Digital bodyguards: A field experiment on the role of personal safety on mobility and empowerment

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Abstract

This research paper examines the impact of providing information on a digital app (Women Safety App) on female mobility and autonomy, using a field experiment in a developing country with high levels of gender-based violence (Lahore, Pakistan). The app was designed by the Punjab Safe City Authority in a bid to improve safety. We ask whether providing information about the app improves female mobility (trips taken outside the home) on both the extensive and intensive margins. The intervention includes a comprehensive training and awareness session, followed by the download and registration of the app on participants' smartphones. Furthermore, we track participants' mobility in two ways: using google location data from their phones, and using monthly travel diaries to explore their modes, motives, and travel companions. We find no evidence of increases in the number of trips, or the distance travelled per trip by participants in the study period. However, we find large and significant increases in the duration of each trip, by approximately 6.4 minutes that is 24 percent increase over the average trip duration in the control group. Further exploratory analysis shows that our participants change their patterns of travel: information about the app increases the number of walked trips by 15 percentage points. Most strikingly, however, we report a 10-percentage point increase in the number of unaccompanied trips overall, consistent with increased autonomy of our participants. Further results show that these increases in autonomy and mobility are concentrated among households that report trust in the serving institution (i.e. the police), and among households with female agency at baseline. These findings underscore the potential and limitations of technology-driven interventions to address gender-based constraints and promote inclusive urban environments.

Keywords: female mobility, women safety app, Pakistan
JEL Classification Codes: B54, C91, Z1

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"Women don't need to find a voice; they have a voice, and they need to feel empowered to use it, and people need to be encouraged to listen." - Meghan Markle

1. Introduction

Can information about the availability of a safety app (i.e. a "digital bodyguard") increase female autonomy in transportation choices? Transportation choices for women is a key issue that effects important life outcomes such as dropout rates, labor force participation rates, and lifetime earnings (see, for example, Martinez et al., 2019). The question of safety is closely linked to mobility: Harassment and sexual violence is often cited as one of the main reasons for female lack of mobility (UN Women briefs 2023).[2] This reduces female ability to participate in school, work and public life, limits access to essential services, enjoyment of cultural and recreational activities, and negatively impacts health and well-being. (UN Brief 2023). Hence, improving female mobility is a critical consideration for many developing countries, and particularly where safety concerns are high.

In this paper, we report the results of a field experiment designed to provide information on an existing mobile application (called the Women Safety App) on working age women in a large urban center in Pakistan. For the experiment, we developed an informational video in conjunction with the Punjab Safe City Authority and the Punjab police (the developers of the App) on the key features of the App. The main feature we highlight is the availability of an "Alert" button, which send GPS coordinates to the police who then deploy special police officers to the location. Additional features include a real time chat function, location reviews, and contact details for a number of emergency services. We recruited working age women from middle- and low-income neighborhoods in Lahore, Pakistan, one of the largest urban centers in the country. We then randomized the participants to view an informational video on the Women Safety App[3], or a control app (the Pakistan Citizen Portal, a grievance redressal app issued by the Prime Ministers performance delivery unit of the Government of Pakistan)[4]. This was followed by a support to help participants install and register their app on their mobile phones. Data was collected through Google mobility data collected using Google maps (June 2022 to December 2023), and through monthly travel diaries (June, 2023 to October, 2023). We also collected baseline (July, 2022), midline (June, 2023), and endline (December, 2023) surveys to measure participant perceptions. We go further than previous efforts by observing our participants mobility directly, and augmenting this with contextual information which allows us to estimate the effect of information on mobility choices and autonomy.

We find strong evidence that information regarding female safety initiatives increases female autonomy of transportation choices. Treated participants do not take more trips, or increase the distance travelled, but are significantly more likely to take more time traveling, spending 7 minutes more per trip in the post intervention period. This increase is mainly attributable to participants that reported trusting the police at baseline, indicating that trust in the authorities is a critical factor when implementing such policies. Furthermore, we find that this increase in trip duration is due to treated

[2]This includes: "unwelcome sexual remarks and touching to rape and femicide. It happens on streets, in and around schools, public transportation, workplaces, parks, public toilets and other spaces in urban, rural, online, and conflict/post conflict settings (UN Brief 2021).

[3] Link to the informational video:
https://drive.google.com/file/d/1uIb7YcLo1JvcvMFvtaZMTHEoHkuqhwni/view?usp=share_link

[4] Link to the control video: https://www.youtube.com/watch?v=091s_Hze_JI

participants changing their mode of transportation: treated participants are more likely to take trips by walking rather than private transport. We also report that treated participants (particularly those that report trusting the police) increase their proportion of unaccompanied trips, indicating greater autonomy; we confirm that this increase in unaccompanied trips is among those participants who reported being allowed to travel alone at baseline. Hence, we show (for the first time) that the treatment, while not changing the frequency of trips, does increase the duration of trips, and time spent outside the home. We show that this is driven by changes in mode of transport, and critically, the ability of women to travel without companions, providing strong evidence of autonomy in transport choices.

South Asia is one of the most suppressed regions in terms of gender parity (Global Gender Gap Report 2023)[5][6] and within the region Pakistan (at 57.5%), ranks worse than most of its South Asian neighbors (just before Afghanistan and Iran)[7]. In recent years, the gender gap with respect to school enrollment has narrowed, but this has not manifested in a greater presence of women in the urban labor force (in 2020 the urban female labor force participation was estimated at 21.4%). Women are also missing from public spaces such as libraries, parks, and community centers (Adeel and Zang 2017; Aftab 2020).[8] Pakistan is ranked as the sixth most dangerous country in the world for women,[9] and ranked 153 out of 156 countries in the Global Gender Gap report.[10]

One potential explanation for critically low labor force participation rates are safety concerns for women. The question of safety is closely tied to the question of mobility (Phadke 2020). Safety is an important constraint in mobility for women around the world, but it is worse in developing countries where the crime rate may be higher, public infrastructure poorer and police and legal recourse less reliable. It can also come at a cost of longer and more expensive travel routes to avoid shorter but possibly unsafe travel routes (Borker, 2020).[11] Travel and safety are often important considerations for women as compared to men when choosing education and employment opportunities (Borker,

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[5] Every year, the Global Gender Gap Index assesses the current status and advancement of gender parity prevailing globally in four key areas: economic participation and opportunity, educational attainment, health and survival, and political empowerment. The ratio of the value of each indicator for women to that for men is used to calculate the parity score for each indicator. Thus, a parity score of 1 means complete parity.

[6] 2023 Global Gender Gap report estimates it will take the South Asia region around 149 years to achieve full gender parity

[7] With a score of 72.2%, Bangladesh secured the 59th position globally, followed by Bhutan (68.2%), Sri Lanka (66.3%), Nepal (65.9%), Maldives (64.9%), India (64.3%), Pakistan (57.5%), and Afghanistan (40.5%).

[8] Using the Pakistan Time-Use Survey, Adeel et al. (2017) find that women make fewer and shorter trips than men by every mode of travel (except walking) and for every purpose of travel (except learning and household care). Women were twice as dependent on public transport as males and exhibited higher reliance on personal automobiles despite lower ability to meet transportation costs. Similar patterns are confirmed by Srivastava and Aftab (2024, forthcoming). They argue that both India and Pakistani women exhibit instrumental mobility (that is they may leave the house for education, paid or unpaid work) but not substantive mobility (to leave the house without a specific reason, to loiter).

[9] https://www.reuters.com/article/world/factbox-which-are-the-worlds-10-most-dangerous-countries-for-women-idUSKBN1JM01Z/

[10] https://www.weforum.org/publications/global-gender-gap-report-2021/

[11] In patriarchal societies such as India and Pakistan, women accessing the public spaces are often subjected to varied forms of harassment, they are often objectified and, in the extreme, face sexual assault and violence (Bhattacharyya, 2015; Madan & Nalla, 2016). Borker (2018) estimates that women tend to enroll in campuses near their home so that they can avoid a long commute. The same decision-making process applies to the choice of employment (women prefer jobs which offer pick-and-drop or are close to where they live and are willing to give up higher paid jobs to be able to live close to their home. She estimates loss in future earnings of around 20 percent as a result of these second-best choices.

