Estimates of the Rate of Illegal Abortion and the Effects of Eliminating Therapeutic Abortion, Alberta 1973-74*

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In the current controversy surrounding abortion, rates of illegal abortion, being difficult to ascertain, seldom inform the debate. We utilize a relatively new survey tool, the randomized response technique (RRT), to estimate rates of illegal abortion in Edmonton, Alberta. A comparison of results obtained by means of the RRT with those obtained by more traditional means reveals that the RRT has the capacity to elicit responses to sensitive questions not possible using other techniques. Two estimated rates of illegal abortion are provided: 1) illegal abortion rate per 100 conceptions; and 2) illegal abortion rate per 100 conceptions surviving the first four weeks of gestation. An analysis of the relative impact of eliminating the option of therapeutic abortion on the birth-rate and the computed rates of illegal abortion reveals that the already fairly high rate of illegal abortion in Alberta would likely increase substantially while the birth-rate would remain relatively unaffected.

A bortion continues to evoke considerable public debate and controversy. Involved in the debate are questions of moral and ethical responsibility to self and others, human rights, purposes for which abortion is used, hazards incurred either to life or health, and costs to the public purse. Not least of the questions is how far termination of unwanted pregnancy, for whatever reason, is a public health concern. Workers within the health care system, including public health personnel, also tend to be sharply divided on the subject of abortion and its implications.

One striking anomaly is that, while we are now accustomed to rely heavily on arguments based on hard data, basic knowledge about abortion is incomplete in most countries including Canada. The explanation is straightforward. Although there is a clear world-wide trend toward greater legalization of abortion cutting across traditional ideological and economic developmental lines, there is strong evidence that abortions are continuing to take place outside the legal code. The number of illegal abortions actually performed is typically not known and very difficult to ascertain. Clearly relevant to public health is that the definition of health within the legal code varies from country to country, thus placing various restrictions on the availability of legal abortion.

We describe a fairly new survey technique which can be used to ascertain the extent of any sensitive attribute in a population, including illegal abortion. Findings from the application of this technique in a survey of women in Edmonton, Alberta, during 1973-74 provide the basis for estimates of the rate of illegal abortion in the Province of Alberta. Lastly, estimates are made of the relative impact on the birth-rate and the rate of illegal abortion under the hypothetical circumstance that the legal code suddenly becomes more restrictive in defining permissible conditions for therapeutic abortion.

Materials and Methods

The data under analysis are from the Growth of Alberta Families Study (GAFS) involving a sample of 1,045 Edmonton women of different marital status between the ages of 18 and 54, and codirected by Krishnan and Krótki (1). A stratified cluster sample based on 1971 Census of Canada distributions of mother tongue was drawn enabling ethnic group differences to be analysed. The survey represents the first major fertility survey to be undertaken in Western Canada and is one of only a handful in the entire country (2, 3). Interviews were conducted by specially-trained interviewers from 19 November 1973 to 15 February 1974. The GAFS questionnaire includes standard questions on family size preferences, contraceptive usage, fertility history, attitudes toward fertility-related matters, and background information as well as some innovative questions on role preferences, values, and abortion experience.

The final sample for which interviews were successfully completed, consisting of 69.5% of the eligible population, was

divided into three interpenetrating sub-samples in order to compare the data-gathering potential of three separate survey techniques. The first sub-sample was asked all questions, including sensitive questions on abortion experiences, in the traditional face-to-face interview. The second subsample was asked sensitive questions by means of an anonymous mail-back questionnaire left with the respondent by the interviewer at the conclusion of the interview. The third subsample was asked the sensitive questions by means of a new survey technique known as the randomized response technique (RRT).

The Randomized Response Technique (RRT)

The randomized response technique was developed in 1965 by Warner (4) as a possible solution to the perplexing problems of obtaining truthful responses to sensitive questions in social surveys. The RRT, in its original version as well as in its many subsequent modifications, randomizes responses to sensitive questions so as to protect the individual from revealing his/her personal answer. The stigma and embarrassment that might result from admitting to certain experiences or behaviours is thus circumvented.

The original RRT model devised by Warner consists of asking respondents one of two questions in a form like:

1) I am a member of Group A;

2) I am not a member of Group A. Probabilities associated with selection of each question are built into the randomizing device. The question which the respondent is answering remains unknown to the interviewer. Answers, therefore, provide information only on an aggregate probability basis.

