

# Estimating the prevalence of infertility in Canada

Tracey Bushnik<sup>1,\*</sup>, Jocelynn L. Cook<sup>2</sup>, A. Albert Yuzpe<sup>3,4</sup>,  
Suzanne Tough<sup>5</sup>, and John Collins<sup>6</sup>

<sup>1</sup>Health Analysis Division, Statistics Canada, Ottawa, Canada K1A 0T6 <sup>2</sup>Department of Obstetrics and Gynecology, University of Ottawa, Ottawa, Canada K1H 8L6 <sup>3</sup>Genesis Fertility Centre, Vancouver, Canada V6H 4A7 <sup>4</sup>Department of Obstetrics and Gynaecology, University of Western Ontario, London, Canada N6A 5W9 <sup>5</sup>Faculty of Medicine, Departments of Pediatrics and Community Health Sciences, University of Calgary, Calgary, Canada T2N 4N1 <sup>6</sup>Department of Obstetrics and Gynecology, McMaster University, Hamilton, Canada L8N 3Z5

\*Correspondence address. E-mail: tracey.bushnik@statcan.gc.ca

Submitted on October 31, 2011; resubmitted on December 11, 2011; accepted on December 14, 2011

**BACKGROUND:** Over the past 10 years, there has been a significant increase in the use of assisted reproductive technologies in Canada, however, little is known about the overall prevalence of infertility in the population. The purpose of the present study was to estimate the prevalence of current infertility in Canada according to three definitions of the risk of conception.

**METHODS:** Data from the infertility component of the 2009–2010 Canadian Community Health Survey were analyzed for married and common-law couples with a female partner aged 18–44. The three definitions of the risk of conception were derived sequentially starting with birth control use in the previous 12 months, adding reported sexual intercourse in the previous 12 months, then pregnancy intent. Prevalence and odds ratios of current infertility were estimated by selected characteristics.

**RESULTS:** Estimates of the prevalence of current infertility ranged from 11.5% (95% CI 10.2, 12.9) to 15.7% (95% CI 14.2, 17.4). Each estimate represented an increase in current infertility prevalence in Canada when compared with previous national estimates. Couples with lower parity (0 or 1 child) had significantly higher odds of experiencing current infertility when the female partner was aged 35–44 years versus 18–34 years. Lower odds of experiencing current infertility were observed for multiparous couples regardless of age group of the female partner, when compared with nulliparous couples.

**CONCLUSIONS:** The present study suggests that the prevalence of current infertility has increased since the last time it was measured in Canada, and is associated with the age of the female partner and parity.

**Key words:** prevalence / infertility / epidemiology / risk factors

## Introduction

Infertility has important implications for individual and public health in Canada. The emotional, physical and financial costs borne by couples experiencing infertility can be substantial (Goldman *et al.*, 2000; Chambers *et al.*, 2009; Macaluso *et al.*, 2010), while the health care system bears the cost of preterm or multiple births that can result from infertility treatments (Allen *et al.*, 2006; Bouzayen and Eggertson, 2009; Deonandan, 2010).

Although infertility is estimated to affect 10–15% of couples in industrialized countries (Evers, 2002), how infertility is defined and measured can result in wide-ranging estimates of prevalence (Marchbanks *et al.*, 1989; Thonneau and Spira, 1990; Guzick and Swan, 2006; Gurunath *et al.*, 2011). Epidemiological studies tend to categorize women as infertile if they have attempted to become pregnant

without success while being exposed to the risk of conception (Gurunath *et al.*, 2011), however the definition of the risk of conception can vary. In some studies, risk of conception refers to lack of contraception use (Dulberg and Stephens, 1993; Bhattacharya *et al.*, 2009) while in others it refers to regular, unprotected sexual intercourse (Webb and Holman, 1992). The duration of exposure to risk is often 12 months (Sciarrà, 1994), but can be longer (Rowe *et al.*, 1993). Studies have also differentiated between 'current' infertility (i.e. are you now having difficulty conceiving?) versus 'lifetime' infertility (i.e. have you ever had difficulty conceiving?). Current infertility is generally less prevalent than lifetime infertility, as the latter sums up all infertility experiences in a woman's life (Boivin *et al.*, 2007, 2009). Despite definitional differences, many studies have found the prevalence of infertility to be associated with the female partner's age, parity and marital status (Chandra and Stephen, 1998; Herbert

*et al.*, 2009) as well as lifestyle factors such as smoking and BMI (Grodstein *et al.*, 1994; Kelly-Weeder and Cox, 2006; Brassard *et al.*, 2008).

In Canada, national estimates of the prevalence of infertility have been published infrequently. Researchers using the 1984 Canadian Fertility Survey categorized women as infertile if they did not become pregnant while not using contraception. They estimated the prevalence of infertility to be 5.4% among women aged 18–44 who were married or living common-law and whose duration of exposure to risk was the previous 12 months (Balakrishnan and Fernando, 1993). Eight years later, researchers using data from the 1992 surveys sponsored by The Royal Commission on New Reproductive Technologies categorized women as infertile if they reported no contraception use and no pregnancy during the 12 months prior to the interview. Under this definition, 8.5% of women 18–44 years of age who were married or living common-law were considered infertile (Dulberg and Stephens, 1993).

Over the past 10 years, there has been a significant increase in the use of assisted reproductive technologies in Canada (Gunby *et al.*, 2005, 2009, 2010, 2011), however, little is known about the overall prevalence of infertility in the population. Using data from the Infertility component in the 2009–2010 Canadian Community Health Survey (CCHS), the purpose of the present study was to estimate the prevalence of current infertility in Canada, according to three definitions of the risk of conception. Further, this study examined associations between couples' socio-demographic characteristics and their risk of current infertility.

