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Individual and community level predictors of maternal timely postnatal care services utilization in Ethiopia: A multilevel-mixed effects analysis

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Abstract

29 **Introduction:** Early identification and management of postpartum complications through
30 timely visit for postnatal care is one of the key interventions in reducing maternal mortality. A
31 community-based national level representative dataset was necessary to inform decision
32 makers in achieving the sustainable development goal (SDG) target of reducing maternal
33 mortality by 70%. This study aims to determine the individual and community level predictors
34 of timely utilization of maternal postnatal care service in Ethiopia.

35 **Methods:** A community based nationally representative survey of Ethiopian Demographic and
36 Health Survey (EDHS) in 2016 was utilized. A total of 3,948 women aged 15-49 giving birth
37 in the two years before the survey were included. A two-level mixed-effects logistic regression
38 analysis was employed.

39 **Result:** Among women aged 15-49 years giving birth in the 2 years before the survey, 17%
40 had a postnatal check during the first 2 days after birth in Ethiopia. Institutional delivery AOR
41 2.14 [95% C.I 1.70, 2.0] and giving birth by caesarean section AOR 1.66 [95% CI 1.10, 2.50]
42 were found to be an individual level determinants, whereas administrative regions(Oromia
43 69%, Somali 56%, Benishangul 55%, SNNPR 43%, Gambela 66%, Afar 50% and Dire Dawa
44 55% which less likely to utilize postnatal care utilization as compared to Addis Ababa city
45 administrative area), Higher community level wealth AOR 1.44 [95% C.I 1.08, 1.2], antenatal
46 care coverage AOR 1.52 [95% C.I 1.19, 1.96] and perceived distance of the health facility as a
47 big problem AOR 0.78[95% C.I 0.60, 0.99] were the community level predictors of timely
48 utilization of post-natal care in Ethiopia.

49 **Conclusion:** Less than one in five women utilized postnatal care in the first 2 days after birth
50 in Ethiopia. Individual level factors (being gave birth at health facility and caesarean delivery)
51 and community level factors (administrative regions, community level wealth, antenatal care
52 and perception of distance to health facility as a big problem) were found to be significant
53 predictors.

54 **Keywords:** Postnatal care; multilevel; DHS; Ethiopia

58 **Introduction**

59 Every day in 2017, approximately 810 women die from preventable causes related to
60 pregnancy and childbirth. Moreover, 94% of all maternal deaths occur in low and lower
61 middle-income countries[1]. Postnatal period is a critical period in the lives of mothers. Yet,
62 this is the most neglected period for the provision of quality care[2]. More than 60% of maternal
63 deaths occurred in the postpartum period, of these more than 80% of the maternal death occurs
64 within two weeks of delivery in both developing countries and the United States[3].

65 According to the World Health Organization(WHO), the postnatal period begins immediately
66 after childbirth and lasts six weeks[4]. On the one hand, postnatal care services are an essential
67 element of the continuum of care for maternal and child health, and it is a bridge in the
68 continuum of care for child health services and family planning services. Woman and her
69 partner/family require more information than they usually receive on care of the baby and
70 mother within the first week after childbirth. On other hand, mothers who didn't received any
71 perinatal care was associated with neonatal complications at six weeks after birth[5].

72 Although there is a good improvement in maternal and child health care services coverage
73 recently, still postnatal care was only 17% of received a postnatal check within the first two
74 days of birth in Ethiopia[6]. Still, the experiences and expectations of women and their families
75 should be considered when deciding the timing of postnatal visits. Barriers to the uptake of
76 services and/or access to services also should be considered when deciding on schedules for
77 postnatal care[4].

