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Bridging the Digital Divide

A Randomized Controlled Trial on Mobile Technology, Gender Equality, and Sexual Risk in Malawi

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Any remaining errors are entirely my own.

Abstract

This thesis examines the long-term impacts of mobile phone distribution on device access and sexual behaviour among Malawian youth. Through a randomized controlled trial, 164 Form 4 students (the final year of secondary school) from four government boarding schools were randomly assigned to receive either smartphones, basic phones, or were placed in a control group that did not receive a phone through the study. Five years later, follow-up surveys assessed the intervention's effects on technology usage and sexual risk outcomes.

The findings reveal that the intervention significantly increased device ownership and internet usage, with particularly pronounced effects among female participants. Females in the treatment group were 13.6 percentage points more likely to have smartphone access and 22.4 percentage points more likely to have laptop access than females in the control group. Notably, females who received phones eventually achieved higher smartphone ownership rates than untreated males – providing evidence that targeted technology interventions can help reverse existing gender disparities in technology access.

Contrary to common concerns that often restrict girls' access to mobile technology, the study found no evidence that increased device ownership led to greater sexual activity or risk-taking behaviour. In fact, the intervention was associated with marginal reductions in sexual risk indicators, including a later age of sexual debut (+0.686 years) and fewer lifetime sexual partners (-0.632), with these effects primarily driven by male participants.

This research challenges prevailing assumptions about technology access and sexual risk among adolescents in sub-Saharan Africa. It provides evidence-based support for policies promoting equitable technology distribution as a means of fostering digital inclusion and addressing gender disparities, without increasing sexual risk behaviours.

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1. Introduction

1.1 Motivation

The rapid increase in mobile phone ownership among youth in sub-Saharan Africa presents a unique opportunity for development. Mobile technology brings substantial benefits across multiple domains, including health, education, and economic advancement.

In the education sector, mobile phones have become powerful tools for reducing learning barriers. By delivering digital resources to remote or underserved areas, they enable self-study and foster collaborative learning through social networks. Initiatives like Eneza Education—a mobile-based platform operating in Kenya and Ghana—have reached millions of learners through SMS and web-based lessons aligned with national curricula. This demonstrates how even low-tech solutions can improve literacy and learning outcomes (Baraka, 2021).

Beyond education, mobile technology has also revolutionized healthcare access, particularly for women and children. Technology access has been linked to lower maternal and child mortality rates by facilitating access to health information, improving antenatal care attendance, and enhancing treatment adherence for HIV-positive pregnant women. Evidence from a 2023 quasi-experimental study in Northern Ghana shows that the Technology for Maternal and Child Health (T4MCH) mobile-messaging programme increased antenatal-care attendance by 18 percentage points and postnatal-care utilization by 27 percentage points compared with control districts, highlighting the concrete gains such platforms can deliver (Nuhu et al., 2023).

In addition to maternal and child health, mobile phones also empower women with critical knowledge about sexual and reproductive health services, contributing to higher rates of contraceptive uptake. Notably, a study analysing data from eight sub-Saharan African countries found that women who accessed the internet at least once per month were 11.4% more likely to use modern contraception, with this likelihood increasing to 53.8% among those who used the internet almost daily (Toffolutti et al., 2020).

Despite these benefits, significant challenges remain, including persistent gender gaps in device access, with boys typically more likely than girls to own or regularly use mobile phones (Fairtrade Africa, 2021). A primary justification for restricting girls' access to mobile technology stems from concerns that such access will increase risky sexual behaviour. The argument is that mobile phones provide youth with greater privacy, connectivity, and unsupervised communication opportunities, which may facilitate romantic or sexual relationships that parents or guardians would otherwise discourage (Girl Effect & Vodafone Foundation, 2018). Some studies support this concern by showing that access to mobile phones is associated with an earlier sexual debut or a higher number of sexual partners, particularly among adolescent girls (Kreniske et al., 2022; Okoye & Saewyc, 2024). Yet, other research finds that mobile access can empower girls with information and tools that promote safer sexual decisions and increased agency in relationships (Wado et al., 2020). This thesis seeks to shed light on this question by investigating the relationship between mobile technology access and adolescent sexual risk.

Addressing the digital gender divide is essential to maximize the potential of mobile technology in advancing sustainable development goals. When equitably distributed, mobile phones are more than communication devices—they are tools for health, education, empowerment, and economic inclusion. Realizing the full potential of mobile technology demands inclusive and gender-responsive policies—without them, the digital divide risks reinforcing the very inequalities it could help resolve.

1.2 Overview of methods and findings

In this study, we conducted a randomized controlled trial (RCT) with 164 Form 4 students (final year of secondary school) across four government boarding schools in Malawi in June 2018. We distributed 52 smartphones and 54 basic phones to students in the treatment groups, while 58 students were assigned to a control group that did not receive phones through the study. Five years later, in 2023, we initiated a follow-up survey which covered a broad range of topics. This thesis draws on that survey to evaluate the intervention's long-term effects on device access, technology usage patterns, and sexual behaviour outcomes.

The survey results indicate that the intervention substantially increased device ownership and access as well as internet usage, with the effect being particularly pronounced for girls. Strikingly, two years after the intervention, treated girls exhibited higher rates of smartphone ownership than males in the control group, suggesting that targeted technology distribution can effectively reverse gender disparities in digital access.

Crucially, and contrary to common belief, the intervention did not lead to increased sexual risk. Instead, the findings indicate modest protective effects, with small but consistent reductions observed in sexual risk indicators for both male and female participants.

1.3 Contribution to related literature

This study contributes to a growing body of work on the causal determinants of sexual risk-taking among adolescent girls and young women in sub-Saharan Africa. Experimental literature already shows that carefully designed interventions can meaningfully shift sexual behaviour: Community-based empowerment and livelihood training for adolescent girls in Uganda reduced teen pregnancy and early marriage (Bandiera et al., 2020); cash transfers combined with HIV prevention initiatives in rural Tanzania reduced HSV-2 (herpes simplex virus type 2) rates and transactional sex (Kuringe et al., 2022); and an RCT in Kenya exploiting variation in teacher incentives demonstrated that higher female schooling attainment led to safer sexual choices in adulthood (Duflo et al., 2015). While previous research has primarily focused on socioeconomic and interpersonal levers, this study broadens the literature by examining how digital access affects adolescents' sexual behaviour and risk profiles.

We also contribute to an emerging literature on randomized controlled trials that provide mobile phones and track downstream effects in developing countries. Handset distribution in Tanzania was found to raise household consumption and women's bargaining power (Roessler et al., 2021); a precursor experiment in Malawian boarding schools showed Wikipedia-enabled smartphones improved exam scores (Derksen et al., 2022); and a large RCT with 1,500 married women in Blantyre, Malawi, documented gains in economic empowerment and property rights when women gained personal smartphones (Roessler, 2023). This thesis complements these studies by examining how access to mobile phones can help reduce gender gaps in digital inclusion and by assessing its effects on sexual outcomes.

The finding that the effects of increased device ownership and internet use were strongest among female participants highlights the potential for targeted technology interventions to address existing gender disparities. Combined with the evidence that mobile phone access did not lead to increased sexual risk-taking, this research provides a compelling case for policies and programs that promote equitable technology access as a means of improving gender equality, education, and health in sub-Saharan Africa.

