intra Vascular Coagulation (1), PPH (1)	Cardiac Arrest (2)	Nil	4
7	Marungur (PHC)	Septic Abortion (1)	Nil	PPH (1)	Nil	Nil	2
8	Perperiyankuppam (PHC)	Nil	Nil	Nil	Nil	Nil	0
9	Veeraperumalnallur (PHC)	Nil	Nil	Nil	Nil	Nosocomial Sepsis	1
10	Panruti (PHC)	Nil	Dengue Shock Syndrome (1)	Nil	Disseminated Intra Vascular Coagulation (1)	Cardiac Arrest Secondary to sepsis (1)	3
11	Panruti (GH)	Nil	Nil	Nil	Nil	Others (1)	1
Total							20

2.5. Cause of Infant Death

Table 2. Cause of Infant Death (Year wise Details) - Panruti Taluk.

Year/Name of the Hospital	2013	2014	2015	2016	2017	Total
Melpattampakkam (PHC)	Others 7	Asphyxia 2, Sepsis 1, Pneumonia 1,	Asphyxia 1, Others 2	sepsis 1, Others 2	Asphyxia 2, Others 1	22

Year/Name of the Hospital	2013	2014	2015	2016	2017	Total
		Others 2				
Melkumaramangalam (PHC)	Asphyxia 2, Sepsis 2, Others 6	Asphyxia 1, Sepsis 1, Others 4	Others 6	Others 6	Asphyxia 1, Pneumonia 1	30
Oraiur (PHC)	Asphyxia 2, Sepsis 1, Others 12	Asphyxia 4, Others 7	Asphyxia 3, Sepsis 1, Pneumonia 1, Others 7	Asphyxia 1, Sepsis 1, Others 10	Sepsis 1, Pneumonia 5, Others 8	64
Keel Arungunam (PHC)	0	Others 6	Asphyxia 3, Others 3	sepsis 1, Others 5	Others 5	23
Nellikuppam (PHC)	Asphyxia 1, Sepsis 1, Others 5	Sepsis 1, Others 3	Asphyxia 2, sepsis 3, Others 3	Others 2	Others 7	28
Kadampuliyur (PHC)	Asphyxia 1, Others 12	Asphyxia 4, Sepsis 3, Others 4	Others 8	Asphyxia 1, Sepsis 1, Others 4	Asphyxia 2, Sepsis 1, Others 11	52
Marungur (PHC)	Asphyxia 1, Others 6	Asphyxia 1, Sepsis 1, Others 5	Asphyxia 1, Pneumonia 1, Others 4	Pneumonia 1, Others 2	Pneumonia 1, Others 2	26
Perperiyankuppam (PHC)	Asphyxia 3, Sepsis 3, Pneumonia 2	Others 9	Others 2	Others 8	Asphyxia 1, Others 4	31
Veeraperumalnallur (PHC)	Sepsis 2, Others 3	Asphyxia 3, Sepsis 1, Pneumonia 1, Others 10	Asphyxia 1, Others 6	Asphyxia 1, Sepsis 3, Pneumonia 2, others 6	Asphyxia 3, Others 2	44
Panruti (PHC)	Others 5	Sepsis 1, Others 2	Asphyxia 2, Sepsis 1, Pneumonia 1	Others 2	Others 1	15
Panruti (GH)	Nil	Nil	Nil	Others 1	Others 1	2
Total	77	78	61	61	60	337

337 infant deaths were registered (Table 2) in various primary health centres and the government hospital of Panruti taluk for diverse reasons, particularly in the primary health centres of Melpattampakkam (22), Melkumaramangalam (30), Oraiur (64), Keel Arungunam (23), Nellikuppam (28), Kadampuliyur (52), Marungur (26), Perperiyankuppam (31), Veeraperumalnallur (44), Panruti primary health centres general hospital (15) and Panruti government hospital (2) between the years 2013 to 2017. Therefore, the highest and lowest infant deaths were recorded in Oraiur Primary Health Centre and Panruti General Hospital, respectively. The main reasons for infant deaths were recorded as Asphyxia and others.