2020).[12] Distance increases the impact of social and safety barriers and reduces uptake of education, training and employment opportunities, especially among women.[13]

Furthermore, there is less freedom for independent travel and increased safety concerns which drive female mobility decisions (Alberts et. al., 2016; Adeel et al, 2017; Cook and Butz, 2017). Age, marital status, employment status, income levels and social restrictions determine female mobility decisions and characteristics, especially in regions where travel is considered dangerous due to male interaction and loss of honour (Papanek, 1971; Sathar and Kazi, 2000; Mumtaz et al., 2003). Travel is often monitored by family and controlled through permission, veiling and escort with non-essential travel often disallowed (Sathar and Kazi, 1997). How stringent are these social norms and how strictly are these followed depends on age, caste, localities and broader social preferences (Khan, 1999; Jejeebhoy and Sathar, 2001).[14]

Remedial policies often focus on providing women access to safe and reliable transportation, either by introducing separate female compartments on public buses, or running women-only buses (see, for example, Sajjad et al, 2018). Such policies restrict interactions with men that a woman herself might find no danger or discomfort from, but that men in her family or community do not condone (Jayachandran 2020), reflecting patriarchal norms. Impact evaluations of these initiatives confirm that these programs led to a decrease in verbal and physical harassment of female-riders.[15] However, one may argue that introducing separate compartments in public transport for women is a patriarchal solution to a patriarchal problem where women are confined in an all-female vehicle and transported from one location to another without any interaction with any unrelated male – as if there exists an invisible tunnel between two locations and women are transported through this tunnel restricting interaction with an outsider (Krishnan 2020).

The Government of Punjab has taken several initiatives to address female safety (such as Women on Wheels, Violence Against Women Center and Women Safety App). In 2020, the Punjab police *re*launched its Women Safety App due to flaws in the original provision.[16] The app is equipped with

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[12] Borker 2020 confirms that in Delhi women choose in the lower half of the quality distribution over a college in the upper quintile in favour of safer travel routes.

[13] For example, Cheema et. al (2022) find reliable group transportation increased females' completion rates of a subsidized skill training program when the training center was located outside the village in Pakistan. Besides financial and time-based costs of travel, they find a "boundary effect" – the cost of travelling outside the village. Women who face this boundary effect are four times less likely to complete the program than those who had the center within the village. They attribute this boundary effect to the threat of safety while travelling through underpopulated spaces.

[14] In Lahore, Pakistan, nearly 40% of respondents said that it was unsafe or very unsafe for women to walk in their neighborhood, and that crowded modes of transport such as wagons are unsafe for women (Sajjad et al 2018). Furthermore, 70% of male respondents said they would discourage female family members from taking public wagon services (CITE?).

[15] Aguilar et al. (forthcoming) evaluate the Viajemos Seguras (Women Traveling Safely) program, by surveying women in Mexico City to measure harassment of women riding the subway. By making comparisons around when the women-only-cars hours start and end each day, they find that the program of women-only-cars reduces harassment. Similarly, Kondylis et al. (2020) finds that a women-only space on the subway in Rio de Janeiro led to a reduction in both verbal and physical harassment experienced by female riders and that many women are willing to pay a substantial premium to be in the women-only space.

[16] While Women Safety App was launched in 2017 by Punjab Safe City Authority to improve the response time in case of an emergency, however, there was lack of awareness regarding the app-resulting in low take-up rates with only 55,000 registered users in a province of 110 million people. Moreover, the app failed to provide the police authorities with GPS coordinates. Resolving these issues, on November 8th, 2020, the Women Safety App was relaunched under the direct

essential emergency features including an alert button which results in a direct call to the police on the emergency helpline '15' or the caller can chat with a representative of Punjab Safe City Authority.[17] To register with the app, no additional information is required except for a working mobile sim. Furthermore, the App had undergone additional testing to ensure its features were operating effectively, especially transmission of GPS coordinates.

In gendered societies (like Pakistan) gender-based norms exist and influence behavior. These norms lead to perceptions of safety, and perceptions of risk, that might differ (systematically) from the real world. In such an environment we expect the introduction of a safety app to intervene on two fronts, first by generating information that corrects misperceptions, and second, by providing a safety net in risky situations. In such an environment we expect the introduction of a safety app (equipped with a panic-button) acts as a social safety net to help mitigate some of the perceived risk associated with women entering and fully participating in the public sphere. Hence, information about the Women Safety App is expected to increase female mobility, both on the extensive (number of trips taken) and on the intensive margins (distance of travel and trip duration). We go beyond facilitating access to the labor market and associated transportation interventions, and change mobility patterns directly through changing risk and safety perceptions.

2. Background

2.1 Safety Issues in Public Spaces of Lahore, Pakistan
2.2 The Woman Safety Application by Punjab Safe City Authority

Pakistan, especially over recent years, has witnessed a surge in gender-based violence – both street and domestic violence -- ranging from the brutal murder of Noor Mukadam in an upscale Islamabad residence (just miles from the local police-station) to the mob attack in the heart of Lahore (at Minar-e-Pakistan) – Pakistan's second largest city and the location of our intervention. Women feel especially more insecure in the low/lower-middle-income areas of Lahore: Poor infrastructure, narrow streets

ownership of Punjab Police and further collaboration with key security agencies like Rescue 1122, Motorway Police, and the Punjab Highway Patrol.

[17] The Women Safety app is a free IOS/Android app developed keeping in mind the Pakistani urban woman, and offers the user 3 main facilities:

1) In case of an emergency, user can press the alert button (directly connects them with the PUCAR-15 service) or chat with a representative, who after noting down the details of the incident, forward the complaint to the relevant department so immediate action could be taken.
2) Provides location reviews which you can check before going to an unknown place or leave your own review (on a scale of 5 stars) along with pictures
3) Awareness documents are available that provide information on legal laws services available for women and children such as Child Marriage Act etc.

The first two components primarily aim at providing a safe and hassle-free travelling experience for women in public spaces and provides them a safety net in case they face any problem. Once the emergency call is made or chat facility is utilized, the police get the GPS coordinates of the user and they use those to immediately respond using their forces such as Dolphin, Police or Motorway authorities depending on which is the most relevant and closest. The third component intends to empower the females by giving them awareness about their rights and services available to facilitate them.

with vehicular congestion, (this is especially true in areas where residential plots have been converted into commercial zones), poor street lighting, insufficient deployment of security guards and inadequate CCTV cameras in public places (Bajwa et al, 2018). In a Center for Economic Research in Pakistan (CERP) survey of 50,000 households in Lahore, almost 40% of respondents said that it was unsafe or very unsafe for women to walk in their neighborhood (Sajjad et al 2018).

Pakistani women often face street harassment, including catcalling, verbal abuse, stalking, and physical assault, while traveling on public transportation or walking on the streets: 38 % female respondents in another survey conducted in Lahore city confirmed having been verbally abused (whistling, singing), while 45 % had experienced visual abuse (staring, leering), while a few had been physically abused (touching, groping etc.) (Bajwa et al, 2018). As one respondent stated, harassment has become 'normalized' in our society (Azeem 2023). In such an environment, the Punjab Government has introduced the Women Safe City app. This intervention is more cognizant of the wholistic character of agency and focuses on safety both within the household and in the public space. The app is equipped with essential emergency features including an alert button which results in a direct call to the police on the emergency helpline '15' or the caller can chat with a representative of Punjab Safe City Authority.

3. Experimental Design

In this section we describe the randomized experiment and data collection process. We then outline our empirical specification and present results on randomization, balance and compliance.

3.1 Intervention and Design

We employ individual level randomize control experiment to evaluate the information regarding the Women Safety App on female mobility and their transportation choices. We identified the low-middle income neighborhoods in Lahore, an urban center of Pakistan. The women in middle- and high-income households often use private transportation, rarely walking or using public transportation when commuting. Therefore, these women are at higher risk of harassment. We focused on working age women (18-55 years) with access to a private smart phone with data bundle since, WSA shares the geo-tagged location of the user only if they are connected to internet.

We randomized 694 households into treatment and control groups. However, there was large attrition in first few months of enrollment leaving us with a sample of 319 participants at the time of intervention. We demonstrate that the attrition is not related to treatment status and table 1 demonstrates that our sample post attrition remains balanced.

For the treatment group we produce a six-minute-long awareness video in collaboration with our partner, Punjab Safe City Authority, in which we provide information regarding the benefits of the Women Safety App – not only explaining how and when to use the app, but also illustrating the back end working of relevant departments /security forces who work together in real time on an emergency alert. Study participants are provided comprehensive training and awareness regarding the utilization of the product. We also facilitate use by downloading the App on their mobile devices and registering them where necessary. Control participants were shown an awareness video for another App produced by the Government of Pakistan, the Pakistan Citizen Portal App (video produced by the

Government of Pakistan). Our intervention required enumerators to display the video to each participant on a tablet, after which participants were asked if they needed assistance in downloading the app on their phones. Upon consent, they were also helped with registering and making an active account on their respective apps for both control and treatment groups. Participants were compensated for completing the study and complying with study protocols (we paid participants 1500 PKR, or 5.5 USD for participation). Our design was pre-registered at AEA RCT Registry. Our analysis extends upon the pre-analysis plan by conducting heterogeneity analysis.

