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Safer If Connected? Mobile Technology and Intimate Partner Violence

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ABSTRACT Mobile phones are an invaluable economic asset for low-income individuals and an important tool for strengthening social ties. They may also help women overcome physical boundaries, especially those who are separated from support networks and are bound within their husbands' social spheres. Using micro-level data on women and men from recent Demographic and Health Surveys, including new information on mobile phone ownership, this study examines whether women's ownership of mobile phones is associated with their likelihood of having experienced intimate partner violence (IPV) across 10 low- and middle-income countries. Findings show that women's ownership of mobile phones is associated with a 9%–12% decreased likelihood of emotional, physical, and sexual violence over the previous 12 months, even after controlling for characteristics proxying for socioeconomic status, household resources, and local development within the community. Estimates are negative in seven out of the 10 countries and results are robust to the use of nonparametric matching techniques and instrumental variables built through georeferenced ancillary sources. In exploring two potential mechanisms, I show that mobile phone ownership is positively associated with women's decision-making power within the household (*decision-making power*) and male partners' lower acceptability of IPV (*attitudes*). Findings speak to scholars and policymakers interested in how technology diffusion relates to dynamics of women's empowerment and global development.

KEYWORDS Digital technology • Intimate partner violence • Women's status • Demographic and Health Surveys • Low- and middle-income countries

Introduction

Intimate partner violence (IPV), the most common form of violence against women, is a fundamental violation of women's rights and a significant public health concern worldwide (Chai et al. 2016).[1] According to 2018 multicountry estimates from the

[1] Violence perpetrated against women by their husbands/partners is referred to using several terms, including "spousal abuse" and "domestic violence." Although I draw on the domestic violence module in the Demographic and Health Surveys, which also contains information on violence from household members

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World Health Organization (WHO), almost one third of women worldwide (26%) experience physical or sexual violence by an intimate partner over their lifetime (WHO 2021). A similar global estimate (30%) of the frequency of lifetime exposure to IPV among women was obtained in a meta-analysis of 141 studies conducted across 81 countries (Devries et al. 2013). The study also showed that the frequency of such exposure was relatively high in Central sub-Saharan Africa (66%), West sub-Saharan Africa (42%), and South Asia (42%). Despite the devastating consequences on the health and well-being of the current and subsequent generations, IPV remains widespread and shows little evidence of waning across multiple contexts.

Information and communication technologies (ICTs) have improved and diffused widely, even across low- and middle-income countries (LMICs). This massive global social transformation has led scholars and policymakers to increasingly consider ICTs' potential to empower marginalized communities and improve the lives of economically vulnerable individuals across multiple domains. Among these technologies, mobile phones have played a crucial role. In LMICs, mobile phones serve a range of functions that may ultimately be associated with improved social development outcomes. With the maturation of the technology and the expansion of mobile data networks, the capabilities of mobile phones have expanded from enabling communication to providing information and delivering services (Aker and Mbiti 2010). The increased affordability of mobile phones has also translated into enhanced financial independence and better labor-market prospects, especially for women (Suri and Jack 2016); food security and dietary quality (Sekabira and Qaim 2017); better educational outcomes (Aker et al. 2012); more decision-making power for women in domestic domains, such as care work (Wekwete 2014) and politics (Abubakar and Dasuki 2018); and more positive attitudes toward women's participation in politics (Varriale et al. forthcoming). A recent global-level study suggests that the expansion of mobile phones has bolstered sustainable development by narrowing gender inequalities, enhancing contraceptive use, and reducing maternal and child mortality, with the biggest payoffs among the poorest countries and communities (Rotondi et al. 2020).

In light of the widely documented potential of mobile phones and ICTs to shape demographic and social development outcomes (Bellou 2015; Billari et al. 2020; Rosenfeld 2017; Rotondi et al. 2020), in this study I explore whether women's mobile phone ownership is associated with an important marker of women's status within the household—namely, their likelihood of experiencing IPV. The study provides three contributions. First, although research has focused on the influence of media and television on women's status (e.g., Bhushan and Singh 2014; Jensen and Oster 2009; La Ferrara et al. 2012; Lee 2009), to my knowledge, no large-scale empirical study has focused on the relationship between mobile phones and IPV as a marker of women's status. This topic has, however, been touched upon in qualitative studies from selected communities in sub-Saharan Africa (SSA) and Southeast Asia (Hobbis 2018; Mpiima et al. 2019; Porter et al. 2020; Svensson and Larsson 2016; Uduji and Okolo-Obasi 2018), and—albeit limitedly—among Latinos in the United States (Garcia 2011).

Mobile phones can facilitate effective communication and connectivity, foster community participation, and enable access to information and vital services linked

other than the husband/partner, here I limit my focus to violence perpetrated by husbands/partners. I thus refer to violence using the term "intimate partner violence" (IPV) throughout the study.

to health, education, and the economy. In so doing, they may help women overcome physical boundaries and promote information dissemination across networks beyond in-person kin ties, especially in places where women are separated from support networks—or have none—and are bound within their husbands' social spheres. Although it might be reasonable to expect mobile phones to have a similar or even enhanced potential as radio or television, theoretically speaking, the relationship between mobile phone ownership and IPV might go either way. For instance, building on the same theoretical model developed in Jensen and Oster (2009), Lee (2009) examined the causal effect of mobile phones on the status of women in India and found them to significantly decrease both men's and women's tolerance for IPV and increase women's autonomy in mobility and economic independence (mobile phones as *empowering*). Conversely, qualitative evidence from selected communities in LMICs suggests that women's solo ownership of mobile phones might threaten the idea of male dominance, unsettle traditional gender norms within households, and challenge rooted patriarchal structures (mobile phones as *disempowering*), thus triggering increased violent behavior from male partners (Uduji and Okolo-Obasi 2018). Underlying some of this heterogeneity are secular changes in the institution of the family and the value attached to women's economic independence (Pesando and GFC Team 2019), alongside persistent barriers to technology adoption and use, such as—in the case of mobile phones—women's ability to use them privately, lack of electricity within households, and high costs of airtime given the pay-as-you-go nature of most phones in LMICs (GSMA 2020; Silver et al. 2019). Either way, I hypothesize that mobile phones might be related to women's recent experiences of IPV and explore this general hypothesis by providing large-scale quantitative evidence.

As a second contribution, I use cross-national, micro-level data from the most recent waves of the Demographic and Health Surveys (DHS), the first to include a question on individual-level mobile phone ownership. The analysis covers 10 LMICs: seven in SSA, one in Latin America and the Caribbean (LAC), and two in South and Southeast Asia (SA). Despite their economic, social, and cultural differences, I selected these countries because their DHS questionnaires feature both the mobile phone variable and a domestic violence module, thus leveraging all existing data on the topic. In addition, these countries are in world regions where IPV remains highest (WHO 2021); I am interested in including countries where IPV is a prevalent phenomenon, alongside contexts in which mobile phone diffusion and technology adoption have proceeded at different paces, thus providing a heterogeneous multisite scenario. Finally, I focus on countries with some qualitative evidence on the topic to complement, contextualize, and better qualify my findings.

Although I shy away from causal conclusions given the cross-sectional nature of the data and the lack of experimental variation related to mobile phone diffusion, as a third contribution I take multiple steps to strengthen correlational evidence by resorting to nonparametric matching techniques and instrumental variable (IV) estimations made possible by novel georeferenced data obtained from external sources, such as the Afrobarometer and the Degree High-Resolution Full Climatology (HRFC) data set. In so doing, I highlight the potential of leveraging multiple data sources and explore a set of mechanisms, including men's attitudes toward IPV. This is an important contribution to the relevant literature for two reasons. First, focusing on both women and their male partners provides a more gender-balanced picture of the relationship between

mobile phone ownership and IPV. Second, policies and public discourse aimed at shaping gender norms and attitudes are often targeted toward women, yet men's attitudes can be more resistant to change, thus requiring adequate consideration.[2]

Findings reveal that women's ownership of mobile phones is associated with a 9–12% decrease in the likelihood of experiencing emotional, physical, and sexual violence, after controlling for a host of individual-, partner-, and household-level socioeconomic characteristics, including educational attainment, household wealth, and ownership of radio, television, and landline telephone. Results also hold at the community level, even after accounting for the presence of community-level facilities, such as electricity, health clinics, and other measures of local development, thus highlighting the importance of community-level influences and generalized attitudes toward IPV, in line with sociodemographic scholarship on IPV in LMICs (Koenig et al. 2003; Yount et al. 2013). Despite the heterogeneous nature of the countries in the analysis, estimates are consistently negative in seven out of the 10 countries and findings are robust to the use of nonparametric matching techniques and household- and cluster-level IVs. I further show that some mechanisms underlying the negative associations may operate through (1) women owning mobile phones exhibiting higher decision-making power within the household and (2) their husbands/partners owning mobile phones holding less favorable attitudes toward IPV. I conclude by discussing limitations and outlining recommendations for subsequent data collection efforts that may help shed better light on the causal nature of the relationship.

Background

Today, the estimated number of mobile phone subscriptions is over seven billion worldwide, and mobile phone diffusion has occurred even in the most remote areas (Rotondi et al. 2020). For many individuals and households in LMICs, mobile phones constitute their only access to the internet (GSMA 2020). Nonetheless, barriers such as high costs of airtime, lack of electricity, bad working conditions of phones, lack of digital skills, and shared device use within households still prevent individuals—mostly women—from fully exploiting the technology (Silver et al. 2019).

