The Burden and Economic Impact of Fetal Alcohol Spectrum Disorder in Canada

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ARBD: Alcohol-related birth defects

ARND: Alcohol-related neurodevelopmental disorder

CanFASD: Canada FASD Research Network

CAPHC: Canadian Association of Paediatric Health Centres

CASLPA: Canadian Association for Speech-Language Pathologists and Audiologists

CDC: Centers for Disease Control and Prevention

CFFAR: Canadian Foundation on Fetal Alcohol Research

CI: Confidence intervals

CIHI: Canadian Institute of Health Information

CIHR: Canadian Institute of Health Research

CMDB: Canadian MIS Database

CND: Canadian dollars

CPNP: Canada Prenatal Nutrition Program

CRCF: Centre for Research on Children and Families

DAD: Discharge Abstract Database

DALYs: Disability-adjusted life years

DATIS: Drug and Alcohol Treatment Information system

DSM: Diagnostic and Statistical Manual of Mental Disorders

F: Females

FAE: Fetal alcohol effects

FAEE: Fatty acid ethyl esters

FAS: Fetal alcohol syndrome

FASD: Fetal alcohol spectrum disorder

GBD: Global burden of disease

GDP: Gross domestic product

HMDB: Hospital Morbidity Database

HMHDB: Hospital Mental Health Database

ICD: International Classification of Diseases

ICCFASD: Interagency Coordinating Committee on Fetal Alcohol Spectrum Disorders

IQ: Intelligence quotient

LHINs: Local Health Integration Networks

M: Males

MBD: Minimal brain dysfunction

MRD: Most responsible diagnosis

NACRS: National Ambulatory Care Reporting System

ND-PAE: Neurodevelopmental disorder associated with prenatal alcohol exposure

OMHRS: Ontario Mental Health Reporting System

PAE: Prenatal alcohol exposure

pFAS: Partial fetal alcohol syndrome

PHAC: Public Health Agency of Canada

SD: Standard deviation

SLD: Speech-language disorders

US: United States

USD: US dollars

WHO: World Health Organization

Executive Summary

The current study aimed to estimate the overall burden and cost associated with fetal alcohol spectrum disorder (FASD) in Canada in 2013. FASD is a group of disorders caused by prenatal alcohol exposure.

This study was conducted within the framework of the revised *International Guidelines for Estimating the Costs of Substance Abuse* (Single et al., 2003) and can be characterized as a cost-of-illness study. In addition, the guidelines generated during the first National Roundtable held by the Public Health Agency of Canada (PHAC, 2008) were also employed, and the methodologies of the few existing studies on the economic cost of FASD from Canada and the United States were taken into consideration.

The following cost drivers were included in this study:

- direct cost of health care (speech-language interventions, prescription drug use, acute inpatient care, psychiatric care, emergency department and day surgery visits, screening and diagnosis, and specialized addiction treatment)
- direct cost of law enforcement (corrections)
- other direct costs (children and youth in care, supportive housing, long-term care, special education, and prevention and research)
- indirect costs (productivity losses due to disability and premature mortality of individuals with FASD).

The cost associated with FASD in Canada in 2013 (based on the cost drivers included in this study) totalled approximately $1.8 billion (from about $1.3 billion as the lower estimate to $2.3 billion as the upper estimate). The highest contributor to the overall FASD-attributable cost was the cost of productivity losses due to disability and premature mortality, which accounted for 42% (between $532 million and $1.2 billion) of the overall cost. The second highest contributor was the cost of corrections, accounting for 30% ($378.3 million). The third highest contributor was the cost of health care at 10% (between $128.5 and $226.3 million).

It is important to highlight that this study used the most conservative assumptions, which means that the costs presented here should be considered the minimal costs associated with FASD in Canadian society.

Although this study estimated more cost components than previous studies, there were issues related to the availability of data. Given this, there are several additional cost components (e.g., the cost of productivity losses of parents/caregivers of people with FASD, and the non-monetary or intangible costs such as pain, suffering, stress and guilt [of mothers]) that need to be estimated in the future, when data become available.

To conclude, these cost figures, as powerful arguments, should not be misused for the further stigmatization of mothers with alcohol dependence. Rather, they should be used as strong scientific evidence demonstrating the burden and cost associated with FASD by policy-makers formulating policies on programs and funding support for the numerous activities required to improve the lives of people with FASD and their families, and to prevent further alcohol-exposed pregancies.

Introduction

The most recent global burden of disease (GBD) and injury study reports that in 2010 alcohol was the fifth leading contributor to disability and mortality: 3.9% of global disability-adjusted life years (DALYs) and 5.2% of all global deaths were attributable to alcohol (Lim et al., 2012). However, alcohol consumption affects not only the drinker, but also other people associated with the drinker. A classic, and the most dramatic, example of such harm is drinking during pregnancy.

The World Health Organization (WHO) global strategy to monitor and reduce the harmful use of alcohol, endorsed by the 63rd World Health Assembly, highlights the importance of prevention and identification of the harmful use of alcohol among pregnant women and women of childbearing age, along with treatment and care for individuals and families affected by FASD (WHO, 2010). Despite attempts to increase public awareness of the risks associated with drinking during pregnancy, a significant portion of pregnancies in Canada are alcohol-exposed: about 14% of women among the general population (PHAC, 2005a), about 50% of women in an isolated Northern community in Alberta (Dow-Clarke et al., 1994), and more than 60% of Inuit women in Arctic Quebec (Muckle et al., 2011) drink during pregnancy.

Maternal alcohol consumption during pregnancy increases the risk for a wide range of adverse outcomes, and is recognized to be the most common preventable cause of mental impairment in the western world. Maternal alcohol consumption during pregnancy is an established cause of fetal alcohol spectrum disorder (FASD). FASD is a non-diagnostic umbrella term used to characterize the full range of damage caused by prenatal alcohol exposure (PAE), varying from mild to severe and encompassing a broad array of deficits (Chudley et al., 2005). FASD includes four alcohol-related categorical diagnoses: fetal alcohol syndrome (FAS), partial FAS (pFAS), alcohol-related neurodevelopmental disorder (ARND) and alcohol-related birth defects (ARBD; Chudley et al., 2005; Stratton et al., 1996). FAS is the most severe and visibly identifiable form of FASD. Alcohol is a teratogen, and therefore PAE can affect any organ or system of the fetus. As a result, individuals with FASD may have a broad array of physical defects; cognitive, behavioural, emotional and adaptive functioning deficits; and congenital anomalies, such as malformations and dysplasia of the cardiac, skeletal, renal, ocular, auditory and other systems. These impairments are likely to have lifelong implications.

Damage to the central nervous system is a unifying concept for nearly all of the FASD diagnoses (Burd et al., 2009; Chudley et al., 2005; Paintner et al., 2012a). Thus, FASD imparts a large burden on society through the health care system, mental health and substance abuse treatment services, foster care, the criminal justice system, and the long-term care of individuals with intellectual and physical disabilities (Abel, 1998; Conry & Fast, 2000; Credé et al., 2011; Harwood, 2000; Interagency Coordinating Committee on Fetal Alcohol Spectrum Disorders [ICCFASD], 2011; Lupton et al., 2004; Popova, Stade et al., 2011; Popova, Stade, Lange, Bekmuradov et al., 2012; PHAC, 2011; Stratton et al., 1996). Without crucial support, people

affected by FASD are at an increased risk of developing secondary disabilities, such as mental health problems, school failure and drop-out, sexually deviant behaviour, alcohol and other drug problems, unemployment, dependent living, homelessness, involvement with the law and incarceration (Streissguth et al., 2004). When combined with the person's primary deficits, these secondary disabilities increase the complexity of care and result in significant social and economic costs to society (Abel & Sokol, 1987; Harwood, 2000; Legge et al., 2001; Lupton et al., 2004; PHAC, 2003b, 2005b; Popova, Stade et al., 2011; Popova, Stade, Lange, Bekmuradov et al., 2012; Stade et al., 2009). In addition, individuals with FASD are at an increased risk for neglect, abuse, foster care, and disrupted family life (Kvigne et al., 2004), which further increases their risk of developmental adversity.

Crude prevalence estimates suggest that approximately 1% of live births in Canada may have FASD (PHAC, 2003b). However, the prevalence of FASD among special populations such as children in care, prisoners and populations in Northern isolated communities has been reported to be much higher (up to 20%; Asante & Nelms-Maztke, 1985; Robinson et al., 1987; Square, 1997; Williams et al., 1999).

The authors of the current report developed a model for estimating the economic impact of FASD in Canada (Popova, Stade, Lange, Mihic et al., 2012; Popova, Stade, Lange & Rehm, 2012). The model was designed to calculate a comprehensive, evidence-based picture of the economic impact that FASD has on Canadian society.

The purpose of the current study was to provide economic estimates of the cost drivers attributable to FASD, inasmuch as the availability of data allows such estimates to be made. All cost components were estimated using the model mentioned above.

This study was conducted within the framework of the revised *International Guidelines for Estimating the Costs of Substance Abuse* (Single et al., 2003), and can be characterized as a cost-of-illness study. Accordingly, in this study, the impact of FASD on the material welfare of Canadian society was examined by analyzing the direct costs of resources expended on treatment and intervention, law enforcement, screening and diagnosis, as well as the indirect costs of productivity losses of individuals with FASD due to their increased morbidity and premature mortality.

As a general rule of thumb, the most conservative assumptions (using the lower cost alternative where appropriate alternatives exist) were used, and sensitivity analyses on the main assumptions with different options (which will allow readers to determine costs for alternative assumptions) were conducted wherever possible. For additional details on the cost model, please see Popova, Stade, Lange, Mihic et al. (2012) and Popova, Stade, Lange & Rehm (2012).

It is also important to note that the prevalence of FASD is currently unknown in Canada; therefore, for the purpose of this study, the most commonly cited rough estimates of the prevalence of FAS (1 per 1,000; PHAC, 2003b) and of FASD (9 per 1,000; Roberts & Nanson, 2000) were used. In addition, the burden and

costs associated with individuals with FAS, the most severe form of FASD, were estimated separately. However, it is important to note that the figures presented for FASD include those for FAS.

Due to data limitations, each module in this study had its own methodology and set of assumptions, and expert opinions were sought whenever data were not readily available.

Although this study has several limitations, all of which are thoroughly described in each module, it does provide a working estimate, and is intended to be used as a powerful tool for understanding the enormous economic burden that FASD places on Canadian society. However, over time, as better data become available, further research can refine these estimates.

All cost figures estimated in this study are presented in Canadian dollars (CND).

1. Direct Health Care Costs

1.1 Acute Inpatient Care, Psychiatric Care, Emergency Department Visits and Day Surgery Visits

People affected by FASD most often experience an array of health problems such as birth defects, growth deficits, cognitive delay, and mental and behavioural disorders. Furthermore, those who are affected by FASD are also more susceptible to cardiac anomalies, urogenital defects, skeletal abnormalities, neurological impairments, and visual and hearing problems (Astley & Clarren, 1999; Burd et al., 2004, 2008; Habbick et al., 1997; Iyasu et al., 2002; Lemoine et al., 1968; Stratton et al., 1996).

Several studies report that individuals with FASD also have higher mortality rates than the general population (Astley & Clarren, 1999; Burd et al., 2008; Lemoine et al., 1968; Stratton et al., 1996).

Because FASD is associated with a vast number and range of health conditions, the health care costs involved in caring for affected individuals result in a substantial burden to society. A recent review conducted by the authors of this study (Popova, Stade et al., 2011; Popova, Stade, Lange, Bekmuradov et al., 2012), revealed that there are only a few studies that have assessed the economic impact of FAS/FASD on health care in Canada (Stade et al., 2006, 2009; Thanh & Jonsson, 2009) and the United States (US; Abel & Sokol, 1987, 1991a, 1991b; Harwood, 2000, 2003; Harwood et al., 1984, 1998; Harwood & Napolitano, 1985; Rice, 1993; Rice et al., 1990, 1991; Weeks, 1989).

In Canada, Stade and colleagues (2006) estimated, on an individual level using a cross-sectional study design, that the annual health care cost per individual with FASD in 2003 was $3,976 CND, based on a prevalence rate of 3 per 1,000 live births for individuals 1 to 21 years of age. This figure accounted for about 30% of the total cost; the total annual cost for all individuals with FASD was $344.2 million CND, and also included education, social services, productivity losses and out-of-pocket expenses. When the authors extended their sample to include those from 0 (newborns) to 53 years of age, the cost per individual (for 2007) rose to $6,630 CND (Stade et al., 2009). The annual cost for all individuals with FASD was $5.3 billion CND, with health care accounting for 35% of the total. All of the same cost drivers mentioned above were included. Thanh and Jonsson (2009), using the methodology of Stade and colleagues (2006, 2009), estimated the annual health care costs for the cohort of children born with FASD in the province of Alberta to be $39.4 million CND, based on a prevalence of 3 per 1,000, and $121.2 million CND, based on a prevalence of 9 per 1,000.

The studies from the US show extensive variation in the estimated health care costs due to FAS. In 1980, Harwood and colleagues (1984) and Harwood and Napolitano (1985) estimated that the annual health care cost for all individuals with FAS was $699 million US dollars (USD; 22% of the total cost, which included residential and home care, special education and productivity losses), based on a prevalence rate of 1.67 per

1,000 for individuals 0 to 65 years of age. Shortly after, Abel and Sokol (1987) estimated the annual health care cost to be $136 million USD (42% of the total cost; residential care accounted for the remaining 58%) in 1984 for individuals with FASD 0 to 21 years of age, based on a prevalence of 1.9 per 1,000 for FAS. This cost was later revised to $16.9 million USD (22.7% of the total costs, of which residential care accounted for the remaining 77.3%) based on a lower prevalence of 0.33 per 1,000 (Abel & Sokol, 1991a) and $104.5 million USD based on the original prevalence of 1.9 per 1,000 (Abel & Sokol, 1991b). Rice and colleagues (1990, 1991) estimated that the annual cost of health care in 1985 was $135 million USD (8.4% of the total cost; residential care was also included in the cost estimate, and accounted for the remaining 91.4%, while research accounted for 0.2%), also based on a prevalence of 1.9 per 1,000 for individuals 0 to 65 years of age.

In 1996/97, for the state of North Dakota, Klug and Burd (2003) estimated that the prevention of one case of FAS each year for 10 years would result in a cost saving of $129,000 USD, and the prevention of one case each year for 20 years would decrease expenditures for care by $492,000 USD.

In a study of the social costs of alcohol in Sweden, Johansson and colleagues (2006) estimated that in 2002 the inpatient and outpatient health care costs associated with FAS were 186,000 Swedish krona.

Recently, Credé and colleagues (2011) undertook an impact study of health care–specific FAS costs in children aged 0 to 12 years in the Western Cape of South Africa, using a cross-sectional design. The authors reported that the total average annual cost per child diagnosed with FAS was approximately $1,039 USD (95% CI: $809–$1,270) and the total annual societal cost was $70,960,054 USD (95% CI: $5,528,895–$86,709,971). The median number of annual visits to public health care facilities was 8 (interquartile range: 4–14) visits per child.

Brief estimates that have included health care as a main cost driver have also been completed for the Atlantic provinces of Canada (PHAC, 2003a) and various states in the US (Kloehn et al., 1997; McDowell Group, 2005; Popovici et al., 2009; Rosen et al., 2008; Russell, 1980), as well as the US as a whole (Miller et al., 2006).

Despite the few existing Canadian FASD cost studies, which were performed on an individual level with cross-sectional study designs (Stade et al., 2006, 2009), very little is known about the utilization of health care services by individuals in Canada with FASD, and the associated costs. As the prevalence and incidence of FASD in Canada remain uncertain, establishing the burden of health care and economic cost for FASD is challenging.

The purpose of this module was to determine the utilization of health care by individuals in Canada diagnosed with FAS, and to estimate the associated direct cost for the most recent available fiscal year (2008/09), by using official medical data collected across Canada by the Canadian Institute of Health Information (CIHI).

Given that FAS is the only FASD-related diagnosis coded in the *International Classification of Diseases* (ICD) (in the ICD, Version 9, clinical modification [ICD-9-CM; NCHS, 2011], “Alcohol affecting foetus or newborn via

placenta or breast milk" 760.71, and in the ICD, Version 10 [ICD-10; WHO, 2010], "Fetal alcohol syndrome [dysmorphic]" Q86.0), it is the only FASD-related diagnosis that can be extracted from health records/databases. Mortality data were also sought in order to further the understanding of the mortality rate among individuals with FAS.

METHODS

Sources of health care utilization data

Health care utilization data of individuals diagnosed with FAS were obtained from CIHI (http://www.cihi.ca). CIHI is a government-funded non-profit agency that collects, consolidates and provides unbiased, credible and comparable Canadian health care information. CIHI manages a large number of Canadian health databases, and receives data from the Canadian government and Canadian hospitals.

Up to 25 diagnoses may be recorded on a patient's medical chart in Canada. The most responsible diagnosis (MRD) is defined as the single diagnosis that describes the most significant condition of the patient that is responsible for his or her stay in hospital. In a case where multiple diagnoses may be classified as the MRD, coders are instructed to code the diagnosis responsible for the greatest length of stay.

The data on health care service utilization from April 1, 2008, to March 31, 2009, where a diagnosis of FAS was captured as the MRD or a secondary or other diagnosis, was searched for in the following databases: the Discharge Abstract Database (DAD), the Hospital Morbidity Database (HMDB), the National Ambulatory Care Reporting System (NACRS), the Ontario Mental Health Reporting System (OMHRS) and the Hospital Mental Health Database (HMHDB). The OMHRS replaces the DAD and the Hospital Mental Health Survey as the mechanism for collecting data on adult inpatients occupying designated mental health beds in Ontario. It was requested that the data be broken down by sex, age group (0–14, 15–29, 30–44, 45–59, 60–69, 70–79 and 80+), and province and territory.

It is important to note that each hospitalization does not represent a separate case of FAS, as one case can be counted multiple times (once per visit).

Acute inpatient care. The DAD contains the number of acute care hospitalizations and hospital days in all provinces and territories, whereas the HMDB contains adult inpatient data for Quebec only.

Psychiatric care. The DAD contains the number of psychiatric hospitalizations and hospital days by provinces and territories, except for the province of Ontario. Data on adult inpatient mental health services, as either acute or psychiatric care, for Ontario are available from OMHRS. The HMHDB contains data from five specialty psychiatric facilities (in Manitoba, Saskatchewan and Prince Edward Island) that do not report to the DAD.

Day surgery. The DAD contains the number of day surgery hospitalizations and number of hours for all provinces and territories except for Ontario, Quebec, Alberta and a small part of Nova Scotia, while the NACRS

contains day surgery data for Ontario and a small part of Nova Scotia. Thus, day surgery data represent all provinces and territories except for Alberta and Quebec.

Emergency department. The NACRS contains the number of emergency department visits and the number of hours for Ontario only.

Sources of cost data

The authors requested that CIHI estimate the average cost per day at acute care and psychiatric hospitals, as well as the average cost per hospitalization for day surgery and emergency department visit by province and territory, and for all of Canada, using data from the Canadian MIS Database (CMDB) for 2008/09 (Table 1). Data from Quebec and Nunavut were unavailable.

Cost of acute inpatient care. The average cost per day in acute inpatient care was obtained for all provinces and territories.

Cost of psychiatric care. The average cost per day in psychiatric care was obtained for all provinces and territories of Canada, except for Yukon Territory (data unavailable).

Cost of day surgery. The average cost per hospitalization for day surgery was obtained for all provinces and territories, except for Prince Edward Island, Northwest Territories and Yukon Territory (data unavailable).

Cost of emergency department. The average cost per visit to an emergency department was obtained for all provinces and territories of Canada.

Table 1.
Average cost per day/visit by expense type on a provincial and territorial and national level in Canada in 2008/09

Provinces and territories	Average cost per day in acute care ($)	Average cost per day in psychiatric care ($)	Average cost per visit in day surgery ($)	Average cost per visit in emergency department ($)
Alberta	759.65	463.48	219.38	127.36
British Columbia	740.54	424.68	110.22	166.17
Manitoba	564.67	349.57	206.87	166.24
New Brunswick	607.33	576.01	130.66	133.95
Newfoundland	675.51	445.39	164.59	98.25
Nova Scotia	657.59	379.60	107.97	126.70
Ontario	674.73	394.61	163.86	191.02
Prince Edward Island	569.53	363.13	n/a	90.48
Quebec	n/a	n/a	n/a	n/a
Saskatchewan	725.73	347.18	101.72	168.29
Northwest Territory	836.92	691.46	n/a	163.92
Nunavut	n/a	n/a	n/a	n/a
Yukon Territory	647.99	n/a	n/a	94.68
Canada	**684.49**	**412.58**	**157.48**	**163.96**

n/a: not available
Source: CIHI (CMDB)

Cost calculations

The total cost of acute inpatient and psychiatric care in Canada for 2008/09 was calculated by taking the average respective cost per day and multiplying by the number of hospital days associated with FAS in acute inpatient and psychiatric care, respectively.

