

A STUDY OF REFUSAL RATES TO THE PHYSICAL MEASURES  
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This article presents the findings of an experimental design set up to study the variation in refusal rates to the different modules of the physical measures component of the Canada Health Survey. The study indicated that interviewer teams have a significant impact on refusal rates. Also, a large proportion of the refusals was due to total family refusals rather than individual refusals within responding families.

## 1. INTRODUCTION

The broad objectives of the Canada Health Survey are to provide reliable information on the health status of Canadians. The survey consists of two components:

- a) an interview component which covers self-perceived and self-reported data collected by trained interviewers, and data given by respondents in self-administered questionnaires;
- b) a physical measures component where the observations and tests are taken with the help of qualified nurses.

The three modules comprising the physical measures component are:

A - anthropometric measurements (height, weight, blood pressure and arm skinfold thickness)

B - blood tests

F - fitness test

There was concern over public reaction to collection of the physical measures data in a field survey. The greatest concern was that in requesting blood samples from respondents for module B, reaction would be such that response to the entire physical measures component (and eventually to the Canada Health Survey) would be jeopardized.

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A pilot survey was mounted in Peterborough, Ontario, in the last week of July and the first two weeks of August 1976 to test the acceptability of each of the three modules of the physical measures component to the general public. The primary objective of the test was to examine the variation in response rates (or conversely in refusal rates) to the modules of the physical measures component and to study the causes of such variation. For this purpose, the test was set up as a factorial split-plot design controlling for the effects of two factors which it was felt could affect the refusals rates—interviewing teams and family types.

Although the test sample covered both rural and urban families, because of problems with the availability of suitable sampling frames, the main experimental design to test refusal rates to modules A, B and F was confined to urban families. Single member families and families containing only aged persons were also excluded owing to inadequate numbers of such cases in the frame, and to logistical difficulties.

A sample of urban families with only aged persons was used for a design involving modules A and B only, since aged persons (defined as those aged 65 and above) were not eligible for the fitness test. In rural areas an experimental design controlling for different factors was not possible and all that was attempted was a feasibility study of the field and laboratory procedures of the physical measures component. Details of the Peterborough test are given in [1] and [2].

This article describes the main experimental design set up for urban families (excluding single member families and those with only aged persons) and the analysis of the refusal rates observed in the experiment.

## 2. SAMPLE DESIGN

Peterborough city, as defined by the 1971 Census, consisting of 103 census enumeration areas (EA's) was the target population.

A two-stage sample of families was selected where EA's were the first stage sampling units. A random systematic sample of 8 EA's was selected from the 103 in Peterborough city after excluding uninhabited EA's, collective EA's (which were large institutions and hotels etc.) and those EA's covered by the current Labour Force Survey. The EA's were arranged in increasing order of average income per household (1971 Census data) before selection, in an attempt to represent families with different economic status in the sample.

The list of households in the sampled EA's was obtained from the 1975 city street directory for Peterborough and those households with telephones were contacted by telephone to build the sampling frame for the second stage sample. This telephone listing operation provided information on the composition of the households by families which was used to classify them into types for the experimental design. (Details on the success of the telephone enquiry in contacting households, types of families, etc. are given in Table A.1 of the Appendix.)

Cost considerations suggested a field staff of 12 interviewer teams, each consisting of an interviewer and a nurse. It was expected that a team would be able to complete 1 family on the average per working day, working in the evenings, so that a total sample size of about 200 families was feasible in the three week test. (As it turned out, many of the interviews were completed during the day itself which resulted in the assignments being completed earlier than expected.)

Families other than single member families and those with aged persons only were classified into two types for the experimental design:

TYPE 1: adults only

TYPE 2: mixed families (adults with aged and/or children).

It was felt that the presence of aged and/or children might affect the response rates to the different modules.

From each of family types 1 and 2, 80 families were selected at random for the experimental design. A random sample of 32 households from among those that could not be contacted by telephone during the listing operation was also included for the test and those families among them that belonged to types 1 or 2 were added to the appropriate sample.

The total sample consisted of all the individuals in these 192 families. On contact some of these families were not eligible for the enquiry since they were single member families or had only aged persons. The effective sample size was therefore reduced to 177 families and 540 persons in these families.

### 3. EXPERIMENTAL DESIGN

The main objective of the test was to study the effects of modules B and F and their interaction on refusal rates. Module A was a standard part of the Physical Measures component to be applied as a 'control' to all the sampled persons. A factorial design therefore appeared suitable with combinations of two levels (presence and absence) of each of the 'factors' B and F giving rise to four treatments to be tested—modules A, AF, AB and ABF. A split-plot design was set up to improve the precision of the comparisons between the treatments and to allow an adequate workload of 16 families to each of the interviewer teams. Family types were used as blocks, each block consisting of about 96 families (80 that were sampled within the type and those among the additional sample of 32 families that belonged to the type). Within each type, random subsamples of 8 families were used as plots (so as to best represent each block) and a plot was assigned at random to each of the 12 interviewing teams which were the 'whole plot treatments'. Random subsamples of 2 families within each plot were used as sub-plots and these were assigned at random to the four treatments.