2. Context

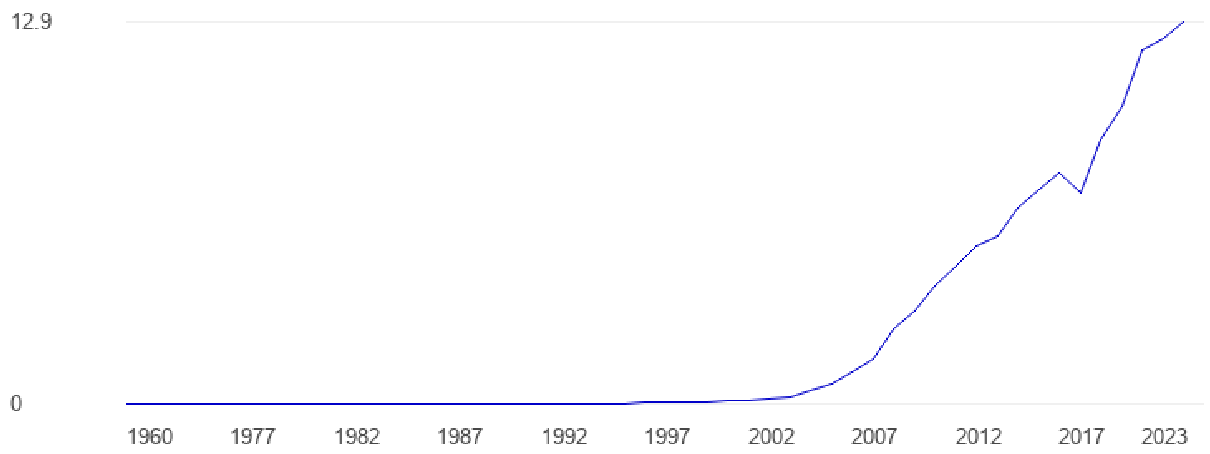
2.1 Mobile phone use in Malawi

The Republic of Malawi is a landlocked country located in Southeastern Africa, bordered by Mozambique, Zambia and Tanzania. The country's topography is dominated by the Great Rift Valley, featuring Lake Malawi, which comprises approximately 20% of the total territory. Malawi ranks among the world's least developed economies with a population of 21.1 million and a GDP per capita of just US$602.3. According to the World Bank approximately 71.2% of Malawi's population lives below the international poverty line of $2.15 per day as of 2024 (World Bank, 2025a). Malawi has a youthful population, with a median age of 17.2 years; about one in seven citizens (14.4%) is aged 18–24—the cohort that is the focus of this study (DataReportal, 2024). It is an agrarian society with most of the labour force employed in the agricultural sector. Since its transition from British colonial administration in 1964, Malawi has experienced varying degrees of political stability, including a transition to multiparty democracy in 1994.

There has been a rapid increase in mobile phone penetration in Malawi, with penetration rates increasing from roughly 0% of the population in 2000 to 60% in 2021 (see Figure 1; TheGlobalEconomy.com, 2023). Mobile phone penetration provides a general sense of how accessible mobile phone technology is within a population and is measured here by the number of mobile-cellular subscriptions per 100 inhabitants. Since individual users often own multiple SIM cards, this penetration statistic is an upper-bound estimate. Malawi has been ranked 137th within a group of 144 countries in terms of mobile phone penetration as a percentage of the population (Helgi Library, 2023).

Figure 1

Mobile phone penetration in Malawi (millions), 1960–2023.



Note. Data from *Mobile phone subscribers – Malawi*, by TheGlobalEconomy.com, 2023, https://www.theglobaleconomy.com/Malawi/mobile_subscribers/

Despite the growth in mobile penetration, smartphone ownership remains low. The Malawi Communications Regulatory Authority (MACRA) reported in April 2023 that only about 500,000 people owned smartphones out of the 12 million mobile device users in the country (Capital Radio Malawi, 2023), implying that fewer than one in sixteen mobile users (approximately 4.2%) can access app-based services.

Socioeconomic and gender disparities persist. As of 2022, 70% of Malawian men owned a mobile phone compared to 48% of women, indicating a 22-percentage-point gender gap (Amakoh et al., 2023). This disparity stems from a combination of economic inequality, traditional gender roles, and lower digital literacy rates among women (Handforth & Wilson, 2019).

In rural districts, ownership drops to 47% for men and 26% for women — a 21-percentage-point gap, meaning women are about half as likely to own a phone as men (Handforth & Wilson, 2019). By contrast, a study conducted at the Lilongwe University of Agriculture and Natural Resources (LUANAR) found that 99.2% of surveyed students owned a mobile phone, with the majority owning smartphones (Matto & Kazungu, 2018).

Despite increasing adoption rates of phones, the high cost of smartphones and data services limits access for many young people. In 2023, the average monthly cost of mobile phone usage in Malawi was estimated at US$6.70, which is substantial considering the low average income levels (Worlddata.info, 2025). Additionally, 1GB of data costs about 18 percent of the average Malawian monthly income (Derksen et al., 2022).

Although 88% of Malawi's population was covered by a mobile-cellular network as of 2021 (World Bank, 2021), this figure reflects population coverage rather than geographic coverage—meaning vast rural areas remain underserved. At the same time, only about 6.1% of the rural population had access to electricity in 2023, highlighting the extent of infrastructure limitations in these regions (Trading Economics, 2025).

In summary, while mobile phone usage among young people in Malawi is on the rise, challenges related to affordability, infrastructure, and gender disparities continue to affect access and utilization. Addressing these issues could further enhance the benefits of mobile technology in Malawi.

2.2 Sexual Health Challenges and Risks in Malawi

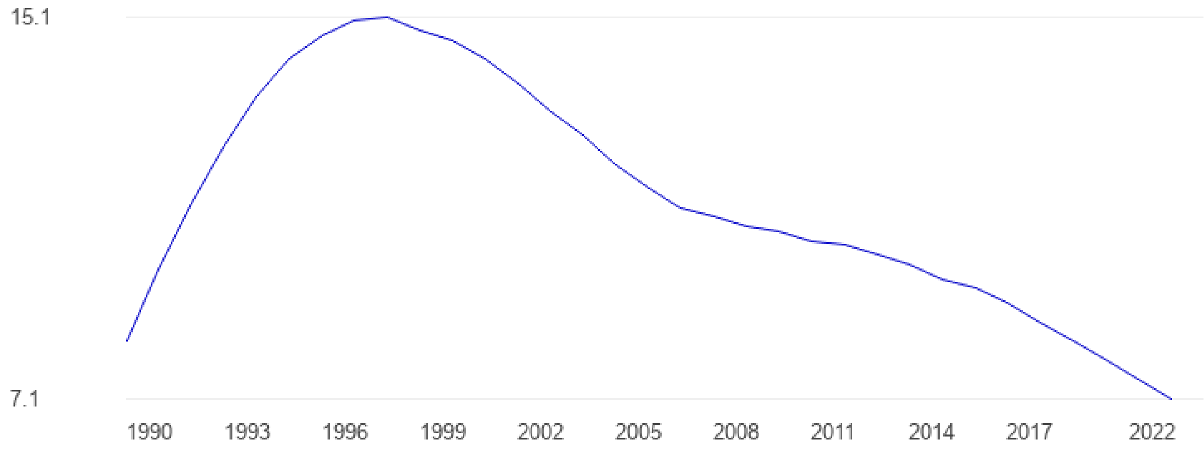
As of 2022, Malawi had one of the highest HIV prevalence rates in the world, with 7.1% of the population living with the virus and 12,000 AIDS-related deaths recorded that year. (World Bank, 2025b; National AIDS Commission Malawi, 2024). Adolescent girls and young women (aged 20–24) are disproportionately affected; in 2020, their HIV prevalence in Malawi was estimated at 4%, compared to 1% of young men (ICAP at Columbia University, 2022).

Even though the country remains heavily affected by HIV, deaths have decreased since the epidemic's peak in 1998, when the prevalence reached 15.1% of the population (see Figure 2; World Bank, 2025b). This is largely due to the wider availability and implementation of antiretroviral treatment (ART) programs. By 2021, 97.9% of adults living with HIV who knew their status were receiving ART (ICAP at Columbia University, 2022).

In recent years, mobile phone-based interventions have played a growing role in efforts to combat HIV. These include simple text message systems that remind patients to take their medication or attend clinic appointments, tools that send test results directly to patients' phones, and toll-free hotlines offering HIV information. These approaches have proved to be very effective—for instance, text-based delivery of test results reduced waiting times by over 60%, while two-way messaging systems increased treatment retention after one year from 75% to 91% (Feldacker et al., 2024; Haggard et al., 2025; NAPHAM, 2018).

