An Application of the List Experiment to Estimate Abortion Prevalence in Karachi, Pakistan

CONTEXT: *Abortion is particularly difficult to measure, especially in legally restrictive settings such as Pakistan. The List Experiment—a technique for measuring sensitive health behaviors indirectly—may minimize respondents' underreporting of abortion due to stigma or legal restrictions, but has not been previously applied to estimate abortion prevalence in Pakistan.*

METHODS: *A sample of 4,159 married women of reproductive age were recruited from two communities of Karachi in 2018. Participants completed a survey that included a double list experiment to measure lifetime abortion prevalence, as well as direct questions about abortion and other background characteristics. Data were used to calculate direct and indirect estimates of abortion prevalence for the overall sample and by sociodemographic characteristics, as well as to test for a design effect. Regression analyses were conducted to examine associations between characteristics and abortion reporting from direct questioning and the list experiment.*

RESULTS: *The estimate of abortion prevalence from the list experiment was 16%; the estimate from the direct question was 8%. No evidence of a design effect was found. Abortion reporting was associated with most selected characteristics in the regression model for direct questioning, but with few in the list experiment models.*

CONCLUSIONS: *That the estimate of abortion prevalence in Karachi generated from the list experiment was twice that generated from direct questioning suggests that the indirect method reduced underreporting, and may have utility to estimate abortion in similar settings and to improve the accuracy of data collecting for other sensitive health topics.*

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By Sarah Huber-Krum, Kristy Hackett, Navdep Kaur, Sidrah Nausheen, Sajid Soofi, David Canning and Iqbal Shah

Sarah Huber-Krum and Kristy Hackett are research associates, Navdep Kaur is data manager, David Canning is professor and Iqbal Shah is principal research scientist–all with Harvard T.H. Chan School of Public Health, Cambridge, MA, USA. Sidrah Nausheen and Sajid Soofi are assistant professors–both with Aga Khan University, Karachi, Pakistan.

Underreporting of sensitive and stigmatized health information, such as sexual and reproductive health behaviors, poses significant challenges to both research and health service delivery.[1,2] The prevalence of induced abortion, in particular, is difficult to measure accurately.[3–5] In contexts in which abortion is legally restricted or highly stigmatized, abortion services–if available–may not be recorded by facilities or providers, and women may seek clandestine services outside of the formal health care sector and may not seek postabortion care (PAC) for complications of unsafe procedures. Additionally, women are likely to underreport abortions in surveys.[4] Consequently, abortion estimates in such settings tend to be unavailable or unreliable, making it difficult to develop appropriate and responsive evidenced-based policies and programs.

Researchers have developed numerous methodologies to measure abortion behaviors. Direct methods include surveying women to obtain their self-reports and surveying known abortion providers. Direct measurement using women's self-report is particularly advantageous because it allows for estimation among subgroups–for example, by race or ethnicity, age and marital status–and for examination of abortion in the context of other health data.[6] However, direct questioning is subject to substantial underreporting–up to 70%, depending on the social context and women's characteristics–resulting in biased estimates.[4,6] Further, self-report is susceptible to misreporting and social desirability bias.[6]

Indirect methods of abortion measurement have been designed to address the limitations of direct reports and to allow for the respondent's privacy to be protected. Indirect measurement methods–such as the Abortion Incidence Complication Method (AICM), the Anonymous Third Party Reporting Method (ATPR), the Best Friend Method (an adaptation of the ATPR), the Confidante Approach, the Randomized Response Technique (RRT), the Secret Ballot Method and the Network Scale-up Method–tend to result in more valid estimates than self-reporting.[7,8] However, each method has limitations. For example, the AICM is a robust estimation method based on the level of PAC services provision, but requires a high degree of survey completeness among abortion-providing health facilities and a sufficient number of key informants who are highly knowledgeable about abortion provision in the setting. The Best Friend Method, which asks women to report on the behaviors of their friends, may result in underreporting because women may not tell their friends about their abortions. In a U.S.-based study, only 51% of women seeking abortion had told a friend.[9] RRT requires a high level of literacy among respondents and correct use of a randomization tool. The Secret Ballot Method requires extensive time and that participants be literate. In addition,

few of these methods provide information about the characteristics of the women who have abortions.

The List Experiment—also known as the Item-Count Technique—is another indirect method, which is used to measure stigmatized behavior while maintaining participant privacy and reducing the tendency to underreport. In list experiments to measure abortion, women are randomly selected into either a treatment or control group. Each group is presented with a list of 4–5 statements typically related to other, nonsensitive health events (e.g., "I have had a tuberculosis test"); of the items on the treatment list, one will be related to abortion. Rather than have women answer any specific questions, they are asked to report their total number of positive responses to the items on the list. Induced abortion incidence is calculated by taking the difference between the mean number of items reported by the treatment and control groups. This approach reduces underreporting and social desirability bias by ensuring that the interviewer does not know whether a respondent has experienced an abortion.[10] Further, embedding the list experiment into existing surveys requires limited additional enumerator training and costs.[11] Despite the potential benefits, the list experiment cannot measure women's experience of multiple abortions and does not allow for additional follow-up, such as whether the abortion was safe.

In the last five years, list experiments have been used to measure a range of abortion-related data, including prevalence of abortion and self-managed abortion in the United States;[12,13] abortion incidence or prevalence in Ghana,[14] India,[15] Iran[16] and Liberia;[17,18] and prevalence of sex-selective abortion in Vietnam.[19] However, reliability of these estimates is mixed.[15,20,21] In 2015, an application of the list experiment in Liberia resulted in a lifetime prevalence 26 percentage points higher than the most recent estimate obtained through direct reporting in the country's 2007 Demographic and Health Survey (DHS).[17] A year later, a pilot study in the United States reported a lifetime abortion prevalence estimate of 22% using the list experiment, compared with 18% using a direct question.[12] In 2019, another study in the United States found that the estimated proportion of women who had ever attempted to end an unwanted pregnancy on their own produced by the list experiment was almost five times larger than that obtained by direct questioning.[13] These studies suggest that the list experiment may reduce underreporting of abortion behaviors in comparison to direct questioning.