3.2 Data

The study relies on three primary sources of data. We break new ground in measuring mobility through high frequency data using Global Positioning System (GPS) to accurately track respondents' daily trips, distance travelled and its duration. This method is free from reporting and recall bias. Further, we complement it with travel diaries, which may not be very accurate with mobility data, yet it enriches the context by giving information on mode of transportation and who they travelled with. Lastly, we collect survey data at three points in time to better understand their underlying perceptions, beliefs and agency.

Global Positioning System Data

Our main data source comes from GPS backed mobility data collected via Google maps. Each participant of our study consented to being tracked via Google Maps during the study period. To obtain this data, at the time of the baseline, we installed an additional user in their Google maps application, which allowed us access to their GPS information during the period of study. All participants were informed about this and the period of study, and the additional user was subsequently deleted from their phone at endline. This allows us to generate information on trips undertaken by our participants, where a trip is defined as a significant change in the GPS coordinates, in accordance with Google's code. Note that participants had full control over access by our user profile and had to periodically renew permissions. This meant that we have some attrition in the dataset as trip data would not be recorded during times when permissions were not renewed. Our protocol mandated that we get in touch with participants who chose not to renew permissions to understand whether they wanted to no longer participate in the study. If this was the case, we then visited the participant to return the device to the original condition by deleting the additional profile. 375 participants dropped out partway through the study, but we still use the data that was provided until they chose to no longer participate.

Our dataset contains 31,378 trips, and their associated coordinates, the distance travelled (in km), and the duration (in minutes). As with any high frequency data, we also observe the presence of outliers, that are too large to be undertaken in a single day with typical modes of transport. Hence, we retain trips that are a maximum of 43 km (the length of Lahore), and 300 minutes (5 hours), which is the time taken to complete a circuit of Lahore by car, or travel from the center to the edges by foot. This leaves us with a final sample of 30,909 trips. For robustness, we also conduct our analysis on the full dataset, which is reported in Appendix A. The core results are robust to including these outliers. Further, due to high attrition immediately post baseline, that ended on August 13th 2022, we wait till mobility data is stabilized in terms of unique households as illustrated in Figure X in Appendix A. Similarly, on the tail end, we restrict the data 2 weeks before the endline begins. Finally, we only

employ mobility data from for a total span of 15 months from 1st September 2022 to 30th November 2023 bringing down our final sample size to 27,762.

Travel Diaries

Our second source of data on mobility and transportation choices is travelling diaries. These data augment the trip data by providing key contextual information on trip purpose and companions. We collect travel diary data from participants to complement the high frequency google mobility data. These data are collected during the post-intervention period, and on a monthly basis, between the months of June and October 2023. To collect this, participants were called once a month and were asked about their travel activity during the past week. We ask them for the number of trips made each day, starting from the first day of the week, the approximate distance travelled, the approximate duration of each trip, the mode of transportation, the purpose of the trip, and who accompanied them on the trip. This data has lower frequency and is self-reported, so we do not expect trip duration and distance to be very accurate, but it provides critical contextual information that the high frequency mobility data is unable to capture. Please see the travel diary template in appendix XXX.

Survey Data

Our survey data comes from 319 working age women between 18-55 years old living in low-income neighborhoods in Lahore, Pakistan.

We conducted surveys of the participants at three points in the study period the baseline (conducted pre-intervention) in September 2022; a midline (conducted post-intervention) in June 2023; and an endline conducted in December 2023. The survey is divided into three main sections: 1) participant socio-demographics, household socio-economic status, and household type (nuclear or multi-generational); 2) perceptions and beliefs of gender equality, gender roles, female access to public spaces, and female labor force participation; 3) participant mobility (access to transportation, and concerns about females traveling on their own, and travel norms).

3.3 Empirical Specification

In this section we lay out the empirical methodology employed to examine the impact of information regarding Women Safety App on i) female mobility and ii) mobility choices.

Female Mobility

While we have randomized the intervention, for stronger empirical results we estimate the impact of Women Safety App on female mobility using difference-in-difference methodology. We estimate the treatment effects using the following equation:

$$y_{ih} = \alpha + \gamma Post_i + \delta T_h + \beta\, Post_i * T_h + \Gamma' X_h + \mathcal{E}_{ih} \qquad (1)$$

where y_{ih} is the outcome for trip i of participant h. Our main outcome variables are the number of trips taken (the extensive margin), and the distance and duration of each trip (the intensive margin). $Post_i$ takes the value of 1 if trip i is post-intervention and T equals 1 if participant h belongs to the treatment group. X_h is a set of control variables capturing participant and household level

characteristics for participant h, including age, marital status, participant trusts in the police, mobility agency, owns land, and trip timings (night, weekend, summer, Ramadan). The main coefficient of interest in this regression is β that estimates if the impact of the intervention is differential by treatment status while controlling for pre-treatment characteristics. The error terms are clustered at the participant level.

A priori, if the participants trust the authority, we expect female mobility to improve. The information video in the intervention had two major parts: i) first it elaborated on the quick response they could get in case of emergency through technological innovation and ii) illustrates the back end working by authorities to overcome trust issues. Understanding authority's efficient work at the backend and knowing that help in case of an emergency is just a call/message away, we expect the participants to increase the number of trips, traveling farther and spending more time on each trip. Therefore, in general we expect β to be positive for all mobility outcomes.

The control variables include age, marital status, participant trusts in the police, mobility agency, owns land, and trip timings (night, weekend, summer, Ramadan). Age is a continuous variable capturing the age of the respondent. Marital status captures using binary variables that takes the value of one if the respondent is married. Baseline survey asks if the respondent trust Punjab Police where they could respond with a yes or no. We create a binary variable of trust Punjab policy if the respondent said yes. Mobility agency indicates if the respondent, at baseline, has the permission to go out of the house alone. Owns land is binary variable indicating if the household respondent belongs to own residential or agriculture land, proxying their wealth level. Further, we use various variables to capture the timings of the trip. Night trip is any trip between 10 pm and 5 am, weekend trip are those mode on Saturday or Sunday, summer trips capture summer months between June and August whereas Ramadan trips identify the month of Ramadan (a religious month of fasting for Muslims) in year 2023 that fell between 23nd March 2023 to 21th April 2023.

Mode of Transportation and Trip Company

Further, we leverage travel diaries to explore any impact of the information regarding women safety application on the mode of transportation and the trip company. We specifically employ travel diaries for this section since despite GPS data having broad categories of mode of transportation such as walking, motorbike, in passenger and flying, we fail to find the categorizations particularly informative. For instance, in passenger vehicle could be a car, bus or taxi. Further, GPS data has no information on trip company. The travel diary data is only collected post intervention, between mid-line and end-line survey. Given the intervention is randomized, we estimate the impact of Women Safety App using a linear model:

$$y_{ih} = \alpha + \beta T_h + \Gamma' X_h + \mathcal{E}_{ih} \qquad (2)$$

where y_{ih} is the outcome variable for trip i of participant h. Our two outcome variables are i) mode of transportation and ii) trip company. The mode of transportation was an open ended question in our travel diaries that we convert into three broad categories, namely, public transport, private transport and walking. Public transport includes bus, metros and ride sharing services (such as uber, rickshaw etc), while private transportation includes car or motorbike. We did identify use of multiple modes of transportation for a single trip, for instance they walked till the metro station and then took metro. A dummy variable is created that takes the value of 1 if they at all walked in trip i . The trip company

was cleaned into three broad categories, travelling alone, with males or with females. We create a binary variable that takes the value of 1 if the trip was made alone and 0 otherwise. This captures mobility autonomy, as trips walked require less household coordination and resources, and trips taken alone signal autonomy for our female participants. T_h is the treatment status, X_h is the same set of control variables as above, capturing individual and household level characteristics for participant h, including age, marital status, participant trusts in the police, mobility agency, owns land, and trip timings (night, weekend, summer). We remove Ramadan as it did not overlap with the months in which travel diary data was collected. If information about the Women Safety App increases female autonomy in transport choice, we would expect β to be positive.