Figure 2

HIV prevalence in Malawi (% of population ages 15–49), 1990–2022.



Note. Data are from the World Bank (2025b).
https://data.worldbank.org/indicator/SH.DYN.AIDS.ZS?locations=MW

Risky sexual behaviours contribute significantly to the spread of HIV and other sexually transmitted infections (STIs). According to the Malawi Demographic and Health Survey (2024) only 31% of women with multiple partners used a condom during their most recent sexual intercourse, while 16% of men reported having multiple sexual partners in the past 12 months.

Transactional sex, particularly in fishing communities, further exacerbates the risk of HIV transmission. In regions like Mangochi, the "sex for fish" phenomenon is prevalent, where women engage in sexual activities with fishermen to secure their livelihood. This practice is linked to higher HIV prevalence in these communities. For instance, in the South-East region of Malawi, where Mangochi is located, HIV prevalence among women is reported at 17.4%—significantly higher than the national average of 10.5% (ICAP at Columbia University, 2022; MacPherson et al., 2023)

The combination of low contraception rates and restrictive abortion laws has created a dangerous situation in Malawi. Under current legislation, abortion is criminalised except when performed to save the life of the pregnant woman. This leads many women to resort to unsafe abortion procedures, which are responsible for approximately 6–18% of all maternal deaths in the country. (African Population and Health Research Center, 2023).

Teen pregnancy remains a critical public health concern in Malawi, with approximately 31.5% of girls aged 15–19 having been pregnant (Malawi National Statistical Office & ICF, 2024). Early pregnancies often lead to school dropouts, reduced economic opportunities, and increased dependency, thereby perpetuating cycles of poverty. Furthermore, teenage mothers are at greater risk of complications during childbirth and are less likely to access antenatal care, heightening both maternal and infant health risks (Chaura et al., 2021).

Addressing sexual health challenges in Malawi requires comprehensive strategies that encompass education, economic empowerment, improved access to healthcare services, and targeted interventions for vulnerable populations.

3. Study Setting and Research Design

3.1 Intervention

In 2018, four government boarding schools in Malawi participated in an experiment conducted by Derksen, Michaud-Leclerc and Souza for their paper "Restricted Access: How the Internet Can Be Used to Promote Reading and Learning". This experiment provided schools with smartphones to see how Wikipedia impacted learning outcomes. Once the experiment was completed, the smartphones used in this experiment were distributed to Form 4 students along with a collection of basic phones. This is the intervention used in the thesis.

Each of these schools had around 500 students spread across four grade levels (Forms 1 to 4), drawing students from diverse socioeconomic backgrounds. The four schools consisted of one all-boys school, one all-girls school and two co-educational schools. Despite being relatively more academically competitive than government day schools and most private schools in the country, many students at these schools came from low-income households—42% did not have electricity at home and 45% lacked running water. Although 87% of students lived in households with a mobile phone, only about half had ever used the internet before the 2018 baseline study began. Admission to these schools was based on national primary school examination results, making them academically selective yet socioeconomically accessible.

Through a randomized lottery process, a group of 164 students were selected to participate in the experiment. Among these participants, students either received internet-enabled Itel Android smartphones, basic Nokia phones with calling and SMS functionality only, or were assigned to the control group who received no device through the study. The random distribution of phones amongst the students enabled us to perform a randomized controlled trial.

3.2 Theory of Change

This thesis tests whether distributing phones has a lasting impact on device access and usage as well as examining the effects of technology on sexual risk. Gender dynamics are central to the analysis, as we hypothesize that the intervention will have differential impacts on males and females due to pre-existing inequalities in technology access and sexual risk profiles.

A gender disparity in device ownership rates in Malawi suggests that the intervention's impact on device ownership and access may be more pronounced among female participants. Girls are less likely to independently acquire phones, whereas many boys might have eventually obtained phones through other means. We posit that the initial provision of phones could lead to persistent effects on technology ownership five years later by creating technological familiarity that encourages continued investment in devices as well as shifting societal attitudes about the appropriateness and utility of technology for females.

When considering sexual risk and behaviour, competing hypotheses exist about technology's potential impact. On one hand, smartphones might increase risk by expanding social networks beyond the immediate community and facilitating communications for private meetings. On the other hand, technology might decrease risk by providing access to health information and increasing agency in relationships. We hypothesize that these effects will differ by gender, with females potentially experiencing greater exposure to sexual solicitation via mobile platforms. This is particularly important to consider given that young women in Malawi face significantly higher HIV infection rates than males of the same age group and bear the risks associated with unintended pregnancy. Given these biological and social vulnerabilities, understanding the link between mobile access and sexual risk is particularly critical for young women.

3.3 Experimental Design

The core of this study is a randomized controlled trial (RCT), which allows for credible causal inference regarding the effect of mobile phone access on long-term behaviour outcomes.

A total of 164 Form 4 students were selected to be part of the study and were randomly assigned to one of three groups:

- **Smartphone group** (n = 52): Received a smartphone.
- **Basic phone group** (n = 54): Received a basic phone.
- **Control group** (n = 58): Received no device.

Randomization was conducted at the individual level in Stata, stratifying by gender, baseline academic performance (above or below the median), and whether they had access to Wikipedia through the previous study. Students were randomly assigned in equal proportions to one of three groups: smartphone, basic phone, or control. Random assignment helped ensure transparency and minimize concerns about selection bias. Tables 1a and 1b present covariate balance across the treatment arms, demonstrating the effectiveness of the randomization procedure.

3.4 Data

In September 2023, five years after the intervention, we launched a follow-up survey to assess long-term outcomes. The follow-up surveys were primarily conducted via phone interviews, which enabled us to reach participants who had relocated across the country for university, work, or other reasons. The process of locating respondents demanded considerable effort, prolonging the data collection process. The survey was completed in March 2025, nearly two years after it began.

Out of the original 164 students, we were able to successfully follow up with 138 participants: 42 from the smartphone group, 47 from the basic phone group, and 49 from the control group.

The attrition rate for the study was 15.9% overall (26 out of 164 participants).

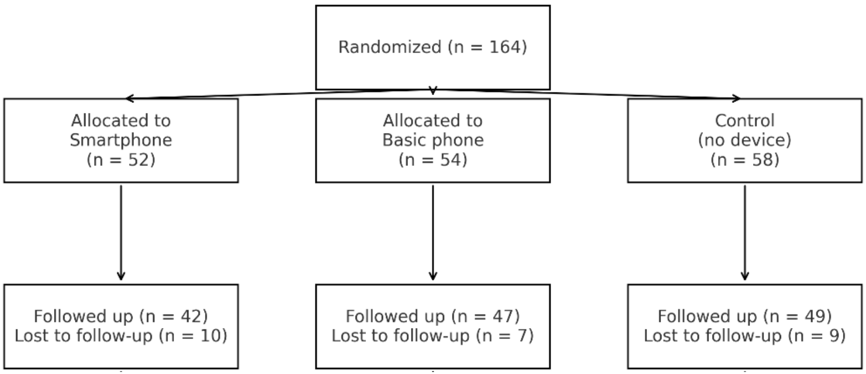
Breaking it down by group:

- Smartphone group: 19.2% attrition (10 out of 52 participants)
- Basic phone group: 13.0% attrition (7 out of 54 participants)
- Control group: 15.5% attrition (9 out of 58 participants)

These relatively balanced attrition rates across the three groups (ranging from 13.0% to 19.2%) help minimize concerns about differential attrition bias potentially affecting the study results.

Figure 3

Participant flow by study group and follow-up status.