78 Studies so far focus on individual level factors associated with post-natal care utilization like
79 residence, antenatal care follow-up, maternal occupation, awareness about problems of
80 postnatal period, institutional delivery, [7-13] marital status[14] decision-making styles,
81 household distances from health institutions, being model family [15] level of education,

82 wealth, alive birth outcome of last pregnancy[16, 17], experience of postpartum
83 complications[18] maternal knowledge about postnatal danger signs[19], Mothers' having
84 husband attended formal education, knowledge of postnatal care[20]. However, equity of the
85 postnatal care services will not be addressed with individual level factors, especially in
86 developing country like Ethiopia with diverse sociocultural, and socioeconomic populations.
87 Regression models with individuals as the units of analysis that include both group/community
88 level and individual level variables as predictors of individual level outcomes will provide
89 contextual effects of explanatory variables on response variables. The multilevel effect data
90 analysis utilized in this study was essential to identify both individual and community level
91 barriers of postnatal care. Thus, it is helpful for effective national level design and improvement
92 of existing policies, and strategies for contextualized interventions.

93 The findings of the study were also decisive in achieving SDG, the global target of reducing
94 maternal mortality ratio to less than 70 per 100,000 births. In addition, it was a vital for the
95 global strategy, aimed at ending preventable maternal mortality through enlightening
96 predictors of inequalities in access to and quality of maternal, and newborn health care services
97 in different clusters of the Ethiopian community[1].

98

99 **Methods**

100 **Study setting**

101 Ethiopia is the second populous country in Africa next to Nigeria bordered by Eretria, South
102 Sudan, Sudan, Djibouti and Somalia with a total of more than one hundred ten million
103 people[21]. Ethiopia has a decentralized three-tier system of primary, secondary and tertiary
104 care. The primary level health cares are district hospitals, health centers and their satellite

105 health posts; the secondary level health cares are general hospitals and the tertiary level health
106 care are specialized hospitals[22]. Administratively, Ethiopia is divided into nine geographical
107 regions (Tigray, Afar, Amhara, Oromia, Somali, Benishangul-Gumuz, SNNPR, Gambella and
108 Harari) and two administrative cities, Addis Ababa and Diredawa. The 2016 EDHS was a
109 population-based cross-sectional study conducted from January 18, 2016 to June 27, 2016,
110 across the country[6]

111 **Data Source**

112 In this study the dataset was obtained from MEASURE DHS database at
113 <http://dhsprogram.com/data/>. The DHS program office gave an authorization letter to access
114 the 2016 EDHS, which is the fourth comprehensive survey. The 2016 EDHS sample was
115 selected in two stages. In the first stage, total of 645 clusters (202 in urban and 443 in rural)
116 were selected randomly proportional to the household size from the sampling strata and in the
117 second stage, 28 households per cluster were selected using systematic random sampling[6].
118 Representative samples of 18008 households were selected and 16, 650 households were
119 interviewed in 2016 EDHS. For individual interview, 16, 583 eligible women were identified
120 from the interviewed household. Interviews were completed with 15,683 women aged 15-49
121 years [22]. In this study, among women aged 15-49 years, 3984 gave birth in the two years
122 before the survey were included.

123 **Study variables**

124 **Dependent variable:** The outcome variable was binary categorized as “use of postnatal care
125 coded as 1” and “do not use of postnatal care coded as 0” within 6 weeks or 42 days of delivery.

126 **Independent variables:** The independent variables for postnatal care use were broadly
127 classified into individual level and community level variables in line with multilevel analytic
128 approach.

129 **Individual level variables:** Educational level of women, household wealth index, perceived
130 distance to health facility to get medical help, employment status of women's, number of ANC
131 visit during pregnancy, delivery by caesarean section, birth order and place of delivery were
132 included as individual level variables.

133 **Community level variables:** Aggregated variables at the community level based on the
134 individual information and then the aggregated values were classified as low and high if the
135 median values or the proportions of the clusters were below and above the national value
136 respectively. Based on this, community level wealth index, community level ANC coverage,
137 community level women's education, perceived distance to health facility to get medical help
138 at the community level were considered as community level variables.

139 **Region:** The EDHS sample was collected from nine regions and two administrative cities. We
140 used these administrative boundaries as community level factor.

141 **Place of residence:** It was classified as rural and urban, considered as a community level factor.

