TITLE
Assessing the Role of Women's Autonomy and Acceptability of Intimate Partner Violence on Maternal Health Care Utilization in 63 Low- and Middle-Income Countries

SHORT RUNNING HEAD
Women's Autonomy and Acceptability of Intimate Partner Violence

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COMPETING INTERESTS
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Abstract

Our study investigates the role of women's autonomy and attitudes towards the acceptability of intimate partner violence against women (IPVAW) on maternal health care utilization outcomes. We combine data from 113 Demographic and Health Surveys (DHS) conducted between 2003 and 2016, which gives us a pooled sample of 765,169 mothers and 777,352 births from 63 countries. We generate composite scores of women's autonomy and acceptability of intimate partner violence against women and assess the associations between these measures and women's use of antenatal care (ANC) services and facility delivery in both the pooled sample as well as for each country. Our findings suggest that strong and significant associations exist between autonomy, normalized IPV, and utilization of maternal healthcare services. In particular, we find that a change in a woman's autonomy score from "no contribution to any decision-making domain" (a composite autonomy score of 0) to "contribution to all decision-making domains" (a score of 6) is associated with a 31.2 percent increase in her odds of delivering in a facility and a 42.4 percent increase in her odds of receiving at least 8 ANC visits over the course of her pregnancy. In contrast, a change in a woman's attitude towards acceptability of IPVAW from "IPVAW is not acceptable under any scenario" (a score of 0) to "IPVAW is acceptable in all scenarios" (a score of 5) is associated with an 8.9 percent decrease in her odds of delivering in a facility and a 20.3 percent decrease in her odds of receiving 8 ANC visits.

Introduction

In spite of the recent global progress that has been made to reduce maternal morbidity and mortality, nearly 830 women continue to die each day from preventable causes related to pregnancy and childbirth, with most of these deaths occurring in low- and middle-income countries (1). The use of antenatal and skilled delivery care is associated with both improved maternal health and reduced maternal deaths related to childbirth, including pre-eclampsia and postpartum hemorrhage; however, utilization of these and other basic maternal health services in such settings remains low (2–6).

A large body of literature has investigated the determinants of poor care-seeking behavior by women, including physical barriers to access (distance to care, lack of transport, etc.), health systems constraints, as well as key demographic and socioeconomic risk factors for low utilization of reproductive health services. In contrast, fewer studies have examined the extent to which sociocultural dimensions that shape women's status and autonomy are related to their use of health services (7). In contexts where inequitable gender norms and practices restrict women's freedom to act in their own interests, it is important to understand how women's relative lack of decision-making power impact their potential to seek and receive care, particularly while they are pregnant (8,9). Discriminatory gendered practices are likely to directly disempower women relative to men – this constraint on women's autonomy is reflected in their observed behavior and limits their interpersonal control over decision-making relative to men. Over time, these gendered practices may become institutionalized and reinforced through the social fabric such that they begin to shape and dictate gender attitudes – as a result, the subordination of women through these practices are subsequently normalized. The acceptability of intimate partner violence against women (IPVAW)

is one example of a general attitude in many societies; for example, in many Sub-Saharan African and South Asian contexts, a husband beating his wife is often accepted and may even be considered a right by both men *and* women (10).

The definition of empowerment has varied in the literature but is generally described as the "expansion in people's ability to make strategic life choices in a context where this ability was previously denied to them" (11); similarly, terms such as women's autonomy, agency, and status have been interchangeably defined, measured, and analyzed (9,12). Empirical studies using Demographic and Health Survey (DHS) data have previously investigated the role of women's empowerment and autonomy on maternal health care use (9,13–15) as well as on fertility and family planning outcomes (14,16). These studies have varied in their country and sample coverage and in the types of proxies that have been used to measure autonomy and empowerment, although most of the proxies did include some indicators of women's involvement in household decision-making with respect to control over household purchases for daily needs, access to health care, and visitation of family and friends. In reviewing the Demographic and Health Survey analyses, we have identified several single-country studies (13,15–17) as well as a few multi-country studies, which have ranged from analyzing data from 8 to 31 countries across Sub-Saharan Africa, South Asia, and Latin America, (14,18,19). However, no analysis, to our knowledge, has investigated the role of women's autonomy and empowerment on maternal health care utilization on a global level.

The acceptability of IPVAW, which reinforces a collective attitude of sanctioning women emotionally, physically, or sexually for deviating from contextually-specified gender roles, is a

global public health concern that has direct implications for maternal health service utilization. To date, empirical studies have found limited and mixed evidence on the relationship between women's acceptability of IPVAW and care-seeking behaviors, particularly with respect to age, marital status, place of residence, and decision-making power (10,20). These studies, which either focused on single or selected multi-country samples, propose that the acceptability of IPVAW may be context-dependent and highlight the cross-country variation how these attitudes relate to actual experience IPVAW (21,22). At a global level, it is likely that the role of gender dynamics in shaping women's well-being extend well beyond their decision-making autonomy around health service utilization. A more comprehensive exploration of these dynamics, particularly as they relate to global attitudes toward IPVAW, may therefore speak to understanding the deeper normative constraints to women's agency, which include their decision to seek and receive care. While DHS surveys may not provide ideal measures of women's autonomy and acceptability of IPVAW, both of which are multidimensional latent constructs that are inherently difficult to conceptualize and even more difficult to measure (10,14,18), they offer a foundation for undertaking a global analysis from which first-stage inferences across countries and within specific sub-groups can be drawn.

In this study, we investigate the role of women's autonomy and acceptability of IPVAW on maternal health care utilization outcomes (antenatal care use and facility delivery). Our study draws on all available recent DHS data from 63 low-and middle-income countries to investigate how gender dynamics are related to women's care-seeking behavior at a global level. Pooling data provides us with sufficient power and sample size to estimate global associations in low- and

middle-income countries. We also conduct several disaggregated analyses by country and present results that are stratified by key sub-groups of interest.

Methods

This proposed analysis was exempt according to guidelines issued by the Population Council Institutional Review Board (IRB).

Study Population

We combine data from 113 DHS surveys that were conducted between 2003 and 2016, resulting in a pooled sample of 765,169 mothers and 777,352 births in 63 countries. The DHS surveys are nationally representative cross-sectional surveys that cover a range of health topics (USAID & ICF Macro International, 2014). All surveys employ a two-stage cluster sampling design, stratifying by region and urban/rural residence and interviewing about 20 to 30 women aged 15 to 49 per primary sampling unit, each of which generally corresponds to a census enumeration area and which is randomly selected within each strata. Figure 1 shows the geographical distribution of the 63 countries that are covered in our sample, and Table A2 in the Supplemental Materials section presents a list of the countries that contributed observations to the final analytic sample.

Outcome Variables

We analyze women's use of antenatal care services (ANC) and delivery in a health facility as primary outcomes. A woman was coded to have received appropriate antenatal care for a given birth if she reported receiving at least eight visits during pregnancy, as previously recommended as minimum number requirement by the World Health Organization (WHO) and considered standard in previous DHS analyses (24). Both variables were coded as binary outcomes for the analysis.

Explanatory Variables

We constructed two scores of women's autonomy and acceptability of IPVAW. A woman's decision-making autonomy was assessed based on the extent to which she contributed to making decisions over a series of response items, including decisions over household finances, health care seeking, household purchases, visiting relatives and friends, and cooking food. For each of these items, a woman's response was coded as 1 if a she answered "yes" to making the decision alone or jointly with a partner or someone else and 0 otherwise. In this regard, as long as a woman expressed that she was contributing to the decision-making process in any capacity, her response was coded as 1. A woman's composite autonomy score (a value between 0 and 6) was derived by aggregating her six autonomy responses, and an autonomy percentage score (a value between 0 and 1) for each woman was calculated by dividing her composite autonomy score by six. A similar coding structure was applied to generate our measures for women's attitudes towards IPVAW. A woman's composite acceptability of IPVAW score (a value between 0 and 5) as well as her acceptability of IPVAW percentage score was calculated over a series of five response items that captured her attitudes towards whether or not a husband beating his wife is justified if she were to: 'go out without telling her husband'; 'neglect her children'; 'argue with her husband'; 'refuse sex'; and 'burn food'. A higher acceptable IPVAW score indicates that a woman is more accepting of a husband beating his wife across these domains.

Statistical Analysis

We use multivariable logistic regressions to estimate the associations between our generated autonomy and acceptability of IPVAW attitudes scores and our binary outcomes of interest. Our regressions include mother-, birth-, and cluster-level controls. At the mother level, we control for wealth index of the household (in quintiles), mother's educational attainment group (no education,

primary, secondary, higher), maternal age (in five-year age groups), marital status, and place of residence (urban/rural). At the birth level, we control for birth order and child sex. To control for spatial differences in socioeconomic characteristics, we include average cluster wealth and average cluster educational attainment. For regressions with women's use of ANC as the dependent variable, we include a percentage score of quality of care, which, in a similar fashion to the autonomy and acceptability of IPVAW composite scores, is calculated by taking the average score across a list of seven response items that capture the level and quality of care that was provided to the woman during her pregnancy. The list of response items include: whether a woman's weight was checked, whether her height was checked, whether her blood pressure was checked, whether a urine sample was taken, whether a blood sample was taken, whether she was told about possible pregnancy-related complications, and whether she was told where to go in the event that she experienced complications. Table A1 in the Supplemental Materials section presents additional information for each variable used in the analysis. Lastly, we include survey and year-of-birth fixed effects in all of our models to control for country and temporal trends. Standard errors are clustered at the primary sampling unit (DHS cluster) level. We interpret regression coefficients as odds ratios of the outcome, and we conduct regression analyses separately for the full sample and for each survey. All analyses were performed using Stata, version 13 (25).