The follow-up survey covered a broad range of topics. The question domains we focus on in this thesis are:

- **Device access and usage**: Current ownership, frequency of use and internet access
- **Sexual behaviour**: Age of sexual debut, number of sexual partners and contraception use

By using self-reported data, we acknowledge the potential for social desirability bias. However, the surveys were administered with strict confidentiality protocols and the interviewers worked to build trust with participants to minimize underreporting.

Informed consent was obtained from all participants, and they were compensated for their participation. Data confidentiality was maintained through rigorous protocols. All survey responses were de-identified using unique participant codes, with personal identifiers stored separately from research data in files with restricted access. The study was ethically approved by the Malawi National Committee on Research in the Social Sciences and Humanities.

In addition to the long-run survey, we also used data from the Baseline and follow-up surveys used in the Derksen, Michaud-Leclerc and Souza paper "Restricted Access: How the Internet Can Be Used to Promote Reading and Learning". The baseline and follow-up surveys, conducted in October 2017 and June 2018 respectively, captured participants' background characteristics such as age, family context, and prior internet use. These variables, along with administrative school records—including endline Malawi School Certificate of Education

(MSCE) scores in English and Biology—were incorporated into the regression models to better isolate the effects of the intervention.

4. Empirical Strategy

This thesis relies on a randomized controlled trial (RCT) to identify the causal effect of mobile phone access on long-run device use and sexual behaviour among Malawian youth. The random assignment of smartphones, basic phones, and placement in a control group enables credible estimation of treatment effects. Because the allocation of devices was conducted via a public lottery and attrition was balanced across treatment groups over the five-year study period, we can reasonably assume independence between treatment assignment and potential outcomes.

We estimate treatment effects using two complementary sets of regressions. In the first approach, we treat both smartphone and basic phone recipients as a single treatment group and compare them to the control group. This allows us to estimate the average effect of receiving any kind of phone, regardless of technological capacity. In the second approach, we analyse the effects of smartphones and basic phones separately, allowing us to test whether access to internet-enabled devices had different effects than access to basic phones with only calling and SMS functionality.

Tables 1a and 1b present balance tests for the covariates used as controls in our regression analyses. These tables examine key baseline characteristics collected prior to the intervention, including demographic factors (gender, age), socioeconomic indicators (parental education, household wealth, phone ownership), prior technology exposure (internet use, participation in the Wikipedia treatment), and academic performance (grade average).

Table 1a compares participants who received any phone (either smartphone or basic phone) to those in the control group. As shown, there are no statistically significant differences between treatment and control groups across any of these control variables.

Table 1b compares basic phone recipients (B), smartphone recipients (S), and the control group separately. Again, we observe no statistically significant differences across the three groups for any of the regression covariates.

The balance across these covariates supports the validity of our randomization procedure and strengthens the causal interpretation of our findings. While we include these variables as controls in our regression specifications to increase precision, the demonstrated balance suggests that their inclusion should not substantially alter the estimated treatment effects, further supporting the robustness of our results.

Table 1a
Balance Table (binary treatment).

	Treatment	Control	p-value
Male	0.607	0.531	0.394
	(0.491)	(0.504)	
Parent education	1	0.98	0.89
	(0.866)	(0.803)	
Internet use	0.708	0.653	0.516
	(0.457)	(0.481)	
Phone in Household	0.854	0.878	0.697
	(0.355)	(0.331)	
Wikipedia treatment	0.517	0.51	0.941
	(0.503)	(0.505)	
Grade average	4.227	4.323	0.744
	(1.531)	(1.677)	
Wealth	2.596	2.796	0.46
	(1.475)	(1.541)	
Age	23.876	24.082	0.639
	(2.373)	(2.49)	
School	2.629	2.633	0.986
	(1.181)	(1.074)	

Notes: Balance table across the treatment (N=89) and control (N=49) groups. Means are reported with standard deviations in parentheses. The p-value is from a two-sided t-test of equality of means between treatment and control groups.

Table 1b
Balance Table (categorical treatment).

	B	S	Control	p-value
Male	0.574	0.643	0.531	0.559
	(0.5)	(0.485)	(0.504)	
Parental Education	0.957	1.048	0.98	0.878
	(0.884)	(0.854)	(0.803)	
Internet Use	0.681	0.738	0.653	0.674
	(0.471)	(0.445)	(0.481)	
Phone in Household	0.83	0.881	0.878	0.753
	(0.38)	(0.328)	(0.331)	
Wikipedia Treatment	0.532	0.5	0.51	0.954
	(0.504)	(0.506)	(0.505)	
Grade Average	4.087	4.388	4.323	0.629
	(1.499)	(1.571)	(1.677)	
Wealth	2.617	2.571	2.796	0.759
	(1.407)	(1.564)	(1.541)	
Age	23.809	23.952	24.082	0.85
	(2.193)	(2.585)	(2.49)	
School	2.723	2.524	2.633	0.731
	(1.192)	(1.174)	(1.074)	

Notes: Balance across the three study arms— B (N = 47), S (N = 42), and Control (N = 49). Means are reported with standard deviations in parentheses. The omnibus p-value comes from a one-way ANOVA of equality of means across the three groups.

The combined treatment specification takes the form:

$$y_i = \beta_0 + \beta_1 \cdot \mathrm{T}_i + \gamma' \boldsymbol{X}_i + \varepsilon_i \tag{1}$$

where:

• y_i is the outcome measure for student i at endline.

• T_i is an indicator equal to 1 if student i was assigned to receive a phone (either smartphone or basic phone), and 0 if in the control group.

• β_1 captures the average effect of receiving any phone relative to receiving no phone.

• $\boldsymbol{X}_i$ is a vector of control variables including gender, parental education, household phone ownership, wealth, school fixed effects, and stratification bin fixed effects. $\boldsymbol{\gamma}$ is the corresponding vector of coefficients.

• ε_i is a mean-zero error term.

In the disaggregated treatment specification, we use the model:

$$y_i = \beta_0 + \beta_1 \cdot \mathrm{B}_i + \beta_2 \cdot \mathrm{S}_i + \boldsymbol{\gamma}'\boldsymbol{X}_i + \varepsilon_\mathrm{i} \tag{2}$$

Where:

• B_i is an indicator equal to 1 if student i received a basic phone and 0 otherwise.

• S_i is an indicator equal to 1 if student i received a smartphone and 0 otherwise.

• β_1 captures the effect of receiving a basic phone relative to not receiving a phone.

• β_2 captures the effect of receiving a smartphone relative to not receiving a phone.

• $\boldsymbol{X}_i$ and ε_i are as defined in Equation (1).

We further explore heterogeneous treatment effects by gender, motivated by the known disparity in baseline phone ownership between boys and girls in Malawi. To do so, we estimate a model that includes interaction terms between treatment assignment and gender. The regression specification for the combined model is:

$$\begin{aligned} y_i = {} & \beta_1 \cdot \mathrm{Female}_i + \beta_2 \cdot \mathrm{Male}_i \\ & + \delta_1 \cdot (\mathrm{Female}_i \times \mathrm{T}_i) + \delta_2 \cdot (\mathrm{Male}_i \times \mathrm{T}_i) \\ & + \boldsymbol{\gamma}'\boldsymbol{X}_i + \epsilon_i \end{aligned} \tag{3}$$

Where:

• $Female_i$ is an indicator variable equal to 1 if student i is female and 0 otherwise.

• $Male_i$ is an indicator variable equal to 1 if student i is male and 0 otherwise.

•β_1 and β_2 are the mean outcomes for females and males, respectively.

•δ_1 and δ_2 capture the treatment effects for females and males, respectively.

• T_i, $\boldsymbol{X}_i$ and ε_i are as defined in Equation (1).