As explained earlier, the family 'types' as determined by the listing operation needed correction. Consequently the total sample size reduced to 177 families and the sample sizes in the different split-plots were unequal.

Table 1 shows the layout of the design indicating the number of sample families allotted to each interviewer team x family type x module combination cell.

TABLE 1: Distribution of sample families by interviewer-team, family type and module

Interviewer Team	Family Type								Total
	1 adults only				2 mixed				
	Module Combination								
	ABF	AF	AB	A	ABF	AF	AB	A	
1	2	2	1	1	2	1	2	2	13
2	2	2	2	3	2	1	2	0	14
3	2	1	1	1	1	2	3	3	14
4	2	3	3	1	2	1	1	3	16
5	1	2	1	1	2	1	2	3	13
6	1	3	1	2	2	1	2	2	14
7	1	2	1	2	2	3	3	2	16
8	2	2	3	2	2	1	1	2	15
9	2	2	1	2	2	2	3	2	16
10	2	3	2	2	2	1	2	1	15
11	2	2	1	2	2	2	3	2	16
12	3	1	1	1	1	3	3	2	15
Sub-total	22	25	18	20	22	19	27	24	177
Total	85				92				177

Any family that was away (e.g. on vacation) and could not be interviewed during the test period was replaced by a family belonging to the same type from a reserve list to retain the sample size for the experimental design. 16.4% of the sample families needed such replacement. Replacement was not done for the cell with no family (module A, family type 2, interviewer team 2 in table 1) because that was not discovered until after the completion of the field work.

Table 2 shows the distribution of the number of eligible persons in the sample families in the different cells of the split-plot design. This number excluded infants (who could not stand) and members who were temporarily absent during the field test period.

TABLE 2: Distribution of no. of persons in sample families by interviewer-team, family type and module

Interviewer Team	Family Type								Total
	1 adults only				2 mixed				
	Module Combination								
	ABF	AF	AB	A	ABF	AF	AB	A	
1	5	5	2	2	6	5	7	3	35
2	4	6	4	6	9	6	7	0	42
3	5	5	2	2	4	8	8	12	46
4	5	9	7	3	8	2	4	11	49
5	3	5	4	2	8	3	7	15	47
6	3	9	2	4	6	4	8	6	42
7	2	6	2	6	7	11	9	8	51
8	6	5	8	6	8	3	2	5	43
9	5	7	3	4	6	8	11	6	50
10	4	6	5	5	8	7	11	4	50
11	5	4	2	7	5	6	6	8	43
12	4	3	2	4	3	11	10	5	42
Sub-total	51	70	43	51	78	74	90	83	540
Total	215				325				540

#### 4. DATA COLLECTED IN THE EXPERIMENT

For each sample family a short interview component was administered as a preface to the physical measures component and to collect basic information on the family composition. That was followed by data collected for all the members in the family for the combination of modules assigned to it as per the experimental design. A family and a person were the two types of units considered for the study of refusals to the modules and the analysis of variance was done only for persons because of the small numbers of families in each cell.

## 5. RESULTS AND ANALYSIS

There were three types of refusals to the physical measures component, each of which was handled differently for the response analysis.

a) Entire family refusals to both interview and physical measures components:

In this case, the entire family refused and no data was obtained on the family during the survey. The only data available for such families was the number of persons in them obtained from the telephone listing operation if they were contacted in that operation. The number of refusals was then set equal to the number of persons in the family. For those family refusals that were not contacted by telephone (5 families), family type and size was imputed by randomly selecting a contacted survey family and imputing its type and size to the refusal family.

b) Family refusals to physical measures component only:

For those families that refused only the physical measures component, data on family size was obtained from the interview part of the survey and the number of refusals for that family was set equal to its family size.

c) Individual refusals to the physical measures component within participating families.

Table 3 shows the distribution of families and persons within these families that were classified as refusals of type (a), (b), or (c). Refusals of type (a) were most common, refusals of type (b) were infrequent, while individual refusals to the physical measures component within participating families were rare.

The majority of person refusals was due to the refusal at the doorstep to the interviewer on first contact.

TABLE 3: Distribution of families and persons within these families by type of refusal

	Families		Persons	
	Number	% of total	Number	% of total
Type (a) refusals of whole families to interview and physical measures components ..	20	11.3	58	10.7
Type (b) refusals of whole families to physical measures component only .....	9	5.1	26	4.8
Type (c) refusals of individuals within participating families to physical measures component .....	-	-	20	3.7
Total refusals to physical measures .....	29	16.4	104	19.3
Total number in sample .....	177	100.0	540	100.0

The person refusal rate,  $p$ , in each cell of the experimental design layout was calculated as  $\frac{r}{n}$  where  $r$  = total no. of persons who had refused the physical measures among the families in that cell and  $n$  = no. of eligible persons in the families in the cell.