Results

Tables 1 and 2 present descriptive statistics on the final analytic sample of 765,169 mothers and 777,352 births, respectively. Globally, 16.9 percent of mothers received at least 8 antenatal care visits for their last birth, and 59.8 percent of mothers delivered their last birth in a health facility. The mean age for women in our sample is 28.6 years, and 65 percent of women in our sample had

only a primary level of education or less. As shown in Table 3, we find large variation in the extent to which women received services during antenatal care for their last birth; while 72 percent of women reported having received blood pressure checks during their pregnancy, only 43.1 percent were informed about the types of complications that may occur during pregnancy and only 20.2 percent of women were informed on what do to when danger signs arise.

Table 4 presents the response items to the autonomy and the acceptable IPVAW measures that were calculated for our analysis. Over half of women in our sample (54.7 percent) reported that they were involved in decisions around their own healthcare and in visiting their relatives. Between 30 to 49 percent of women reported being involved decisions over household finances and purchases, including making decisions over money and household and daily purchases. Only 17.4 percent of women reported being involved in decisions over cooking food. When assessing women's attitudes towards IPVAW, we find that 24.8 percent of women in our sample reported that it was acceptable for a husband to beat his wife if she went out without telling him, if she neglected her children, if she argued with him, if she refused sex, or if she burned food. Relative to other factors, women's attitudes toward acceptability of IPVAW is slightly higher if a woman were to neglect her children (31.9 percent) or were to leave the home without informing her husband (29.7 percent).

Results from the pooled analysis for our primary outcomes of interest are presented in Table 5. A change in a woman's autonomy score from "no contribution to any decision-making domain" (a composite average autonomy score of 0) to "contribution to all decision-making domains" (a score of 6) is associated with a 31.2 percent increase in the odds of delivering in a facility and a 42.4

percent increase in the odds of receiving at least 8 ANC visits. In contrast, a change in a woman's acceptability of IPVAW score from "IPVAW is not acceptable under any scenario" (a composite average IPVAW score of 0) to "IPVAW is acceptable in all scenarios" (a score of 5) is associated with an 8.9 percent decrease in the odds of delivering in a facility and a 20.3 percent decrease in the odds of receiving 8 ANC visits.

Table 6 assesses the associations between increases in the autonomy and acceptability of IPVAW aggregate score scales and the primary outcomes of interest under both linear (top section) and non-linear (bottom section) assumptions. When assuming that the association between our score scales and our outcomes increases constantly (linearly), we find that a one point increase in the aggregate autonomy score (for example, an increase in the autonomy score scale from an aggregate score of 4 to 5 or from 0 to 1) is associated with a 4.6 percent increase in the odds of delivering in a facility and a 6.1 percent increase in the odds of receiving 8 ANC visits. By the same token, a one point increase in the acceptability of IPVAW aggregate score is associated with a 1.9 percent and 4.4 percent decrease in the odds of delivering in a facility and of receiving 8 ANC visits, respectively. These results are confirmed in our assessment of the associations between increases in aggregate autonomy and acceptability of IPVAW scores and outcomes using non-linear (categorical) specifications of the score exposures. When we graph the point estimates and confidence intervals from Table 6 under the categorical specifications for the exposures (see Figures 3 and 4), we find evidence for a significant non-linear association, given that the largest increases in the odds of facility delivery and women's use of ANC are found at the highest end of the scale (i.e. at the points where the aggregate autonomy score increases from 5 to 6 and where the acceptable IPVAW score increases from 4 to 5). These findings imply that while we are likely

to see increased health service utilization as women's decision-making power and autonomy increases, this increased utilization is highest when women are most empowered, i.e. when they move from a score of 5 to 6 on the aggregate autonomy score and from a 1 to 0 on the aggregate acceptability of IPVAW score.

A series of robustness checks and stratified analyses are presented in Tables 7 and 8. We show that our estimated results continue to hold under alternative specifications, such as: 1) when we include partner's educational attainment and measures of the wantedness of the birth in the empirical specification; 2) when we stratify the global sample by a variety of subgroups, including women's educational attainment, women's age (adolescents versus non-adolescents), marital status, and place of residence; and 3) when we stratify the global sample into regions (Africa, Asia) and run the analysis for these regional sub-samples.

Missing autonomy and acceptability of IPVAW indicator data affected our composite scores. To account for missingness, we conducted sensitivity analyses to assess the robustness of our coefficients. We first ran the full set of regressions by dropping all observations with missing data. In doing so, we found similar results, but our sample size dropped to 8.2 percent (63,481 observations) and 8.1 percent (63,002 observations) of the analytic samples for the facility delivery and ANC analyses, respectively. We then conducted a bounds analysis by re-running the full set of regressions, first setting all missing data to zero (as a lower bound) and subsequently setting missing data to one (as an upper bound). Under the lower bound scenario, a woman who had missing data on a given autonomy indicator is assumed to report 'no decision-making capacity' for that indicator; in contrast, women who had missing data on a given acceptability of IPVAW

indicator is assumed to report violence against women by husbands is "unacceptable". The upper bound scenario assumes the (opposite) counterfactual of both sets of indicators. We find that our estimates from our bounds analysis, presented in Table A4 in the Supplemental Materials section, are qualitatively consistent with the analysis where missing autonomy and acceptability of IPVAW indicator data is dropped. Given the consistency in our estimates across our bounds analysis, we present the results from the lower bound scenario, which are the most conservative and allows us to retain the largest sample for the pooled and disaggregated analyses.

Supplemental Figures A1 to A4 present the results from a disaggregated estimation of the main empirical specification by country (Figures 2 to 5). As these figures show, there is considerably more variation in the country-specific point estimates, both in terms of their magnitudes as well as their statistical significance; while some country-specific estimates concur with the global results, other country-specific estimates present associations that go in the opposite direction of the global findings, and many of the country-specific estimates also show null associations between the autonomy and IPVAW scores and the key utilization outcomes. We note that the confidence intervals around the country-specific estimates are quite large, thereby suggesting that the lack of statistical significance in the country-specific analyses is likely due to the small sample size rather than to a real null effect.

Discussion

We find strong and significant associations between women's reported autonomy and decision-making capacity, women's reported attitudes towards IPVAW, and their utilization of maternal health care services. These relationships persist even after having controlled for confounding

factors such as age, education, marital status, parity, place of residence and wealth at the individual level and education and wealth at the cluster level. Moreover, our results support the hypothesis that women's decision-making capacity and perceptions of IPVAW are, at a global level, integral to their health utilization and care-seeking behavior. The estimates from our global analysis are further confirmed by the findings from our stratified analyses, which demonstrate considerable qualitative and quantitative consistency across a wide range of subgroups.

With this said, the heterogeneity that we observe in some of our region- and country-specific analyses suggests that the role of women's autonomy and acceptability of IPVAW in shaping health-seeking behavior may, to various degrees, differ by context and should be explored further. Our stratified results suggest that the generally positive relationship between women's reported autonomy and facility delivery is stronger among non-adolescents, women with lower education levels, married women, and women who reside in rural areas. In contrast, the inverse relationship between acceptability of IPVAW and facility delivery is found to be stronger among non-adolescent women, women with secondary or higher education, unmarried women and women residing in urban areas. Similar trends within subgroups are found in our estimates of the relationships between autonomy, women's acceptability of IPVAW, and women's use of ANC services. These findings suggest that contextual norms that govern women's decision-making potential may vary for women of different age groups (adolescents versus older women), places of residence (urban versus rural), and marital status (unmarried versus married women).

Our analysis faces the following limitations. Although we include several individual, temporal, and spatial controls in our analysis, our estimates may still suffer from residual confounding. For

example, we are unable to sufficiently control for physical access to care or services (e.g. distance to facility), which is likely to be correlated with both autonomy as well as with receipt of care (26). In addition, we are unable to rule out reverse causality between our autonomy and empowerment exposures and our outcomes of interest; it may be that women who seek ANC services or who deliver in a facility may be more empowered as a result of having received care. To this end, we run a robustness check where we re-do the main analysis for the sample of women who have not moved in the past two years and therefore would not have moved to seek care for their pregnancy; results from this analysis are presented in Table A5 in the Supplemental Materials section. Results from this analysis are consistent with our main findings and do not suggest that women who are planning to become pregnant move residences to seek care. While we conduct several other robustness checks and stratification tests across a wide variety of samples, we are unable to fully account for potential self-selection and composition effects, whereby women who are more autonomous and who are less accepting of IPVAW may be more likely to select into care because they are different in unobservable ways. If this is the case, then we may not be able to attribute differences in health-seeking behavior to autonomy or lack of acceptability of IPVAW. Although we run a bounds analysis to account for concerns over missing data, we also cannot completely eliminate the possibility that there may exist unobservable factors that are both correlated with missingness in our exposure variables and our outcomes of interest. Finally, it is possible that the extent to which women's responses to the questions around autonomy and acceptability of IPVAW in the DHS surveys are comparable may be limited due to differential survey designs across countries and years (27). To account for this concern, we select the questions related to autonomy and IPVAW that are identical across survey rounds and countries and use responses from these comparable questions for our analysis.

