

RECENT TRENDS AND SOCIODEMOGRAPHIC COVARIATES OF CHILDLESSNESS IN CANADA

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Résumé — Tendances récentes et facteurs socio-démographiques de l'infécondité au Canada. Nous examinons les tendances et facteurs de l'infécondité parmi les femmes déjà mariées selon l'enquête canadienne de fécondité. La méthode des hasards proportionnels et la régression logistique permettent une analyse multivariée détaillée selon la parité. Selon l'analyse de régression logistique de la parité, les facteurs de l'infécondité sont la durée de mariage réduite, le plus haut niveau d'éducation, la naissance ailleurs qu'au Canada, le travail présent et l'absence de cohabitation. Nous ne trouvons pas de différences selon le nombre de mariages, mais la cohabitation avant le mariage est associée avec une parité plus élevée. L'analyse par hasards proportionnels est plus claire et permet d'allouer les risques relatifs à différents groupes de femmes. En général, l'infécondité est associée avec l'âge au mariage de 22 ans ou plus, la durée de mariage de moins de 5 ans, la résidence dans les grands centres urbains, 14 ans ou plus d'éducation, avoir moins de deux frères et soeurs, et le travail présent. Nous présentons les risques relatifs pour diverses cohortes et âges afin de discuter le rôle de l'infécondité dans l'abaissement de la fécondité au Canada.

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Abstract — This paper examines the trends and patterns of childlessness among ever married women in Canada using the data from the Canadian Fertility Survey. The proportional hazards model and the logistic regression are used for a detailed multivariate analysis of parity status. The results of the analysis, with logistic regression of parity status, indicate that shorter marriage duration, higher education, foreign birth, current work, and no cohabitation before marriage are some of the typical characteristics of the childless ever married women. Though the analysis does not show significant differences between once married, currently married and women married more than once, it does show that cohabitation before marriage is associated with higher parity. The proportional hazards model analysis is clearer and allows us to calculate relative risks for various groups of women. In general, women who marry at age 22 or later, and are married less than five years, residing in large urban areas, having grade 14 or more education, with one or no siblings, and currently working are more likely to remain childless compared to other groups. Relative risks for various cohorts at various ages have been presented, and the role of childlessness in the overall framework of fertility decline in Canada is discussed.

Key Words — **Cox model, relative risks, childlessness, logistic regression**

The phenomenon of below replacement fertility levels in developed countries has been of recent discussion among demographers and other social scientists and has been observed curiously by policy specialists. It is often difficult to quantify various factors that influence the decision-making process of couples to have or not to have a child. This general difficulty with fertility research stems from the complex mechanisms through which its levels and trends are determined, and often it is difficult to identify and measure the various personal and biological factors that are involved. Thus, our empirical knowledge about the factors of fertility behaviour remains inconclusive.

In a recent study, Romaniuc (1984) analyzed fertility trends from the baby-boom period to the recent baby-bust period in Canada and enumerated a number of factors that seem to be responsible for the all-time low levels of fertility and the maintenance of those levels. Romaniuc used census, vital statistics, and some local surveys conducted in Quebec, to identify the following factors as some of the determinants of prevailing fertility levels. These include late

age at marriage; delaying the first birth to a later age and/or forgoing motherhood altogether; increasing marital breakdown; a decline in the proportion marrying; a reduction of unwanted and unplanned pregnancies; a general preference for small families; changing sex roles and the changing status of women; and an increase in labour force participation among women with an increasing number of years of schooling. Though the above list is long, it is still incomplete, and more factors that in one way or another affect the reproductive decision making are yet to be identified. In the context of this paper, childlessness at various ages is the proportion childless at that age and should not be confused with eventual childlessness for a particular cohort of women. Many will go on to have a child at a later age. Thus, age specific childlessness is to be seen as a combined measure of the delay of the first birth as well as the forgoing of childbearing altogether among a few. Unlike many other factors, postponing of the first birth or avoiding it altogether will have a direct effect on fertility levels in a society, and thus it is important to identify the role of this factor in the overall framework of fertility decline.

In an earlier paper on childlessness in Ontario and Quebec by Rao (1987), the main emphasis was to study the cohort trends from the 1971 and 1981 censuses. By contrast, this paper has two main objectives: (i) to illustrate the recent developments in the methodology for analyzing the cross-sectional data, and comparing that with the more traditional logistic regression suggested in the past for the analysis of parity status; and (ii) to identify the covariates associated with childlessness among ever married women in recent times and present the relative risks for various groups of women. Also we wish to examine the trends and correlates of childlessness in the overall framework of fertility decline in Canada. Since an extensive review of the related work was presented in our earlier publication (Rao, 1987), we will briefly review the developments since then.