## Materials and Methods

### Data sources and study population

Data from the Infertility (IFT) component of the 2009–2010 CCHS conducted by Statistics Canada were used. The target population of the IFT component consisted of opposite-sex couples in the 10 provinces living in private dwellings where the female spouse was aged 18–49. The couple also had to be living together in the same household at the time of the survey. The target population excluded the three Territories, as well as persons living on Indian Reserves or Crown lands, those residing in institutions, full-time members of the Canadian Forces and residents of certain remote regions.

The CCHS used a multistage stratified cluster sampling strategy, described in detail elsewhere (Statistics Canada, 2011b). Data for the IFT component were collected from September to December 2009 and from July to August 2010. In total, 41 501 of the CCHS units selected during these collection periods were in-scope for the CCHS. Once contacted by telephone or in person, 33 468 households agreed to participate in the CCHS resulting in a CCHS household-level response rate of 80.6%. In each responding household, one person was selected to participate in the survey. In the end, CCHS responses were obtained for 29 858 individuals, resulting in a CCHS person-level response rate of 89.2%. Among these respondents, 6520 were eligible for the IFT component and 5617 completed it, for an IFT person-level response rate of 86.2%. Multiplying the CCHS household-level response rate, the CCHS person-level response rate and the IFT person-level response rate yields an estimated overall response rate for IFT of 62.0% (Statistics Canada, 2010a).

For inclusion in the present study, subjects were required to be married or living common-law for at least the 12 months prior to the date of interview, their use of birth control and their pregnancy status in the 12 months prior to the interview were reported, and the female partner

was aged 18–44 years. Applying these criteria resulted in a sample of 4412 couples.

### Study variables

Socio-demographic characteristics were examined including the age group in years of the female partner (18–24, 25–29, 30–34, 35–39 and 40–44), age group in years of the male partner (18–24, 25–29, 30–34, 35–39, 40–44 and 45 and older), the female partner's highest level of education (less than secondary school, secondary school graduation and post secondary degree or diploma), the couple's marital status (married or common-law) and their parity (zero, one, or two or more children). To examine the potential interaction between parity and age group of female partner, a composite measure was derived (0, 18–34; 0, 35–44; 1, 18–34; 1, 35–44; 2+, 18–34 and 2+, 35–44). Household income quartiles (\$29 650 or less, >\$29 650–\$44 050, >\$44 050–\$64 450, more than \$64 450) were derived based on a modified version of the equivalence score method, which adjusts household income by household size. This method was developed at Statistics Canada (Carson, 2002) and uses a weight factor based on the '40/30' rule. For each respondent in the study population, a household weight factor was calculated based on the number of people in the household. The first household member was assigned a weight of 1; the second member, a weight of 0.4; and the third and all subsequent members, a weight of 0.3. The household weight factor was then calculated as the sum of these weights. For example, for a four-member household, it would be 2.0 (1 + 0.4 + 0.3 + 0.3). Household income was then divided by the household weight factor to derive the income adjusted for household size. The adjusted household incomes were then grouped into quartiles (four groups, each containing one-fourth of the study population).

### Definitions

#### *Use of birth control within the past 12 months*

Respondents were categorized as having used birth control if they responded yes to the question 'Within the past 12 months, did you or your partner use any form of birth control?' Respondents were also categorized as having used birth control if they answered no to the above question, but reported that their reason for not using birth control was 'they or their partner have had a vasectomy, a hysterectomy or had their tubes tied'.

#### *Pregnant in the past 12 months*

Respondents were categorized as being pregnant if they responded yes to the question 'Are you or your partner currently pregnant?' or responded yes to the question 'In the past 12 months did you or your partner become pregnant?'

#### *Current infertility*

For the purposes of this study, couples were categorized as currently infertile if they did not become pregnant after exposure to the risk of conception during the previous 12 months.

#### *Risk of conception*

Risk of conception was defined in three different ways: (i) did not use any form of birth control within the past 12 months (ii) did not use any form of birth control within the past 12 months and reported having sexual intercourse in the past 12 months (iii) did not use any form of birth control within the past 12 months, reported having sexual intercourse in the past 12 months, and reported ever having tried to become pregnant with their current partner. The first definition is consistent with what was applied in previous studies in Canada (Balakrishnan and Fernando,

1993; Dulberg and Stephens, 1993) and assumes that the couples had intercourse within the past 12 months. The second definition builds on the first by explicitly including sexual intercourse within the past 12 months as a criterion. The third definition builds on the second by including an indicator of the couple's desire to become pregnant.

#### Prevalence of current infertility

The prevalence of current infertility was estimated by dividing the number of couples categorized as currently infertile by the number of couples in the target population.

### Statistical analyses

Because current infertility status was an attribute of the couple, analyses were weighted using the couple-level survey weight rather than the person-level weight. Using the couple-level weight ensured that weighted estimates were representative of the number of couples in 2009–2010 rather than the number of individuals (Statistics Canada, 2010a).

The data were analyzed with SAS 9.1 and SUDAAN 10 software. Proportions and their confidence intervals (CIs) were calculated. A separate logistic regression model was run for each of the three definitions of current infertility to estimate the association between current infertility and the composite measure of parity and age group of the female partner, marital status, highest level of education of the female partner and household income. Variance estimation (95% CIs) and significance testing (*t*-test or Wald *F*-statistic) of differences between estimates were done using the replicate weights to account for the survey's complex sampling design. Statistical significance was set at  $P < 0.05$ , but was Bonferroni-adjusted depending on the number of comparisons (Abdi, 2007).