In the disaggregated version we use the following equation:

$$
\begin{aligned}
y_i = {} & \beta_1 \cdot (\text{Female}_i \times \text{N}_i) + \beta_2 \cdot (\text{Male}_i \times \text{N}_i) \\
& + \beta_3 \cdot (\text{Female}_i \times \text{B}_i) + \beta_4 \cdot (\text{Female}_i \times \text{S}_i) \\
& + \beta_5 \cdot (\text{Male}_i \times \text{B}_\text{i}) + \beta_6 \cdot (\text{Male}_i \times \text{S}_i) \\
& + \boldsymbol{\gamma}' \boldsymbol{X}_i + \varepsilon_i
\end{aligned} \tag{4}
$$

Where:

• $Female_i$ and $Male_i$ are as defined in Equation (3).

• N_i is an indicator equal to 1 if student i was assigned to the control group and 0 otherwise.

• B_i and S_i are defined as in Equation (2).

• β_1 to β_6 capture the mean outcomes for each gender–treatment combination.

• $\boldsymbol{X}_i$ and ε_i are as defined in Equation (1).

Our main outcomes fall into two categories. The first is device access and usage, including current phone ownership, frequency of use, and internet access. The second category relates to sexual behaviour, including age of sexual debut, number of sexual partners, and contraceptive use. These variables are constructed from self-reported data in the 2023 follow-up survey. While self-reports may be subject to social desirability bias—particularly regarding sexual behaviour—we implemented strict confidentiality protocols, used trained interviewers, and reassured participants about privacy to encourage honest responses.

5. Results and Mechanisms

5.1 Device Access and Ownership

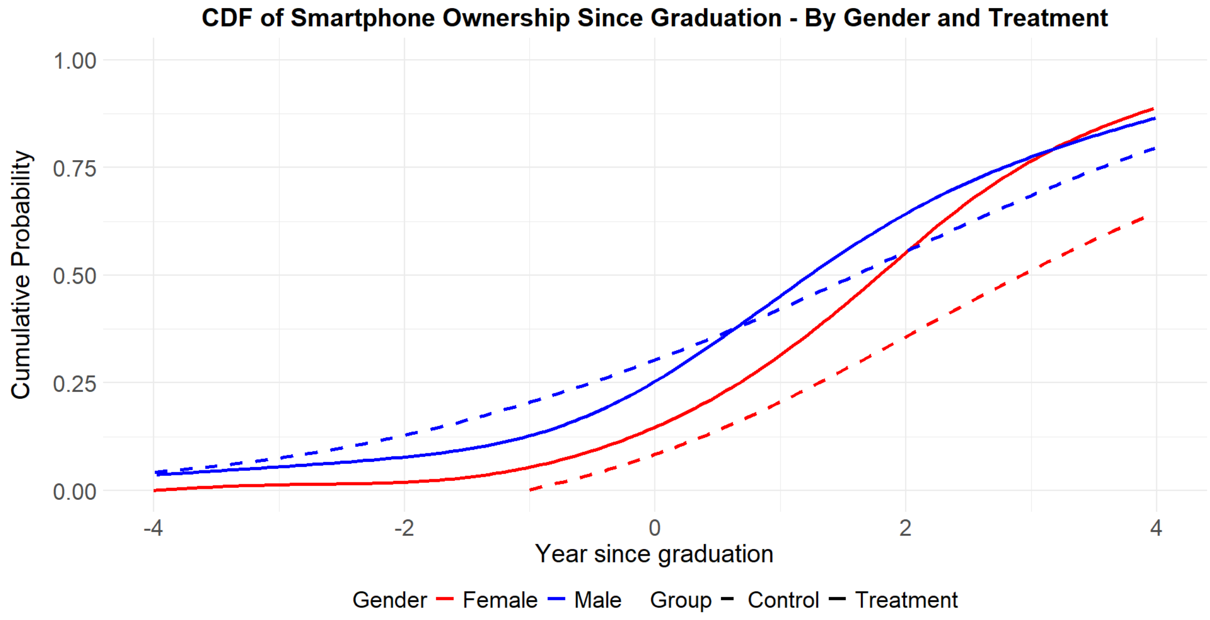
Five years after the intervention, we find persistent positive effects on device access and usage among female participants. Table 2 shows that while the overall treatment effect on smartphone access was not statistically significant, there was a significant heterogeneous effect by gender. Female students who received a phone (either basic or smartphone) were 13.6 percentage points more likely to have access to a smartphone compared to females in the control group ($p = 0.031$) and 14.5 percentage points more likely to own a smartphone (marginally significant; $p = 0.096$). This represents a substantial increase over the control group mean for females (82.6%) and (73.9%) respectively. Similarly, treated females were 22.4 percentage points more likely to have access to a laptop ($p = 0.051$), a 42.9% increase relative to the female control mean (52.2%).

In contrast, we found no significant positive effects on device access for male students, and in fact observed a marginally significant negative effect on smartphone ownership (-12.9 percentage points, $p = 0.096$). This suggests that the intervention may have substituted for, rather than supplemented, other pathways to device acquisition for males. The divergent gender effects align with the baseline disparities in device access in Malawi, where boys typically have greater access to technology than girls.

Figure 4 illustrates the cumulative probability of smartphone ownership relative to secondary school graduation year by gender and treatment group. The chart reveals that treatment group participants acquired smartphones earlier than control group participants, with the effect particularly pronounced for females. As shown, females in the treatment group (solid red line) consistently show higher smartphone ownership rates compared to females in the control group (dashed red line) across all time periods. Notably, by years 2–3 post-graduation, treated females overtook male control group participants (dashed blue line) in smartphone ownership probability. This visual representation reinforces the finding that the intervention had a more substantial impact on female participants, helping to bridge and even overcome the pre-existing gender gap in technology access.

Figure 4

Age at first smartphone, by binary treatment and gender.



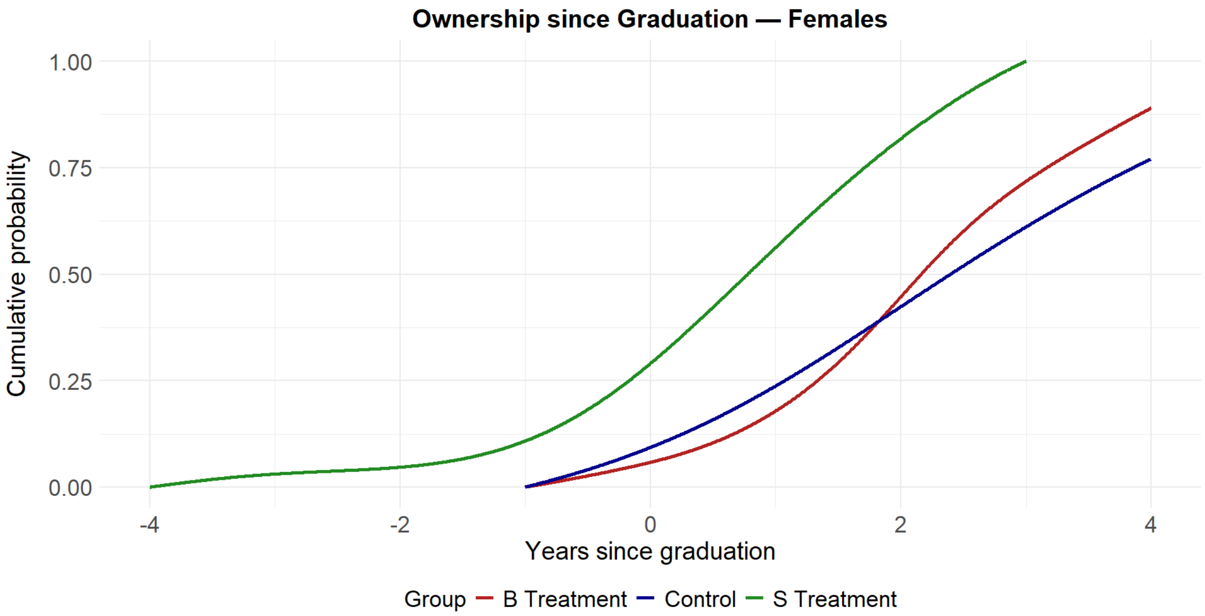
Note. The y-axis represents the cumulative probability of smartphone ownership.