In Canada, Veevers pioneered the research on childlessness, with her analysis of census data using simple cross-tabulation techniques, and published a series of articles emphasizing the importance of this neglected area (see Veevers, 1979, 1980). Besides using the census data, Veevers also conducted a special micro-study, dealing exclusively with voluntary childless couples in a Canadian city. Others explored the childless behaviour of Canadian married women with more powerful statistical techniques, in a multivariate setting, using the Public Use Sample Tape of Statistics Canada (Wolowyna, 1977; Grindstaff *et al.*, 1981; Tomes, 1985; Rao, 1987).

Most of the studies on childlessness identify late age at marriage, marital instability and changing attitudes towards family as some of the possible factors associated with it. The effect of late marriage on childlessness may be

due to both biological and psychological reasons. Recent trends of late marriage seem to be, partly at least, because of an increase in the number of women who adopt cohabitation and common law unions with secure personal relationships but have less commitment to having children. The number of births outside wedlock are a clear example of these women's attitudes towards child-bearing. In a recent report, Burch and Madan (1986) indicated that about 90 per cent of common law relationships have taken place since 1970, and on average common law unions have lasted for only three years in Canada, according to a recent Statistics Canada survey.

Rao (1987), analyzing 1971 and 1981 census data for Quebec and Ontario, observed an increase in the proportion of childless ever married women in the reproductive ages, and these proportions are well above the national average. The study showed that age at marriage, marriage duration, income, other income, labour force participation, non-Catholic or no religious affiliation and large urban residence were associated with childlessness in Ontario and Quebec.

Recent studies carried out in the United States using data from 1980 current population survey projected an increase in childlessness among young American women (Bloom, 1982a, 1982b). However, a more recent study by Bloom (1986), using the 1985 population Survey, indicated a levelling off of childlessness in the United States. Bloom (1986) based his prediction on the Coale-McNeil parametric model, in order to complete the reproductive experience of younger cohorts. Currently, one of the authors is working on the application of the Coale-McNeil marriage model to age at the first birth in Canada and hopes that the study will provide some basis for the comparison of trends in childlessness in Canada to those in the United States (Rao, 1987).

Methods and Materials

The data for this study came from the Canadian Fertility Survey that was conducted in April-June 1984 for the detailed analysis of parity status. The Canadian Fertility Survey was the first national fertility survey to be conducted using the telephone for both the selection and in-depth interviewing of the selected respondent: namely a woman in the reproductive age group 18-49, living in a private household that can be reached through the telephone. A total of 5,315 women of all marital statuses were interviewed. Though there is some fertility outside marriage, most reproduction in Canada occurs within marriage. As such, we selected the 3,884 ever-married women in the sample for our analysis of parity status. The earlier studies using census data were

also based on ever married women (Tomes, 1985; Rao, 1987; Grindstaff *et al.*, 1981). The national fertility survey provides information on many standard topics in fertility analysis, such as the complete marriage, pregnancy, work histories, contraceptive use and the socioeconomic characteristics of the respondent.

As with most other data sets, the main limitation of this data set is that we cannot distinguish clearly between voluntary and involuntary childlessness. But this data set does allow us to compute actual or exact marriage durations from first marriage to the date of interview, giving due credit to the breaks that occurred in this time. Thus, we have constructed effective marriage duration, and by following Bogue's (1969) rule of thumb, can guess the extent of voluntary childlessness indirectly. Since having a child is an age dependent characteristic, we planned a separate analysis for each of the age cohorts chosen. The age cohorts considered for ever married women are 18-24, 25-29, 30-34, 35-39 and 40-49. The last group of women can be treated as having completed their fertility, at least for our interest of childlessness. An earlier study by Rao and Balakrishnan (1986), using Canadian Fertility Survey data, indicated that very few first births occur after age 30.

Since the dependent variable, parity status, is a dichotomous variable, it has been suggested that the logit or probit models should be employed for multivariate analysis (Rao, 1987; Tomes, 1985). Though the logit model takes care of the skewed nature of the dummy dependent variable, it is based on a closed situation at the time of survey, i.e., the dependent variable reflects the status of women at the time of interview. Unlike the logit model, later developments in methodology; such as proportional hazards models, allow one to use the incomplete experience of the women, i.e., women who are exposed to childbearing but could not have a child by the time of interview.

