

# Supplementary File

**Table A.1:** The WHO recommended immunization schedules for four core vaccines

Vaccine	Age of the first dose	Interval between doses	
		First and second	Second and third
<b>Bacillus Calmette-Guérin (BCG)</b>	As soon as possible after birth		
<b>Diphtheria-tetanus-pertussis (DTP)</b>	6 weeks (Min†)	4 weeks (Min)	4 weeks (Min)
<b>Polio</b>	6 weeks (Min)	4 weeks (Min)	4 weeks (Min)
<b>Measles</b>	39 weeks (Min)		

Adopted from:

[http://www.who.int/immunization/policy/Immunization\\_routine\\_table2.pdf?ua=1](http://www.who.int/immunization/policy/Immunization_routine_table2.pdf?ua=1)

†Min: Minimum

**Table A.2:** Survey year, sample size and GNI per capita for the sampled countries

Country	Code	Survey year	Sample size		GNI per capita (current US\$)†
			Household	Children (10-59 months)	
<b>Low-income countries (LICs)‡</b>					
Bangladesh	BD	2014	17,300	6,384	1,080
Benin	BJ	2011-12	17,422	10,490	780
Burkina Faso	BF	2010	14,424	11,255	610
Burundi	BI	2010	8,596	6,051	200
Cambodia	KH	2014	15,825	5,755	1,020
Comoros	KM	2012	4,482	2,453	770
Congo Democratic Republic	CD	2013-14	18,171	13,990	375
Ethiopia	ET	2011	16,702	8,843	390
Gambia	GM	2013	6,217	6,216	500
Guinea	GN	2012	7,109	5,165	430
Haiti	HT	2012	13,181	5,457	750
Liberia	LR	2013	9,333	5,781	370
Malawi	MW	2010	24,825	15,256	350
Mali	ML	2012-13	10,105	7,799	610
Mozambique	MZ	2011	13,919	8,428	480
Nepal	NP	2011	10,826	4,189	610
Niger	NE	2012	10,750	9,403	390
Rwanda	RW	2014-15	12,699	6,194	700
Sierra Leone	SL	2013	12,629	8,664	500
Tajikistan	TJ	2012	6,432	4,049	890
Tanzania	TZ	2010	9,623	6,204	700
Togo	TG	2013-14	9,549	5,414	545
Uganda	UG	2011	9,033	6,033	610
Zimbabwe	ZW	2010-11	9,756	4,102	595
<b>Lower-middle-income countries (IMICs)‡</b>					
Armenia	AM	2010	6,700	1,193	3,370
Cameroon	CM	2011	14,214	8,752	1,210
Congo Brazzaville	CG	2011-12	11,632	7,185	2,370
Cote d'Ivoire	CI	2011-12	9,686	5,734	1,205
Egypt	EG	2014	28,175	12,654	3,210
Ghana	GH	2014	11,835	4,578	1,590
Honduras	HN	2011-12	21,362	8,755	2,145
Indonesia	ID	2012	43,852	14,384	3,580
Kenya	KE	2014	36,430	16,883	1,290
Kyrgyz Republic	KG	2012	8,040	3,436	1,040
Nigeria	NG	2013	38,522	23,372	2,700

<b>Pakistan</b>	<b>PK</b>	2012-13	12,943	9,141	1,310
<b>Philippines</b>	<b>PH</b>	2013	14,804	5,862	3,340
<b>Senegal</b>	<b>SN</b>	2014	4,231	10,832	1,050
<b>Yemen</b>	<b>YE</b>	2013	17,351	12,565	1,060
<b>Zambia</b>	<b>ZM</b>	2013-14	15,920	10,630	1,700
<b>Upper-middle-income countries (uMICs)‡</b>					
<b>Colombia</b>	<b>CO</b>	2010	51,447	14,736	5,540
<b>Dominican Republic</b>	<b>DO</b>	2013	11,464	3,045	5,860
<b>Gabon</b>	<b>GA</b>	2012	9,755	4,646	9,460
<b>Jordan</b>	<b>JO</b>	2012	15,190	8,595	4,660
<b>Namibia</b>	<b>NA</b>	2013	9,849	3,914	5,740
<b>Peru</b>	<b>PE</b>	2012	27,218	7,982	5,650
<b>Total</b>			709,528	372,499	

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† The gross national income (GNI), converted to U.S. dollars using the World Bank Atlas method.