To calculate the cost of FAS-associated day surgery hospitalizations and emergency department visits, the average cost per day surgery visit for Canada and the average cost per emergency department visit for Ontario were multiplied by the number of hospitalizations in the respective categories. It should be noted that CIHI suppresses cells with fewer than five cases for hospitalizations, hospital days and/or visits in order to ensure the confidentiality of the data. In instances where there were fewer than five cases, a midpoint of 2.5 was imputed.

Sources of mortality data

Mortality data on FAS from 2000 to 2008 were obtained from Statistics Canada by age group and sex (Statistics Canada, 2011a).

RESULTS

The data associated with FAS for acute inpatient care, psychiatric care, day surgery hospitalizations and emergency department visits (Ontario only) were extracted from CIHI's respective databases as described above. CIHI's privacy and confidentiality policies, described above, made it impossible to obtain data by province and territory, or by sex. The search revealed that there were no cases with a diagnosis of FAS reported to the HMHDB.

Health care utilization data

The highest number of recorded hospitalizations and hospital days/hours for acute care, psychiatric care and emergency department visits, among individuals diagnosed with FAS, was observed among those 15 to 29 years of age, and the second highest rate was among those from birth to 14 years (Tables 2 and 3; Figures 1 and 2). The rate of utilization dropped substantially in the age group 45 to 59, and after age 60 there were zero recorded cases for all levels of care except for acute care hospitalizations.

The pattern is somewhat different for day surgery, where the highest utilization rate was in the age group from birth to 14 years, followed by the age group 15 to 29.

The highest rate of utilization across all age groups was in acute inpatient care, even when compared with psychiatric care—this is surprising since the MRDs were overrepresented by mental and behavioural disorders (as will be discussed below).

Table 2.
Number of recorded hospitalizations and visits associated with a diagnosis of FAS in Canada in 2008/09

Level of care (Database of CIHI)	Age groups (years)						
	0–14	15–29	30–44	45–59	60–69	70–79	80+
Number of acute care hospitalizations Canada (DAD, HMDB & OMHRS)	256	249	103	21	6	<5	0
Number of psychiatric care hospitalizations Canada (DAD & OMHRS)	14	43	9	<5	0	0	0
Number of day surgery hospitalizations[a] (DAD & NACRS)	26	9	5	5	0	0	0
Number of emergency department visits Ontario (NACRS)	18	24	<5	0	0	0	0

a Data from Quebec and Alberta are not included
Source: CIHI (DAD, HMDB, NACRS, OMHRS)

Table 3.
Number of recorded hospital days and hours associated with a diagnosis of FAS in Canada in 2008/09

Level of care (Database of CIHI)	Age groups (years)						
	0–14	15–29	30–44	45–59	60–69	70–79	80+
Number of acute care hospital days Canada (DAD, HMDB & OMHRS)	2,911	3,628	973	356	32	74	0
Number of psychiatric care hospital days Canada (DAD & OMHRS)	308	1,353	1,230	14	0	0	0
Number of hours in day surgery[a] (DAD & NACRS)	120.4	44.8	24.8	12.0	0	0	0
Number of hours in emergency department Ontario (NACRS)	99.4	114.2	12.2	0	0	0	0

a Data from Quebec and Alberta are not included
Source: CIHI (DAD, HMDB, NACRS, OMHRS)

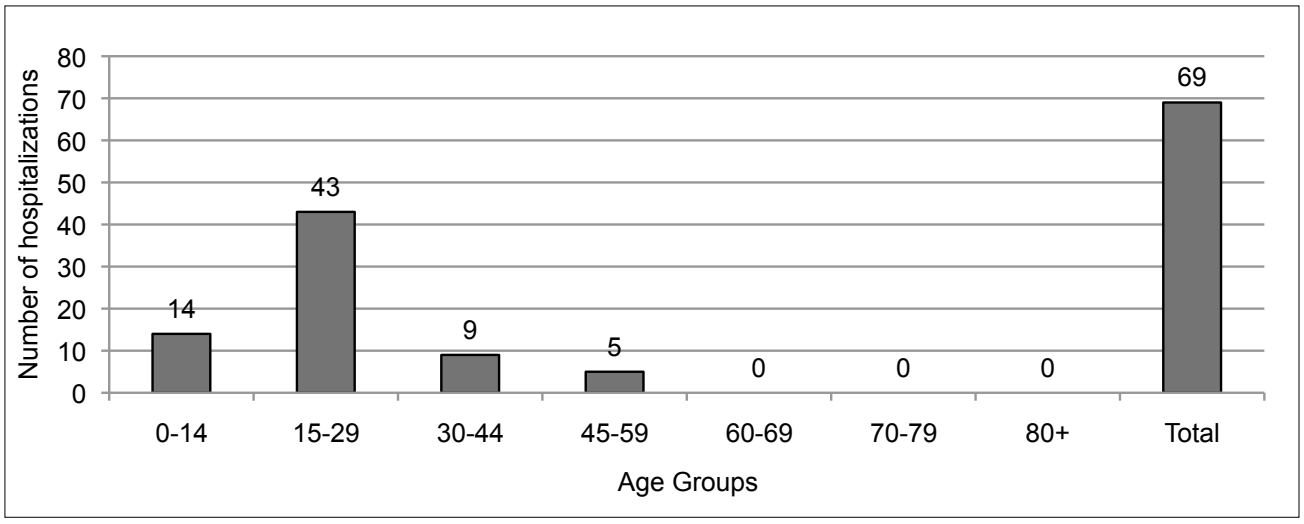

Figure 1. Number of psychiatric care hospitalizations among individuals with FAS in Canada in 2008/09

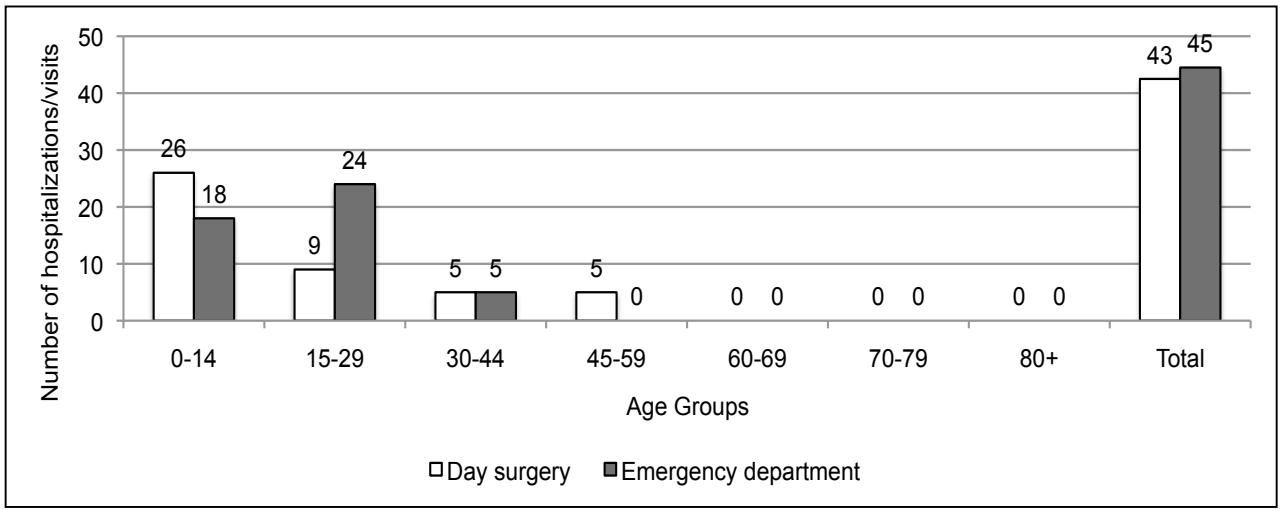

Figure 2. Number of day surgery hospitalizations and emergency department visits among individuals with FAS in Canada in 2008/09

Table 4 presents the percentage of records of the top ICD MRDs among individuals diagnosed with FAS who used acute care, psychiatric care, day surgery and emergency department services in Canada in 2008/09. The list represents only 55% of all records with a diagnosis of FAS; the remaining 45% had MRDs for which the percentage of records was negligible (i.e., <0.5%).

Twenty-five out of the 34 MRDs listed (i.e., 74%) are coded within Chapter V of the ICD: Mental and Behavioural Disorders (F00–F99). The leading MRD was Adjustment Disorders: in 2008/09 about 7% of individuals (approximately 1 in 15) diagnosed with FAS were admitted either to acute care, to psychiatric care, for day surgery or to the emergency department primarily due to this condition.

Only 7% of individuals accounted for by the DAD, the HMDB and the NACRS had an MRD of FAS.

Table 4.
Percentage of records of the top most responsible diagnoses among individuals diagnosed with FAS who used acute care, psychiatric care, day surgery and emergency department services in Canada in 2008/09

ICD-10 code	Most responsible diagnosis	Percentage of records[a]
Q86.0	Fetal alcohol syndrome (dysmorphic)	7.1
F43.2	Adjustment disorders	6.9
F90.0	Disturbance of activity and attention	5.4
F29	Unspecified nonorganic psychosis	3.3
F20.9	Schizophrenia, unspecified	2.6
F91.9	Conduct disorder, unspecified	2.5
F32.9	Depressive episode, unspecified	2.1
P07.1	Other low birth weight	1.7
F32.2	Severe depressive episode without psychotic symptoms	1.6

ICD-10 code	Most responsible diagnosis	Percentage of records[a]
F31.9	Bipolar affective disorder, unspecified	1.4
F39	Unspecified mood [affective] disorder	1.4
F91.3	Oppositional defiant disorder	1.3
K02.9	Dental caries, unspecified	1.3
F43.1	Post-traumatic stress disorder	1.2
F25.9	Schizoaffective disorder, unspecified	1.0
J18.9	Pneumonia, unspecified	1.0
R56.8	Other and unspecified convulsions	0.9
T39.1	Poisoning by 4-Aminophenol derivatives	0.9
F43.0	Acute stress reaction	0.8
F60.3	Emotionally unstable personality disorder	0.8
F19.1	Mental and behavioural disorders due to multiple drug use and use of psychoactive substances, harmful use	0.7
F23.9	Acute and transient psychotic disorder, unspecified	0.7
F25.2	Schizoaffective disorder, mixed type	0.7
F69	Unspecified disorder of adult personality and behaviour	0.7
F79.9	Unspecified mental retardation without mention of impairment of behaviour	0.7
F90.1	Hyperkinetic conduct disorder	0.7
R45.8	Other symptoms and signs involving emotional state	0.7
B24	Human immunodeficiency virus [HIV] disease	0.6
E10.1	Type 1 diabetes mellitus with ketoacidosis	0.6
F10.0	Mental and behavioural disorders due to use of alcohol, acute intoxication	0.6
F10.2	Mental and behavioural disorders due to use of alcohol, dependence syndrome	0.6
F32.3	Severe depressive episode with psychotic symptoms	0.6
F41.9	Anxiety disorder, unspecified	0.6
F94.1	Reactive attachment disorder of childhood	0.6
G40.9	Epilepsy, unspecified	0.6

a The most responsible diagnoses listed above represents 55% of all the records with a diagnosis of FAS
Source: CIHI (DAD, HMDB, NACRS)

Table 5 and Figure 3 present the percentage of records of the top MRDs among individuals diagnosed with FAS who used adult inpatient mental health services (acute and psychiatric care) in Ontario in 2008/09.

The listed MRDs, with the corresponding DSM-IV codes, represent 100% of the records associated with a diagnosis of FAS. The leading MRD was Mood Disorders: more than 38% of adult inpatients diagnosed with FAS occupied designated mental health beds in Ontario due to this condition. In other words, in 2008/09, 38% of people with a diagnosis of FAS required inpatient mental health care for a mood disorder.

It is important to note that the DSM-IV MRDs discussed here represent adult inpatient mental health services in Ontario only, and so should not be generalized to Canada as a whole.

Table 5.
Percentage of records of the top most responsible DSM-IV diagnoses among individuals diagnosed with FAS who used adult inpatient mental health services (acute and psychiatric care) in Ontario in 2008/09

DSM-IV diagnosis	Most responsible diagnosis	Percentage of records[a]
Q1f	Mood disorders	38.5
Q1o	Adjustment disorders	15.4
Q1a	Disorders of childhood/adolescence	7.7
Q1b	Delirium, dementia, and amnestic and other cognitive disorders	7.7
Q1c	Mental disorders due to general medical conditions	7.7
Q1d	Substance-related disorders	7.7
Q1e	Schizophrenia and other psychotic disorders	7.7
Q1n	Impulse-control disorders not elsewhere classified	7.7

a The most responsible diagnoses listed above represents 100% of all the records with a diagnosis of FAS
Source: CIHI (OMHRS)

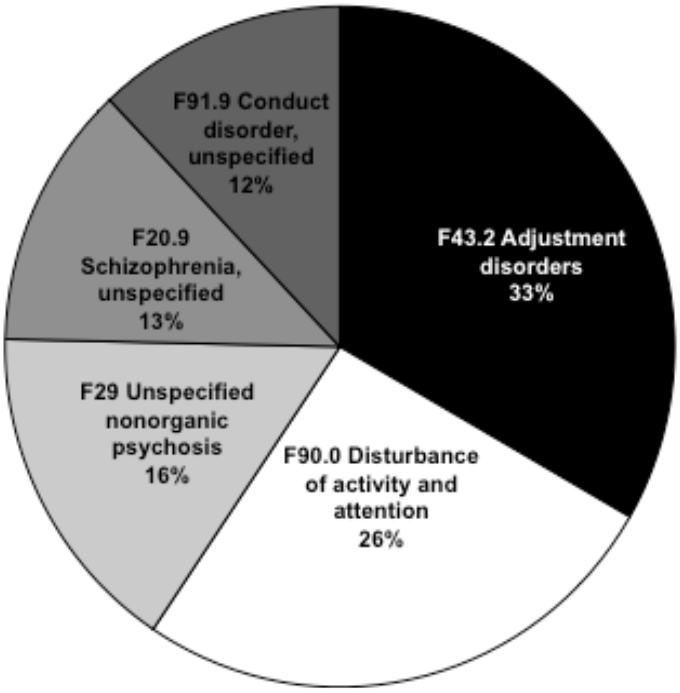

Figure 3. The top five most responsible ICD-10 diagnoses among individuals with FAS who used acute care, psychiatric care, day surgery and emergency department services in Canada in 2008/09

Table 6 presents the combined number of hospital days (data for Canada aggregated with data for Ontario), for acute and psychiatric care, and the number of hospitalizations for day surgery for Canada and emergency department visits for Ontario, by age group.

It was estimated that the cost for acute care hospital days associated with a diagnosis of FAS in Canada in 2008/09 was approximately $5.5 million; for psychiatric care hospital days $1.2 million, and for day surgery hospitalizations $6,700. The cost of emergency department visits associated with a diagnosis of FAS in Ontario in 2008/09 was $8,500.

The total direct health care cost associated with FAS in Canada in 2008/09, based on the official CIHI data, was over $6.67 million (Table 6; Figure 4)

Table 6.

Number of recorded hospital days, hospitalizations and visits associated with a diagnosis of FAS and the associated costs in Canada in 2008/09

Level of care	Age groups (years)							Total number of days/ hospitalizations	Costs
	0–14	15–29	30–44	45–59	60–69	70–79	80+		
Number of acute care hospital days (DAD, HMDB & OMHRS)	2,911	3,628	973	356	32	74	0	7,974	$5,458,123.26
Number of psychiatric care hospital days (DAD & OMHRS)	308	1,353	1,230	14	0	0	0	2,905	$1,198,544.90
Number of day surgery hospitalizations* (DAD & NACRS)	26	9	5	<5	0	0	0	42.5	$6,692.90
Number of emergency department visits (ON only; NACRS)	18	24	<5	0	0	0	0	44.5	$8,500.39
TOTAL									$6,671,861.45

Source: CIHI (DAD, HMDB, NACRS, OMHRS)
Data from Quebec and Alberta are not included
Note. In instances where there were fewer than five cases (<5), a midpoint of 2.5 was imputed for those cells

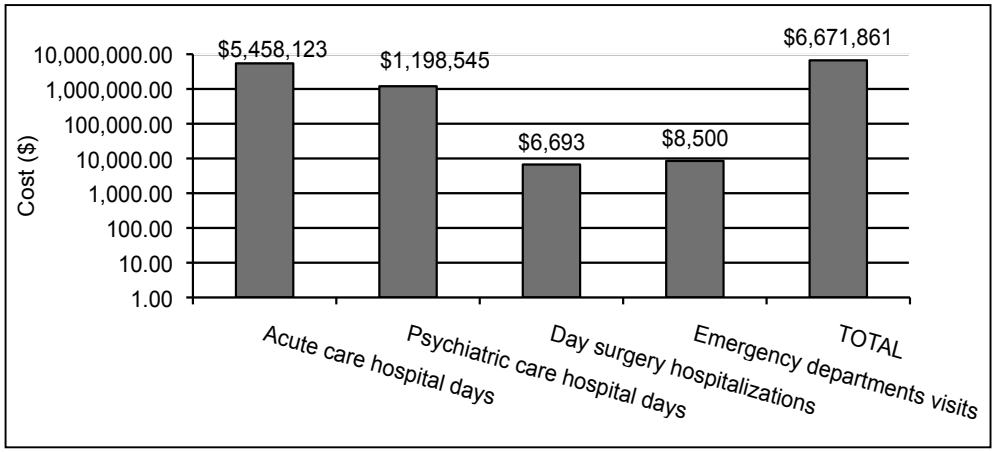

Figure 4. Cost of recorded hospitalizations and visits associated with a diagnosis of FAS in Canada in 2008/09

Mortality

Surprisingly, the data show only 1 death due to FAS in 2001 (under the age of 1, male), 1 in 2002 (20–24 years of age, female), 2 in 2006 (both 15–19 years of age, females), 1 in 2007 (40–44 years of age, female), and 1 in 2008 (25–29 years of age, female). In total, there were only 6 deaths (1 male and 5 females) documented as being attributable to FAS during the 9-year period (2000–2008), as reported by Statistics Canada (2011a; Table 7).

Table 7.
The number of deaths of individuals diagnosed with FAS by sex in Canada in 2000–2008

Age group (years)	2000		2001		2002		2003		2004		2005		2006		2007		2008	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Under 1	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1–4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5–9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
10–14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
15–19	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—
20–24	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
25–29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
30–34	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
35–39	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
40–44	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
45–49	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
50–54	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
55–59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
60–64	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
65–69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70–74	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
75–79	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
80–84	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
85–89	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
90+	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Age, not stated	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total, all ages	—	—	1	—	—	1	—	—	—	—	—	—	—	2	—	1	—	1

F: females; M: males
Source: Statistics Canada, 2011a

DISCUSSION

Of the four categorical diagnostic entities of FASD, FAS was the only diagnosis for which official data on health care utilization could be obtained. Therefore, the estimates in the current module are limited to only the available diagnosed FAS cases that were listed in the diagnostic formulations for episodes of health care. It is therefore likely that the burden and cost figures in this module underestimate the true cost impact of FAS on Canada's health care system, and would increase if all FASD-related diagnoses were included. It is thought that FAS represents only 10–20% of cases of FASD (PHAC, 2003b; Roberts & Nanson, 2000), and that ARND represents the largest category of affected individuals, with three to four cases of ARND for every case of FAS (Chudley, 2008). Further, given that FAS is not widely recognized by health care practitioners, it is quite likely that if an individual had been officially diagnosed prior to their hospitalization in 2008/09, FAS was not recorded in the medical chart if the precipitating event leading to care was not attributed to FAS. This too would result in an underestimate of utilization and, in turn, the cost of health care associated with FAS.

In order to estimate the error rate in capturing cost-of-care data for FAS due to inadequate diagnoses, we used the following assumptions: 1) the crude prevalence of FAS in Canada is 1 per 1,000 (0.1%; PHAC, 2003b), and 2) the total population of Canada in 2009 was 33.7 million (Statistics Canada, 2011b). Therefore, there were approximately 33,730 people with FAS in Canada in 2009.

As reported in this module, there were 771 acute care hospitalizations and emergency department visits in 2008/09. Based on these data, the rate of hospitalization during this period among the 33,730 people with FAS was about 2.3%.

However, according to official data obtained from CIHI (2010), the rate of acute care hospitalizations and emergency room visits among the general population of Canada in 2008/09 was about 8.3% (2.8 million hospitalizations in acute care facilities). Therefore, the rate of acute care hospitalizations among the general population appears to have been 3.6 times higher than among individuals with FAS. This is unrealistic, given the much higher rate of morbidity among individuals with FAS.