## Results

### Characteristics of couples in Canada

In 2009–2010, about 3.2 million couples were married or living common-law for at least 12 months with a female partner 18–44 years of age (Table I). Just over 50% of couples had a female partner between the ages of 35 and 44, while 63% of couples had a male partner aged 35 or over. Seventy-four percent of couples were married and 70% of couples had at least one child. Among the couples with no children, about one-third also had a female partner between the ages of 35 and 44. Seventy-four percent of couples had a female partner with a post secondary diploma or degree, and couples in the top income quartile had a household income greater than \$64 450 in the previous 12 months.

Examining the individual criteria used to define current infertility indicated that within the previous 12 months 99% of couples reported having sexual intercourse, 76% of couples reported using some form of birth control and 16% of couples reported being pregnant. Furthermore, about 79% of couples reported ever having tried to become pregnant with their current partner.

### Prevalence of current infertility

According to Definition 1, about 16% of couples experienced current infertility in 2009–2010 (Table II). This was higher than the prevalence of 14% produced by Definition 2 and the prevalence of 11.5% produced by Definition 3. Prevalence varied mainly by age group of the female partner and parity (Table III). The linear age trend in prevalence according to Definitions 1 and 3 was statistically significant (Fig. 1). A similar age trend was not evident for age group of the male partner.

Regarding parity, couples with fewer than two children generally had a higher prevalence of current infertility than couples with two or more children, with one exception. According to Definition 3 only, couples with one child had a higher prevalence of infertility than couples with two or more children.

The prevalence of current infertility varied across the composite measure of parity and age group of the female partner. For couples with one or no children, the prevalence of current infertility was significantly higher when the female partner was 35–44 years of age compared with those of 18–34 years of age (Fig. 2). For couples with two or more children, prevalence did not differ across the age group of the female partner.

Only Definition 3 produced an association with marital status where a lower prevalence of current infertility was found among common-law couples (Table III). Highest level of education and household income were not associated with the prevalence of current infertility.

After controlling for highest level of education of the female partner and household income, both the composite measure of parity and age group of the female partner, and marital status were significantly associated with current infertility (Table IV). According to Definition 1, higher odds of experiencing current infertility were observed for couples with a female partner aged 35–44 years and no (OR 3.17, 95% CI 2.10–4.77) or one (OR 2.52, 95% CI 1.61–3.95) child compared with two or more children. Definitions 2 and 3 produced a similar result. Furthermore, Definitions 1 and 2 also yielded lower odds of current infertility for multiparous couples regardless of age group of the female partner, when compared with nulliparous couples. Lastly, Definitions 1 and 3 found that couples with lower parity (0 or 1 child) had significantly higher odds of experiencing current infertility when the female partner was aged 35–44 years versus 18–34 years. In all three models, couples who lived common-law had lower odds of experiencing current infertility than couples who were married.

## Discussion

Current infertility is defined as not achieving a pregnancy while being exposed to the risk of conception. In Canada, the prevalence of current infertility in 2009–2010 was between 11.5 and 15.7%, reflecting the use of three different definitions of the risk of conception. The highest prevalence of 15.7% resulted from defining the risk of conception as no birth control use in the previous 12 months. This definition was used the last time the prevalence of current infertility was measured in Canada, and a similar definition was used for the prevalence estimates produced by the Canadian Fertility Survey in 1984. Comparing the three sets of results suggests that according to this definition, the recent measure of overall prevalence is significantly higher than the prevalence of 5.4% in 1984 (Balakrishnan and Fernando, 1993) and 8.5% in 1992 (Dulberg and Stephens, 1993). Increases across age groups of the female partner were also observed. In 1984 the prevalence of current infertility among couples with a female partner between the ages of 40–44 was 4.6% (Balakrishnan and Fernando, 1993); an estimate that falls below the range of 14.3–20.7% observed for the same age group in 2009–2010. Similarly, the prevalence of 4.9% observed in 1984 for couples with a female partner aged 18–29 was also lower than the range of 7.0–13.7% found for the same age group in the present study.

**Table 1** Characteristics of couples in Canada.

	2009–2010				
	Sample size	Weighted sample size	%	95% CI	
				From	To
All couples	4412	3 225 900	100.0		
Age group of female partner					
18–24 years	356	247 000	7.7	7.2	8.1
25–29 years	847	596 100	18.5	17.8	19.2
30–34 years	1 164	758 000	23.5	22.7	24.3
35–39 years	1 142	793 200	24.6	23.8	25.4
40–44 years	903	831 600	25.8	24.3	27.4
Age group of male partner					
18–24 years	171	109 300	3.4	2.8	4.1
25–29 years	605	445 100	13.8	12.7	14.9
30–34 years	995	647 000	20.1	18.8	21.4
35–39 years	1 140	741 500	23.0	21.7	24.3
40–44 years	878	730 300	22.6	20.9	24.5
45 and older	623	552 600	17.1	15.5	18.9
Marital status					
Common-law	1 181	839 800	26.0	24.4	27.8
Married	3 231	2 386 100	74.0	72.2	75.6
Parity					
0 children	1 320	972 200	30.1	28.3	32.0
1 child	1 029	693 700	21.5	19.8	23.4
2 or more children	2 063	1 560 000	48.4	46.2	50.5
Parity, age group of female partner					
0, 18–34 years	848	660 500	20.5	19.1	22.0
0, 35–44 years	472	311 700	9.7	8.5	10.9
1, 18–34 years	613	393 400	12.2	11.0	13.5
1, 35–44 years	416	300 300	9.3	8.1	10.6
2+, 18–34 years	906	547 100	17.0	15.7	18.3
2+, 35–44 years	1 157	1 012 900	31.4	29.6	33.3
Highest level of education of female partner					
Less than secondary school graduation	229	153 400	4.8	4.0	5.8
Secondary school graduation	881	666 700	21.0	19.2	22.9
Post secondary degree or diploma	3 241	2 358 800	74.2	72.2	76.1
Used birth control within the previous 12 months					
Yes	3 343	2 437 500	75.6	73.7	77.4
No	1 069	788 400	24.4	22.6	26.3
Pregnant within the previous 12 months					
Yes	770	525 000	16.3	14.9	17.7
No	3 642	2 700 900	83.7	82.3	85.1
Had sexual intercourse within the previous 12 months					
Yes	4 129	2 966 300	98.9	98.3	99.3
No	36	33 000	1.1	0.7	1.7