When examining the disaggregated treatment effects by phone type, we find similar positive impacts on female smartphone access for both treatments, though the point estimate is somewhat larger for basic phones (+15.4 percentage points, $p = 0.035$) than for smartphones (+11.2 percentage points, $p = 0.146$). This result suggests that receiving any type of phone may have established habits and demonstrated value that encouraged continued technology adoption, with basic phone recipients potentially upgrading their devices over time. This could have important implications for the cost-efficiency of future interventions.

Figure 5 shows the cumulative share of female participants who acquired a smartphone in the years following graduation. By the second year, both treatment groups had already pulled ahead of the control group, with a steeper initial rise for those who received smartphones, reflecting earlier adoption. Although basic phone recipients started more slowly, their uptake steadily increased, eventually approaching that of the smartphone group. The figure highlights how the intervention helped close the gender gap in technology access, leading to sustained increases in smartphone adoption among young women—regardless of the type of phone initially provided.

The benefits of the intervention extended beyond mobile phones alone. For laptop access, the effect was strongest for females who received smartphones with an increase of 22.4 percentage points (p = 0.051) (Table 2), suggesting that exposure to mobile devices may have encouraged adoption of other technologies.

Figure 5
Age at first smartphone by treatment – females.



Note. The y-axis represents the cumulative probability of smartphone ownership.

Table 2

Effect of Receiving *Any Phone* on Device Access.

	(1) Smartphone access	(2) Laptop access	(3) Smartphone ownership	(4) Laptop ownership
Panel A. Overall effects				
Overall Treatment	0.030	0.076	-0.013	-0.008
	(0.042)	(0.075)	(0.058)	(0.075)
	p = 0.467	p = 0.312	p = 0.823	p = 0.914
Panel B. Differential effects				
Treatment × Male	-0.045	-0.034	-0.129*	-0.096
	(0.055)	(0.101)	(0.077)	(0.099)
	p = 0.415	p = 0.739	p = 0.096	p = 0.336
Treatment × Female	0.136**	0.224*	0.145*	0.135
	(0.062)	(0.113)	(0.086)	(0.111)
	p = 0.031	p = 0.051	p = 0.096	p = 0.227
Control Mean (Overall)	0.898	0.551	0.857	0.490
Control Mean (Male)	0.962	0.577	0.962	0.538
Control Mean (Female)	0.826	0.522	0.739	0.435
Number of students	134	134	134	134

Notes: Treatment effects on device access and ownership. Interaction terms indicate differential treatment effects by gender. (1) and (2) correspond to the responses to the question: "Do you sometimes have access to the internet on a device such as a smart phone, tablet, computer or laptop?". (3) and (4) indicate that the device belonged to the student. All regressions control for gender, parents' education, past internet use, wealth, age, school, and a categorical variable capturing the stratification bin (based on gender, baseline academic performance, and prior Wikipedia access). Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 3

Effect of Basic vs. Smartphone Treatment on Device Access.

	(1) Smartphone access	(2) Laptop access	(3) Smartphone ownership	(4) Laptop ownership
Panel A. Overall effects				
Treatment B	0.067	0.104	0.027	0.023
	(0.047)	(0.085)	(0.066)	(0.085)
	p = 0.152	p = 0.226	p = 0.682	p = 0.789
Treatment S	-0.004	0.070	-0.048	-0.035
	(0.048)	(0.088)	(0.068)	(0.088)
	p = 0.942	p = 0.427	p = 0.478	p = 0.695
Panel B. Differential effects				
Treatment B × Male	-0.008	0.003	-0.059	-0.015
	(0.064)	(0.117)	(0.088)	(0.114)
	p = 0.904	p = 0.977	p = 0.505	p = 0.893
Treatment S × Male	-0.083	-0.070	-0.197**	-0.174
	(0.063)	(0.116)	(0.088)	(0.113)
	p = 0.195	p = 0.550	p = 0.027	p = 0.128
Treatment B × Female	0.154**	0.212	0.122	0.105
	(0.073)	(0.133)	(0.100)	(0.130)
	p = 0.035	p = 0.114	p = 0.227	p = 0.420
Treatment S × Female	0.112	0.236*	0.168	0.167
	(0.077)	(0.140)	(0.106)	(0.137)
	p = 0.146	p = 0.095	p = 0.115	p = 0.224
Control Mean (Overall)	0.898	0.551	0.857	0.490
Control Mean (Male)	0.962	0.577	0.962	0.538
Control Mean (Female)	0.826	0.522	0.739	0.435
Number of students	134	134	134	134

Notes: See Table 2.

5.2 Internet Usage and Connectivity

The intervention produced substantial and statistically significant changes in internet usage patterns, once again with particularly pronounced effects among female participants. As shown in Table 4 of the internet usage results, the overall treatment increased monthly internet use by 0.368 points on a 4-point scale ranging from *Not at all* (1) to *Almost every day* (4) ($p = 0.021$) and the likelihood of purchasing a data bundle in the past month by 21.3 percentage points ($p = 0.002$). Treatment also increased WhatsApp frequency by 0.435 points on the same 4-point scale ($p = 0.009$).

Heterogeneous effects analysis reveals that these impacts were primarily driven by female participants. Treated females showed a 0.624-point increase in monthly internet use ($p = 0.009$), a 23.1 percentage point increase in bundle purchases ($p = 0.022$), a 20.3 percentage point increase in internet access (Column 6, $p = 0.022$), and a 0.694-point increase in WhatsApp usage ($p = 0.005$). This increase in monthly internet and WhatsApp usage represents a shift from weekly to near-daily use. These effects substantially exceeded those for males, where only bundle purchases reached statistical significance. (+19.9 percentage points, $p = 0.025$).

Disaggregating by phone type, in Table 5, we find that both basic and smartphones led to long-term increases in internet engagement for women, with similar or stronger effects observed for basic phones across several measures. For instance, basic phone recipients reported 1.22 more days of weekly internet use ($p = 0.008$) compared to the control group, a finding that was significant for females (+1.390 days, $p = 0.046$) and marginally significant for males (+1.061 days, $p = 0.083$). This pattern challenges assumptions that smartphones necessarily yield stronger long-term impacts on digital connectivity. However, whilst the estimates suggest that a basic phone may have had an even larger effect on long-run internet use than a smartphone, the estimates are not precise enough to state this with confidence.

These findings suggest that the intervention not only increased access but also fostered lasting engagement with internet technology—especially among girls, who were less likely to have baseline access. This supports our theory of change, which suggests that initial exposure to technology can produce long-term digital engagement, particularly among female adolescents who have historically faced barriers to access.

Table 4

Effect of Receiving *Any Phone* on Internet Outcomes.

	(1) Weekly use	(2) Monthly use	(3) Bought bundle	(4) Bundle costs	(5) Paid internet	(6) Has internet	(7) Whatsapp use
Panel A. Overall effects							
Overall Treatment	0.648	0.368^{**}	0.213^{***}	1202	0.108	0.098^{*}	0.435^{***}
	(0.405)	(0.157)	(0.066)	(842)	(0.071)	(0.058)	(0.162)
	p = 0.113	p = 0.021	p = 0.002	p = 0.156	p = 0.131	p = 0.096	p = 0.009
Panel B. Differential effects							
Treatment × Male	0.351	0.170	0.199^{**}	1177	0.150	0.015	0.230
	(0.539)	(0.208)	(0.087)	(1133)	(0.096)	(0.078)	(0.214)
	p = 0.517	p = 0.414	p = 0.025	p = 0.301	p = 0.120	p = 0.842	p = 0.285
Treatment × Female	1.031^{*}	0.624^{***}	0.231^{**}	1233	0.055	0.203^{**}	0.694^{***}
	(0.612)	(0.236)	(0.099)	(1276)	(0.108)	(0.088)	(0.241)
	p = 0.095	p = 0.009	p = 0.022	p = 0.336	p = 0.609	p = 0.022	p = 0.005
Control Mean (Overall)	4.92	3.20	0.675	1887	0.655	0.776	3.22
Control Mean (Male)	4.92	3.23	0.654	1846	0.615	0.808	3.23
Control Mean (Female)	4.91	3.17	0.696	1933	0.696	0.739	3.22
Number of students	132	133	133	134	134	134	129

Notes: Treatment effects on internet habits. Interaction terms indicate differential treatment effects by gender. (1) is the typical number of days students use the internet per week. (2) is reported use of internet per month from a scale from 1 (none) to 4 (almost every day). (3) indicates whether the student bought a bundle in the past month and (4) indicate the amount of money spent on bundles. (5) indicates whether the students paid for internet through bundles or other means. (6) indicates wehther the student has either paid for internet or has free access. (7) indicates how frequently the student used Whatsapp in the past month, from a scale from 1 to 4 (see (2)). All regressions control for gender, parents' education, past internet use, wealth, age, school, and a categorical variable capturing the stratification bin (based on gender, baseline academic performance, and prior Wikipedia access). Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 5

Effect of Basic vs. Smartphone Treatment on Internet.