3. Discussion

Multiple Regression Analysis: Utilisation of Antenatal Healthcare

3.1. Hypothesis 1

H_0 : Socio-economic and demographic characteristics are not associated with utilisation of antenatal healthcare.

H_1 : Socio-economic and demographic characteristics are associated with the utilisation of antenatal healthcare.

Regression is the determination of a statistical relationship between two or more variables (Appendix II). In simple regression, two variables are used. One variable (independent) is the cause of the behaviour of another one (dependent). When there are more than two independent variables, the analysis concerning the relationship is known as multiple correlation, and the equation describing such a relationship is called the multiple regression equation.

Regression analysis is concerned with the derivation of an appropriate mathematical expression for finding values of a dependent variable based on an independent variable. It is thus designed to examine the relationship of a variable Y to a

set of other variables $X_1, X_2, X_3, \dots, X_n$. The most used linear equation is $Y = b_1 X_1 + b_2 X_2 + \dots + b_n X_n + b_0$

Here, Y is the dependent variable, which is to be found. $X_1, X_2, \dots, X_n$ are the known variables with which predictions are to be made and $b_1, b_2, \dots, b_n$ are the coefficients of the variables.

In this hypothesis, the dependent variable is Utilisation of Antenatal Healthcare. Independent variables are as follows:

Socio-Economic and Demographic Variables:

Age (X_1)
 Age at marriage (X_2)
 Family Income (X_3)
 Occupation of pregnant women (X_4)
 Occupation of husband (X_5)
 Educational Background of pregnant women (X_6)
 Educational Background of Husband (X_7)
 Community (X_8)
 Types of Houses (X_9)

Table 3. Model Summary^b.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.112 ^a	0.012	0.007	3.51596	0.012	2.413	9	1719	0.010*

a. Predictors: (Constant), Age, Age at marriage, Family's Income, Occupation of pregnant women, Husband's Occupation, Community, Educational Qualification of Women, Educational Qualification Husband, Type of house

b. Dependent Variable: Utilization of Antenatal Healthcare

The SPSS table (Table 3) model summary illustrates the following: R = 0.112, R Square = 0.012 and Adjusted R Square = 0.007. Four of the Nine independent variables are statistically significant (Table 4) at one and five per cent level specifically present age (p value = 0.031), educational qualification of pregnant women (p value = 0.001), educational qualification of husband (p value = 0.012) and types of houses (p value = 0.011). As a result, these socio-economic and demographic variables

are associated with the utilisation of antenatal health care by women in the study area. Nevertheless, the variables, namely age at marriage (p value = 0.259), family's income (p value = 0.970), occupation of pregnant women (p value = 0.558), husband's occupation (p value = 0.808), and community (p value = 0.665) are not statistically significant. Therefore, these variables do not predict the utilisation of antenatal healthcare of pregnant women in Panruti taluk.

Table 4. Coefficients^a.

Variable	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta				Tolerance	VIF
(Constant)	7.128	0.898			7.937	0.000		
X ₁ Present age	0.069	0.032	0.069		2.162	0.031*	0.572	1.747
X ₂ Age at marriage	-0.044	0.039	-0.036		-1.130	0.259	0.552	1.811
X ₃ Family's Income.	0.003	0.070	0.001		0.038	0.970	0.920	1.087
X ₄ Occupation of pregnant women	0.019	0.032	0.015		0.586	0.558	0.831	1.203
X ₅ Husband's Occupation	0.015	0.063	0.006		0.244	0.808	0.858	1.165
X ₆ Community	-0.049	0.114	-0.011		-0.434	0.665	0.965	1.036
X ₇ Educational Qualification of Women	0.265	0.082	0.098		3.256	0.001**	0.634	1.576
X ₈ Educational Qualification Husband	-0.187	0.074	-0.075		-2.515	0.012*	0.654	1.528
X ₉ Type of house	-0.136	0.054	-0.064		-2.534	0.011*	0.899	1.112

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF

a. Dependent Variable: Utilization of Antenatal Healthcare

Note: ** denotes significant at 1% level.