3.4 Parallel Trend Assumption and Balance Table

Parallel Trend Assumption

For the difference-in-difference to give causal impact, it is necessary to assure that both the groups (control and treatment) have a similar time trend before intervention even if the levels are different. To examine the parallel trend assumption, first we graphically examine the monthly time trend of number of trips (figure 1), distance per trip and duration per trip by treatment group (figure 2). Note that the time trend of number of trips is parallel for both, control and treatment group. Figure 1 displays the effect of providing information about the Women Safety App on the extensive margin of mobility: the average number of trips taken per participant per month for both the pre-intervention period (Sept 2022 to January 2023) and the post-intervention period (February 2023 to November 2023). Note that our treated participants were taking fewer trips on average in the pre-intervention period, yet the time trend of number of trips remain parallel to each other for control and treatment group.

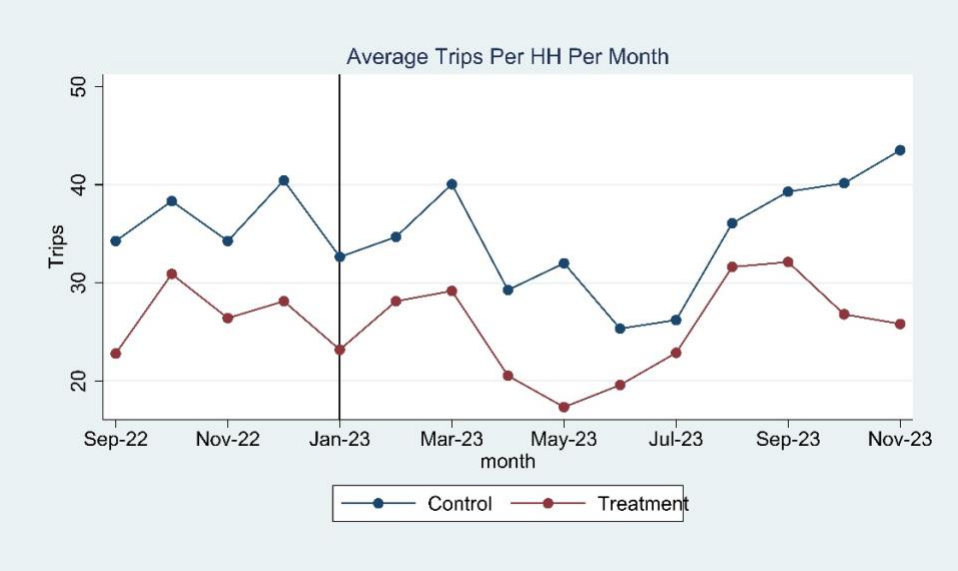


Figure 1: Number of trips per month per participant, by treatment and control groups

Notes: vertical line indicates beginning of the post-treatment period; the figures exclude clear outliers in terms of distance and duration.

Next, we focus on the intensive margins of mobility: the average distance (Figure 2a) and average duration (Figure 2b) per trip per participant per month. Focusing on distance first, what is immediately apparent is the gap in the average distance travelled by the treated households prior to the intervention. Despite being randomly assigned to treatment, control participants travelled an average of 1.37 km per trip more that treated households. However, the time trends remain parallel.

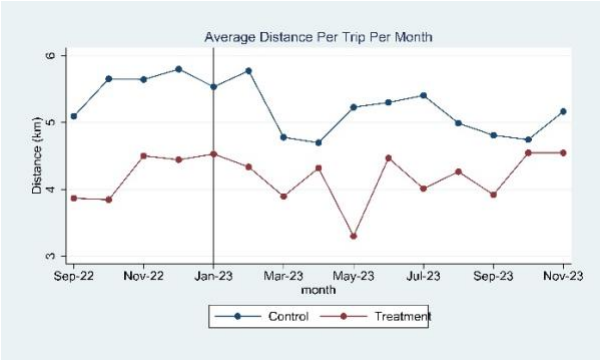




Figure 2a and 2b: Average distance (a) and duration (b) per trip per participant per month, by treatment and control groups

Notes: vertical line indicates beginning of the post-treatment period; the figures exclude clear outliers in terms of distance and duration.

Figure 2b displays the duration of each trip undertaken by our participants. Average duration of travel was largely similar in the pre-intervention period, with control participants spending 0.93 minutes more per trip than treated participants in September but then both groups converge in levels and trend in October 2022. Of all the outcome variables, duration per trip seem to slightly invalidate parallel trend assumption in the initial one month.

To further strengthen the evidence of parallel trend assumption, we empirically test if the time trends are different. Exploiting pre-treatment data, we run regressions estimating the treatment effect interacting it with the data variable. Table 1 shows that the coefficient of the interaction term is statistically insignificant for all three primary outcome variables, total trips per day (column 1), distance per trip (column 2) and duration per trip (column 3). This implies, that the parallel trend assumption holds for all variables.

Table 1: Parallel Trends Test

	(1) Total Trips Per Day	(2) Distance Per Trip	(3) Duration Per Trip
Trip Date	-0.0001	0.0042**	0.0414***
	(0.0010)	(0.0018)	(0.0119)
Treatment	-0.5120***	-1.4884***	-1.6844
	(0.1205)	(0.2280)	(1.4884)
Treatment x Trip Date	-0.0014	0.0019	0.0136
	(0.0014)	(0.0027)	(0.0177)
Constant	3.2551***	5.2440***	27.2297***
	(0.0875)	(0.1581)	(1.0321)
Observations	3804	11162	11162

R^2	0.0285	0.0150	0.0028

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Balance Table

Table 2 provides a balance table of differences at baseline between treatment and control participants. We report no significant differences on observables save one: incidence of ownership of land is 10 percentage points higher for treated participants relative to control participants ($p<0.031$). Besides this, participants are comparable on all other observables indicating that randomization was successful. The analysis controls for this disparity in land ownership. Therefore, comparing the control and treatment group would give reliable causal estimate of the intervention. The average age of our sample is 33-years; 63 percent of the sample is currently married; 18 percent are students and 12 percent have acquired tertiary education. 13 percent of the women in our sample are employed, and of these 75 percent work full time. The safety perceptions of our sample regarding their neighborhoods indicate that 83 percent women deem their neighborhoods as safe to walk. These women live in a household with an average of 5 household members, and 69 percent of our sample has an average household income between PKR 25,000 – 75,000 (127 and 380 USD[18]).

Table 2: Balance Table

Variable	Control	Treatment	Difference	P-Values
Panel A: Individual Level Characteristics				
Age	33.66	32.29	-1.36	0.264
Currently Married	0.63	0.57	-0.06	0.303
Never married	0.30	0.35	0.05	0.338
Tertiary Education	0.12	0.16	0.04	0.353
Student	0.18	0.23	0.06	0.220
Employed	0.13	0.14	0.01	0.873
Work Fulltime	0.75	0.67	-0.08	0.569
Weekly Work Hours	30.90	26.05	-4.85	0.352
Own Monthly Income				
PKR 0-9999	0.01	0.02	0.01	0.480
PKR 10000-24999	0.03	0.04	0.01	0.673
PKR 25000-49999	0.04	0.01	-0.03	0.117
PKR 50000-74999	0.01	0.02	0.01	0.480
PKR 75000-100000	0.03	0.02	-0.01	0.612
PKR 100000+	0.01	0.01	-0.00	0.947
Current Social Status	5.11	5.13	0.01	0.899
Aspired Social Status	7.72	7.78	0.06	0.714
Weekly Trips for Family	1.37	1.27	-0.10	0.563
Weekly Trips for Work	2.25	1.96	-0.29	0.258
Weekly Trips for Education	1.53	1.98	0.46	0.143
Weekly Trips for Friends	1.19	1.08	-0.11	0.560
Distance willing to commute for the job	9.48	10.17	0.69	0.804
Max Time Willing to Spend on travelling for job	2.41	574.63	572.22	0.422
Trnspt. Method: Metro Bus	0.43	0.39	-0.04	0.416
Trnspt. Method: Orange Line	0.32	0.33	0.01	0.797
Trnspt. Method: Speedo	0.36	0.32	-0.04	0.403
Trnspt. Method= SWVL	0.11	0.17	0.06	0.117
Hrs Spent Away Weekdays	5.34	5.47	0.13	0.887
Hrs Spent Away Weekends	3.03	3.46	0.43	0.278

[18] Using the exchange rate of 1st July 2022.

