3G Internet, Intimate Partner Violence, and Women's Empowerment: Evidence from Nigeria

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December 9, 2024

Keywords: Digital Technology; Women's Empowerment; Gender Inequality; IPV; Africa

Abstract

A growing body of research has highlighted the impacts of mobile phones on women's status in low- and middle-income countries (LMICs), through improved labour market opportunities, contraceptive knowledge and access, and decision-making power within the household. However, this literature relies on cross-sectional designs, in which individual technology adoption may be endogenous, and does not distinguish between type of mobile technology (2G v 3G). This distinction is important because the spread of the internet can have theoretically ambiguous and complex effects, which can enable exposure to information and globalized liberal ideas, but also reinforce gender stereotypes, perpetuate technology-facilitated gender-based violence, trigger backlash effects, and spread misinformation. We examine how the rollout of 3G mobile networks over time in Africa's most populous country, Nigeria, affects women's status within the household looking at the experience of intimate partner violence and women's decision-making power. We draw on two waves of the Demographic and Health Survey data's men's and women's modules, which we link with mobile coverage maps, and estimate the impact of 3G using cluster-matched difference-in-difference models. We find the 3G network expansion results in reductions in emotional and physical IPV, as well as improved women's autonomy within the household. Our findings emphasize how technological changes can spread new ideas and norms, which in turn influence gender dynamics within households.

Introduction

The widespread diffusion of mobile phones has been the defining technological transformation of the new millennium. Since the mid-2000s, the spread of 3G+ networks have accelerated the spread of the internet

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Funding Information: This work received funding from the Bill and Melinda Gates Foundation (INV-045370) and Leverhulme Trust (Grant RC-2018-003) for the Leverhulme Centre for Demographic Science.

through mobile phones, especially for the African continent, where fixed internet infrastructure remains limited (International Telecommunication Union, 2024). Beyond the communication capabilities offered by 2G-enabled mobile technology, the spread of mobile internet via 3G has the potential to improve access to a more advanced array of information and services, and enable exposure to globalized media content. These impacts of technologies may be especially salient for marginalised populations, such as women, who face disadvantaged access to economic resources and social networks through traditional channels. Recognising this potential, global sustainable development goal number 5 (SDG 5) on gender equality calls to "enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women" (United Nations, 2016).

A growing body of empirical research has explored these ideas and highlighted the positive impact of mobile phones on women's status through improved labour market outcomes (Suri and Jack, 2016; Chiplunkar and Goldberg, 2022; Viollaz and Winkler, 2022; Amber and Chichaibelu, 2023), decision-making power within the household (Rotondi et al., 2020; Pesando, 2022), contraceptive knowledge and access (Vahdat et al., 2013; Smith et al., 2015; Rotondi et al., 2020), and reductions in experiences of intimate partner violence (Pesando, 2022). However, this literature has, by and large, not distinguished between between type of technology enabled by mobile phone (2G v 3G), even though these technologies may plausibly result in differential impacts, given the distinct functionalities they offer (simple calling and messaging versus more advanced internet capabilities). Further, the existing work has largely drawn on cross-sectional designs where mobile ownership is measured at the individual-level at one point in time. This approach is thus limited being able to address the endogeneity of individual-level technology adoption. Mobile ownership at the individual-level is correlated with socioeconomic characteristics, and significant gender gaps in mobile adoption persist (Fatehkia, Kashyap and Weber, 2018).

This paper re-visits the question of mobile technology and women's empowerment by investigating the impacts of 3G expansion on women's experience of intimate partner violence, a key marker of women's status, and decision-making power within the household in the context of Africa's most populous country, Nigeria. In contrast to previous work, we study the *rollout* of mobile internet via 3G networks by linking the Demographic and Health Surveys (DHS) with geospatial data on mobile coverage maps within a matched difference-in-difference design. This design enables us to estimate the causal impacts of mobile internet rollout, or in other words explore how 3G expansion affects attitudes and behaviours linked to women's status within the household.