Despite barriers, the diffusion of mobile phones has been linked to social, economic, and demographic outcomes, and a prominent literature describes the causal impacts of television and radio on social behaviors and attitudes (DellaVigna and Kaplan 2007; Jensen and Oster 2009; Kearney and Levine 2015; La Ferrara 2016; La Ferrara et al. 2012; Olken 2009). Of particular relevance for this study, Jensen and Oster (2009) found that the introduction of cable television in India led to improvements in women's status and gender attitudes: specifically, women reported increased autonomy and decreased son preference and acceptability of IPV. For a review on the topic of mobile phones and social and economic outcomes, see Pesando and Rotondi (2020). In the following, I discuss a few studies that highlight mechanisms and dynamics (*channels*) through which mobile phones may be related to IPV within

[2] Important work in sociology and demography on attitudes toward IPV in LMICs includes Yount et al. (2013) and Yount, VanderEnde et al. (2014).

the household and, ultimately, to women's status in society—a research area that has been largely neglected.

The literature on the role of mobile phones suggests that they may contribute to a shortening of social time and space (Geser 2004; Green 2002). Using survey data from Taiwan, Wei and Lo (2006) showed that mobile phones—irrespective of whether they enable online connectivity—may strengthen individuals' family and nonfamily bonds, expand their psychological boundaries, and facilitate symbolic proximity to the people they reach by streamlining communication (*communication* channel). Phones are especially valuable to women, as they sometimes serve as "liberators" (Frissen 1995; Rakow 1992). Examining women's use of phones in a small community setting, Rakow (1992) found that phones often contribute to mitigating women's fears, sense of isolation, loneliness, and boredom by helping them cope with confinement at home and physical separation from family members, friends, and more distal networks.

Mobile phones may also contribute to expanding women's community outreach and participation (*community outreach/participation* channel). Women in LMICs tend to face high barriers to traveling to visit family, friends, or potential business contacts. Thus, they have fewer opportunities to voice their concerns, viewpoints, ideas, or plans and to form networks to find jobs, start businesses, or discuss private matters. A qualitative study from the northern city of Kano, Nigeria, suggests that WhatsApp gives women more decision-making power by expanding their freedom to participate in social, economic, and political activities (Abubakar and Dasuki 2018), as well learning activities that enhance their information capabilities. These same women improved their media literacy, gained knowledge in the areas of health and education, and voiced their opinions more openly. Even just through the use of SMS (Short Message Service), mobile phones may foster connectivity for individuals within communities to enable greater civic participation around specific agendas (e.g., health or politics), with the potential to shift how women's roles are perceived (Abreu Lopes and Srinivasan 2014).

Given the foregoing evidence, there is reason to expect that mobile phones may be related to women's status within households and their decision-making power vis-à-vis other family members (*within-household decision-making power* channel). Focusing on India, Lee (2009) provided evidence aligned with these expectations, finding that mobile phones significantly decrease both men's and women's tolerance for IPV and increase women's autonomy in mobility and economic independence. In Uganda, Sekabira and Qaim (2017) found positive causal impacts of mobile phones on a household-level measure of gender equality (i.e., the share of household assets owned by females).

Because mobile phones allow people to connect with wider networks beyond coresident kin ties, they may open up new avenues for social learning, mutual information exchange, and broader information dissemination (*information dissemination* channel), thereby reshaping the traditional learning paths long recognized as drivers of gender-role changes (Bongaarts and Watkins 1996; Montgomery and Casterline 1996). Furthermore, access to "the life of others" through the internet and social networking sites might change the desirability and social acceptability of certain roles and behaviors and increase the reporting of undesirable behaviors. For instance, given the additional privacy afforded by mobile phones relative to other media,

women could more easily report IPV, gather information on help-seeking strategies, or directly consult family planning agencies.

Mobile phones may also enable access to media content beyond national boundaries and thus may promote exposure to less context-specific and more globalized and liberalized cultural scripts about women's roles in society. In turn, these scripts may shape attitudes toward women's roles in society, including such undesirable behaviors as IPV (*gender attitudes* channel). For instance, Okenwa-Emegwa et al. (2016) found access to television and radio to be associated with men's reduced odds of tolerating IPV in Nigeria. In the same country, Banerjee et al. (2019) found that an edutainment MTV series reduced the acceptability of IPV for men but had no effect for women. Consistent with this idea, Charles (2020) found that, for Africa, gender liberalism regarding the belief that men and women should have equal rights is stronger among individuals more exposed to globalized culture, including through mobile phone use.

Although the channels outlined here are related to increased female autonomy, individual ownership of mobile phones may also trigger reactions from male partners, who may feel threatened by "new" status imbalances within the household. Some qualitative research in LMICs supports this possibility (Mpiima et al. 2019; Uduji and Okolo-Obasi 2018). In discussing the suitability of agricultural extension policies in Uganda, Mpiima et al. (2019) claimed that men and women jointly—rather than women only—need to be included in the provision of ICT-enabled agricultural information services, as this pushes men to understand the benefit of ICTs for the household's economic well-being without feeling excluded. Men's exclusion is, in fact, associated with increased IPV, tied to the idea of threatened male dominance. Some of this evidence is also consistent with literature on women's autonomy in terms of higher relative education, employment, and financial independence and unequal gender dynamics within households, as demonstrated by Weitzman (2014) in India and by Behrman (2019) in Kenya, Uganda, and Zimbabwe. It is crucial to stress that, alongside liberalized cultural scripts, technology and media may also spread gender-traditional ideas and strengthen gender stereotypes, thus reinforcing the just-mentioned backlash effects—as shown by Forsyth and Ward (forthcoming) in Honduras and Gray (2014) in Malawi.

Whether ICTs in the form of mobile phone access are associated with higher or lower IPV is ultimately an empirical question, and one that I explore in the current study. Because of data limitations, however, I am only able to explore mechanisms related to decision-making power and gender attitudes. Evidence from related research suggests that enhanced connectivity and communication, more active information-seeking, increased outreach and community participation, and expanded access to services are other viable mechanisms.

Data and Measures

This study uses data from the DHS, publicly available nationally representative surveys of women aged 15–49 and men aged 15–60.[3] DHS data are a sensible choice

[3] See https://dhsprogram.com/data/.

for this kind of analysis for several reasons. First, although data on individual-level adoption of mobile technologies that can be linked to development outcomes are rarely available, some of the latest DHS surveys collect data on whether respondents themselves—not the household—own a mobile phone. Second, some DHS surveys include a domestic violence (DV) module that collects information on women's experiences of IPV within the household.[4] Also, since 1999, DHS has widely collected information on men's and women's attitudes toward wife beating, one of the most common forms of violence across LMICs (Kishor and Subaiya 2008). Third, DHS surveys contain detailed geographic information about where respondents live, which allows augmentation of DHS data with geocoded data from ancillary sources.

To summarize, I utilize DHS surveys that report information on respondents' ownership of mobile phones and contain a DV module.[5] Following these constraints on the women's samples, I identify the respective men's samples to obtain information on men's attitudes toward IPV; there is no reporting of actual violence in the men's samples. The combined data set includes 10 LMICs—Angola, Burundi, Ethiopia, Malawi, Tanzania, Uganda, and Zimbabwe in SSA; Haiti in LAC; and Nepal and Timor-Leste in SA. I pool these countries' latest DHS survey waves for women and men, obtaining a pooled women's file for the core of the analysis and a pooled men's file (of current partners/husbands of women who completed the DV module) for exploration of potential mechanisms. Country-specific results are provided by leveraging country and mobile phone ownership interactions.

Although the core of the analysis is solely based on DHS data to preserve internal consistency, country coverage, and adequate sample sizes, I also conduct a series of ancillary analyses augmenting DHS data with external sources using geographic information. Specifically, I link DHS data with information from the Afrobarometer,[6] exploiting the fact that survey enumerators in the Afrobarometer recorded the availability of specific facilities, including mobile phone coverage in the respondent's local geographic unit. Second, I link DHS data to the HRFC data set, which contains information on total lightning flash rates seen by the space-borne Optical Transient Detector and Lightning Imaging Sensor, a distal proxy for the functioning of antennas on the ground. Third, to make sure that access to technology does not mask wider developmental processes unfolding at the local (cluster or community) level, I further link augmented DHS data to the Visible Infrared Imaging Radiometer Suite (VIIRS)

[4] DHS methodology includes protocols to ensure quality and rigor in the data collection process. For example, all interview facilitators and participants are gender matched, and one-on-one interviewing is the standard procedure. However, when privacy is not possible, interviewers are trained to record the presence of others (i.e., women, husband, other men, children <10 years) and whether they appear to be listening. Although this procedure does not apply to the full DHS questionnaire, others' presence in the immediate interview context is recorded during inquiry into sensitive subjects (e.g., sexual behaviors and health, female genital mutilation/cutting), including attitudes toward IPV. In this study, we limited the sample to women who completed the entire DV module in conditions of full privacy.

[5] Some countries (e.g., Armenia) had both types of information, but they were excluded from this analysis because mobile phone ownership is near universal and, thus, there was no variability in the main predictor of interest.

[6] See https://www.afrobarometer.org/data.

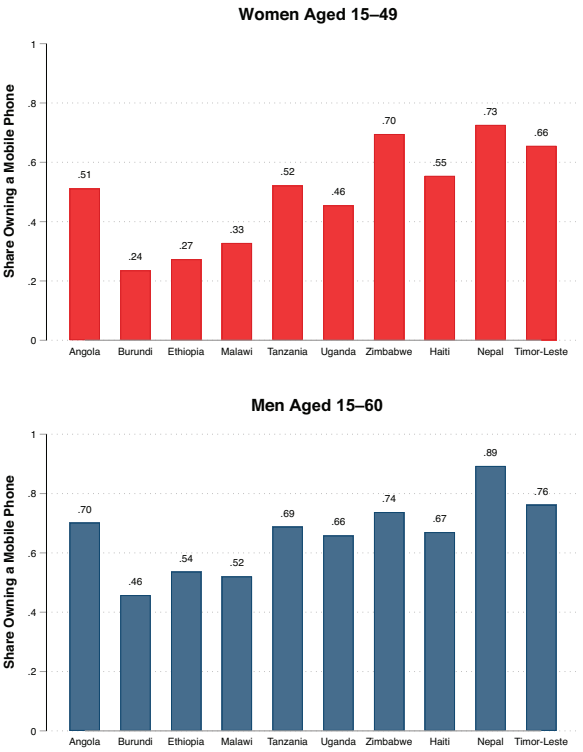

Fig. 1 Mobile phone ownership for women and men, by country. Data are from DHS women's and men's complete files, with respective sampling weights. Women: $N = 154{,}900$. Men: $N = 71{,}219$. Figure A.1 in the online appendix reports corresponding estimates (aligned) on the analytic samples.