Because of the fact that  $p$  has a binomial distribution and  $n$  varies from cell to cell, the transformed variable  $y = \sin^{-1} \sqrt{c + (1-2c)p}$  was used for the analysis of variance where  $c = \frac{1}{4\bar{n}}$  and  $\bar{n}$  is the harmonic mean of the  $n$ 's. (Refer [3]).

The following table gives the analysis of variance for  $y$  for the experimental design adopted. The formulae used are described in Appendix B. The value of  $p = 0$  was imputed for the cell with the missing observation since it belonged to Module A and 17 of the 24 module A cells had  $p = 0$ .



TABLE 4: Analysis of variance for refusals to the physical measures

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Sum of Squares	F
Between family types ....	1	0.1324	0.1324	3.0839
Between interviewers ....	11	1.4323	0.1302	3.0338*
Main plot error .....	11	0.4721	0.0429	-
Main effect - blood .....	1	0.0968	0.0968	1.0563
Main effect - fitness ...	1	0.0136	0.0136	0.1484
Interaction - blood x fitness ...	1	0.1606	0.1606	1.7525
Interaction - module x team .....	33	4.2851	0.1299	1.4174
Residual error .....	36	3.2980	0.0916	
Total .....	95	9.8908		

FOOTNOTE:

\*5% significance level

\*\*1% significance level

$F_{1,11}$	4.84	9.65
$F_{11,11}$	2.82	4.46
$F_{1,36}$	4.11	7.39
$F_{33,36}$	1.76	2.23

The F test showed that the variation among the interviewer teams was the only component to achieve significance at the 5% level. None were significant at the 1% level.

Table 5 gives the refusal rates to physical measures, by persons for each of the module combinations, family types 1 and 2 and interviewer teams 1 to 12.

TABLE 5: Refusal rates to physical measures by person

Total refusal rate among all sample persons - 19.3%		
By module combinations:	ABF	- 20.9%
	AB	- 21.5%
	AF	- 22.6%
	A	- 11.9%
By household types:		
Type 1:	multiple member adult hhlds.	- 23.7%
Type 2:	mixed hhlds. (adults with aged and/or children)	- 16.3%
By interviewer teams:	Team No.	
	1	- 31.4%
	2	- 42.9%
	3	- 10.9%
	4	- 18.4%
	5	- 19.1%
	6	- 9.5%
	7	- 19.6%
	8	- 34.9%
	9	- 10.0%
	10	- 8.0%
	11	- 23.3%
	12	- 9.5%

Although the analysis of variance showed that there was no significant variation among refusal rates to the modules, the above table shows that the overall refusal rate for A only was half of that for the other modules. The refusal rates between interviewer teams varied from as low as 8.0% to 42.9%.

## 6. CONCLUSIONS

The following conclusions are based on the findings of the Peterborough test presented above. It must be emphasized that this was a specially mounted first test on the general public at one point of time, confined to one small English speaking area. The test has a high publicity profile and was undertaken under survey conditions that did not and could not quite simulate those that would prevail in the final survey. It must be noted also that the experiment was set up to compare response rates between modules and not to obtain estimates of response or refusal rates. As such, the main findings presented above

and conclusion in (a) below are valid outcomes of this test. However estimates of refusal rates that occurred in the test and that are incidental to its main findings have been presented above and commented upon in (b) below since they are indicative of the order of magnitude of refusal rates that might be met in the final survey and of the causes for such refusals. Given the scope and purposes of the test, it is recognized that generalizations are difficult and simple extrapolations could be misleading.

- a) The analysis of variance of refusal rates for urban families other than single member and aged families showed that interviewer teams rather than modules, family types or interactions between them, was the significant factor affecting refusal rates to the physical measures component.

Initial fears that the blood test module would increase refusal rates appear to be unfounded on the basis of this test, although it should be noted that the refusal rate to the A module was half that to the other modules.

- b) The overall refusal rate to the physical measures at the family level was high at 16.4% of all sample families. The refusal rate at the person level was even higher at 19.3%. A large proportion of these refusals (15.5% out of the 19.3%) was accounted for by total family refusals to the interview or physical measures component, and these were basically refusals on behalf of the whole family of the person first contacted by the interviewer. To add to this, 16.4% of the households could not be contacted during the survey and were replaced for the experimental design.

Also, it should be noted that this study was conducted essentially among households that were initially contacted by telephone so that the 8% refusals to the telephone and 21% non-contacts by telephone were excluded from the study. (See Table A.1 of the Appendix.)