Using the most conservative assumption that the rate of utilization by people with FAS is the same as for the general population, the cost of acute care, psychiatric care, day surgery and emergency department services would be 3.6 times greater than the figure derived from the official CIHI data—that is, about $24 million per year. Using the assumption that the rate of utilization among individuals with FAS is twice as high as that of Canada's general population, the estimated cost of health care would double to $48 million per year.

The FAS-specific mortality data obtained from Statistics Canada (2011a) reported only 6 deaths attributable to FAS during the nine-year period (2000–2008). Some studies have reported that individuals with FASD have higher mortality rates than the general population (Astley & Clarren, 1999; Burd et al., 2008; Lemoine et al., 1968; Stratton et al., 1996), which is not demonstrated in the official data obtained from Statistics Canada. It is likely that FASD mortality rates are underreported because mortality in newborns, infants and young children most commonly occurs before an FASD diagnosis can be made, and because underdiagnosis ultimately leads

to underreporting. Thus, the rates of FAS-attributable mortality are likely invalid, and efforts are needed to improve case identification by provincial and territorial medical examiners across Canada.

While it is not possible to accurately estimate the error rate in capturing cost-of-care data for FAS due to inadequate diagnoses, it is realistic to suggest that these data represent a modest fraction of the actual cost of health care for FAS. Despite this limitation, the results of this module confirm that FAS is a significant burden to Canada's already over-burdened health care system.

These results draw attention to three main concerns in regard to FASD. First, there is an urgent need for increased capacity to properly diagnose individuals affected by PAE; second, doctors must be trained to both recognize and diagnose the full range of FASD diagnoses; and third, a better recording system is needed, to allow the full range of FASD diagnoses to be recorded (i.e., the full range of FASD diagnoses should be coded in the ICD).

Improving capture rates for FASD and providing early and accurate diagnoses would aid efforts to decrease the health care utilization rate and prevent secondary disabilities of individuals affected by PAE. In addition, early diagnosis has the potential to increase the use of substance abuse treatment for mothers, and thus prevent recurrent cases of FASD.

1.2 Screening and Diagnosis

Given the wide range of deficits and disabilities associated with FASD, individuals who may be affected by PAE must be screened. This is especially important for ARND, since these disorders are not apparent from physical features (ICCFASD, 2011). The recognition of FASD is important for an individual at any age. Early screening may lead to early diagnosis, which can lead to early participation in developmental interventions, which can, in turn, improve the quality of life for people with FASD. Early intervention may also increase the potential for the prevention of secondary disabilities, including school failure and drop out, addictions, mental health problems, sexually deviant behaviour, dependent living, involvement with the law, and incarceration (Streissguth et al., 1996, 2004). Having an official diagnosis of FAS appears to have long-term benefits. Early diagnosis and providing an appropriate environment improves outcomes and results in up to a four-fold decrease in the risk for additional impairments (e.g., Paintner et al., 2012b). Early diagnosis is also important for parents and caregivers. It provides them with an explanation for the behavioural problems often exhibited by children with FASD and can improve parenting by increasing their understanding of the various disabilities and impairments.

Screening children for PAE and early diagnosis can also help prevent subsequent FASD-affected births by providing appropriate interventions, treatment, counselling and support for birth mothers with unrecognized alcohol dependence and mental health problems (Astley et al., 2000a). Appropriate screening strategies may also facilitate early recognition and intervention for other affected siblings (Astley et al., 2000b).

In 2005, PHAC endorsed the Canadian guidelines for the diagnosis of FASD (Chudley et al., 2005). According to these guidelines, the full diagnostic process involves screening and referral, the physical examination (including the dysmorphology assessment), the neurobehavioural assessment, differential diagnosis and confirmation of PAE (with exception of an FAS diagnosis, which can be diagnosed without confirmation of PAE).

Screening and referral for FASD

Screening is a process in which members of a defined population are asked a question or offered a test to determine which of these individuals are more likely to be helped by further tests or assessments. For example, an individual positively screened for FASD will ideally then undergo a diagnostic evaluation for FASD. It is important to understand that not all positively screened individuals will receive an FASD diagnosis. The purpose of FASD screening is to facilitate referral to a diagnostic clinic, and to call attention to the need for referral and support for the birth mother (Chudley et al., 2005).

Despite having a rough prevalence estimate of 1 per 1,000 for FAS (PHAC, 2003b) and 9 per 1,000 for FASD (Roberts & Nanson, 2000), there is currently no widely accepted standardized FASD screening test in Canada (Goh et al., 2008). One of the reasons for this is that the validity and reliability of screening tools have not yet been verified. However, great strides have been made in screening tool research and development in Canada. In a review and evaluation of published and practiced methods of screening, Goh and colleagues

(2008) selected five tools to be included in an FASD screening toolkit. The tools were screening for fatty acid ethyl esters (FAEE) in neonatal meconium, the modified Child Behaviour Checklist, Medicine Wheel tool, Asante Centre Probation Officer Tool (Asante Centre for Fetal Alcohol Syndrome, 2010) and maternal history of drinking and drug use. Tool selection was based on the tools' feasibility and test characteristics (sensitivity, specificity, positive and negative predictive values). The Canadian Association of Paediatric Health Centres (CAPHC) facilitated the development of a national screening toolkit for children and youth identified as potentially affected by FASD (CAPHC, 2010). This toolkit, which contained many of the tools selected by Goh and colleagues (2008), includes the Neurobehavioural Screening Tool, Meconium FAEE Testing, Maternal Drinking Guide, Medicine Wheel tool and the Asante Centre Probation Officer Tool (Asante Centre for Fetal Alcohol Syndrome, 2010). It was officially launched in October 2010.

The screening tools used with children and youth may not be applicable for adults: tools should be age appropriate—some tools have been recommended specifically for use with adults (see PHAC, 2011).

Screening is only effective if the right individuals get screened. Populations who should be screened for FASD are (in no particular order): women using maternal substance abuse treatment programs, children seen in neurodevelopmental and/or birth defect clinics, children in special education programs, children in childcare systems (e.g., orphanages, foster care, child welfare or social services), prison populations, youth in juvenile justice programs, and clients in the mental health care system.

The role of the family physician or primary care health provider in screening for FASD is to recognize patients with dysmorphic features and/or developmental/learning and behavioural problems and to refer them to a multidisciplinary diagnostic team with expertise in FASD (Loock et al, 2005). However, similar screening could, and should, also be conducted through social services and the educational, mental health and judicial systems (Chudley et al., 2005).

Screening should not equate to and should not be used in lieu of a full diagnostic assessment (Chudley et al., 2005).

FASD diagnosis

Diagnosing FASD is complicated because it means determining whether or not a patient's behavioural problems can be explained by diffuse brain damage that is more likely due to PAE than other causes. A diagnosis requires a comprehensive, multidisciplinary assessment involving physicians (generally developmental pediatricians, dysmorphologists and/or clinical geneticists, psychiatrists or neurologists), psychologists or neuropsychologists, other developmental specialists (e.g., speech or language pathologists, occupational therapists and physiotherapists) and a case management co-ordinator (Chudley et al., 2005; Clarren & Lutke, 2008; Stratton et al., 1996).

The criteria for FASD diagnoses have been described thoroughly in the current literature (Astley & Clarren, 1999, 2000; Chudley et al., 2005; Stratton et al., 1996). An FASD diagnosis involves four components: the

physical examination, the dysmorphology assessment, the neurobehavioural assessment and the PAE confirmation. The general physical examination involves appropriate measurements of growth (height, weight and head circumference), assessment of characteristic findings and documentation of anomalies (e.g., congenital heart defects, abnormal palmar creases, high arched palate), while the dysmorphology assessment is intended to identify PAE-related facial features (e.g., length of palpebral fissures, philtrum smoothness, and vermilion border [upper lip] thinness). The neurobehavioural assessment involves an evaluation of multiple domains including hard and soft neurological signs, brain structure, cognition (intelligence quotient; IQ), communication (receptive and expressive), academic achievement, memory, executive functioning and abstract reasoning and attention deficit/hyperactivity. The specific diagnostic tests and evaluations will differ depending on the age of the individual (e.g., children versus adults; PHAC, 2011). Confirmation of PAE (i.e., of the mother's alcohol consumption during pregnancy) is also required for FASD diagnosis (with the exception of an FAS diagnosis, as stated above) and can be obtained through a direct interview with the mother (i.e., self-reports), or other sources such as reliable clinical observation, reports by a reliable source, or medical records (Astley & Clarren, 1999, 2000; Chudley et al., 2005).

With so many components, making an FASD diagnosis can be a lengthy process, requiring many trained specialists. Like other complex brain-based developmental disorders, the assessment can also be very costly. To date, the cost per person, and the annual cost for any country, is unknown.

Intervention plan and follow-up

It would be unethical to identify an individual with FASD and not provide them with the necessary referrals, resources and services specific to their needs. An individualized intervention plan and follow-up is thus part of the full diagnostic procedure.

An intervention plan involves identifying the areas in which an individual with FASD requires intervention services so that appropriate referrals can be made. The intervention plan involves an evaluation, treatment plan and the physician's recommendations of services tailored to the affected individual. When evaluating the individual needs of a person with an FASD diagnosis, a speech and language pathologist and an occupational therapist are usually required.

Finally, a follow-up co-ordinator then follows up to ensure that the affected individual has received the appropriate referrals, has made contact with the service providers, and that the treatment plan is progressing as intended. This is also the time to make any additional referrals if needed.

The purpose of this module was to estimate the per-person cost of FASD diagnosis, and the annual cost of FASD diagnostic services in Canada.

METHODS

Cost of FASD diagnosis per person

The diagnostic process breakdown was based on *Fetal alcohol spectrum disorder: Canadian guidelines for diagnosis* (Chudley et al., 2005). The number of hours required by each specialist involved in the diagnostic process was estimated, based on the opinion of the following experts: Larry Burd, Albert Chudley, Gideon Koren, Sally Longstaffe, Mary Cox-Millar, Kelly Nash and Shelley Proven. The average rate per hour for each respective specialist was estimated based on hourly costs across Canada.

Cost of all FASD cases diagnosed per year

Estimating the annual cost of all FASD cases diagnosed in Canada involves knowing how many cases are referred, evaluated and diagnosed per year across the country. Unfortunately, these figures are not available. Therefore, the number of FASD cases diagnosed per year in Canada was estimated based on the existing clinical capacity (the maximum number of assessment slots available for diagnostic purposes per year) of all FASD multidisciplinary clinics in Canada in 2011 (Clarren et al., 2011). The assumption that at most, about 70% (used as the upper boundary) of all individuals referred and evaluated are actually diagnosed with FASD in Canada was based on a 2005 survey, conducted by the Canada Northwest FASD Research Network among 27 FASD multidisciplinary clinics in Northwest Canada (response rate 56%). The survey revealed that among 816 evaluations in 2005, about 23% of those assessed were found to have FAS or pFAS and another 44% had other forms of FASD (Clarren & Lutke, 2008). Fifty percent was then used as the lower boundary, in order to calculate the minimum number of people diagnosed annually with FASD (also based on the clinical capacity of Canada). The cost of FASD diagnosis per person was then applied to the number of cases diagnosed annually.

RESULTS

Cost of FASD diagnosis per person

The estimated number of hours, average cost per hour, and total cost for each component of the multidisciplinary diagnostic process are presented in Table 8. Screening and referral was estimated to cost from $150 to $300 per person screened (1–2 hours per individual). Intake into the diagnostic clinic, or the point at which information is gathered, was estimated to cost from $160 to $320 (2–4 hours per person). Diagnosis was estimated to cost between $2,650 to $3,750 per person (23–33 hours per person), and general support was estimated to cost between $150 to $200 per individual (6–8 hours per person). Thus, the total cost for one individual to be screened, referred, diagnosed, and receive an intervention plan and follow-up ranges from $3,110 to $4,570 (32–47 hours per person).

Cost of FASD cases diagnosed per year

Estimation of number of FASD diagnoses per year. A recent survey by Clarren and colleagues (2011) reported that there were 44 clinics in 2011 that performed FASD multidisciplinary diagnostics in six provinces and one territory in Canada. The clinical capacity per year, which is the number of assessment slots available for diagnostic purposes (the maximum number of cases that can be assessed in any given year) was

estimated as 2,288 for 2011 (Clarren et al., 2011; Table 9). However, in most clinics, these slots are also used for diagnosing other complex developmental conditions, such as autism spectrum disorder, that usually involve the same diagnostic team. As a result, there are fewer FASD diagnostic evaluations performed per year than the existing total number of diagnostic slots.

Based on a capacity of 2,288 (i.e., the available number of evaluation slots) in all FASD clinics in Canada per year (Clarren et al., 2011), there are at most 1,602 cases of FASD diagnosed per year: this is assuming that all slots are completely filled, and assuming that about 70% of all individuals evaluated for FASD will be found to have FASD (Clarren & Lutke, 2008),

Assuming that only 50% of all individuals referred and evaluated in the multidisciplinary clinics are diagnosed with FASD, 1,144 cases (50%; lower boundary) of FASD would be diagnosed per year in Canada. An estimated 1,144 (50%; lower boundary) to 1,602 (70%; upper boundary) cases of FASD diagnosed per year in Canada was used to calculate the annual cost of FASD diagnosis in Canada. In Canada, the total cost of diagnosing FASD would thus range from $3.6 million to $5.2 million (lower estimate), up to $5.0 million to $7.3 million (upper estimate) per year (Table 9).

Table 8.
The per-person cost estimate for each service involved in the FASD diagnostic process

Services	Involved specialists	Average number of hours	Average cost per hour	Average cost for total number of hours
Screening and referral	Physician/pediatrician/family doctor/social worker/probation officer[a]	1–2	$150	$150–$300
Intake	Coordinator/social worker	2–4	$80	$160–$320
Diagnosis	**a. Physical/developmental/medical assessment/examination**			
	Physician/pediatrician/developmental pediatrician/family doctor specifically trained in FASD diagnosis	2–3	$160	$320–$480
	b. Dysmorphology assessment			
	Dysmorphologist and/or geneticist	1–2	$160	$160–$320
	c. Neurobehavioural assessment			
	Developmental pediatrician	2–3	$160	$320–$480
	Psychologist	12–15	$100	$1,200–$1,500
	• Forms/questionnaires: cost per person (cost of kits are not included)			$100
	Speech-language pathologist	2–3	$100	$200–$300
	• Forms/questionnaires: cost per person (cost of kits are not included)			$25
	Occupational therapist	2–3	$80	$160–$240
	• Forms/questionnaires: cost per person (cost of kits are not included)			$25
	d. Interviewing biological mother or foster parents or obtaining 2nd sources for confirmation of maternal prenatal alcohol consumption	2–4	$70	$140–280
	Coordinator for case management (e.g., nurse, social worker)			
Total per person[b]		**26–39**		**$2,960–$4,370**
General support	Secretarial/clerical	6–8	$25	$150–$200
Overall per person[c]		**32–47**		**$3,110–$4,570**

a This stage is not limited to the individuals listed here
b Excluding screening and referral, intake, and general support
c Including screening and referral, intake, diagnosis, and general support

Table 9.
Clinical capacity of FASD diagnosis, estimated number of people diagnosed with FASD and cost for FASD diagnosis, by available provinces and territories in Canada in 2011

Provinces and territories	Clinical capacity (number of evaluation slots) in 2011 (Clarren et al., 2011)	Estimated number of people diagnosed with FASD per year (based on a 50% diagnosis rate) Lower boundary	Cost of diagnosis per year (assuming 50% diagnosed and cost per person = $3,110) Lower estimate	Cost of diagnosis per year (assuming 50% diagnosed and cost per person = $4,570) Upper estimate		Estimated number of diagnosed people with FASD per year (based on a 70% diagnosis rate[b]) Upper boundary	Cost of diagnosis per year (assuming 70% diagnosed and cost per person = $3,110) Lower estimate	Cost of diagnosis per year (assuming 70% diagnosed and cost per person = $4,570) Upper estimate
Alberta	387	194	$601,785	$884,295		271	$842,499	$1,238,013
British Columbia	765	383	$1,189,575	$1,748,025		536	$1,665,405	$2,447,235
Manitoba	198	99	$307,890	$452,430		139	$431,046	$633,402
New Brunswick	16	8	$24,880	$36,560		11	$34,832	$51,184
Ontario	512	256	$796,160	$1,169,920		358	$1,114,624	$1,637,888
Saskatchewan	280	140	$435,400	$639,800		196	$609,560	$895,720
Yukon	20	10	$31,100	$45,700		14	$43,540	$63,980
Canada	**2,288[a]**	**1,144**	**$3,557,840**	**$5,228,080**		**1,602**	**$4,980,976**	**$7,319,312**

a The final number is the full estimated capacity for FASD diagnosis in Canada as a whole, including additional slots from the rest of provinces and territories (Clarren et al., 2011)
b Obtained from Clarren & Lutke (2008)

DISCUSSION

Much of the cost of FASD diagnostic services may be attributed to the need for a multidisciplinary approach. This approach could be considered to be too expensive and cumbersome for a high frequency disorder like FASD. But people assessed by a multidisciplinary team benefit from seeing professionals they may not otherwise meet with if they were to be assessed by a single practitioner. For people affected by FASD, it requires a large amount of time to establish that their brain is damaged, the extent and specificity of its damage, and what interventions would be the most advantageous. In addition, many diagnostic clinics are involved in recommending and/or providing direct management, intervention and services for these affected patients, services that would not be recognized as needed without the use of the diagnostic tests.

Given that FASD is not widely recognized by health care practitioners (Clark & Tough, 2003), the disorder is largely underdiagnosed. Coupled with this reality is the fact that the capacity of FASD clinics is low and the expertise needed to accommodate the demand is lacking. Clarren and colleagues (2011) estimated that a 17-fold increase in FASD diagnostic capacity across Canada is needed to diagnose the number of FASD cases that currently exist (based on an FASD prevalence rate of 1%). Based on the above estimate, one can assume that the estimated cost for FASD diagnostic services in this module would be much higher, if the diagnostic capacity across Canada were not limited.

The estimated cost of FASD diagnostic services in this module is most likely underestimated for many other reasons as well. First, the current cost estimate of FASD diagnosis per person includes the cost of core team members only, not additional team members, which may include addiction counsellors, childcare workers, mental health workers, probation officers, psychiatrists, teachers, vocational counsellors, nurses, neuropsychologists and family therapists (Chudley et al., 2005). There may also be the need to consult with other professionals or community members. For example, providing diagnostic assessments to Aboriginal people may involve consulting individual elders or elder councils.

Second, the cost of instruments (kits) was not included in the current cost estimate, even though this cost is likely significant. For example, according to a psychologist at the Hospital for Sick Children's Motherisk Program in Toronto (Nash, K., personal communication, March 2012), psychological instruments can add an additional $330 to $500 per person, particularly in a clinic's first year of operation.

Third, these cost estimates do not include facility costs (e.g., office space, medical records or the other costs required to operate a medical facility), the cost of the time spent preparing for the assessments and writing the final reports, or the cost of the diagnostic team's time in case conferences, where the final diagnosis is confirmed. A final diagnosis is a collaborative decision in which all members of the diagnostic team weigh in through weekly or monthly diagnostic team meetings. According to the 2005 survey conducted by the Canada Northwest FASD Research Network among FASD clinical programs in Western and Northern Canada, the mean time directly spent with a patient was reported to be approximately the same as the time estimated by the experts in the current module. However, time for indirect care, which included chart review,

team discussions, scoring of tests and note preparations, was estimated to be approximately twice as high as that reported for direct patient care (Clarren & Lutke, 2008).

Finally, the estimated cost of diagnosis does not include the cost of completing an intervention plan and/or follow-up. Intervention plans should consist not only of identifying the deficits and impairments of individuals with FASD, but also identifying the person's strengths.

Canada is a multicultural country, so the entire diagnostic process must also be culturally appropriate and sensitive, and use appropriate language. Cultural interpreters may well be required, likely incurring additional costs for such cases.

Further, neither the cost of negatively screened individuals nor the cost of screening pregnant women are included in the current total annual estimate. Such costs would not be incurred if maternal alcohol consumption while pregnant had a prevalence of zero. Including such costs would increase the current estimate.

There are several limitations of the cost estimation in the current module. First, the estimated cost of FASD diagnosis is based on hourly wages. However, some multidisciplinary team members work on salary, while others are paid a sessional fee. This form of payment could affect the cost estimate in either direction depending on the level of compensation for salary and sessional fees relative to the hourly wages used here.

Second, not all individuals screened are referred for a full diagnostic assessment, not every person referred will show up for their evaluation, and not all individuals referred to a diagnostic assessment will receive an FASD diagnosis; therefore, not all individuals will proceed through the listed services in a linear fashion. As a result, the total cost of FASD diagnosis in Canada might be higher or lower.

Third, it was not possible to estimate the costs for all provinces and territories separately, since data on the clinical capacity of Quebec, Newfoundland and Labrador, Nova Scotia, Prince Edward Island, Northwest Territories and Nunavut were not available.