Continued

**Table I** Continued

	2009–2010				
	Sample size	Weighted sample size	%	95% CI	
				From	To
Ever tried to become pregnant with current partner					
Yes	3523	2 533 700	78.6	76.9	80.3
No	886	688 100	21.4	19.7	23.1

CI, confidence interval.

Weighted sample sizes have been rounded to the nearest 100.

Notes: Includes couples who lived together for at least the previous 12 months, the female partner was 18–44 years old, and the couples' use of birth control and pregnancy status within the past 12 months was known.

Source: 2009–2010 CCHS.

**Table II** Prevalence of current infertility according to three definitions.

	Total number (weighted) of couples currently infertile	Total number (weighted) of couples in target population	Prevalence (%)	95% CI	
				From	To
Definition 1	508 100	3 225 900	15.7	14.2	17.4
Definition 2	445 500	3 176 900	14.0	12.6	15.6
Definition 3	365 100	3 176 600	11.5	10.2	12.9

CI, confidence interval.

Weighted counts have been rounded to the nearest 100.

Notes: The number of couples in the target population for each definition differs slightly due to item non-response.

For Definition 2, if 'had sexual intercourse in the past 12 months' was not reported then the respondent was excluded from the target population. For Definition 3, if 'had sexual intercourse in the past 12 months' or ever tried to become pregnant with current partner' was not reported, then the respondent was excluded from the target population.

Definition 1: couples who reported no pregnancy and did not use any form of birth control during the previous 12 months.

Definition 2: couples who reported no pregnancy, did not use any form of birth control, and reported having sexual intercourse during the previous 12 months.

Definition 3: couples who reported no pregnancy, did not use any form of birth control, reported having sexual intercourse during the previous 12 months and had tried at some point to become pregnant with their current partner.

Source: 2009–2010 CCHS.

The second definition of the risk of conception differed from the first by including sexual intercourse in the previous 12 months as a criterion, resulting in a prevalence of 14%. This criterion aligns Definition 2 more closely with what has been used in other studies of current infertility, but direct comparisons are difficult due to differences in age groups and marital status of the target populations, as well as variations in the questions and responses used to determine prevalence. Nonetheless, the prevalence of 14% falls within the range of 3.5–16.7% reported by population studies in other industrialized countries (Boivin et al., 2007, 2009).

The third definition of the risk of conception included the additional criterion of whether the couple had ever tried to become pregnant, resulting in a prevalence of 11.5%. Including a question about 'trying for pregnancy' when estimating infertility has been recommended for epidemiologic surveys (Larsen, 2005), however it is generally tied to the reference period of interest, i.e. the previous 12 months. In this study, although it was reported that pregnancy was attempted, whether the attempt took place within the previous 12 months was unknown.

Regardless of the definition, the present study suggests that over time, the prevalence of current infertility has increased in Canada. There are a number of possible explanations for this. The past

several decades have seen a delay in conjugal union formation, resulting in couples starting to live together or getting married at older ages (Clark, 2007). This has led to a delay in childbearing, with women being older when first attempting pregnancy. In fact, the proportion of first-born children among women aged 35 and over has increased from 3% in 1984 (Statistics Canada, 1985) to 11% in 2008 (Statistics Canada, 2011a). Female age as a risk factor for infertility is well documented, with the risk of infertility increasing as female age increases (van Noord-Zaadstra et al., 1991; Gougeon, 2005; Swanton and Child, 2005). A similar result was found in the present study. Furthermore, not only did the prevalence of current infertility increase as female age increased, the increased odds of experiencing current infertility among couples with older female partners varied across parity. Age group of the female partner mattered for couples with lower parity (0 or 1 child) as they had significantly higher odds of experiencing current infertility when the female partner was aged 35–44 years versus 18–34 years. Conversely, multiparous couples had lower odds of experiencing current infertility regardless of the age group of the female partner, when compared with couples with fewer children and an older female partner. This interaction between female age and parity supports a link between delayed childbearing and an increased risk of experiencing current infertility.