Nighttime Imagery data set, which contains information on nighttime lights, a well-established proxy for local development (Bruederle and Hodler 2018; Pokhriyal and Jacques 2017). These additional data sources provide useful control variables that may operate as confounders in the relationship of interest, as well as allow for the construction of novel and plausibly exogenous IVs for mobile phone ownership. A similarly augmented DHS data set was used by Rotondi et al. (2020) to study the relationship between mobile phone ownership and sustainable development. Note that the augmented file—mostly because of country coverage in the Afrobarometer (i.e., Africa)—limits some robustness analyses to the seven SSA countries.[7]

Figure 1 provides summary information on the country-specific share of women 15–49 and men 15–60 owning a mobile phone, computed on full DHS samples. Despite considerable sex differences, whereby men's shares are generally higher than women's by at least 10 percentage points, the two panels show similar patterns across countries. Burundi has the lowest shares of women and men owning a mobile phone (24% and 46%, respectively) and Nepal has the highest shares (73% and 89%). Over-

[7] Where excluded, countries—together with overall sample sizes—are specified in table and figure footnotes.

all, there is considerable variation in access to mobile technology in the study countries, which suggests a differential pace of mobile phone expansion across contexts, alongside persistent gender gaps favoring men. With respect to the mobile phone variable, the DHS provides information only on mobile phone ownership. Although intensity of use is not captured, external information from the Afrobarometer suggests that once women own a mobile phone, using it daily is the norm.[8]

Table 1 provides summary statistics on the outcomes of interest for both women and men, listing the survey waves included in the analysis and their sample sizes. In this respect, a few specificities of the DV module are worth noting. The DHS program, in accordance with guidelines from WHO (WHO 2001), randomly selects one woman from the eligible women in the household for the optional individual questionnaire for this module (Chai et al. 2016; Kishor and Johnson 2004). Thus, the number of women with information on domestic violence is lower than the number selected for the complete DHS individual interview.

DHS data feature two IPV measures: an indicator of violence experienced in the 12 months before the survey and a cumulative lifetime victimization measure. As there is no information on the exact timing of mobile phone ownership, I am interested in outcomes that measure recent experiences of IPV to allow for proper temporal specificity. Therefore, I use the former measure and build indicator variables for emotional, physical, and sexual violence experienced over the previous 12 months (see Table A.1 of the online appendix for the exact instances that make up each category). Note that "less severe" and "severe" physical violence are merged together and, although sexual violence is a form of physical violence, I keep the two distinct following the relevant literature on the topic (Ahinkorah et al. 2018; Caridad Bueno and Henderson 2017; Chai et al. 2016; Peterman et al. 2015). I also construct an overall dummy variable of whether the woman has recently experienced *any* type of violence.[9]

A large part of the DV module asks about violence perpetrated by the current husband/partner for women who are currently married and the most recent husband/partner for women who are currently divorced, separated, or widowed. Thus, the sample is women ever married or in a union. Ever-married women are those who self-report as being married, divorced, separated, or widowed, or living with or having ever lived with a man as if married. Following influential literature on the topic that suggests that in settings where the definition of union is ambiguous (e.g., because civil and customary marriages coexist) the process of union formation is fluid and distinguishing between formal and informal unions may be impossible (Casterline et al. 1986; Clark and Brauner-Otto 2015; Pesando 2021), I keep "married" and "living together" as a single category.

I restrict the sample of women who completed the DV module to women who were interviewed in conditions of full privacy and who were currently married or

[8] Data from the Afrobarometer 2015 reveal—conditional on owning a mobile phone—the share of women who use their mobile phone daily is .81 in Burundi, .82 in Malawi, .89 in Tanzania, .83 in Uganda, and .73 in Zimbabwe. No data are readily available for the remaining countries, yet shares might be similar or even higher, especially in more highly developed contexts, such as Nepal.

[9] I favor a dichotomous variable over an index so that all four outcomes are binary. Results are virtually unchanged irrespective of how this summary indicator is built (index as the sum of instances, index of frequency, index with principal component analysis).

Table 1 Demographic and Health Surveys included, sample sizes, and descriptive statistics of women's experience of intimate partner violence over the previous 12 months (top panel, %) and men's attitudes supporting that wife beating is justified for various reasons (bottom panel, %)

Country	Survey Year	Overall *N* (O)	Domestic Violence Sample *N* (DV)	Analytic Sample *N* (A)	Emotional		Physical		Sexual		Any	
					(DV)	(A)	(DV)	(A)	(DV)	(A)	(DV)	(A)
Angola	2015–2016	14,379	7,697	6,647	23.99	23.88	24.23	24.06	6.68	6.66	33.75	33.98
Burundi	2016–2017	17,269	7,396	6,401	16.49	17.26	17.90	19.04	18.37	20.32	31.46	34.29
Ethiopia	2016	15,683	4,733	4,123	20.22	20.11	16.87	16.81	8.29	8.56	26.95	27.19
Malawi	2015–2016	24,562	5,422	4,622	23.03	22.37	16.23	15.43	15.41	15.44	32.52	32.38
Tanzania	2015–2016	13,266	7,626	6,479	28.12	28.08	26.92	26.61	10.39	9.65	37.50	38.04
Uganda	2016	18,506	7,562	6,395	29.30	30.63	22.36	22.68	16.43	16.70	39.43	41.19
Zimbabwe	2015	9,955	5,819	4,917	23.54	25.12	15.24	15.89	9.31	9.53	30.15	32.26
Haiti	2016–2017	15,513	4,322	3,847	17.84	18.67	9.96	10.19	7.04	7.22	22.29	23.65
Nepal	2016	12,862	3,826	3,708	7.69	7.69	9.99	10.05	4.00	3.97	13.50	13.68
Timor-Leste	2016	12,607	3,694	3,573	8.86	8.58	33.07	33.11	4.82	4.77	36.75	36.89

Country	Survey Year	Overall *N* (O)	Analytic Sample *N* (A)	Goes Out Without Telling Husband		Neglects the Children		Argues With Husband		Refuses to Have Sex		Burns Food		Attitude Index (sum, 0–5)	
				(O)	(A)	(O)	(A)	(O)	(A)	(O)	(A)	(O)	(A)	(O)	(A)
Angola	2015–2016	5,684	2,034	8.27	8.27	11.51	12.07	10.78	11.55	5.72	5.34	5.94	4.60	0.42	0.42
Burundi	2016–2017	7,552	1,481	16.62	13.71	25.32	21.94	9.90	8.38	13.16	8.96	4.65	3.41	0.70	0.56
Ethiopia	2016	12,688	2,687	17.07	17.05	19.22	16.90	16.07	15.02	12.79	10.80	11.74	10.28	0.77	0.70
Malawi	2015–2016	7,478	3,379	4.69	2.91	6.22	3.41	5.17	2.80	4.75	2.99	2.28	1.29	0.23	0.13
Tanzania	2015–2016	3,514	1,278	22.94	20.56	31.02	26.71	24.77	20.03	14.03	11.20	6.45	4.87	0.99	0.83
Uganda	2016	5,336	—	22.05	—	28.11	—	23.19	—	11.85	—	7.08	—	0.92	—
Zimbabwe	2015	8,396	2,966	17.59	13.89	18.00	14.28	13.82	10.15	5.96	4.52	5.73	3.22	0.61	0.46
Haiti	2016–2017	11,886	2,517	6.31	5.42	5.42	3.37	1.44	1.26	2.41	1.94	1.67	0.93	0.17	0.13
Nepal	2016	4,063	1,884	9.44	8.84	18.62	14.95	8.76	8.40	3.82	3.23	1.56	0.92	0.42	0.36
Timor-Leste	2016	4,622	—	48.93	—	50.10	—	33.49	—	30.58	—	21.64	—	1.78	—

Notes: Women's outcomes are weighted using domestic violence weights. O = overall sample; DV = domestic violence sample; A = analytic sample (for women: currently married/in union who completed DV module in full privacy; for men: partners/husbands of the women who completed the DV module and live in the same households). Men's outcomes are weighted using men's sampling weights.

in union at the time of the survey. This restriction is needed because of the types of outcomes explored—IPV over the previous 12 months—and the lack of proper information on the timing of mobile phone purchase. By restricting the sample to women currently in violent versus nonviolent relationships, I reduce the concern that ownership of a mobile phone might follow the experiencing of IPV, thus assuaging concerns related to temporal ordering.

Analyses of women's IPV experiences are complemented with analyses of men's IPV attitudes. DHS surveys ask all men—not just one randomly selected per household—a series of questions regarding whether they deem wife beating justifiable under five specific circumstances: if the wife goes out without telling the husband, neglects the children, argues with the husband, refuses to have sex, or burns food. I combine these variables and dichotomize responses into an attitude index built as the sum of the instances, ranging from 0 to 5. I also restrict the sample of men to the partners/husbands of the women who completed the DV module and live in the same household. Hence, sample sizes are significantly reduced (e.g., Uganda and Timor-Leste are not included, as no men were interviewed in such households).