Employing the list experiment method does not guarantee increased reporting or greater accuracy, however. According to a 2018 multimethod study in Iran, the estimated abortion prevalence was found to be 12% using the list experiment and 14% using the RRT; the estimates were not significantly different from each other but were substantially higher than previous estimates obtained using direct methods. A 2019 study in India found that the proportion of women who had ever had an abortion was 1.8% using the list experiment, compared with 3.5% among the same sample via a direct question.[15] Most recently, a study in Ghana that compared five methods of abortion measurement, including a list experiment, found that the abortion list estimates were unreliable and did not outperform other indirect methods.[14] In addition to the mixed results in estimation, only one study has used multivariable regression analysis to assess sociodemographic correlates of abortion reporting in a list experiment.[18]

Considering the limitations of recent abortion estimates, in this study we tested the list experiment as a new method for measuring lifetime abortion prevalence in Karachi, Pakistan—where abortion is legally restricted and highly stigmatized, and abortion data are limited. We conducted our list experiment using a large, representative survey of reproductive-age women in two communities in Karachi with the aim of generating more reliable estimates of lifetime abortion prevalence. We compared list experiment estimates to a direct measure captured within the same sample to gauge the validity of the estimate. Reliable abortion estimates could be helpful for policies and programs in Pakistan.

Given the novelty of the list experiment in the abortion measurement literature, we also tested for a design effect and conducted multivariable regression. A design effect occurs if the number of control items reported depends on whether the list includes the abortion-related item.[22,23] For example, a participant who is presented with the list containing the abortion-related item intentionally responds that she has only experienced one item on the list; however, in truth she has experienced two. In this example, the list experiment did not meet the assumption of no design effect. We conducted multivariable regression analyses using list-experiment and direct-question data to understand the relationship between women's background characteristics and reports of lifetime abortion history, and to compare and contrast results.

Abortion in Pakistan

In Pakistan, low modern contraceptive use (25% among married women) and high levels of unmet need (17% among married women) put women at risk of unintended pregnancy and abortion.[24] Current law permits abortion to save the woman's life, and to protect her physical and mental health, as well as early in pregnancy to provide "necessary treatment;" however, the vagueness of these legal grounds may lead to their being misinterpreted and inconsistently implemented. In addition, abortion is not permitted in cases of rape, incest or fetal impairment; for economic or social reasons; or on request. Consequently, many women resort to unsafe procedures,[25] which contributes to the country's high maternal mortality rate. In 2015–2016, there were 247 deaths per 100,000 live births, and about 6% of maternal deaths resulted from complications of unsafe abortion.[24,26]

Pakistan has no comprehensive reporting system for abortion service provision, and women are reluctant to report induced abortions.[27,28] The most recent estimate of

the national abortion rate—calculated in 2012 using the AICM—was 50 abortions per 1,000 women of reproductive age.[29] This rate may be an underestimate, however, because the AICM relies on perceptions of knowledgeable informants. Misoprostol is widely available in Pakistan, and although the extent of its off-label use as an abortifacient and of its availability in 2012 are unknown, researchers and physicians presume it is widely used in urban settings such as Karachi.[30] As a result, underestimation may occur because knowledgeable informants may be less likely to know about uncomplicated abortions that did not receive facility-based treatment.[31] Further, this abortion estimate is outdated. Given the possible increases in availability of misoprostol, in access to abortion information via social media and other outlets, and in activity of organizations providing education regarding safe abortion, we would expect that abortion rates have increased since 2012.

Other small-scale, community-based studies have attempted to measure abortion prevalence in Pakistan.[32] A 2012 study in Karachi found that about 15% of lifetime total pregnancies ended in induced abortion, although women who had abortions were purposively selected and abortion prevalence could not be established.[28] Despite the limitations of these smaller studies, the findings suggest a high prevalence of induced abortion in Pakistan despite it being legally restricted.

METHODS

Study Design and Sampling

As part of an independent impact evaluation of the Willows International Reproductive Health Program (Willows program), we conducted a cross-sectional household survey in two communities located in Karachi from February to May 2018. The Willows program was a contraceptive counseling and education intervention implemented in Ghana, Pakistan, Tanzania and Turkey between 2018 and 2020. The focus of the larger parent study was to evaluate the effectiveness of this program on contraceptive outcomes; however, we were also interested in understanding the prevalence of abortion to provide a more complete picture of how women regulate their fertility in the study communities.

In Pakistan, the intervention was carried out in four union councils in Jamshed Town, Karachi. The intervention sites were selected in consultation with local health authorities, based on community need for family planning services. Typically, sites were densely populated areas with low modern contraceptive use despite widespread availability of family planning services at nearby health facilities. The comparison site was Yousuf Goth, Karachi, and was selected in consultation with Willows International. It was chosen primarily on the basis of having similar demographics of women in the intervention site of Jamshed Town (similar socioeconomic status, population size, ethnicity, languages spoken and religion). Neither the intervention nor comparison site had a previous or ongoing community-based family planning intervention by any organization.

We used geographic information system mapping to demarcate boundaries for the intervention site and the comparison site, and to construct study clusters containing approximately 80 households each, on average. Of the 282 clusters in the intervention site and 197 clusters in the comparison site, 105 and 97 were randomly selected, respectively. In each selected cluster, we conducted a complete household listing and administered a short questionnaire to identify eligible women. All married women between the ages of 16–44 were eligible for the study; we chose not to include 15-year-olds in the sample because, in Pakistan, 16 is both the age of consent and the legal minimum age of marriage for females. We randomly sampled 25 eligible women in each cluster with a target sample of 2,000 women per study arm. If more than one eligible woman lived in a household, we randomly selected one to participate in the study. In total, 5,245 women were eligible for the survey, and 4,205 women participated (80%).