**Table III** Prevalence of current infertility according to three definitions, by selected characteristics.

	2009–2010			2009–2010			2009–2010		
	Definition 1 (%)	95% CI		Definition 2 (%)	95% CI		Definition 3 (%)	95% CI	
		From	To		From	To		From	To
Age group of female partner <sup>a</sup>									
18 to 24 years	10.5 <sup>b</sup>	6.2	17.2	10.5 <sup>b</sup>	6.2	17.2	7.0 <sup>b</sup>	3.6	13.2
25–29 years	13.7	10.9	17.2	13.6	10.8	17.0	8.5	6.3	11.4
30–34 years	13.7	11.2	16.8	12.4	9.9	15.4	10.8	8.5	13.5
35–39 years	16.2	13.6	19.2	14.5	12.0	17.4	13.0	10.6	15.9
40–44 years	20.1	16.2	24.7	16.5	13.1	20.6	14.3	11.2	18.1
Age group of male partner									
18–24 years	<20.9			<20.9			<16.2		
25–29 years <sup>c</sup>	12.2	8.9	16.5	11.8	8.5	16.1	7.2 <sup>b</sup>	4.9	10.4
30–34 years	15.9	12.8	19.7	14.8	11.8	18.5	11.7	9.0	15.1
35–39 years	13.6	11.2	16.6	12.6	10.2	15.4	11.4	9.2	14.1
40–44 years	15.8	12.6	19.7	14.4	11.3	18.0	12.6	9.7	16.1
45 and older	22.0*	17.2	27.7	17.1	12.9	22.3	14.5*	10.6	19.4
Marital status									
Common-law	13.5	11.0	16.4	12.2	9.8	15.1	7.8*	6.0	10.2
Married <sup>c</sup>	16.6	14.7	18.7	14.7	12.9	16.6	12.8	11.2	14.6
Parity									
0 children	20.6*	17.8	23.7	18.7*	15.9	21.7	10.2	8.3	12.5
1 child	18.6*	15.5	22.1	16.4*	13.7	19.6	16.4*	13.7	19.6
2 or more children <sup>c</sup>	11.4	9.5	13.8	10.1	8.3	12.3	10.1	8.3	12.3
Parity, age group of female partner									
0, 18–34 years	16.9	13.6	20.8	16.0	12.8	19.8	8.2	5.9	11.1
0, 35–44 years	28.5 <sup>*,d</sup>	23.4	34.3	24.5 <sup>*,d</sup>	19.5	30.3	14.7 <sup>d</sup>	10.9	19.6
1, 18–34 years	12.4	9.6	15.9	12.3	9.5	15.8	12.3	9.5	15.8
1, 35–44 years	26.7 <sup>*,d</sup>	21.0	33.2	22.0 <sup>*,d</sup>	17.0	28.0	22.0 <sup>*,d</sup>	17.0	28.0
2+, 18–34 years	9.4	6.8	12.9	8.6 <sup>b</sup>	6.1	12.0	8.6 <sup>b</sup>	6.1	12.0
2+, 35–44 years <sup>c</sup>	12.6	9.9	15.8	10.9	8.5	14.0	10.9	8.5	14.0
Highest level of education of female partner									
Less than secondary school graduation	19.9 <sup>b</sup>	13.2	29.0	17.3 <sup>b</sup>	10.8	26.4	15.1 <sup>b</sup>	9.0	24.2
Secondary school graduation	15.9	12.5	20.1	14.2	11.0	18.1	11.3	8.4	15.1
Post secondary degree or diploma <sup>c</sup>	15.2	13.5	17.1	13.7	12.0	15.5	11.3	9.9	12.8
Household income adjusted for household size <sup>e</sup>									
First quartile (\$29 650 or less)	16.4	13.2	20.3	15.1	12.0	18.8	12.6	9.7	16.2
Second quartile (>\$29 650–\$44 050)	12.6	9.9	15.9	11.0	8.7	14.0	9.1	7.1	11.7
Third quartile (>\$44 050–\$64 450)	15.5	12.6	19.1	14.5	11.6	17.9	12.0	9.4	15.2
Fourth quartile (more than \$64 450) <sup>c</sup>	16.6	13.8	19.9	15.7	12.8	19.0	12.2	9.8	15.1

If coefficient of variation of estimate exceeds 33.3%, estimate is indicated as being less than the upper limit of the 95% confidence interval.

Notes: Prevalence of current infertility was calculated by dividing the number of married or common-law couples categorized as infertile by the number of married or common-law couples who had lived together for at least the past 12 months.

Definition 1: couples who reported no pregnancy and did not use any form of birth control during the previous 12 months.

Definition 2: couples who reported no pregnancy, did not use any form of birth control, and reported having sexual intercourse during the previous 12 months.

Definition 3: couples who reported no pregnancy, did not use any form of birth control, reported having sexual intercourse during the previous 12 months and had tried at some point to become pregnant with their current partner.

Source: 2009–2010 CCHS.

CI, confidence interval.

\*Significantly different from the reference category ( $P > 0.05$  adjusted for number of comparisons).

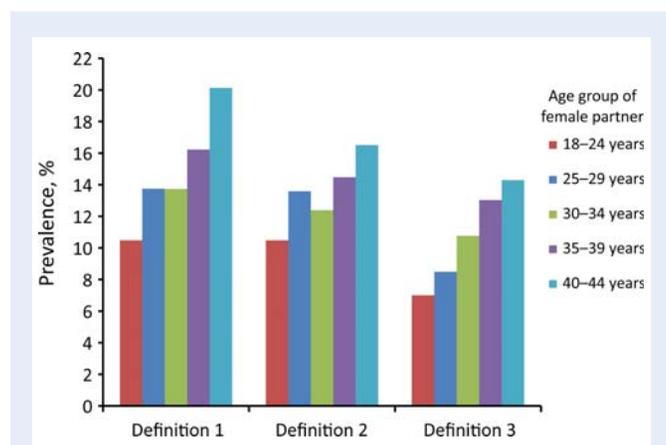
<sup>a</sup>Linear age trend for Definition 1 and Definition 3 statistically significant ( $P < 0.01$ ) but not statistically significant for Definition 2 ( $P > 0.05$ ).