‡ The 2016 World Bank classification of the world's economies is used to categories sampled countries into LICs, IMICs, uMICs groups. The World Bank classification is based on the GNI per capita, calculated using the World Bank Atlas method.

**Table A.3:** The percentage of children who received all four core vaccines in 46 developing countries by gender and region.

Country	Total	Gender			Region		
		Male	Female	Male-Female§	Urban	Rural	Urban-Rural
<b>Low-income countries (LICs)</b>							
Bangladesh	84.4	84.5	84.4	0.1	86.9	83.6	3.3†
Benin	37.1	36.8	37.4	-0.6	38.9	35.9	3.0
Burkina Faso	75.9	76.0	75.9	0.2	78.5	75.4	3.1
Burundi	81.5	81.9	81.0	0.9	81.9	81.5	0.4
Cambodia	80.3	79.9	80.8	-0.9	88.8	78.8	10.0†
Comoros	51.8	50.9	52.8	-1.9	54.0	51.0	3.0
Congo Democratic Republic	43.3	43.4	43.2	0.2	49.8	40.4	9.4†
Ethiopia	23.9	23.8	24.1	-0.3	42.5	21.2	21.2†
Gambia	74.4	75.7	72.9	2.8†	67.0	81.2	-14.2†
Guinea	35.6	35.4	35.7	-0.3	41.3	33.5	7.8†
Haiti	47.4	47.8	47.0	0.8	46.6	47.8	-1.2
Liberia	47.8	47.3	48.4	-1.2	52.9	42.7	10.2†
Malawi	75.5	75.7	75.3	0.4	69.7	76.5	-6.7†
Mali	34.4	35.1	33.8	1.3	40.8	32.9	8.0†
Mozambique	61.5	61.4	61.5	0.0	69.1	58.5	10.5†
Nepal	87.5	88.6	86.3	2.2	89.1	87.3	1.8
Niger	49.1	49.0	49.1	-0.2	66.1	46.3	19.7†
Rwanda	36.3	35.6	36.9	-1.4	36.8	36.2	0.6
Sierra Leone	68.6	68.1	69.0	-0.9	69.0	68.5	0.5
Tajikistan	82.3	82.9	81.6	1.3	80.2	82.9	-2.7
Tanzania	76.8	78.3	75.5	2.8†	85.5	74.7	10.8†
Togo	55.2	56.1	54.3	1.8	57.2	54.0	3.3
Uganda	51.8	52.3	51.2	1.2	60.1	50.4	9.7†
Zimbabwe	68.0	66.6	69.4	-2.7	73.7	65.6	8.0†
Total‡	58.3	58.5	58.0	0.5	64.9	56.4	8.5†
<b>Lower-middle-income countries (LMICs)</b>							
Armenia	86.1	85.9	86.4	-0.4	87.1	84.8	2.3
Cameroon	54.8	54.1	55.4	-1.2	63.5	48.1	15.4†
Congo Brazzaville	41.1	42.9	39.3	3.5	45.7	34.1	11.6†
Cote d'Ivoire	47.6	49.3	46.0	3.3	55.6	42.8	12.9†
Egypt	46.4	46.1	46.8	-0.7	50.3	44.7	5.6†
Ghana	71.4	71.9	70.9	1.1	69.5	73.0	-3.5
Honduras	87.5	88.3	86.6	1.7	85.6	89.0	-3.4†
Indonesia	64.4	64.6	64.2	0.3	69.4	59.3	10.1†
Kenya	69.1	69.4	68.7	0.7	68.7	69.3	-0.5
Kyrgyz Republic	75.8	75.5	76.2	-0.7	68.5	78.8	-10.4†

