

Table 1: The description of the socio-economic, demographic and environmental factors of PNC utilization in the regional states of Ethiopia.

Variable Names	Category	Postnatal care		Total
		no	yes	
Age	15-19	323 (92.8%)	25(7.2%)	348(4.8%)
	20-34	4535 (90.1%)	499 (9.9%)	5034(70.0%)
	35-49	1654 (91.4%)	155(8.6%)	1809(24.2%)
Residence	Urban	1284 (85%)	227(15%)	1511(21.0%)
	Rural	5228 (92.0%)	452(8.0%)	5680(79.0%)
Region	Tigray	649(84.1%)	123(15.9%)	772(10.7%)
	Afar	605(93.5%)	42(6.5%)	647(9.0%)
	Amhara	687 (89.8%)	78 (10.2%)	765(10.6%)
	Oromia	973(94.4%)	58(5.6%)	1031(14.3%)
	Somali	765(94.9%)	41(5.1%)	806(11.2%)
	Benishangul	521(90.6%)	55(9.5%)	576(8.0%)
	SNNPR	5799(89.5%)	94(10.5%)	893(12.4%)
	Gambella	504(94.4%)	30(5.6%)	534(7.4%)
	Harari	355(86.4%)	56(13.6%)	411(5.7%)
	Addis Ababa	3319(84.8%)	57(15.2%)	376(5.2%)
	Dire Dawa	3335(88.2%)	45(11.8%)	380(5.3%)
Delivery	Home	6164(91.0%)	612(9.0%)	6779(94.2%)
	Health facility	348(83.9%)	67(16.1%)	412(5.8%)
Birth Order	1	1282(87.3%)	187(12.7%)	1469(20.41%)
	2-3	1988(89.7%)	228(10.3%)	2216(30.8%)
	4-5	1510(92.2%)	127(7.8%)	1637(22.8%)
	≥ 6	1732(92.7%)	137(7.3%)	1869(26.0%)
ANC visits	No visits	2407(97.0%)	74(3.0%)	248(34.5%)
	1-3 visits	1866(89.2%)	225(10.8%)	2091(29.1%)
	4 and more	2239(85.5%)	380(14.5%)	2619(36.4%)
Mother education level	No educated	4049(93.0%)	305(7.0%)	4354(60.5%)
	Primary	1720(88.6%)	222(11.4%)	1942(27%)
	Secondary and above	1659(87.5%)	238(12.5%)	1897(26.4%)
Husband education level	No educated	2943(93.9%)	191(6.1%)	3134(43.6%)
	Primary	1910 (88.4%)	250(11.6%)	2160(30.0%)
	Secondary and above	11659(87.5%)	238(12.5%)	1897(26.4%)
Media exposure	No	4330(93.2%)	314(6.8%)	4644(64.6%)
	Yes	2182(85.7%)	365(14.3%)	2547(35.4%)
Employment status	No	4623(91.9%)	407(8.1%)	5030(69.9%)
	Yes	1889(87.4%)	272(12.6%)	2161(30.1%)

Religion	Orthodox	2146(90.6%)	222 (9.4%)	2368(32.9%)
	Protestant	1227(91.7%)	111(8.3%)	1338(18.6%)
	Muslim	2993(90.1%)	330(9.9%)	3323(46.2%)
	Others	146(90.1%)	16 (9.9%)	162(2.3%)
Birth size	Very large	1085(91.3%)	103(8.7%)	1188(16.5%)
	Larger than average.	903(89.6%)	105(10.4%)	1008(14.0%)
	Average	2729(90.5%)	285(9.5%)	3014(41.9%)
	Smaller than average	599(90.9%)	60(9.1%)	659(9.2%)
	Very small	1196 (90.5%)	126(9.5%)	1322(18.4%)
Wealth index	Poorest	2302(94.8%)	125(5.2%)	2427(33.8%)
	Poorer	1076(91.3%)	103(8.7%)	1179(16.4%)
	Middle	927(90.2%)	101(9.8%)	1028(14.3%)
	Richer	824(90.0%)	92(10.0%)	916(12.7%)
	Richest	1383(84.3%)	258(15.7%)	1641(22.8%)

Table 2:Results of Global Morans I and Gearys C statistics.

Assumption	Coefficient	Observed	Expected	Std Dev	Z	Pr> Z
Normality	Morans I	0.2201	-0.014	0.0757	3.092	0.0009924
Normality	Gearys C	0.7049	1.00000	0.087	-3.392	0.0003626
Randomization	Morans I	0.22005	-0.014	0.0734	3.19	0.0007
Randomization	Gearys C	0.7049	1.0000	0.108	-2.73	0.003

Table 3:Summary results of DIC for each model.

Model comparision	Model1	Model2	Model3
Deviance	4830.4	4831.0	4830.0
PD	35.60	35.58	35.62
DIC	4901.60	4902.16	4901.24

Table 4: Summary results of Bayesian hierarchical model with spatially unstructured and structured random effect.

