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USE OF RANDOMIZED RESPONSE TECHNIQUE TO MEASURE THE INDUCED ABORTION LEVELS IN MULTAN



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Abstract

Objectives: The objectives include finding out the status of induced abortion for Multan using (Randomized Response Technique) RRT and specifying the aspects of women who practiced an abortion.

Material and methods: The study population consists of women from Multan. Convenient sampling was used to collect data from women. A total of 217 women were interviewed. The survey was conducted using questionnaires and randomized response methods. An innocent question was used for an unrelated question method. We collected the data from visiting females from different maternity clinics, visiting mothers in girls' schools, and teachers in girls' schools. Our sample contained 217 women of the age group 15-55. The data analysis was done on SPSS.

Results: Our study shows that the predicted induced abortion of women in their lives is 63 percent, with a standard error of 0.064.

Discussion and Conclusion: Our proportion for induced abortion was 63 percent. The ratio of induced abortion was high (31.46%) for the older women who were from the city (20.99%) and had high education levels (33.92%), in contrast with other categories. The proportions of induced abortion were also found for different groupings of knowledge among women. They can get easy access to such clinics that give facilities for induced abortion. One thing is the act of abortion, and the other one is to hide it. However, our technique is essential to get information about these acts, which women are reluctant to discuss. Our methodology estimated truthful responses.

Keywords: Asking sensitive questions indirectly, Lam's Method, Randomized Response Technique, Survey Method, Unrelated question technique, Warner's method

INTRODUCTION

Abortion is permitted under some limited conditions because it becomes complicated for females and causes many health-related problems. Poor ladies in some miserable conditions have to undergo this procedure. They have to be dependent on untrained workers. The Randomized Response Technique (RRT) was developed by Warner (1965) for a survey to ask questions of sensitive nature (1). Later, works were done on it by different authors for several years. This method could minimize biased answers, and this indirect type of method could fulfill the respondent's privacy. In this paper, our focus is to compute the induced abortion levels in Multan by following the randomized response method. Though this topic is considered sensitive for women, this method helped maintain their privacy.

This method uses randomization devices: a coin flip, a roll of dice, and cards. The interviewer hides the outcome of the randomization device. Depending on the distinct design, the randomization device determines which question the respondents answer. In this way, respondents tend to give true answers (1-4). RRTs are commonly used in cognitive research; different investigations were done in the field of medical management described by on drug use and alcohol (5).

UNSAFE ABORTION

Global Picture and Situation in Pakistan (2008) reported that, in Pakistan, 10–12 percent of maternal deaths occur due to abortion or miscarriage (11). This includes both induced as well as spontaneous abortion. An annual estimation of induced abortion is 890,000; this means one out of six pregnancies terminated by abortion. This is mostly an unsafe procedure. Each year, 197,000 women are treated for the



aftereffects of unsafe abortion.

In Pakistan, during 2010-2014, 56 million induced abortions occurred each year, on average. It was found in local research methods (2017) reported by Gilda Sedgh (6). There were 35 abortions per 1,000 women aged 15-44; one in four pregnancies ended in abortion. Married women obtained 73% of abortions. The abortion rate has declined in the developed world but not in the developing world.

SUBJECTS AND METHODS

We used the randomized response technique, a survey method that collects truthful responses on sensitive issues to reduce bias in surveys and protect the privacy of respondents. In this condition, either they refuse to answer or give false responses to maintain a positive self-image. The result hurts the data. RRT is a helpful technique to deal with such sensitive questions by ensuring respondents' privacy. This technique minimizes the non-response rate in sensitive questions surveys by ensuring respondents answer indirectly without fear and that their anonymity will be guaranteed.

Both sensitive and non-sensitive questions are taken into account in this method. There is a known likelihood of a positive response to the innocent query. The question that the respondent is responding to is unknown to the interviewer. It is predicated on the ideas of the probability of choosing an innocent question, the ratio of yes answers for the non-sensitive query, and the total number of women who took part and replied yes for the sensitive question or the non-sensitive question. The induced abortion rate in the city of Multan was calculated by randomized response technique.

A pilot survey was conducted for 12 women aged 15–55 years. In this pilot study, 52 percent of the women reported having an induced abortion at some point in their lives. Using RRT instead of a direct method is anticipated to yield better outcomes. Findings were reliable, and responses would become less skewed in this way.