142 **Community level education of women:** The median value of educational attainment at the
143 national level was 5 years. Thus, the median value of the aggregated clusters below 5 were
144 classified as low education of women and the median value of the aggregated clusters 5 and
145 more were classified as high education of women.

146 **Community level wealth:** Similarly, the median value of wealth index at the national level was
147 3. Then, the aggregated clusters were classified as low wealth and high wealth by considering
148 the national value as a cut-off point.

149 **Perceived distance to health facility at the community level:** At the national level the
150 proportion of perception of distance to health facility to get medical help as a big problem was
151 0.45. So, clusters were classified as low perception and high perception using the national
152 proportion as a cut-off point after aggregated of it.

153 **Community level ANC visit:** The median value of ANC visit at the national level was 3. Hence,
154 the median value of the cluster less than 3 ANC visit was classified as low and greater than or
155 equal to 3 ANC visits were classified as high after aggregated the ANC visit.

156 **Data analysis**

157 Two level mixed effects logistic regression analyses were employed using STATA version 14.
158 Since, 2016 EDHS data was hierarchical, i.e., individuals (women) were nested in household
159 and household were nested in cluster. The unit of analysis for the characteristics of community-
160 level factors was the cluster. For this study, we included 645 clusters in which all the women
161 whose most recent birth was within two years preceding the survey resides.

162 First, bi-variable two-level mixed effect logistic regression analyses were done to assess the
163 association between the independent variables and dependent variable of the study. The overall
164 categorical variables with a p-value of <0.25 at the bivariate two-level mixed effect logistic
165 regression analysis were included into the final model of multivariable two-level mixed effect
166 logistic regression model in which odds ratio with 95% confidence intervals were estimated to
167 identify the independent variables of institutional delivery. P-values less than 0.05 were
168 employed to declare the statistical significance. Fixed effect and random effect were calculated
169 to assess the individual and cluster variations respectively. Moreover, the frequency table were
170 displayed for the individual and community level variables. All analysis was done on weighted
171 data.

172 In this analysis four models are displayed, null model (model containing no factors), model I
173 (containing only individual factors), model II (containing only community factors) and model
174 III (both individual and community level factors). The fitted model was:

$$175 \log \left[\frac{\pi_{ij}}{1-\pi_{ij}} \right] = \beta_0 + \beta_1 X_{1ij} + \dots \beta_n X_{nij} + u_{0j} + e_{ij},$$

176 Where

- 177 ✓ π_{ij} is the probability of women who delivered at health facility
- 178 ✓ $1 - \pi_{ij}$ the probability of not delivered at health facility
- 179 ✓ β_0 is log odds of the intercept
- 180 ✓ $\beta_1 \dots \beta_n$ are the amount of effect by the individual and community-level variables
- 181 ✓ $X_1 \dots X_n$ are the independent variables at individual and community level
- 182 ✓ u_{oj} is the random error at community(cluster) and
- 183 ✓ e_{ij} is the random error at the individual level.

184 The intra-class correlation (ICC) was calculated as the proportion of the between cluster
185 variation in the total variation:

186
$$ICC = \frac{Var(u_{oj})}{Var(u_{oj}) + \pi^2/3},$$

187 Where,

- 188 ✓ $Var(u_{oj})$ is the community (cluster) level variance.
- 189 ✓ $\pi^2/3$ is the standard logistic distribution, that is, the assumed household variance
190 component, which is $\pi^2/3 \approx 3.29$.

191 The variability on the odds of institutional delivery explained by successive models were
192 calculated by Proportional Change in Variance (PCV) as:

193
$$PCV = \frac{V_e - V_{mi}}{V_e},$$

194 Where,

- 195 ✓ V_e is the variance in institutional delivery in the null model.
- 196 ✓ V_{mi} the variances in the successive models.