* denotes significant at 5% level.

When evaluating the standardised beta values, the maximum power upon the dependent variables is educational qualification of pregnant women (beta = 0.098), present age (beta = 0.069), educational qualification of husband (beta = -0.075) and types of house (beta = -0.064). Hence, the null hypothesis 'socio-economic and demographic characters are not associated with the utilisation of antenatal healthcare' is rejected, and the alternate hypothesis 'socio-economic and demographic characters are associated with the utilisation of antenatal healthcare' is accepted. As a result, this study has conclusively established that the above-mentioned characters are remarkably visualising the utilisation of antenatal healthcare of pregnant women in this study area.

3.2. Hypothesis 2

H_0 : The pregnant women's haemoglobin level is not associated with socio-economic and demographic conditions, miscarriage, infant death before and after birth.

H_1 : The pregnant woman's haemoglobin level is associated

with socio-economic and demographic conditions, miscarriage, infant death before and after birth.

In this statement, the dependent variable is the haemoglobin level of pregnant women, and the independent variables are as follows:

Variables of socio-economic and demographic conditions:

Family's Annual Income (X_1)

Occupation of pregnant women (X_2)

Which class do you belong to? (X_3)

What is your Educational Qualification? (X_4)

Have you had any miscarriages? (X_5)

Was any baby born dead before birth? (X_6)

Did any babies die after birth? (X_7)

The Table 5 model summary illustrates the $R = 0.164$, R Square = 0.027 and Adjusted R Square = 0.023. Four of the seven independent variables are statistically significant (Table 6) at one and five per cent level, particularly, occupation of pregnant women (p value = 0.001), educational qualification of pregnant women (p value = 0.001), miscarriage (p value = 0.003) and community (p value = 0.022).

Table 5. Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.164 ^a	0.027	0.023	4.069	0.027	6.814	7	1721	0.001**

a. Predictors: (Constant), Was any baby died after birth? Family's Annual Income., Which class does you belongs to? Have you had any miscarriage? What is your Educational Qualification? Your Occupation, Was any baby born dead before birth?

Table 6. Coefficients^a.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	7.615	1.048		7.265	0.000		
X_1 Family's Annual Income.	0.141	0.079	0.043	1.775	0.076	0.973	1.028

Variable		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
X ₂	Occupation of pregnant women	0.153	0.034	0.108	4.461	0.001**	0.965	1.036
X ₃	Which class do you belong to?	-0.299	0.131	-0.055	-2.290	0.022*	0.978	1.022
X ₄	Educational Qualification of pregnant women	-0.265	0.076	-0.084	-3.486	0.001**	0.977	1.023
X ₅	Have you had any miscarriage?	0.908	0.309	0.071	2.943	0.003**	0.979	1.021
X ₆	Was any baby born dead before birth?	0.636	0.711	0.023	.895	0.371	0.882	1.134
X ₇	Was any baby died after birth?	-0.994	0.643	-0.039	-1.545	0.123	0.894	1.119

Hence, these four variables are associated with the haemoglobin level of pregnant women in the set. However, the variables specifically, family's annual income ($p=0.076$), baby born dead before birth (p value $=0.371$), and baby died after birth ($p=0.123$) are not statistically significant. Therefore, these independent variables do not predict the haemoglobin level of pregnant women.

When evaluating the standardised beta values, the greatest influences upon the dependent variables are the occupation of pregnant women ($\beta = 0.108$), educational qualification of pregnant women ($\beta = -0.084$), miscarriage ($\beta = 0.071$) and community ($\beta = -0.055$). Hence, 'The pregnant women's haemoglobin level is associated with socio-economic and demographic conditions and miscarriage'. However, 'The pregnant women's haemoglobin level is not associated with infant death before and after birth'. Therefore, this result shows that the pregnant women's occupation, community, educational qualification and miscarriage are predicting their haemoglobin level.