Background

Diffusion theories of fertility transitions have long acknowledged the role that mass media technologies can play in the spread of new ideas and norms, and in turn influence gender and demographic outcomes (Barber and Axinn, 2004). Consistent with these ideas, studies have shown how TV and radio have impacted on fertility ideals, son preference, and women's status within the household (Jensen and Oster, 2009; Ferrara, Chong and Duryea, 2012). While mass media technologies may help promote liberal and more 'modern' ideas of family and gender equality, spreading cultural norms associated with global elites (Pierotti, 2013), they may also reinforce gender stereotypes (Wood, 1994). The digital revolution, generated by the spread of mobile phones and the internet, have re-invigorated interest in the impacts of technological change on gender and demographic dynamics. Burgeoning research has shown how the spread of mobile phones has impacted on improved access to labour market opportunities for women (Suri and Jack, 2016; Chiplunkar and Goldberg, 2022; Viollaz and Winkler, 2022; Amber and Chichaibelu, 2023), access to contraception and antenatal care (Rotondi et al., 2020), and women's empowerment, as measured through reductions in IPV (Pesando, 2022) and decision-making within the household (Rotondi et al., 2020).

While this literature points to associations between mobile phones and women's status, the technological measure of interest across many of these studies is the ownership of mobile phones at the individual level, without distinguishing between 3G v 2G technologies. Individual-level digital adoption is endogenous to socioeconomic factors, which makes it challenging to distinguish causal impacts of technologies versus selection into technology access. Furthermore, the maturation of mobile technologies, and in particular, the spread of mobile internet with 3G may plausibly generate more complex, theoretically ambiguous effects, especially in relation to household dynamics and women's status.

In contrast to 2G technologies, which allow for calling or messaging within existing social networks, internet technologies via 3G enable improved access to more advanced informational and health resources, as well as access to broader social networks, e.g. through social media, where information sharing is interactive and amplified. The internet enables globalized media exposure and exposure to liberalized cultural norms of global elites (Pierotti, 2013; Pesando, 2022; Varriale et al., 2022). However, the internet also potentially amplifies messages of dis- and misinformation, reinforce gender stereotypes for men and women, trigger backlash effects, as well as provide a new outlet to perpetuate gender-based violence against women (Dunn, 2020; Faith, 2022; Lisnek et al., 2022). The existing literature also points to conflicting associations between media exposure and IPV and gender attitudes for men and women. While some studies show reduced tolerance for IPV only for men (Banerjee, La Ferrara and Orozco, 2019; Okenwa, Lawoko and Jansson, 2009), others show similar patterns only for women (Uthman, Lawoko and Moradi, 2009). Others find

increases in tolerance for IPV among women with higher media exposure (Okenwa, Lawoko and Jansson, 2009). Much of this literature, however, has focused on TV and radio exposure, and less is known about how these translate to media exposures via internet technologies. In light of these, we hypothesize that the net effect of 3G expansion on women's experiences and attitudes of intimate partner violence, and their decision-making autonomy within the household could either be negative or positive. We expect similarly theoretically ambiguous effects for men in relation to their gender attitudes.

Data and Methods

We rely on two waves of geo-referenced, nationally-representative Demographic and Health Survey (DHS) data from Nigeria for the period 2008 and 2018 for our analysis. We use both the women's and men's survey questionnaire files of the DHS. The DHS program uses a multi-step process for sampling. For both the 2008 and 2018 Nigerian DHS, the sampling frame is from the 2006 Population and Housing Census of the Federal Republic of Nigeria (NPHC). The sample is selected using a stratified, two-stage cluster survey design within primary sampling units ("clusters"). Each cluster contains approximately 100-300 households; each household in the cluster is enumerated and a random set of households are selected.