197 Results

198 Individual level women characteristics of the survey

199 Majority (61.09%) of the women of reproductive age in Ethiopia who gave birth in the two
 200 years preceding the survey did not attend formal education. More than seventy five percent of
 201 the women were unemployed. Still there is great problem of access to health facility in Ethiopia
 202 as majority (61.43%) of the women perceived distance to health facility to get medical help
 203 was big problem. Regarding maternal health services in the last two years only 32.62% percent
 204 of the women attended four and more ante-natal care and 35.6% percent gave birth in health
 205 facility(table 1).

206 Table 1: Individual variables of women aged 15-49 giving birth in the 2 years before the 2016
 207 EDHS (n=3948)

Individual level variables	Categories	Frequency	% unweighted	% weighted
Educational level of women				
	No education	2373	60.1	61.09
	Primary	1086	27.5	30.34
	Secondary	323	8.2	5.83
	Higher	166	4.2	2.74
Wealth index				
	Poorest	1417	35.9	23.92
	Poorer	662	16.8	22.06
	Middle	558	14.1	20.93
	Richer	496	12.6	18.53
	Richest	815	20.6	14.55
Perceived distance to health facility to get medical help				
	Not big problem	1779	45.1	38.57
	Big problem	2169	54.9	61.43
women's employment status				
	No	2958	74.9	75.23
	Yes	990	25.1	24.77
Number of ANC visit				
	<4	2527	64.0	67.38
	4+	1421	36.0	32.62
Delivery by caesarean section				
	No	3818	96.7	97.4
	Yes	130	3.3	2.60
Place of delivery				
	Home	2382	60.3	64.78
	Health facility	1566	39.7	35.22

208

209 **Community level characteristics of the survey**

210 More than eighty eight percent of the clusters were from rural areas of Ethiopia. While, sixty
 211 percent of them were classified under higher community level wealth status. There is also about
 212 75% community level of antenatal care coverage and women’s unemployment status revealed.
 213 One in three clusters perceived the distance to Health facility to get medical help at the
 214 community level is a big problem (table 2).

215 **Table 2:** Community level variables of women aged 15-49 giving birth in the 2 years before survey
 216 (n=3948)

Community level variables	Categories	n	Unweighted %	Weighted %
Administrative regions	Tigray	409	10.4	6.83
	Afar	379	9.6	1.00
	Amhara	365	9.2	18.27
	Oromia	612	15.5	45.10
	Somali	521	13.2	4.21
	Benishangul	313	7.9	1.03
	SNNPR	477	12.1	20.40
	Gambela	264	6.7	0.24
	Harari	221	5.6	0.23
	Dire Dawa	182	5.2	2.30
	Addis Ababa	205	4.6	0.41
Place of residence	Urban	767	19.4	11.34
	Rural	3181	80.6	88.66
Community level wealth	low	2017	51.1	40.33
	High	1931	48.9	59.67
Community level ANC coverage				
	low	2687	68.1	74.95
	High	1261	31.9	25.05
Community level women's employment				
	low	2854	72.3	75.49
	High	1094	27.7	24.51
Community level women's education				
	low	1874	47.5	61.43
	high	1541	39.0	38.57
Perceived distance to Health facility to get medical help at the community level				
	Not big problem	1506	38.1	30.02
	Big problem	2442	61.9	69.98

217

218

219 **Multi-variable multilevel analyses**

220 A two-level mixed effects logistic regression model was used to analyse the effects of
221 community characteristics and women's individual-level factors in post-natal care services
222 utilization in Ethiopia.

223 As depicted in the empty model, 36.5% of the total variance in the odds of postnatal care
224 utilization was accounted for by between-cluster/communities variation of characteristics (ICC
225 = 0.365). The between-cluster variability declined over successive models, from 36.5% in the
226 empty model to 7.1 % in individual-level only model, 6.8% in community-level only model,
227 and 1% in the combined model. Accordingly, the combined model of individual-level, and
228 community-level factors was selected for determining postnatal care services utilization.