Although there is considerable variation across countries and types of violence, findings from Table 1 (top panel) suggest that women experience IPV at very high frequencies. Nepal is the only country in which less than 20% of women reported having experienced any form of violence in the previous 12 months. In the other countries, estimates range between 24% in Haiti to 41% in Uganda. Looking at each type of violence separately, Uganda has the highest share of women having experienced emotional violence (31%), followed by Tanzania (28%) and Zimbabwe (25%). Physical violence is most prevalent in Timor-Leste (33%), followed by Tanzania (27%) and Angola (24%). Conversely, sexual violence is highly prevalent in Burundi (20%) and Uganda (17%), while less common (below 5%) in Nepal and Timor-Leste**.** Only very minor discrepancies are observed across the different samples. Looking at the sample of men (bottom panel), acceptability of IPV is particularly widespread in Timor-Leste, Tanzania, and Uganda.

Methodology

My methodological approach begins with providing graphical descriptive evidence on the relationship between women's mobile phone ownership and their experience of IPV in the previous 12 months. I then run a series of ordinary least-squares (OLS) regressions predicting emotional, physical, sexual, and any violence, coded as dummy variables (hence linear probability models, LPM). In these models, I incrementally control for a series of variables. Specifically, I run four models per outcome in which model 1 provides a simple bivariate association; model 2 adds *individual-level controls*, namely, whether the respondent has ever accessed the internet, her level of education (none, primary, secondary, or higher), age, current working status, and current marital status (married vs. in union); model 3 adds *partner-level controls,* such as his level of education (none, primary, secondary, or higher), current working status, coresidence with the woman, and whether he drinks alcohol; and model 4 (*full specification*, henceforth) adds *household-level controls,* including location of residence (rural vs. urban), wealth index, and three dummy variables for whether the

household has radio, television, and landline telephone. The main analyses are pooled to preserve statistical power, with country fixed effects included in all models. Coefficient estimates by country are obtained through mobile phone ownership–country interactions and reported alongside the pooled analyses. Analyses of women's IPV outcomes are weighted using the appropriate DV weights provided by the DHS and account for the complex DHS survey design by adjusting the standard errors for cluster sampling at the level of the primary sampling unit (PSU).[10]

For the community-level analyses, I aggregate the violence variables at the community level, so that they represent the cluster-level share of women experiencing emotional, physical, sexual, and any violence. The logic follows the same four stepwise models with three minor differences: (1) categorical variables, such as level of education, are collapsed into dummy variables before the aggregation (e.g., share of women with secondary education or above); (2) the full specification also includes cluster-level controls from the geolocalized Afrobarometer (presence of electricity and health clinics within the PSU) and the VIIRS Nighttime Imagery data set (nighttime lights); and (3) the full specification also accounts for generalized attitudes toward IPV in the community, in line with evidence provided by Cools and Kotsadam (2017) and Koenig et al. (2003) suggesting that community influences matter greatly for explaining IPV outcomes in LMICs.

Despite the fact that the foregoing approach takes steps to minimize concerns of reverse causality, I work with cross-sectional data, suggesting that unobserved heterogeneity may prevent one from drawing solid causal conclusions. For instance, although it is possible that women who enter a union might be less at risk of being victimized if they own a mobile phone, it is equally likely that women who have controlling husbands might face barriers to owning a personal phone. Similarly, there may be real personality differences between women who spend money to purchase a mobile phone and those who do not. While these issues can hardly be solved without experimental variation, I complement these associations with estimates from nonparametric matching models and instrumental variable techniques. In so doing, I see this complementarity of approaches as a way to test the robustness of the findings rather than infer causality.

Nonparametric matching models have two distinct features relative to regression-based approaches: they do not assume any *a priori* functional form for the relationship between mobile phone ownership and IPV outcomes, and they rely on comparing (or "matching") the treatment observations with a closely matched set of control observations rather than using all the untreated observations in the sample as controls. I estimate two types of matching models—namely, nearest-neighbor and coarsened exact matching.[11] I match on respondents' education, location of residence, wealth, and country, with exact matches requested by location of residence and country. By matching on these socioeconomic status (SES) variables, I attempt to address the

[10] In other words, setting the right survey design by using the proper weights does not require additional clustering of standard errors (Hindin et al. 2008).

[11] Nearest-neighbor matching with distance based on propensity score differences or Mahalanobis distance involves running through the list of treated units and selecting the closest eligible control unit to be paired with each treated unit. It is the most common form of matching used (Thoemmes and Kim 2011). Coarsened exact matching is a form of stratum matching that involves first coarsening the covariates by creating bins and then performing exact matching on the new coarsened versions of the covariates (Iacus et al. 2012).

concern that women owning a mobile phone might experience lower rates of IPV simply because they have higher SES to start with. Like OLS, however, nonparametric matching models assume that selection into owning a mobile phone is solely based on observable characteristics and is, therefore, exogenous to women's IPV outcomes, conditional on including these characteristics. As this assumption may not hold (e.g., because of personality differences), I provide additional estimates through IV, likely the most reliable way to minimize endogeneity concerns with cross-sectional data in the absence of experimental variation. Assaad et al. (2017) adopted a similar approach combining matching techniques with IV estimates using cross-sectional DHS data to study IPV in Colombia.

The main assumption for IV approaches is that an exogenous instrument can be found that affects the "treatment" (mobile phone ownership) but is excludable from the outcome equation. I made a good faith effort to identify instruments that satisfy these conditions but, as always, it is hard to exclude all possible threats to validity. Using the mobile phone variable, I build a household-level instrument that measures the share of households within the same cluster—excluding the respondent's household—in which at least one woman has a mobile phone. This variable is likely to proxy for network coverage within the cluster, thus affecting a woman's likelihood to own a mobile phone herself (*positive* first-stage coefficient); however, by excluding the household of interest, it is arguably exogenous to that woman's IPV outcomes.[12] I complement this household-level IV—which retains the full sample size and the 10 countries, as it is built solely using DHS data—with cluster-level IVs built using geocoded information from the Afrobarometer (mobile service coverage) and the HRFC (lightning flash rates). Mobile service coverage is expected to increase the probability of owning and using a mobile device (*positive* first stage). At the same time, it is highly dependent on such geographic factors as the presence of hills, mountains, and valleys, hence arguably unrelated to other factors affecting IPV outcomes. Similarly, the rationale for considering lightning strikes is that mobile-technology adoption is slower and connectivity weaker in areas where strikes are more frequent, likely because of damaged antennas on the ground (*negative* first stage). The reliability of these cluster-level variables as IVs for mobile phone access and use has been tested in relevant studies on the topic (Manacorda and Tesei 2020; Rotondi et al. 2020; (Varriale et al. forthcoming). When all IVs are used together, the sample is reduced to the seven SSA countries, yet a Sargan–Hansen statistic (*J* test) can be obtained. As both the endogenous variable and the outcomes are binary, I adopt a two-stage least-squares (2SLS) approach following Angrist and Pischke (2009) and report complementary bivariate probit estimates in the online appendix.

Descriptive Evidence

Figure 2 provides descriptive evidence (i.e., no controls included) on the relationship between women's mobile phone ownership and IPV over the previous

[12] This variable is built using information from the entire sample of women in the DHS women's surveys, not just those who completed the DV module.

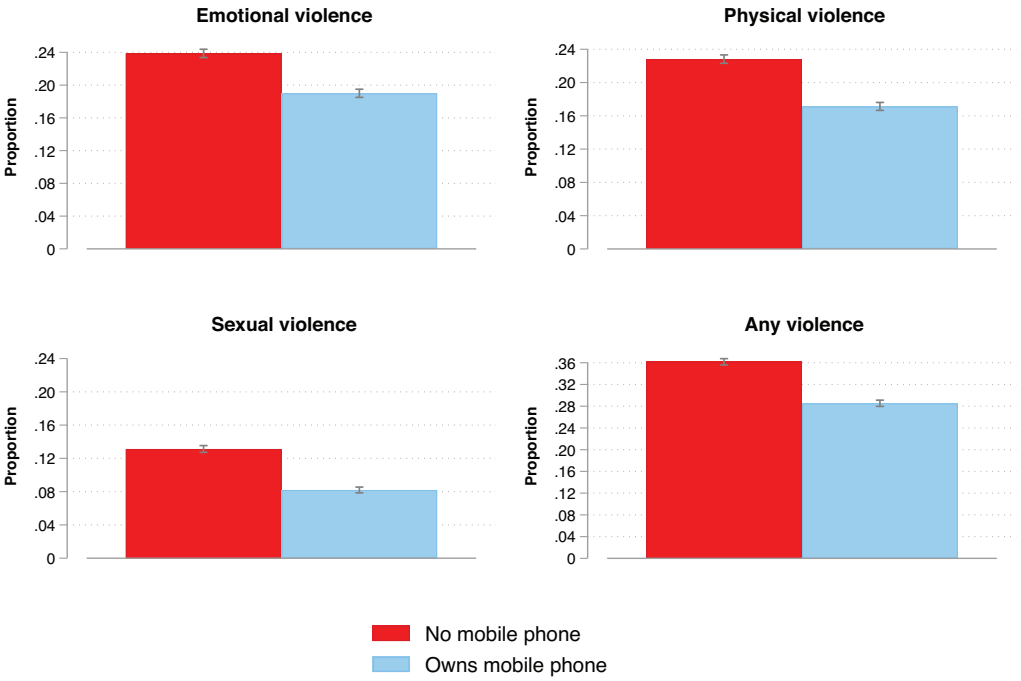

Fig. 2 Experience of intimate partner violence over the previous 12 months by women's mobile phone ownership. Data are from DHS women's files, with domestic violence weights. Analytic sample: currently married women who completed the DV module in full privacy. The first three dichotomous variables are plotted on the same scale. $N = 50{,}712$.