The diagnostic schema could differ slightly from clinic to clinic, and so the overall diagnostic process may vary, for example, in the team members involved. This is likely to be true in remote areas and small communities, altering the overall cost per person.

The cost of diagnosing an individual with FASD in the general population, as presented here, will also differ from the cost of diagnosing an individual with FASD in certain special populations. For example, diagnosing an individual in the criminal justice system will likely incur additional costs, including the cost of transportation (transporting the prisoner or transporting the FASD-trained team members to the facility) and the cost of security or prison guards.

Early detection of disease is not beneficial to the patient or his or her family if existing interventions are not offered or are not available (Hermeren, 1999). Therefore, FASD diagnosis should not be just a label for patients and their families, but should provide the basis for access to early interventions, treatment, family support and other preventive measures to minimize subsequent health, social and economic consequences of FASD.

1.3 Specialized Addiction Treatment

Individuals with FASD are at a higher risk for substance use problems, as a result of the damage caused to their central nervous system from their prenatal exposure to alcohol. This damage manifests as developmental delays, cognitive impairment, mental disorders, high rates of incarceration and increased rates of substance use problems (Burd et al., 2007; Lange, Rehm, Bekmuradov et al., 2012; Popova, Lange, Bekmuradov et al., 2011).

These impairments typically lead to high-risk behaviours, such as alcohol and other drug problems, or an increased likelihood of being in high-risk situations, which makes them more likely to be exposed to alcohol and/or other drugs. Currently, there are few epidemiological studies reporting on the prevalence of substance use or abuse among individuals with FASD. However, the literature does indicate that a disproportionate number of individuals with FASD will have problematic substance use issues at some point in their lives (Streissguth et al., 1996, 2004). For instance, Famy et al. (1998) reported a 55% prevalence of alcohol or other drug dependence among their sample of individuals with FAS. Additionally, Clark and colleagues (2004) and Streissguth and colleagues (2004) reported that 22% and 35% of their respective cohorts of individuals with FASD had problems with alcohol or other drugs. Lastly, in a study conducted by Grant, Huggins and colleagues (2004), about 68% of women with FASD had reported abusing alcohol and 79% had used illegal drugs in the 10 months prior to being admitted into a community program.

There are several potential explanations for the high prevalence of substance use among individuals with FASD: they may have a biological vulnerability to substance use; they may use substances to self-medicate; and they tend to have difficulties with impulse control, making them susceptible to developing a substance use disorder (Streissguth et al., 2008). Regardless of the reason for such high rates of substance use problems among those with FASD, this population places greater demands on treatment service providers (Burd, Klug et al., 2003; Clark et al., 2004; Fryer et al., 2007).

Prenatal alcohol use exposes three generations to the harmful effects of alcohol (the mother, the fetus and the germ line of the fetus). Increased rates of substance use problems increase the risk for additional familial cases of FASD among siblings, and increase the risk of generational FASD (Abel, 1998; Burd et al., 2007). Therefore, it is important to address this issue, so that the generational effects of FASD can be halted.

In Canada, as is common elsewhere, specialized addiction treatment services provide a continuum of care, from assistance with symptoms of withdrawal through to active treatment and continuing care (Rush, 2010). They vary, however, in their capacity to assist clients with co-occurring disorders (McGovern et al., 2006; Rush, 2010), including complications arising from FASD. Prior research suggests that people with comorbid substance use and mental disorders have a more complicated trajectory of service use, including higher rates of relapse and readmission to addiction treatment (Bartels et al., 1995; Carey et al., 1991; Enns et al., 2001; Haywood et al., 1995; Moos et al., 1994; Rouillon, 1996). Given the high risk of people with FASD

having multiple health and social comorbidities, it is of interest to understand their representation in the specialized addiction treatment system.

The purpose of this module was to estimate the use of specialized addiction treatment services and the associated cost, as a part of the total cost of health care associated with FASD in Canada.

METHODS

Because we do not know the prevalence of FASD in the general population or the prevalence of substance use problems among this population, and because we lack FASD-specific data on specialized addiction treatment services in Canada, we have made many assumptions and have conducted sensitivity analyses. The methods are described step by step below.

Source of data

Data were obtained from the Drug and Alcohol Treatment Information System (DATIS; www.datis.ca), which monitors the use of specialized addiction treatment services in Ontario. Started in 1992, DATIS collects data on the numbers and types of clients entering publicly funded specialized addiction treatment across the province. This system includes approximately 200 treatment programs administered by 170 agencies (Ogborne et al., 1998; Rotondi & Rush, 2012). The types of services provided by each agency can vary; some agencies provide a specific type of service (e.g., assessment and referral, withdrawal management, individual counselling), while others provide a comprehensive mix of services. Regardless of the type of service, all services are covered by the province's universal health insurance plan; thus, they are delivered free of charge to the client. Agency-level participation has been more than 95% since 2000.

The DATIS database is structured by admissions to treatment programs, such that a new admission is triggered when a client enters a new treatment program or transitions between two different types of services. Since 2002, data entry has been supported by a web-based user platform accessible by all front-line clinicians working in the designated programs across the province. Data entry fields correspond to 66 data elements that are mandatory for all admissions. The service provider enters sociodemographic characteristics, information on substance use, and information on other treatment-related factors (e.g., referral source, current and past diagnoses of mental disorders, and treatment mandates) at admission, typically following the first face-to-face encounter with the client. Unique identifiers for individual clients and agencies are generated automatically by the software, as is a variable documenting the type of treatment program or service (i.e., outpatient, residential or residential withdrawal management). Service providers at discharge enter details on service use, including the number of outpatient visits and days or residential care. Data are stored on a central server located at the Centre for Addiction and Mental Health in Toronto.

Study population

All admissions corresponding to services received during the 2010/11 fiscal year (April 1, 2010 to March 31, 2011; N=91,333) were extracted for analysis. This included all admissions during the fiscal year, as well as those where treatment had started prior to April 1, 2010, but had continued into the study period. As noted above, an admission corresponds to a particular type of service, with movement between types of services (e.g., from a residential service to an outpatient program) counted as separate admissions. Multiple admissions per individual client were included to ensure that the most complete estimates of the volume and costs of services delivered during the study period were obtained. Thus, each admission does not necessarily represent a separate individual, as one individual can have multiple admissions.

Data elements

In order to determine whether a client has had a "lifetime mental disorder" (i.e., a diagnosed mental disorder at any point in their life), each client is asked at the beginning of treatment (response: yes versus no): "Have you ever been diagnosed by a qualified mental health professional with a mental disorder within the last 12 months or within your lifetime?" Age groups, divided into five-year intervals from 14 years of age and younger to 70 years of age and older, were generated from the clients' date of birth. All variables (lifetime mental disorder, date of birth and sex) were self-reported by the clients during their initial clinical encounter.

Service type (i.e., outpatient, residential treatment or residential withdrawal management, which are automatically generated in DATIS) was abstracted, as were the number of visits for outpatient treatment and days in residential treatment and residential withdrawal management. The numbers of visits and days of care, entered by service providers based on client charts, provide estimates of the volume of services received. For admissions that began prior to or ended after the 2010/11 fiscal year, only those visits or days that occurred within the study period were counted. To comply with the *Personal Health Information Protection Act* (2004), cells with values less than 6 were redacted and replaced with "<6".

Estimation of the prevalence of clients with FASD in specialized addiction treatment and their utilization of these services

Number of people with FASD in Canada. Using data on the general population of Canada in 2010, by age group and sex (Statistics Canada, 2012a), and assuming a prevalence rate of 9 per 1,000 for FASD (Roberts & Nanson, 2000), the number of people with FASD in Canada was estimated.

Number of people with FASD who abuse or are addicted to alcohol and/or other drugs. In order to estimate the number of clients with FASD who had received specialized addiction treatment services in Canada in 2010/11, the prevalence of individuals with FASD who abuse or are addicted to alcohol and/or others drugs was calculated based on available epidemiological studies (Clark et al., 2004; Famy et al., 1998; Grant, Huggins et al., 2004; Streissguth et al., 2004) using a meta-analysis technique described below.

Meta-analysis. Prevalence data from the epidemiological studies on alcohol/drug abuse/use/dependence among those with FASD were transformed into log-odds for the meta-analysis (Lipsey & Wilson, 2001). Log-odds estimates were weighted by the inverse variance of the log-odds transformed prevalence. Heterogeneity between studies was assessed using the Cochrane Q-test and the I^2 statistic (Cochran, 1954; Higgins & Thompson, 2002). The prevalence estimates were pooled using the Mantel-Haenszel method, using a random-effects model (Mantel & Haenszel, 1959).

Publication bias was tested by: 1) visually inspecting a funnel plot for skewed distribution, 2) using a ranked correlation test (Begg & Mazumdar, 1994), and 3) employing a weighted regression test (Egger et al., 1997). Publication bias was then adjusted for using the trim and fill method (Duval & Tweedie, 2000).

Number of people with FASD who used specialized addiction treatment services and rate of utilization in 2010/11. To calculate the number of people with FASD who used specialized addiction treatment services in 2010/11, it was assumed that the rate of specialized addiction treatment services among individuals with FASD was the same as the rate among individuals with a lifetime mental disorder. This assumption is based on a very high rate of comorbid mental illness reported among individuals with FASD (Famy et al., 1998; Pei et al., 2011; Streissguth et al., 1999, 2004). To estimate the rate of utilization of specialized addiction treatment services for individuals with a lifetime mental disorder, the number of specialized addiction treatment services admissions for individuals with a lifetime mental disorder was divided by the total number of individuals with a mental illness in Ontario (Health Canada, 2002; Ministry of Health and Long-Term Care, 2008).

In turn, in order to estimate the total number of admissions and visits/days, by treatment type, among clients with FASD in Canada, the distribution for each treatment type among clients who received specialized addiction treatment services in Ontario was extrapolated to the total Canadian population. This approach is justifiable given that Ontario represents about 39% of the total Canadian population.

Estimation of costs

The cost for specialized outpatient treatment in 2010/11 ranged from $60 to $109 per service and for residential treatment ranged from $138 to $314 per resident day (Martin, G., personal communication, December 2012). These unit costs are estimated based on the costs reported by five Local Health Integration Networks (LHINs) across Ontario. The overall estimates include the cost of supervision, facility costs, salaries and other sundry expenses. The ranges reported account for the differences in costs incurred due to the number of spots or beds available (capacity), whether the treatment is hospital based or community based, the intensity of activities provided, and staff professionalism (which affects both their salaries and the scope of the staff complement).

The corresponding costs—for outpatient treatment $60 and $109 per service as the lower and upper estimates, respectively; and for residential treatment $138 and $314 per resident day as the lower and upper

estimates, respectively—were applied to substance-attributable specialized outpatient visits and residential days to obtain the total costs of such services for clients with FASD.

Sensitivity analysis

Due to a limited number of epidemiological studies, the prevalence of individuals with FASD who abuse or are addicted to alcohol and/or drugs is unclear. As described above, the weighted mean of 37% (CI: 21.6%–54.5%), which was calculated based on the available epidemiological studies (Clark et al., 2004; Famy et al., 1998; Grant, Huggins et al., 2004; Streissguth et al., 2004) was used in the main analysis. In addition, two separate analyses were performed assuming that 22% (as the lower estimate) and 55% (as the upper estimate; both are based on the estimated CI) of individuals with FASD abuse or are addicted to alcohol and/or other drugs.

RESULTS

Calculation of the rate of specialized addiction treatment services among individuals with a lifetime mental disorder

Given that 20% of the Ontario population 12 years of age and over reported a mental health diagnosis such as a mood disorder, anxiety disorder, and/or schizophrenia in 2005 (Ministry of Health and Long-Term Care, 2008) and based on the population of Ontario (13,227,791; Statistics Canada, 2012a), the total number of individuals with a mental illness in Ontario was calculated to be 2,645,558. The rate of 20% has also been reported for all of Canada (Health Canada, 2002).

To estimate the rate of utilization of specialized addiction treatment services for individuals with a lifetime mental disorder, the number of specialized addiction treatment service admissions for clients with a lifetime mental disorder (N=37,164; obtained from DATIS for 2010/11) was divided by the total number of individuals with a mental illness in Ontario (2,645,558), resulting in the rate of 1.4%. The rate of utilization of specialized addiction treatment services for individuals without a lifetime mental disorder was estimated to be almost three times lower (i.e., 0.5%).

Estimation of the number of clients with FASD who received specialized addiction treatment services in Ontario and Canada in 2010/11

Using data on the general population of Ontario in 2010 (13,227,791; Statistics Canada, 2012a) and assuming a prevalence rate of 9 per 1,000 for FASD (Roberts & Nanson, 2000), it was estimated that there were 119,050 individuals with FASD in Ontario in 2010/11.

Results of the meta-analysis revealed that approximately 37% of individuals with FASD abuse or are addicted to alcohol and/or other drugs (Figures 5 and 6). Applying 37% to 119,050 individuals with FASD results in 44,049 individuals with FASD who abuse or are addicted to alcohol and/or drugs in Ontario in 2010/11. Assuming that the utilization rate of specialized addiction treatment services among individuals with FASD is the same as those for people with a lifetime mental disorder (1.4%; see above), the number of admissions for

clients with FASD who received specialized addiction treatment services in Ontario in 2010/11 was estimated to be 617.

Similarly, using data on the general population of Canada in 2010 (34,126,181; Statistics Canada, 2012a) and an assumed prevalence rate of 9 per 1,000 for FASD (Roberts & Nanson, 2000), it was estimated that there were 307,136 individuals with FASD in Canada in 2010/11.

Assuming that approximately 37% of individuals (113,640) with FASD abuse or are addicted to alcohol and/or other drugs and that the utilization rate of specialized addiction treatment services among individuals with FASD is the same as those for people with a lifetime mental disorder (1.4%; see above), the number of admissions for clients with FASD who received specialized addiction treatment services in Canada in 2010/11 was estimated to be 1,591 (546 outpatient, 189 residential and 856 withdrawal management).

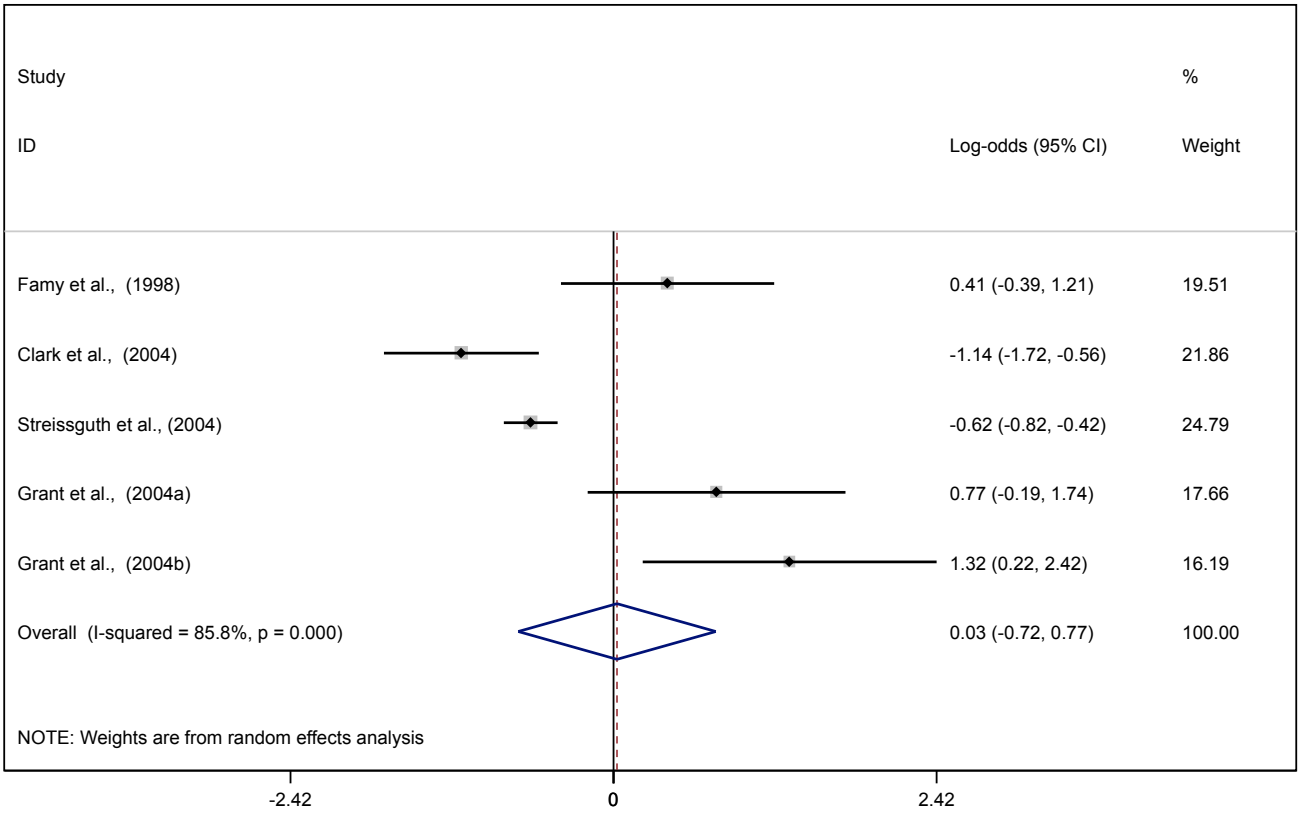

Figure 5. Forest plot of the prevalence of substance use/abuse among individuals with FASD

CI: confidence interval

Note: The size of the box around the point estimate is representative of the weight of the estimate used in calculating the aggregated point estimate.

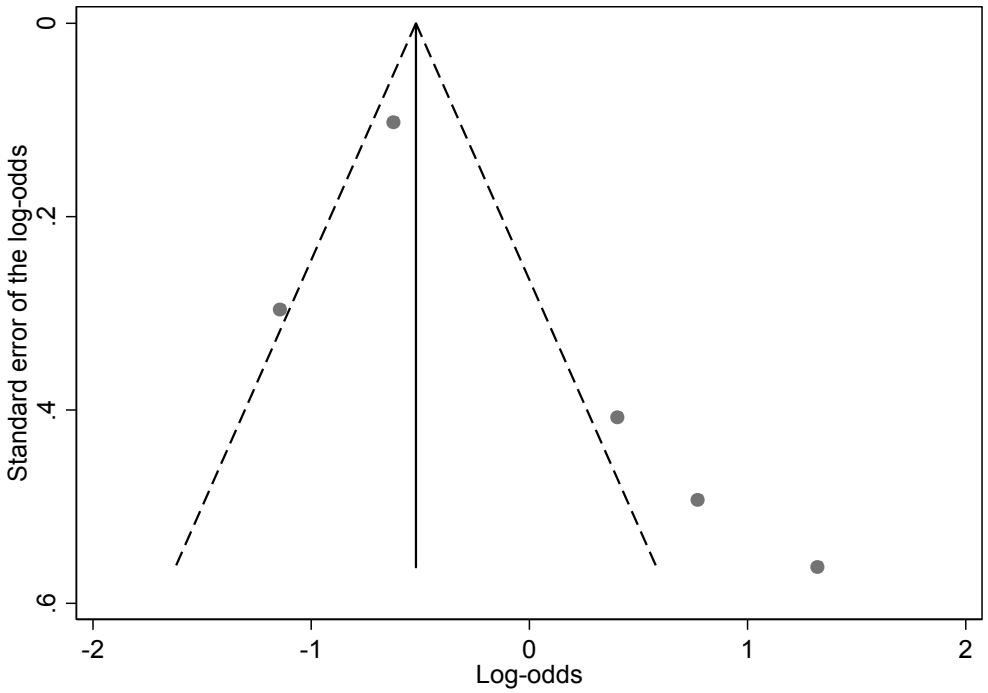

Figure 6. Funnel plot of the five studies that measured the prevalence of substance use/abuse among individuals with FASD used in the meta-analysis with pseudo 95% confidence intervals

Service utilization and estimation of the cost associated with addiction treatment services for clients with FASD

The 1,591 admissions described above resulted in 5,526 outpatient visits and 9,529 residential days; the associated cost was estimated to range from $1.65 million to $3.59 million.

The number of admissions, visits/days in outpatient treatment, residential treatment and residential withdrawal management services and costs among clients with FASD by age group and sex in Ontario and Canada in 2010/11 are presented in Tables 10, 11 and 12, respectively.

The total number of admissions, visits/days and costs of specialized addiction treatment services among clients with FASD by province and territory, and for Canada as a whole, in 2010/11 are presented in Table 13 and Figures 7, 8 and 9 (FAS is presented separately in the figures).

On average, in Canada, there were approximately 10 visits for outpatient treatment per admission; 39 days for residential treatment; and three days for residential withdrawal management services.

It was also estimated that in Canada in 2010/11 approximately 445 women of childbearing age with FASD (15-44) were admitted for specialized addiction treatment services (Figure 10). These admissions resulted in 1,819 outpatient visits and 2,378 residential days (1,896 days in residential treatment, and 482 days in residential withdrawal treatment; Figure 11).