Our target was to collect information from 230 women of reproductive age. Convenient sampling was used to collect data from women of reproductive age of 15–55 years. A total of 217 women were interviewed. 205 were from Multan City, and 12 women were from villages near Multan. Data consists of educated women as well as housewives. 54 women were teachers at Government Girls Comprehensive Higher Secondary School; 32 were from Government Girls Muslim School, Multan. 90 women were visiting mothers of both schools. 28 women were from Zoya Clinic, and 13 were from Family Hospital.

After that, a random selection of pieces of paper was used. Women aged 15 to 55 from selected samples were asked to participate in survey questionnaires and interviewed with RRT. We explained the whole method procedure to the respondents loudly. Educated women on their own filled out the survey questionnaire, and we filled it out by asking questions from uneducated respondents or housewives. In the end, we filled out a questionnaire to note the presence of difficulty in applying the method and to mark our own opinion about the respondent's skill in responding to the RRT (16).

The questionnaire consisted of two sections. The first household questionnaire contained 10 questions about demographic characteristics, and the second questionnaire contained 7 questions about women's reproductive characteristics.

Demographic characteristics include age group, place of residence, education level, marital status, employment status, husband's earning status, living status, number of family members, earning members in the family, and husband's behavior.

Questions about the reproductive history of women include questions about the ideal number of children, the woman who has given birth, the use of birth control methods, unwanted pregnancy, the use of contraceptives, and an opinion about the legalization of abortion.

Before we filled out the third questionnaire by ourselves, the researcher applied the RRT method and then filled out the third questionnaire about the interviewer's perception. After completing a questionnaire, we applied the RRT method individually to the respondent. Two white papers were used as randomizers. One is written as a statement:

- Have you ever had an abortion?

Two words, yes and no, were also written after the question. Likewise, the other paper is written as a statement:

- Is Urdu your mother tongue?

Again, yes and no were written for the options to select.

The unrelated question was kept as the national language, Urdu. The probability of this was known in advance by the 2017 census: Urdu is spoken 7.08 percent as the first language in Pakistan. So, all the yes answers were counted and calculated.

Questions were loudly spoken to tell all the respondents. Then, the papers were folded so the other did not recognize one. Respondents were asked to toss both papers, pick one of them, and answer loudly without showing us which question was opened and answered. We just noted the answers in Yes and No. Then, we told the respondent to fold the paper into the previous form. We recorded all the yes-answers and counted the number of yes-answers of RRT questions for the proceeding calculations. The interview with one woman lasted between eight and ten minutes on average.

RRT gives valid results compared with simple question-answer methods. When the issue under consideration is super sensitive, RRT positively affects the strength of the results.

RESULTS

The proportion of females who declared an abortion could be obtained by the following equation.

$$\pi = \frac{\lambda - \pi_y(1-P)}{P} \quad [1]$$

Where:

- π = Ratio of women who declared about 1 or more abortions during their lifetime.
- $\lambda = \frac{\text{no.of yes answers of respondents}}{\text{total no.of respondents}}$ = Ratio of women (reported yes in RRT).
- π_y = Proportion of women expected to report yes to the innocuous question.

The language data of the 2017 census shows that Urdu is spoken as the mother language, which is 7.08 percent = 0.0708.

- P = Probability of choosing the sensitive RRT statement (about abortion question). There are two statements, so the probability of selecting one is 0.5.

- $1 - P$ = The probability of choosing the other question (speaking Urdu as the mother tongue) is 0.5.

By our data, the calculation is

$$\pi = \frac{0.35 - 0.0708(0.5)}{0.5} = 0.637. \quad [2]$$

Where

$$\lambda = \frac{78}{217} = 0.359$$

$\pi_y = 0.0708$ we can estimate the SE π by using the formula:

$$SE = \sqrt{\frac{\lambda(1-\lambda)}{nP^2}} \quad [3]$$

$$SE = \sqrt{\frac{0.35(1-0.35)}{(217)*(0.25)}} = 0.064 \quad [4]$$

So, this study shows that the standard error (SE) for the predicted induced abortion of women in their lives (63 percent) is 0.064.

These formulas were used to predict, within the city and within groups of selected demographic characteristics (Tables I and II), the percentage of ladies who had disclosed their induced abortion. The proportion of induced abortions and their standard errors were calculated using the formulas above, replacing λ with the proportion of each socio-demographic group that answered 'yes' to the RRT element.

We conducted two analyses: first, we used statistical tests to determine whether components in the bivariate analysis were significantly related to induce abortion at the $P < 0.05$ level. Additionally, we applied the Wald test for multilevel data and used the chi-square test to assess the independence of dichotomous variables.