Karachi is located in Sindh province. Compared with women throughout the urban areas of Sindh province, women in our study sample tended to be less educated (58% of married women in our sample had primary education or less vs. 46% of ever-married women in urban Sindh province), and slightly larger proportions used traditional contraceptive methods (18% vs. 11%) and modern methods (39% vs. 24%);[24] however, our sample was similar in terms of the proportion of women currently employed (14% vs. 15%). Compared with national estimates, a smaller proportion of our study sample had large families (18% vs. 29% had had at least five children) and a greater proportion was in the middle wealth quintile (38% vs. 20%). In addition, women in our sample tended to be younger; however, our sample consisted of women aged 16–44, whereas the 2017–2018 Pakistan DHS included women aged 15–49).[24]

Data Collection

The survey was administered by female enumerators who had completed their bachelor's degree. They received two weeks of training led by senior researchers at the Aga Khan University and Harvard University that covered interviewing techniques, survey content, specific questions and ethical considerations. The enumerators also met weekly with the research team throughout data collection to review data entry errors and receive refresher training when needed.

In most cases, participants were interviewed in the privacy of their home. If a private room was not available in the home, the survey was conducted wherever the participant was most comfortable, typically, an outdoor location nearby, so long as privacy could be maintained. To ensure privacy, enumerators explained to family members and neighbors who were present that they needed to talk with the respondent alone. In some cases, enumerators scheduled a return visit for a later date when privacy could be ensured; however, if a participant preferred to be interviewed in the presence of a family member, we respected this preference.

We developed the study instrument in English first, using language from the DHS. One of our coauthors, who is an obstetrician-gynecologist in Karachi, provided guidance on the appropriate phrasing of the abortion-related questions in Urdu, the local language. The field team piloted the Urdu questionnaire on three separate days in different communities in Karachi to ensure comprehension of the questions; no changes were made to the abortion-related questions in response to the pilot testing.

We collected data through a survey conducted on an electronic tablet, which we programmed to randomly split respondents into two groups for the list experiment. We used a double list experiment to measure lifetime prevalence of abortion.[33] This method was used because it helps minimize bias and variance, increases the analytical power for a given sample size, could be easily integrated into our baseline survey and did not require additional extensive training for enumerators. In the double list experiment, the interviewer read aloud to both groups of respondents two lists of nonsensitive health items, referred to as List A and List B (Table 1); the abortion-related item was randomly added to either list (i.e., the treatment list) and the other list was left in its original form (i.e., the control list). Thus, each participant received one treatment list and one control list, and each group served as the control for the other. After hearing each list read aloud, participants stated only the total number of items they had experienced.

Later in the survey, we asked women direct questions about their abortion-seeking behaviors. This sequencing ensured that direct questions did not impact responses to the list experiment. In addition, we asked women about their background characteristics. Interviews lasted 60–90 minutes. Women who consented to participate were provided nonmonetary compensation (e.g., soap or a tea mug) for their time in accordance with local customs and norms.

The study protocol was approved by the Ethical Review Committee at Aga Khan University and by the Institutional Review Board at Harvard University.

TABLE 1. Items used in a double list experiment to measure abortion prevalence among married women of reproductive age, Karachi, Pakistan, 2018

List A	List B
Control	**Treatment**
I have heard of an illness called polio	I have heard of an illness called polio
I have received a medical injection in the past 2 years	I have received a medical injection in the past 2 years
I have ever smoked cigarettes	I have ever smoked cigarettes
I had malaria as a child	I had malaria as a child
	I have had an induced abortion (ended a pregnancy on purpose)
Treatment	**Control**
I have had a cold in the last year	I have had a cold in the last year
I have heard of an illness called diabetes (high blood sugar)	I have heard of an illness called diabetes (high blood sugar)
I know someone who has told me they have high blood pressure	I know someone who has told me they have high blood pressure
I have been diagnosed with cancer	I have been diagnosed with cancer
I have had an induced abortion (ended a pregnancy on purpose)	

Measures

• *List experiment.* The sensitive item used for our double list experiment regarded participants' lifetime abortion history. The statement read, "I have had an induced abortion (ended a pregnancy on purpose)." The other statements on the two lists regarded nonsensitive health issues: for example, "I have had a cold in the last year" and "I have ever smoked cigarettes." Items were deliberately chosen to be positively correlated with one another; for any item on one list that a respondent would have experienced, there was a corresponding item on the other list that would also be true for that respondent.[33] To limit extreme values, items within a list were negatively correlated with one another.

• *Abortion-seeking behavior.* We asked all women, regardless of their response to any other question about pregnancy, "Have you ever had a pregnancy that miscarried, was aborted, or ended in a stillbirth?" If the response was yes, we asked, "How many pregnancies were terminated by induced abortion (intentional termination of pregnancy)?" Women could respond "don't know" or refuse to answer the question.

• *Background characteristics.* The survey included categorical variables for age (16–19, 20–24, 25–29, 30–34, 35–39 and 40–44), education (no education, primary, middle, secondary and higher), ethnicity (Urdu speaking, Sindhi, Punjabi and other), age at first marriage (younger than 20, 20–24, 25–29 and 30 or older) and number of lifetime births (0, 1, 2, 3 and 4 or more). In addition, wealth was measured as a categorical variable containing three levels: lowest (poor and poorest combined), middle and highest (rich and richer combined). Also, religion was a dichotomous variable of Islam or another religion.

Furthermore, we included a dichotomous variable of lifetime modern contraceptive use. Respondents were asked, "Have you ever used anything or tried in any way to delay or avoid getting pregnant?" If they responded yes, they were asked to specify the methods they had ever used. Response options included male and female sterilization, the IUD, the injectable, the implant, the pill, male and female condoms, emergency contraceptives, lactational amenorrhea method, calendar or rhythm method, withdrawal, no method, other or refuse to specify. If respondents reported a method not included on the list, enumerators marked "other" and listed the method. Open-ended responses were reviewed and recoded/categorized accordingly. We classified the following methods as modern contraceptives: male and female condoms, the pill, emergency contraceptives, the injectable, the implant, the IUD, and male and female sterilization.