229 **Maternal level predictors of timely postnatal care service utilization**

230 The details of effect sizes of both individual and community-level factors on odds of postnatal
231 care service utilization are described in Tables 3 and 4. Delivery by caesarean section were
232 independently and significantly associated with postnatal care utilization.

233 After adjusting for individual and community-level factors, the odds of using postnatal care
234 was 1.66 times OR 1.66 (95% CI 1.10, 2.50) higher among women gave birth by caesarean
235 section compared to their counter parts. Similarly, women who gave birth at health facility
236 were twice higher odds of using postnatal care OR 2.14 (95% CI 1.70, 2.70) as compared those
237 delivered at home (table 3).

238

239

240 Table 3: Multilevel mixed-effect logistic regression results of individual and community level
 241 factors associated with timely use of postnatal care in Ethiopia, 2016 EDHS.

Variables/ characteristics	Null model	Model I	Model II	Model III
		Individual characteristics	Community level characteristics	Individual and community level characteristics
		OR (95% C I)	OR (95% C I)	OR (95% C I)
Educational level of women				
No education ^(Ref)		1		
Primary		0.97(0.78, 1.21)		0.92(0.73, 1.14)
Secondary		1.15(0.84, 1.59)		1.04(0.75, 1.46)
Higher		1.55(1.02, 2.34) *		1.40(0.92, 2.14)
Household wealth				
Poorest ^(ref)		1		
Poorer		1.38(1.03, 1.85) *		1.14(0.83, 1.56)
Middle		1.40(1.03, 1.90) *		0.97(0.68, 1.38)
Richer		1.43(1.05, 1.97) *		0.99(0.68, 1.43)
Richest		2.59(1.90, 3.53) ***		1.29(0.82, 2.01)
Perceived distance to Health facility to get medical help				
Not big problem ^(ref)		1		
Big problem		0.75(0.62, 0.91) **		1.0(0.79, 1.26)
Number of ANC visit during pregnancy				
<4 visit ^(ref)		1		
4+ Visit		1.26(1.04, 1.53) *		0.95(0.76, 1.18)
Delivery by caesarean section				
No ^(ref)		1		
Yes		1.76(1.18, 2.63) **		1.66(1.10, 2.50) *
Place of delivery				
Not at health facility		1		
Health facility		2.84(2.27, 3.55) ***		2.14(1.70, 2.70) ***

242 *P<0.05, ** P<0.001, ***P<0.0001

243 Community level predictors of timely postnatal care service utilization

244 There is significant administrative regional variation in postnatal care use. The conspicuous
 245 observation to emerge from the data comparison was in Oromia 69%, Somali 56%,
 246 Benishangul 55%, SNNPR 43%, Gambela 66%, Afar 50% and Dire Dawa 55% which less
 247 likely to utilize postnatal care utilization as compared to Addis Ababa city administrative area.
 248 While there is no significant difference between residents of Harari city, Amhara regional state
 249 and Tigray regional state as compared to Addis Ababa city. Community level wealth and

250 antenatal care coverage were also found to be significant determinants of postnatal care
 251 utilization. Community level wealth was 1.4 times OR 1.44 (95% C.I 1.08, 1.2) and community
 252 level antenatal care coverage were 1.5 times OR 1.52 (95% C.I 1.19, 1.96) more likely to use
 253 post-natal care utilization. Perceived community level distance of health facility as a big
 254 problem was found to be highly significant determinants of postnatal care. A community who
 255 perceived the distance to health facility as a big problem were 22% less likely OR 0.78 (95%
 256 C.I 0.60, 0.99) to utilize postnatal care as compared to their counter parts (table 4).

257 Table 4: Multilevel mixed-effect logistic regression results of individual and community level
 258 predictors of postnatal care in Ethiopia, 2016.