<b>Nigeria</b>	24.2	24.6	23.9	0.7	40.1	15.3	24.8†
<b>Pakistan</b>	55.3	56.2	54.3	1.9	64.8	51.3	13.6†
<b>Philippines</b>	77.4	77.2	77.6	-0.4	80.6	74.6	6.0†
<b>Senegal</b>	71.7	71.7	71.7	-0.1	71.7	71.7	0.0
<b>Yemen</b>	42.5	42.6	42.3	0.3	59.9	35.9	24.0†
<b>Zambia</b>	71.0	71.3	70.8	0.4	76.2	68.4	7.8†
<b>Total‡</b>	52.9	53.3	52.4	0.9	61.7	47.6	14.1†
<b>Upper-middle-income countries (uMICs)</b>							
<b>Colombia</b>	69.0	69.6	68.4	1.1	69.4	68.1	1.3
<b>Dominican Republic</b>	45.6	47.0	44.2	2.7	44.8	48.2	-3.5
<b>Gabon</b>	16.0	17.6	14.3	3.3†	15.7	17.3	-1.6
<b>Jordan</b>	95.5	95.5	95.6	-0.1	95.8	94.2	1.6
<b>Namibia</b>	58.9	59.1	58.7	0.5	52.5	65.4	-12.9†
<b>Peru</b>	63.7	64.3	62.9	1.4	64.3	62.4	2.0
<b>Total‡</b>	68.0	68.6	67.4	1.2	68.7	66.3	2.4†
<b>Total‡</b>	55.5	55.8	55.1	0.7	63.1	51.7	11.4†

† Statistically significant values at p-value= 5% based on Chi-squared test.

‡ A de-normalized standard weight (as per the DHS Sampling and Household Listing Manual (*Reference*: ICF International, 2012. Demographic and Health Survey Sampling and Household Listing Manual. MEASURE DHS, ICF International, Calverton, Maryland, USA) was used as a weight in the calculation.