The proportional hazards model, first introduced by Cox in 1972, has been improved by others (Cox, 1972; Breslow, 1974; Holford, 1976; Kalbfleisch and Prentice, 1980). Excellent discussion of the method, by applying it to demographic situations, such as marriage dissolution, age at first birth, and infant mortality, can be found in the literature (Menken *et al.*, 1981; Teachman, 1982; Balakrishnan *et al.*, 1987; Rao and Balakrishnan, 1986; Rao and Murty, 1987; Rao, 1987). The core assumptions of this model are that population heterogeneity is captured by the set of covariates included in the analysis and that the relative risks remain constant throughout the duration of exposure to childbearing. The present application of the model is confined to the characteristics of women at the time of the survey, except for a few that are the characteristics at the time of the first birth — our main concern. Besides being categorical in nature, these covariates are fixed and not time dependent. The

superiority of this technique over other traditional methods stems from its ability to handle both open and closed times, and one can identify the groups of women with the highest probability and the lowest probability of remaining childless through the computation of relative risks.

In the hazards model, we employ the time that a woman remains childless since her own birth (age) as the dependent variable and follow these women until the time that they either had a first birth or reached the survey point. This survival time is allowed to be influenced by a set of covariates introduced in the model. The baseline survival function will be calculated for the reference group and for various groups of women with differing characteristics. The model has been fitted for each of the age cohorts of ever married Canadian women.

Findings

Table 1 shows the proportion of ever married childless women in Canada for 1961, 1971 and 1981 censuses; the 1984 FHS (Family History Survey); and the 1984 CFS (Canadian Fertility Survey). For 1961 and 1971, the proportions refer to ever married women in the age group 15-64, whereas the 1981 census and the 1984 FHS are based on women 18-64, and the CFS on women aged 18-49. This table shows that the proportion childless among ever married women has increased in the last two decades from 13.8 in 1961 to 17.7 in 1981. Most of the proportional increase is in the younger age groups, 15-24, 25-29 and 30-34. The childless proportion almost doubled in the age groups 15-24 and 25-29 from 1961 to 1981. The CFS data seems to be a lower estimate of childlessness compared to that of the FHS and the 1981 census data. However, it should be noted that the CFS data is for women in the age group 18-49 and is thus not strictly comparable to that of other data sources. The CFS data shows that about seven per cent of the ever married women expect to remain childless. Among the ever married women, about 9.1 per cent of those married more than once expressed their likelihood of eventually remaining childless compared to 5.5 per cent of those who are once married and currently married.

Grindstaff *et al.*, (1981), analyzing the 1971 census data, found that childlessness among ever married women is closely associated with age at marriage and marriage duration. In a more recent study, Tomes (1985) analyzed the same data with probit analysis and found that religion, place of birth, rural-urban residence and income (both wife's and husband's) are statistically significant, as well as the age at marriage and marriage duration, in the study

TABLE 1: PROPORTION OF CHILDLESS EVER MARRIED
WOMEN IN CANADA

Age at Interview	1961 Census	1971 Census	1981 Census	FHS, 1984	CFS, 1984
15 - 24	28.6	43.0	55.7*	56.4*	46.0*
25 - 29	13.6	20.7	29.9	29.8	25.6
30 - 34	9.7	9.4	14.5	17.8	12.6
35 - 39	9.2	7.4	9.2	9.0	11.2
40 - 49	11.6	8.9	7.27	7.2	5.6
50 - 65	15.1	14.0	9.0	9.3	-
Total	13.8	16.0	17.7	17.3	15.7

* 18-24 for 1981, 1984 FHS and 1984 CFS

Sources: 1961: Statistics Canada Catalogue 98-507, 1961

1971: Statistics Canada Catalogue 92-751, 1971

1981: Public Use Sample Tape, 1981

of childlessness in Canada. Numerous other studies by Veevers with 1961 census data also indicated the importance of age at marriage and marriage duration for childlessness in Canada, with simpler methods of analysis. The CFS data show more than threefold increase of childlessness among those who marry at 18 years of age or younger compared to those who marry late, i.e., after age 25. In the 25-29 age cohort, only 8.3 per cent of women married before the age of 18 are childless compared to 34.1 per cent of those who married at age 22-24 (Table not presented). These trends confirm the earlier findings that age at marriage is one of the most important correlates of childlessness.