3.3. Hypothesis 3

H₀: The pregnant women's miscarriage is not associated with socio-economic and demographic conditions.

H₁: The pregnant women's miscarriage is associated with socio-economic and demographic conditions.

In this assumption, the dependent variable is miscarriage of pregnant women, and the independent variables are as fol-

lows:

Variables of socio-economic and demographic conditions:

Present age (X₁)

Age at marriage (X₂)

Number of family members (X₃)

Family's annual income (X₄)

Occupation of pregnant women (X₅)

Husband's occupation (X₆)

Which religion do you belong to? (X₇)

Which class do you belong to? (X₈)

Educational qualification of pregnant women (X₉)

Husband's educational qualification (X₁₀)

The (Table 7) model summary illustrates the $R = 0.148$, R Square = 0.022 and Adjusted R Square = 0.016. Three of the ten independent variables are statistically significant (Table 8) at the one and five per cent level, particularly present age (p value = 0.001), age at marriage (p value = 0.001) and educational qualification of pregnant women (p value = 0.017).

Therefore, these three variables are associated with the miscarriage of pregnant women in the study area. However, the variables specifically, size of family ($p=0.187$), family's annual income ($p = 0.889$), occupation of pregnant women ($p=0.187$), husband's occupation ($p = 0.187$), religion ($p = 0.187$), community ($p = 0.187$) and husband's educational qualification ($p = 0.187$) are not statistically significant. Therefore, these independent variables do not envisage the miscarriage of pregnant women in Panruti taluk.

Table 7. Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.148 ^a	0.022	0.016	0.318	0.022	3.824	10	1718	0.001

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change

a. Predictors: (Constant), What is your Husband's Educational Qualification?, Number of Family members, Which religion do you belong to?, Age, Family's Annual Income., Your Occupation, Which class do you belong to?, Husband's Occupation, What is your Educational Qualification?, How old were you at the time of marriage?

Table 8. Coefficients^a.

Variable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	0.948	0.117		8.088	0.000		
X ₁ Present age	0.014	0.003	0.156	4.942	0.001**	0.572	1.747
X ₂ Age at marriage	-0.016	0.004	-0.150	-4.667	0.001**	0.552	1.810
X ₃ Number of family members	-0.016	0.012	-0.032	-1.321	0.187	0.986	1.014
X ₄ Family's annual income.	-0.001	0.006	-0.003	-.140	0.889	0.923	1.084
X ₅ Occupation of pregnant women	0.003	0.003	0.028	1.102	0.270	0.872	1.146
X ₆ Husband's occupation	-0.003	0.006	-0.014	-.549	0.583	0.849	1.178
X ₇ Which religion do you belong to?	0.024	0.023	0.026	1.038	0.300	0.926	1.080
X ₈ Which class do you belong to?	0.016	0.011	0.038	1.513	0.130	0.921	1.086
X ₉ Educational qualification of pregnant women	0.018	0.007	0.071	2.382	0.017*	0.633	1.579
X ₁₀ Husband's educational qualification?	-0.005	0.007	-0.022	-.751	0.452	0.657	1.522

When assessing the standardised beta values, the greatest influences upon the dependent variables are, namely, present age of pregnant women (beta = 0.156), age at marriage (beta = -0.150) and educational qualification of pregnant women (beta = -0.071). Thus, 'the pregnant women's miscarriage is associated with social and demographic variables. However, 'The pregnant women's miscarriage is not associated with occupation, size of the family, religion, husband's educational qualification and community'. As a result, the pregnant women's present age, age at marriage and educational qualification of pregnant women are predicting their miscarriage of child.

3.4. Hypothesis 4

H₀: The death of a pregnant woman's baby after birth is not associated with socio-economic and demographic conditions.

H₁: The death of a pregnant woman's baby after birth is associated with socio-economic and demographic conditions.