12 months for the pooled sample of countries. The figure contains a panel for each type of violence, and one for the summary IPV variable; analogous estimates for this latter variable by country are reported in Figure A.2 (online appendix). All four panels provide the same descriptive finding: women who own a mobile phone report experiencing IPV less frequently than other women. The difference is quite substantial, ranging from about five percentage points for emotional and sexual violence to six percentage points for physical violence. Overall, 36% of women without a mobile phone report having experienced any type of violence over the previous 12 months, compared with 28% of women with one. Evidence by country is aligned for nine out of 10 countries and is particularly strong in SSA, except for Angola, where women with and without mobile phones report the same prevalence of IPV (.34). In Timor-Leste, differences still favor women with mobile phones, although just slightly (about two percentage points). These trends may simply be driven by different observed (e.g., socioeconomic) and unobserved characteristics of individuals with and without mobile phones, by household- or community-level factors, or by other omitted variables. Thus, I turn to a more detailed analysis that accounts for potential confounders and alternative methodologies.

Results

Women's Experiences of IPV Over the Previous 12 Months

Individual-Level Analyses

Table 2 reports only the estimated coefficient on mobile phone ownership; see Table A.2 in the online appendix for detailed estimates with coefficients on all controls. In line with the descriptive statistics presented in Figure 2, estimated coefficients provide evidence of a consistently negative association between mobile phone ownership and IPV. For all types of violence, estimates are robust to the inclusion of country fixed effects and individual-, partner-, and household-level controls. For all outcomes, the full specification decreases the magnitude of the estimated coefficients by about half, yet the statistical significance is unaltered. The full specification suggests that owning a mobile phone is associated with a decrease in emotional, physical, sexual, and any violence of 2.6, 2.7, 1.3, and 3.3 percentage points, respectively, or by 9%–12%. Although these associations cannot be deemed causal, they are purged from potential confounders related to SES and wealth differences between individuals and households.

Other controls (see Table A.2) are in line with expectations and existing research on the topic. Use of the internet is negatively and significantly associated with IPV, with a coefficient that is about two thirds that of mobile phone ownership. This suggests that mobile phones matter above and beyond the fact that some (i.e., smartphones) may enable internet access or that households may have internet access through other sources. Education demonstrates a clear negative gradient, whereby more highly educated women are less likely to experience IPV. Women who currently work are more likely to experience IPV, suggesting that work outside of the household—a reasonable proxy for women's autonomy—may trigger within-household conflicts because of the overturning of traditional gender roles. This finding is in line with Yount, Zureick-Brown, and Salem (2014), who documented a positive association between Egyptian women's experiences of IPV and their economic participation, largely attributed to *compensation* theories—that is, whereby women seek to offset dissatisfaction in one domain by pursuing satisfaction in another. Not surprisingly, coresidence with the partner and male drinking behavior are positively associated with IPV, while husbands' education shows a negative gradient. Of the household-level controls, location of residence is not significantly associated with IPV, while household wealth is negatively associated with all types of violence. There is no consistent association between ownership of a radio or landline telephone and IPV; however, television ownership is negatively and significantly associated with the outcome, in line with the literature on television's role in conveying transformative values and ideas and shaping gender norms (e.g., La Ferrara 2016; La Ferrara et al. 2012). A simple comparison of the mobile phone and television coefficients suggests that the former is about double in size, more statistically significant, and more consistently so across IPV outcomes.

Figure 3 (left panel) summarizes the estimated associations (full specifications) on the pooled sample. As sample size allows, I conclude this set of analyses by interacting the mobile phone ownership variable with country dummy variables to

Table 2 Coefficients from ordinary least-squares regression models showing associations between mobile phone ownership by women and experience of intimate partner violence over the previous 12 months

	Model 1	Model 2	Model 3	Model 4
Emotional Violence	–.046**	–.035**	–.024**	–.026**
	(.006)	(.007)	(.006)	(.007)
Physical Violence	–.062**	–.038**	–.026**	–.027**
	(.005)	(.006)	(.006)	(.006)
Sexual Violence	–.031**	–.022**	–.015**	–.013**
	(.004)	(.004)	(.004)	(.004)
Any Violence	–.072**	–.047**	–.032**	–.033**
	(.007)	(.007)	(.007)	(.007)
Country Dummy Variables	Yes	Yes	Yes	Yes
Individual-Level Controls	No	Yes	Yes	Yes
Partner-Level Controls	No	No	Yes	Yes
Household-Level Controls	No	No	No	Yes
Observations	50,712	50,712	50,681	49,849

Notes: Domestic violence (DV) weights were used. Standard errors are shown in parentheses. Analytic sample: currently married/in union women who completed the DV module in full privacy. Individual-level controls include any use of the internet, woman's education, age, current working status, and current marital status (married vs. in union). Partner-level controls include partner's education, current working status, coresidence with the woman, and whether the partner drinks alcohol. Household-level controls include rural/urban location of residence, wealth, and presence of radio, television, and landline phone in the household. Model 4 is the full specification. The discrepancy in number of observations between models 1 and 4 is due to the lack of information on household durable assets (mainly television and radio) for some women.

**$p < .01$

evaluate whether similarly negative associations are observed in each country. For the latter, I only report results from the full specification using the summary IPV outcome (right panel), yet findings across types of violence are consistent. The mobile phone coefficient is negative in seven out of the 10 study countries, and statistically significant at least at the 10% level in six (Burundi, Ethiopia, Malawi, Tanzania, Uganda, and Nepal); the coefficient is roughly zero in Zimbabwe and Timor-Leste. In line with the descriptive statistics that show no differences in IPV by mobile phone ownership (Figure A.2, online appendix), Angola emerges as the main exception—especially among SSA countries—in this analysis, as the association between mobile phone ownership and IPV is positive, though not significant**.** Although identifying the precise mechanism is challenging with these data, I hypothesize that channels such as increased female empowerment threatening male dominance—combined with women's limited ability to use phones independently of their partners—might be at play.

Community-Level Analyses

Next, I explore whether the associations found at the individual level hold at the community (or cluster) level, following the same stepwise approach just outlined. Results are summarized in Figure 4, which provides estimates of the mobile phone ownership coefficients for women for each outcome on the pooled sample (left panel) and for the

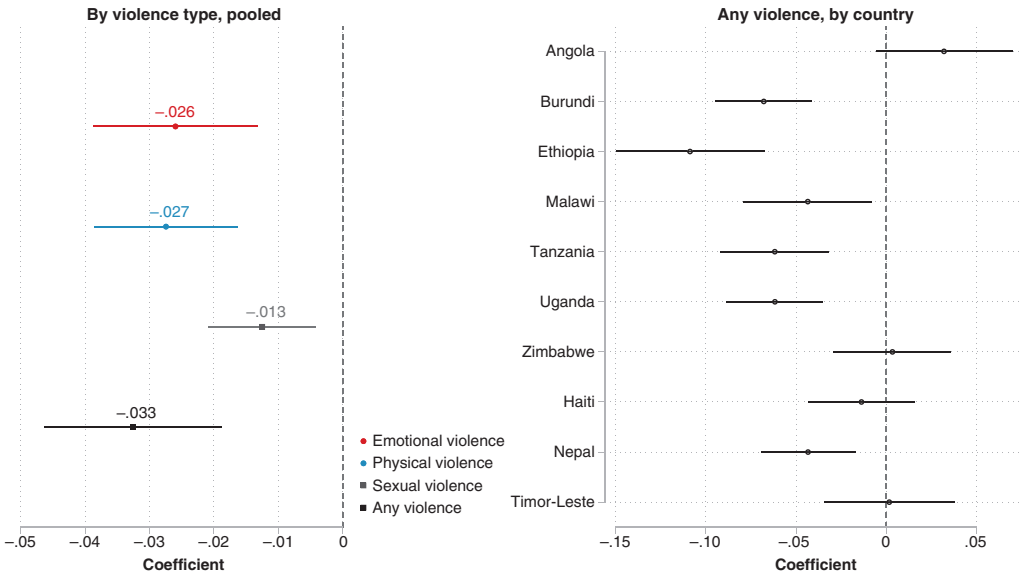

Fig. 3 Associations from OLS regressions between women's mobile phone ownership and experience of intimate partner violence over the previous 12 months, for all countries combined (left panel) and by country (right panel). Data are from DHS women's files, with domestic violence weights. Full specifications are reported (all controls included). The right panel reports estimates from country × mobile phone interactions for the any violence outcome. Analytic sample: currently married women who completed the DV module in full privacy. Corresponding estimates with coefficients on all controls are provided in Table A.2 in the online appendix. Whiskers represent 90% confidence intervals. N=49,849.

summary IPV outcome by country (right panel).[13] Detailed estimates reporting coefficients on all variables are provided in Table A.3 (online appendix).

Results are consistent with the individual-level evidence: higher cluster-level mobile phone ownership is associated with lower prevalence of IPV at the community level across all types of violence, albeit estimates for sexual violence are not different from zero. As expected, the presence of electricity and health clinics in the PSU are negatively associated with IPV outcomes. Conversely, while nighttime lights are negatively associated with attitudes toward violence (as expected in contexts of higher local development), the relationship with IPV is positive. This finding may suggest that reporting of IPV is higher where local development is higher. Alternatively, as indicated by the positive coefficient for location of residence (urban), nighttime lights may be partly capturing more urbanized areas. Nonetheless, I am confident that by including other variables (e.g., mean education of women and their partners, average community wealth), I adequately control for potential confounders tied to SES differences between communities. Lastly, IPV is much higher in communities where women's acceptance of IPV is higher. Estimates by country suggest that, despite the different contexts, there is little cross-country variability in the estimated

[13] Note that, once aggregated, mobile phone ownership is not an individual-level, binary variable anymore. Hence, I use a 50% threshold for mobile phone ownership to estimate the interactions and to plot the country-specific coefficients.