Table 2 displays the mean age at first marriage by age and by parity status for ever married women in Canada. The CFS data indicate that lower age at marriage is associated with higher parity. The difference between the means is about two years. The mean age at marriage ranges from 20.9 years to 25.5 years for zero parity women and from as low as 19.5 to 21.7 for those who have had one or more children. The overall observation from this table is that childlessness is always associated with higher age at marriage. Late age at

TABLE 2: PROPORTION OF EVER MARRIED CHILDLESS WOMEN BY AGE AND BY MARITAL DURATION (EXACT), AND MEAN AGE AT FIRST MARRIAGE BY PARITY STATUS

Age at Interview	Marital Duration				Mean Age at Marriage	
	0 - 4	5 - 9	10-14	15+	Zero Parity	1+ Parity
18 - 24	49.9	8.3*	--	--	20.9	19.5
25 - 29	43.6	9.8	7.0	--	23.1	20.9
30 - 34	33.9	12.6	6.1	5.7*	23.9	21.6
35 - 39	36.7	18.2	12.8	3.8	24.2	21.7
40 - 49	21.4	21.6	9.2*	4.4	25.5	21.7
Total	43.9	12.5	9.1	4.3	23.1	21.4
#	370	105	69	60	609	3259

* less than 10 cases

marriage may be an indication of lower desire for childbearing and is associated with higher education, higher income and urban environment. In addition to these, the higher age at marriage limits the exposure time for childbearing and thus reduces the probability of having children to some extent.

As discussed earlier, marital duration is another important associate of childlessness, as it directly measures the exposure time. Table 2 also displays the proportion of ever married childless women by age and marital duration as observed in the Canadian Fertility Survey. The marriage duration presented here is somewhat different from studies done so far in the literature on childlessness. The CFS data allowed us to compute the marriage duration as the exact time spent in marriage, i.e., the breaks between marriages were excluded in the calculation. This table indicates that about 43.9 per cent of women married for less than five years are childless compared to 12.5 per cent of those with five to nine years duration. The marriage duration is more important for younger cohorts, whereas it has less effect for older cohorts. For example, for the 40-49 cohort, marriage duration of less than five years and five to nine years has the same proportion of childless women.

Preliminary analysis of marriage cohorts shows that only 4.4 per cent of women married between 1960 and 1964 remained childless compared to 8.6 per cent of those married between 1965 and 1969. This is almost a 100 per

cent increase from the previous marriage cohort, which indicates that those married from 1960 to 1964 were still influenced by the baby-boom period, whereas the effect of baby-boomers went down 1965 to 1969. The expectations data indicates that about 4 per cent of women married from 1960 to 1964 expect to remain childless, whereas about 8 per cent of the women in the 1965-1969 marriage cohort expect to do so.

Based on past research in Canada and elsewhere, as discussed earlier, we have chosen a set of theoretical and statistically important covariates for the study of childlessness in Canada. The selection is also affected by our preliminary analysis of the data in explaining fertility levels, trends and expectations. These correlates include both ascribed and achieved characteristics of ever married women. The correlates selected include age at first marriage; marriage duration; education (number of years of schooling); place of residence (with three categories, urban, small city, farm); nativity (with two categories, native-born and foreign-born); religiosity (with three categories, church attended weekly, sometimes, rarely or never); work status (with three categories, never worked, ever worked, and currently working); marital status (with three categories, once married and currently married; currently separated, divorced or widowed; and currently and more than once married); cohabitation status before marriage (with two categories, cohabited before marriage, and not cohabited before marriage); and the number of children mother had. The above covariate categories are used in the logit model analysis; for the proportional hazards model, we introduced all the covariates in categorical form due to the program restrictions. Table 3 displays the results of logistic regression analyses. Separate equations are considered for different age cohorts of ever married women. In general, a predictor with a *t* value of about 2.00 is a statistically significant predictor of childlessness. The dependent variable in the logistic regression is the parity status, with value one for childless and zero for one or more children. The logistic model is given by

$$\text{Log } (P/1-P) = \text{Intercept} + B X,$$

where *P* is the proportion of women childless, *B* is the set of regression coefficients, and *X* is a set of correlates considered in the model.

Tomes (1985), analyzing the 1971 census data, indicated that marriage duration and age at marriage do not have a linear relationship with childlessness, but they are related in a curvilinear fashion. Later analysis by Rao (1987), using 1971 and 1981 census data for the provinces of Quebec and Ontario, found that this relationship between the age at marriage and marriage duration is curvilinear for certain age cohorts, while it is not so for some other

TABLE 3: CORRELATES OF CHILDLESSNESS: RESULTS FROM LOGIT REGRESSION OF EVER MARRIED WOMEN SAMPLE, CANADA, 1984
(Model: $\text{Log}(P/C1-P)/2+5) = \text{Intercept} + \text{BX}$)