**Table A.4:** Socioeconomic inequalities in child vaccination coverage in 46 developing countries: The AC results

Country	Code	Absolute concentration index			
		Total	Urban	Rural	Urban-Rural
<b>Low-income countries (LICs)</b>					
Bangladesh	BD	0.131 (0.094 to 0.167)	0.095 (0.054 to 0.136)	0.144 (0.101 to 0.187)	-0.049 (-0.109 to 0.01)
Benin	BJ	0.085 (0.048 to 0.123)	0.078 (0.02 to 0.137)	0.073 (0.03 to 0.116)	0.005 (-0.068 to 0.078)
Burkina Faso	BF	0.098 (0.061 to 0.135)	0.034 (-0.022 to 0.089)	0.111 (0.072 to 0.149)	-0.077 (-0.144 to -0.009)
Burundi	BI	0.019 (-0.012 to 0.05)	0.028 (-0.103 to 0.159)	0.016 (-0.016 to 0.049)	0.012 (-0.123 to 0.147)
Cambodia	KH	0.187 (0.149 to 0.226)	0.121 (0.065 to 0.177)	0.176 (0.132 to 0.22)	-0.056 (-0.127 to 0.015)
Comoros	KM	0.232 (0.158 to 0.306)	0.111 (-0.013 to 0.234)	0.28 (0.195 to 0.365)	-0.169 (-0.319 to -0.019)
Congo Democratic Republic	CD	0.187 (0.144 to 0.23)	0.238 (0.172 to 0.304)	0.147 (0.097 to 0.198)	0.091 (0.008 to 0.174)
Ethiopia	ET	0.16 (0.116 to 0.205)	0.401 (0.309 to 0.493)	0.077 (0.035 to 0.119)	0.324 (0.222 to 0.425)
Gambia	GM	-0.111 (-0.17 to -0.052)	-0.063 (-0.147 to 0.021)	0.053 (0.013 to 0.093)	-0.116 (-0.209 to -0.023)
Guinea	GN	0.112 (0.057 to 0.166)	0.04 (-0.053 to 0.133)	0.093 (0.042 to 0.144)	-0.053 (-0.159 to 0.053)
Haiti	HT	0.045 (-0.008 to 0.098)	0.068 (-0.003 to 0.14)	0.076 (0.009 to 0.142)	-0.007 (-0.105 to 0.09)
Liberia	LR	0.191 (0.126 to 0.255)	0.127 (0.045 to 0.208)	0.205 (0.153 to 0.258)	-0.078 (-0.175 to 0.018)
Malawi	MW	0.021 (-0.008 to 0.05)	-0.003 (-0.075 to 0.068)	0.062 (0.037 to 0.087)	-0.065 (-0.141 to 0.01)
Mali	ML	0.116 (0.069 to 0.163)	0.037 (-0.031 to 0.106)	0.099 (0.043 to 0.154)	-0.061 (-0.149 to 0.027)
Mozambique	MZ	0.186 (0.139 to 0.233)	0.015 (-0.066 to 0.097)	0.191 (0.14 to 0.242)	-0.176 (-0.272 to -0.08)
Nepal	NP	0.099 (0.051 to 0.148)	0.14 (0.086 to 0.193)	0.097 (0.042 to 0.152)	0.043 (-0.035 to 0.12)
Niger	NE	0.253 (0.217 to 0.288)	0.085 (0.018 to 0.151)	0.211 (0.173 to 0.249)	-0.126 (-0.202 to -0.05)
Rwanda	RW	0.119 (0.074 to 0.164)	0.073 (-0.018 to 0.164)	0.081 (0.032 to 0.13)	-0.008 (-0.111 to 0.096)
Sierra Leone	SL	0.119 (0.074 to 0.164)	0.073 (-0.018 to 0.164)	0.081 (0.032 to 0.13)	-0.008 (-0.111 to 0.096)
Tajikistan	TJ	0.119 (0.074 to 0.164)	0.073 (-0.018 to 0.164)	0.081 (0.032 to 0.13)	-0.008 (-0.111 to 0.096)
Tanzania	TZ	0.119 (0.074 to 0.164)	0.073 (-0.018 to 0.164)	0.081 (0.032 to 0.13)	-0.008 (-0.111 to 0.096)
Togo	TG	0.022 (-0.036 to 0.081)	0.153 (0.08 to 0.226)	-0.069 (-0.131 to -0.007)	0.222 (0.127 to 0.318)
Uganda	UG	0.066 (0.02 to 0.112)	0.03 (-0.069 to 0.128)	0.034 (-0.016 to 0.083)	-0.004 (-0.114 to 0.107)
Zimbabwe	ZW	0.149 (0.101 to 0.197)	0.104 (0.039 to 0.169)	0.135 (0.079 to 0.192)	-0.031 (-0.117 to 0.054)
<b>Lower-middle-income countries (LMICs)</b>					