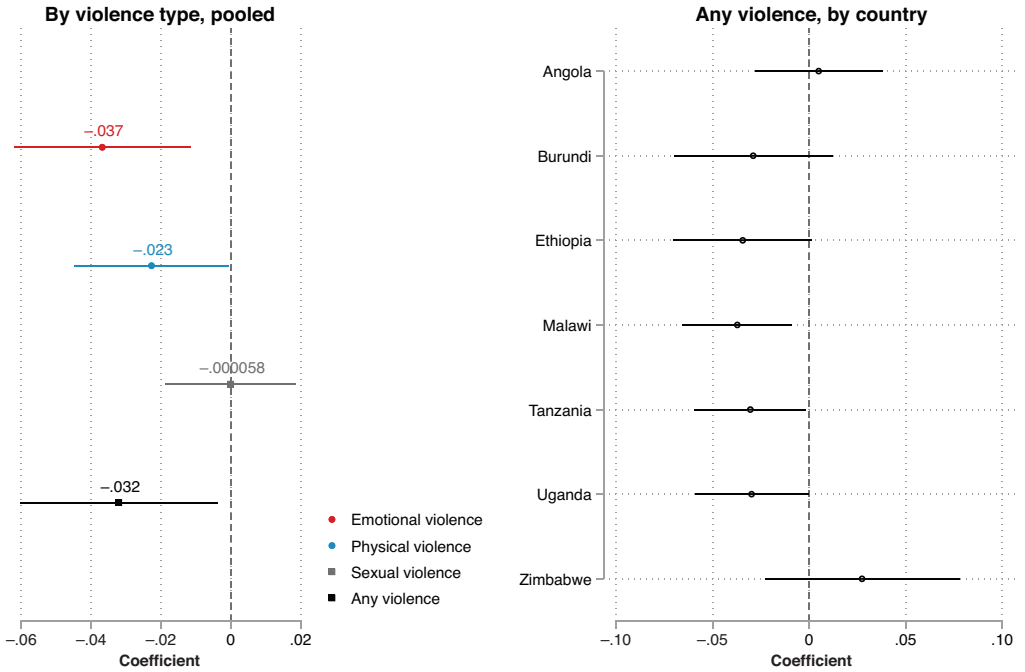

Fig. 4 Community (cluster)-level associations from OLS regressions between women's mobile phone ownership and prevalence of intimate partner violence over the previous 12 months in the community, for all countries combined (left panel) and by country (right panel). Data are from DHS women's files, aggregated by cluster and merged with georeferenced information from the Afrobarometer (presence of electricity and health clinics within the PSU) and Visible Infrared Imaging Radiometer Suite data (nighttime lights). Full specifications are reported (all controls included). The right panel reports estimates from country × mobile phone diffusion (dichotomized to 50% as threshold for diffusion) for the any violence outcome. Corresponding estimates with coefficients on all controls are provided in Table A.3 in the online appendix. Haiti, Nepal, and Timor-Leste are missing from these analyses owing to the lack of georeferenced information. Whiskers represent 90% confidence intervals. $N = 4{,}282$ (clusters).

associations, which are negative in five out of seven countries. While Angola and Zimbabwe depart from the overall trends, there is not enough evidence to conclude that the community-level associations are in fact positive in either context.

Robustness Checks

Matching

I conduct several robustness checks that move beyond OLS estimates to at least in part address some endogeneity concerns. I proceed incrementally, starting from a series of nonparametric matching models matching individuals on the basis of observed characteristics. In panel A of Table 3, I present two models: (1) nearest-neighbor matching (nn) with Mahalanobis distance metric, matching on education, household wealth, location of residence (rural/urban), and country; and (2) coarsened exact matching (cem), coarsening these same covariates first and then performing exact matching on them. The table provides the average treatment effect of women's mobile phone

Table 3 Robustness checks: Matching on observable characteristics showing average treatment effects of mobile phone ownership on intimate partner violence (top panel) and instrumental variable 2SLS estimates (bottom panel)

A. Matching		Nearest-Neighbor Matching (Mahalanobis metric) (1)	Coarsened Exact Matching (2)
Emotional Violence	Coef.	–.043**	–.032†
	(SE)	(.007)	(.017)
	Observations	47,144	47,144
Physical Violence	Coef.	–.040**	–.055**
	(SE)	(.006)	(.014)
	Observations	47,144	47,144
Sexual Violence	Coef.	–.019**	–.031*
	(SE)	(.005)	(.016)
	Observations	47,144	47,144
Any Violence	Coef.	–.053**	–.061**
	(SE)	(.008)	(.020)
	Observations	47,144	47,144
B. IV 2SLS		**Household-Level IV (1)**	**Household- and Cluster-Level IVs (2)**
Emotional Violence	Coef.	–.096*	–.093†
	(SE)	(.045)	(.056)
	Observations	47,604	36,675
	Hansen *J* (*p* value)		.121
Physical Violence	Coef.	–.078*	–.124**
	(SE)	(.035)	(.045)
	Observations	47,604	36,675
	Hansen *J* (*p* value)		.143
Sexual Violence	Coef.	–.060*	–.044†
	(SE)	(.024)	(.026)
	Observations	47,604	36,675
	Hansen *J* (*p* value)		.432
Any Violence	Coef.	–.099*	–.136*
	(SE)	(.048)	(.062)
	Observations	47,604	36,675
	Hansen *J* (*p* value)		.241
First-Stage Estimates			
Share of Households		.902**	.629**
		(.011)	(.019)
Flash Rates (log)		–.037**	–.008*
		(.007)	(.003)
Cellphone Coverage		.127**	.024**
		(.015)	(.009)
Controls and Country Fixed Effects	Yes	Yes	Yes
F Statistic	87.7	65.3	64.3
Observations	47,604	36,675	36,675

Notes: Domestic violence (DV) weights were used. Standard errors are shown in parentheses. Panel A presents nearest-neighbor (nn) matching (left) with Mahalanobis distance metric, matching on respondent's education, rural/urban, wealth index, and country. Exact matches were requested by country and rural/urban. On the right are shown coarsened exact matching (cem) coarsening on the same covariates as in nn. Panel B presents two-stage least-squares (2SLS) estimates, with first-stage regressions reported at the bottom. Full specifications (with all controls) are provided. Household-level IV: share of households within the cluster—excluding the woman's household—where at least one woman has a mobile phone, computed on the overall sample. Cluster-level IVs: flash rates matched at the geospatial level from the Degree High-Resolution Full Climatology data set (HRFC) and cellphone coverage matched at the geospatial level from the Afrobarometer. Haiti, Nepal, and Timor-Leste are excluded from specifications with cluster-level IVs because no georeferenced information is available for these countries. Corresponding estimates with bivariate probit are provided in Table A.4 of the online appendix.

†$p < .10$; *$p < .05$; **$p < .01$

ownership on IPV outcomes. As such, the coefficients indicate the absolute difference in women's likelihood of experiencing IPV by mobile phone ownership. Estimates suggest that mobile phone ownership is significantly and negatively associated with experiencing any type of IPV. Treatment effects are robust across matching techniques and slightly higher in magnitude for cem relative to nn, except for emotional violence. Translated in percentage terms, mobile phone ownership is associated with an 18%, 17.5%, 14%, and 15% lower likelihood of experiencing emotional, physical, sexual, and any violence, respectively—less conservative estimates relative to the OLS ones.

Instrumental Variable Estimates

While nonparametric matching techniques do not impose any *a priori* functional form, they assume—similar to OLS—that selection into owning a mobile phone is based on observable characteristics only. Because unobserved characteristics may determine both mobile phone ownership and IPV outcomes, I conclude this robustness analysis by resorting to IV techniques. To preserve sample size and the 10 countries, I first rely on a household-level IV built solely through DHS data—namely, the share of households within the same cluster where at least one woman has a mobile phone, excluding the woman's household. I then complement the household-level IV with cluster-level IVs built through external sources—namely, network coverage within the cluster and lightning flash rates. Panel B of Table 3 provides the results from 2SLS estimates, with only the full specification reported. The bottom of panel B reports first-stage estimates predicting mobile phone ownership, suggesting that all IVs—regardless of whether they are used individually or jointly—are relevant and exhibit the expected sign, alongside an F statistic that is well above conventional thresholds for relevance.

Irrespective of specification, the IV results also suggest that mobile phone ownership is negatively associated with emotional, physical, and sexual violence. Although magnitudes are 2–3 times greater than for OLS and matching,[14] signs are consistently negative across all outcomes. Importantly, specifications with both individual- and household-level IVs suggest that there is not enough evidence ($p > .10$) to reject the null hypothesis that the instruments are orthogonal to the second-stage disturbance term, strengthening confidence in the validity of the chosen instruments. Model 2, which leverages both household- and cluster-level IVs, suggests that owning a mobile phone is associated with a decrease in emotional, physical, sexual, and any violence (9.3, 12.4, 4.4, and 13.6 percentage points, respectively). Table A.4 (online appendix) provides average marginal effects from bivariate probit models, the only other viable alternative when working with a binary outcome and a binary endogenous regressor.

[14] This is often the case when comparing OLS and IV estimates and may be because of several factors: an omitted variable that biases the OLS estimate downward, measurement errors in the variables of interest, validity of the instrument, or the IV estimating the local average treatment effect on the "compliers," rather than the average treatment effect on the overall population.

Mechanisms

Given the consistent findings, I conclude by exploring the two mechanisms that may underlie the negative relationship between women's mobile phone ownership and IPV, and that can be identified given the richness of the DHS data. I acknowledge, however, that this is a nonexhaustive set that does not fully match the range of *channels* outlined in the background. I seek to expand on these analyses in future research using both complementary data sources and newly collected variables in the upcoming DHS waves.