Debriefing of 7 of the complete refusal families showed that these families had decided that they would not participate even before the interviewer had contacted them. The general comment was that they did not wish to participate in a government survey—it was a waste of time and money. 5 of the refusals to physical measures were debriefed. It appeared that usually the 'too old' were not interested and that the main reasons for other refusals were 'too busy' or 'other household members would not be interested'. (Refer [2])

In a survey situation, the total refusals at the household or family level would be decreased by attempts to call back on such households to persuade them to participate in the survey—attempts that were not made in this test. Also, it is difficult to judge the net result of the positive and negative effects that the high publicity profile (initial telephone contact, letter to the household and the various publicity programmes on the news media) had on response rates. On the other hand, in a survey situation, replacements for non-contacted families would not be allowed. This would inflate the total non-response rates although it would be mitigated to some extent by the lack of pressure to make early contacts and fix appointments for the physical measures that operated in this test.

The test suggests the need for strengthening door-step diplomacy tactics to persuade the first person contacted to co-operate in the survey and the need for steps to be taken while hiring and training interviewers to ensure a standard interviewer approach to respondents that would lower refusal rates.

The formulae for sums of squares in the ANOVA table are as follows:

Source of Variation	d.f.	Sum of Squares
Between hhld types .....	1	$\sum_i \frac{y_{i..}^2}{48} - CF$
Between interviewer teams (main plots) .....	11	$\sum_j \frac{y_{.j.}^2}{8} - CF$
Main plot error .....	11	$\sum_{ij} \frac{y_{ij.}^2}{4} - \sum_i \frac{y_{i..}^2}{48} - \sum_j \frac{y_{.j.}^2}{8} + CF$
Main effect B .....	1	$\sum_{B=0} \frac{y_{... (B.)}^2}{48} - CF$
Main effect F .....	1	$\sum_{F=0} \frac{y_{... (.F)}^2}{48} - CF$
Interaction B x F .....	1	$\sum_{B=0} \sum_{F=0} \frac{y_{... (BF)}^2}{24} - \sum_{B=0} \frac{y_{... (B.)}^2}{48} - \sum_{F=0} \frac{y_{... (.F)}^2}{48} + CF$
Interaction: interviewer team x module (main-plot x sub-plot) .....	33	$\sum_{jk} \frac{y_{.jk}^2}{2} - \sum_j \frac{y_{.j.}^2}{8} - \sum_k \frac{y_{.k}^2}{24} + CF$
Sub-plot error .....	36	obtained by subtraction
TOTAL .....	95	$\sum_{ijk} y_{ijk}^2 - CF$

(where  $CF = \frac{y_{...}^2}{96}$ )

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#### RESUME

Cet article présente les conclusions tirées d'un plan expérimental qui a été élaboré pour étudier la variation des taux de refus aux différents modules de la composante des mesures de bien-être physique de l'Enquête Santé Canada. L'étude a indiqué que les équipes d'interviewers ont un effet significatif sur les taux de refus. De plus, une grande proportion des refus étaient des refus de toute la famille plutôt que des refus individuels dans des familles répondantes.

#### REFERENCES

- [1] Canada Health Survey - Experimental Design and Analysis for the Peterborough Field Test of Physical Measures (Test 3) dated June 29, 1976.
- [2] Canada Health Survey - Peterborough Test - Preliminary Report, August 26, 1976.
- [3] Chanter, D.O., Modification of the Angular Transformation, Applied Statistics, 1975, 24, No. 3.

APPENDIX A

TABLE A.1: Results of the Telephone Listing Operation

Total no. of households listed in the 8 sample EA's ...	1,028
Households with telephones .....	920 (100%)
Households which had moved or which had disconnected phones .....	115 (12%)
Non-contacted households (after at least 3 call-backs).	201 (21%)
Refusals .....	72 (8%)
Effective number of households contacted .....	532 (59%)

APPENDIX B

Formulae for Analysis of Variance of Refusal Rates

Let the proportion of refusals in each cell of the experimental design be  $p = \frac{r}{n}$ , where  $n$  is the no. of sampled persons in that cell and  $r$  is the number of refusals. The transformation used for analysis is

$$y = \text{Sin}^{-1} \sqrt{c + (1-2c) \frac{r}{n}}$$

where  $c = \frac{1}{4\bar{n}}$  and  $\bar{n}$  is the harmonic mean of the  $n$ 's, where  $n$  varies. This is necessary to allow the analysis of variance and usual tests of significance. (Refer [3])

Let  $y_{ijk}$  be the transformed variable for the  $k^{\text{th}}$  module in the  $i^{\text{th}}$  household type and  $j^{\text{th}}$  team; and  $y_{ijk}(\text{BF})$  the corresponding value for different levels of B and F (B=0 if absent, 1 if present; F=0 if absent, 1 if present).