Correlates Considered	18 - 24		25 - 29		30 - 34		35 - 39		40 - 49	
	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat	Coef.	t-stat
1. <u>Age at first marr.</u>	0.058	1.11	0.048	1.31	0.096	3.05	0.079	2.68	0.066	3.13
2. <u>Marriage duration (Madur)</u>	-0.368	6.21	-0.180	4.99	-0.187	3.45	-0.027	1.05	-0.023	1.30
3. <u>Madur Sq</u>					0.009	2.88				
4. <u>Education</u>	0.141	3.37	0.095	3.93	0.042	1.77	0.027	1.31	0.009	0.43
5. <u>Place of residence</u>										
urban	0.152	0.95	0.050	0.40	0.162	1.09	0.023	0.16	0.005	0.03
farm	0.530	1.82	-0.156	0.65	0.462	1.81	-0.279	-0.90	0.205	0.79
6. <u>Nativity</u>										
native-born	-0.587	2.31	0.076	0.45	0.199	1.15	0.048	0.31	0.292	1.55
7. <u>Religiosity</u>										
Weekly	0.157	0.82	-0.303	2.03	-0.367	1.86	0.016	0.10	-0.024	0.14
Rarely	0.184	1.09	-0.148	1.20	0.336	2.49	0.149	0.98	0.177	1.03
8. <u>Work Status</u>										
Never worked	0.218	0.91	0.044	0.17	0.266	0.74	-0.348	0.58	0.026	0.09
Now working	0.885	5.27	0.777	6.34	0.673	4.41	0.649	3.90	0.080	0.53
9. <u>Marital Status</u>										
Once currently married	0.342	1.36	-0.140	0.73	-0.270	1.34	-0.192	0.85	0.128	0.55
1+ marr. currently married	0.369	0.33	-0.313	0.93	0.212	0.83	0.542	2.38	0.409	1.40
10. <u>Cohab Stat</u>										
Cohab BF										
marr	-0.401	2.48	-0.235	1.90	-0.323	2.15	-0.018	-0.10	-0.569	2.37
11. <u># of children</u>										
Mother had 2 or less			-0.036	1.53						
intercept	2.53	2.33	2.92	3.29	1.52	1.78	1.64	1.80	1.87	2.37

age cohorts. To tackle this problem, we introduced the square and cube terms of marriage duration, age at marriage for each of the age cohorts, and made some preliminary analysis with stepwise logistic regression. In the process, we observed curvilinear relationship with marriage duration for the 30-34 age

cohort, and all other age cohorts seem to follow a simple linear relationship. The authors feel that the curvilinear relationships observed by Rao (1987) and Tomes (1985) with Canadian census data seem to be a function of the sample sizes. Thus, we introduced square terms for marriage duration to the age cohort of 30-34 only.

The regression coefficients shown in Table 3 represent reductions or increases (depending on the sign of the coefficient) in the log odds of the conditional probability of childlessness. These coefficients are to be interpreted relative to the reference category.

This table shows that marriage duration, education, nativity, current work status and cohabitation before marriage are the significant correlates of childlessness among the 18-24 age cohort of married women in Canada. Shorter marriage duration, higher education, foreign birth, current work and no cohabitation before first marriage are some of the characteristics of those women who are more likely to remain childless. As observed in the earlier cross-tabulation, marriage duration is important for younger cohorts, whereas age at marriage is important for older cohorts, i.e., starting from 30-34 onwards. The effect of education is significant for younger cohorts, i.e., for 18-24 and 25-29, whereas currently working is significant throughout except for the 40-49 age cohort. The trends of marital status are not very clear. The women who are married more than once and currently married at the time of the survey are more likely to remain childless in all cohorts except the 25-29 cohort; however, this result is found to be significant only for the 35-39 age cohort. Cohabitation before first marriage is always associated with lower chances of remaining childless. Women who cohabited before marriage may be more family oriented.

The logit analysis of childlessness among ever married women confirms the earlier findings of Tomes (1985) and Rao (1987), with census data that age at marriage and marriage duration are the prime demographic factors important to the study of childlessness. As well as these, education, native born, currently working and not cohabited before first marriage are some of the characteristics associated with childlessness. The results in Table 4 are from the proportional hazards model. The details of the application of the proportional hazards model have been presented in detail elsewhere and they are not repeated here (see Menken *et al.*, 1981; Teachman, 1982). Basically, the proportional hazards function allows the risk dependent not only on time as in a single state life table but also on the personal characteristics of the individual women. There are two important functions on which the model is based and the two functions are related. The hazards function or the force of mortality (having a birth in our case) can be written as

TABLE 4: CORRELATES OF CHILDLESSNESS AMONG EVER MARRIED WOMEN, CANADA, 1984

(Proportional Hazards Model Analysis - Coefficients in Exponential Form)