Each DHS cluster is geo-referenced using GPS receivers. The clusters are randomly displaced to preserve privacy by up to 2 kilometers for urban clusters and 5 kilometers for rural clusters, with an additional 1% of rural clusters displaced to a maximum of 10 kilometers. We supplement the data from DHS with information on 3G mobile coverage expansion from Collins Bartholomew (CB)-GSMA mobile coverage maps. Collins Bartholomew is the official mapping partner of GSMA, the global business association of mobile network operators, and has published mobile coverage maps on an annual basis for almost every country in the world since 1999, with unified reporting since 2009. Although these maps are published on an annual basis by CB-GSMA, mobile operators may not update the underlying maps over time, not all (or only minor operators) may report these maps to CB-GSMA, and the reporting methodologies may vary across operators. We performed a series of validation checks to confirm their reliability and coverage for Nigeria, including checks to ensure that we only use coverage maps that have been updated by a major operator less than two years before DHS data collection.

To process the coverage maps, we first construct buffers around the displaced coordinates of each DHS cluster. These buffers are 2km for urban areas or 10km for rural areas, corresponding to the maximum amount of displacement. Since DHS clusters are just displaced within given admin-level 1 boundaries (since 2009 even admin-level 2), we crop these buffers to the admin-level 1 areas of the respective country using the survey

boundaries provided by the spatial data repository of the DHS [1]. This way, we narrow down the coverage status at the true cluster location without actually re-identifying it. We then overlay these buffers with 2G and 3G coverage maps and calculate the area within each cluster with and without coverage, respectively. In addition, we further overlay 100m X 100m UN-adjusted population counts from Worldpop (WorldPop, 2023), and use these population estimates to calculate the proportion of people living in each cluster covered by a 2G and a 3G network. We interpret these proportions (area-weighted v population-weighted) as probabilities of the surveyed population within a cluster being covered by a given technology.

To examine the causal impact of 3G internet on intimate partner violence and women's empowerment, we exploit plausibly exogenous variation generated by the 3G coverage expansion in Nigeria over the period 2008-2018. In Nigeria, mobile phone coverage has expanded rapidly over the course of the past two decades (Forenbacher et al., 2019). As shown in Figure 1, in 2008, the year of our first DHS survey, no DHS cluster in our sample had 3G coverage. In 2018 DHS, 39.5% of DHS clusters in our sample were covered by 3G coverage.

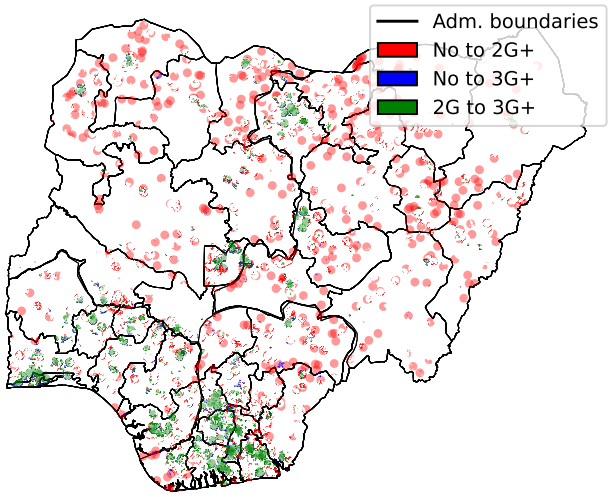


Figure 1: Expansion of 2G and 3G rollout in Nigeria between 2008 and 2018. Only areas with DHS clusters are shown in the figure.

Our quasi-experimental setup relies on matching methods and a difference in difference design, where we match DHS clusters that are geographically as close as possible across waves. As the DHS is not a longitudinal survey, DHS clusters change across waves, which does not allow us to put cluster fixed effects. Hence, our design matches clusters that are as geographically proximate, or pseudo-clusters, so that we can assess differences between pseudo-clusters that gain 3G versus those that do not. We validate the quality of the match by comparing the correlation on key control variables between matched clusters vs randomly

[1] https://spatialdata.dhsprogram.com/data

matched clusters.