<sup>b</sup>Data should be interpreted with caution because of high sampling variability (coefficient of variation  $\geq 16.6\%$  and  $< 33.3\%$ ).

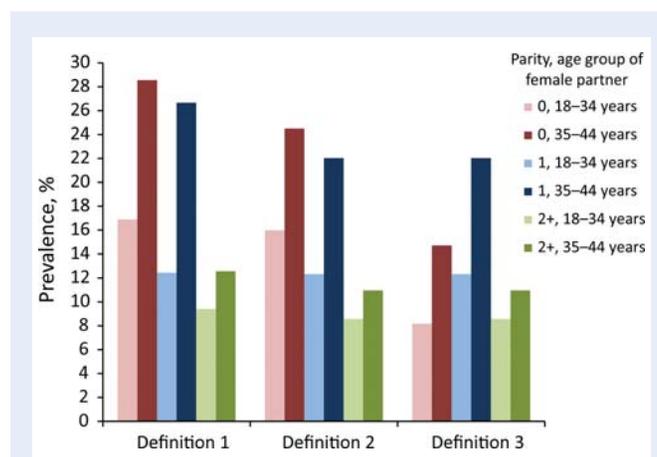
<sup>c</sup>Reference category.

<sup>d</sup>Within parity grouping, 35 to 44 years significantly different from 18 to 34 years ( $P < 0.05$ ).

<sup>e</sup>Adjusted using 40/30 formula; adjusted household incomes for all respondents ranked and divided into quartiles.



**Figure 1** Prevalence of current infertility by age group of female partner, according to three definitions.



**Figure 2** Prevalence of current infertility by parity and age group of female partner, according to three definitions.

**Table IV** Odds of experiencing current infertility according to three definitions.

	Definition 1, Odds ratio	95% CI		Definition 2, Odds ratio	95% CI		Definition 3, Odds ratio	95% CI	
		From	To		From	To		From	To
Parity, age group of female partner									
0, 18–34 years	1.78 <sup>a,b</sup>	1.18	2.68	1.90 <sup>a,b</sup>	1.25	2.88	0.89	0.54	1.48
0, 35–44 years	3.17 <sup>a,b,c</sup>	2.10	4.77	2.76 <sup>a,b</sup>	1.79	4.24	1.63 <sup>a,b,c</sup>	1.01	2.64
1, 18–34 years	1.16	0.76	1.76	1.28	0.84	1.95	1.32	0.86	2.02
1, 35–44 years	2.52 <sup>a,b,c</sup>	1.61	3.95	2.35 <sup>a,b,c</sup>	1.48	3.74	2.37 <sup>a,b,c</sup>	1.49	3.77
2+, 18–34 years	0.78	0.48	1.27	0.80	0.48	1.33	0.82	0.49	1.37
2+, 35–44 years <sup>d</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Marital status									
Common-law	0.62 <sup>a</sup>	0.45	0.85	0.64 <sup>a</sup>	0.46	0.88	0.55 <sup>a</sup>	0.38	0.80
Married <sup>d</sup>	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

CI, confidence interval.

Notes: Each model controlled for highest level of education of female partner and household income quartiles.

Definition 1: couples who reported no pregnancy and did not use any form of birth control during the previous 12 months.

Definition 2: couples who reported no pregnancy, did not use any form of birth control, and reported having sexual intercourse during the previous 12 months.

Definition 3: couples who reported no pregnancy, did not use any form of birth control, reported having sexual intercourse during the previous 12 months and had tried at some point to become pregnant with their current partner.

Source: 2009–2010 CCHS.

<sup>a</sup>Significantly different from the reference category ( $P < 0.05$ ).

<sup>b</sup>Significantly different from 2+, 18–34 years ( $P < 0.05$ ).

<sup>c</sup>Within parity grouping, 35–44 years significantly different from 18 to 34 years ( $P < 0.05$ ).

<sup>d</sup>Reference category.

In addition to the known impact of female age, factors such as obesity, smoking, alcohol use and sexually transmitted infections (STIs) have been shown to adversely affect female fecundity (Grodstein et al., 1994; Goldman et al., 2000; Kelly-Weeder and Cox, 2006; Brassard et al., 2008; Anderson et al., 2010). While direct links between lifestyle factors and the results from this study cannot be made, detrimental changes in these factors over time may be related to the observed increase in the prevalence of current infertility. Between 1981 and 2007–2009, the average measured BMI of women between 20 and 39 years of age increased from 22.5 to 25.9 kg/m<sup>2</sup>.

At the same time, the proportion of women in this age group categorized as obese rose from 4 to 21% (Shields et al., 2010). Although the prevalence of daily or occasional smoking among women aged 20–44 years fell from 35% to about 20% between 1994 and 2010 (Statistics Canada, 1998a, 2010b), over the same period the rate of heavy drinking (five or more drinks at a time at least once a month) increased from 9 to 20% among women aged 20–34 years (Statistics Canada, 1998b, 2010b). Reported rates of STIs such as chlamydia and gonorrhea have risen, with the majority of cases being reported for women under 30 years of age. The chlamydia infection rate of 1999 increased

71% to 1824.3 per 100 000 in 2008 for women 20–24 years of age, while for the same age group the gonorrhoea infection rate more than doubled to 166.3 per 100 000 over the same period (Public Health Agency of Canada, 2010). Of particular concern is that chlamydia is commonly asymptomatic, leading to both underreporting and increased risk of the spread of infection (Public Health Agency of Canada, 2010). Despite the presence of such factors known to be related to infertility, however, it is difficult to establish a cause-and-effect relationship in population studies.