Table 10.
Estimated number of admissions, visits and cost of outpatient treatment services among clients with FASD by age groups and sex in Ontario and Canada in 2010/11

Sex		Age group (years)														Cost	
		≤14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70+	All ages	Lower estimate	Upper estimate
	Clients with FASD in Ontario																
Number of admissions	Male	<6	15	13	11	12	11	13	13	10	7	<6	<6	<6	112		
	Female	<6	10	11	13	13	12	11	12	8	<6	<6	<6	<6	99		
	Total	**<6**	**25**	**24**	**24**	**25**	**23**	**24**	**25**	**18**	**11**	**6**	**<6**	**<6**	**212**		
Number of visits	Male	17	98	91	93	124	124	143	137	111	90	29	14	7	1,078	$64,670	$117,484
	Female	23	82	106	143	127	121	127	147	79	56	31	15	9	1,065	$63,914	$116,111
	Total	**40**	**180**	**197**	**237**	**250**	**245**	**270**	**283**	**190**	**146**	**60**	**29**	**16**	**2,143**	**$128,585**	**$233,595**
	Clients with FASD in Canada																
Number of admissions	Male	6	38	32	29	31	29	34	33	26	18	8	<6	<6	290		
	Female	<6	26	30	34	32	30	28	31	20	12	6	<6	<6	256		
	Total	**10**	**63**	**62**	**63**	**64**	**59**	**61**	**64**	**46**	**29**	**14**	**6**	**<6**	**546**		
Number of visits	Male	43	251	236	241	319	320	369	353	286	232	75	37	18	2,779	$166,759	$302,946
	Female	59	212	272	370	326	312	327	378	204	145	81	38	22	2,747	$164,810	$299,405
	Total	**102**	**463**	**508**	**610**	**645**	**632**	**696**	**731**	**490**	**377**	**156**	**74**	**40**	**5,526**	**$331,569**	**$602,350**

FASD: Fetal alcohol spectrum disorder
Note. Cells with values less than 6 were redacted and replaced with "<6."

Table 11.
Estimated number of admissions, resident days and cost of residential treatment services among clients with FASD by age groups and sex in Ontario and Canada in 2010/11

Sex		Age group (years)														Cost	
		≤14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70+	All ages	Lower estimate	Upper estimate
	Clients with FASD in Ontario																
Number of admissions	Male	<6	<6	<6	<6	6	7	6	6	5	<6	<6	<6	<6	44		
	Female	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	29		
	Total	**<6**	**<6**	**8**	**11**	**10**	**10**	**9**	**10**	**7**	**<6**	**<6**	**<6**	**<6**	**73**		
Number of days	Male	<6	99	158	200	234	264	235	292	223	93	41	9	7	1,855	$256,056	$582,621
	Female	<6	84	104	174	143	116	114	102	90	49	10	<6	<6	989	$136,472	$310,524
	Total	**7**	**183**	**262**	**374**	**376**	**381**	**349**	**394**	**313**	**142**	**51**	**12**	**7**	**2,844**	**$392,529**	**$893,145**
	Clients with FASD in Canada																
Number of admissions	Male	<6	6	11	14	15	17	14	16	13	6	<6	<6	<6	115		
	Female	<6	<6	10	13	10	9	9	9	<6	<6	<6	<6	<6	74		
	Total	**<6**	**10**	**21**	**27**	**25**	**25**	**23**	**25**	**18**	**9**	**<6**	**<6**	**<6**	**189**		
Number of days	Male	13	254	407	515	603	682	607	753	576	241	105	24	18	4,785	$660,269	$1,502,351
	Female	<6	217	267	450	368	300	294	263	231	126	27	6	<6	2,550	$351,908	$800,718
	Total	**18**	**471**	**675**	**965**	**971**	**982**	**900**	**1,016**	**807**	**367**	**131**	**30**	**19**	**7,335**	**$1,012,177**	**$2,303,069**

FASD: Fetal alcohol spectrum disorder
Note. Cells with values less than 6 were redacted and replaced with "<6."

Table 12.
Estimated number of admissions, resident days and cost of residential withdrawal management services among clients with FASD by age groups and sex in Ontario and Canada in 2010/11

	Sex	Age Group (years)														Cost	
		≤14	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70+	All ages	Lower estimate	Upper estimate
	Clients with FASD in Ontario																
Number of admissions	Male	<6	7	19	29	31	28	31	30	24	14	<6	<6	<6	219		
	Female	<6	<6	15	18	16	13	14	13	10	<6	<6	<6	<6	111		
	Total	**<6**	**12**	**34**	**47**	**48**	**42**	**45**	**43**	**33**	**19**	**6**	**<6**	**<6**	**332**		
Number of days	Male	<6	20	41	61	70	83	90	88	75	30	23	<6	<6	587	$80,941	$184,169
	Female	<6	10	35	36	40	28	36	28	29	13	<6	<6	<6	264	$36,455	$82,948
	Total	**<6**	**30**	**76**	**97**	**110**	**111**	**126**	**117**	**104**	**43**	**28**	**<6**	**<6**	**851**	**$117,438**	**$267,213**
	Clients with FASD in Canada																
Number of admissions	Male	<6	18	49	74	81	73	81	77	61	37	12	<6	<6	566		
	Female	<6	14	37	47	42	35	36	32	25	12	<6	<6	<6	287		
	Total	**<6**	**32**	**87**	**121**	**123**	**107**	**117**	**110**	**86**	**49**	**16**	**<6**	**<6**	**856**		
Number of days	Male	<6	51	105	157	180	214	232	228	194	78	60	8	7	1,512	$208,714	$474,901
	Female	<6	26	91	94	104	73	94	73	74	33	12	<6	<6	681	$94,003	$213,891
	Total	**<6**	**77**	**196**	**251**	**285**	**286**	**325**	**301**	**268**	**111**	**72**	**12**	**9**	**2,194**	**$302,825**	**$689,037**

FASD: Fetal alcohol spectrum disorder
Note. Cells with values less than 6 were redacted and replaced with "<6."

Table 13.
Estimated number of admissions, outpatient visits, resident days and costs of specialized addiction treatment services among clients with FASD by province and territory, and for Canada in 2010/11

Province / territory	Number of admissions, outpatient visits and resident days; associated cost (lower & upper estimate)	Total population (2010)[a]	Number of clients with FASD (based on a prevalence of 9 per 1,000)	Types of specialized addiction treatment services			
				Outpatient	Residential	Withdrawal	Overall
Alberta		**3,720,928**	**33,488**				
	Number of admissions			60	21	93	**174**
	Number of visits			603			**603**
	Number of days				800	239	**1,039**
	Cost (lower estimate)			$36,180	$110,400	$33,035	**$179,614**
	Cost (upper estimate)			$65,727	$251,200	$75,166	**$392,092**
British Columbia		**4,529,674**	**40,767**				
	Number of admissions			73	25	114	**211**
	Number of visits			734			**734**
	Number of days				974	291	**1,265**
	Cost (lower estimate)			$44,040	$134,397	$40,215	**$218,652**
	Cost (upper estimate)			**$80,006**	**$305,801**	**$91,504**	**$477,310**
Manitoba		**1,234,535**	**11,111**				
	Number of admissions			20	7	31	**58**
	Number of visits			200			**200**
	Number of days				265	79	**345**
	Cost (lower estimate)			$12,000	$36,630	$10,961	**$59,590**
	Cost (upper estimate)			$21,800	$83,346	$24,939	**$130,085**

Province / territory	Number of admissions, outpatient visits and resident days; associated cost (lower & upper estimate)	Total population (2010)[a]	Number of clients with FASD (based on a prevalence of 9 per 1,000)	Types of specialized addiction treatment services			
				Outpatient	Residential	Withdrawal	Overall
New Brunswick		**752,838**	**6,776**				
	Number of admissions			12	4	19	**35**
	Number of visits			122			**122**
	Number of days				162	48	**210**
	Cost (lower estimate)			$7,320	$22,338	$6,684	**$36,343**
	Cost (upper estimate)			$13,298	$50,828	$15,209	**$79,335**
Newfoundland and Labrador		**511,281**	**4,602**				
	Number of admissions			8	3	13	**24**
	Number of visits			83			**83**
	Number of days				110	33	**143**
	Cost (lower estimate)			$4,980	$15,171	$4,540	**$24,691**
	Cost (upper estimate)			$9,047	$34,520	$10,329	**$53,897**
Northwest Territories		**43,830**	**394**				
	Number of admissions			1	0	1	**2**
	Number of visits			7			**7**
	Number of days				9	3	**12**
	Cost (lower estimate)			$420	$1,299	$389	**$2,108**
	Cost (upper estimate)			$763	$2,955	$884	**$4,603**

Province / territory	Number of admissions, outpatient visits and resident days; associated cost (lower & upper estimate)	Total population (2010)[a]	Number of clients with FASD (based on a prevalence of 9 per 1,000)	Types of specialized addiction treatment services			
				Outpatient	Residential	Withdrawal	Overall
Nova Scotia		**944,810**	**8,503**				
	Number of admissions			15	5	24	**44**
	Number of visits			153			**153**
	Number of days				203	61	**264**
	Cost (lower estimate)			$9,180	$28,032	$8,388	**$45,600**
	Cost (upper estimate)			$16,677	$63,783	$19,085	**$99,545**
Nunavut		**32,580**	**293**				
	Number of admissions			1	0	1	**2**
	Number of visits			5			**5**
	Number of days				7	2	**9**
	Cost (lower estimate)			$300	$966	$289	**$1,555**
	Cost (upper estimate)			$545	$2,198	$658	**$3,401**
Ontario		**13,227,791**	**119,050**				
	Number of admissions			212	73	332	**617**
	Number of visits			2,143			**2,143**
	Number of days				2,844	851	**3,695**
	Cost (lower estimate)			$128,585	$392,529	$117,438	**$638,551**
	Cost (upper estimate)			$233,595	$893,145	$267,213	**$1,393,953**

Province / territory	Number of admissions, outpatient visits and resident days; associated cost (lower & upper estimate)	Total population (2010)[a]	Number of clients with FASD (based on a prevalence of 9 per 1,000)	Types of specialized addiction treatment services			
				Outpatient	Residential	Withdrawal	Overall
Prince Edward Island		**143,395**	**1,291**				
	Number of admissions			2	1	4	**7**
	Number of visits			23			**23**
	Number of days				31	9	**40**
	Cost (lower estimate)			$1,380	$4,256	$1,274	**$6,910**
	Cost (upper estimate)			$2,507	$9,684	$2,898	**$15,089**
Quebec		**7,905,679**	**71,151**				
	Number of admissions			127	44	198	**369**
	Number of visits			1,281			**1,281**
	Number of days				1,700	509	**2,208**
	Cost (lower estimate)			$76,860	$234,563	$70,188	**$381,611**
	Cost (upper estimate)			$139,629	$533,717	$159,702	**$833,048**
Saskatchewan		**1,044,028**	**9,396**				
	Number of admissions			17	6	26	**49**
	Number of visits			169			**169**
	Number of days				224	67	**292**
	Cost (lower estimate)			$10,140	$30,976	$9,269	**$50,385**
	Cost (upper estimate)			$18,421	$70,481	$21,090	**$109,992**

Province / territory	Number of admissions, outpatient visits and resident days; associated cost (lower & upper estimate)	Total population (2010)[a]	Number of clients with FASD (based on a prevalence of 9 per 1,000)	Types of specialized addiction treatment services			
				Outpatient	Residential	Withdrawal	Overall
Yukon		**34,559**	**311**				
	Number of admissions			1	0	1	**2**
	Number of visits			6			**6**
	Number of days				7	2	**10**
	Cost (lower estimate)			$360	$1,025	$307	**$1,692**
	Cost (upper estimate)			$654	$2,333	$698	**$3,685**
CANADA (All provinces/territories)		**34,126,181**	**307,136**				
	Number of admissions			546	189	856	**1,591**
	Number of visits			5,526			**5,526**
	Number of days				7,335	2,194	**9,529**
	Cost (lower estimate)			$331,569	$1,012,177	$302,825	**$1,646,571**
	Cost (upper estimate)			$602,350	$2,303,069	$689,037	**$3,594,456**
1) Sensitivity analysis, assuming 22% (lower estimate) of individuals with FASD suffer from addiction		**34,126,181**	**307,136**				
	Number of admissions			325	112	509	**946**
	Number of visits			3,286			**3,286**
	Number of days				4,361	1,305	**5,666**
	Cost (lower estimate)			$197,144	$601,866	$180,029	**$979,037**
	Cost (upper estimate)			$358,145	$1,369,464	$409,626	**$2,137,235**

Province / territory	Number of admissions, outpatient visits and resident days; associated cost (lower & upper estimate)	Total population (2010)[a]	Number of clients with FASD (based on a prevalence of 9 per 1,000)	Types of specialized addiction treatment services			
				Outpatient	Residential	Withdrawal	Overall
2) Sensitivity analysis, assuming 55% (upper estimate) of individuals with FASD suffer from addiction		**34,126,181**	**307,136**				
	Number of admissions			812	281	1,272	**2,365**
	Number of visits			8,214			**8,214**
	Number of days				10,903	3,261	**14,165**
	Cost (lower estimate)			$492,859	$1,504,666	$450,066	**$2,447,592**
	Cost (upper estimate)			$895,361	$3,423,661	$1,024,064	**$5,343,086**

FASD: Fetal alcohol spectrum disorder
a Source: Statistics Canada (2012a)
Note. Columns may not add up due to rounding errors.

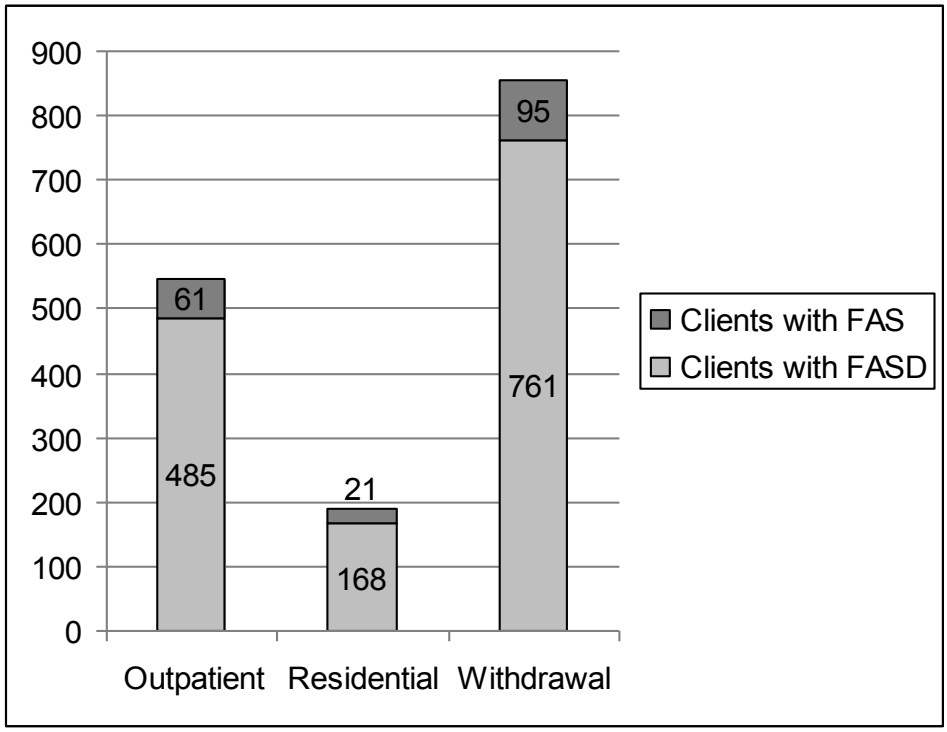

Figure 7. Estimated number of admissions in specialized addiction treatment services among clients with FASD (including FAS[a]) in Canada in 2010/11

a Estimated based on a prevalence rate of 1 per 1,000 (PHAC, 2003)

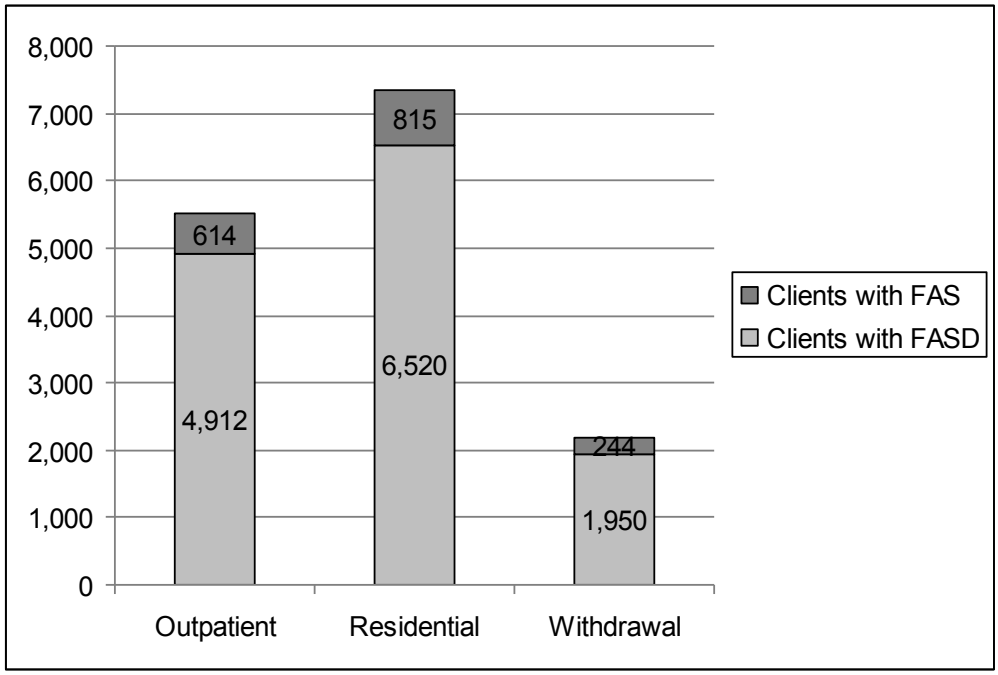

Figure 8. Estimated number of visits/inpatient days in specialized addiction treatment services among clients with FASD (including FAS[a]) in Canada in 2010/11

a Estimated based on a prevalence rate of 1 per 1,000 (PHAC, 2003)

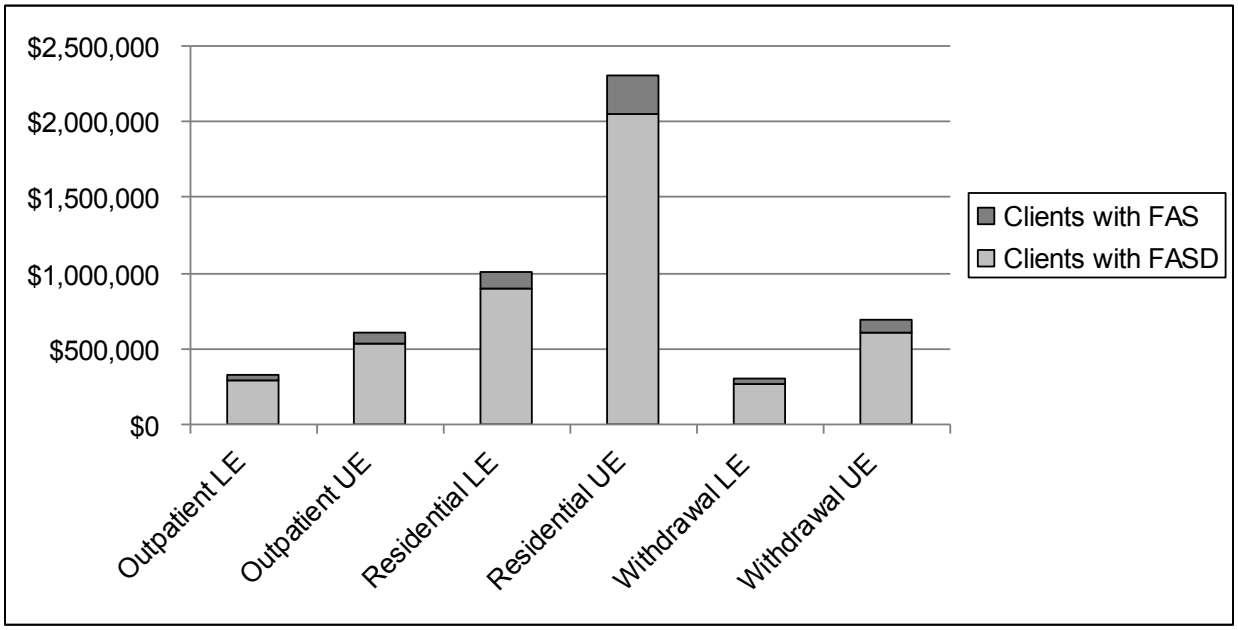

Figure 9. Overall estimated costs associated with specialized addiction treatment among clients with FASD (including FAS[a]) in Canada in 2010/11