<b>Armenia</b>	<b>AM</b>	-0.008 (-0.069 to 0.053)	-0.004 (-0.077 to 0.069)	-0.066 (-0.149 to 0.016)	0.062 (-0.048 to 0.173)
<b>Cameroon</b>	<b>CM</b>	0.271 (0.215 to 0.326)	0.145 (0.089 to 0.201)	0.259 (0.188 to 0.331)	-0.114 (-0.205 to -0.024)
<b>Congo Brazzaville</b>	<b>CG</b>	0.141 (0.085 to 0.198)	0.036 (-0.045 to 0.117)	0.132 (0.073 to 0.191)	-0.096 (-0.196 to 0.005)
<b>Cote d'Ivoire</b>	<b>CI</b>	0.154 (0.094 to 0.213)	0.156 (0.075 to 0.237)	0.037 (-0.03 to 0.105)	0.118 (0.013 to 0.224)
<b>Egypt</b>	<b>EG</b>	0.095 (0.029 to 0.161)	0.078 (0.001 to 0.155)	0.217 (0.084 to 0.35)	-0.139 (-0.293 to 0.014)
<b>Ghana</b>	<b>GH</b>	0.112 (0.057 to 0.166)	0.04 (-0.053 to 0.133)	0.093 (0.042 to 0.144)	-0.053 (-0.159 to 0.053)
<b>Honduras</b>	<b>HN</b>	-0.012 (-0.035 to 0.012)	0.038 (-0.006 to 0.082)	0.005 (-0.023 to 0.033)	0.033 (-0.019 to 0.085)
<b>Indonesia</b>	<b>ID</b>	0.241 (0.211 to 0.271)	0.155 (0.115 to 0.194)	0.272 (0.23 to 0.313)	-0.117 (-0.175 to -0.059)
<b>Kenya</b>	<b>KE</b>	0.191 (0.126 to 0.255)	0.127 (0.045 to 0.208)	0.205 (0.153 to 0.258)	-0.078 (-0.175 to 0.018)
<b>Kyrgyz Republic</b>	<b>KG</b>	-0.166 (-0.223 to -0.11)	-0.206 (-0.308 to -0.104)	-0.111 (-0.176 to -0.047)	-0.095 (-0.216 to 0.026)
<b>Nigeria</b>	<b>NG</b>	0.402 (0.38 to 0.424)	0.284 (0.234 to 0.333)	0.292 (0.263 to 0.322)	-0.009 (-0.066 to 0.049)
<b>Pakistan</b>	<b>PK</b>	0.38 (0.323 to 0.437)	0.189 (0.115 to 0.263)	0.431 (0.368 to 0.493)	-0.241 (-0.338 to -0.145)
<b>Philippines</b>	<b>PH</b>	0.119 (0.074 to 0.164)	0.073 (-0.018 to 0.164)	0.081 (0.032 to 0.13)	-0.008 (-0.111 to 0.096)
<b>Senegal</b>	<b>SN</b>	0.119 (0.074 to 0.164)	0.073 (-0.018 to 0.164)	0.081 (0.032 to 0.13)	-0.008 (-0.111 to 0.096)
<b>Yemen</b>	<b>YE</b>	0.333 (0.293 to 0.373)	0.185 (0.121 to 0.249)	0.226 (0.175 to 0.277)	-0.041 (-0.123 to 0.041)
<b>Zambia</b>	<b>ZM</b>	0.123 (0.093 to 0.154)	0.127 (0.082 to 0.172)	0.076 (0.041 to 0.11)	0.051 (-0.006 to 0.108)
<b>Upper-middle-income countries (uMICs)</b>					
<b>Colombia</b>	<b>CO</b>	0.031 (0.005 to 0.057)	0.013 (-0.018 to 0.044)	0.105 (0.06 to 0.149)	-0.092 (-0.146 to -0.037)
<b>Dominican Republic</b>	<b>DO</b>	0.095 (0.029 to 0.161)	0.078 (0.001 to 0.155)	0.217 (0.084 to 0.35)	-0.139 (-0.293 to 0.014)
<b>Gabon</b>	<b>GA</b>	0.013 (-0.026 to 0.052)	0.005 (-0.039 to 0.049)	0.123 (0.046 to 0.201)	-0.118 (-0.207 to -0.029)
<b>Jordan</b>	<b>JO</b>	0.025 (-0.004 to 0.055)	0.015 (-0.018 to 0.049)	0.066 (0.021 to 0.11)	-0.05 (-0.106 to 0.006)
<b>Namibia</b>	<b>NA</b>	-0.09 (-0.141 to -0.039)	-0.029 (-0.102 to 0.044)	0.03 (-0.028 to 0.087)	-0.059 (-0.152 to 0.034)
<b>Peru</b>	<b>PE</b>	-0.008 (-0.048 to 0.032)	0.019 (-0.026 to 0.064)	-0.109 (-0.187 to -0.03)	0.128 (0.038 to 0.219)
<b>Median (IQR)</b>		0.119 (0.142; 0.045–0.187)	0.105 (0.13; 0.052–0.182)	0.131 (0.166; 0.027–0.193)	0.022 (0.048; 0.003–0.05)

**Note:** The AC values were calculated by multiplying the C by  $4\mu$ . This index ranges from  $-1$  to  $+1$ , with zero indicating “perfect equality”; 95% confidence intervals in parentheses.