We estimate how expansion in 3G coverage over time affects intimate partner violence faced by women, and assess the impacts on women's decision-making power in the household as the inter-mediating mechanism, as reported by both men and women. We also examine attitudes to IPV, as reported by both men and women. To ensure that our results are on account of access to 3G internet, we control for the share of population covered by 2G network in an area, in all our regressions (Chiplunkar and Goldberg, 2022). We also include controls for age, education, gender of the household head, age of the household head, number of members and children in the household, age of the husband, education of the husband, years of cohabitation, drinking status of the husband, wealth status of the household, place of residence (rural vs urban), along with time and geographic (pseudo-cluster) fixed effects in our regressions. In order to account for potential selection issue where network providers may choose to provide 3G coverage in regions with favorable socio-economic and geographic characteristics, we control for several geo-spatial characteristics at the cluster level including elevation, distance to coast, rainfall, temperature, forest share, share of desert, availability of mine, availability of roads, GDP and area in our regressions. Our estimation equation for individual i residing in pseudo-cluster c at time t is given below:

$$Y_{i,c,t} = \alpha_c + \beta_t + \theta \cdot 3G_{c,t} + \gamma \cdot X_{i,c,t} + \epsilon_{i,c,t} \tag{1}$$

where, α_c and β_t represent pseudo-cluster and time fixed effects, respectively. $3G$ is a continuous measure which captures the proportion of population of a given cluster that is covered by 3G network at given time t. θ captures the effect of 3G on our outcomes of interest Y. X accounts for time varying controls at the individual, household, and cluster level. We cluster our standard errors at the geographic pseudo-cluster level.

Preliminary Results

Table 1 reports the results for the effect of 3G internet on intimate partner violence faced by women in Nigeria. We find that women exposed to 3G expansion were likely to face lower levels of intimate partner violence. Specifically, we find that emotional violence and physical violence experienced by women reduced significantly on account of 3G network expansion in the country.

Table 1: DID estimates for the impact of 3G on Intimate Partner Violence in Nigeria

	Emotional Violence (1)	Sexual Violence (2)	Physical Violence (3)
3G Effect	-0.057**	-0.009	-0.052**
	(0.028)	(0.014)	(0.022)
R^2	0.16	0.10	0.19
Observations	21,989	21,967	21,971

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the pseudo-cluster level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

Potential Channels

The 3G network, in contrast to 2G, allows for improved internet accessibility to users. Using 3G, users can browse the internet and they can view, download, as well as transfer content including videos and images easily. While 2G network focuses on calling and text messaging capabilities, 3G services have given a new meaning to always staying connected. These features of 3G internet, could work to reduce intimate partner violence in different ways. For instance, exposure to informational, and educational content on the internet in the form of videos, blogs, or social media can help empower women by assisting them in decision making and enabling them to become self-reliant (*empowerment channel*), and also promote men's views around women's decision-making say in the household. Second, exposure to internet could also affect social norms, for instance, around education of women and early marriage, factors which literature shows could affect intimate partner violence faced in later life (Sara and Priyanka, 2023; Chatterjee and Poddar, 2024; Roychowdhury and Dhamija, 2021). Furthermore, it can also affect norms around the acceptability of IPV for both men and women (*ideational channel*). Third, 3G could also enable men to be less controlling of wife's behaviours, especially if there are tangible benefits associated with 3G connectivity (e.g. more frequent communication or connectivity).

We first assess if 3G network expansion affected women's autonomy (Table 2). The results suggest that women exposed to 3G were more likely to be the sole decision makers in matters related to their own health. Furthermore, women exposed to 3G were also more likely to be the decision makers in matters related to large purchases for the household. This suggests the empowering effect of 3G that can help improve women's autonomy in the household. We examine if men's views on women's say in decision-making in the household was affected by 3G expansion. The same questions are available for a fewer set of domains in the men's questionnaire compared with the women's, but in the case of large household purchases we find that men

also saw increases in support for women's decision-making within the household (Table 3).