Correlates	18 - 24	25 - 29	30 - 34	35 - 39	40 - 49
<u>Age at Marriage</u>					
< 19	2.295*	1.690*	2.216*	1.865*	2.458*
20 - 21	1.000	1.000	1.000	1.000	1.000
22 - 24	0.123*	0.642*	0.650*	0.553*	0.602*
25 +	--	0.343*	0.398*	0.358*	0.309*
<u>Marriage Duration</u>					
0 - 4	0.587*	0.628*	0.774*	0.787	0.888
5 - 9	1.000	1.000	1.000	1.000	1.000
10 - 14	--	1.128	1.030	1.059	1.317
15 +	--	--	1.682*	1.190	1.445*
<u>Place of Residence</u>					
Urban	0.880	0.845*	0.842*	0.878	0.941
Other	1.000	1.000	1.000	1.000	
<u>Nativity</u>					
Native Born	1.383	0.903	1.125	0.878	1.008
Foreign Born	1.000	1.000	1.000	1.000	1.000
<u>Education</u>					
Le Gr. 11	1.979*	1.697*	1.385*	1.165	1.373*
Gr. 12-13	1.000	1.000	1.000	1.000	1.000
Gr. 14 +	0.452	0.670*	0.841*	0.836*	0.975
<u># of Siblings</u>					
< 2	0.823	0.990	0.814*	0.732*	0.829*
3 or more	1.000	1.000	1.000	1.000	1.000
<u>Religiosity</u>					
Weekly	0.780	1.314*	1.303*	0.933	1.174*
Sometimes	1.000	1.000	1.000	1.000	1.000
Rarely	0.950	1.026	0.788*	0.855	1.144*
<u>Marital Status</u>					
Once-curr.married	1.234	1.031	1.052	0.885	0.748*
S, D, W	1.000	1.000	1.000	1.000	1.000
More than once	1.409	1.211	0.746	0.524*	0.411*
<u>Work Status</u>					
Never	1.000	1.000	1.000	1.000	1.000
Now	0.313*	0.476*	0.600*	0.512*	0.880
Ever	0.585*	0.690*	0.764*	0.635*	0.860
<u>Cohabitation Status</u>					
Cohab. BF marriage	1.699*	1.282*	1.240*	1.125	0.706*
Not cohabited	1.000	1.000	1.000	1.000	1.000
Global χ^2	228	389	441	404	725
	p=0.000	0.000	0.000	0.000	0.000

* $p \leq 0.05$

$$\lambda(t; z) = \lambda_0(t) \cdot e^{\beta'z} \quad (1)$$

where β is a vector of parameters. The hazards function ($\lambda(t; z)$) is the product of an underlying duration dependent risk ($\lambda_0(t)$) and another factor that depends on the covariates. The duration dependent risk is calculated for the base-

line group, consisting of all the omitted categories of the categorical variables. The hazards function enables one to estimate the relative risks of having a first birth of other groups in relation to this baseline group.

Based on equation 1, the survivorship function can be written as

$$S(t; z) = [S_0(t)]^{\exp(\beta z)} \quad (2)$$

where $S_0(t)$ is the survivorship function (remaining childless) for the baseline or reference group. Each of the exponentials of the coefficients in equation 1 represent the effect of covariates on the hazards function for the baseline group. When there are no covariates present in the model, $\exp(\beta z)$ reduces to unity. The coefficient values greater than one indicate that the probability of remaining childless is lower for the group compared to the reference group. Once we compute the baseline survival function, we can compute the survival probabilities for various groups of women subject to the assumption that the relative risks remain the same at all ages.

The proportional hazards model coefficients presented in Table 4 are in their exponential form for the five age cohorts. The covariate categories considered for the proportional hazards model include age at first marriage (with four categories, ≤ 19 , 20-21, 22-24 and 25+); marriage duration (with four categories 0-4, 5-9, 10-14, and 15+ years); place of residence (with two categories, large urban and other); nativity (with two categories, native-born and foreign-born); education (with three categories, less than grade 12, grade 12-13, and grade 14+); number of children mother had (with two categories, 1 or 2 children, and 3 or more); religiosity (with three categories, church attended weekly, sometimes, and rarely or never); marital status (with three categories, once-currently married; currently separated, divorced, widowed; and more than once married and currently married); work status (with three categories, never worked, now working, and ever worked); and cohabitation status before first marriage (with two categories, cohabited and not cohabited before first marriage). The baseline group consists of women who are married at the age of 20-21 and have a marital duration of five to nine years, residing in other than a large urban centre, foreign-born, with grade 12-13 education, with 3 or more siblings, going to church sometimes, currently separated, widowed or divorced, never worked more than six months continuously, and who have not cohabited before their first marriage.