Safety Perceptions of Neighborhood	0.83	0.86	0.03	0.504
Trust in Policy	0.32	0.31	-0.01	0.933
Panel B: Household Characteristics				
Durable Assets	0.10	0.20	0.10	0.651
Household Size	4.47	4.47	-0.00	1.000
Owns Land	0.18	0.29	0.10	0.031
Type of Land Owned: Agricultural land	0.04	0.07	0.03	0.296
Type of Land Owned: Residential land	0.10	0.15	0.05	0.170
Household Income Categories				
(PKR) 10000-24999	0.09	0.11	0.03	0.403
(PKR) 25000-49999	0.42	0.40	-0.02	0.720
(PKR) 50000-74999	0.27	0.23	-0.04	0.458
(PKR) 75000-100000	0.11	0.13	0.02	0.570
(PKR) 100000_and_above	0.12	0.13	0.01	0.842
Own their house	0.77	0.74	-0.03	0.494
Floor Material				
Cement	0.24	0.19	-0.05	0.263
Chips	0.34	0.36	0.02	0.749
Tiles	0.20	0.25	0.04	0.377
Marble	0.22	0.21	-0.01	0.870
Internet Type				
Cable/Wired	0.63	0.62	-0.00	0.967
Wireless	0.38	0.38	0.00	0.967
Observations	151	168	319	319

4. Results

In this section, we present two primary findings. First, while there is no impact on the extensive margin (number of trips), we show that the mobility increases on intensive margins. The duration per trip increases significantly, despite no increase in distance per trip. These findings signify that with a soft-touch information intervention regarding safety mechanisms, women can extend the time spent on each trip. In the next section, we explore for who does the intervention works and why.

4.1 Female Mobility

Table 3 present the effects of information about the Women Safety App on the main outcome variables, mobility on the extensive margin (specifically, the number of trips taken by participants during the study period - column 1), and on the intensive margin (the distance travelled per trip in kilometers - column 2; and duration of each trip in minutes - column 3). Our key variable of interest is the difference in difference estimate - the interaction term between the treatment dummy and the post intervention period. Contrary to expectations, the number of trips taken by participants is negative but not significant ($p=0.667$), and the distance per trip, while positive, is similarly statistically insignificant ($p=0.716$). However, duration per trip is large, positive and significant in the post intervention period for treated participants. This indicates that information about the Women Safety app significantly increases the participants duration of each trip by 6.4 minutes, which is a 24 percent increase in time spent on an average trip relative to the control group. Overall, these results indicate that the treatment increases the time spent on each trip, but not the number of trips, or the distance travelled per trip. This is possible if i) the respondents are combining trips or ii) changing mode of transportation.

First, we note that the treatment dummy is negative and significant ($p<0.05$) for both the number of trips (column 1) and the distance of each trip (column 2). This indicates that there were differences in mobility patterns in levels between the treated and control groups pre-intervention, through as shown previously the trends remain parallel for the two groups. While it is not clear why this is the case (we note that households were balanced on the baseline survey observables (table 1), it is important to account for these pre-intervention differences. We do not observe a similar pre-treatment effect on duration of each trip ($p=0.632$), however, indicating that our control participants took more trips that traveled greater distances on average than our treated group, but for the same duration.

The post-intervention time period dummy variable is the effect of the post treatment period, is small and insignificant for both the number of trips taken, and the distance travelled per trip in the post intervention period (albeit, in opposite direction). Interestingly, the duration per trip is negative and insignificant in the post intervention period.

Additional findings show that older participants take fewer trips ($p<0.05$), participants from wealthier households (who own land) take more trips ($p<0.05$). Married participants take the same number of trips on average but travel shorter distances on each trip. We find that participants take fewer trips on weekends ($p<0.01$) and travel shorter distances in Ramadan ($p<0.05$). We also note that our participants travel further distances and for more time at night, relative to day trips.

Table 3: Treatment effects on mobility

	(1) Total Trips Per Day	(2) Distance Per Trip	(3) Duration Per Trip
Treatment x Post Intervention	-0.1095	0.1932	6.3963**
	(0.2597)	(0.5301)	(2.6807)
Post Intervention	0.1626	-0.1794	-4.1220**
	(0.2023)	(0.3675)	(1.7711)
Treatment Group	-0.6317**	-1.4549**	-1.3123
	(0.2955)	(0.7100)	(2.7353)
Age (Years)	-0.0296*	0.0660	0.0991
	(0.0165)	(0.0400)	(0.1529)
Own Land	0.5915**	0.8315	1.5425
	(0.2979)	(0.8291)	(2.2578)
Married	0.4352	-1.5325*	-1.1550
	(0.2831)	(0.8094)	(3.1173)
Weekend	-0.2147**	-0.1022	1.9375
	(0.0846)	(0.5354)	(1.4157)
Summer	0.0053	0.0442	-0.4501
	(0.1876)	(0.2052)	(1.2945)
Ramadan	-0.1529	-0.5063**	-0.4309
	(0.1614)	(0.2332)	(1.3669)
Night Trip	-0.0830	2.9872**	9.4485***
	(0.0866)	(1.1769)	(1.7258)
Allowed Outside Alone	0.1017	-0.6796	5.2534*
	(0.3574)	(0.6653)	(2.6695)
Trust Punjab Police	0.2332	-0.2688	-1.3113
	(0.3058)	(0.7628)	(2.2606)
Constant	3.6198***	4.4135***	23.8873***
	(0.4857)	(1.1518)	(4.2716)
Mean of Dependent Variable	3.37	5.29	27.16
Observations	9226	27762	27762
R2	0.1015	0.0527	0.0219

Notes: OLS specifications with participant level clusters, robust standard errors in parentheses. * 10%, ** 5%, *** 1% significance level.

4.2 Mode of Transportation and Trip Company

We next explore how the treatment changed mode of transportation or the trip company of our participants. The idea is to examine if the women are becoming more autonomous by walking in public spaces and traveling alone. For this purpose, we use data from monthly travel diaries for our respondents. Note that, similar to the mobility data above, our travel diaries contain some attrition, with 230 participants in the beginning of data collection, but only 218 participants completing all diaries. Nevertheless, we note no systematic differences between participants with incomplete data across treatment and control groups.

Figure 3a reports the method of transport using travel diaries. From the figure we observe a marked increase in the proportion of trips walked by the treatment group (48.2%) relative to the control group (34.1%). This increase is mainly due to a decrease in private transport methods used by our participants. This suggests that the treatment is causing participants to take more trips on foot rather than rely on private transport methods. Furthermore, figure 3b reports trip companions, which we break down into four categories, trips undertake alone, with all male companions, with all female companions, and with mixed gender companions. We note a marked increase in the proportion of trips taken alone by our participants: 58.1 percent of all trips were undertaken alone by treated participants, compared to 50.2% of all trips by control participants. This suggests that the treatment increased the proportion of trips taken alone and yielded similar reductions in all other categories. This pattern of results is consistent with greater autonomy of our study participants and helps to explain the average increase in trip duration, even when the number of trips and the distance of each trip remained largely the same.

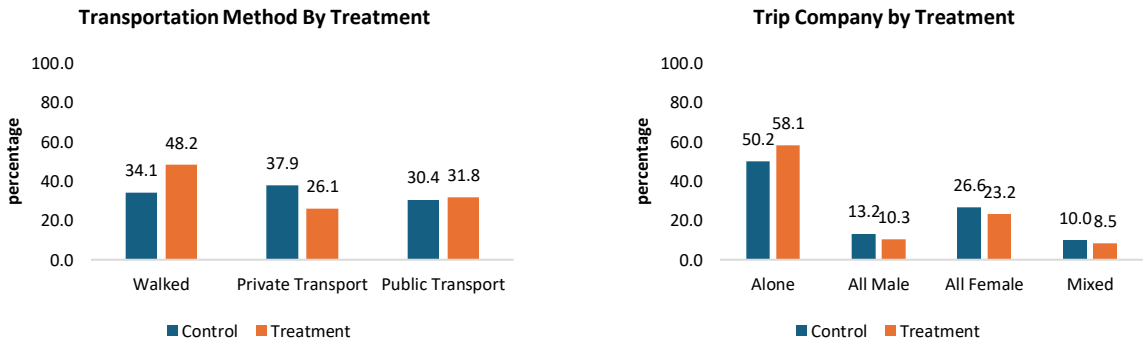


Figure 3a and 3b: Travel diary date, transportation method (a) and trip companions (b) by treatment and control groups

Table 4 below report the effect of information of Women Safety app on likelihood of walking (column 1) and taking unchaperoned trips (column 2) using linear probability models. Note that the travel diaries were only collected in the post intervention period (between June and October of 2023), and hence we cannot estimate difference in differences using the pre-intervention period. Based on questions about transportation methods asked at baseline (see table 2), we do not observe any significant differences between the treated and control group participants. Post intervention we find that treated participants' probability of walking on a given trip increases by 15.31 percentage points relative to the control ($p<0.05$). Moreover, we observe a significant increase in the likelihood of

taking a trip unaccompanied of 9.85 percentage points compared to the control ($p<0.10$). What we can say is that the increase in the duration of each trip observed in table 3 for the whole sample may be partially explained by the change in mode of transportation because of the treatment. That is, women are spending more time per trip since now they are walking more instead of using private or public transportation.