LE Lower estimate; UE Upper estimate
a Estimated based on a prevalence rate of 1 per 1,000 (PHAC, 2003)

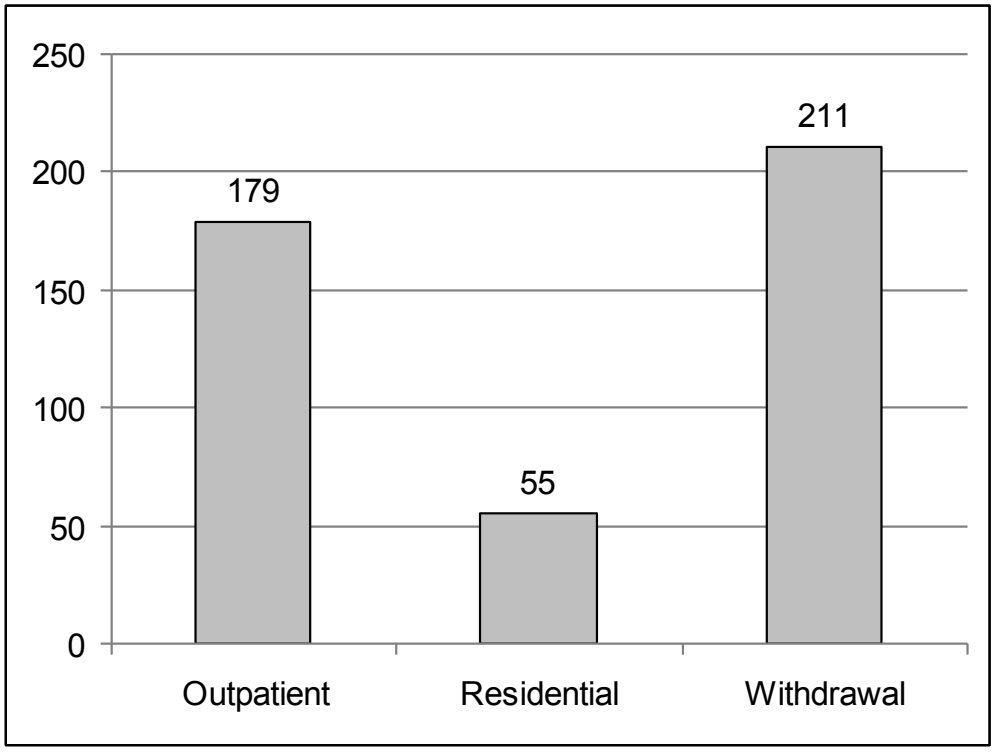

Figure 10. Estimated number of admissions in specialized addiction treatment services among female clients of childbearing age with FASD in Canada in 2010/11

Figure 11. Estimated number of visits/inpatient days in specialized addiction treatment services among female clients of childbearing age with FASD in Canada in 2010/11

Sensitivity analysis

Assuming that 22% (as the lower estimate) of individuals with FASD abuse or are addicted to alcohol and/or other drugs, there were an estimated 946 admissions in total (325 outpatient, 112 residential and 509 withdrawal management) in Canada in 2010/11, resulting in 3,286 outpatient visits and 5,666 resident days. The associated cost was estimated to range from $979 thousand to $2.14 million.

Assuming that 55% (as the upper estimate) of individuals with FASD abuse or are addicted to alcohol and/or other drugs, there were an estimated 2,365 admissions in total (812 outpatient, 281 residential and 1,272 withdrawal management) in Canada in 2010/11. These admissions resulted in 8,214 outpatient visits and 14,165 resident days. The associated cost was estimated to range from $2.45 million to $5.34 million (see Table 13).

Discussion

The estimated costs associated with specialized addiction treatment services for clients with FASD in Canada clearly demonstrate how substance use problems among this specific population place an additional economic burden on Canadian society.

As the results indicate, individuals with a comorbid mental disorder represent a large portion (about 404%) of those utilizing specialized addiction treatment services in Canada. This conclusion has also been supported by previous research (Castel et al., 2006; Grant, Stinson et al., 2004; Rush et al., 2008). Within this group are people with FASD, who are at high risk for concurrent mental health disorders (Burd, Klug et al., 2003; Elliott et al., 2008; Famy et al., 1998; Fryer et al., 2007; O'Connor et al., 2002). Research shows that such high-risk populations with comorbid mental disorders have higher rates of relapse and readmission to treatment, and thus have a more complicated trajectory of service use and place a greater demand on service providers (Bartels et al., 1995; Carey et al., 1991; Enns et al., 2001; Haywood et al., 1995; Moos et al., 1994; Rouillon, 1996).

Individuals with FASD who abuse substances constitute a special population for service providers for many reasons. First, all individuals with FASD have a family member (i.e., their biological mother) who was or is affected by substance use or abuse, and many will have multiple family members affected (Abel, 1998; Paintner et al., 2012a,b). Second, nearly all individuals with FASD have neurocognitive impairments that will affect their response to substance use treatment (Burd, Klug et al., 2003). Third, many, if not most individuals with FASD entering substance abuse treatment will not be recognized as having FASD. This is especially true in the correctional system (Burd, Fast et al., 2011; Burd, Selfridge et al., 2003). Fourth, many of these treatment programs may lack the needed adaptations for clients with FASD, thus increasing their risk of treatment failure and/or relapse. Fifth, treatment strategies for women with FASD should be different from those for men (Gelb & Rutman, 2011). An essential goal for women with FASD must be to increase their knowledge of the effects of PAE and a goal of treatment must be not to drink alcohol until after their childbearing years. This is crucial since no level of alcohol use during pregnancy has been deemed to be safe. While some interventions focus on educating women about the use of birth control, this intervention is not 100% effective, and some women will not adhere to treatment protocols. In the current module, it was estimated that each month women of childbearing age are responsible for about 18 admissions to withdrawal management programs in Canada.

The current module has at least two limitations. First, the utilization rate of specialized addiction treatment services in Canada by individuals with FASD is unknown; therefore, it was assumed that the utilization rate is the same as that for people with a lifetime mental disorder. Second, the number of individuals with a lifetime mental disorder may be underestimated for at least two reasons: 1) these self-reported data are subject to recall bias; and 2) by asking clients to self-report mental diagnoses, those who have not previously sought services or have not received a diagnosis were excluded. As such, using the assumption that the utilization

rate of specialized addiction treatment services among individuals with FASD is the same as that for people with a lifetime mental illness, it is likely that the utilization rate of individuals with FASD is also underestimated.

The data presented here on the number of women of childbearing age (15 to 44 years) with FASD in substance abuse treatment (approximately 450 admissions) highlights the increased risk for additional FASD cases among the future children of these women. Based on these data, there is an evident need for additional training for programs serving this population. System-wide screening strategies and targeted interventions for women of childbearing age with FASD also need to be developed. These recommendations should be primary prevention priorities for substance abuse prevention programs.

Special attention must be paid to at-risk groups of individuals, such as those with FASD, in order to reduce the likelihood of their developing secondary disabilities (in this case, substance use problems). Reducing the occurrence of substance use problems will alleviate a portion of the costs being allocated to specialized addiction treatment services in Canada and thus will reduce the overall burden on Canadian society.

1.4 Prescription Drugs

FASD is associated with a vast number and range of health conditions (Astley & Clarren, 1999; Burd et al., 2004, 2008; Habbick et al., 1997; Iyasu et al., 2002; Lemoine et al., 1968; Stratton et al., 1996) and a higher mortality rate than the general population (Astley & Clarren, 1999; Burd et al., 2008; Lemoine et al., 1968; Stratton et al., 1996). As a result of the increased morbidity, there are likely huge prescription drug costs associated with FASD.

Using prescription drug claims data from Manitoba, Brownell and colleagues (2013) estimated the use of certain prescription drug categories and overall prescription drug use among 717 individuals with FASD, ranging from 6 to 36 years of age, in 2005/06. When compared with the general population, and with individuals with asthma, the authors reported that the use of antidepressants and psychostimulants was higher among individuals with FASD (Brownell et al., 2013).

Unfortunately, there are limited data on prescription drug use among individuals with FASD. Fuchs and colleagues (2009) conducted the only other study that exists. These authors estimated that, in Manitoba, 74% of children in care with FASD used prescription drugs, and that this usage resulted in a total cost of $386,682 in 2006. For comparative purposes, Fuchs et al. (2009) also estimated the percentage of children using prescription drugs among a small sample of children (0 to 16+ years of age) diagnosed with FASD, but not in care, and a sample of the general population.

The purpose of the current module was to estimate the cost of prescription drugs among individuals with FASD in Canada in 2012.

METHODS

Number of individuals with FASD in Canada

Using data on the number of individuals 0 to 64 years of age among the general population of Canada in 2012 (Statistics Canada, 2012a), and assuming a prevalence of 9 per 1,000 for FASD (Roberts & Nanson, 2000), the number of individuals with FASD, by age group (0 to 64 years of age), in Canada was estimated.

Number of individuals with FASD who use prescription drugs

Brownell et al. (2013) reported that the incidence of at least one prescription drug use among individuals 6 to 36 years of age with FASD was 66.35% (Table 14). To estimate the number of individuals with FASD who use prescription drugs in Canada, the percentage of individuals with FASD using prescription drugs obtained from Brownell and colleagues (2013) was applied to the total estimated number of individuals with FASD, by age group (0 to 64 years of age), in Canada in 2012. The age was restricted to 64 years as it is believed that individuals with FASD have a shorter life expectancy, compared with the general population, due to their health and other problems associated with risky behaviour (e.g., addictions, criminal activity, promiscuous sexual behaviour). However, there are no epidemiological data to support this.

Table 14.
The incidence of at least one prescription drug use over a one-year period, per 100 person years

Prescription drug category	Adjusted rates per 100 person years (95% confidence interval)
Antibiotics	38.98 (31.13–48.80)
Antidepressants	5.76 (1.86–17.95)
Antipsychotics	6.92 (1.52–31.51)
Narcotic analgesics	1.91 (0.77–4.72)
Non-steroidal anti-inflammatory drugs	9.21 (4.99–16.98)
Psychostimulants	13.97 (8.22–23.72)
Overall	**66.35 (55.84–78.82)**

Source: Brownell et al. (2013)

Estimation of prescription drug costs

In the Fuchs et al. (2009) study, the average cost of prescriptions per child diagnosed with FASD, but not in care, in 2006 was reported to be $232 CND. The corresponding cost was applied to the total estimated number of individuals with FASD who use prescription drugs, in order to obtain the total cost of prescription drug use for individuals with FASD, by age group (0 to 64 years of age), in Canada in 2012.

RESULTS

Number of individuals with FASD in Canada

Using data on the general population of Canada, by age group, in 2012 (Statistics Canada, 2012a), and assuming a prevalence of 9 per 1,000 for FASD (Roberts & Nanson, 2000), it was estimated that there were 267,243 individuals, 0 to 64 years of age, with FASD in Canada in 2012 (Table 15).

Table 15.
The number of individuals with FASD (0 to 64 years of age) using prescription drugs, and the total cost associated with prescription drug use among individuals with FASD in Canada in 2012

Age group (years)	Total population (2012)[a]	Number of individuals with FASD (based on a prevalence of 9 per 1,000)	Number of individuals with FASD using prescription drugs	Total cost of prescription drug use among individuals with FASD in 2012[b]
0–4	1,928,762	17,359	11,518	$2,672,084
5–9	1,857,086	16,714	11,090	$2,572,785
10–14	1,877,315	16,896	11,210	$2,600,810
15–19	2,162,960	19,467	12,916	$2,996,539
20–24	2,441,086	21,970	14,577	$3,381,851
25–29	2,452,285	22,071	14,644	$3,397,366
30–34	2,406,319	21,657	14,369	$3,333,685
35–39	2,307,219	20,765	13,778	$3,196,394
40–44	2,384,574	21,461	14,239	$3,303,560
45–49	2,681,337	24,132	16,012	$3,714,692
50–54	2,703,198	24,329	16,142	$3,744,978
55–59	2,428,528	21,857	14,502	$3,364,454
60–64	2,063,000	18,567	12,319	$2,858,055
Total	**29,693,669**	**267,243**	**13,778**	**$3,196,394**

a Obtained from Statistics Canada (2012a)
b Based on an average cost of $232 per person, per year

Number of individuals with FASD who use prescription drugs

By applying the percentage of individuals with FASD using prescription drugs (66.35%; Brownell et al., 2013) to the estimated number of individuals with FASD in Canada, by age group, it was estimated that 177,316 individuals, 0 to 64 years of age, with FASD used prescriptions drugs in Canada in 2012 (Table 15).

Estimation of prescription drug costs

It was estimated that the total cost of prescription drugs among individuals with FASD, 0 to 64 years of age, in Canada in 2012 was $41.1 million. See Table 15 for the cost, per age group, of prescription drugs among individuals with FASD in Canada in 2012.

DISCUSSION

The figures presented here clearly demonstrate the substantial cost of prescription drugs among individuals with FASD in Canada. However, these figures are rough estimates only, due to at least two limitations. First, the percentage of individuals with FASD using prescription drugs was obtained from a single study conducted on a clinically referred sample in one province (Manitoba; Brownell et al., 2013). However, Fuchs et al. (2009) reported that among a sample of children (0 to 16+ years of age) with FASD not in care, the percentage using prescription drugs was 70.6%. Second, the average cost of prescriptions per individual was based on a sample of 119 children (0 to 16+ years of age) with FASD obtained from Fuchs and colleagues (2009): this average cost was assumed to be the same for older individuals, but this may not be the case.

1.5 Speech-language Interventions

According to the Participation and Activity Limitation Surveys of 2001 and 2006, speech disability was the third most prevalent disability (after learning and chronic disabilities) among children 5 to 14 years of age in the general population of Canada (Statistics Canada, 2007). In 2006, approximately 45% of children 5 to 14 years of age who had one or more disabilities reported a speech disability. This means that about 78,240 Canadian school-age children experienced difficulty speaking and/or being understood (Statistics Canada, 2007).

Among these children[1] with disabilities, one population had a very high proportion of speech-language disorders (SLD)—children who were prenatally exposed to alcohol (Centers for Disease Control and Prevention [CDC], 1995; Church et al., 1997; Egeland et al., 1998; Elliott et al., 2008; Kvigne et al., 2004; Spohr et al., 1994; Steinhausen et al., 1982).

People with FASD often have SLD due to brain damage caused by the teratogenic effects of PAE (Church et al., 1997). PAE can disrupt both an individual's development and their use of language (Mattson & Riley, 1998; Streissguth et al., 1996). Individuals with FASD may also be vulnerable to developing SLD as a result of their greater propensity for atypical or adverse social interactions (Coggins et al., 2007). SLD that are prevalent among the FASD population include poor receptive and expressive language skills, phonological deficits, fluency and articulation difficulties, and associated neurocognitive abnormalities, all of which can adversely impact speech-language development (Church et al., 1997). In addition, individuals with FASD often have other mental disorders, which is a well-established dimension of FASD that may also contribute to difficulties in acquisition, leading to difficulties with speech and articulation (Church et al., 1997).

Several studies have reported a high occurrence of SLD among individuals with FASD (Church et al., 1997; Egeland et al., 1998; Elliott et al., 2008; Kvigne et al., 2004; Pensiero et al., 2007). Unspecified SLD have been reported to occur in 40% (CDC, 1995) to 90% (Church et al., 1997) of individuals with FAS, and 37% (Spohr et al., 1994) to 60% (Elliott et al., 2008) of individuals with FASD. Furthermore, Mills and colleagues (2006) found, based on self-reports obtained from caregivers in Alberta, that about 79% of children with FASD under the age of 7 years have visited a speech language pathologist and 57% of them received speech and language therapy.

SLD in children with FASD have been linked to learning problems and social difficulties. Due to hearing, speech and language acquisition difficulties, individuals with FASD may also struggle with social and interpersonal communication and behavioural problems, and have difficulty following social norms, social reasoning, and information processing (Carmichael Olson, 1994; Church et al., 1997; Coggins et al., 2003). For individuals with FASD, these impairments may persist into adolescence and adulthood.

1. The broad term "children" will be used in this module to refer to children and youth

The purpose of this module was two-fold: first, to estimate the number of children with FASD and SLD by age group (2–4, 5–9, 10–14, 15–19 years), sex and level of severity (mildly and moderately-to-severely impaired); and second, to estimate the cost of one-to-one speech-language interventions associated with these disorders in Canada in 2011.

Until now, no estimate exists for the number of children with FASD and SLD and the associated cost of one-to-one speech-language interventions, at the national level, in Canada, or in any other country.

METHODS

Definition of speech-language disorders

SLD fall under the communication disorders umbrella. A speech disorder refers to an impairment of the respiratory system, phonation system and/or articulation system of speech production (Justice, 2010). This group of disorders includes articulation and phonological disorders, fluency disorders, voice disorders and motor speech disorders. A language disorder refers to deficit(s) in the linguistic system that ultimately affect semantics, syntax, morphology, phonology and/or pragmatics (Justice, 2010). In the current module, the term SLD will be used to describe all of the above disorders, and the rates of each are comparable to their treatment and the frequency at which they occur in individuals with FASD.

Estimation of the number of children with FASD by age group and sex

To estimate the number of children, 2 to 19 years of age, with FASD in Canada in 2011, the most commonly cited prevalence of FASD (9 per 1,000; Roberts & Nanson, 2000) was applied to the general population of Canada by age group and sex in 2011 (Statistics Canada, 2012a). Children under 2 years of age were excluded due to their natural level of speech-language development during these years. Further, this module did not estimate the cost of one-to-one speech-language interventions among individuals over 19 years of age, as most treatments for children with SLD in Canada are linked to the educational system.

Estimation of the number of children with FASD and SLD by age group and sex

There were three steps involved in estimating the number of children with FASD and SLD by age group and sex in Canada in 2011.

1. Systematic literature search. A systematic literature search of available epidemiological and medical literature was performed in order to identify studies that have reported the prevalence of SLD among individuals with FASD. The search was conducted in multiple electronic bibliographic databases, including Ovid MEDLINE, PubMed, EMBASE, Web of Science (including Science Citation Index, Social Sciences Citation Index, Arts and Humanities Citation Index), PsycINFO, ERIC, Scopus and Social Work Abstracts. The search was conducted using multiple combinations of the following key words: FASD, FAS, pFAS, fetal alcohol effects, ARND, ARBD, PAE, speech, language, disorder*, disabilit*, impairments*, delay*, deficit*, prevalence, frequenc* and occurrence.

2. Meta-analysis. To estimate the pooled prevalence of SLD among individuals with FASD, the data available on the prevalence of SLD among individuals with FASD was analyzed by performing a meta-analysis. A double arcsine transformation was applied to the prevalence estimates obtained from the epidemiological studies reporting on the prevalence of SLD among individuals with FASD so that the data followed a normal distribution (Freeman & Tukey, 1950). The double arcsine-transformed prevalence estimates were weighted by the inverse variance of the double arcsine-transformed prevalence. The pooled prevalence of SLD among individuals with FASD was calculated using the Mantel-Haenszel method, assuming a random-effects model (Mantel & Haenszel, 1959). Heterogeneity between studies was assessed using the I^2 statistic (Higgins & Thompson, 2002). Results of the meta-analysis were displayed using a forest plot.

Publication bias was tested by visually inspecting a funnel plot for skewed distribution and, if present, was adjusted for using the trim and fill method (Duval & Tweedie, 2000).

3. Estimation. To estimate the number of children in Canada with FASD and SLD by age group and sex in 2011, the pooled prevalence of SLD among individuals with FASD was applied to the number of children with FASD by age group and sex.

Estimation of the number of children with FASD and SLD by level of severity

The number of children with FASD and SLD by level of severity in Canada in 2011 was estimated based on data from the only available study (Coggins et al., 2007). The authors of this study examined communication deficits among 393 school-aged children with FASD. These children completed numerous standardized tests of language performance, which assessed their fundamental language skills, language comprehension, language development, overall language competence and word knowledge. The authors indexed the data on a language severity scale containing three levels—normal, mildly impaired and moderately-to-severely impaired. The data were gathered from each participant using norm-referenced, standardized language tests. The mildly impaired severity level applied to children who obtained scores between –1.25 standard deviations (SD) and –2.00 SD from test means, while the moderately-to-severely impaired level applied to children with test scores that fell more than –2.00 SD below test means. Sixty-nine percent of the children with FASD displayed significant language deficits, with 31% scoring in the mildly impaired range and 38% classified as moderately-to-severely impaired. This distribution of severity was applied to the total number of children with FASD and SLD in order to estimate the number of children with FASD and SLD by level of severity in Canada in 2011.