Women's Decision-making Power

I hypothesize that women with mobile phones might face a lower likelihood of experiencing IPV partly because they have higher decision-making power, such as more autonomy in making decisions and more freedom in joining and participating in, for instance, community groups, forums, and activities. I thus explore associations between mobile phone ownership and women's decision-making by relying on a set of questions measuring decision-making power in the following domains: health care, household purchases, visits to family and friends, and management of their husband's money. I code each of these as dummy variables that equal 1 if the woman or the woman jointly with the partner/husband is the main decision maker in each of these domains. I also construct a decision-making index as the sum of these domains (range, 0–4). For consistency with the main analyses, I run simple OLS using the four decision-making dummy variables and the decision-making index as outcomes. Previous research limited to SSA has demonstrated that the relationship between mobile phone ownership and these same female decision-making measures can be deemed causal (Rotondi et al. 2020).

Figure 5 (top panel, left) provides estimates of the mobile phone ownership coefficient from the full specification; detailed estimates reporting coefficients on all controls are provided in Table A.5 (online appendix). Findings confirm the hypothesis that women with mobile phones are more likely than others to be the sole or joint decision makers regarding health care, household purchases, visits to family and friends, and money management (by 4.5, 4.6, 3.0, and 3.5 percentage points, respectively). Coefficients are robust to the inclusion of controls and statistically significant at the 1% level. Also, estimated coefficients by country (top panel, right) suggest that the association is positive in eight out of the 10 study countries (all except for Timor-Leste and Zimbabwe) and statistically significant in seven, including Angola. This latter finding suggests that the positive association between mobile phone ownership and IPV in Angola might have more to do with shared device use and lack of privacy from husbands rather than lack of decision-making power altogether.

Men's Attitudes Toward IPV

Next, I turn to data on men's attitudes toward IPV, as information on their perpetration of violence is not available in the DHS. In these analyses, I focus on the

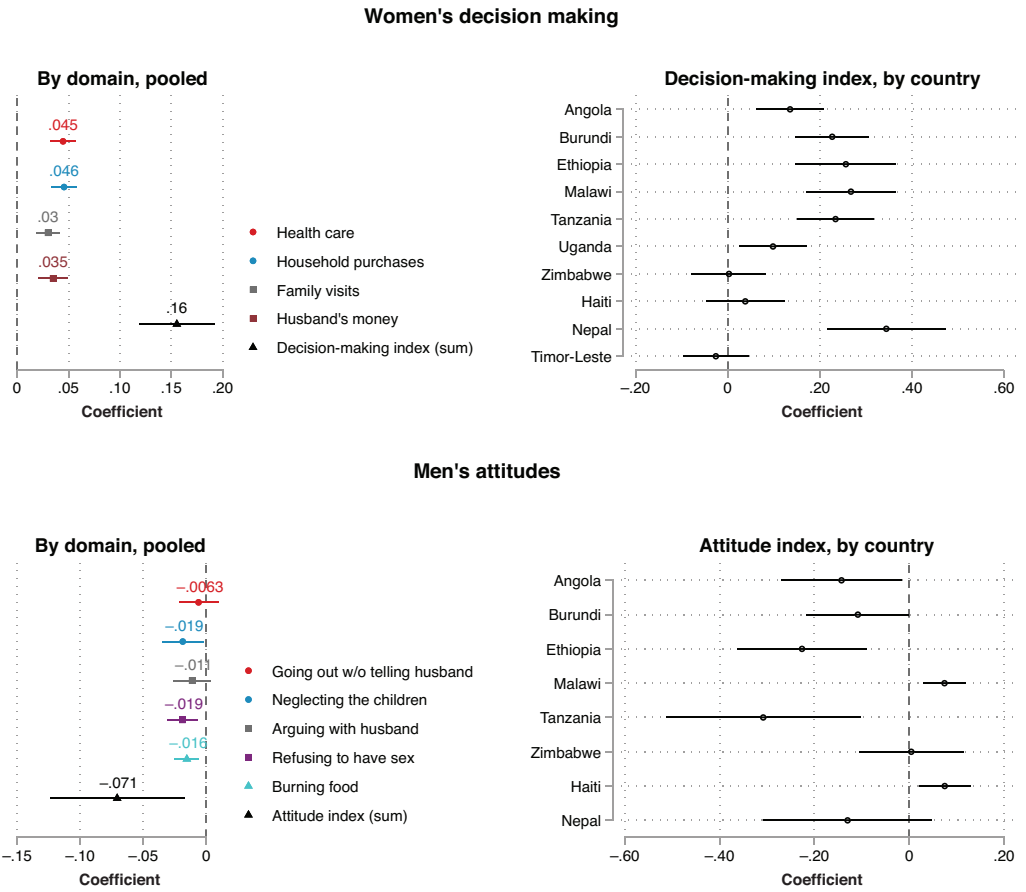

Fig. 5 Potential mechanisms. Top panel: Associations from OLS regressions between women's mobile phone ownership and their decision-making power within the household, for all countries combined (left panel) and by country (right panel). Bottom panel: Associations from OLS regressions between men's mobile phone ownership and their attitudes that wife beating is justified for various reasons, for all countries combined (left) and by country (right). Women's data are from DHS women's files, with domestic violence weights. Full specifications are reported (all controls included). The top right panel reports coefficients from country × mobile phone interactions for the decision-making index outcome. Analytic sample: currently married women who completed the DV module in full privacy. Corresponding estimates with coefficients on all controls are provided in Table A.5 in the online appendix. Whiskers represent 90% confidence intervals. N=49,849. Men's data are from DHS men's and couple-level files, with sampling weights. Full specifications are reported (all controls included). The bottom right panel reports estimates from country × mobile phone interactions for the attitude index outcome. Analytic sample: husbands/partners located in the same household of the woman selected for the DV module. Uganda and Timor-Leste are not included as no men were interviewed in such households. Corresponding estimates with coefficients on all controls are provided in Table A.6 in the online appendix. Whiskers represent 90% confidence intervals. N=18,219.

subsample of current male partners of women who completed the DV module to explore whether men's attitudinal shifts might constitute a viable channel through which lower occurrence of IPV for women with mobile phones operates. Although little research exists on the topic, a study from India suggests that greater access to media may influence norms about IPV, and regularly accessing television and radio is

equivalent to the effect of three additional years of education on reducing acceptability of IPV (Bhushan and Singh 2014).

As a counterpart to the women's analyses, I first provide raw descriptive evidence on the relationship between men's mobile phone ownership and their attitudes toward IPV for the pooled sample of countries (Figure A.3, online appendix). All panels show the same finding: men who own a mobile phone are less likely than men without one to deem wife beating as justifiable under specific circumstances. Trends for the combined attitude index are aligned both for the pooled sample and for each country (Figure A.4, online appendix), except for Malawi, where between-group differences are minimal.

In line with women's estimates, Figure 5 (bottom panel, left) presents coefficients on mobile phone ownership from full specifications; detailed estimates reporting coefficients on all controls are provided in Table A.6 (online appendix). Findings are again in line with expectations and with the descriptive evidence discussed earlier. Men's mobile phone ownership is associated with less favorable attitudes toward IPV, even after controlling for country fixed-effects, internet use, individual- and household-level measures of SES, and household durable assets. Although all estimated coefficients are negative, estimates are not statistically significant in two instances—namely, if the woman goes out without telling her husband and if she argues with him. For instance, men's mobile phone ownership is associated with a 1.9-percentage-point lower likelihood of considering wife beating justifiable if the woman neglects the children or refuses to have sex with her husband, which corresponds to a 12% and 21% decrease, respectively. Lastly, coefficient estimates by country for the attitude index (bottom panel, right) confirm that these negative associations are observed across most countries. Specifically, the association is negative and statistically significant in four of the eight countries (Angola, Burundi, Ethiopia, and Tanzania), negative and nonsignificant in Nepal, roughly zero in Zimbabwe, and positive and significant in Malawi and Haiti.[15]

Discussion

To the best of my knowledge, this study is among the first to examine the relationship between the technological revolution of mobile phone ownership and a specific sociodemographic outcome related to women's status, namely, IPV. Using micro-level DHS data on women and men from 10 LMICs and adopting a variety of methodological approaches, I have shown that women's mobile phone ownership is associated with a 9–12% decrease in the likelihood of experiencing emotional, physical, and sexual violence over the previous 12 months. These associations

[15] By limiting the sample size to current partners/husbands of women who completed the DV module, the size is considerably reduced, and two countries are lost (Uganda and Timor-Leste) as no men were interviewed in such households. In Figure A.5 of the online appendix, I show that these relationships also hold—even more consistently—keeping all men (not just partners/husbands) in the same households of the DV women (top panel; $N = 27{,}643$) and keeping all men in the DHS samples (bottom panel; $N = 68{,}447$). This suggests that men's mobile phone ownership might be associated with favorable attitudinal shifts not just within violent versus nonviolent households, but in societies more broadly.

may be partly explained by an empowerment mechanism whereby women owning mobile phones hold greater decision-making power within the household vis-à-vis their male partners. I have further shown that a change in male partners' attitudes toward less acceptability of IPV might be an additional underlying mechanism. I have documented associations that hold at both the individual and community levels, are consistently negative across the majority of countries, and are robust to the use of matching techniques and instrumental variables. Although unobserved heterogeneity remains a concern that prevents the drawing of causal conclusions, the consistency of the findings sheds light on a novel correlate of IPV that deserves further consideration in light of the digital revolution taking place worldwide.

Readers may be skeptical that mobile phone diffusion might simply be another proxy for progress in socioeconomic development and, as such, the mobile phone estimates would capture the relationship between socioeconomic progress and IPV, suggesting lower violence where socioeconomic progress is higher. I addressed this issue by controlling for a broad range of individual- and community-level characteristics related to socioeconomic status. Furthermore, I controlled for household ownership of radio, television, and landline telephone to capture technology adoption within the household and evaluate whether mobile phones held any predictive power above and beyond "monological" (and household-level) sources of information. While monological technologies imply a unidirectional communication flow without allowing any interaction, "dialogical" communication technologies enable an interactive communication flow that—irrespective of online connectivity—is more instantaneous and strengthens connections with networks outside one's own. All my estimates point toward the same two conclusions: the predictive power of mobile phones matters above and beyond socioeconomic progress, and mobile phones matter more than radio, television, or landlines for explaining variability in women's IPV outcomes. My findings align with other evidence from the African context suggesting that simple SMS-based communication can amplify the participatory features of unidirectional media, creating new spaces for dialogue and public discussion around critical issues, such as IPV (Abreu Lopes and Srinivasan 2014).