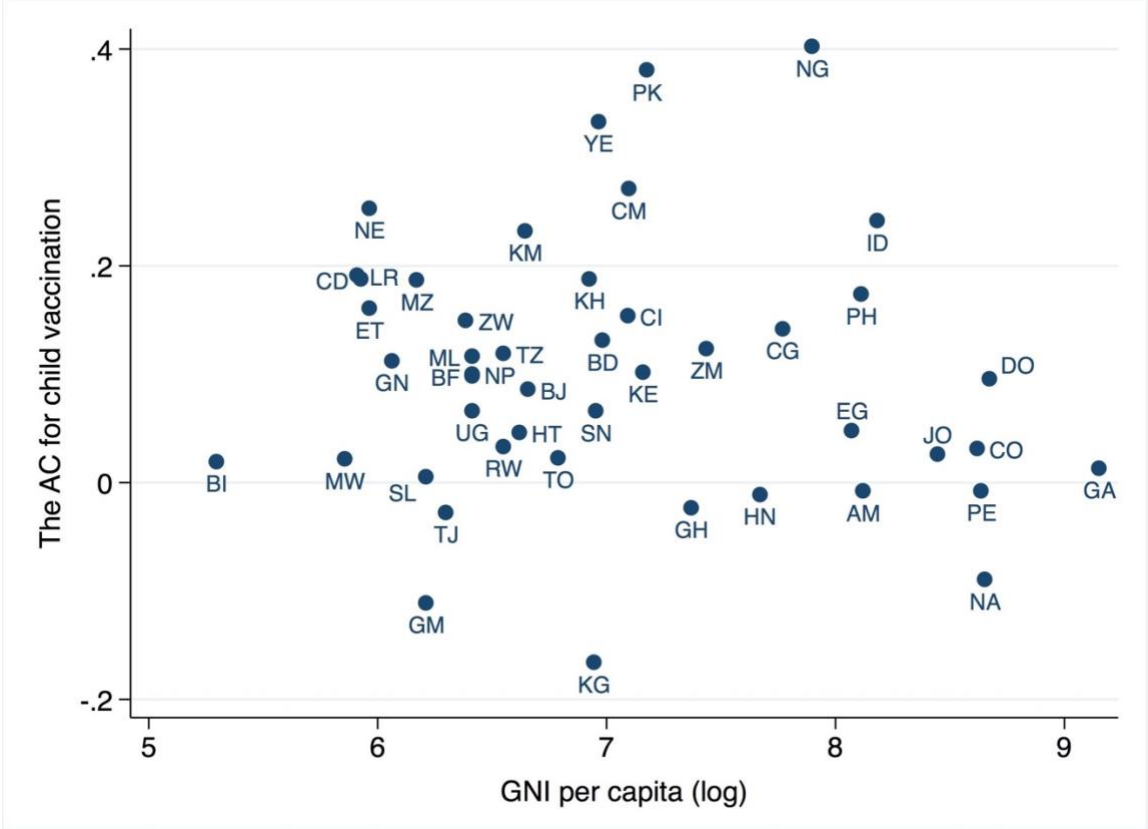
**Table A.5:** Meta-regression analysis results using the AC as the dependent variable

Explanatory variables	The AC for child vaccination				
	Univariate meta-regression			Multivariate meta-regression	
	Coefficient	P-value	Adjusted R <sup>2</sup> (%)	Coefficient	P-value
<b>Absolute Gini index (log)†</b>	-0.011 (-0.054 to 0.031)	0.59	-1.66	-	-
<b>The AC for mother's educational level (year)</b>	0.173 (0.075 to 0.272)	0.001	21.02	0.134 (0.055 to 0.213)	0.001
<b>The AC for mother's age at birth - less than 19</b>	0.157 (-1.049 to 1.362)	0.795	-2.17	0.362 (-0.42 to 1.144)	0.355
<b>The AC for number of children (less than 5 years old) 3 and above</b>	0.005 (-0.719 to 0.729)	0.989	-2.35	0.664 (0.189 to 1.14)	0.007
<b>The AC for antenatal care coverage (at least 4 visits)</b>	0.618 (0.381 to 0.855)	0.000	38.47	0.471 (0.274 to 0.667)	0.000
<b>Adjusted R<sup>2</sup> (%)</b>				54.15	
<b>N</b>	46				