Table 2: DID estimates for the impact of 3G on autonomy of women in Nigeria

	Decision maker for:				
	own healthcare (1)	large hh purchases (2)	visit to family/relatives (3)	husband earnings (4)	Autonomy Index (5)
3G Effect	0.031*	0.026***	0.005	0.006	0.073*
	(0.016)	(0.010)	(0.021)	(0.013)	(0.043)
R^2	0.14	0.12	0.14	0.08	0.16
Observations	39,433	39,418	39,426	38,923	38,906

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the pseudo-cluster level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

Table 3: DID estimates for the impact of 3G on women's say in decision making (as reported by men) in Nigeria

	Say in decision making for:	
	large hh purchases (1)	husband's earnings (2)
3G Effect	0.088***	0.034
	(0.029)	(0.027)
R^2	0.25	0.30
Observations	13,125	9,358

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the pseudo-cluster level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

We further assess the impact of 3G on controlling behavior of the husband in Table 4. We find that expansion of 3G network coverage resulted in significantly lower likelihood of husband insisting on knowing of location of the woman. While 3G coverage did not have a significant effect on any other 'control' measure, it's effect on husband's insistence to know the location, directly ties into the connectivity benefits of the 3G technology.

We next examine how 3G expansion affected norms around women's education and age at marriage coupled with social acceptability with respect to intimate partner violence against women. Table 5 shows estimates for the effect of 3G expansion on education of women as well as age of marriage. We observe that

Table 4: DID estimates for the impact of 3G on husband's controlling behavior in Nigeria

	Husband:				
	jealous if talks with other men	accuses of unfaithfulness	doesn't permit to meet female friends	limits wife's contact with family	insists on knowing location
	(1)	(2)	(3)	(4)	(5)
3G Effect	-0.051	0.006	0.012	-0.012	-0.137***
	(0.034)	(0.021)	(0.024)	(0.016)	(0.032)
R^2	0.16	0.13	0.10	0.09	0.15
Observations	21,775	21,875	21,877	21,851	21,840

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the pseudo-cluster level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

women residing in regions with 3G were likely to be educated for higher number of years and were likely to marry at a much older age as well. Consequently, we also observe that average marital duration was likely to be lower and women were likely to be much older at the time of first birth on account of exposure to 3G. These results suggest that exposure to 3G can potentially reduce IPV on account of improved bargaining power due to higher educational level of women. Furthermore, higher age at marriage is likely to likely to result in reduced lifetime IPV experience. In Table 6 we also report estimates for effect of 3G on women's views regarding acceptability of IPV. We observe that 3G expansion was linked to reduced tolerance for IPV, although the coefficients are statistically significant for only one category (burns food).

Table 5: DID estimates for the impact of 3G

	Years of Education	Age at Marriage	Duration of Marriage	Age at First Birth
	(1)	(2)	(3)	(4)
3G Effect	0.578***	0.392**	-0.398**	0.480***
	(0.164)	(0.170)	(0.167)	(0.167)
R^2	0.68	0.40	0.83	0.33
Observations	39,466	39,466	39,466	36,448

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the pseudo-cluster level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

Table 6: DID estimates for the impact of 3G on women's views on IPV in Nigeria

	Beating justified if wife:					
	goes out without telling husband (1)	neglects children (2)	argues with husband (3)	refuses sex with husband (4)	burns food (5)	IPV Views Index (6)
3G Effect	0.016	-0.030	-0.016	-0.008	-0.050*	-0.083
	(0.029)	(0.029)	(0.027)	(0.026)	(0.027)	(0.130)
R^2	0.22	0.19	0.20	0.25	0.17	0.25
Observations	39,099	39,076	38,982	38,854	38,973	38,449

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the pseudo-cluster level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