## Limitations

The three definitions used in this study to estimate the prevalence of current infertility are constructed variables and not clinical diagnoses. It is possible that some couples categorized as infertile may conceive beyond a 12-month period, while it is unknown to what extent those couples using birth control may have trouble conceiving. Furthermore, it was not possible to identify couples where the male and/or female partner had been sterilized, which precluded a more detailed analysis. Nonetheless, these prevalence estimates are generalizable to the study population and can be considered reliable and valid from the standpoint of estimating population-based prevalence (Stephen and Chandra, 2006).

Due to data limitations, it was not possible to examine factors such as obesity, smoking behavior, alcohol use, etc. in this study. The contribution of these and other factors to estimates of infertility prevalence require further investigation.

## Conclusion

Current infertility is frequently defined as the inability to achieve a pregnancy after being exposed to the risk of conception for at least the previous 12 months. This study provides a current assessment of the prevalence of infertility among Canadian couples, according to three definitions of the risk of conception. The results show that regardless of the definition, the prevalence of current infertility has increased since the last time it was measured in Canada, and is associated with the age of the female partner and parity. Using relevant population-based data to estimate prevalence helps to inform both practice and program initiatives aimed at reducing the social, economic and health burdens of infertility.

## Acknowledgements

The authors thank Lindsay Patrick for her review and feedback on the manuscript. The authors also thank all who were involved in the development and production of the 2009–2010 Infertility component of the CCHS at Statistics Canada and Assisted Human Reproduction Canada.

## Authors' roles

T.B. and J.L.C. contributed to the conception and design of the study. T.B. conducted the analysis, and all authors assisted in the interpretation of the results. T.B. and J.L.C. drafted the manuscript and all authors critically reviewed the manuscript for important intellectual content and approved the final version submitted for publication.

## Funding

This research was supported by funding from Assisted Human Reproduction Canada. Funding to pay the Open Access publication charges for this article was provided by Assisted Human Reproduction Canada.

## Conflict of interest

The authors have no conflict of interest to declare.

## References

- Abdi H. The Bonferroni and Šidák Corrections for Multiple Comparisons. In: Salkind N (ed). *Encyclopedia of Measurement and Statistics*. Thousand Oaks, CA: Sage, 2007.
- Allen VM, Wilson RD, Cheung A. Pregnancy outcomes after assisted reproductive technology. *J Obstet Gynaecol* 2006;**173**:220–233.
- Anderson K, Nisenblat V, Norman R. Lifestyle factors in people seeking infertility treatment - A review. *Aust N Z J Obstet Gynaecol* 2010;**50**:8–20.
- Balakrishnan TR, Fernando R. Infertility among Canadians: an analysis of data from the Canadian Fertility Survey (1984) and General Social Survey (1990). In: *The Prevalence of Infertility in Canada: Research Studies of the Royal Commission on New Reproductive Technologies*. Ottawa: Minister of Supply and Services Canada, 1993, 107–162.
- Bhattacharya S, Porter M, Amalraj E, Templeton A, Hamilton M, Lee A, Kurinczuk J. The epidemiology of infertility in the North East of Scotland. *Hum Reprod* 2009;**24**:3096–3107.
- Boivin J, Bunting L, Collins JA, Nygren KG. International estimates of infertility prevalence and treatment-seeking: potential need and demand for infertility medical care. *Hum Reprod* 2007;**22**:1506–1512.
- Boivin J, Bunting L, Collins JA, Nygren KG. Reply: International estimates on infertility prevalence and treatment seeking: potential need and demand for medical care. *Hum Reprod* 2009;**24**:2380–2383.
- Bouzayen R, Eggertson L. In vitro fertilization: a private matter becomes public. *Can Med Assoc J* 2009;**181**:243.
- Brassard M, AinMelk Y, Baillargeon J-P. Basic Infertility Including Polycystic Ovary Syndrome. *Med Clin North Am* 2008;**92**:1163–1192.
- Carson J. Family spending power. *Perspect Labour Income* 2002;**10**:5–13.
- Chambers GM, Sullivan E, Ishihara O, Chapman M, Adamson G. The economic impact of assisted reproductive technology: a review of selected developed countries. *Fertil Steril* 2009;**91**:2281–2294.
- Chandra A, Stephen EH. Impaired Fecundity in the United States: 1982–1995. *Fam Plan Perspect* 1998;**30**:34–42.
- Clark W. Delayed transitions of young adults. *Canadian Social Trends 2007 Winter* 2007;13–21.
- Deonandan R. The public health implications of assisted reproductive technologies. *Chronic Dis Can* 2010;**30**:119–124.
- Dulberg CS, Stephens T. The prevalence of infertility in Canada, 1991–1992: analysis of three national surveys. In: *The Prevalence of Infertility in Canada: Research Studies of the Royal Commission on New Reproductive Technologies*. Ottawa: Minister of Supply and Services Canada, 1993, 61–106.
- Evers J. Female subfertility. *Lancet* 2002;**360**:151–159.
- Goldman MB, Missmer SA, Barbieri RL. Infertility. In: Goldman MB, Missmer SA (eds). *Women and Health*. San Diego, CA: Academic Press, 2000, 196–214.
- Gougeon A. The biological aspects of risks of infertility due to age: the female side. *Rev Epidémiol Santé Publique* 2005;**53**:2S37–2S45.
- Grodstein F, Goldman MB, Cramer DW. Body Mass Index and Ovulatory Infertility. *Epidemiology* 1994;**5**:247–250.