In addition, we also report some interesting correlates: walked and unaccompanied trips are less likely to occur on weekends or at night. We also find that married participants and are less likely to take unaccompanied trips, while those that report being allowed to go out alone are more likely to take unaccompanied trips. Finally, the number of trips walked and the number of unaccompanied trips also increases during the summer months.

Table 4: Treatment effects on mobility choices

	(1) Walked	(2) Alone
Treatment Group	0.1531**	0.0985*
	(0.0637)	(0.0541)
Age (Years)	0.0026	0.0021
	(0.0038)	(0.0028)
Own Land	-0.0843	-0.1117
	(0.0748)	(0.0690)
Married	0.0474	-0.1934***
	(0.0839)	(0.0666)
Weekend	-0.0847**	-0.1922***
	(0.0326)	(0.0311)
Summer	0.1641***	0.0807*
	(0.0438)	(0.0450)
Night Trip	-0.3749***	-0.4187***
	(0.0512)	(0.0536)
Allowed Outside Alone	0.0847	0.1706***
	(0.0691)	(0.0615)
Trust Punjab Police	0.0799	-0.0440
	(0.0709)	(0.0611)
Constant	0.0976	0.4665***
	(0.1051)	(0.0844)
Observations	2443	2443
R2	0.0900	0.1281

Notes: OLS specifications with participant level clusters, robust standard errors in parentheses. * 10%, ** 5%, *** 1% significance level.

5. Heterogeneity Analysis

In this section, we try to better understand what is driving our findings. One important consideration is the degree of trust participants place in the institution providing the service. In developing countries, public sector initiatives often must overcome the hurdle of weak trust, which would theoretically yield a weaker overall treatment effect. In other words, we would expect that participants that trust the institution providing a service to internalize the information about their service, while participants that do not trust the institution providing the service to ignore the information about the service. We view this as akin to complying with the treatment (a la Angrist et al. 1996). Further, we explore who are these women, that is do the results vary by mobility agency of the women. If yes, the women spending more time travelling are those who go out in routine due to commitment (work/education) or have more flexibility. For this we examine if the results vary for women who are

either not in education, employment or training (NEET) or are employed/student. Overall, we demonstrate that the results are driven by women who trust police, have the mobility agency and are NEET.

5.1 Not in Education, Employment or Training

Further, we examine if the data is driven by women who are committed to go out for their work or education or others who are not in education, employment or training (NEET). Table 8 exhibits that women who are either in education or are employed, they have no impact on extensive (column 1) or intensive margins (columns 2 & 3). On the contrary women who are NEET, despite no statistically significant increase in their number of trips (column 4), they travel farther by about 1 km per trip (column 5) and spend 6.5 minutes per trip higher compared to the control group. Therefore, the results are clearly driven by the women who do not have work or school/college commitments and perhaps have a more flexible daily schedule such that they are better placed to change their mobility patterns upon receiving information about the Women Safety App.

Table 5: Treatment effects on mobility: heterogeneity by Employment & Student.

	Employed or Student			NEET		
	(1) Total Trips Per Day	(2) Distance Per Trip	(3) Duration Per Trip	(4) Total Trips Per Day	(5) Distance Per Trip	(5) Duration Per Trip
Treatment x Post Intervention	0.2587	-0.6479	-1.0575	-0.1647	0.9811*	6.5601**
	(0.4265)	(0.5616)	(2.8833)	(0.2999)	(0.4989)	(2.7621)
Post Intervention	-0.2190	0.3747	0.7456	0.2715	-0.2719	-3.5585*
	(0.3968)	(0.3668)	(2.1734)	(0.1886)	(0.3709)	(2.0474)
Treatment	-0.5918	-0.0264	0.6798	-0.5480*	-1.2972*	-3.7847
	(0.5237)	(0.7626)	(2.8939)	(0.3295)	(0.6621)	(2.9684)
Age (Years)	-0.0154	0.2291***	0.7333**	-0.0312	0.0730*	0.1402
	(0.0235)	(0.0533)	(0.3231)	(0.0208)	(0.0438)	(0.1434)
Own Land	0.4241	-0.0508	5.5847**	0.7464*	1.2981	-0.1626
	(0.3693)	(0.5678)	(2.5358)	(0.4057)	(0.8512)	(1.9399)
Married	-0.4307	-3.8540***	4.8972	0.5021	0.1779	-0.1760
	(0.3040)	(0.8130)	(4.9224)	(0.4800)	(0.6399)	(3.6039)
Weekend	-0.1011	0.2062	3.9715**	-0.2730**	-0.2185	1.3788
	(0.0809)	(0.4114)	(1.6789)	(0.1131)	(0.7215)	(1.7585)
Summer	-0.1018	-0.5345	1.9419	0.0312	0.1625	-0.1907
	(0.1508)	(0.3899)	(2.5568)	(0.2533)	(0.3208)	(1.0465)
Ramadan	0.1590	-0.4644	-2.1180	-0.2879	-0.4922	-0.5535
	(0.1838)	(0.3619)	(1.3706)	(0.2057)	(0.2999)	(1.6597)
Night Trip	-0.0533	1.2872***	3.7673	-0.0115	4.2236**	11.5978***
	(0.0960)	(0.4481)	(2.5038)	(0.1773)	(1.7903)	(1.7391)
Allowed Outside Alone	0.3807	-2.7820***	2.3314	0.2807	1.1424	-1.6343
	(0.3453)	(0.6263)	(3.7959)	(0.3469)	(0.8614)	(2.0707)
Trust Punjab Police	0.6640	-1.6640**	1.9616	0.0372	-1.3528	3.5006
	(0.5666)	(0.7579)	(4.0607)	(0.5317)	(0.9571)	(2.8912)
Constant	2.9840***	2.4535*	8.6606	3.5856***	1.8017	21.7280***
	(0.7128)	(1.3397)	(7.1800)	(0.6310)	(1.4476)	(5.0432)
Observations	3145	8596	8596	6081	19166	19166
R2	0.0498	0.1833	0.0299	0.1314	0.0711	0.0201

Notes: OLS specifications with participant level clusters, robust standard errors in parentheses. * 10%, ** 5%, *** 1% significance level.

Moreover, the NEET women have 17 percentage points higher probability of taking a trip by walking and 16 percentage point higher probability of taking unchaperoned trip. However, the effect of the intervention is statistically insignificant for women who are employed or are students. Literature on female mobility using time-use data argues that Indian and Pakistani women mostly leave their dwelling for 'instrumental' reasons such as paid/unpaid work or education in contrast to 'substantive' mobility which is defined as movement in spaces for leisure that is not tied to any paid/unpaid work (Srivastava and Aftab, 2024). The concentration of the effect on women who are not just going out for work or going to school/university, suggests that these women may not be going out of compulsion of their pre-committed schedules.

Table 6: Impact on probability to take walking and unchaperoned trips by Employment & Student

	Employed or Student		NEET	
	(1)	(2)	(3)	(4)
	Walked	Unaccompanied	Walked	Unaccompanied
Treatment Group	0.0844	0.0132	0.1756**	0.1642**
	(0.0899)	(0.0828)	(0.0778)	(0.0646)
Age (Years)	-0.0097*	-0.0029	0.0020	0.0042
	(0.0053)	(0.0049)	(0.0047)	(0.0036)
Own Land	0.0558	-0.0348	-0.1513	-0.1619*
	(0.1145)	(0.1027)	(0.0980)	(0.0858)
Married	0.2885*	0.0054	-0.0345	-0.2014**
	(0.1641)	(0.1338)	(0.0952)	(0.0794)
Weekend	-0.0249	-0.1943***	-0.1249***	-0.1700***
	(0.0449)	(0.0474)	(0.0406)	(0.0387)
Summer	0.1026	0.0206	0.1849***	0.1118**
	(0.0714)	(0.0787)	(0.0523)	(0.0544)
Night Trip	-0.4868***	-0.2897*	-0.3806***	-0.3720***
	(0.1818)	(0.1482)	(0.0615)	(0.0567)
Allowed Outside Alone	0.0672	0.1713**	0.1108	0.1832**
	(0.0962)	(0.0855)	(0.0924)	(0.0773)
Trust Punjab Police	0.0487	-0.1299	0.0754	0.0306
	(0.1141)	(0.1019)	(0.0872)	(0.0750)
Constant	0.3532**	0.6727***	0.2010	0.2817**
	(0.1419)	(0.1326)	(0.1830)	(0.1277)
Observations	931	931	1512	1512
R^2	0.0691	0.0712	0.1210	0.1664

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Overall, our results are consistent with information about the Women Safety App increasing female autonomy over their own transportation choices. We find strong evidence that information about the Women Safety App changes mobility patterns of working age women in an urban center of a developing country with a history of gender-based violence. Results indicate that women, knowing they can reach out for immediate help through their phones, increase the duration of trips taken, and increase the proportion of trips walked. These results are driven by women who reported trusting the police at baseline, which we view as those participants who are likely to comply with the treatment. These participants take fewer but longer trips, are more likely to walk, and (most importantly) are

more likely to travel unaccompanied. We also find evidence that the increase in the proportion of trips walked and taken unaccompanied occurs mostly in households where participants were allowed to travel alone at baseline.