Following Warner's method, we applied statistical tests (like chi-square and P-values) to analyze sociodemographic factors (12). Additionally, we used multiple logistic regressions to calculate odds ratios and other key values (such as P-values, standard errors, and coefficients) for reproductive participants.

SAMPLE CHARACTERISTICS

A total of 230 women of Multan were visited to participate in the survey; only 3 refused to do so. A total of 227 women answered the questions of demographic aspects, reproductive characteristics, and views about abortion, but 5 of them (2.2 percent) were unable to respond to the method of RRT. Three women (1.3 percent) did not want to learn the technique due to their interests and hence refused to cooperate with us. Two women refused by saying that they had never had an abortion and so did not ask interview questions.

Table I. Characterization of women by demographic aspects (Characterization of Sample [n=217] and proportions of females who declared ever had an induced abortion by demographic aspects, Multan)

Variables	Number (n)	Percentages	Answer Yes on RRT	Proportion ever had induced abortion (%)	SE
Age groups					
15-24	15	6.91	3	12.92	0.21
25-34	34	15.67	13	31.16	0.17
35-44	72	33.18	25	27.64	0.11
45-55	96	44.24	37	31.46	0.10
Place of residence					
Multan City	205	94.47	76	29.99	0.07
Village	10	4.61	2	12.92	0.25
Education level					
No schooling completed	28	12.90	7	17.92	0.16
Nursery to 8th class	23	10.60	7	23.35	0.19
9th to 12th class	66	30.41	23	27.77	0.12
12th or more	100	46.08	41	33.92	0.10
Marital status					
Married	202	93.09	73	29.06	0.07
separated, widowed, or divorced	15	6.91	5	26.25	0.24
Employment status					
Working	122	56.22	47	31.44	0.09
Not working	95	43.78	31	25.55	0.10
Husband's earning status					
Private	61	28.11	18	22.43	0.12
Government employ skilled	64	29.49	29	38.23	0.12
43	19.82	12	20.83	0.14	
businessman	47	21.66	18	31.22	0.14
Living status					
Separate	144	66.36	52	29.03	0.08
with in-laws	72	33.18	26	29.03	0.11
Number of family members					
2-4	60	27.65	24	32.92	0.13
5-7	107	49.31	32	22.83	0.09
8-10	31	14.29	15	41.31	0.18
11 & above	19	8.76	7	29.76	0.22
Earning members					
One person	62	28.57	21	26.79	0.12
2 person	108	49.77	39	29.03	0.09
3 person	29	13.36	9	23.95	0.17
4 or More	18	8.29	9	42.92	0.24
Husband's behavior					
Bad	8	3.69	3	30.42	0.34
Fair	42	19.35	13	23.87	0.14

Good	105	48.39	40	31.02	0.09
Good & helpful	62	28.57	22	28.40	0.12

Table I demonstrates the categories of our sample of females who are in the desired age group by their chosen demographic, economic, and other aspects, with their predicted proportions and standard errors separately for every subgroup in which women declared about induced abortion. A sample distributed by reproductive age shows more women in their late 30s and late 40s than in their teens and early 20s. The greater number of women is from Multan (94.5 percent), as it is our desired sample. Most (46.1 percent) completed their 12 years of education and onward. A greater number (93.1 percent) of them were married. Over half (56.2 percent) of women were employed or working. Most women (29.5 percent) have their husbands employed in government jobs. The proportion is high (66.4 percent) for those living in their separate homes compared to those living with a combined family. Most women (49.3 percent) belong to families with 5 to 7 members. Most women (49.8 percent) have two earning members in their family, including their own. The proportion of women who have husbands with good behavior was high (48.4 percent) as compared with the husbands (3 percent) with bad behavior.