The RRT has seen a flurry of modifications since Warner's 1965 pioneering efforts. One of these involves the use of unrelated questions sometimes with two independent samples (5, 6). Another permits estimation of quantitative as well as qualitative information (dimensions rather than proportions) (7). Yet another innovation sets probabilities of question selection at .5 enabling the use

of a coin as the randomizing device (8).

Randomized response technique has been used successfully thus far to improve responses to questions on illegitimate births (6), to estimate past-year incidence of abortion, lifetime abortion, and use of oral contraception (9), to estimate income (10), as well as to measure equally sensitive but non-demographic behaviours such as illicit drug use (11) and impaired driving (12). For a comprehensive summary of developments in the RRT since 1965, see Krotki and McDaniel (13). Estimates computed on the basis of the RRT of most sensitive attributes have tended to compare favourably with estimates obtained by independent measures which also protect the privacy of the individual to an extent greater than the typical survey. The contribution that this technique has made to social survey research so far seems to invite further exploration of its potential.

The specific RRT approach chosen for use in the GAFS constitutes a replication of that used in the massive North Carolina studies dedicated to testing the utility of the technique in a field situation (10). Respondents were introduced to the technique as a game designed to ask some additional questions subsequent to the formal interview. They were informed that this was a new technique being used in the Edmonton study to see whether it was a good method for obtaining information. To avoid confusion and misunderstanding, abortion was defined for respondents prior to administration of the RRT. The following definition of abortion was read to respondents as part of the RRT instructions: "An abortion is an operation of some kind which a pregnant woman has in order to end her pregnancy and keep her from having a baby, or something which she might do to herself to end the pregnancy and keep from having the baby."

The respondents, a total of 352 women, were presented with a transparent plastic box containing 35 blue balls and 15 red balls. The box contained a window in which a single ball could appear. As well, respondents were pro-

vided with a card listing seven pairs of statements or questions identified by number. These are presented below:

1. A. I was pregnant at some time during the past 12 months and had an abortion which ended the pregnancy.
   B. I was born in the month of June.
2. A. How many abortions have you had during your lifetime?
   B. How many children does your best friend have?
3. A. As an unmarried woman I had sexual intercourse.
   B. I was born in the first ten days of a month.
4. A. As an unmarried woman I became pregnant.
   B. My mother was born in the month of May.
5. A. As an unmarried woman, I became pregnant and gave birth to a child.
   B. I was living in the same dwelling five years ago.
6. A. As an unmarried woman, I used contraception to prevent pregnancy.
   B. I was born in the month of December.
7. A. As an unmarried woman, I had an abortion to end a pregnancy.
   B. I was born in the month of September.

For each pair of statements or questions a blue mark appeared in front of the first statement and a red mark in front of the second. Respondents were asked to shake the box and tip it so that a single ball appeared in the window. They were then instructed to answer the question or say "yes" or "no" to the statement on the card with the same colour code. The interviewer who sits at some distance from the respondent never knows which question is being answered by the respondent. Following each question and at the conclusion of the interview, the respondent was requested to shake the box thoroughly.

Since probabilities associated with the selection of each of the two possible questions are built into the randomizing device and the distribution of responses

to the non-sensitive question are known from other available sources, the technique permits an unbiased maximum likelihood estimate to be made of the true proportion of the population possessing the sensitive attribute. Let:

Y_B = true proportion of population with sensitive attribute A

Y_R = proportion of the general population who would answer "yes" to nonsensitive question

P = probability that the statement "I am a member of Group A" is selected by the randomizing device to be answered

n = sample size

Y = proportion of respondents who give a "yes" response.

Then the value of the unbiased likelihood estimate of the proportion of persons possessing the sensitive attribute would be:

$$\hat{Y}_B = \frac{Y - (1 - P)\, Y_R}{P}$$

The variance of this estimate would be:

$$Var(\hat{Y}_B) = \frac{Y_B(1 - Y_B)}{n} + \frac{P(1 - P)}{n(2P - 1)^2}$$

Findings

Estimates of past-year and lifetime abortion incidents were made and comparisons drawn on the basis of the three data-gathering techniques: face-to-face interview, anonymous mail-back questionnaire, and randomized response technique. It is clear from Table I that there is a greater tendency for respondents to report abortions when the questions are randomized than if questions are contained in a self-administered questionnaire. A greater tendency to report abortion in both these situations than in the traditional face-to-face interview is also indicated. It is, of course, difficult to estimate the degree to which underreporting occurred even with use of the RRT. Two somewhat contradictory bits of evidence seem to