Variables/ characteristics	Null model	Model I	Model II	Model III
		Individual characteristics	Community level characteristics	Individual and community level characteristics
Administrative regions				
Tigray			1.31(0.82, 2.10)	1.35(0.88, 2.07)
Afar			0.38(0.21, 0.68) **	0.50(0.29, 0.87) *
Amhara			0.49(0.29, 0.83) **	0.63(0.39, 1.03)
Oromia			0.24(0.14, 0.42) ***	0.31(0.19, 0.50) ***
Somali			0.32(0.18, 0.56) ***	0.44(0.26, 0.73) **
Benishangul			0.36(0.21, 0.63) ***	0.45(0.28, 0.79) **
SNNPR			0.47(0.29, 0.78) **	0.57(0.36, 0.90) **
Gambela			0.27(0.15, 0.48) ***	0.34(0.20, 0.58) *
Harari			1.06(0.62, 1.80)	1.10(0.68, 1.79)
Dire Dawa			0.49(0.29, 0.83) **	0.55(0.34, 0.89) *
Addis Ababa ^(ref)			1	
Place of residence				
Urban ^(ref)			1	
Rural			0.60(0.44, 0.82) **	0.94(0.65, 1.37)
Community level wealth				
low ^(ref)			1	
High			1.60(1.21, 2.13) **	1.44(1.08, 1.2) *
Community level ANC coverage				
low ^(ref)			1	
High			1.73(1.34, 2.25) ***	1.52(1.19, 1.96) **
Community level perceptions of distance to HF				
Not big problem ^(ref)			1	
Big problem			0.70(0.54, 0.90) **	0.78(0.60, 0.99) **

259 *P<0.05, ** P<0.001, ***P<0.0001

260

Random effects	Model 0	Model 1	Model 2	Model 3
ICC (%)	36.5%	7.1%	6.8%	1%
PCV	Reference	81%	81.4%	97%
Model fitness				
Log likelihood	-1883.6	-1736.0	-1633.2	-1536.0

261

262 **Discussion**

263 Postnatal care is an indispensable intervention in safe motherhood through early identification
 264 and management complications which is fatal for the mother and new-borns. Although Ethiopia
 265 recently has a great achievement in maternal and child mortality reduction, still there is high
 266 maternal mortality ratio and perinatal mortality rate largely due to low postnatal care coverage
 267 in which large proportion of maternal and child mortality occurs. Therefore, identifying
 268 individual characters and community level determinants of postnatal care has a great
 269 contribution designing different interventions for improving maternal and child health.

270 This study found different individual and community-level determinants of postnatal care
 271 service utilization were identified. In this study 36.5% of the total variance in the odds of
 272 postnatal care utilization was accounted for the characteristics between-cluster variation. While
 273 7.1 % in individual-level and 6.8% in community-level variation were identified. We found
 274 much higher values than a cross-sectional study in remote and poorest rural communities of
 275 Zambia in 2012, which revealed 22% and study in Nigeria 10.35% [23], variance in the use of
 276 PNC within 48 hours were attributable to the variations across community clusters[24]. This
 277 implies the issues of equity in postnatal care services for availability and accessibility were still
 278 great challenge for community.

279 This study found that women who gave birth by caesarean section were 1.66 times higher odds
 280 of using postnatal care services within the first two days compared to those gave birth by
 281 another mode of delivery. This is in a good agreement with the study in rural Tanzania in 2015

282 revealed caesarean section delivery was positively associated with postnatal care use[25]. This
283 might be women's who gave birth by caesarean section stay at the facility for about two days
284 for which they receive postnatal check-up.

285 In another way, women who gave birth at health facility were twice more likely to utilize
286 postnatal care as compared those delivered at home. This substantiates previous findings in the
287 study in different parts of Ethiopia like Tigray and SNNPR, [7-9, 25] and Tanzania[25]. This
288 might be clients who visit health facility would have different health seeking behaviours with
289 those never attended health facility.