Statistical Analysis

• *Abortion estimates.* We calculated the proportions of women who had ever had an induced abortion according to the list experiment and the direct question. For the list

experiment, we excluded women with missing data for key variables, resulting in a sample of 4,159 women. Four women who had complete data for the list experiment had missing data for the direct question, resulting in a size of 4,155 for that calculation.

For the list experiment data, we summed the numbers that respondents provided for each list and then calculated the average for each list. We subtracted the averages for the control lists from the treatment lists to generate an estimate of the proportion of women for each list who had ever had an abortion. Next, we averaged the two lifetime abortion prevalence estimates to obtain a final estimate. Weights were calculated to account for selection probabilities at each sampling stage. We repeated the steps outlined above to produce a weighted estimate of lifetime history of abortion.

We assessed the list experiment data for a design effect, the absence of which is required for valid estimation and inference using list experiment data.[22] As an initial diagnostic test, we calculated the difference between the treatment and control groups in the proportions of participants with at least one positive response. Then we repeated the calculation for each number of control items. The presence of a design effect was unlikely if the differences were positive, and likely if the differences were negative.[22] Next we used the R list package (the package for "list" within R statistical software) to implement a likelihood ratio that formally assesses whether the observed pattern in differences was due to a design effect.[23] The direct estimate was calculated by dividing the number of women who reported that they had ever had an abortion by the total number of women.

• *Bivariate analysis.* We calculated weighted lifetime abortion prevalence by sociodemographic characteristics of women. We wanted to know whether the proportion of women who self-reported that they had an abortion was equal to the mean proportion of women who we estimated had an abortion using the list experiment method. We conducted Z tests to determine whether the differences were equal.

• *Multivariate analysis.* We used multivariate regression to examine whether women's sociodemographic characteristics (age, education, wealth, ethnicity, religion, age at first marriage, number of lifetime births and ever-use of modern contraceptives) were associated with the outcome variable, reporting a lifetime history of abortion. To implement multivariate regression, we used the R list package;[23] a detailed explanation of how to implement multivariate regression using item-count data can be found in the R list package software manual. The multivariate regressions for the list experiment data subdivide the analysis into two sections: one for responses to the abortion-related item and one for responses to the control items.

We excluded 46 women from the analyses because of missing sociodemographic data. We used three estimates of lifetime abortion prevalence as outcomes: responses to List A, responses to List B and responses to the direct question. For list experiment analysis, regression methods were designed for a single list only; thus, we calculated separate models for List A and List B. The primary objective was to demonstrate how multivariate regression using list experiment data compared with regression findings with a direct question in the same sample, rather than to draw inferences about the correlates of lifetime abortion prevalence.

RESULTS

Descriptive Statistics and Tests of Design Effects

Half of the women in the weighted overall sample were between the ages of 25 and 34 (Table 2); 28% had never attended school, and 26% were in the lowest wealth group. Nearly half (47%) were Urdu-speaking, and the majority (88%) were Muslim. Forty-five percent of women were first married before age 20, and about one-third (32%) had had at least four lifetime births; half of women had ever used a modern contraceptive.

We examined participants' background characteristics by list experiment group: Group 1 received control list B and then treatment list A, while group 2 received control list A and then treatment list B. With the exception of ethnicity, there were no significant differences across groups by characteristics, which we tested using two-sample test of proportions (not shown). These results suggest that we achieved randomization in the double list experiment design.

We also assessed whether a design effect was present in either list. As an initial diagnostic, we calculated the response proportions by number of reported items for each list (Appendix Table 1). The treatment–control differences in proportions were positive and consistent with the assumption of no design effect.[23] As a final definitive test for a design effect, we followed the recommendations outlined by Blair and Imai,[22] and used the list package in R to implement the likelihood ratio test (Appendix Table 2). The likelihood ratio test for the design effect was not statistically significant for either list ($p_{List\ A}$=1.0; $p_{List\ B}$=1.0), so we cannot reject the null hypothesis of no design effect. This indicates that respondents did not alter their responses to the control items based on the presence of the abortion item. In sum, there was no statistical evidence for a design effect.

Abortion Estimates

Under the assumption of no design effect, we estimated the prevalence of lifetime abortion history for the list experiment—in total and by background characteristics. Further, we calculated estimates of lifetime abortion history from the direct question. The difference-in-means estimator produced a weighted estimate of lifetime abortion prevalence of 12% and 20% for List A and List B, respectively, resulting in an average final estimate of 16% (Table 3). The direct question produced an estimate of 8%.

List experiment estimates were typically larger than direct estimates for each subgroup. For example, direct estimates were smallest for women aged 16–24 (3%), but list experiment estimates were highest for this group (19%).

TABLE 2. Percentage distribution of married women aged 16–44 surveyed as part of the Willows program, by selected characteristics, according to study group, Karachi, Pakistan, 2018

Characteristic	All		Group 1 weighted % (n=2,087)	Group 2 weighted % (n=2,072)
	Unweighted % (n=4,159)	Weighted % (n=4,159)		
Age				
16–19	2.1	2.3	1.9	2.7
20–24	14.4	15.0	16.1	13.9
25–29	24.2	24.9	24.7	25.0
30–34	26.0	25.2	24.8	25.6
35–39	21.0	20.4	20.2	20.6
40–44	12.3	12.2	12.3	12.2
Education				
None	28.5	28.1	27.7	28.3
Primary	14.4	13.8	14.3	13.3
Middle	15.1	15.0	14.2	15.8
Secondary	24.7	24.9	25.6	24.2
>secondary	17.3	18.2	18.2	18.4
Wealth				
Lowest	27.5	25.5	24.7	26.2
Middle	38.4	37.6	38.3	36.9
Highest	34.1	36.9	37.0	36.9
Ethnicity				
Urdu speaking	51.9	47.3	48.7	46.0
Sindhi	8.2	9.0	9.9	8.0
Punjabi	22.8	24.1	23.0	25.1
Other	17.1	19.6	18.4	20.9
Religion				
Islam	88.6	87.8	87.8	87.8
Other	11.4	12.2	12.2	12.2
Age at first marriage				
<20	46.1	45.1	44.6	45.6
20–24	40.0	38.1	38.1	38.2
25–29	13.7	14.1	15.0	13.4
≥30	2.3	2.6	2.3	2.9
No. of lifetime births				
0	12.1	12.9	12.7	13.0
1	14.5	15.1	15.4	14.9
2	19.7	20.0	19.8	20.3
3	19.9	19.8	20.2	19.4
≥4	33.8	32.2	31.9	32.4
Ever used modern contraceptives				
Yes	50.2	50.5	51.2	49.8
No	49.8	49.5	48.8	50.2
Total	100.0	100.0	100.0	100.0