Robustness Check

Alternative Identification Strategy

We also use an alternative identification strategy based on local government areas (LGA) (administrative level 2) in Nigeria to estimate the effect of 3G on intimate partner violence. The advantage of using the design is that we can use a standard difference in difference setup without relying on pseudo-clusters for our analysis. However, this comes at a cost of precision with which we can estimate our effects as by studying local government areas we are looking at a much aggregated geographic level. Our estimation equation now becomes:

$$Y_{i,c,t} = \alpha_g + \beta_t + \omega \cdot 3G_{c,t} + \gamma \cdot X_{i,c,t} + \epsilon_{i,c,t} \tag{2}$$

where, α_g and β_t represent LGA and time fixed effects, respectively. $3G$ captures the proportion of population of a given local government area that is covered by 3G network at given time t. ω captures the effect of 3G on our outcomes of interest Y. X accounts for time varying controls at the individual, household, and cluster level. We cluster our standard errors at the local government area level. The results for this exercise are reported in Table 7 and are very similar to our primary estimates.

Next Steps

These preliminary results point to a causal effect of 3G internet expansion and women's IPV experience, as well as shifts in attitudes surrounding women's empowerment in Nigeria. We will supplement this analysis

Table 7: DID estimates for the impact of 3G on IPV using an administrative level 2 design

	Emotional Violence (1)	Sexual Violence (2)	Physical Violence (3)
3G Effect	-0.061*	-0.020	-0.067**
	(0.037)	(0.017)	(0.027)
R^2	0.16	0.10	0.17
Observations	24,285	24,264	24,267

Notes: All columns represent different regressions for currently married women from the DHS 2008 and 2018 dataset for Nigeria. Robust standard errors clustered at the local government area level are reported in parentheses. *** p<0.01 **p<0.05 *p<0.1

in the followings ways:

1. incorporate additional coverage maps, aligned to DHS years in the intervening period to capture different stages of technology diffusion. We have recently acquired additional maps for the period from 2013-20 from GSMA that will feed into this analysis.

2. test the robustness of our pseudo-cluster matching design using a range of further robustness checks

3. assess to what extent the effects of technology rollout are mediated through individual device ownership versus infrastructure rollout, thereby distinguishing between direct and spillover effects.

4. expand to a multi-country analyses in Africa, pending the maps meeting our quality control criteria

References

Amber, Hina and Bezawit Beyene Chichaibelu. 2023. "Narrowing the gender digital divide in Pakistan: Mobile phone ownership and female labor force participation." *Review of Development Economics* 27(3):1354–1382.

Banerjee, Abhijit, Eliana La Ferrara and Victor Orozco. 2019. Entertainment, education, and attitudes toward domestic violence. In *AEA Papers and Proceedings*. Vol. 109 American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203 pp. 133–137.

Barber, Jennifer S and William G Axinn. 2004. "New ideas and fertility limitation: The role of mass media." *Journal of marriage and family* 66(5):1180–1200.

Chatterjee, Somdeep and Prashant Poddar. 2024. "Women's empowerment and intimate partner violence: Evidence from a multidimensional policy in india." *Economic Development and Cultural Change* 72(2):801–832.

Chiplunkar, Gaurav and Pinelopi Koujianou Goldberg. 2022. The employment effects of mobile internet in developing countries. Technical report National Bureau of Economic Research.

Dunn, Suzie. 2020. "Technology-facilitated gender-based violence: An overview." *Suzie Dunn," Technology-Facilitated Gender-Based Violence: An Overview"(2020) Centre for International Governance Innovation: Supporting a Safer Internet Paper* (1).

Faith, Becky. 2022. "Tackling online gender-based violence; understanding gender, development, and the power relations of digital spaces." *Gender, Technology and Development* 26(3):325–340.

Fatehkia, Masoomali, Ridhi Kashyap and Ingmar Weber. 2018. "Using Facebook Ad Data to Track the Global Digital Gender Gap." *World Development* 107:189–209. https://www.sciencedirect.com/science/article/pii/S0305750X18300883.