- Gunby J, Daya S, on behalf of the IVF Directors Group of the Canadian Fertility and Andrology Society. Assisted reproductive technologies (ART) in Canada: 2001 results from the Canadian ART Register. *Fertil Steril* 2005;**84**:590–599.
- Gunby J, Bissonnette F, Librach C, Cowan L, on behalf of the IVF Directors Group of the Canadian Fertility and Andrology Society. Assisted reproductive technologies in Canada: 2005 results from the Canadian Assisted Reproductive Technologies Register. *Fertil Steril* 2009; **91**:1721–1730.
- Gunby J, Bissonnette F, Librach C, Cowan L, on behalf of the IVF Directors Group of the Canadian Fertility and Andrology Society. Assisted reproductive technologies (ART) in Canada: 2006 results from the Canadian ART Register. *Fertil Steril* 2010;**93**:2189–2201.
- Gunby J, Bissonnette F, Librach C, Cowan L, on behalf of the IVF Directors Group of the Canadian Fertility and Andrology Society. Assisted reproductive technologies (ART) in Canada: 2007 results from the Canadian ART Register. *Fertil Steril* 2011;**95**:542–547.
- Gurunath S, Pandian Z, Anderson RA, Bhattacharya S. Defining infertility – a systematic review of prevalence studies. *Hum Reprod Update* 2011; **17**:575–588.
- Guzick DS, Swan S. The decline of infertility: apparent or real? *Fertil Steril* 2006;**86**:524–526.
- Herbert DL, Lucke JC, Dobson AJ. Infertility, medical advice and treatment with fertility hormones and/or in vitro fertilisation: a population perspective from the Australian Longitudinal Study on Women's Health. *Aust N Z J Public Health* 2009;**33**:358–364.
- Kelly-Weeder S, Cox CL. The impact of lifestyle risk factors on female infertility. *Women Health* 2006;**44**:1–23.
- Larsen U. Research on infertility: which definition should we use? *Fertil Steril* 2005;**83**:846–852.
- Macaluso M, Wright-Schnapp TJ, Chandra A, Johnson R, Satterwhite CL, Pulver A, Berman SM, Wang RY, Farr SL, Pollack LA. A public health focus on infertility prevention, detection, and management. *Fertil Steril* 2010;**93**:16.e1–16.e10.
- Marchbanks PA, Peterson HB, Rubin GL, Wingo PA, and the Cancer and Steroid Hormone Study Group. Research on Infertility: Definition makes a difference. *Am J Epidemiol* 1989;**130**:259–267.
- Public Health Agency of Canada. Report on Sexually Transmitted Infections in Canada: 2008. 2010. Available at <http://www.phac-aspc.gc.ca>. (29 August 2011, date last accessed).
- Rowe PJ, Comhaire FH, Hargreave TB, Mellows HJ. *WHO Manual for the Standard Investigation and Diagnosis of the Infertile Couple*. New York, USA: Cambridge University Press, 1993.
- Sciarrà J. Infertility: an international health problem. *Int J Gynecol Obstet* 1994;**46**:155–163.
- Shields M, Tremblay MS, Laviolette M, Craig CL, Janssen I, Connor Gorber S. Fitness of Canadian adults: results from the 2007–2009 Canadian Health Measures Survey. *Health Reports* 2010;**21**:21–35.
- Statistics Canada. Births and Deaths 1984. 1985. Catalogue 84–204.
- Statistics Canada. CANSIM table #104–0027. *Smoking Status, by Age Group and Sex*. 1998a. Available at <http://www.statcan.gc.ca>. (29 August 2011, date last accessed).
- Statistics Canada. CANSIM table #104–0031. *Frequency of Drinking in the Past 12 Months, by Age Group and Sex*. 1998b. Available at <http://www.statcan.gc.ca>. (29 August 2011, date last accessed).
- Statistics Canada. *Canadian Community Health Survey: Rapid Response on Infertility Complement to the User Guide—December 2010*. 2010a. Available upon request through e-mail to [hd-ds@statcan.gc.ca](mailto:hd-ds@statcan.gc.ca).
- Statistics Canada. CANSIM table #105-0501. *Health Indicator Profile, Annual Estimates, by Age Group and Sex*. 2010b. Available at <http://www.statcan.gc.ca> (29 August 2011, date last accessed).
- Statistics Canada. *Births 2008*. 2011a. Catalogue 84F0210X.
- Statistics Canada. *Canadian Community Health Survey (CCHS) Annual Component User guide—2010 and 2009–2010 Microdata Files—June 2011*. 2011b. Available at [http://www.statcan.gc.ca/imdb-bmdi/document/3226\\_D7\\_T9\\_V8-eng.pdf](http://www.statcan.gc.ca/imdb-bmdi/document/3226_D7_T9_V8-eng.pdf). (15 September 2011, date last accessed).
- Stephen EH, Chandra A. Estimating infertility: not the last word. *Fertil Steril* 2006;**86**:534.
- Swanton A, Child T. Reproduction and ovarian ageing. *J Br Menopause Soc* 2005;**11**:126–131.
- Thonneau P, Spira A. Prevalence of infertility: international data and problems of measurement. *Eur J Obstet Gynecol Reprod Biol* 1990; **38**:43–52.
- van Noord-Zaadstra BM, Looman CW, Alsbach H, Habbema JD, te Velde E, Karbatt J. Delaying childbearing: effect of age on fecundity and outcome of pregnancy. *Br Med J* 1991;**302**:1361–1365.
- Webb S, Holman D. A survey of infertility, surgical sterility and associated reproductive disability in Perth, Western Australia. *Aust J Public Health* 1992;**16**:376–381.