Notes: Group 1 received control list B and treatment list A, and Group 2 received control list A and treatment list B. Distributions may not add to 100.0 due to rounding.

Another large and significant difference was between women of low parity: According to the list experiment estimates, 19% of women who had had one or no births had had an abortion, whereas by their direct report, only 3% of such women had terminated a pregnancy.

Differences were also present in patterns of prevalence by demographic subgroups, including those for age, ethnicity, religion, lifetime number of births and ever-use of modern contraceptives. For example, the direct estimate suggests that lifetime abortion prevalence was lower among Muslim women than among members of other religions (8% vs. 11%); yet, according to the list experiment estimates, a greater proportion of Muslim women had had an abortion (17% vs. 10%).

For other background characteristics, however, the estimates had similar patterns. For example, according to the list experiment and the direct question, the proportion of women who had had an abortion was smallest for those with no education (15% and 7%, respectively) and largest for those who completed primary or middle education (19% and 10%). Similarly, the list experiment and direct question both suggest that prevalence of abortion increases with wealth. Lastly, according to list experiment and direct estimates, the proportion of women who had ever had an abortion decreased with increased age at first marriage.

Multivariate Findings

We conducted multivariate regression to assess the factors associated with women's reporting of ever having had an abortion and present the results of three models: the direct question model, List A model and List B model (Table 4).

In the direct question model, several variables were found to be positively associated with women's reporting of abortion. Compared with women with no education, women with primary education were four percentage points more likely to report ever having had an abortion (coefficient, 0.04); women with middle education, secondary education and higher education were all three points more likely to have had an abortion (0.03 each), although the associations for the latter two were only marginally significant. Women in the highest wealth category were more likely than those in the lowest wealth category to report an

TABLE 3. Lifetime abortion estimates for married women aged 16–44, by the list experiment and direct method, and the difference between the list experiment average and direct method estimates—all according to selected characteristics

Characteristic	List (n=4,159)		Average	Direct (n=4,155)	Difference
	A	B			
Overall (unweighted)	11.59	22.48	17.03 (12.82–21.24)	8.23	8.80***
Overall (weighted)	12.48	19.84	16.18 (10.58–21.78)	8.11	8.08***
Age					
16–24	10.09	28.07	19.08 (13.48–24.68)	3.12	15.96***
25–29	12.15	17.17	14.66 (9.06–20.26)	6.29	8.37***
30–34	21.67	11.54	16.60 (11.00–22.20)	8.45	8.15***
35–44	7.86	23.20	15.53 (9.93–21.13)	11.89	3.54***
Education					
None	8.36	21.08	14.72 (9.12–20.32)	6.60	8.12***
Primary/middle	7.58	29.97	18.78 (13.18–24.38)	9.60	9.18***
≥secondary	18.22	12.68	15.45 (9.85–21.05)	8.08	7.37***
Wealth					
Lowest	3.34	10.49	6.92 (1.32–12.52)	5.78	1.14*
Middle	20.85	17.29	19.07 (13.47–24.67)	7.97	11.10***
Highest	9.81	30.15	19.98 (14.38–25.58)	9.86	10.12***
Ethnicity					
Urdu speaking	12.26	17.89	15.08 (9.47–20.68)	8.15	6.93***
Punjabi	15.47	12.17	13.82 (8.22–19.42)	8.85	4.95***
Other	11.09	29.72	20.40 (14.80–26.00)	7.42	12.98***
Religion					
Islam	13.27	20.79	17.03 (11.43–22.63)	7.77	9.26***
Other	7.45	12.80	10.13 (4.53–15.73)	10.57	–0.44
Age at first marriage					
<20	10.81	23.73	17.27 (11.67–22.87)	9.79	7.48***
20–24	16.28	15.17	15.72 (10.12–21.32)	7.58	8.14***
≥25	8.65	19.98	14.31 (8.71–19.91)	4.78	9.53***
No. of lifetime births					
0–1	12.65	26.27	19.46 (13.86–25.06)	3.12	16.34***
2–3	12.00	14.02	13.01 (7.41–18.61)	7.95	5.06***
≥4	13.23	21.26	17.25 (11.65–22.85)	12.68	4.57***
Ever used modern contraceptives					
Yes	17.16	16.79	16.97 (11.37–22.57)	12.21	4.76***
No	7.44	23.29	15.37 (9.77–20.97)	3.94	11.43***

*p<.05. **p<.01. ***p<.001. *Note:* Z tests were used to determine whether differences in proportions were equal.

abortion (0.04). In addition, the likelihood of abortion was greater among women who had ever used modern contraceptives than among those who had not (0.06).

Furthermore, in the direct question model, reporting an abortion was found to be negatively associated with age, religion and age at first marriage. Compared with women aged 40–44, women aged 16–19 were 10 percentage points less likely, women aged 20–24 were eight percentage points less likely, women aged 25–29 were five percentage points less likely and women aged 30–34 were four percentage points less likely to report ever having had an abortion (coefficients, −0.10 to −0.04); the percentage-point difference between 30–34-year-olds and 40–44-year-olds was only marginally significant. Women who identified as Muslim were less likely than other women to have had an abortion (−0.04). And compared with women who were first married before age 20, women married at an older age were 3–10 percentage points less likely to have ever had an abortion (−0.10 to −0.03).