shed some light on the degree of misreporting. First, at the conclusion of the RRT interview, each respondent was asked whether she thought her friends would find a trick in the technique. Sixty-three percent of respondents answered no. In response to the question, "Are you sure, when you played the 'game', that I did not know which question you were answering?," only 58% replied with confidence that they were sure. This might indicate that although most respondents trust the technique, a minority doubt its privacy-protection capability and thus might be suspected of misreporting. The second piece of evidence with respect to the truthfulness of reporting with the RRT emerged from consistency checks on responses given under RRT. The evidence from an unpublished paper by McDaniel suggests that inconsistencies in reporting (greater incidence of past-year than lifetime abortion for example) are largest for older women and women with only elementary school education than for other women. On average, however, the consistency of reporting suggests considerable forthrightness on the part of the majority of respondents.

Evidence provided in Table II shows that on three basic comparative measures, nuptiality, age structure, and ethnicity, the three subsamples from the Growth of Alberta Families Study do not differ substantially from Census proportions for the City of Edmonton or the Province of Alberta. Exactly comparable data for the GAFS sample and the two census populations on standard measures of socio-economic status, including income, were unfortunately not available. Given, however, that a focus of the GAFS study was on ethnic differentials in family size and fertility attitudes, every attempt was made to render the GAFS sample representative of the total population.

A good check on the rates of past-year abortion reported in the GAFS subsample would be the rates of recorded therapeutic abortion for the City of Edmonton during the same period. These data, however, are not published by city. Having good records

TABLE I.
Comparison of 95% Confidence Intervals around Sample Proportions Based on Three Data-Gathering Techniques

	RRT Weighted	Unweighted†	Mailback Questionnaire	Interview‡
Abortion in Past Year	.0371 (± 028)	.032 (± .032)	.008 (± .011)	.003 (± .003)
Abortion in Lifetime	.0757 (± .018)	.090 (± .068)	.038 (± .023)	.015 (± .013)
Unmarried, Intercourse	.6300 (± .063)	.623 (± .076)	.605 (± .059)	
Unmarried, Pregnant	.1785 (± .045)	.190 (± .055)	.213 (± .049)	
Unmarried, Gave Birth	.1285 (± .051)	.078 (± .063)	.075 (± .032)	
Unmarried, Used Contraceptive	.2940 (± .053)	.326 (± .067)	.281 (± .054)	
Unmarried, Had Abortion	.0185 (± .024)	.021 (± .030)	.034 (± .022)	
N =	342§		269	327

†Source of all but weighted data (14).
‡Due to a typing error in the final version of the questionnaire which omitted the question on month of marriage, comparisons on all three techniques for all variables were precluded.
§The difference from 352 reported in the text is due to missing data on characteristics listed in this table.

TABLE II.
Comparison of GAFS Sample with Edmonton and Alberta

| | | GAFS | | 1971 | 1971 |
	RRT	Questionnaire	Interview	Edmonton	Alberta
Proportion					
Ever Married	.844	.823	.818	.728	.830
Over 29 yrs	.524	.566	.494	.579	.609
From British					
Isles	.384	.373	.332	.429	.462
N =	346§	269	327	126,520	382,670

§The difference from 352 reported in the text is due to missing data on characteristics listed in this table.

TABLE III.
Point Estimates of Induced Abortion, Therapeutic and Illegal, Alberta, 1973

| | RRT | | | |
	Weighted	Unweighted	Questionnaire	Interview
Induced	14,197	12,322	3,058	1,148
Reported				
Therapeutic**	4,040	4,040	4,040	4,040
Estimated				
Illegal	10,157	8,282	-982††	-2,893††

**Source: (15).
††Estimated illegal abortions not admitted to by GAFS respondents in their replies.

on the rates of therapeutic abortion for the province of Alberta, it was decided that some comparisons, although strictly speaking not indicated by a sample of a city within the Province, might prove instructive. Table III shows the estimated number of total abortions that would have occurred in the Province of Alberta had the rates estimated in the GAFS study applied to the entire population of Alberta. If these figures can be given any credence, it would appear that when asked in an interview or in a mail-back questionnaire, the numbers of abortions reported by respondents do not reach the levels recorded by officials at the time of therapeutic abortion. The RRT, in contrast, seems to possess the capacity to ferret out these abortions as well as others not counted in public records. For the purposes of this exercise, these "excess" abortions will be labelled illegal. It may be, of course, that they took place in other provinces or even outside the country and not be illegal at all

according to the standard usage of that term.