In this hypothesis, the dependent variable is the death of a pregnant woman's baby after birth, and the independent variables are as follows:

Variables of socio-economic and demographic conditions:

Present age (X₁)

Age at marriage (X₂)

Number of family members (X₃)

Family's annual income (X₄)

Occupation of pregnant women (X₅)

Husband's occupation (X₆)

Which religion do you belong to? (X₇)

Which class do you belong to? (X₈)

Educational qualification of pregnant women (X₉)

Husband's educational qualification (X₁₀)

Table 9. Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	0.151 ^a	0.023	0.017	0.160	0.023	4.013	10	1718	0.001

a. Predictors: (Constant), What is your Husband's Educational Qualification?, Number of Family members, Which religion do you belong to?, Age, Family's Annual Income., Your Occupation, Which class do you belong to?, Husband's Occupation, What is your Educational Qualification?, How old were you at the time of marriage?

The (Table 9) model summary demonstrates the R = 0.151, R Square = 0.023 and Adjusted R Square = 0.017. Four of the ten independent variables are statistically significant (Table 10) at the one and five per cent level particularly, present age

(p = 0.001), age at marriage (p = 0.001), husband's occupation (p = 0.002) and occupation of pregnant women (p value = 0.015).

Table 10. Coefficients^a.

Variable	Unstandardized Coefficients		Standardized Coefficients		t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta				Tolerance	VIF
(Constant)	1.105	0.059			18.772	0.000		
X ₁ Present age	0.005	0.001	0.119		3.781	0.001**	0.572	1.747
X ₂ Age at marriage	-0.009	0.002	-0.166		-5.182	0.001**	0.552	1.810
X ₃ Number of family members	-0.005	0.006	-0.022		-0.901	0.368	0.986	1.014
X ₄ Family's annual income.	-0.002	0.003	-0.012		-0.491	0.623	0.923	1.084
X ₅ Occupation of pregnant women	-0.003	0.001	-0.062		-2.442	0.015*	0.872	1.146
X ₆ Husband's occupation	0.009	0.003	0.079		3.056	0.002**	0.849	1.178
X ₇ Which religion do you belong to?	-0.007	0.011	-0.016		-0.641	0.521	0.926	1.080
X ₈ Which class do you belong to?	0.005	0.005	0.024		0.967	0.333	0.921	1.086
X ₉ Educational qualification of pregnant women	0.004	0.004	0.035		1.168	0.243	0.633	1.579
X ₁₀ Husband's educational qualification?	-0.003	0.003	-0.029		-0.982	0.326	0.657	1.522

Thus, these four variables are associated with the pregnant women's babies who died after birth in this region. However, the variables specifically, size of family (p value = 0.368), family's annual income (p = 0.623), community (p = 0.521), which class do you belong to? (p = 0.333), educational qualification of pregnant women (p = 0.423) and husband's educational qualification (p = 0.326) are statistically not significant. Therefore, these independent variables do not predict the death of a pregnant woman's baby after birth in the data set.

When we measure the standardised beta values, the greatest

influences upon the dependent variables are, namely, present age of pregnant women (beta = 0.119), age at marriage (beta = -0.166), occupation of pregnant women (beta = -0.062) and husband's occupation (beta = 0.079). As a result, the death of a baby after birth is associated with social and demographic variables. Conversely, 'the death of a pregnant woman's baby after birth is not associated with the size of family members, annual income, religion, community, educational qualification of pregnant women and husband's educational qualification'. As a result, the pregnant women's present age, age at

marriage, occupation of pregnant women and husband's occupation are predicting the death of the baby after birth in the study area.

4. Conclusion

During the years 2013 to 2017, there were 30,625 pregnant women registered for the utilisation of antenatal care in the government general hospital and primary health centres of Panruti taluk. Of which 26,530 mothers delivered a baby in health centres. However, the tendency of pregnant women to register for the utilisation of antenatal care was decreasing with increasing years. Similarly, the childbirth rate also showed a decrease with increasing years. 235 still births were recorded in Panruti taluk, 19 maternal deaths and 335 infant deaths registered in primary health centres of Panruti taluk for diverse reasons in the primary health centres and government general hospitals of the study area.