Estimation of the cost associated with one-to-one speech-language interventions among children with FASD and SLD by age group, sex and level of severity

There were two steps involved in estimating the cost associated with one-to-one speech-language interventions among children with FASD and SLD by age group, sex and level of severity in Canada in 2011:

1. Estimation of the average number of hours required for one-to-one speech-language interventions. To calculate the average number of hours required for one-to-one speech-language interventions, a systematic review and meta-analysis of randomized control trials on speech-language therapy was used (Law et al., 2003). This study revealed an overall positive effect of speech-language interventions for children with expressive phonological and expressive vocabulary difficulties. Based on the 27 studies included in the review by Law and colleagues (2003), interventions ranged on average from 20 to 30 hours (Table 16). Therefore, 20 hours was used as the number of hours needed to treat those who were mildly impaired and 30 hours was used as the number of hours needed to treat those who were moderately-to-severely impaired.

2. Calculation of the cost associated with one-to-one speech-language interventions. The Canadian Association of Speech-Language Pathologists and Audiologists (CASLPA; Charlebois, G., personal communication, April 2013) estimated the cost per hour for a speech-language pathologist ranged from $75 (lower estimate) to $149 (upper estimate) in 2011. These figures were obtained from a fee survey conducted by the CASLPA of its members, and they represent the average provincial responses to the survey, which is only available to association members.

To estimate the cost associated with one-to-one speech-language interventions, the lower ($75) and upper ($149) estimates of the cost per hour were applied to the number of hours needed to treat a child (20 hours for mildly impaired and 30 hours for moderately-to-severely impaired), and multiplied by the respective number of children with FASD and SLD estimated for each province and territory in Canada, by age group and sex.

To estimate the costs associated with one-to-one speech-language interventions among children with FASD and SLD in Canada in 2011, the following assumptions were made. The incidences of FASD and SLD and of the mortality rate (especially in people of younger ages with FASD and SLD) remain stable over time. The population and the percentage of the population screened for FASD (based on the existing clinical capacity of all FASD multidisciplinary clinics in Canada; Clarren et al., 2011) and SLD are also stable over time. And the sensitivity and specificity of screening techniques used to diagnose FASD and SLD have not changed over time. However, since the population has increased (Statistics Canada, 2013d), use of screening techniques for FASD have improved (Chudley et al., 2005), and rates of consuming alcohol while pregnant have been stable (Statistics Canada, 2011c), the use of the previously noted assumptions allowed for a conservative estimate of the cost associated with one-to-one speech-language interventions among children with FASD and SLD in Canada in 2011.

Sensitivity analysis

The main analysis was performed using the estimated pooled prevalence of SLD among individuals with FASD. Subsequently, a sensitivity analysis was performed using the 95% confidence interval (CI) as the lower and upper estimates.

Table 16.
Length of therapy provided to participants in 27 randomized control trials for one-to-one speech-language interventions

Reference	Length of intervention (as reported in the original article)	Length of intervention (hours)
Almost & Rosenbaum, 1998	80 minutes a week over 4 months	21.3
Barratt et al., 1992	40 minutes weekly over six months	16
Cole & Dale, 1986	600 minutes a week given for 8 months	320
Dixon et al., 2001	30 minutes a week for 10 weeks	5
Fey et al., 1993	180 minutes a week for 4.5 months	54
Fudala et al., 1972	25 minutes a week for 4.5 months	7.5
Gibbard, 1994 (study 1)	40 minutes a week over 6 months	16
Gibbard, 1994 (study 2)	30 minutes a week for six months	12
Girolametto et al., 1996a	150 minutes a week for 10 weeks	25
Girolametto et al., 1996b	150 minutes a week for 11 weeks	27.5
Glogowska, et al., 2000	10 minutes a week for 8.4 months	5.6
Lancaster, 1991	17 minutes of therapy a week over 6 months	6.8
Law, et al., 1999	450 minutes a week for 6 weeks	45
Mulac & Tomlinson, 1977	67 minutes of therapy a week for 4 weeks	4.47
Munro, 1998	60 minutes a week for 6 weeks	6
Reid et al., 1996	30 minutes given a week lasting up to 10 weeks	5
Robertson, 1997	20 minutes of therapy a week provided over 3 weeks	1
Robertson & Weismer, 1999	150 minutes a week for 12 weeks	30
Ruscello et al., 1993	120 minutes a week for 8 weeks	16
Rvachew, 1994	45 minutes a week over 6 weeks	4.5
Rvachew & Nowak, 2001	30 minutes a week for 12 weeks	6
Shelton et al., 1978	57 days (listening for 5 minutes a day and reading and talking for 15 minutes a day)	19
Sommers, 1962	200 minutes a week for 4 weeks	13.3
Sommers et al., 1964	200 minutes a week for 4 weeks	13.3
Sommers et al., 1966	40 minutes of therapy a week for 8.5 months	22.7
Tufts & Holliday, 1959	60 minutes a week for 7 months	28
Wilcox et al., 1991	90 minutes a week for 3 months in individual condition and 360 minutes a week in group condition for three months	90

Calculated average: 20 hours (outliers removed: Robertson, 1997; Cole & Dale, 1986) to 30.4 hours (all studies)

Adapted from Law et al. (2003)

RESULTS

Estimated number of children with FASD by age group and sex

In Canada in 2011, there were an estimated 63,637 children (32,650 boys and 30,986 girls) in total, 2 to 19 years of age, with FASD.

Estimated number of children with FASD and SLD by age group and sex

1. Systematic literature search. The systematic literature search revealed seven studies reporting the prevalence of SLD among individuals with FASD (CDC, 1995; Church et al., 1997; Egeland et al., 1998; Elliott et al., 2008; Kvigne et al., 2004; Spohr et al., 1994; Steinhausen et al., 1982; Table 17).

Table 17.
Studies reporting on the prevalence of speech-language disorders among children with FASD

Condition/reference	ICD-10 code	Country	Sample size/diagnosis	Age (mean)	FASD (% affected)
Specific developmental disorders of speech and language	F80				
CDC, 1995		USA	60 FAS	8	40%
Church et al., 1997		USA	22 FAS	11.5	90%
Egeland et al., 1998		USA	145 FAS	0.6 (median)	41%
Elliott et al., 2008		Australia	92 FASD (25 FAS + 65 pFAS + 2 suspected FAS)	3.3 (median)	60%
Kvigne et al., 2004		USA	78 FASD (43 FAS + 35 pFAS)	FAS (10.0); pFAS (9.8)	58%
Spohr et al., 1994		Germany	44 FASD (8 FAE + 36 FAS)	15.3	37%
Steinhausen et al., 1982		Germany	68 FAS	4.3	88%
Specific speech articulation disorder	F80.0				
Church et al., 1997		USA	22 FAS	11.5	10%
Expressive language disorder	F80.1				
Church et al., 1997		USA	22 FAS	11.5	76%
Receptive language disorder	F80.2				
Church et al., 1997		USA	22 FAS	11.5	82%
Stuttering {stammering)	F98.5				
Church et al., 1997		USA	22 FAS	11.5	5%
Cluttering	F98.6				
Church et al., 1997		USA	22 FAS	11.5	5%

FAE: Fetal alcohol effects; FAS: Fetal alcohol syndrome; FASD: Fetal alcohol spectrum disorder; ICD-10: International Classification of Diseases, Version 10; pFAS: Partial fetal alcohol syndrome
Note. Meta-analysis was based on F80 code ("Specific developmental disorders of speech and language") only.

2. Meta-analysis. The random effects analysis of the seven studies reporting the prevalence of SLD among children with FASD indicated an overall pooled prevalence of 59.6% (95% CI: 43.4% to 74.8%). The I^2 statistic demonstrated that heterogeneity between studies was present (I^2= 92.0%, P = 0.000). Figure 12 depicts the forest plot for the meta-analysis of the double arcsine-transformed prevalence of SLD among children with FASD with the studies presented in the order they appear in Table 17.

The funnel plot (see Figure 13) of all of the studies reporting the prevalence of SLD among children with FASD (with the double arcsine-transformed prevalence plotted against the standard error of the double arcsine-transformed prevalence estimates) formed a random scatter plot. Since random effects were present, the funnel plot could be used to determine if publication bias was present.

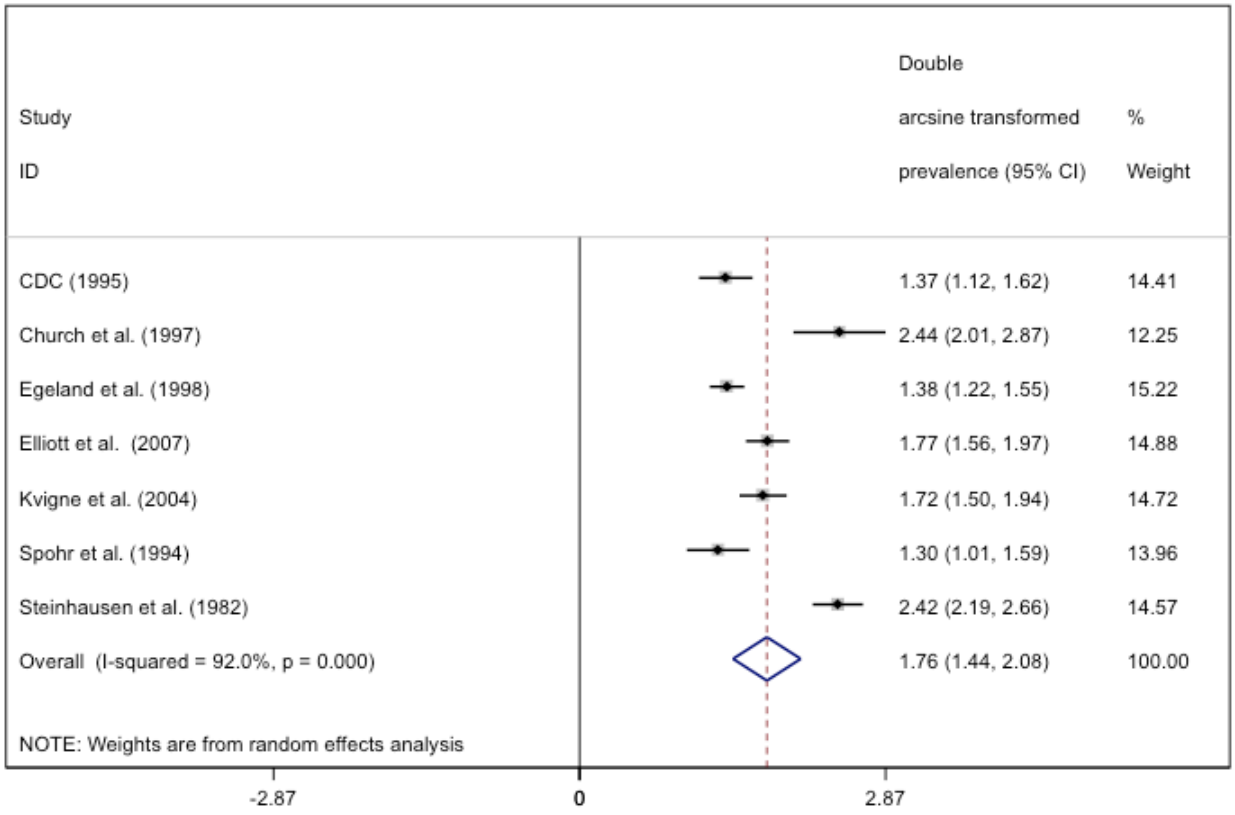

Figure 12. Forest plot of the seven studies that reported the prevalence of speech-language disorders among children with FASD
CI: Confidence interval
Note. The size of the box around the point estimate is representative of the weight of the estimate used in calculating the aggregated point estimate

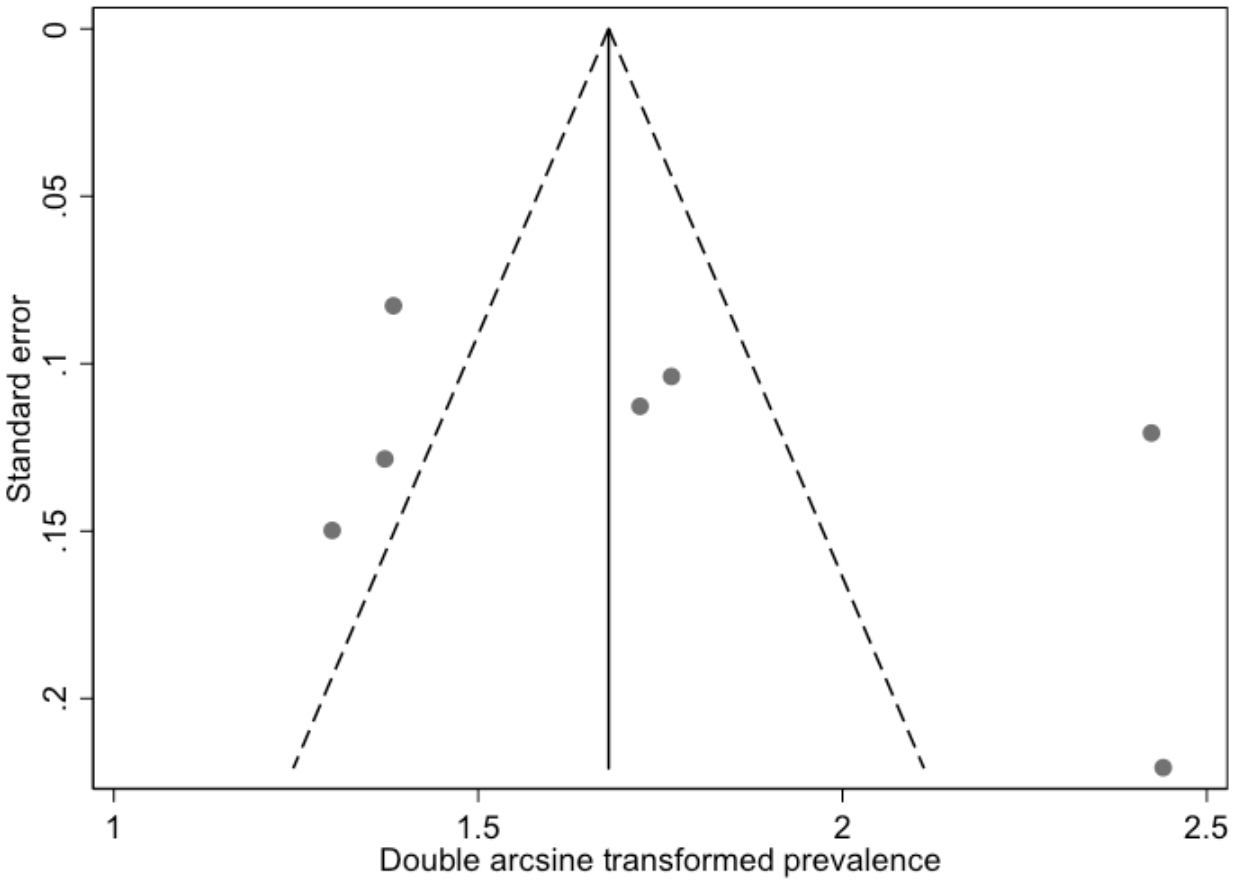

Figure 13. Funnel plot of the seven studies that measured the prevalence of speech-language disorders among children with FASD used in the meta-analysis with pseudo 95% confidence interval

Estimated number of children with FASD and SLD by age group, sex and level of severity

By applying the pooled prevalence of 59.6% (calculated in the meta-analysis described above), it was estimated that there were 37,928 children with FASD and SLD in Canada in 2011: 17,067 of these children had mild SLD (8,757 boys, and 8,311 girls), and 20,860 had moderate-to-severe SLD (10,703 boys, and 10,157 girls; Table 18).

Estimated cost of one-to-one speech-language interventions among children with FASD and SLD by age group, sex and level of severity

The total cost of one-to-one speech-language interventions for children with FASD who had mild SLD was estimated to range from $25.6 million to $50.9 million. For children with FASD who had moderate-to-severe SLD, the total costs associated with one-to-one speech-language interventions ranged from $46.9 million to $94.8 million. The total cost of one-to-one speech-language interventions for children with FASD ranged from $72.5 million to $144.1 million (Table 18).

Table 18.
Total number of children with FAS/FASD and speech-language disorders, and the cost associated with one-to-one speech-language interventions by age group and sex and level of severity in each province and territory, and in Canada in 2011

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Alberta										
Boys	**2 to 4 years**	76,953	77	693	46	413	$87,715	$174,260	$789,434	$1,568,342
	Mildly impaired				21	186	$30,958	$61,504	$278,624	$553,532
	Moderately-to-severely impaired				25	227	$56,757	$112,757	$510,810	$1,014,810
	5 to 9 years	114,298	114	1,029	68	613	$130,283	$258,828	$1,172,543	$2,329,452
	Mildly impaired				31	276	$45,982	$91,351	$413,839	$822,160
	Moderately-to-severely impaired				37	337	$84,300	$167,477	$758,704	$1,507,293
	10 to 14 years	111,653	112	1,005	67	599	$127,268	$252,838	$1,145,409	$2,275,546
	Mildly impaired				30	270	$44,918	$89,237	$404,262	$803,134
	Moderately-to-severely impaired				37	329	$82,350	$163,601	$741,147	$1,472,412
	15 to 19 years	122,722	123	1,104	73	658	$139,885	$277,904	$1,258,962	$2,501,138
	Mildly impaired				33	296	$49,371	$98,084	$444,340	$882,755
	Moderately-to-severely impaired				40	362	$90,514	$179,820	$814,622	$1,618,383

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	73,279	73	660	44	393	$83,527	$165,940	$751,744	$1,493,464
	Mildly impaired				20	177	$29,480	$58,567	$265,321	$527,105
	Moderately-to-severely impaired				24	216	$54,047	$107,373	$486,422	$966,359
	5 to 9 years	105,808	106	952	63	568	$120,605	$239,602	$1,085,447	$2,156,422
	Mildly impaired				28	255	$42,567	$84,566	$383,099	$761,090
	Moderately-to-severely impaired				35	312	$78,039	$155,037	$702,348	$1,395,332
	10 to 14 years	105,723	106	952	63	567	$120,508	$239,410	$1,084,575	$2,154,690
	Mildly impaired				28	255	$42,532	$84,498	$382,791	$760,479
	Moderately-to-severely impaired				35	312	$77,976	$154,912	$701,784	$1,394,211
	15 to 19 years	117,248	117	1,055	70	629	$133,645	$265,508	$1,202,806	$2,389,575
	Mildly impaired				31	283	$47,169	$93,709	$424,520	$843,379
	Moderately-to-severely impaired				38	346	$86,476	$171,800	$778,286	$1,546,196
Total		**827,684**	**828**	**7,449**	**493**	**4,440**	**$943,436**	**$1,874,292**	**$8,490,920**	**$16,868,629**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
British Columbia										
Boys	**2 to 4 years**	70,641	71	636	42	379	$80,520	$159,967	$724,681	$1,439,700
	Mildly impaired				19	171	$28,419	$56,459	$255,770	$508,129
	Moderately-to-severely impaired				23	208	$52,101	$103,508	$468,911	$931,571
	5 to 9 years	115,425	115	1,039	69	619	$131,567	$261,380	$1,184,105	$2,352,421
	Mildly impaired				31	279	$46,435	$92,252	$417,919	$830,266
	Moderately-to-severely impaired				38	341	$85,132	$169,128	$766,185	$1,522,155
	10 to 14 years	122,281	122	1,101	73	656	$139,382	$276,906	$1,254,438	$2,492,150
	Mildly impaired				33	295	$49,194	$97,731	$442,743	$879,582
	Moderately-to-severely impaired				40	361	$90,188	$179,174	$811,695	$1,612,568
	15 to 19 years	144,696	145	1,302	86	776	$164,932	$327,664	$1,484,386	$2,948,979
	Mildly impaired				39	349	$58,211	$115,646	$523,901	$1,040,816
	Moderately-to-severely impaired				47	427	$106,721	$212,018	$960,485	$1,908,163