Conclusions

In this study, we investigate the relationships between women's reported autonomy and decision-making, attitudes towards IPVAW, and health care utilization in low- and middle-income countries. Our findings reinforce the need to take maternal autonomy and empowerment into consideration when designing programs and policies that aim to improve health services for women. Given the robustness of our results, we propose that our global findings may be generalizable to a wide range of settings where women's autonomy and capacity for decision-making is limited. Our work also highlights the need for further study on the relationships between women's health, autonomy, and empowerment, which in turn will serve to promote the development of effective interventions that improve maternal health and well-being.

Acknowledgements

Competing Interests

The authors declare that no competing interests exist.

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Author Contributions

P.S. contributed substantially to the conceptual development of the paper, conducted the literature review, drafted and reviewed the background, results, and discussion sections of the manuscript, and supervised the finalization of the results; M.K. conducted the main statistical analysis, assisted with the literature review, and drafted and reviewing the methods and results sections of the

manuscript; C.W. contributed substantially to the conceptual development of the paper, and M.H. provided valuable feedback on the interpretation of the findings. All named authors contributed to the overall conceptualization, analysis, writing, and finalization of the paper.

Data Availability

All data that are used for this study are available for free download after registering with the DHS Program at http://dhsprogram.com/data/.

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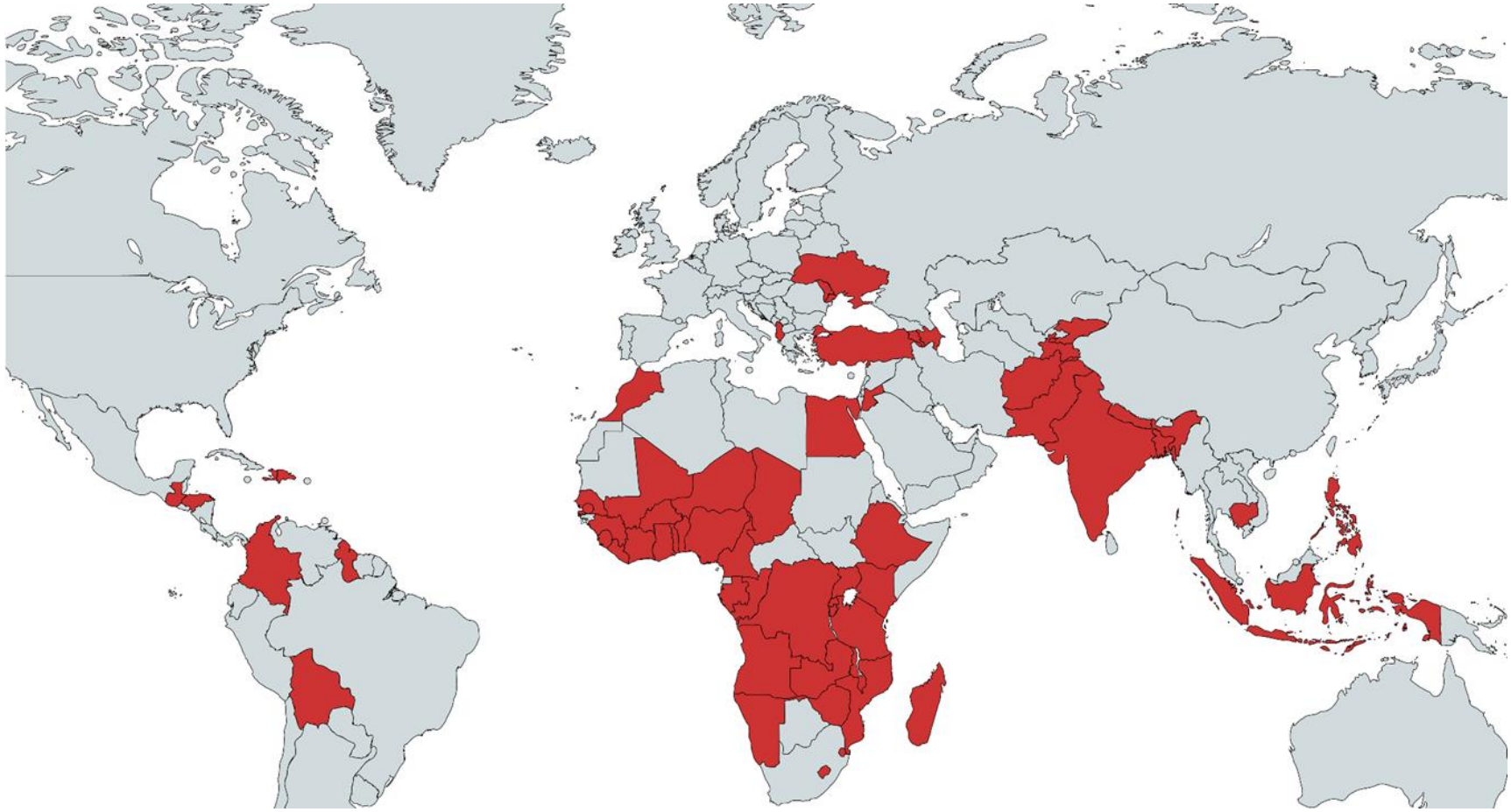
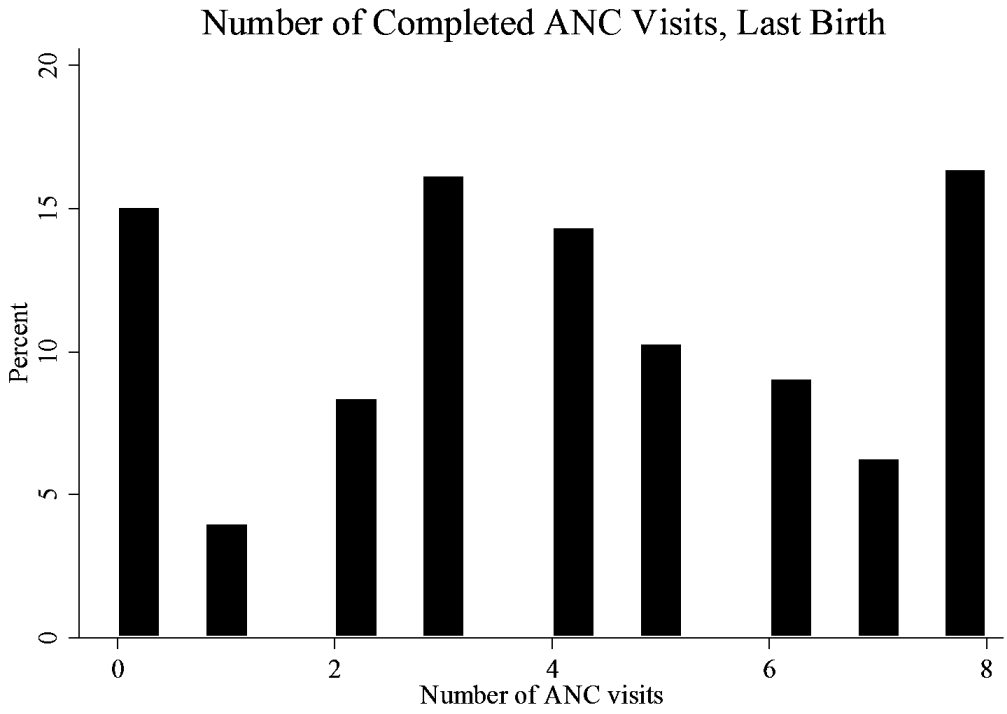
Tables and Figures