To compute an estimate of the rate of "illegal" abortion, as defined here, it is necessary to relate estimated numbers of such abortions to population at risk, or to total conceptions. Abernathy and his colleagues (16) in North Carolina devised two rates: the first denotes the probability that a conception will result in an illegal abortion; the second, the probability that a conception surviving the first four weeks of gestation will result in an illegal abortion. In order to estimate total conceptions, some information must be obtained on total live births, induced abortions, and other foetal loss. A 1963 study in New York City of private hospital patients estimated foetal loss at 295 per 1,000 conceptions (17). If applied to Alberta data, the estimated total number of conceptions per live birth would be:

$$x = \text{live births} + (.295x)$$
$$= \text{live births}/.705$$
$$= 1.418, \text{ where}$$

.295x = foetal loss excluding illegal abortions.

It is of interest to note that this is the same result as obtained by Abernathy in the North Carolina study (16).

Defining the illegal abortion rate per 1,000 total conceptions as:

$$\frac{\text{Estimated illegal abortions}}{1.418 \text{ (live births)} + \text{estimated illegal abortions}} \times 100$$

it is found that the estimated rate of illegal abortion in Alberta, generalizing from the RRT estimates, is 19.7. This means that, according to our estimates, one conception in five ends in what could be termed illegal abortion. The comparable estimate for North Carolina, as found by Abernathy (16), is 22.3 (14.9 for whites and 32.9 for non-whites).

It could be argued that only an insignificantly small number of induced abortions occur under four weeks' gestation. The sequence of events involving illegal abortion might easily involve the exhaustion of legal channels first, a time-consuming venture. Abernathy (16) suggests that "... an index relating illegal abortions to conceptions surviving the first four weeks would be more specific and meaningful. The denominator would be free of a large number of spontaneous abortions and would more accurately reflect those pregnancies subject to the risk of illegal abortion." Erhardt (17), once again, assists in estimating that 888 out of 1,000 conceptions survive the first four weeks of gestation. Applying this estimate, we find

$$Y = .888x$$
$$= .888 \text{ (live births)}/.705$$
$$= 1.260.$$

The total number of conceptions surviving the first four weeks of gestation per live birth is 1.260. Then, the illegal abortion rate per 100 conceptions surviving the first four weeks of gestation would be:

$$\frac{\text{Estimated illegal abortions}}{1.260 \text{ (live births)} + \text{estimated illegal abortions}} \times 100$$

Substituting Alberta estimates, it is found that the rate of illegal abortion per 100 conceptions surviving the first four weeks of gestation is 22.4. The comparable rate computed by Aber-

nathy is 24.4 (16.4 for whites and 35.6 for non-whites). Given the differences in social structure and ethnic/racial composition between North Carolina and Alberta, it is not surprising that both Alberta estimates of illegal abortion are somewhat lower than those obtained by Abernathy (12).

Relative impact of Eliminating Therapeutic Abortion

In light of the continuing controversy surrounding abortion, it is interesting to speculate on what might happen to the birth-rate and the rates of illegal abortion in Alberta if for some reason therapeutic abortion were no longer accessible. Estimates of the rates of illegal abortion based on the application of the randomized response technique in Edmonton allow such speculation.

In an analysis of the impact of liberalized abortion laws on birth-rates in New York, Tietze (18) found an actual increment of some 65,000 legal abortions to resident women during the period from 1 July 1970 to 30 June 1971, the first period after change in the abortion law. Obviously, some of these legal abortions, without a liberalized law, would have resulted in live births, some in unavoidable foetal losses, and some in illegal abortions. Tietze then compared the actual decline in birth-rate over this period to the decline which would have occurred had the 1970 age-specific fertility rates prevailed. This represents "a first approximation" of the possible number of births averted or postponed by legal abortion. On the basis of estimates made by Potter (19), Tietze calculates the number of abortions which would have been required to achieve the

decline as 1.2 abortions per live birth. Tietze concludes that 32-35% of the actual increment in legal abortion during the 1970 to 1971 period would have actually resulted in live births approximately six months earlier. The remainder would have resulted, according to Tietze's estimates, in illegal abortions.