Table II. Characterization of women by reproductive aspects (Characterization of samples [n=217] and proportions of women who declared induced abortion by contraceptive aspects and views about abortion laws, Multan)

Variable	Number (n)	Percentage	(n) Answer		SE
			Yes on RRT	Proportion ever had induced abortion (%)	
Age groups					
0 or 1	4	1.84	0	0.00	-
2	75	34.56	32	85.51	0.09
3	47	21.66	19	80.64	0.14
4 or more	91	41.94	27	57.30	0.15
Given Bbirth					
Yes	196	90.32	69	69.31	0.09
No	21	9.68	9	85.92	0.16
Use of birth control method					
Yes	76	35.02	29	75.72	0.13
No	141	64.98	49	68.33	0.11
Unwanted pregnancy					
Yes	59	27.19	20	66.48	0.17
No	158	72.81	58	72.58	0.09
Number of unwanted pregnancy					
0	158	72.81	60	75.33	0.09
1	39	17.97	11	54.13	0.23
2	12	5.53	5	83.34	0.25
3 or more	8	3.69	2	47.17	0.52
Use of contraceptive medication					
Yes	24	11.06	9	74.30	0.23
No	193	88.94	69	70.50	0.09
Opinion about abortion					
Permitted	29	13.36	10	67.75	0.24
Restricted	43	19.82	14	63.57	0.20
Prohibited	145	66.82	54	73.73	0.10

Table II represents the categories of women according to their contraceptive characteristics and their views about abortion laws. 90 percent of the ladies also had at least one live birth. The mean of live births (0.93 percent) was roughly matched with the average optimal digit of children (0.75 percent). It suggests that most women get the number of children they desire. 35 percent of them reported that they use birth control methods. Around 27 percent disclosed that they had an unwanted pregnancy in their lifetime. Out of these women, 11 percent revealed that they used some type of contraceptive medication at the time of unwanted pregnancy. Opinions about the right to induce abortion from the selected statements came out

somewhat conservative. The majority of them (66.8 percent) have the concept that abortion should be prohibited under any condition. On the contrary, only 13.4 percent thought that abortion should always have an approach to induced abortion. At the same time, 19.8 percent said that induced abortion should be permitted for women under some specific reasons or it should be allowed with some restrictions.

FREQUENCY OF INDUCED ABORTION

As mentioned before, our measurement of the total common occurrence of induced abortion was 63.7%. By using this method for measuring the desired estimate, proportions were calculated for every demographic and contraception characteristic for each subgroup that reported induced abortion (Tables I and II). As presented, it was suggested by descriptive statistics that the abortion rate was high in the late 40s to 50s among married women with a high education level of working women, within those women who did not get childbearing yet, never had any undesirable pregnancy, and thought that women should not get aborted. The data represents the proportion of women for induced abortion for each subgroup.

Table III. Women who found difficulty responding to the RRT by Socio-demographic attributes (n = 217), Multan, 2019

Characteristics	Respondents who found difficulty responding to the RRT			
	Number (n)	Percentage	Chi-square	p-value
Age groups				
15-24	15	6.7	1.168	0.761
25-34	34	11.8		
35-44	72	6.9		
45-55	96	6.3		
Place of residence				
Multan City	205	5.9	12.534	0
Village	12	33.3		
Education level				
No schooling completed	28	39.3	50.544	0.000
Nursery to 8th class	23	8.7		
9th to 12th class	66	4.5		
12th or more	100	0		
Employment status				
Working	122	3.3	6.841	0.009
Not working	95	12.6		

Table III represents the social and demographic characteristics of those women who found difficulty during the RRT. Women who experienced problems were mainly from the age group 25-34 years, but this category of age group is not significant with having problems with RRT. Most women who experienced problems were from the village nearest to Multan, and their ratio was 33.3 percent, which was much higher than that of Multan city residents. This difference was highly significant. In the context of education level, women who faced problems regarding RRT were at the lowest level of education; no schooling was completed or even completely illiterate. The ratio of this group of women was extremely high (39.3 percent) as compared to further education levels. This differs from the non-working status (12.6 percent), so the difference was significant.

Table IV. Associations between Selected Attributes and Induced Abortion (Multiple logistic regression analysis for associations between chosen attributes and induced abortion Multan, 2019)

Variables	Association with having induced abortion			
	Coefficient	SE	p-value	Odds Ratio
Has ever given birth (yes vs. no)	0.849	0.314	0.007	0.252
Ever had an unwanted pregnancy (yes vs. no)	2.336	0.513	0.624	1.286

We performed the multiple logistic regressions because there are binary categorical variables, this means two categories. So, this can be modeled in logistic regression which has binary variables as the outcome or dependent variable. We observed the significant association between two factors an unwanted

pregnancy ever had (no vs. yes) and given birth ever (no vs. yes) with the target group RRT. The analysis indicates that women who have never given birth are more likely to have undergone an induced abortion, as evidenced by an odds ratio of 2.336. This finding suggests that women without previous childbirth experience have a higher probability of seeking an abortion compared to those who have given birth. Furthermore, the results show that women who have not experienced an unwanted pregnancy also exhibit increased odds of having an induced abortion, with an odds ratio of 1.286. These findings highlight the significant relationship between reproductive history and the likelihood of induced abortion.