In the model for List B, only age and wealth were found to be associated with women's reporting an abortion. Compared with the poorest women, those in the middle and highest wealth categories were 19 and 29 percentage points more likely, respectively, to report having had an abortion (coefficients, 0.19 and 0.29). Women aged 30–34 were less likely than those aged 40–44 to report an abortion (−0.23). No covariates were found to be associated with abortion reporting in the model for List A.

DISCUSSION

Our application of the list experiment to measure the lifetime prevalence of abortion among married women in Karachi produced an estimate of 16%, which is double the estimate produced by direct questioning. Further, we found that multivariate regression produced conflicting results depending on whether data from the list experiment or direct question were used. Our study is the first to apply the abortion list experiment in Pakistan, and results suggest that the method may be feasible in similar settings where abortion is highly stigmatized and legally restricted.

The list experiment has produced mixed results in the context of abortion behaviors in low-resource settings. Original application of the list experiment in Liberia produced results five times greater than direct estimates in another sample.[17] In Iran, an application measuring lifetime abortion prevalence resulted in estimates comparable to those from RRT; however, more than 90% of respondents reported the list experiment to be very easy to comprehend (compared with 78% for RRT), and more than 60% completely trusted the confidentiality that the list experiment ensured (compared with 49% for RRT).[16] List experiments conducted in Vietnam on sex-selective abortion and in India on abortion incidence resulted in lower than expected estimates.[15,19] In India, estimates from the list experiment were smaller than direct question estimates in the same sample of women; however, the assumption

TABLE 4. Coefficients (and 95% confidence intervals) from regression models estimating women's likelihood of reporting ever having had an abortion, by model, according to characteristics

Characteristic	Direct	List A	List B
Age (ref=40–44)			
16–19	–0.101 (–0.146 to –0.057)***	–0.149 (–0.608 to 0.311)	0.057 (–0.410 to 0.524)
20–24	–0.077 (–0.120 to –0.035)***	–0.025 (–0.281 to 0.231)	–0.038 (–0.295 to 0.218)
25–29	–0.051 (–0.091 to –0.011)*	–0.015 (–0.225 to 0.196)	–0.129 (–0.341 to 0.083)
30–34	–0.035 (–0.073 to 0.004)†	0.168 (–0.027 to 0.363)	–0.234 (–0.430 to 0.038)**
35–39	–0.008 (–0.049 to 0.032)	0.069 (–0.131 to 0.270)	–0.125 (–0.325 to 0.075)
Education (ref=none)			
Primary	0.035 (0.005–0.065)*	0.029 (–0.151 to 0.210)	0.171 (–0.018 to 0.360)
Middle	0.029 (0.000–0.058)*	–0.051 (–0.231 to 0.129)	0.011 (–0.178 to 0.199)
Secondary	0.025 (–0.001 to 0.051)†	0.100 (–0.064 to 0.263)	–0.057 (–0.224 to 0.110)
≥secondary	0.026 (–0.004 to 0.056)†	0.047 (–0.140 to 0.234)	–0.091 (–0.284 to 0.103)
Islam (ref=other religion)	–0.038 (–0.070 to –0.007)*	0.020 (–0.189 to 0.229)	0.009 (–0.207 to 0.225)
Wealth (ref=lowest)			
Middle	0.017 (–0.004 to 0.038)	0.089 (–0.052 to 0.230)	0.191 (0.044–0.338)*
Highest	0.037 (0.013–0.060)***	0.030 (–0.121 to 0.182)	0.293 (0.135–0.451)*
No. of lifetime births (ref=0)			
1	–0.008 (–0.031 to 0.014)	0.112 (–0.105 to 0.329)	–0.011 (–0.235 to 0.213)
2	0.002 (–0.025 to 0.030)	0.014 (–0.197 to 0.225)	–0.064 (–0.281 to 0.153)
3	0.002 (–0.029 to 0.032)	–0.044 (–0.267 to 0.179)	0.038 (–0.194 to 0.269)
≥4	0.018 (–0.015 to 0.052)	–0.007 (–0.242 to 0.228)	–0.043 (–0.282 to 0.197)
Ethnicity (ref=Urdu speaking)			
Sindhi	0.007 (–0.027 to 0.041)	0.143 (–0.071 to 0.358)	0.005 (–0.223 to 0.233)
Punjabi	–0.006 (–0.029 to 0.016)	0.073 (–0.085 to 0.232)	–0.045 (–0.208 to 0.118)
Other	0.003 (–0.023 to 0.029)	0.007 (–0.151 to 0.165)	0.086 (–0.075 to 0.247)
Ever used modern contraception (ref=no)	0.059 (0.040–0.079)***	0.065 (–0.056 to 0.186)	0.003 (–0.123 to 0.128)
Age at first marriage (ref=<20)			
20–24	–0.026 (–0.048 to 0.003)*	0.045 (–0.088 to 0.178)	–0.079 (–0.215 to 0.056)
25–29	–0.059 (–0.087 to –0.031)***	–0.046 (–0.243 to 0.150)	–0.035 (–0.239 to 0.170)
≥30	–0.100 (–0.137 to –0.062)***	0.023 (–0.410 to 0.456)	–0.186 (–0.618 to 0.246)

*p<0.05. **p<0.01. ***p<0.001. †p<0.10. *Notes:* Sampling weights used for direct question regression model. ref=reference group.

of no design effect was violated.[17] In our study, the list experiment performed well and there was no evidence of a design effect. Taken together, these results provide support for wider application of list experiments measuring abortion behaviors, although researchers should test the validity of the method across settings.