Additionally, scholars and policymakers interested in the topic might worry that unobserved factors (e.g., personality differences) or other observed factors omitted from the model specifications because they are not collected in the DHS (e.g., digital skills, phone type, barriers to owning/using a mobile phone) might influence both mobile phone diffusion and IPV outcomes, thus raising concerns on the interpretation of the estimates as causal. This is a valid concern that is hard to tackle fully when working with cross-sectional data in the absence of experimental variation. I did my best to combine several methodological approaches to test for the sensitivity of the results to alternative functional forms and presence of unobserved factors driving potential endogeneity. Although IV estimates might reflect measurement error in the mobile phone predictors or validity concerns related to the instruments themselves, the sign of the estimated coefficients is in line with OLS results, suggesting a negative association between mobile phone ownership and IPV. Treatment effects obtained through matching are also in line with OLS results. Hence, I see these approaches as complementing each other toward a broad understanding of the phenomenon under investigation, rather than simply testing whether associations are causal. The consistency of the findings

may hint at the causal nature of the estimates, yet I prefer to not make causal claims, as I see this work as valuable beyond the interpretation of the estimates as causal.

To date, little large-scale empirical work has addressed a topic of the kind studied here, likely because of the lack of individual-level measures of mobile phone ownership in sample surveys. Nonetheless, in light of previous research on such media and technology as television and radio (Bhushan and Singh 2014; Jensen and Oster 2009; La Ferrara et al. 2012; Lee 2009), one reasonable hypothesis was that owning mobile phones may be negatively associated with IPV by giving women more autonomy within and outside of the household (mobile phones as "empowering"), for instance by promoting exchange and communication with outside networks, shelters, and communities (including other groups of women). My study provides generalized evidence in favor of this hypothesis, thus complementing a recent global-level study by Rotondi et al. (2020), who—despite not focusing on IPV—found the expansion of mobile phones to be associated with reduced gender inequalities, greater contraceptive use, and decreased maternal and child mortality.

I also discussed an alternative hypothesis in which women's ownership of mobile phones, by increasing their autonomy, would threaten male dominance and challenge rooted patriarchal structures, in turn triggering increased violence by male partners (mobile phones as "disempowering"). Qualitative evidence in favor of this hypothesis has been found in selected communities in SSA and Southeast Asia (Hobbis 2018; Mpiima et al. 2019; Svensson and Larsson 2016; Uduji and Okolo-Obasi 2018) and suggests that realities for LMIC women are complex and that the presumably "liberating" role of phones for women in some domains of social life (e.g., education, occupation) might trigger unexpected reactions on the part of male partners, leading to increased IPV and/or "double-burden" responsibilities in terms of childcare or housework (Garcia 2011; Mpiima et al. 2019). Reality may also be more complicated than either a positive or a negative scenario, as women themselves might consciously decide the extent to which to adopt a particular technology based on how they think it will affect the gender equilibrium (Masika and Bailur 2015).

Despite cultural and societal heterogeneity in the subset of LMICs analyzed here, results point toward a positive scenario. Yet, country-specific estimates show some variability that corroborates the aforementioned complexity, providing evidence of "reversed" associations between mobile phones and IPV outcomes in such countries as Angola, and nearly null associations in such countries as Timor-Leste and Zimbabwe. Similar variability has been documented in a global-level study on the association between women's financial inclusion and IPV, owing to variation in gender norms across national contexts (McDougal et al. 2019). My findings also relate to previous scholarship documenting context-specific associations between measures of female autonomy and IPV in Bangladesh depending on the level of cultural conservatism of specific communities (Koenig et al. 2003). Timor-Leste and Zimbabwe are interesting case studies as the association of interest is null, as well as both mechanisms explored, suggesting widespread IPV that coexists with unequal gender norms and rooted cultural conservatism that shows little evidence of waning (Bengesai and Derera 2021; Fidan and Bui 2016). Angola provides yet another scenario, as the association of interest is positive, while the two mechanisms operate in the expected direction. Thus, mobile phone ownership is associated with both higher female decision-making power and men's less favorable attitudes toward IPV, which suggests

that mechanisms might have more to do with shared device use among partners and dynamics of women's autonomy threatening the idea of male dominance, in line with the disempowering scenario and the arguments in McDougal et al. (2019). Because identifying precise mechanisms for each country is beyond the scope of this study, future research might leverage cross-country variation and variables at the meso level (e.g., cultural conservatism and patriarchal norms in the community) and macro level (e.g., Human Development Index and Global Gender Gap) to explore the relevance of economic, cultural, and societal factors for explaining such heterogeneity.

Limitations

As the first of its kind, this study has several limitations. An important one is the cross-sectional nature of the data, which prevents the drawing of causal conclusions. Future studies—most likely focused on single-country scenarios—might leverage natural experiments exploiting temporal discontinuity in technology rollout or design randomized controlled trials on mobile phone expansion. Moreover, despite the novelty of including mobile phone ownership in the DHS, this variable presents several limitations, some of which are being addressed in current DHS data collection efforts. Specifically, the variable measures only ownership, while evidence suggests that women may face multiple barriers to using phones (Blumenstock and Eagle 2010; GSMA 2020). In the current DHS data, there is no information on intensity or frequency of use, how women use phones, the type of phone, or the types of barriers they face. While complementary data sources, such as the Afrobarometer, suggest that such factors as intensity of use, digital skills, and access to electricity may be less of a concern, other factors such as phone type and financial barriers lead to important omissions that—if data were available—could shed better light on underlying mechanisms behind the negative associations found. For instance, knowing which share of phones enable internet connection would help us better disentangle the communication channel (e.g., reaching out to one's network by calling or texting) from the information-seeking one (e.g., collecting information on online health-related services through mobile internet).

Considering related research on the topic (Abubakar and Dasuki 2018; (Varriale et al. forthcoming), operating mechanisms other than the two channels tested in this study are linked to access to information, as well as better connectivity and expanded communication with wider networks beyond coresident kin; however, these cannot be tested with the current data. Existing research suggests that for many of the mechanisms to be effective, even simple-feature phones are instrumental for closing information gaps, providing media access,[16] and enabling better connectivity and access to services (Pesando and Rotondi 2020; Rotondi et al. 2020; Suri and Jack 2016). Future data collection efforts should complement information on mobile phone ownership with additional variables on intensity of use, phone type and quality, ownership and usage barriers, and within-couple dynamics vis-à-vis technology.

[16] Media content, while not as rich and varied potentially as it would be through an internet-enabled smartphone, can also be accessed via feature phones. Therefore, I have not featured *online connectivity* as one mechanism of its own, as it tends to magnify all the other channels outlined throughout.

Two limitations relate to the IPV outcomes. First, these outcomes measure whether women had experienced violence in the previous 12 months, which raises some timing concerns, albeit minor, as information is lacking on when individuals purchased a mobile phone. Second, despite all the measures adopted to ensure that women had a safe space to discuss IPV matters, the variables remain self-reported. Underestimation of IPV because of stigma and other factors remains a concern, and one widely documented (Cullen 2020; Palermo et al. 2014; Peterman et al. 2015). Previous work using DHS data has also provided evidence of social desirability bias in responses to questions on IPV (Yount et al. 2013). Additionally, I obtained some cluster-level information from the Afrobarometer thus limiting sample size for the community-level analyses and cluster-level IVs. It would be ideal to obtain equivalent cluster-level information for the excluded countries to avoid loss of sample size. Lastly, although the decision-making power variables are commonly used in sociodemographic studies, including some on IPV, they have been criticized as measures of empowerment for not accounting for how decision-making processes vary as women's personal goals evolve (Donald et al. 2020; Miedema et al. 2018).

Conclusion

Despite these limitations, this study complements the growing literature on the role of the media and digital technologies as potentially empowering tools for women in disadvantaged settings. The evidence provided speaks to scholars and policymakers interested in how technology diffusion relates to dynamics of women's empowerment and global social development. Findings from this study suggest that owning a mobile phone bears a positive relationship with women's status in LMICs; however, for these positive associations to translate into actual policy recommendations, I believe several factors would be required. For example, a more elaborate infrastructural overhaul would be needed to sustain a population's access to charged phones, alongside broader investments in cheaper, equitable access to technology enabling independent use and ICT skill development, especially among women.

I conclude by stressing the relevance of my results in light of the COVID-19 pandemic. There is widespread agreement that crises and epidemics exacerbate stress, poverty, and within-household conflicts, thus making IPV more recurrent and visible (Abel and McQueen 2020; van Gelder et al. 2020; World Health Organization 2020). For instance, evidence supporting this view in the wake of the Great Recession is clear (Schneider et al. 2016). During a pandemic that imposes lockdowns and movement restrictions, women and their abusers are bound to share the same space for long periods of time, thus increasing women's risk of experiencing IPV (Peterman et al. 2020). Women in such situations might be more likely to use mobile phones to report IPV by accessing online services, by joining online forums and networks, or through recently developed mobile apps for help-seeking, such as myPlan (Decker et al. 2020; El Morr and Layal 2020). However, it is also likely that lacking a safe space and facing men who engage in more controlling behaviors (Schneider et al. 2016), women might find it even more difficult to access mobile phones privately. Hence, ownership of mobile phones may be *more* or *less* strongly associated with IPV outcomes in LMICs in COVID-19 times. I see this as a critical avenue for future research, the

findings of which—subject to proper causal identification—will provide evidence-based policy recommendations on whether mobile phones could be an effective tool to promote gender equality during epidemics. ■

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