DISCUSSION

It is very typical for developed nations to make fruitful use of some methodologies and obtain certain results. In contrast, developing nations find some difficulties due to their high levels of illiteracy, lack of advanced technology, and different population characteristics. The statement of US research firm Guttmacher Institute described in the Daily Times (2019) that the pregnancies occurring in Pakistan contained half planned and half unplanned (8). While the ratio of pregnancies is 54 percent, that ends in abortion due to unplanned pregnancies. The RRT seems to perform best with educated women in the city.

Prior study comparing four methods of gathering data on abortion in Mexico—the randomized-response technique (RRT), self-administered questionnaires (SAQ), audio computer-assisted self-interviews (ACASI), and face-to-face interviews (FTF)—found that the RRT method had the highest rates of attempted induced abortion: 17.9% in household samples, 21.7% in hospital patients, and 36.1% in rural women (16). Our findings reveal considerably greater rates than these, suggesting that the number of induced abortions reported using the unrelated question has increased.

The proportion of women who are working was high (31.44%), as it concludes that these women have less time to bring up the child, so they terminate their pregnancy. The women who reported the good behavior of their husbands (30.42%) also have a high proportion of abortions. This concludes that these women have no restriction from their families to give birth to a child.

As we discussed, the place of residence, education level, and employment status, these factors were highly statistically significant, with difficulty in responding to RRT. So, we can say that women living in the village have not completed schooling, are not self-employed, and have more difficulty understanding RRT.

Suppose we observe the group of women who reported the use of contraceptive medication at the time of unwanted pregnancy when their percentage of using contraceptive medication is low. In that case, the proportion of induced abortions is high. In the group of women who used contraceptive medication at the time of unwanted pregnancy, the percentage was low in the proportion of induced abortions. This sounds like women who were aware of their pregnancy; they ended their pregnancy with medicines in their starting trimesters. However, multiple logistic regressions did not detect its significance.

In this study, interviews occur either in the clinic or the school. The result from the clinic is a proportion of induced abortion as compared to school. The reason behind this term is that women in the clinic were frightened by the fame of the clinic, just like the gynecologist. Our study includes visits to different clinics and asking directly from gynecologists whether they were doing induced abortions for patients, so we may be able to survey a mix of women, including aborted and non-aborted and they refused that this practice is not common in their clinic or it is banned by them. However, when we conducted the survey here by RRT, some women had practiced an induced abortion. Just because of their doctor, they did not consider the RRT procedure. Also, they were less educated. The proportion was high for schools because they were educated. The chi square p value gives statistically significant results.

CONCLUSION

The sample mainly comprised women from Multan (94.5%), with a higher proportion in their late 30s and early 40s. Nearly half (46.1%) had 12 or more years of education, and 91% were married. The data collected through RRT highlights that this method effectively captures sensitive reproductive behavior and attitudes.

The Randomized Response Technique (RRT) effectively measured sensitive topics, such as



contraception use and views on abortion. Results showed that 90% of women had at least one live birth, while 35% used birth control. Opinions on abortion were largely conservative, with 66.8% opposing it in any condition, highlighting the RRT's ability to capture accurate data on sensitive issues.

Women facing difficulties with RRT were primarily from rural areas (33.3%) and had lower education levels, with 39.3% being illiterate. This indicates that lower education and rural backgrounds may impact the effectiveness of the RRT technique.

Our study estimates that 63% of the 217 women in Multan have had an induced abortion at least once in their lifetime, which is significantly higher than Lara's (2006) findings in Mexico, where the rate was 16.3% among 1,792 women with a standard error of 0.016 (7). By incorporating an unrelated question in the Urdu language, we were able to obtain more accurate and truthful responses to the sensitive question regarding induced abortion.

Additionally, prevalence of abortion was estimated to be 16% in the list experiment and 8% in the direct query in Karachi (9). By comparison, our results of induced abortion through RRT in Multan are higher than those obtained through these two different methods.

The proportion of induced abortion in the city was higher than in the village. This illustrates that women who were from the city have more easy access to abortion services. Meanwhile, women from villages do not have a better approach to abortion, and they belong to a conservative society that never permits them to make this decision. In research comparing the abortion rates recorded in several regions of Mexico, Singh and Sedgh (1997) noted this tendency (10). Large cities like Monterey, Guadalajara, and Mexico City have greater abortion rates than areas made up of smaller towns, cities, and rural areas.