Our application of the list experiment revealed a different profile of women potentially more likely to have had an abortion as compared with our results from the direct question and to previous studies using direct questioning. For example, studies of PAC, which typically rely on direct questioning, suggest that Pakistani women who have had an abortion tend to be in their late 20s or 30s, married and have at least three children.[32,34,35] Our results suggest that number of lifetime births does not predict abortion history, and many women younger than 25 have had an abortion. Studies of women receiving PAC are inherently biased because women who do not experience complications or do not seek care—which may be correlated with women's background characteristics—are not captured by such studies. For example, women who present for PAC may be more comfortable with the health care system and with self-reporting of abortion because of previous births and their age, whereas younger women and those with lower parity may be reluctant to seek care and disclose whether they have had an abortion due to stigma and social norms regarding fertility. Further, if use of misoprostol is as widespread as presumed,[30] then the list experiment may be a more reliable method and better able to obtain unbiased results regarding the sociodemographic profile of women who have had an induced abortion than other methods.

That the significance of covariates varied between the direct question method and the list experiment method in the multivariate regression results is not surprising. Age, education, religion, age at first marriage and modern contraceptive use were significantly associated with reporting ever having had an abortion in the direct question model, but not in the list experiment models. These differences are likely due to the underreporting of abortion that we observed in the direct question and represent the demographic factors that influence reporting of abortion. Additionally, few differences were found between List A and List B, with the exception of wealth, which was highly significant in List B. Although we achieved randomization in the double list experiment design, large differences were found in the variations in prevalence by wealth between List A and List B. These differences suggest that wealthier women are more likely to be able to access abortion services. Legal restrictions on induced abortion do not lower the rate of abortion but do make obtaining a safe abortion more difficult.[36] The wealthier women in our sample may have had the resources necessary to obtain abortion services, whereas women with less wealth may have been unable to do so or might have accessed unsafe services they were not comfortable reporting.

The only previous national estimate of abortion in Pakistan—50 abortions per 1,000 women of reproductive age—was measured in 2012 using the AICM.[29] Although this method is likely biased, it is indicative of high prevalence

of induced abortion. In Karachi, a 2012 study reported that about 15% of total lifetime pregnancies ended in induced abortion, although the sample was purposively selected for women who had abortions and abortion prevalence could not be estimated. Our weighted estimate (16%) was similar to results found in previous community-based studies but substantially less than the national estimate. These differences are likely attributable to many factors, including differences in location (our study was conducted in two communities in Karachi and not representative of Karachi), sampling methods and changes in abortion behavior.

Our study supports the conclusion that many women in Pakistan rely on induced abortion. High utilization of unsafe abortion methods or providers places a heavy burden on the health care system and suggests a need to reassess abortion policies and resources in Pakistan. Most abortions in Pakistan take place in clandestine conditions, and complications from unsafe abortion account for a substantial proportion of maternal deaths.[29] Indeed, more than 700,000 women were treated for postabortion complications in 2012. Increasing access to modern contraceptives and providing education and outreach regarding pregnancy prevention can help reduce the high prevalence of unintended pregnancy (46% in 2012).[29] Reevaluation of policies concerning abortion may result in improvement of resource allocation and reduction of unsafe abortion, given the large population of women affected. For instance, given that PAC services are mandated in public facilities, policies should support the integration of family planning services into PAC, and provider training regarding abortion and family planning should be improved.

Limitations

This study was not without limitations. We measured lifetime abortion prevalence as opposed to abortion incidence, which limited the utility of the multivariate analysis. Because we did not measure the precise timing of women's abortions, drawing inferences about the direction of causality in the associations we observed is difficult. For instance, results from List B and the direct question suggest that wealth is positively associated with having had an abortion. It is possible that women with more wealth are more informed about abortion and may have easier access to services. However, it is also plausible that having an abortion allows participants to pursue employment, increasing their wealth. Future studies should collect abortion data relative to a specific time period (e.g., abortions in the past 10 years) and design list items to assess the total number of abortions to allow for estimation of abortion incidence and to limit the possibility of reverse causation in multivariate regression. Additionally, this study was conducted on a large sample of married women of reproductive age (16–44) in densely populated communities in Karachi, the largest city in Pakistan. We are unable to generalize these findings beyond these study communities; however, the large sample size allowed us to detect differences across subgroups of women. Further, the survey included both direct and list experiment questions on abortion, providing an in-sample comparison of the two methods. The list experiment itself has limitations for measuring abortion behaviors. For example, estimating the total number of abortions would be difficult, and we could not ask follow-up questions to determine the method of termination or whether a safe abortion was performed. However, compared with directly asking women about abortion, the list experiment produced an estimate twice as large, which suggests a vast amount of underreporting in this population.

CONCLUSIONS

Reliable current estimates of abortion prevalence inform resource prioritization, policy decisions and access to services and should thus be prioritized in global public health research. In settings where induced abortion is legally restricted and highly stigmatized, indirect methods are necessary to provide valid estimates. Through comparison of indirect and direct estimation techniques, we demonstrated that the list experiment produced higher estimates of abortion prevalence than did direct questioning in the context of two communities in Karachi, Pakistan. The list experiment, and other methods designed to reduce underreporting, are important epidemiological tools for collecting data on sensitive topics like abortion. Future work should explore the benefit of the abortion list experiment across diverse settings and populations, and be applied to collecting data on sensitive topics other than abortion. Population-based surveys should consider incorporating the abortion list experiment into existing tools to facilitate broader application in nationally representative samples. Lastly, additional research is needed in other contexts and in nationally representative samples, to assess and compare the accuracy of abortion prevalence estimates from the list experiment.