Ferrara, Eliana La, Alberto Chong and Suzanne Duryea. 2012. "Soap operas and fertility: Evidence from Brazil." *American Economic Journal: Applied Economics* 4(4):1–31.

Forenbacher, Ivan, Siniša Husnjak, Ivan Cvitić and Ivan Jovović. 2019. "Determinants of Mobile Phone Ownership in Nigeria." *Telecommunications Policy* 43(7):101812. https://www.sciencedirect.com/science/article/pii/S0308596118303665.

International Telecommunication Union. 2024. "ITU DataHub." https://datahub.itu.int/. Accessed: 2024-09-25.

Jensen, Robert and Emily Oster. 2009. "The power of TV: Cable television and women's status in India." *The Quarterly Journal of Economics* 124(3):1057–1094.

Lisnek, Jaclyn A, Clara L Wilkins, Megan E Wilson and Pierce D Ekstrom. 2022. "Backlash against the# MeToo movement: How women's voice causes men to feel victimized." *Group Processes & Intergroup Relations* 25(3):682–702.

Okenwa, Leah E, Stephen Lawoko and Bjarne Jansson. 2009. "Exposure to intimate partner violence amongst women of reproductive age in Lagos, Nigeria: Prevalence and predictors." *Journal of Family Violence* 24:517–530.

Pesando, Luca Maria. 2022. "Safer if connected? Mobile technology and intimate partner violence." *Demography* 59(2):653–684.

Pierotti, Rachael S. 2013. "Increasing rejection of intimate partner violence: Evidence of global cultural diffusion." *American sociological review* 78(2):240–265.

Rotondi, Valentina, Ridhi Kashyap, Luca Maria Pesando, Simone Spinelli and Francesco C Billari. 2020. "Leveraging mobile phones to attain sustainable development." *Proceedings of the National Academy of Sciences* 117(24):13413–13420.

Roychowdhury, Punarjit and Gaurav Dhamija. 2021. "The causal impact of women's age at marriage on domestic violence in India." *Feminist Economics* 27(3):188–220.

Sara, Raisa and Sadia Priyanka. 2023. "Long-term effects of an education stipend program on domestic violence: Evidence from Bangladesh." *The World Bank Economic Review* 37(4):640–658.

Smith, Chris, Judy Gold, Thoai D Ngo, Colin Sumpter and Caroline Free. 2015. "Mobile phone-based interventions for improving contraception use." *Cochrane Database of Systematic Reviews* (6).

Suri, Tavneet and William Jack. 2016. "The long-run poverty and gender impacts of mobile money." *Science* 354(6317):1288–1292.

United Nations. 2016. "Sustainable Development Goals: Goal 5." https://sdgs.un.org/goals/goal5#targets_and_indicators. Accessed: 2024-09-25.

Uthman, Olalekan A, Stephen Lawoko and Tahereh Moradi. 2009. "Factors associated with attitudes towards intimate partner violence against women: a comparative analysis of 17 sub-Saharan countries." *BMC international health and human rights* 9:1–15.

Vahdat, Heather L, Kelly L L'Engle, Kate F Plourde, Loice Magaria and Alice Olawo. 2013. "There are some questions you may not ask in a clinic: providing contraception information to young people in Kenya using SMS." *International Journal of Gynecology & Obstetrics* 123:e2–e6.

Varriale, Carlotta, Luca Maria Pesando, Ridhi Kashyap and Valentina Rotondi. 2022. "Mobile phones and attitudes toward women's participation in politics: Evidence from Africa." *Sociology of Development* 8(1):1–37.

Viollaz, Mariana and Hernan Winkler. 2022. "Does the internet reduce gender gaps? The case of Jordan." *The Journal of Development Studies* 58(3):436–453.

Wood, Julia T. 1994. "Gendered media: The influence of media on views of gender." *Gendered lives: Communication, gender, and culture* 9:231–244.

WorldPop. 2023. "Open Spatial Demographic Data and Research." https://www.worldpop.org/.