Table IV shows the results of application of Tietze's estimates to Alberta data. It has been suggested that Tietze's estimates might become non-generalizable after their first application. This assertion rests on the observation that at the time when New York first liberalized its abortion laws, virtually no other place in North America had laws of facilities sufficient to accommodate the demand for abortion. Once New York's law changed, it may have become an oasis for those women seeking legal abortion. To prevent non-generalizability, however, Tietze restricted his analysis to resident women.

Two additional points might be made about the applicability of Tietze's analysis to the Alberta situation. First, the social and cultural milieu in Alberta might be sufficiently different from New York as to affect the rates of potential live births to illegal abortions. Second, the two- or three-year period from 1970-71 to 1973 saw a proliferation of institutional "supports" for the woman facing unwanted pregnancy. This, too, could influence our estimates of the relative impact of eliminating legal abortion on the birth-rate and on the rate of illegal abortion.

It is clear that if Tietze's proportions are credible in Alberta that the effect of inaccessibility of legal abortion in

Alberta would be largest on the rate of illegal abortion. The impact of such a change on the birth rate is negligible. In contrast, however, the rate of illegal abortion per 100 conceptions surviving the first four weeks' gestation could increase as much as 12% as a consequence of eliminating legal abortion.

Conclusions

It seems justifiable to conclude, first of all, as other investigators have, that the randomized response technique is a useful addition to the survey researcher's repertoire. This technique appears to have the capacity to elicit information on sensitive questions such as abortion which is internally consistent and compares favourably with estimates of sensitive events obtained in other parts of the world by alternative, more cumbersome, means.

If any credence is to be given to the estimates of abortion provided in this paper, it would seem clear that an important social and health problem has been isolated as well as a thriving economic enterprise. Clearly more research on this topic is necessary and will no doubt be forthcoming. It is hoped that such future research might provide the informed background necessary for consideration of the many issues involved in abortion. If this analysis is taken seriously, it might be concluded that "mother love" in this modern world is a less likely response to the perplexing problem of unwanted pregnancy than is the seeking of an end to such pregnancy, by whatever means possible.

Acknowledgement

Dans la controverse qui fait rage de nos jours sur l'avortement, le nombre d'avortements illégaux, difficile à déterminer, ne contribue guère au débat. Nous utilisons un instrument d'enquête relativement neuf: la technique de réponse au hasard (TRH) pour évaluer les taux d'avortement illégal à Edmonton. Une comparaison des résultats obtenus par TRH et ceux qui sont

TABLE IV.
Effect of Eliminating Therapeutic Abortion in Alberta, based on RRT Estimates of Illegal Abortion

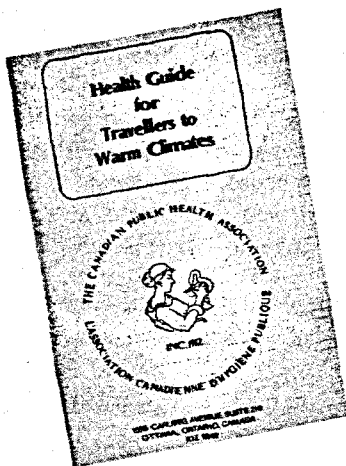|	1973 Rates	High After Elimination	Low After Elimination
Crude birth-rate	18.2	19.2	19.1
Illegal abortions per 100 conceptions	19.7	22.9	22.8
Illegal abortions per 100 conceptions surviving first four weeks	22.4	25.1	24.9

recueillis de façon plus conventionnelle montre que le TRH est en mesure de produire les réponses à des questions très personnelles que d'autres techniques ne permettraient même pas de poser. On obtient deux calculs de taux d'avortement: 1) taux d'avortement

illégal par 100 conceptions et 2) taux d'avortement illégal par 100 conceptions survivant les quatre premières semaines de gestation. Une analyse de l'impact relatif que provoquerait l'élimination des possibilités d'avortement thérapeutique sur les taux de natalité et

les taux calculés d'avortement illégal démontre que le taux déjà passablement élevé d'avortement illégal en Alberta, augmenterait de façon substantielle tandis que le taux de natalité demeurerait à toutes fins pratiques constant.

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