Figure 1. Geographic Distribution of Countries used in the Analysis



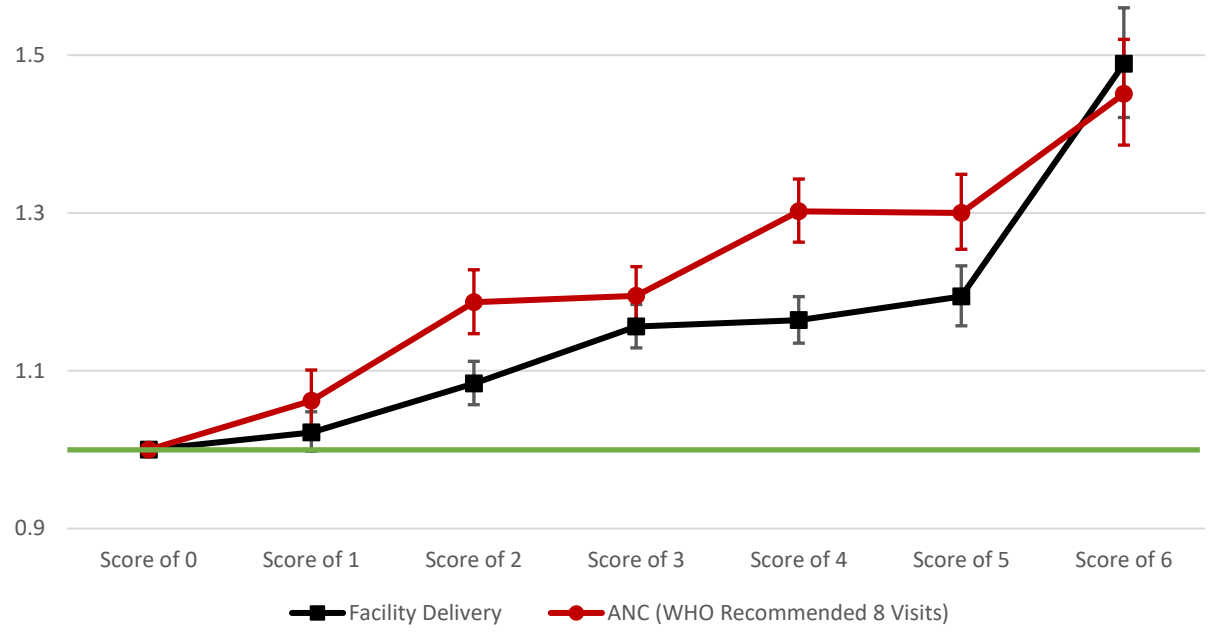
Notes:

Figure 2. Distribution of ANC Visits for Last Birth



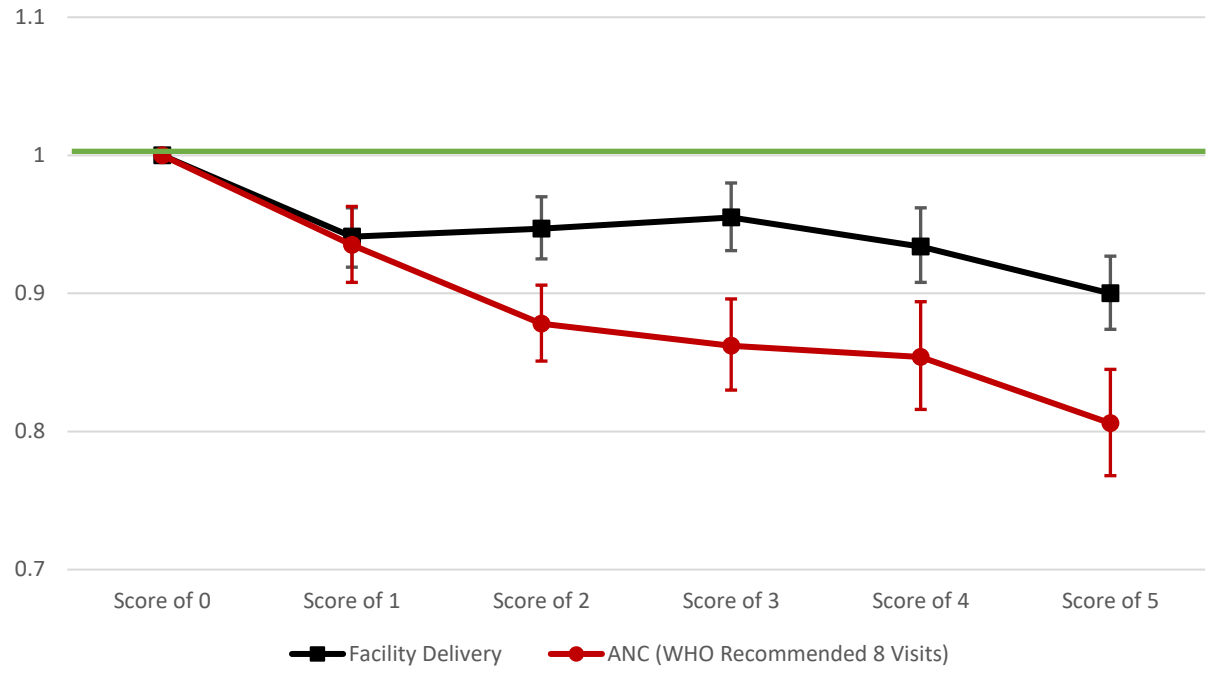
Notes:

Figure 3. Association between women's decision-making autonomy and maternal health outcomes: Pooled Analysis



Notes: The results are based on the logistic regression results that are reported in Table 6. The odds ratios are for each aggregate autonomy score category, compared with the reference group of having an aggregate autonomy score of 0. The error bars indicate the 95% confidence interval. The green horizontal line at 1 represents the odds ratio value under the null hypothesis.

Figure 4. The Association between women's attitudes towards IPVAW and maternal health outcomes: Pooled Analysis



Notes: The results are based on the logistic regression results that are reported in Table 6. The odds ratios are for each aggregate normalized IPVAW score category, compared with the reference group of having an aggregate normalized IPVAW score of 0. The error bars indicate the 95% confidence interval. The green horizontal line at 1 represents the odds ratio value under the null hypothesis.

Table 1. Descriptive Statistics, Mother-Level Outcomes and Covariates

	Mean	SD	No. Cases	Min	Max
Mother-Level Outcomes					
Delivery in a health facility (1 = yes)	0.598		457,571		
WHO Recommended 8 ANC Visits (1 = yes)	0.169		131,373		
Mother-Level Covariates					
Wealth, quintiles	2.887	1.400		1	5
Maternal education, none (1 = yes)	0.333		254,801		
Maternal education, primary (1 = yes)	0.319		244,089		
Maternal education, secondary (1 = yes)	0.284		217,308		
Maternal education, higher (1 = yes)	0.064		48,971		
Maternal age, years	28.607	6.979		13	49
Marital status (1 = married)	0.755		577,703		
Urban (1 = yes)	0.345		263,983		
Cluster-Level Covariates					
Average wealth, quintiles	2.873	1.135		1	5
Average education, highest level	1.068	0.719		0	3.8
N	**765,169**				

Notes: Each observation corresponds to a woman.

Table 2. Descriptive Statistics, Child-Level Covariates

	Mean	SD	No. Cases	Min	Max
Child-Level Covariates					
Birth order	3.364	2.349		1	19
Multiple birth (1 = yes)	0.017		13,215		
Child sex (1 = male)	0.512		398,004		
N	**777,352**				

Notes: Each observation corresponds to a birth.

Table 3. Descriptive Statistics, Prenatal and Postnatal Quality Covariates

	Mean	No. Cases
Quality Covariates		
Checked weight at pregnancy (1 = yes)	0.544	422,879
Checked height at pregnancy (1 = yes)	0.209	162,467
Checked blood pressure at pregnancy (1 = yes)	0.720	559,693
Took urine sample at pregnancy (1 = yes)	0.525	408,110
Took blood sample at pregnancy (1 = yes)	0.564	438,427
Told about pregnancy complications (1 = yes)	0.431	335,039
Told where to go for complications (1 = yes)	0.202	157,025
Health professional checked after delivery (1 = yes)	0.293	227,764
Quality score (0 – 1, percent out of 8)	0.436	338,925
Quality score, prenatal (0 – 1, percent out of 7)	0.456	354,473
N	**777,352**	

Notes: Each observation corresponds to a birth.

Table 4. Distribution of Autonomy and Acceptability of IPVAW Covariates

	Mean	No. Cases
Autonomy		
Respondent involved in decisions over money (1 = yes)	0.303	231,846
Respondent involved in decisions over own healthcare (1 = yes)	0.547	418,547
Respondent involved in decisions over household purchases (1 = yes)	0.486	371,872
Respondent involved in decisions over daily purchases (1 = yes)	0.308	235,672
Respondent involved in decisions over visiting relatives (1 = yes)	0.586	448,389
Respondent involved in decisions over cooking food (1 = yes)	0.174	133,139
Woman autonomy score (0 – 1, percent out of 6)	0.401	306,833
Acceptability of IPVAW		
Beating justified if wife goes out without telling husband (1 = yes)	0.297	227,255
Beating justified if wife neglects children (1 = yes)	0.319	244,089
Beating justified if wife argues with husband (1 = yes)	0.262	200,474
Beating justified if wife refuses sex (1 = yes)	0.213	162,981
Beating justified if wife burns food (1 = yes)	0.149	114,010
Women's acceptability of IPVAW score (0 – 1, percent out of 5)	0.248	189,762
N	**765,169**	

Notes: Each observation corresponds to a woman.