The RRT gives better estimates of such a confidential topic as abortion as compared to asking direct questions. As we have a limited number of women (only 217) to apply for the RRT, and due to lack of time, the unavailability of any team or cost, and fewer cooperative gynecologists, it is not possible to fix these results for the whole country based on one city. Also, we have no previous measures of induced abortion for Multan to compare our results to whether the understanding of the method increases or decreases; no consistent trend was found. However, we observed some explicit association between a few demographic characteristics and outstanding use of RRT. The most suitable women for using the RRT were from the city, with higher education levels, and currently working.

We recommend that RRT be practiced only for educated persons who can understand and speak the interviewer's language. There should be proper campaigns for teaching the RRT to the participants. Furthermore, RRT should be applied in privacy; this condition is a must for appropriate results of the RRT. Provide the respondent with the availability of participation other than the house; there should be no relatives or friends with the respondent. There should be a proper time for the interview.

Studies indicate that in developing countries, RRT makes respondents suspicious that the respondent thought that there was some trick. In this study, we found the highest level of compliance. Moreover, it developed interest in some respondents. A limitation of our study is that there was one innocent question. There should be another innocent question to increase the validity of the study. However, this method will be complicated for respondents with a low education grade.

The validity of the RRT can be increased by hiring a team of interviewers, training them to protect privacy during the interview, and checking participants' understanding of the method. Work should be done to calculate the effectiveness of RRT conclusions in separate groups of the population, especially for the respondents who are illiterate and literate. The sample should be large enough to confirm the validity of the technique; in this way, conditions of lack of time, cost, and staff must be fulfilled.

References:

1. Warner SL. Randomized response: A survey technique for eliminating evasive answer bias. *Journal of the American Statistical Association*. 1965; 60(309):63-9.
2. Greenberg BG, Abul-Ela AL, Simmons WR, Horvitz DG. The unrelated question randomized response model: Theoretical framework. *Journal of the American Statistical Association*. 1969; 64(326):520-39.
3. Mangat NS, Singh R. An alternative randomized response procedure. *Biometrika*. 1990; 77(2):439-42.

4. Mangat NS. An improved randomized response strategy. *Journal of the Royal Statistical Society: Series B (Methodological)*. 1994; 56(1):93-5.
5. Volicer BJ, Volicer L. Randomized response technique for estimating alcohol use and noncompliance in hypertensives. *Journal of Studies on Alcohol*. 1982; 43(7):739-50.
6. Sedgh G. *Induced abortion: Global trends, local research methods*. Guttmacher Institute; 2017.
7. Lara D, García SG, Ellertson C, Camlin C, Suárez J. The measure of induced abortion levels in Mexico using random response techniques. *Sociological Methods & Research*. 2006; 35(2):279-301
8. Pakistan's alarming abortion rate. *Daily Times*. 2019.
9. Huber-Krum S, Hackett K, Kaur N, Nausheen S, Soofi S, Canning D, Shah I. An application of the list experiment to estimate abortion prevalence in Karachi, Pakistan. *International Perspectives on Sexual and Reproductive Health*. 2020; 46(Supplement 1):13-24.
10. Singh S, Sedgh G. The relationship of abortion to trends in contraception and fertility in Brazil, Colombia and Mexico. *International Family Planning Perspectives*. 1997 Mar 1:4-14
11. Ahsan A, Jafarey SN. Unsafe abortion: global picture and situation in Pakistan. *JPMA. The Journal of the Pakistan Medical Association*. 2008; 58(12):660-1.
12. Scheers NJ, Dayton CM. Covariate randomized response models. *Journal of the American Statistical Association*. 1988; 83(404):969-74.
13. Abernathy JR, Greenberg BG, Horvitz DG. Estimates of induced abortion in urban North Carolina. *Demography*. 1970; 7:19-29.
14. *Abortion in North Carolina*. NC State Center for Health Statistics; 2016.
15. Lensvelt-Mulders GJ, Hox JJ, Heijden PG. How to improve the efficiency of randomized response designs. *Quality and Quantity*. 2005; 39:253-65.
16. Lara D, Strickler J, Olavarrieta CD, Ellertson C. Measuring induced abortion in Mexico: a comparison of four methodologies. *Sociological Methods & Research*. 2004 May; 32(4):529-58.