	(1) Weekly use	(2) Monthly use	(3) Bought bundle	(4) Bundle costs	(5) Paid internet	(6) Has internet	(7) Whatsapp use
Panel A. Overall effects							
Treatment B	1.22***	0.557***	0.242***	1446	0.118	0.163**	0.641***
	(0.449)	(0.176)	(0.075)	(971)	(0.082)	(0.066)	(0.182)
	p = 0.008	p = 0.002	p = 0.002	p = 0.139	p = 0.152	p = 0.015	p = 0.001
Treatment S	-0.054	0.139	0.178*	929	0.097	0.025	0.195
	(0.475)	(0.185)	(0.079)	(999)	(0.085)	(0.068)	(0.190)
	p = 0.910	p = 0.454	p = 0.0256	p = 0.355	p = 0.255	p = 0.712	p = 0.308
Panel B. Differential effects							
Treatment B × Male	1.061*	0.482**	0.266***	1730	0.169	0.124	0.574**
	(0.606)	(0.233)	(0.100)	(1311)	(0.111)	(0.088)	(0.245)
	p = 0.083	p = 0.041	p = 0.009	p = 0.189	p = 0.129	p = 0.160	p = 0.021
Treatment S × Male	-0.409	-0.138	0.134	640	0.131	-0.091	-0.081
	(0.609)	(0.233)	(0.100)	(1305)	(0.110)	(0.087)	(0.238)
	p = 0.503	p = 0.555	p = 0.183	p = 0.625	p = 0.240	p = 0.299	p = 0.735
Treatment B × Female	1.390**	0.625**	0.203*	1009	0.054	0.198*	0.707**
	(0.688)	(0.265)	(0.114)	(1492)	(0.126)	(0.100)	(0.270)
	p = 0.046	p = 0.020	p = 0.078	p = 0.500	p = 0.672	p = 0.050	p = 0.010
Treatment S × Female	0.503	0.600**	0.264**	1468	0.056	0.202*	0.652**
	(0.752)	(0.290)	(0.125)	(1575)	(0.133)	(0.106)	(0.296)
	p = 0.505	p = 0.041	p = 0.037	p = 0.353	p = 0.675	p = 0.059	p = 0.030
Control Mean (Overall)	4.92	3.20	0.675	1887	0.655	0.776	3.22
Control Mean (Male)	4.92	3.23	0.654	1846	0.615	0.808	3.23
Control Mean (Female)	4.91	3.17	0.696	1933	0.696	0.739	3.22
Number of students	132	133	133	134	134	134	129

Notes: See Table 4.

5.3 Sexual Behaviour and Risk

Contrary to common concerns that mobile phone access would increase sexual activity or risk-taking among adolescents, our findings suggest no such effect and indicate potential protective effects in some domains. Table 6 of the sexual behaviour results shows that the intervention had a marginally significant effect on increasing the age of sexual debut by 0.686 years ($p = 0.095$) and reducing the number of lifetime sexual partners by 0.632 ($p = 0.059$) with a 95 % confidence interval ranging from –1.283 to 0.02.

When examining heterogeneous effects by gender, we find that the reduction in lifetime sexual partners was driven primarily by male participants, who reported 0.952 fewer partners ($p = 0.039$) than males in the control group. The effect on female participants was directionally consistent but smaller in magnitude (-0.264 partners) and not statistically significant ($p = 0.589$).

Disaggregating by phone type reveals that both basic phones and smartphones were associated with reductions in lifetime sexual partners for male participants (Table 7). The effect of basic phones was -0.756 ($p = 0.148$), while smartphones had an effect of -1.130 ($p = 0.032$). Although the point estimates differ in magnitude, the effects appear similar. For females, there were no significant effects for either phone type.

For the remaining sexual behaviour measures—including sexual activity status, recent sexual encounters (past month), and contraception use—neither smartphone nor basic phone access showed statistically significant effects.

While most estimates are not statistically significant, the associated confidence intervals are wide, indicating that these are not precise null results. Rather than providing strong evidence of no effect, the findings reflect statistical uncertainty and leave room for both modest protective and adverse effects. For instance, the estimated effect on being sexually active is close to zero ($\beta = 0.0267$, $p = 0.682$), yet the 95 % confidence interval ranges from –0.097 to 0.149—encompassing both a potential 10 percentage-point reduction and a 15-point increase. Similarly, the estimate for unprotected sex ($\beta = –0.027$, $p = 0.649$) has a confidence interval from –0.143 to 0.089, meaning the data are consistent with either a sizeable decrease or a modest increase in unprotected sex. These wide confidence intervals highlight the need for future research with larger sample sizes to more precisely estimate these effects.

These findings challenge the assumption that providing mobile phones to adolescents inherently increases sexual risk. While there is often heightened concern about the impact on girls, our results show no evidence of increased sexual risk for either gender. This calls into question the rationale often used to restrict technology access for female adolescents in sub-Saharan Africa.

Table 6

Effect of Receiving *Any Phone* on Sexual-Risk Indicators.

	(1) Active	(2) Debut Age	(3) Lifetime Partners	(4) Partners (Month)	(5) Sex (Month)	(6) Unprotected	(7) Debut 20+
Panel A. Overall effects							
Overall Treatment	0.026	0.686*	-0.632*	-0.084	-0.133	-0.027	0.087
	(0.063)	(0.407)	(0.332)	(0.105)	(0.087)	(0.059)	(0.087)
	p = 0.682	p = 0.095	p = 0.059	p = 0.428	p = 0.128	p = 0.649	p = 0.321
Panel B. Differential effects							
Treatment × Male	0.009	0.635	-0.952**	-0.047	-0.110	-0.031	0.104
	(0.085)	(0.520)	(0.455)	(0.142)	(0.118)	(0.079)	(0.118)
	p = 0.914	p = 0.225	p = 0.039	p = 0.740	p = 0.353	p = 0.701	p = 0.378
Treatment × Female	0.047	0.774	-0.264	-0.128	-0.161	-0.022	0.065
	(0.095)	(0.692)	(0.488)	(0.158)	(0.131)	(0.089)	(0.130)
	p = 0.623	p = 0.266	p = 0.589	p = 0.421	p = 0.221	p = 0.802	p = 0.622
Control Mean (Overall)	0.816	19.4	2.85	0.674	0.652	0.143	0.604
Control Mean (Male)	0.962	19.5	4.00	0.720	0.680	0.115	0.560
Control Mean (Female)	0.652	19.3	1.65	0.620	0.619	0.174	0.652
Number of students	136	113	133	132	132	138	135

Notes: Treatment effects on internet habits. Interaction terms indicate differential treatment effects by gender. (1) is whether the student has ever had sex. (2) indicates how old the student was when they first engaged in intercourse. (3) is the number of reported lifetime sexual partners, whilst (4) is number of sexual partners in the past month. (5) indicates whether the respondent had sex in the past month. (6) is a binary indicator showing whether the respondent had sexual intercourse with neither contraception or HIV prevention in the past month. (7) is a binary indicator showing whether the respondent first had sex after the age of 20 or has still never had sex. All regressions control for gender, parents' education, past internet use, wealth, age, school, and a categorical variable capturing the stratification bin (based on gender, baseline academic performance, and prior Wikipedia access). Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table 7

Effect of Basic vs. Smartphone Treatment on Sexual-Risk Indicators.