Table 5. Odds Ratios of Facility Delivery and Antenatal Care Use

VARIABLES	(1) Facility Delivery	(2) Antenatal Care (WHO Recommended 8 Visits)
Main Exposures		
Woman's autonomy score	1.312*** (1.274 - 1.352)	1.424*** (1.374 - 1.475)
Women's acceptability of IPVAW score	0.911*** (0.888 - 0.934)	0.797*** (0.769 - 0.827)
Covariates		
Wealth Quintile 2	1.307*** (1.280 - 1.333)	1.116*** (1.085 - 1.148)
Wealth Quintile 3	1.520*** (1.487 - 1.555)	1.223*** (1.185 - 1.262)
Wealth Quintile 4	1.868*** (1.822 - 1.915)	1.397*** (1.348 - 1.448)
Wealth Quintile 5	2.858*** (2.761 - 2.958)	1.933*** (1.853 - 2.016)
Education, Primary	1.427*** (1.401 - 1.455)	1.254*** (1.216 - 1.292)
Education, Secondary	2.081*** (2.035 - 2.128)	1.396*** (1.353 - 1.440)
Education, Higher	4.049*** (3.857 - 4.250)	1.740*** (1.670 - 1.813)
Marital Status (1 = yes)	1.001 (0.979 - 1.023)	1.191*** (1.160 - 1.222)
Birth Order	0.840*** (0.836 - 0.844)	0.876*** (0.870 - 0.881)
Child Sex (1 = male)	1.069*** (1.057 - 1.082)	0.998 (0.983 - 1.013)
Urban (1 = yes)	1.389*** (1.345 - 1.435)	0.978 (0.950 - 1.007)
Average wealth score	1.422*** (1.397 - 1.448)	1.143*** (1.123 - 1.164)
Average schooling	1.811*** (1.752 - 1.872)	1.309*** (1.271 - 1.348)
Quality score		8.934*** (8.586 - 9.297)
Constant	0.206*** (0.0820 - 0.515)	0.00318*** (0.00134 - 0.00752)
Observations	**765,169**	**760,871**

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes: The unit of observation is the birth. Odds ratios are presented with 95% confidence intervals in the parentheses below. Delivery in a facility (column 1) reports whether the mother delivered the birth in a health facility or not. ANC visits (column 2) reports whether the mother received at least 8 ANC visits for the birth. Results are from logistic regressions that include cluster, mother, birth, and quality of care controls. Cluster-level covariates are the average wealth index value of mothers in the cluster, and the average educational attainment of mothers in the cluster. Mother

controls include the household wealth index (in quintiles), educational attainment of the mother (no education, primary, secondary, higher), age of the mother (in 5-year age groups), mother's marital status, and mother's place of residence (urban/rural). Birth level controls include birth order and sex of the child. For Column 2, quality of care controls include the 7-point average quality score that was generated for the birth. Survey and year-of-birth fixed effects are included, and standard errors are clustered at the primary sampling unit (DHS cluster) level.

Table 6. Odds Ratios of Facility Delivery and Antenatal Care Use, Summed Autonomy and Acceptability of IPVAW Scores, Categorical

VARIABLES	(1) Facility Delivery	(2) Antenatal Care (WHO Recommended 8 Visits)
Main Exposures, Summed		
Woman's autonomy score	1.046***	1.061***
	(1.041 - 1.051)	(1.054 - 1.067)
Women's acceptability of IPVAW score	0.981***	0.956***
	(0.977 - 0.986)	(0.949 - 0.963)
Main Exposures, Categorical		
Woman's autonomy score of 1	1.022*	1.062***
	(0.998 - 1.048)	(1.024 - 1.101)
Woman's autonomy score of 2	1.084***	1.187***
	(1.057 - 1.112)	(1.147 - 1.228)
Woman's autonomy score of 3	1.156***	1.195***
	(1.129 - 1.184)	(1.160 - 1.232)
Woman's autonomy score of 4	1.164***	1.302***
	(1.135 - 1.194)	(1.263 - 1.343)
Woman's autonomy score of 5	1.194***	1.300***
	(1.157 - 1.233)	(1.254 - 1.349)
Woman's autonomy score of 6	1.489***	1.451***
	(1.421 - 1.560)	(1.386 - 1.520)
Women's acceptability of IPVAW score of 1	0.941***	0.935***
	(0.919 - 0.962)	(0.908 - 0.963)
Women's acceptability of IPVAW score of 2	0.947***	0.878***
	(0.925 - 0.970)	(0.851 - 0.906)
Women's acceptability of IPVAW score of 3	0.955***	0.862***
	(0.931 - 0.980)	(0.830 - 0.896)
Women's acceptability of IPVAW score of 4	0.934***	0.854***
	(0.908 - 0.962)	(0.816 - 0.894)
Women's acceptability of IPVAW score of 5	0.900***	0.806***
	(0.874 - 0.927)	(0.768 - 0.845)
Observations	**765,169**	**760,871**

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes: The unit of observation is the birth. Odds ratios are presented with 95% confidence intervals in the parentheses below. Delivery in a facility (column 1) reports whether the mother delivered the birth in a health facility or not. ANC visits (column 2) reports whether the mother received at least 8 ANC visits for the birth. Results are from logistic regressions that include cluster, mother, birth, and quality of care controls. Cluster-level covariates are the average wealth index value of mothers in the cluster, and the average educational attainment of mothers in the cluster. Mother controls include the household wealth index (in quintiles), educational attainment of the mother (no education, primary, secondary, higher), age of the mother (in 5-year age groups), mother's marital status, and mother's place of residence (urban/rural). Birth level controls include birth order and sex of the child. For Column 2, quality of care controls include the 7-point average quality score that was generated for the birth. Survey and year-of-birth fixed effects are included, and standard errors are clustered at the primary sampling unit (DHS cluster) level.

Table 7. Odds Ratios of Facility Delivery: Adjusted and Stratified Results

VARIABLES	(1) Women's autonomy score OR (95% CI)	(2) Women's acceptability of IPVAW score OR (95% CI)	(3) Observations ***N***
Adjustments			
Partner's educational attainment	1.321*** (1.280 - 1.364)	0.921*** (0.897 - 0.945)	693,917
Wantedness of birth	1.313*** (1.274 - 1.353)	0.913*** (0.891 - 0.937)	753,874
Stratified analyses			
Women under 19 years	1.189*** (1.085 - 1.303)	0.959 (0.892 - 1.030)	55,515
Women 20+ years	1.325*** (1.285 - 1.366)	0.908*** (0.884 - 0.931)	709,424
Women with none or primary education	1.356*** (1.310 - 1.403)	0.933*** (0.907 - 0.959)	498,374
Women with secondary or higher education	1.150*** (1.090 - 1.214)	0.784*** (0.747 - 0.824)	266,723
Unmarried sample	1.229*** (1.168 - 1.294)	0.853*** (0.813 - 0.896)	191,065
Married sample	1.352*** (1.303 - 1.403)	0.923*** (0.897 - 0.949)	573,127
Urban sample	1.256*** (1.190 - 1.326)	0.791*** (0.753 - 0.832)	268,915
Rural sample	1.312*** (1.266 - 1.359)	0.948*** (0.921 - 0.976)	495,000
Unmarried adolescents	1.248*** (1.080 - 1.442)	0.903 (0.799 - 1.021)	24,966
Married adolescents	1.083 (0.956 - 1.226)	0.980 (0.896 - 1.071)	30,473
Urban adolescents	1.159 (0.961 - 1.397)	0.974 (0.832 - 1.140)	17,891
Rural adolescents	1.192*** (1.071 - 1.326)	0.948 (0.873 - 1.029)	37,565
Africa sample	1.304*** (1.258 - 1.353)	0.890*** (0.865 - 0.916)	467,935
Asia sample	1.154*** (1.083 - 1.228)	0.968 (0.915 - 1.024)	189,189

Notes: The unit of observation is the birth. Odds ratios are presented with 95% confidence intervals in the parentheses below. Delivery in a facility reports whether the mother delivered the birth in a health facility or not. Results are from logistic regressions that include cluster, mother, and birth controls. Cluster-level covariates are the average wealth index value of mothers in the cluster, and the average educational attainment of mothers in the cluster. Mother controls include the household wealth index (in quintiles), educational attainment of the mother (no education, primary, secondary, higher), age of the mother (in 5-year age groups), mother's marital status, and mother's place of residence (urban/rural). Birth level controls include birth order and sex of the child. Survey and year-of-birth fixed effects are included, and standard errors are clustered at the primary sampling unit (DHS cluster) level.