5.2 Mobility Agency

An additional point on the effect of treatment on female autonomy is to understand whether the treatment influenced mobility patterns for participants that reported not being able to travel unaccompanied at baseline. For these participants, traveling alone is typically not permitted in their household for a variety of reasons, most significantly social and cultural norms. For these participants information regarding the Women Safety App may not result in increased unaccompanied trips as it is not safety per se, but patriarchal norms (perhaps disguised in the garb of the excuse of safety) that limit their mobility.

Table 7 reports the heterogeneous results on the impact of Women Safety App on female mobility by participants reporting to have mobility agency or not. Mobility agency is if the women is allowed to go outside home alone. Note that the results are driven by women who have the mobility agency, that is women who are not allowed to go on their own, the Women Safety App does not affect their mobility patterns. Instead, women who have the mobility agency, their distance per trip increases by 1.1 km per trip and duration increases by 10 minutes per trip. This provides strong evidence in favor of the argument that while information treatment increases female autonomy over their transportation choices in households where the permission to travel alone is already provided. However, the information may not easily change patriarchal attitudes, and therefore not manifest in increased mobility of participants not allowed to go out alone in the first place.

Table 7: Treatment effects on the number of trips taken alone, by mobility agency.

	With Mobility Agency			No Mobility Agency		
	(1) Total Trips Per Day	(2) Distance Per Trip	(3) Duration Per Trip	(4) Total Trips Per Day	(5) Distance Per Trip	(5) Duration Per Trip
Treatment x Post Intervention	0.0923	1.1262*	10.4339***	-0.5484*	-1.1293*	3.0194
	(0.3958)	(0.6056)	(3.3212)	(0.3200)	(0.5711)	(2.1588)
Post Intervention	0.1738	-0.8647*	-8.2355***	0.0966	0.4269	-1.0497
	(0.3450)	(0.4504)	(2.4009)	(0.2067)	(0.4705)	(1.5944)
Treatment	-0.5287	-2.2089***	-6.1911*	-0.6379*	-0.8293	1.0264
	(0.4449)	(0.7231)	(3.5295)	(0.3400)	(1.0278)	(3.3288)
Age (Years)	-0.0182	0.0254	-0.0918	-0.0215	0.0682	0.0863
	(0.0195)	(0.0310)	(0.1567)	(0.0291)	(0.0555)	(0.2019)
Own Land	0.3780	-0.5677	1.2540	1.2799***	1.3837	-1.1215
	(0.4525)	(0.5018)	(3.2210)	(0.3059)	(1.0561)	(2.9260)
Married	-0.0070	-1.6261**	5.2321	0.9907***	0.4506	-7.0558*
	(0.4059)	(0.7674)	(3.6984)	(0.3581)	(1.3982)	(3.7264)
Weekend	-0.1986*	0.2854	3.2735**	-0.2582**	-0.5627	0.7435
	(0.1110)	(0.2560)	(1.2437)	(0.1267)	(0.9995)	(2.3910)
Summer	0.0303	0.0529	0.1645	-0.0824	-0.4196	-0.6716
	(0.1848)	(0.2663)	(2.2584)	(0.2990)	(0.4278)	(1.3154)
Ramadan	-0.2234	-0.6088*	-2.0003	0.0075	-0.5202	0.9951
	(0.2347)	(0.3217)	(1.9398)	(0.2047)	(0.3577)	(1.6660)
Night Trip	0.0434	1.6903***	9.6110***	-0.1616	4.4328**	7.5732**
	(0.0952)	(0.5952)	(2.0841)	(0.1536)	(1.9525)	(2.9886)

Trust Punjab Police	0.4067	-1.8977***	-4.8763	0.0841	1.5127	0.7331
	(0.3239)	(0.5245)	(3.1236)	(0.3549)	(1.2696)	(3.1163)
	(0.3239)	(0.5245)	(3.1236)	(0.3549)	(1.2696)	(3.1163)
Constant	3.4373***	6.8292***	36.6420***	2.9182***	1.3173	27.6274***
	(0.8758)	(1.0718)	(5.2999)	(0.5697)	(1.7413)	(3.5005)
Observations	5135	14428	14428	4091	13334	13334
R2	0.0534	0.0963	0.0200	0.1915	0.0868	0.0230

Notes: OLS specifications with participant level clusters, robust standard errors in parentheses. * 10%, ** 5%, *** 1% significance level

Table 8 reports the impact on mode of transportation and trip company by mobility agency. Note that the effect on mode of transportation does not vary by mobility agency, it remains significant for both. On the contrary, the probability to have an unaccompanied trip increase by 11 percentage points only for women who already had the agency to go out alone. Instead, women who never had the mobility agency, the Women Safety App has no significant impact on their autonomy of transportation choices.

Table 8: Impact on probability to take walking and unchaperoned trips by Employment & Student

	With Mobility Agency		No Mobility Agency	
	(1)	(2)	(3)	(4)
	Walked	Unaccompanied	Walked	Unaccompanied
Treatment Group	0.1514*	0.1099*	0.1918**	0.0515
	(0.0777)	(0.0658)	(0.0926)	(0.0971)
Age (Years)	0.0034	0.0003	0.0027	0.0069*
	(0.0042)	(0.0035)	(0.0085)	(0.0035)
Own Land	-0.0839	-0.1559*	-0.0623	-0.0434
	(0.0891)	(0.0882)	(0.1367)	(0.0942)
Married	0.0007	-0.1711**	0.1261	-0.2407***
	(0.1029)	(0.0864)	(0.1699)	(0.0903)
Weekend	-0.0715*	-0.1785***	-0.1280**	-0.2086***
	(0.0362)	(0.0349)	(0.0617)	(0.0584)
Summer	0.1915***	0.0829	0.1165	0.0638
	(0.0523)	(0.0513)	(0.0772)	(0.0864)
Night Trip	-0.3200***	-0.4734***	-0.4133***	-0.2686***
	(0.0725)	(0.0578)	(0.0865)	(0.0901)
Trust Punjab Police	0.1600*	0.6739***	-0.0700	0.3522***
	(0.0893)	(0.1159)	(0.0997)	(0.1206)
Constant	0.1361	1632	0.1179	811
	(0.1379)	0.1064	(0.2064)	0.0912
Observations	1632	0.1099*	811	0.0515
R^2	0.0943	(0.0658)	0.0988	(0.0971)

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5.3 Trust in Police

To account for this, prior to the intervention (i.e. at baseline) we asked our participants whether they trust the institution (i.e. the police) providing the service as a simple yes/no question. We note that disaggregating by those that report trusting the police at baseline constitutes a form of a local average treatment effect (LATE), as those participants are the ones who are more likely to be receptive of the

intervention, while those that report not trusting the police are more likely to ignore the effect of the treatment (Angrist et al., 1996; Angrist, 2004). Hence, in table 3 we report difference-in-difference estimates of participants that report that they trust the police at baseline (31.4% of the sample, models 1-3) and those that do not (models 4-6).

We find that participants that report trusting the police at baseline take one fewer trip per day on average (model 1 coefficient on the treatment and post intervention period interaction: $p<0.01$), and each trip took 15 minutes longer on average ($p<0.01$), but the distance travelled remained the same ($p=0.136$). Moreover, we also observe a significant increase of half a trip among participants reporting not trusting the police at baseline. In percentage terms, participants that report trusting the police take 29 percent fewer trips but show a 58 percent increase in the duration of each trip.