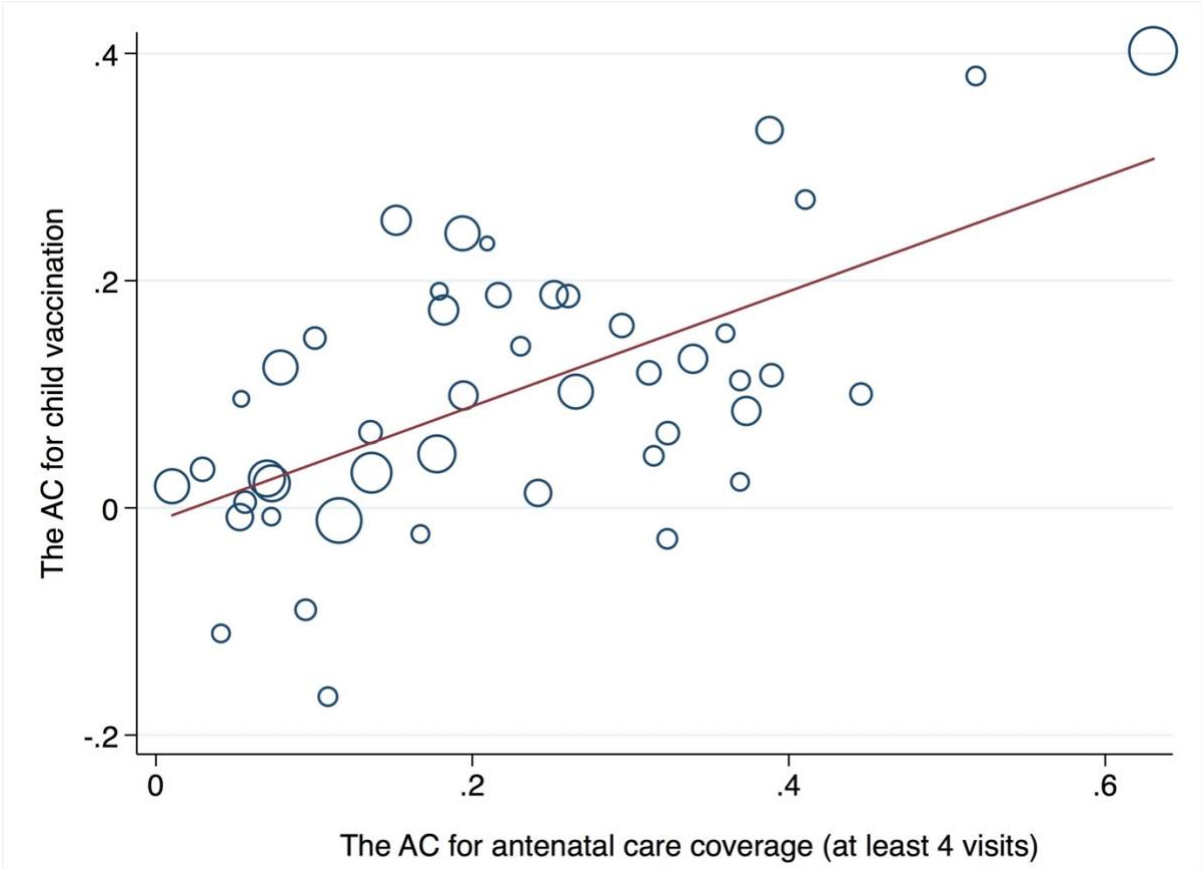
**Note:** 95% confidence intervals shown in parentheses.

†The Gini index is multiplied by GNI per capita to obtain absolute (generalized) Gini index for each country. To correct for excessive skewness, the natural logarithm transformation of absolute (generalized) Gini index was used in the analysis. To avoid collinearity in the multivariate meta-regression, the (log) absolute Gini index was excluded from the analysis because the correlation matrix of the explanatory variables proposed higher correlations between the (log) absolute Gini coefficient and the AC for mother's age 19 and below (-0.66).

**Figure A.1:** Absolute socioeconomic inequalities in child vaccination coverage and Gross National Income (GNI) per capita (current US\$) in 46 developing countries



**Figure A.2:** Bubble-plot of the association between the AC indices for child vaccination and antenatal care coverage (at least 4 visits)



*Note:* the size of the bubbles in the figure is proportional to the weight of each observation in the meta-regression analysis