Fixed effects	Category	Estimate	sd	Median	95% CI
Intercept		-3.3496	0.3436	-3.3633	(-4.0152, -2.6474)
Residence	Urban(ref)				
	Rural	-0.023	0.1505	-0.0185	(-0.3291, 0.2648)
Mother education attainment	no education(ref)				
	Primary	0.0900	0.0961	0.0918	(-0.1063, 0.2763)
	Secondary and above	0.2953	0.1306	0.2920	(0.0291, 0.5425)
Age of mother	15-19				
	20-34	0.0207	0.1808	0.0237	(-0.3433, 0.3631)
	35-49	0.1170	0.2082	0.1201	(-0.3015, 0.5146)
Place of Delivery	Home(ref)				
	Health facility	0.8631	0.1411	0.8645	(0.5873, 1.1368)
Wealth index	Poorest(ref)				
	Poorer	0.4459	0.1253	0.4450	(0.2018, 0.6951)
	Medium	0.4578	0.1315	0.4542	(0.2020, 0.7116)
	Richer	0.2609	0.1427	0.2587	(-0.0257, 0.5391)
	Richest	0.4058	0.1685	0.4040	(0.0767, 0.7236)
Birth order	One(ref)				
	2-3	-0.1365	0.1025	-0.1370	(-0.3374, 0.0586)
	4-5	-0.2082	0.1274	-0.2055	(-0.4489, 0.0376)
	6 and more	-0.0813	0.1452	-0.0829	(-0.3689, 0.2074)
Number of ANC visits	No visits(ref)				
	1-3 visits	1.1764	0.1394	1.1776	(0.9116, 1.4577)
	At least 4 visits	1.4472	0.1382	1.4504	(1.1873, 1.7235)
Husbands education	Illiterate(ref)				
	primary	0.2074	0.1043	0.2063	(0.0001, 0.4091)
	Secondary and above	0.2396	0.1216	0.2406	(0.0177, 0.4838)
Media exposure	No(ref)				
	Yes	0.3520	0.0916	0.3547	(0.1622, 0.5320)
Employment status	No(ref)				
	Yes	0.2466	0.0791	0.2455	(0.0887, 0.3945)
Birth size	Very large(ref)				
	Larger than Average	-0.3807	0.1374	-0.3788	(-0.6518, -0.1142)
	Average	-0.2960	0.1063	-0.3004	(-0.5011, -0.0863)
	Smaller than aver.	-0.2524	0.1556	-0.2526	(-0.5595, 0.0629)
	Very small	-0.2322	0.1311	-0.2342	(-0.4919, 0.0274)
Religion	Orthodox(ref)				
	Protestant	-0.3685	0.1371	-0.3664	(-0.6332, -0.0870)
	Muslim	-0.2194	0.1116	-0.2197	(-0.4472, 0.0003)
	Others	-0.7816	0.3798	-0.7699	(-1.5806, -0.0483)

Spatial unstructured and structured Random effects variances

effects	variances	category	estimate	sd	Median	95% CI
Region:mrf			0.1636	0.2341	0.0668	(0.012, 0.8415)
Region:re			0.1308	0.1150	0.1047	(0.02, 0.4483)

Appendices

Table 5: Summary result of Bayesian hierarchical model with spatially structured random effect.

Fixed effects	Category	Estimate	sd	Median	95% CI
Intercept		-3.2330	0.2835	-3.2386	(-3.7918,-2.6403)
Residence	Urban(ref)				
	Rural	-0.1340	0.1412	-0.1318	(-0.4253,0.1401)
Mother education attainment	no education(ref)				
	Primary	0.1006	0.0958	0.1012	(-0.0758,0.2931)
	Secondary and above	0.3136	0.1316	0.3106	(0.0606,0.5671)
Age of mother	15-19				
	20-34	0.0300	0.1794	0.0254	(-0.3062,0.3918)
	35-49	0.1510	0.2065	0.1576	(-0.2560,0.5469)
Place of Delivery	Home(ref)				
	Health facility	0.8752	0.1361	0.8788	(0.5968,1.1467)
Wealth index	Poorest(ref)				
	Poorer	0.4079	0.1302	0.4064	(0.1537,0.6610)
	Medium	0.3851	0.1307	0.3842	((0.1242,0.6378)
	Richer	0.1708	0.1439	0.1756	(-0.1084,0.4477)
	Richest	0.2969	0.1691	0.2976	(-0.0412,0.6448)
Birth order	One(ref)				
	2-3	-0.1289	0.1002	-0.1303	(-0.3271,0.0783)
	4-5	-0.2061	0.1315	-0.2089	(-0.4625,0.0514)
	6 and more	-0.0849	0.1413	-0.0896	(-0.3650,0.1974)
Number of ANCvisits	No visits(ref)				
	1-3 visits	1.2076	0.1360	1.2127	(0.9368,1.4809)
	At least 4 visits	1.5428	0.1338	1.5455	(1.2762,1.8069)
Husbands education	Illiterate(ref)				
	primary	0.1866	0.1011	0.1847	(-0.0069,0.3789)
	Secondary and above	0.2268	0.1162	0.2280	(-0.0112,0.4492)
Media exposure	No(ref)	0.00			
	Yes	0.3207	0.0899	0.3211	(0.1409,0.4954)
Employment status	No(ref)				
	Yes	0.2432	0.0791	0.2422	(0.0939,0.4048)
Birth size	Very large(ref)				
	Larger than Average	-0.3155	0.1309	-0.3189	(-0.5633,-0.0451)
	Average	-0.2184	0.1059	-0.2200	(-0.4302,-0.0184)
	Smaller than aver.	-0.1932	0.1545	-0.1947	(-0.4958,0.1017)
	Very small	-0.1899	0.1240	-0.1853	(-0.4409,0.0612)
Religion	Orthodox(ref)				
	Protestant	-0.4579	0.1291	-0.4558	(-0.7101,0.1998)
	Muslim	-0.3327	0.1075	-0.3348	(-0.5427,-0.1165)
	Others	-0.8908	0.3731	-0.8682	(-1.6714,-0.2272)

Spatial structured random effects variances

spatial effect category	estimate	sd	Median	95% CI
Region:mrf	0.5455	0.3693	0.4526	(0.1576,1.4635)