Table 8. Odds Ratios of Antenatal Care Use: Adjusted and Stratified Results

VARIABLES	(1) Women's autonomy score OR (95% CI)	(2) Women's acceptability of IPVAW score OR (95% CI)	(3) Observations ***N***
Adjustments			
Partner's educational attainment	1.401*** (1.348 - 1.457)	0.815*** (0.785 - 0.846)	690,271
Wantedness of birth	1.425*** (1.375 - 1.477)	0.802*** (0.773 - 0.832)	749,580
Stratified analyses			
Women under 19 years	1.377*** (1.217 - 1.558)	0.794*** (0.698 - 0.904)	53,816
Women 20+ years	1.417*** (1.365 - 1.470)	0.797*** (0.768 - 0.827)	705,458
Women with none or primary education	1.475*** (1.398 - 1.557)	0.832*** (0.792 - 0.874)	495,422
Women with secondary or higher education	1.356*** (1.295 - 1.419)	0.770*** (0.732 - 0.809)	265,445
Unmarried sample	1.344*** (1.275 - 1.417)	0.814*** (0.754 - 0.880)	189,410
Married sample	1.435*** (1.367 - 1.507)	0.807*** (0.776 - 0.840)	571,040
Urban sample	1.418*** (1.352 - 1.489)	0.752*** (0.710 - 0.795)	268,562
Rural sample	1.401*** (1.329 - 1.477)	0.847*** (0.808 - 0.888)	492,309
Unmarried adolescents	1.276*** (1.094 - 1.487)	0.765** (0.622 - 0.941)	23,951
Married adolescents	1.497*** (1.207 - 1.857)	0.824** (0.699 - 0.971)	28,613
Urban adolescents	1.480*** (1.243 - 1.762)	0.747*** (0.603 - 0.926)	17,244
Rural adolescents	1.220** (1.023 - 1.456)	0.826** (0.701 - 0.973)	35,066
Africa sample	1.102*** (1.068 - 1.137)	0.919*** (0.897 - 0.943)	465,927
Asia sample	1.425*** (1.336 - 1.519)	0.974 (0.921 - 1.029)	187,909

Notes: The unit of observation is the birth. Odds ratios are presented with 95% confidence intervals in the parentheses below. The outcome variable reports whether the mother received at least 8 ANC visits for the birth. Results are from logistic regressions that include cluster, mother, birth, and quality of care controls. Cluster-level covariates are the average wealth index value of mothers in the cluster, and the average educational attainment of mothers in the cluster. Mother controls include the household wealth index (in quintiles), educational attainment of the mother (no education, primary, secondary, higher), age of the mother (in 5-year age groups), mother's marital status, and mother's place of residence (urban/rural). Birth level controls include birth order and sex of the child. Quality of care controls include the 7-point average quality score that was generated for the birth. Survey and year-of-birth fixed effects are included, and standard errors are clustered at the primary sampling unit (DHS cluster) level.

Supplemental Material

Table A1. Variable Descriptions

	Variable Description
Outcome Variables	
Delivery in a facility	Binary: whether mother delivered the birth in a health facility
WHO Recommended 8 ANC Visits	Binary: whether mother received at least 8 ANC visits for the birth
Child-Level Covariates	
Birth order	Birth order of the child
Multiple birth	Binary: whether the child was a multiple birth
Child sex	Whether the child was male or female
Time from birth to survey date	The hypothetical age of the child (in months), irrespective of whether the child is alive or not, at the time of the survey
Wantedness of the birth	Binary: whether the birth was wanted then or not
Mother-Level Covariates	
Wealth	Wealth quintile, derived from DHS household asset index*
Maternal education	Highest level of schooling achieved by mother (none, primary, secondary, higher)
Partner education	Highest level of schooling achieved by partner (none, primary, secondary, higher)
Maternal age	Age of mother, in 5-year age groups
Marital status	Binary: marital status of the mother, either married or not (not married includes single, separated, divorced and widowed)
Urban	Place of residence: either urban or rural
Cluster-Level Covariates	
Average wealth	Average of mother's wealth quintile index score in the cluster (based on lowest=1 to highest=5)
Average education	Average level of maternal education in the cluster (based on none=0, primary=1, secondary=2, higher=3)
Quality Covariates	
Checked weight at pregnancy	Binary: whether mother's weight was checked during pregnancy
Checked height at pregnancy	Binary: whether mother's height was checked during pregnancy
Checked blood pressure at pregnancy	Binary: whether mother's blood pressure was checked during pregnancy
Took urine sample at pregnancy	Binary: whether urine sample was taken during pregnancy
Took blood sample at pregnancy	Binary: whether blood sample was taken during pregnancy
Told about pregnancy complications	Binary: whether mother was informed of any pregnancy complications
Told where to go for complications	Binary: whether mother was told where to go for pregnancy complications
Health professional checked after delivery	Binary: whether health professional followed up for postnatal visit
Quality score	Average of the 8 quality covariates, between 0 and 1
Quality score, prenatal only	Average of the 7 prenatal quality covariates, between 0 and 1
Autonomy Covariates	
Respondent involved in decisions over money	Binary: whether respondent makes decisions over money in HH
Respondent involved in decisions over own healthcare	Binary: whether respondent makes decisions over her own healthcare
Respondent involved in decisions over HH purchases	Binary: whether respondent makes decisions over large household purchases
Respondent involved in decisions over daily purchases	Binary: whether respondent makes decisions over daily purchases
Respondent involved in decisions over visiting relatives	Binary: whether respondent makes decisions over visiting her family / relatives
Respondent involved in decisions over cooking food	Binary: whether respondent makes decisions over cooking food in HH
Woman autonomy score	Average of the 6 autonomy covariates, between 0 and 1
Acceptability of IPVAW Covariates	
Beating justified if wife goes out without telling husband	Binary: Beating justified if wife goes out without telling husband
Beating justified if wife neglects children	Binary: Beating justified if wife neglects children
Beating justified if wife argues with husband	Binary: Beating justified if wife argues with husband

Beating justified if wife refuses sex	Binary: Beating justified if wife refuses sex
Beating justified if wife burns food	Binary: Beating justified if wife burns food
Woman acceptability of IPVAW score	Average of the 5 IPVAW covariates, between 0 and 1

*For additional information on the wealth index, see to Filmer and Pritchett (2001) and Rutstein et al (2004) [51,52].

Table A2. Demographic and Health Survey (DHS) countries used in the analysis

Abbreviation	Country Name	Abbreviation	Country Name
AF	Afghanistan	MD	Madagascar
AL	Albania	ML	Mali
AM	Armenia	MV	Maldives
AO	Angola	MW	Malawi
AZ	Azerbaijan	MZ	Mozambique
BD	Bangladesh	NG	Nigeria
BF	Burkina Faso	NI	Niger
BJ	Benin	NM	Namibia
BO	Bolivia	NP	Nepal
BU	Burundi	PH	Philippines
CD	DRC	PK	Pakistan
CG	Congo, Republic	RW	Rwanda
CI	Cote d'Ivoire	SL	Sierra Leone
CM	Cameroon	SN	Senegal
CO	Colombia	ST	Sao Tome and Principe
DR	Dominican Republic	SZ	Swaziland
EG	Egypt	TD	Chad
ET	Ethiopia	TG	Togo
GA	Gabon	TJ	Tajikistan
GH	Ghana	TL	Timor-Leste
GM	Gambia	TR	Turkey
GN	Guinea	TZ	Tanzania
GU	Guatemala	UA	Ukraine
GY	Guyana	UG	Uganda
HN	Honduras	ZM	Zambia
HT	Haiti	ZW	Zimbabwe
IA	India		
ID	Indonesia		
JO	Jordan		
KE	Kenya		
KH	Cambodia		
KM	Comoros		
KY	Kyrgyz Republic		
LB	Liberia		
LS	Lesotho		
MA	Morocco		
MB	Moldova		
	Total	**777,352 births** **765,169 women**	

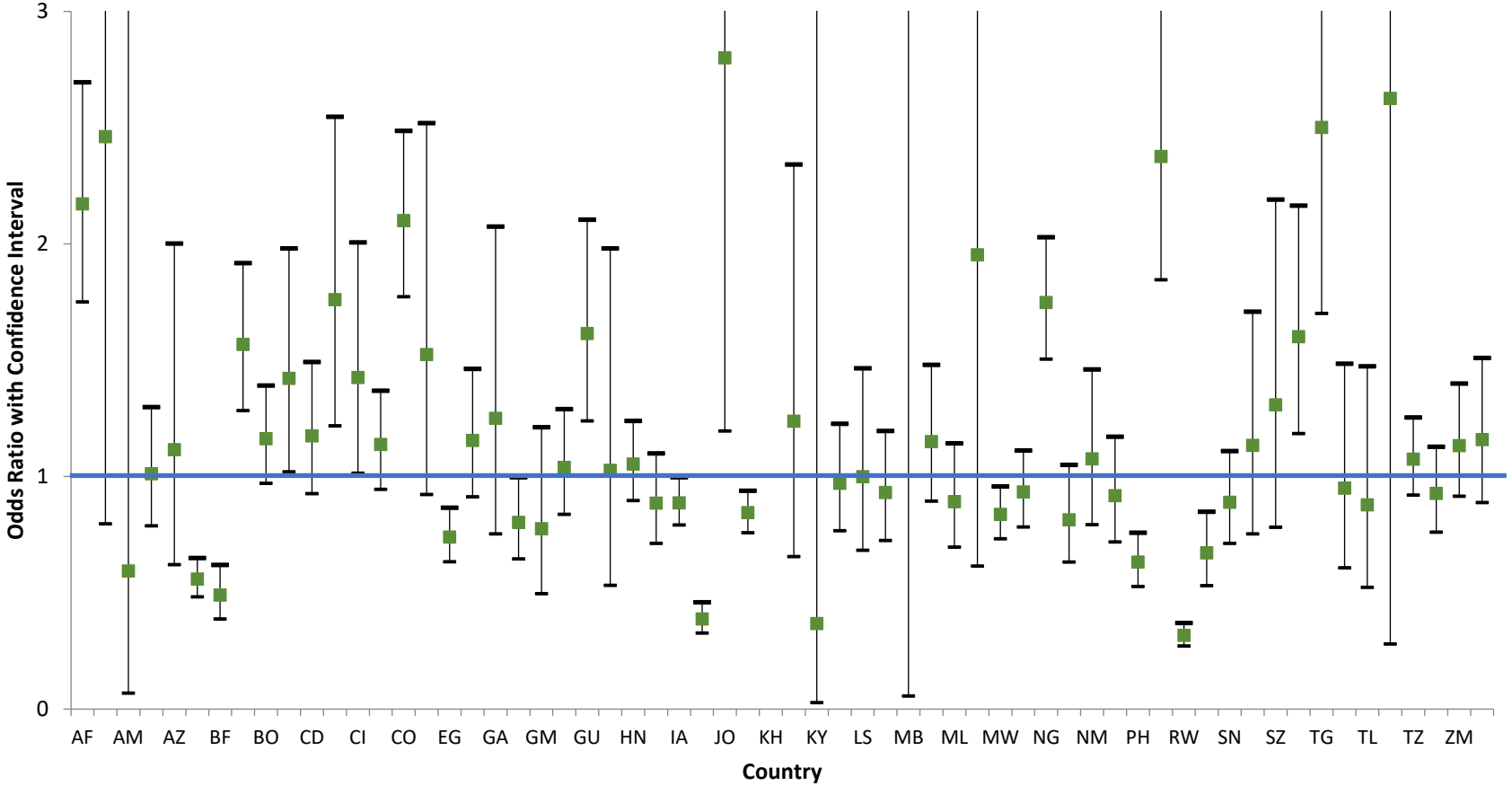
Notes:

Table A3. Observations (Births) Dropped from Analysis due to Missing Data

Starting Sample	**1,136,033**	
	No. Obs. Dropped	Pct. of Starting Sample
Outcome Variables		
Delivery in a health facility	9,510	0.837%
WHO Recommended 8 ANC Visits	332,950	29.31%
Mother-Level Covariates		
Wealth	0	0.0%
Maternal education	16,204	1.43%
Maternal age	0	0.0%
Marital status	6	0.0005%
Urban	0	0.0%
Child-Level Covariates		
Birth order	0	0.0%
Child sex	0	0.0%
Time from birth to survey date	0	0.0%
Cluster-Level Covariates		
Average wealth	0	0.0%
Average education	0	0.0%
Sample Probability Weight of 0	11	0.001%
Final Sample	**777,352**	**68.4%**

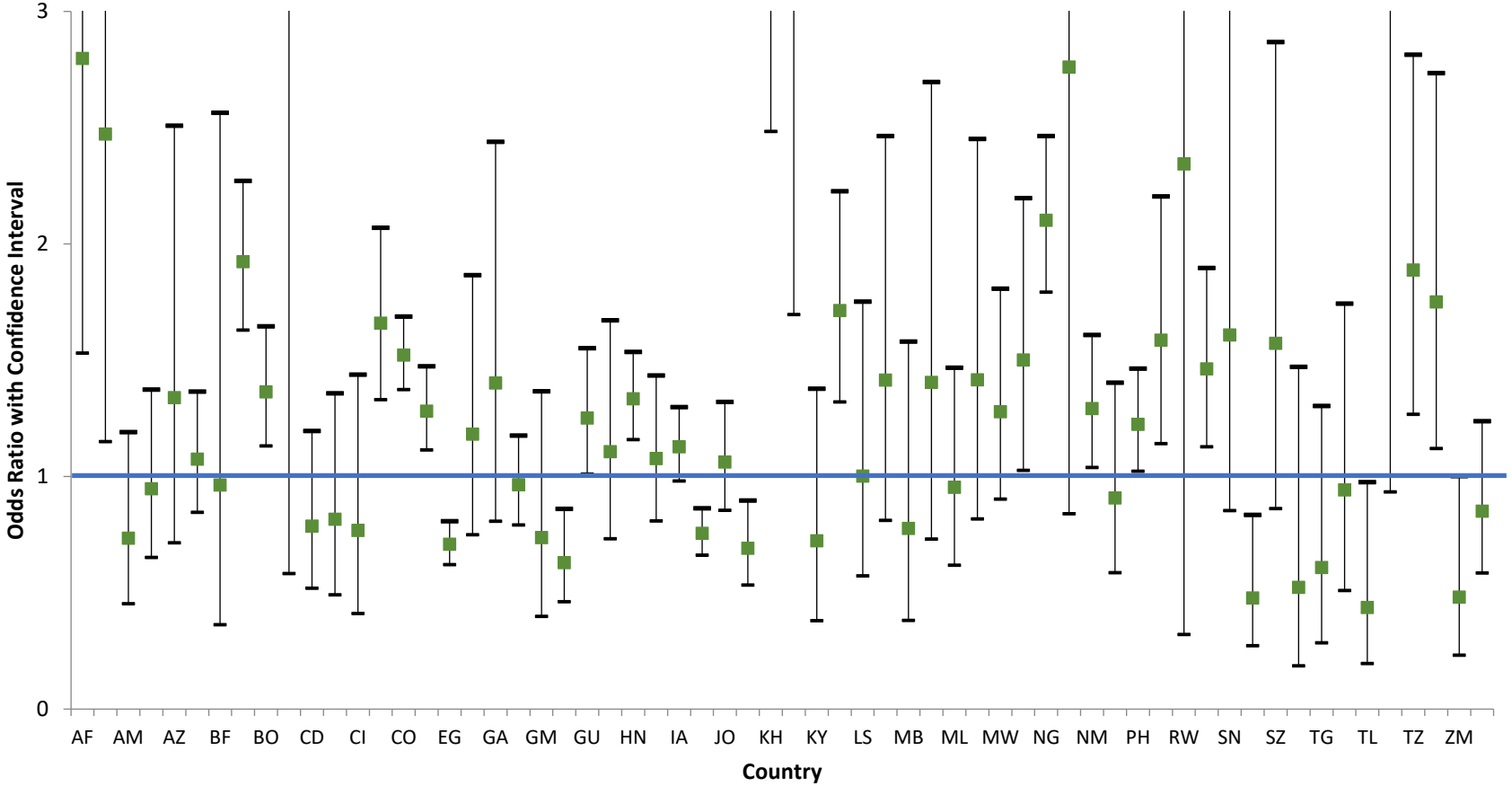
Notes: The large number of observations dropped due to missing data on ANC visits is mainly because some surveys only recorded the number of ANC visits for mothers for her last birth and not for all of her births in the previous five years.

Figure A1. Country-Specific Estimates of the Association between Autonomy Score and Facility Delivery



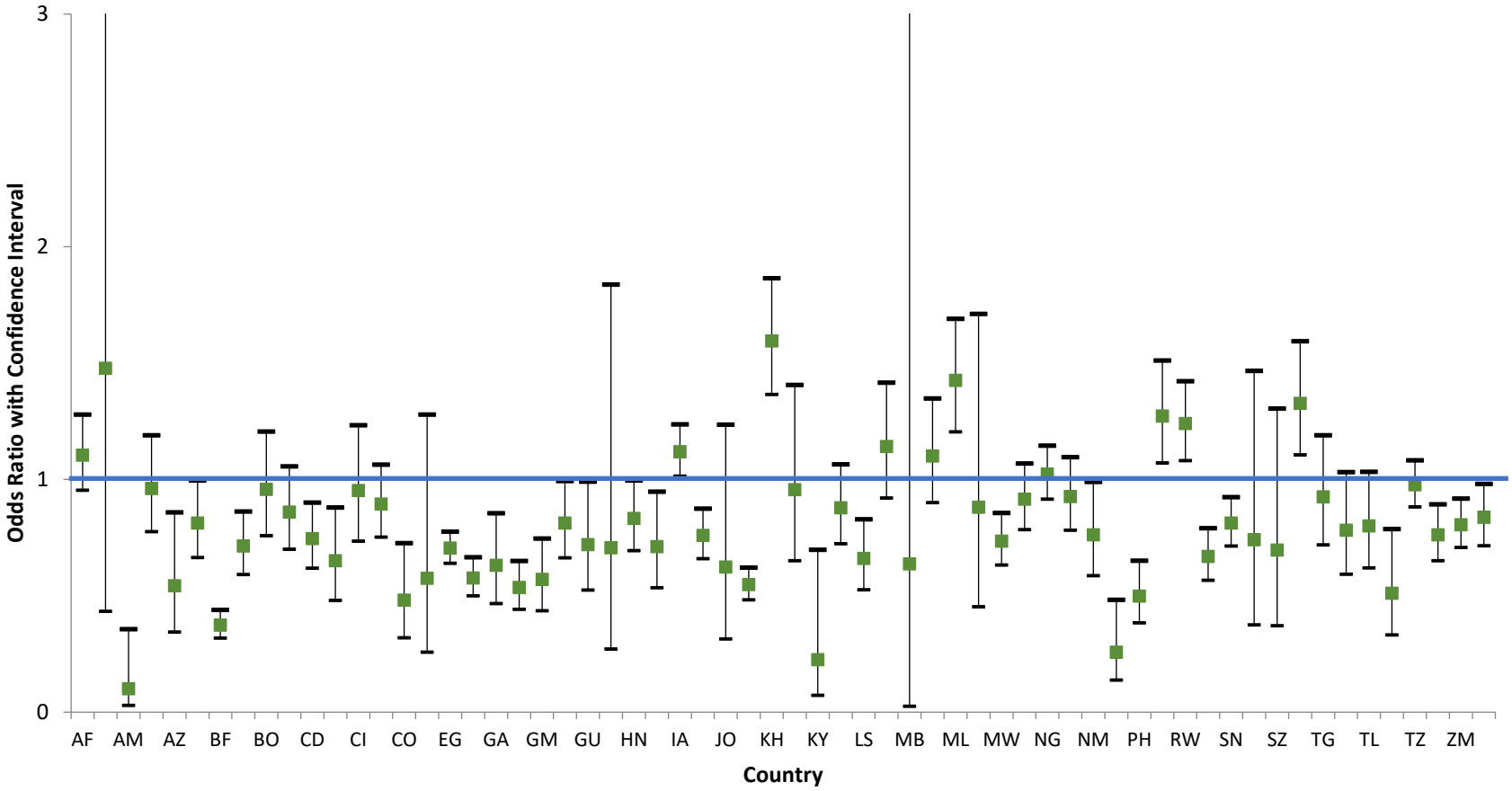
Notes: The blue horizontal line represents the null odds ratio value of 1.