	(1) Active	(2) Debut Age	(3) Lifetime Partners	(4) Partners (Month)	(5) Sex (Month)	(6) Unprotected	(7) Debut 20+
Panel A. Overall effects							
Treatment B	0.065	0.604	-0.641*	-0.119	-0.142	-0.009	0.055
	(0.073)	(0.481)	(0.384)	(0.120)	(0.099)	(0.069)	(0.103)
	p = 0.376	p = 0.212	p = 0.098	p = 0.322	p = 0.155	p = 0.892	p = 0.592
Treatment S	-0.026	0.721	-0.543	-0.062	-0.120	-0.040	0.085
	(0.075)	(0.510)	(0.398)	(0.125)	(0.103)	(0.0707)	(0.107)
	p = 0.728	p = 0.161	p = 0.175	p = 0.621	p = 0.249	p = 0.569	p = 0.429
Panel B. Differential effects							
Treatment B × Male	0.033	0.626	-0.756	-0.148	-0.189	-0.030	0.061
	(0.098)	(0.602)	(0.519)	(0.161)	(0.133)	(0.092)	(0.136)
	p = 0.738	p = 0.301	p = 0.148	p = 0.361	p = 0.158	p = 0.741	p = 0.653
Treatment S × Male	-0.017	0.643	-1.130**	0.060	-0.025	-0.032	0.148
	(0.098)	(0.607)	(0.519)	(0.165)	(0.136)	(0.092)	(0.137)
	p = 0.863	p = 0.292	p = 0.032	p = 0.714	p = 0.852	p = 0.729	p = 0.283
Treatment B × Female	0.095	0.679	-0.667	-0.037	-0.063	0.016	0.095
	(0.153)	(0.776)	(0.566)	(0.183)	(0.151)	(0.105)	(0.153)
	p = 0.537	p = 0.384	p = 0.241	p = 0.839	p = 0.677	p = 0.877	p = 0.537
Treatment S × Female	-0.037	0.924	0.208	-0.227	-0.271	-0.069	0.031
	(0.117)	(0.876)	(0.597)	(0.192)	(0.158)	(0.111)	(0.161)
	p = 0.753	p = 0.294	p = 0.728	p = 0.238	p = 0.090	p = 0.535	p = 0.850
Control Mean (Overall)	0.816	19.4	2.85	0.674	0.652	0.143	0.604
Control Mean (Male)	0.962	19.5	4.00	0.720	0.680	0.115	0.560
Control Mean (Female)	0.652	19.3	1.65	0.620	0.619	0.174	0.652
Number of students	134	109	129	128	128	134	131

Notes: See Table 6.

5.4 Mechanisms

This intervention appears to have established sustained digital engagement, especially among female participants who experienced significant increases in smartphone access (+13.6 percentage points) and laptop access (+22.4 percentage points) (Table 2). The binary intervention (any phone vs. no phone) had such a large impact on females that treated girls eventually achieved higher smartphone ownership rates than untreated boys (Figure 4). The fact that girls experienced substantially stronger treatment effects suggest that gender norms played a key role, with the intervention helping females overcome access barriers while revealing that control group males often acquired technology through other means.

Basic phones appear also to have been effective in reducing access barriers, potentially acting as a stepping stone toward future upgrades. Receiving even a basic handset may have acted as a *visible signal* within the household and wider community demonstrating that girls' use of digital technology is legitimate and valuable. This social endorsement may have lowered normative barriers and encouraged further investments—such as upgrading to a smartphone or purchasing a laptop. Therefore, crossing the initial technology-adoption threshold may be more important than the specific capabilities of the device. This is worth noting for the cost-effectiveness of future interventions.

Despite common concerns, there were no findings that suggested that device access increased sexual risk for either gender. On the contrary, the results suggest modest protective effects—particularly among male participants. This may be because phones gave adolescents greater access to health information, strengthened social connections, and increased girls' autonomy in navigating relationships—factors that can promote safer sexual behaviour. Another plausible mechanism is a substitution effect, where the phones served as a distraction, absorbing time and attention that might otherwise have gone toward riskier offline activities.

Rather than serving as a gateway to risky encounters, digital connectivity may have expanded adolescents' opportunities and empowered better decision making. These findings challenge widely held concerns about sexual risk and highlight how technology access can be part of a broader strategy to promote health, education, and gender equality in resource-constrained settings.

6. Conclusion

This thesis investigates the long-term impacts of mobile phone access among youth in Malawi, focusing on device usage and sexual behaviour outcomes. Through a randomized controlled trial that distributed smartphones and basic phones to Form 4 students and followed them over five years, we have uncovered several important findings that challenge prevailing assumptions about technology access in sub-Saharan Africa.

The results indicate that providing phones significantly increased device ownership, internet usage, and digital connectivity. Girls generally experienced stronger effects than boys and had significantly higher rates of smartphone access, laptop ownership, and internet engagement compared to the control group. The intervention not only increased female participants' device access relative to control group females but in fact elevated treated females' smartphone ownership above that of control group males—demonstrating how strategic technological interventions can help to reshape gender-based digital divides.

Notably, we found that basic phones also led to significant increases in internet use and eventual smartphone access for female participants. This suggests that initial device ownership, regardless of device-specific capabilities, can help to overcome technology barriers and lead to sustained digital engagement. This could have important implications for the cost-efficiency of future interventions.

Contrary to prevailing concerns that often motivate restrictions on girls' access to technology, we find no evidence that increased access to mobile devices led to greater sexual activity or risk-taking behaviour. Instead, mobile phones appear to have modest protective effects, particularly among boys.

Despite the promising findings, this study has several limitations that warrant consideration. The sample size of 164 students across four boarding schools limits the statistical power to detect smaller effects and does not fully represent the diverse socioeconomic contexts within Malawi. The 15.9% attrition rate, while relatively balanced across treatment groups, introduces potential selection bias if those lost to follow-up differed systematically from those retained. Self-reported sexual behaviour data is susceptible to social desirability bias, particularly in a cultural context where discussing sexuality carries significant stigma. Moreover, there is a possibility of treatment spillovers between groups. Students from the same schools may have borrowed devices, shared internet access, or been indirectly influenced by peers who received phones, potentially blurring group distinctions and weakening the estimated treatment effects.

Nonetheless, these findings contribute to ongoing debates surrounding technology access and gender equity by empirically challenging misconceptions that restrict young women's access to digital devices.

Policymakers and development organizations should leverage these results to advocate for mobile phone distribution, recognizing digital access as a tool for supporting sustainable development goals related to gender equality, health, education, and economic opportunity.

Future research should explore the specific mechanisms through which mobile phone access influences long-term outcomes, including educational attainment, employment prospects, and health behaviours. Additionally, investigations into cost-effective strategies for scaling digital inclusion initiatives would provide valuable insights for implementation across sub-Saharan Africa.

In conclusion, this study provides evidence-based support for policies that promote equitable technology access as a means of fostering digital inclusion and addressing gender disparities—without increasing sexual risk behaviours among adolescents in Malawi. By challenging misconceptions that limit technology access for girls, these findings contribute to creating pathways for more inclusive digital access in sub-Saharan Africa. In a world where digital literacy increasingly determines economic opportunity, educational advancement, and social mobility, ensuring that young women have equal access to technology is not merely a question of fairness— it is a strategic and essential investment in the region's future.

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