The results of the proportional hazards model indicates that women who marry at less than or equal to 19 years of age have a 130 per cent higher chance of having at least one baby compared to those who marry between ages 20-21, for women in the 18-24 age cohort. The interpretation of the table is simple,

in the sense that having a coefficient greater than one indicates that the group is more likely to have one or more children compared to the reference group, whereas the coefficient of less than one indicates a higher chance of remaining childless compared to the reference group.

The trends across the table are consistent for different age cohorts of women. In particular, the group of women whose marriage age is 22+, with a marriage duration of less than five years, residing in urban areas, having grade 14+ education, having one or no siblings, and either currently working or ever worked for more than six months continuously are more likely to remain childless compared to other groups. Marital status does not show any consistent trends, but it is interesting to note that women who are married more than once are more likely to have one or more children if they are young (before age 30), but are more likely to remain childless if their age cohort is above 30 years of age. Similarly, cohabitation before marriage seems pronatal for all age groups except for the 40-49 age cohort, but the chances are high for the 18-24 cohort (about 70 per cent more likely to have children). Similarly, no trends can be found in the religiosity variable across the age cohorts. Religion was found to be insignificant in the preliminary analysis and is thus dropped from the final analysis. Table 5 displays the estimated probability of remaining childless at certain selected ages and for some selected groups of ever married women in Canada. The survival function with all the covariates is given by the survival analysis programme in BMDP2L (BMDP manual, 1985), and by employing the relation given in equation 2 earlier, one can compute the baseline survival function representing the reference categories of various covariates. The survival probabilities, when all of the covariates are present in the model, are given in column A of the table. About 98 per cent of the women remained childless by the age of 17 and more than 50 per cent remained childless by the exact age of 24 for the age cohorts 25-29, 30-34 and 35-39, and this percentage is down to 38 for women in the 40-49 age cohort. The figures in column B refer to the baseline group of women computed for column A. The baseline group consists of all omitted categories or, in other words, the categories with coefficient 1.000 in Table 4.

Column C of Table 5 shows the probabilities of remaining childless for the group of women with the following characteristics: married at ages 22-24 (for the 18-24 age group) and 25 or over for the other cohorts of women; had marriage duration of less than five years; residing in a large urban place; with grade 14 or more education; had only one or no siblings; rarely going to church; currently working outside the home for more than six months continuously; and not cohabitated before first marriage. The results indicate that about 70 per cent of the women in the 18-24, 77 per cent in the 25-29, 66 per cent

TABLE 5: ESTIMATED PROBABILITY OF REMAINING CHILDLESS AT CERTAIN SELECTED AGES AND FOR CERTAIN GROUPS OF EVER MARRIED WOMEN IN CANADA
(Model: Proportional Hazards Model)

Age Cohorts	S _z (t) A	S ₀ (t) B	S ₁ (t) C	S ₂ (t) D	S ₃ (t) E
<u>18 - 24</u>					
17	0.978	0.956	0.992	0.994	0.850
20	0.853	0.726	0.947	0.957	0.312
22	0.629	0.393	0.853	0.681	0.033
24	0.357	0.125	0.702	0.754	0.005
<u>25 - 29</u>					
17	0.977	0.959	0.980	0.986	0.917
20	0.861	0.868	0.956	0.962	0.788
22	0.725	0.737	0.886	0.921	0.599
24	0.504	0.521	0.772	0.839	0.336
29	0.105	0.117	0.427	0.560	0.028
<u>30 - 34</u>					
17	0.967	0.980	0.991	0.993	0.965
20	0.875	0.819	0.910	0.928	0.699
22	0.738	0.635	0.80	0.844	0.443
24	0.559	0.418	0.664	0.722	0.210
29	0.145	0.056	0.258	0.340	0.006
34	0.056	0.013	0.132	0.200	0.0004
<u>35 - 39</u>					
17	0.988	0.966	0.985	0.992	0.953
20	0.872	0.669	0.837	0.906	0.572
22	0.713	0.369	0.643	0.783	0.251
24	0.517	0.144	0.423	0.621	0.068
29	0.157	0.004	0.089	0.263	0.0005
34	0.064	0.0003	0.028	0.138	0.00001
39	0.053	0.0002	0.021	0.120	0.00006
<u>40 - 49</u>					
17	0.983	0.985	0.989	0.993	0.963
20	0.848	0.858	0.894	0.935	0.689
22	0.624	0.647	0.726	0.824	0.345
24	0.375	0.404	0.514	0.669	0.109
29	0.084	0.101	0.186	0.362	0.004
34	0.024	0.032	0.079	0.216	0.0002
39	0.014	0.019	0.055	0.173	0.00006
44	0.0132	0.0185	0.053	0.170	--