290 There is significant administrative regional variation in postnatal care use in Oromia, Somali,
291 Benishangul, SNNPR, Gambela, Afar and Dire Dawa which less likely to utilize postnatal care
292 utilization as compared to Addis Ababa city administrative area. While there is no significant
293 difference between residents of Harari city, Amhara regional state and Tigray regional state as
294 compared to Addis Ababa city. Variation in postnatal care service utilization varies was also
295 observed in different parts of Ethiopia[7, 8, 17, 18, 26] and West African countries[27]. There
296 are several possible explanations for this finding, first the difference in geographic accessibility
297 of the postnatal care services due to topography and unfavourable roads for the mothers in rural
298 areas of Ethiopia; second, there were difference in local cultures and beliefs in different areas
299 of the country; third, difference in urbanized geographical areas among different regions.

300 Being in the higher community level antenatal care coverage were 1.5 times more likely to
301 utilize post-natal care services. Our findings appear to be well supported by a multilevel
302 analysis of DHS in sub-Saharan Africa in 2014, which found significant associations between
303 four or more antenatal care visits and ever breastfed with both outcomes[28]. The results point
304 to the likelihood of information diffusion for postnatal care utilization in the community.

305 Being resident of higher community level wealth was 1.4 times more likely to utilize post-natal
306 care services. This concurs well with the study in West Africa in 2018, which revealed

307 community level poverty was a significant determinants of postnatal care use[27]. This would
308 appear to indicate that wealthy community were more probability of getting health information
309 and reside in urban areas.

310 A community who perceived the distance to health facility as a big problem were 22% less
311 likely to utilize postnatal care as compared to their counter parts. We believe that no other
312 authors have found that postnatal care utilization is less likely in the community who perceived
313 the distance of health facility as a big problem. There is a good probability that community
314 telling can influence any health care service utilization.

315 This study provides strong evidence in utilizing community based representative data of DHS
316 and the use of multilevel mixed-effects analysis which bring disaggregated data on individual
317 characteristics and community level determinants for designing contextual interventions.

318 We aware that our research may have two limitations. The first is findings are based on
319 quantitative data only which cannot explore the detailed reasons in the community for low level
320 of postnatal care use. The second is excluding men's and other community level significant
321 others view, may not give fully address the community level determinants. These limitations
322 are evidence of the DHS women's data not inclusive of the above problems.

323 **Conclusion**

324 Our work has led us to the conclusion that less than one in five women utilized postnatal care
325 in the last two years before the survey in Ethiopia. Institutional delivery and giving birth by
326 caesarean section were found to be individual level determinants while administrative regions,
327 community level wealth, community level antenatal care coverage and perceived distance of
328 the health facility as a big problem were community level determinants.

329 Federal ministry of health maternal health directorate should realize the equity in postnatal care
330 services among administrative regions of the country. Public health interventions on maternal

331 health should give priority for mothers never attended antenatal care visits, those who gave
332 birth at home and who gave spontaneous vaginal delivery. Exploring community level
333 determinants in different areas of the country using qualitative data with the inclusion male
334 responses were recommended for scientific communities.

335 **Declarations**

336 **Ethics approval and consent to participate:** the EDHS program was conducted the survey
337 after getting necessary ethical reviews at country level and obtained necessary permission as
338 an organization to conduct the survey. Privacy and confidentiality of every individuals
339 interviewed was maintained.

340 **Consent for publication and availability of data:** the data was obtained after necessary
341 agreement to publish for this research title from MEASURE DHS database at
342 <https://dhsprogram.com/data/available-datasets.cfm>

343 **Competing interests:** The authors declare that they have no competing interests.

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353 **List of Abbreviations**

354 **AOR:** Adjusted Odds Ratio, **ANC:** Antenatal Care, **CI:** Confidence Interval, **EDHS:**
355 Ethiopian Demography and Health Survey, **HF:** Health Facility, **HH:** Household, **ICC:** Intra
356 Class Correlation, **MEASURE DHS:** Monitoring and Evaluation to Assess and Use Results
357 Demographic and Health Surveys, **PCV:** Proportional Change in Variance, **PNC:** Postnatal
358 Care, **SDG:** Sustainable Development Goal, **SNNPR:** Southern Nations, Nationalities, and
359 Peoples' Region.

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