However, the multiple regression analysis shows that the socio-economic and demographic conditions of pregnant women are associated with the utilisation of antenatal health care, haemoglobin level, miscarriage and infant death after birth in the study area.

5. Research Gaps

The study focuses exclusively on Panruti Taluk, Tamil Nadu, India. Future research could expand to other regions to compare the utilisation of antenatal care and its impact on maternal and infant health. While the study examines socio-economic and demographic factors, it does not investigate deeply into the definite socio-economic barriers that prevent women from accessing antenatal care. Further research could explore these barriers in more aspect. The study covers the period from 2013 to 2017. Longitudinal studies that track changes over a longer period could provide more inclusive understandings into trends and long-term impacts of antenatal care utilisation. The study primarily uses quantitative data. Incorporating qualitative data through interviews or focus groups could deliver deeper insights into the individual experiences and challenges faced by pregnant women in accessing antenatal care. The study does not broadly explore the role of healthcare system factors, such as the availability of healthcare facilities, quality of care, and healthcare provider attitudes, in employing antenatal care utilisation. Future research could consider these aspects. The study does not evaluate the efficiency of precise interventions aimed at enlightening antenatal care utilisation and maternal and infant health outcomes. Research on the impact of targeted interventions could offer appreciated information for policymakers.

6. Recommendations

Efforts should be made to improve educational programs targeting pregnant women, specifically in rural areas. Information, Education, and Communication (IEC) activities should be considered to educate mothers about the reputation of antenatal care and its benefits. Healthcare amenities should be made more manageable to pregnant women, principally in remote areas. This incorporates improving transportation facilities and safeguarding that healthcare centres are sufficiently operated and fortified. Policies should be executed to address socio-economic barriers that avert women from accessing antenatal care. This may contain financial assistance, community support programs, and ingenuities to improve living conditions. The quality of antenatal care services should be improved by training healthcare providers, enlightening the availability of medical supplies, and confirming that healthcare centres track national guidelines for antenatal care. Pregnant women should be encouraged to register for antenatal care early in their pregnancy to ensure appropriate monitoring and intervention. Awareness campaigns can be directed to highlight the importance of timely registration. Regular assessment of interventions aimed at improving antenatal care utilisation should be conducted to evaluate their success and make essential modifications.

7. Implications

The findings of this study can inform policymakers about the critical factors prompting antenatal care utilisation and maternal and infant health outcomes. This can lead to the progress of targeted strategies and plans to improve healthcare services. Understanding the socio-economic and demographic factors associated with antenatal care utilisation can help in the well-organized allocation of resources to areas where they are most required. Engaging communities in consciousness and educational programs can lead to improved health consequences by confirming that pregnant women obtain the required support and information. Strengthening the health system by addressing the recognised gaps can lead to improved quality of care and improved health outcomes for mothers and infants. The study highlights the need for further research in other regions and integrates qualitative data to increase a deeper understanding of the barriers and encounters faced by pregnant women.

Abbreviations

GH	General Hospital
PHC	Primary Health Centre

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data collected in Panruti Taluk, Tamil Nadu, India.

Author Contributions

Vadivel Sivalingam: Statistical Analysis, Interpretation of Results, Writing - Review, Editing and Writing - Original Draft.

Balachandar Govindarajan: Data collection, Literature Review, Compiling data, Writing, Review and Editing.

Sankar Karuppaiyan: Conceptualisation, Methodology, and Data Collection.

Mayakannan Ayyanar: Data analysis and attribution.

Ethics Approval

This study was conducted according to ethical standards and guidelines. Approval was obtained from the relevant institutional review board (IRB) before the commencement of the research. Informed consent was obtained from all participants involved in the study, ensuring their voluntary participation and confidentiality of their data. The research adhered to ethical principles such as respect for persons, beneficence, and justice, ensuring that the rights and welfare of the participants were protected throughout the study.

Consent to Participate

Informed consent was obtained from all individual participants' parents or legal guardians included in the study.

Data Availability Statement

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

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Conflicts of Interest

The authors declare no conflicts of interest.

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