Figure A2. Country-Specific Estimates of the Association between Autonomy Score and Antenatal Care



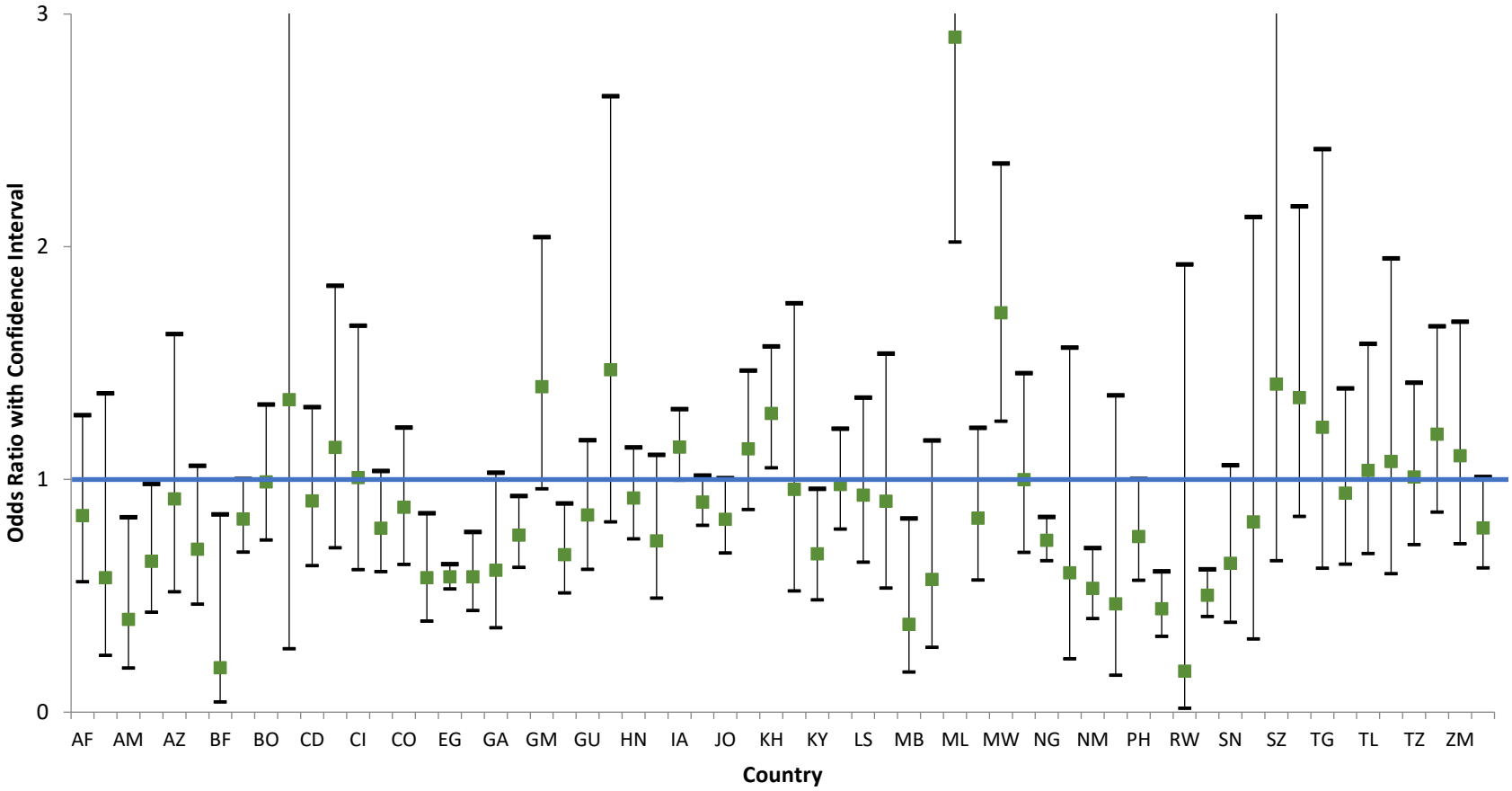
Notes: The blue horizontal line represents the null odds ratio value of 1.

Figure A3. Country-Specific Estimates of the Association between Acceptability of IPVAW Score and Facility Delivery



Notes: The blue horizontal line represents the null odds ratio value of 1.

Figure A4. Country-Specific Estimates of the Association between Acceptability of IPVAW Score and Antenatal Care



Notes: The blue horizontal line represents the null odds ratio value of 1.

Table A4. Odds Ratios of Facility Delivery and Antenatal Care Use, Bounds Analysis

VARIABLES	(1) Facility Delivery	(2) Antenatal Care (WHO Recommended 8 Visits)
Lower Bound Scenario		
Woman's autonomy score	1.312***	1.424***
	(1.274 - 1.352)	(1.374 - 1.475)
Women's acceptability of IPVAW score	0.911***	0.797***
	(0.888 - 0.934)	(0.769 - 0.827)
Upper Bound Scenario		
Woman's autonomy score	1.254***	1.374***
	(1.211 - 1.298)	(1.315 - 1.436)
Women's acceptability of IPVAW score	0.878***	0.799***
	(0.857 - 0.900)	(0.771 - 0.828)
Observations	**765,169**	**760,871**

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes: The unit of observation is the birth. Odds ratios are presented with 95% confidence intervals in the parentheses below. Delivery in a facility (column 1) reports whether the mother delivered the birth in a health facility or not. ANC visits (column 2) reports whether the mother received at least 8 ANC visits for the birth. Results are from logistic regressions that include cluster, mother, birth, and quality of care controls. Cluster-level covariates are the average wealth index value of mothers in the cluster, and the average educational attainment of mothers in the cluster. Mother controls include the household wealth index (in quintiles), educational attainment of the mother (no education, primary, secondary, higher), age of the mother (in 5-year age groups), mother's marital status, and mother's place of residence (urban/rural). Birth level controls include birth order and sex of the child. For Column 2, quality of care controls include the 7-point average quality score that was generated for the birth. Survey and year-of-birth fixed effects are included, and standard errors are clustered at the primary sampling unit (DHS cluster) level.

Table A5. Odds Ratios of Facility Delivery and Antenatal Care Use, Sub-sample of women who have not moved in the past two years

VARIABLES	(1) Facility Delivery	(2) Antenatal Care (WHO Recommended 8 Visits)
Women who have not moved in past 2 years		
Woman's autonomy score	1.220***	1.189***
	(1.173 - 1.270)	(1.149 - 1.231)
Women's acceptability of IPVAW score	0.958**	0.954***
	(0.924 - 0.993)	(0.925 - 0.985)
Observations	**364,681**	**363,159**

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Notes: The unit of observation is the birth. Odds ratios are presented with 95% confidence intervals in the parentheses below. Delivery in a facility (column 1) reports whether the mother delivered the birth in a health facility or not. ANC visits (column 2) reports whether the mother received at least 8 ANC visits for the birth. Results are from logistic regressions that include cluster, mother, birth, and quality of care controls. Cluster-level covariates are the average wealth index value of mothers in the cluster, and the average educational attainment of mothers in the cluster. Mother controls include the household wealth index (in quintiles), educational attainment of the mother (no education, primary, secondary, higher), age of the mother (in 5-year age groups), mother's marital status, and mother's place of residence (urban/rural). Birth level controls include birth order and sex of the child. For Column 2, quality of care controls include the 7-point average quality score that was generated for the birth. Survey and year-of-birth fixed effects are included, and standard errors are clustered at the primary sampling unit (DHS cluster) level.