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RESUMEN

Contexto: *El aborto es particularmente difícil de medir, especialmente en entornos legalmente restringidos, como en Pakistán. El Experimento de Lista–una técnica para medir de manera indirecta comportamientos de salud sensibles–podría minimizar el hecho de que las personas encuestadas subnotifiquen el número de abortos debido al estigma o a restricciones legales; sin embargo, esta técnica no ha sido aplicada previamente para estimar la prevalencia del aborto en Pakistán.*

Métodos: *En 2018, se reclutó una muestra de 4,159 mujeres casadas en edad reproductiva, provenientes de dos comunidades de Karachi. Las participantes completaron una encuesta que incluyó un experimento de lista doble para medir la prevalencia de aborto, así como preguntas directas sobre el aborto y otras características del contexto. Los datos se usaron para calcular estimaciones directas e indirectas de la prevalencia de aborto en la muestra en general y por características sociodemográficas, así como para probar el efecto de diseño. Se realizaron análisis de regresión para examinar las asociaciones entre las características y los abortos reportados a partir de las preguntas directas y el experimento de lista.*

Resultados: *La estimación de la prevalencia de aborto del experimento de lista fue del 16%; la estimación a partir de la pregunta directa fue del 8%. No se encontró evidencia de un efecto de diseño. La notificación del número de abortos se asoció con la mayoría de las características seleccionadas en el modelo de regresión para la pregunta directa, pero con pocas características en los modelos de experimento de lista.*

Conclusiones: *El hecho de que la estimación de la prevalencia de aborto en Karachi generada a partir del experimento de lista fue el doble que la obtenida a partir de preguntas directas, sugiere que el método indirecto reduce la subnotificación. El experimento de lista podría ser útil para estimar el aborto en entornos similares y para mejorar la precisión de la recolección de datos sobre otros temas sensibles de salud.*

RÉSUMÉ

Contexte: *Il est extrêmement difficile de mesurer la prévalence de l'avortement, en particulier dans les contextes soumis à des lois restrictives, comme le Pakistan. La technique de mesure indirecte de comportements de santé sensibles « List Experiment » peut minimiser la sous-déclaration de l'avortement pour raisons de stigmatisation ou de restrictions légales, mais elle n'a pas précédemment été utilisée pour estimer la prévalence de l'avortement au Pakistan.*

Méthodes: *Un échantillon de 4 159 femmes mariées en âge de procréer a été recruté dans deux communautés de Karachi en 2018. Les participantes ont répondu à une enquête menée par double approche List Experiment pour mesurer la prévalence de l'avortement et qui comprenait aussi des questions directes sur l'avortement et d'autres caractéristiques socioculturelles. Les données ont servi à calculer les estimations directes et indirectes de la prévalence de l'avortement pour l'échantillon global et par caractéristiques sociodémographiques, ainsi qu'à tester l'effet du plan de sondage. Les associations entre les caractéristiques et la déclaration de l'avortement dans le questionnaire direct et la List Experiment ont été examinées par analyses de régression.*

Résultats: *L'estimation de la prévalence de l'avortement selon la mesure List Experiment était de 16%; sur la base du questionnaire direct, elle était de 8%. Aucun signe d'effet de plan de sondage n'a été observé. La déclaration de l'avortement était associée à la plupart des caractéristiques sélectionnées dans le modèle de régression pour le questionnaire direct, mais à quelques-unes seulement dans les modèles de l'outil List Experiment.*

Conclusions: *Le fait que l'estimation de la prévalence de l'avortement à Karachi générée d'après la List Experiment s'est révélée le double de celle produite par le questionnaire direct laisse entendre que la méthode indirecte réduit la sous-déclaration. La mesure List Experiment peut être utile à l'estimation de l'avortement dans des contextes similaires et pour améliorer l'exactitude des données collectées sur d'autres sujets de santé sensibles.*

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Author contact: *shuber@hsph.harvard.edu*

APPENDIX TABLE 1. Detailed assessment of response proportions by number of reported items in the entire sample, by list

Estimated proportion	Source	No. of reported items						
		0	1	2	3	4	5	Sum
List A								
Row 1	List with abortion	0.154	0.381	0.328	0.128	0.009	0.000	1.000
Row 2	Proportion at least*	1.000	0.846	0.464	0.137	0.009	0.000	-
Row 3	List without abortion	0.169	0.403	0.347	0.081	0.001	0.000	1.000
Row 4	Proportion at least*	1.000	0.831	0.429	0.082	0.001	0.000	-
Row 5	Row 2 minus Row 4	0.000	0.015	0.035	0.055	0.008	0.000	0.113
List B								
Row 1	List with abortion	0.084	0.227	0.333	0.326	0.029	0.001	1.000
Row 2	Proportion at least*	1.000	0.916	0.689	0.356	0.030	0.001	-
Row 3	List without abortion	0.085	0.267	0.447	0.200	0.001	0.000	1.000
Row 4	Proportion at least*	1.000	0.915	0.648	0.201	0.001	0.000	-
Row 5	Row 2 minus Row 4	0.000	0.001	0.041	0.155	0.029	0.000	0.226

Notes: Rows 1 and 3 represent the proportion reporting each number of items on the treatment and control lists, respectively. Rows 2 and 4 represent the proportions reporting at least each number of items on the treatment and control lists, respectively. Row 5 represents the differences between Row 2 and 4, which is equal to the proportion of women who report having an abortion and the total number of treatment list items indicated by the column.

APPENDIX TABLE 2. Estimated proportion of respondent types, $\hat{\pi}yz$ for each of the two lists, characterized by the total number of affirmative answers to the control questions, y, and the answer for the sensitive item (1 indicates affirmative and 0 represents negative)

	List A				List B			
y value	$\hat{\pi}y^0$	*SE*	$\hat{\pi}y^1$	*SE*	$\hat{\pi}y^0$	*SE*	$\hat{\pi}y^1$	*SE*
0	15.33	0.0079	1.61	0.0114	8.45	0.0061	0.04	0.0086
1	36.53	0.0137	3.72	0.0154	22.65	0.0119	4.04	0.0146
2	29.15	0.0132	5.45	0.0096	29.26	0.0148	15.40	0.0137
3	7.34	0.0064	0.81	0.0021	17.13	0.0096	2.90	0.0039
4	0.05	0.0005	0.00	0.0000	0.05	0.0011	0.10	0.0007
Total	88.40	na	11.59	na	77.54	na	22.48	na

Notes: SE=standard error. na=not applicable.