- Notes:
1. The probabilities in column A are obtained from the model when all covariates categories are present.
 2. The probabilities in column B are for the baseline group representing women with the following characteristics: Married at 20-21 ages, with marriage duration of 5-9 years, residing in small city or on farms, foreign born, with Grade 12-13 education, 3 or more siblings, sometimes going to church, currently separated, divorced, or widowed, never worked, and not cohabited before first marriage.
 3. The probabilities given in column C are for women with the following characteristics: Married at 22-24 (18-24 age group), and 25+ for other cohorts, with marriage duration of 0-4 years, Gr. 14 or more education, with 2 siblings, rarely going to church, currently working and not cohabited before first marriage.
 4. The probabilities given in column D are for women whose characteristics advance the probability of remaining childless i.e. whose category coefficients are less than 1 of in Table 4.
 5. The probabilities given in column E are for women whose characteristics are identified with lower probabilities of remaining childless i.e. whose category coefficients are greater than 1.00 in Table 4, and they vary from age cohort to age cohort.

in the 30-34, 42 per cent of the 35-39 and about 51 per cent of the 40-49 cohorts of women from this group remained childless by the exact age of 24 years. Almost all studies to date on childlessness in Canada childless behaviour, and the results from the Canadian Fertility Survey support this view.

Column D and Column E of Table 5 are for groups of women who are most likely and least likely to remain childless, respectively. The covariate categories that form the groups for these columns are different for different age cohorts and are indicated at the bottom of Table 5. Though most of the covariate categories are the same for all cohorts for these two groups, there are certain categories which change their effect from younger cohorts to older cohorts. In general, the covariate categories with less than the value 1.0 in Table 5 are represented by the column D and the covariate categories with greater than one are represented by column E. Thus, the probabilities presented in Table 5 allow us to identify the ever married women who are most likely and least likely to remain childless at various ages. As well as these extreme groups of women, we have presented a group of women whose chances of remaining childless lie between the extremes and are presented in column C of Table 5. Some of the probabilities computed and presented in this table are unrealistic, given the levels of natural sterility. The probabilities represented by the columns, however, are a general indication of childlessness, and so it is necessary to interpret them above the natural sterility limit rather than in absolute terms.

Summary and Conclusions

Total fertility rate in Canada reached its highest level of 3.9 births in 1959 and has since declined to an all-time low of 1.7 births by 1984. During this quarter of a century, profound social and economic changes have taken place in Western societies, and Canada is no exception. The labour force participation of married women had more than doubled. Women are spending more time in higher education and delaying marriage, and the proportion never marrying is also on the increase. Cohabitation is becoming more popular among the young. Availability of effective contraceptives and their widespread use is largely eliminating unplanned and unwanted pregnancies. Our analysis in this paper has shown that the effect of these changes is to increase childlessness among ever married women at various ages of their life cycle. For example, the proportion childless among young ever married women less than 30 years of age has more than doubled between 1961 and 1981, in the age group

25-29 from 13.6 per cent to 29.8 per cent. Overall childlessness would be even higher if we included all women, and not just ever married women, as has been done in this study.

Unfortunately, our data do not enable us to separate "voluntary" and "involuntary" childlessness. Though there is some evidence in medical studies that "involuntary" physiological sterility in Canada may have increased due to the more permissive sexual behaviour and increase in sexually transmitted diseases, they are unlikely to explain the dramatic increases in childlessness among younger women.

It may be argued that it is only logical that childlessness will increase with an overall decline in fertility, as it is just one cell in the parity distribution. However, it is also true that the decision to have or not have children is not the same as the decision to have two or three children. This study shows that the factors associated with childlessness or delay of the first child are essentially the same as those usually found to be correlated with low fertility. One variable we have employed here, not used before, is the number of siblings the women has. It was hypothesized that women who come from small families are likely to delay their first birth or eventually remain childless. Our analysis supports this hypothesis.

One cannot predict the future course of childlessness in Canada with any certainty. It may, however, be said that in all probability young women who are now below 30 years of age and who have chosen to delay substantially their first birth are more likely to be childless eventually compared to say women 40-49 years old. The proportion childless among these older women (1981 census) was 7.3 per cent. This is probably a lower limit for childlessness, as these women were in their prime childbearing years during the baby-boom period and had an average of three to four children. In a recent study, Bloom predicted that childlessness among younger women in the United States might level off at about 16 per cent (Bloom, 1986). If we project the experience of young women in our sample, a similar figure for Canada may not be unreasonable. The most significant covariate of childlessness in this study was the work status of woman. Future trends in labour force participation and, more importantly, improved provisions for child care and maternity leave will have a noticeable impact on childlessness. The effects of marriage dissolution and remarriage on childlessness and fertility are, however, still to be sorted out.

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