Table 9: Treatment effects on mobility: heterogeneity by trust in the police.

	Trust Police			Do Not Trust Police		
	(1) Total Trips Per Day	(2) Distance Per Trip	(3) Duration Per Trip	(4) Total Trips Per Day	(5) Distance Per Trip	(5) Duration Per Trip
Treatment x Post Intervention	-1.0715***	0.7922	14.9038***	0.5423*	-0.2809	-2.1482
	(0.2468)	(0.5208)	(2.5438)	(0.2894)	(0.5023)	(3.2601)
Post Intervention	0.7993***	-0.9606***	-8.2234***	-0.1346	0.2720	-0.5125
	(0.1496)	(0.3199)	(1.8462)	(0.2034)	(0.2977)	(1.5539)
Treatment	-0.3921	-2.7939***	-3.4446	-0.6177**	-0.5828	-0.6088
	(0.3770)	(0.5488)	(3.9334)	(0.3040)	(0.7303)	(3.3382)
Age (Years)	-0.0789***	-0.0733	-0.0663	-0.0050	0.0570**	0.0791
	(0.0246)	(0.0513)	(0.1557)	(0.0185)	(0.0271)	(0.1642)
Own Land	0.4503	2.4173***	2.2673	1.0689***	-0.6593	-0.8977
	(0.3454)	(0.6961)	(2.9594)	(0.3875)	(0.4830)	(3.1588)
Married	0.9228**	1.5743*	3.2288	-0.2071	-2.8005***	-0.9005
	(0.3639)	(0.7982)	(3.1295)	(0.3805)	(0.6703)	(3.9876)
Weekend	-0.1322	-0.5082	1.6631	-0.2454**	0.1533	1.8199
	(0.1179)	(1.2127)	(2.8639)	(0.1067)	(0.2533)	(1.2570)
Summer	0.1109	-0.1884	1.2027	-0.0825	-0.2176	-2.5258*
	(0.2994)	(0.4552)	(2.0814)	(0.1826)	(0.2734)	(1.3674)
Ramadan	-0.0024	-0.5074	-1.0138	-0.1917	-0.7819***	-0.8361
	(0.2680)	(0.4228)	(1.8833)	(0.1472)	(0.2690)	(1.7157)
Night Trip	-0.0880	2.6643	8.8560***	-0.1594	2.2094***	8.4303***
	(0.1512)	(1.7908)	(2.1042)	(0.1063)	(0.4374)	(2.8609)
Allowed Outside Alone	0.4895	-0.9382	2.9750	-0.6387	0.1561	10.5489***
	(0.4194)	(0.7546)	(3.5706)	(0.4007)	(0.6745)	(3.9543)
Constant	4.6569***	6.9063***	26.7869***	3.6466***	5.2391***	22.2995***
	(0.8068)	(1.3735)	(4.5834)	(0.5154)	(0.7773)	(3.7913)
Observations	4004	12566	12566	5222	15196	15196
R2	0.1454	0.1327	0.0289	0.1319	0.0961	0.0302

Notes: OLS specifications with participant level clusters, robust standard errors in parentheses. * 10%, ** 5%, *** 1% significance level

Overall, the above analysis demonstrates that information about the Women Safety App changes participant mobility patterns, though in unexpected ways: The intervention does not change the distance travelled, and in fact, reduces the number of trips our participants take (specifically for those that report trusting the institution). However, in line with expectations, the duration of each trip does increase, and especially amongst those participants that report trusting the police.

Finally, table 5 reports local average treatment effects (LATE) on participants that report trusting the police at baseline, similar to the analysis reported in table 4 above. Models 1 and 2 estimate the effect of the treatment on trips walked (model 1) and trips taken unaccompanied (model 2). Models 3 and 4 report the results for participants reporting not trusting the police at baseline. We find clear evidence that the treatment increases the proportion of unaccompanied trips for treated participants that report trusting the police ($p<0.01$). Treated participants from the subgroup that trust the police are 25.5 percentage points more likely to take a trip unaccompanied. By contrast, we find little to no effect of the treatment on unaccompanied trips of participants that do not trust the police ($p=0.491$). This indicates that trusting participants are more likely to take trips alone when are informed about the Women Safety App. Interestingly, trips walked increase among both trusting and untrusting participants ($p<0.10$ in both cases).

Table 10: Impact on probability to take walking and unchaperoned trips by trust in police.

	Trust Police		Do Not Trust Police	
	(1)	(2)	(3)	(4)
	Walked	Alone	Walked	Alone
Treatment	0.1962*	0.2552***	0.1531**	0.0456
	(0.1085)	(0.0834)	(0.0735)	(0.0661)
Age (Years)	-0.0043	-0.0049	0.0061	0.0048
	(0.0069)	(0.0055)	(0.0042)	(0.0032)
Household Wealth Index	-0.0044	-0.0208	-0.1259	-0.1571*
	(0.1084)	(0.0935)	(0.0919)	(0.0920)
Married	0.0077	-0.1421	0.0640	-0.2090**
	(0.1551)	(0.1179)	(0.0998)	(0.0818)
Weekend	-0.0424	-0.1301**	-0.1178***	-0.2263***
	(0.0655)	(0.0547)	(0.0332)	(0.0352)
Summer	0.1874***	0.0535	0.1404***	0.0830
	(0.0691)	(0.0668)	(0.0535)	(0.0566)
Night Trip	-0.2776**	-0.0592	-0.3831***	-0.4225***
	(0.1152)	(0.0988)	(0.0548)	(0.0605)
Allowed Outside Alone	0.2484**	0.3181***	-0.0116	0.0974
	(0.1153)	(0.0845)	(0.0731)	(0.0761)
Constant	0.2486	0.4186***	0.0667	0.4729***
	(0.1876)	(0.1565)	(0.1179)	(0.0925)
Observations	778	778	1665	1665
R^2	0.1360	0.2004	0.1012	0.1325

Notes: OLS specifications with participant level clusters, robust standard errors in parentheses. * 10%, ** 5%, *** 1% significance level

6. Conclusion

To the best of our knowledge, we provide the first evidence on the effect of information about safety initiatives targeting women, on female mobility and autonomy in transport choice. The results show that providing information to female participants on resources available that preserve their safety in public spaces leads to increased female autonomy. We find clear evidence for the effect of treatment on the duration traveled for each trip, with participants spending 6.4 minutes more per trip relative to the control. Assuming an average of 3 trips taken per day, this amounts to an additional 19.2 minutes spent outside the home. Furthermore, we also find increases in the proportion of trips walked, and the proportion of trips taken alone and we demonstrate that these results are driven by participants that report trust in the police. We also show that the effect on trips taken alone is concentrated

among households that allow participants to take trips alone at baseline, indicating that the intervention is better placed to change safety perceptions of households which already practice female autonomy. Administrative data from the Punjab police shows that no participant actually ever had to use the alert button or service. The effects are entirely driven by the knowledge of the existence of the app and its features.

Our results have important implications for increasing female mobility and enabling greater mobility agency in developing countries. The change in transport choice towards walking, and of taking trips unaccompanied is remarkable and gives women space and agency. Furthermore, it reduces their dependency on male family members to escort them. We recognize that spaces are not static sites, but are animated by history, location, presence of other people, time of the day etc.– and therefore, inclusivity, access, and safety are dynamically produced and reproduced through space, and negotiated in tandem with other people (Beebeejaun, 2017). In such an environment, the Women Safety app allows women to renegotiate their right to the public space: as more and more women find their neighborhoods safe enough to walk alone the gender-space dialectic will slowly change to accommodate the new norm.

In a patriarchal society like Pakistan patriarchal control is largely expressed in terms of spaces and times that female bodies can inhabit particular spaces. Within this discourse, female presence in public spaces has mostly been framed as an issue of safety, but rather, in practice, we can see that it is an expression of patriarchal norms. As Kavita Krishnan shows in her work, restrictions on women's freedom are often legitimized as ways of keeping them 'safe', whereas "it is actually the opposite, that the restrictions on women's freedoms are themselves perhaps the most widespread form of gender-based violence in South Asia" (Krishnan 2020).

In such an environment the Women Safety App gives women the opportunity to escape such confines/restrictions in the name of safety. It has been argued that both home and work/education spaces are characterized by surveillance and monitoring; Sidra Kamran focuses on the "in-betweenness" of private and public: how girls stretch their time between the two to steal moments of leisure (Kamran, 2021). We document an important way to achieve exactly this: to stretch their travel time, an opportunity to meet other women and enjoy their time from the home.

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