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	66,387	66	597	40	356	$75,671	$150,333	$681,041	$1,353,001
	Mildly impaired				18	160	$26,707	$53,059	$240,367	$477,530
	Moderately-to-severely impaired				22	196	$48,964	$97,275	$440,674	$875,472
	5 to 9 years	107,277	107	965	64	575	$122,280	$242,929	$1,100,517	$2,186,361
	Mildly impaired				29	259	$43,158	$85,740	$388,418	$771,657
	Moderately-to-severely impaired				35	316	$79,122	$157,189	$712,099	$1,414,704
	10 to 14 years	114,775	115	1,033	68	616	$130,826	$259,908	$1,177,437	$2,339,174
	Mildly impaired				31	277	$46,174	$91,732	$415,566	$825,591
	Moderately-to-severely impaired				38	339	$84,652	$168,176	$761,871	$1,513,583
	15 to 19 years	136,280	136	1,227	81	731	$155,339	$308,606	$1,398,049	$2,777,457
	Mildly impaired				37	329	$54,825	$108,920	$493,429	$980,279
	Moderately-to-severely impaired				45	402	$100,513	$199,686	$904,620	$1,797,178
Total		**877,762**	**878**	**7,900**	**523**	**4,708**	**$1,000,517**	**$1,987,694**	**$9,004,653**	**$17,889,244**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Manitoba										
Boys	**2 to 4 years**	24,144	24	217	14	130	$27,521	$54,674	$247,685	$492,067
	Mildly impaired				6	58	$9,713	$19,297	$87,418	$173,671
	Moderately-to-severely impaired				8	71	$17,807	$35,377	$160,267	$318,396
	5 to 9 years	38,956	39	351	23	209	$44,404	$88,216	$399,636	$793,943
	Mildly impaired				10	94	$15,672	$31,135	$141,048	$280,215
	Moderately-to-severely impaired				13	115	$28,732	$57,081	$258,588	$513,728
	10 to 14 years	41,164	41	370	25	221	$46,921	$93,216	$422,287	$838,944
	Mildly impaired				11	99	$16,560	$32,900	$149,042	$296,098
	Moderately-to-severely impaired				13	121	$30,361	$60,316	$273,245	$542,846
	15 to 19 years	45,506	46	410	27	244	$51,870	$103,048	$466,830	$927,436
	Mildly impaired				12	110	$18,307	$36,370	$164,764	$327,330
	Moderately-to-severely impaired				15	134	$33,563	$66,678	$302,067	$600,106

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	23,332	23	210	14	125	$26,595	$52,835	$239,355	$475,518
	Mildly impaired				6	56	$9,386	$18,648	$84,478	$167,830
	Moderately-to-severely impaired				8	69	$17,209	$34,188	$154,877	$307,688
	5 to 9 years	36,724	37	331	22	197	$41,860	$83,162	$376,739	$748,454
	Mildly impaired				10	89	$14,774	$29,351	$132,967	$264,160
	Moderately-to-severely impaired				12	108	$27,086	$53,810	$243,772	$484,294
	10 to 14 years	38,647	39	348	23	207	$44,052	$87,516	$396,466	$787,646
	Mildly impaired				10	93	$15,548	$30,888	$139,929	$277,993
	Moderately-to-severely impaired				13	114	$28,504	$56,628	$256,537	$509,653
	15 to 19 years	43,237	43	389	26	232	$49,284	$97,910	$443,553	$881,192
	Mildly impaired				12	104	$17,394	$34,557	$156,548	$311,009
	Moderately-to-severely impaired				14	128	$31,889	$63,354	$287,005	$570,183
Total		**291,710**	**292**	**2,625**	**174**	**1,565**	**$332,506**	**$660,578**	**$2,992,551**	**$5,945,201**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
New Brunswick										
Boys	**2 to 4 years**	11,497	11	103	7	62	$13,105	$26,035	$117,944	$234,315
	Mildly impaired				3	28	$4,625	$9,189	$41,627	$82,699
	Moderately-to-severely impaired				4	34	$8,480	$16,846	$76,317	$151,615
	5 to 9 years	18,773	19	169	11	101	$21,398	$42,511	$192,586	$382,603
	Mildly impaired				5	45	$7,552	$15,004	$67,971	$135,037
	Moderately-to-severely impaired				6	55	$13,846	$27,507	$124,614	$247,567
	10 to 14 years	20,769	21	187	12	111	$23,674	$47,031	$213,062	$423,283
	Mildly impaired				6	50	$8,355	$16,599	$75,198	$149,394
	Moderately-to-severely impaired				7	61	$15,318	$30,432	$137,864	$273,889
	15 to 19 years	23,538	24	212	14	126	$26,830	$53,302	$241,468	$479,717
	Mildly impaired				6	57	$9,469	$18,812	$85,224	$169,312
	Moderately-to-severely impaired				8	69	$17,360	$34,489	$156,244	$310,405

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	10,927	11	98	7	59	$12,455	$24,744	$112,096	$222,698
	Mildly impaired				*3*	*26*	*$4,396*	*$8,733*	*$39,563*	*$78,599*
	Moderately-to-severely impaired				4	32	$8,059	$16,011	$72,533	$144,099
	5 to 9 years	17,706	18	159	11	95	$20,182	$40,095	$181,640	$360,857
	Mildly impaired				5	43	$7,123	$14,151	$64,108	$127,361
	Moderately-to-severely impaired				6	52	$13,059	$25,944	$117,532	$233,496
	10 to 14 years	19,254	19	173	11	103	$21,947	$43,601	$197,520	$392,406
	Mildly impaired				5	46	$7,746	$15,388	$69,713	$138,496
	Moderately-to-severely impaired				6	57	$14,201	$28,212	$127,807	$253,910
	15 to 19 years	22,391	22	202	13	120	$25,522	$50,704	$229,701	$456,340
	Mildly impaired				6	54	$9,008	$17,896	$81,071	$161,061
	Moderately-to-severely impaired				7	66	$16,514	$32,809	$148,630	$295,279
Total		**144,855**	**145**	**1,304**	**86**	**777**	**$165,113**	**$328,024**	**$1,486,017**	**$2,952,220**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Newfoundland and Labrador										
Boys	**2 to 4 years**	7,605	8	68	5	41	$8,669	$17,222	$78,017	$154,994
	Mildly impaired				2	18	$3,059	$6,078	$27,535	$54,704
	Moderately-to-severely impaired				2	22	$5,609	$11,143	$50,482	$100,290
	5 to 9 years	12,420	12	112	7	67	$14,157	$28,125	$127,412	$253,126
	Mildly impaired				3	30	$4,997	$9,927	$44,969	$89,339
	Moderately-to-severely impaired				4	37	$9,160	$18,199	$82,443	$163,787
	10 to 14 years	13,901	14	125	8	75	$15,845	$31,479	$142,605	$283,310
	Mildly impaired				4	34	$5,592	$11,110	$50,331	$99,992
	Moderately-to-severely impaired				5	41	$10,253	$20,369	$92,274	$183,318
	15 to 19 years	15,356	15	138	9	82	$17,504	$34,774	$157,532	$312,963
	Mildly impaired				4	37	$6,178	$12,273	$55,599	$110,458
	Moderately-to-severely impaired				5	45	$11,326	$22,501	$101,932	$202,506

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	7,251	7	65	4	39	$8,265	$16,420	$74,385	$147,779
	Mildly impaired				2	18	$2,917	$5,795	$26,254	$52,157
	Moderately-to-severely impaired				2	21	$5,348	$10,625	$48,132	$95,622
	5 to 9 years	11,900	12	107	7	64	$13,564	$26,948	$122,078	$242,528
	Mildly impaired				3	29	$4,787	$9,511	$43,086	$85,598
	Moderately-to-severely impaired				4	35	$8,777	$17,437	$78,992	$156,930
	10 to 14 years	13,039	13	117	8	70	$14,863	$29,527	$133,763	$265,742
	Mildly impaired				3	31	$5,246	$10,421	$47,210	$93,791
	Moderately-to-severely impaired				4	38	$9,617	$19,106	$86,552	$171,950
	15 to 19 years	14,272	14	128	9	77	$16,268	$32,319	$146,411	$290,871
	Mildly impaired				4	34	$5,742	$11,407	$51,675	$102,660
	Moderately-to-severely impaired				5	42	$10,526	$20,912	$94,737	$188,210
Total		**95,744**	**96**	**862**	**57**	**514**	**$109,134**	**$216,812**	**$982,204**	**$1,951,312**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Northwest Territories										
Boys	**2 to 4 years**	1,000	1	9	1	5	$1,140	$2,265	$10,259	$20,381
	Mildly impaired				0	2	$402	$799	$3,621	$7,193
	Moderately-to-severely impaired				0	3	$738	$1,465	$6,638	$13,187
	5 to 9 years	1,497	1	13	1	8	$1,706	$3,390	$15,357	$30,510
	Mildly impaired				0	4	$602	$1,196	$5,420	$10,768
	Moderately-to-severely impaired				0	4	$1,104	$2,194	$9,937	$19,742
	10 to 14 years	1,429	1	13	1	8	$1,629	$3,236	$14,660	$29,124
	Mildly impaired				0	3	$575	$1,142	$5,174	$10,279
	Moderately-to-severely impaired				0	4	$1,054	$2,094	$9,486	$18,845
	15 to 19 years	1,927	2	17	1	10	$2,196	$4,364	$19,768	$39,273
	Mildly impaired				1	5	$775	$1,540	$6,977	$13,861
	Moderately-to-severely impaired				1	6	$1,421	$2,824	$12,791	$25,412

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	953	1	9	1	5	$1,086	$2,158	$9,776	$19,423
	Mildly impaired				0	2	$383	$762	$3,451	$6,855
	Moderately-to-severely impaired				0	3	$703	$1,396	$6,326	$12,568
	5 to 9 years	1,656	2	15	1	9	$1,888	$3,750	$16,988	$33,750
	Mildly impaired				0	4	$666	$1,324	$5,996	$11,912
	Moderately-to-severely impaired				1	5	$1,221	$2,426	$10,992	$21,838
	10 to 14 years	1,485	1	13	1	8	$1,693	$3,363	$15,234	$30,265
	Mildly impaired				0	4	$597	$1,187	$5,377	$10,682
	Moderately-to-severely impaired				0	4	$1,095	$2,176	$9,857	$19,583
	15 to 19 years	1,674	2	15	1	9	$1,908	$3,791	$17,173	$34,117
	Mildly impaired				0	4	$673	$1,338	$6,061	$12,041
	Moderately-to-severely impaired				1	5	$1,235	$2,453	$11,112	$22,076
Total		**11,621**	**12**	**105**	**7**	**62**	**$13,246**	**$26,316**	**$119,216**	**$236,842**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Nova Scotia										
Boys	**2 to 4 years**	14,026	14	126	8	75	$15,988	$31,762	$143,888	$285,857
	Mildly impaired				4	34	$5,643	$11,210	$50,784	$100,891
	Moderately-to-severely impaired				5	41	$10,345	$20,552	$93,104	$184,966
	5 to 9 years	22,516	23	203	13	121	$25,665	$50,988	$230,984	$458,888
	Mildly impaired				6	54	$9,058	$17,996	$81,524	$161,960
	Moderately-to-severely impaired				7	66	$16,607	$32,992	$149,460	$296,927
	10 to 14 years	25,421	25	229	15	136	$28,976	$57,566	$260,785	$518,093
	Mildly impaired				7	61	$10,227	$20,317	$92,042	$182,856
	Moderately-to-severely impaired				8	75	$18,749	$37,249	$168,743	$335,237
	15 to 19 years	29,362	29	264	17	157	$33,468	$66,490	$301,214	$598,413
	Mildly impaired				8	71	$11,812	$23,467	$106,311	$211,205
	Moderately-to-severely impaired				10	87	$21,656	$43,023	$194,903	$387,208

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	13,416	13	121	8	72	$15,292	$30,381	$137,630	$273,425
	Mildly impaired				4	32	$5,397	$10,723	$48,575	$96,503
	Moderately-to-severely impaired				4	40	$9,895	$19,658	$89,055	$176,922
	5 to 9 years	21,616	22	195	13	116	$24,639	$48,949	$221,751	$440,545
	Mildly impaired				6	52	$8,696	$17,276	$78,265	$155,487
	Moderately-to-severely impaired				7	64	$15,943	$31,673	$143,486	$285,059
	10 to 14 years	23,801	24	214	14	128	$27,130	$53,897	$244,166	$485,077
	Mildly impaired				6	57	$9,575	$19,023	$86,176	$171,204
	Moderately-to-severely impaired				8	70	$17,554	$34,875	$157,990	$313,873
	15 to 19 years	29,112	29	262	17	156	$33,183	$65,924	$298,650	$593,318
	Mildly impaired				8	70	$11,712	$23,267	$105,406	$209,406
	Moderately-to-severely impaired				10	86	$21,472	$42,657	$193,244	$383,911
Total		**179,270**	**179**	**1,613**	**107**	**962**	**$204,341**	**$405,957**	**$1,839,068**	**$3,653,615**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Nunavut										
Boys	**2 to 4 years**	1,110	1	10	1	6	$1,265	$2,514	$11,387	$22,622
	Mildly impaired				0	3	$447	$887	$4,019	$7,984
	Moderately-to-severely impaired				0	3	$819	$1,626	$7,368	$14,638
	5 to 9 years	1,754	2	16	1	9	$1,999	$3,972	$17,994	$35,747
	Mildly impaired				0	4	$706	$1,402	$6,351	$12,617
	Moderately-to-severely impaired				1	5	$1,294	$2,570	$11,643	$23,131
	10 to 14 years	1,776	2	16	1	10	$2,024	$4,022	$18,219	$36,196
	Mildly impaired				0	4	$714	$1,419	$6,430	$12,775
	Moderately-to-severely impaired				1	5	$1,310	$2,602	$11,789	$23,421
	15 to 19 years	1,615	2	15	1	9	$1,841	$3,657	$16,568	$32,915
	Mildly impaired				0	4	$650	$1,291	$5,847	$11,617
	Moderately-to-severely impaired				1	5	$1,191	$2,366	$10,720	$21,298

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	1,080	1	10	1	6	$1,231	$2,446	$11,079	$22,011
	Mildly impaired				0	3	$434	$863	$3,910	$7,769
	Moderately-to-severely impaired				0	3	$797	$1,582	$7,169	$14,242
	5 to 9 years	1,625	2	15	1	9	$1,852	$3,680	$16,670	$33,118
	Mildly impaired				0	4	$654	$1,299	$5,884	$11,689
	Moderately-to-severely impaired				1	5	$1,199	$2,381	$10,787	$21,430
	10 to 14 years	1,645	2	15	1	9	$1,875	$3,725	$16,875	$33,526
	Mildly impaired				0	4	$662	$1,315	$5,956	$11,833
	Moderately-to-severely impaired				1	5	$1,213	$2,410	$10,919	$21,693
	15 to 19 years	1,611	2	14	1	9	$1,836	$3,648	$16,527	$32,833
	Mildly impaired				0	4	$648	$1,288	$5,833	$11,588
	Moderately-to-severely impaired				1	5	$1,188	$2,361	$10,694	$21,245
Total		**12,216**	**12**	**110**	**7**	**66**	**$13,924**	**$27,663**	**$125,320**	**$248,968**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Ontario										
Boys	**2 to 4 years**	221,559	222	1,994	132	1,188	$252,544	$501,721	$2,272,896	$4,515,487
	Mildly impaired				59	535	$89,133	$177,078	$802,199	$1,593,701
	Moderately-to-severely impaired				73	654	$163,411	$324,643	$1,470,698	$2,921,786
	5 to 9 years	374,819	375	3,373	223	2,011	$427,237	$848,778	$3,845,137	$7,639,005
	Mildly impaired				101	905	$150,790	$299,569	$1,357,107	$2,696,120
	Moderately-to-severely impaired				123	1,106	$276,448	$549,210	$2,488,030	$4,942,886
	10 to 14 years	389,110	389	3,502	232	2,087	$443,527	$881,140	$3,991,743	$7,930,263
	Mildly impaired				104	939	$156,539	$310,991	$1,408,851	$2,798,916
	Moderately-to-severely impaired				128	1,148	$286,988	$570,150	$2,582,893	$5,131,347
	15 to 19 years	446,024	446	4,014	266	2,392	$508,400	$1,010,022	$4,575,604	$9,090,200
	Mildly impaired				120	1,077	$179,435	$356,478	$1,614,919	$3,208,306
	Moderately-to-severely impaired				146	1,316	$328,965	$653,544	$2,960,685	$5,881,894

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	210,968	211	1,899	126	1,132	$240,472	$477,737	$2,164,247	$4,299,637
	Mildly impaired				57	509	$84,872	$168,613	$763,852	$1,517,519
	Moderately-to-severely impaired				69	622	$155,599	$309,124	$1,400,395	$2,782,118
	5 to 9 years	354,172	354	3,188	211	1,900	$403,703	$802,023	$3,633,327	$7,218,209
	Mildly impaired				95	855	$142,483	$283,067	$1,282,351	$2,547,603
	Moderately-to-severely impaired				116	1,045	$261,220	$518,956	$2,350,976	$4,670,606
	10 to 14 years	370,267	370	3,332	221	1,986	$422,049	$838,470	$3,798,440	$7,546,233
	Mildly impaired				99	894	$148,958	$295,931	$1,340,626	$2,663,376
	Moderately-to-severely impaired				121	1,092	$273,090	$542,540	$2,457,814	$4,882,857
	15 to 19 years	426,476	426	3,838	254	2,288	$486,119	$965,756	$4,375,068	$8,691,802
	Mildly impaired				114	1,029	$171,571	$340,855	$1,544,142	$3,067,695
	Moderately-to-severely impaired				140	1,258	$314,547	$624,901	$2,830,926	$5,624,107
Total		**2,793,395**	**2,793**	**25,141**	**1,665**	**14,984**	**$3,184,051**	**$6,325,649**	**$28,656,462**	**$56,930,837**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Prince Edward Island										
Boys	2 to 4 years	2,228	2	20	1	12	$2,540	$5,045	$22,856	$45,408
	Mildly impaired				1	5	$896	$1,781	$8,067	$16,026
	Moderately-to-severely impaired				1	7	$1,643	$3,265	$14,789	$29,382
	5 to 9 years	3,784	4	34	2	20	$4,313	$8,569	$38,819	$77,120
	Mildly impaired				1	9	$1,522	$3,024	$13,701	$27,219
	Moderately-to-severely impaired				1	11	$2,791	$5,545	$25,118	$49,901
	10 to 14 years	4,443	4	40	3	24	$5,064	$10,061	$45,579	$90,551
	Mildly impaired				1	11	$1,787	$3,551	$16,087	$31,959
	Moderately-to-severely impaired				1	13	$3,277	$6,510	$29,492	$58,592
	15 to 19 years	5,241	5	47	3	28	$5,974	$11,868	$53,766	$106,814
	Mildly impaired				1	13	$2,108	$4,189	$18,976	$37,699
	Moderately-to-severely impaired				2	15	$3,865	$7,679	$34,789	$69,115

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	2,259	2	20	1	12	$2,575	$5,116	$23,174	$46,040
	Mildly impaired				1	5	$909	$1,805	$8,179	$16,249
	Moderately-to-severely impaired				1	7	$1,666	$3,310	$14,995	$29,790
	5 to 9 years	3,613	4	33	2	19	$4,118	$8,182	$37,065	$73,635
	Mildly impaired				1	9	$1,454	$2,888	$13,082	$25,989
	Moderately-to-severely impaired				1	11	$2,665	$5,294	$23,983	$47,646
	10 to 14 years	4,134	4	37	2	22	$4,712	$9,361	$42,409	$84,253
	Mildly impaired				1	10	$1,663	$3,304	$14,968	$29,736
	Moderately-to-severely impaired				1	12	$3,049	$6,057	$27,441	$54,517
	15 to 19 years	4,997	5	45	3	27	$5,696	$11,316	$51,262	$101,841
	Mildly impaired				1	12	$2,010	$3,994	$18,093	$35,944
	Moderately-to-severely impaired				2	15	$3,686	$7,322	$33,170	$65,897
Total		**30,699**	**31**	**276**	**18**	**165**	**$34,992**	**$69,518**	**$314,930**	**$625,662**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Quebec										
Boys	**2 to 4 years**	135,693	136	1,221	81	728	$154,670	$307,277	$1,392,027	$2,765,494
	Mildly impaired				36	328	$54,589	$108,451	$491,304	$976,057
	Moderately-to-severely impaired				44	400	$100,080	$198,826	$900,723	$1,789,437
	5 to 9 years	201,281	201	1,812	120	1,080	$229,430	$455,801	$2,064,871	$4,102,211
	Mildly impaired				54	486	$80,975	$160,871	$728,778	$1,447,839
	Moderately-to-severely impaired				66	594	$148,455	$294,930	$1,336,093	$2,654,372
	10 to 14 years	209,121	209	1,882	125	1,122	$238,367	$473,555	$2,145,299	$4,261,994
	Mildly impaired				56	505	$84,129	$167,137	$757,164	$1,504,233
	Moderately-to-severely impaired				69	617	$154,237	$306,418	$1,388,135	$2,757,761
	15 to 19 years	249,408	249	2,245	149	1,338	$284,288	$564,785	$2,558,589	$5,083,064
	Mildly impaired				67	602	$100,337	$199,336	$903,032	$1,794,023
	Moderately-to-severely impaired				82	736	$183,951	$365,449	$1,655,558	$3,289,042

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	129,305	129	1,164	77	694	$147,388	$292,811	$1,326,495	$2,635,303
	Mildly impaired				35	312	$52,019	$103,345	$468,175	$930,107
	Moderately-to-severely impaired				42	381	$95,369	$189,466	$858,320	$1,705,196
	5 to 9 years	191,740	192	1,726	114	1,028	$218,555	$434,196	$1,966,994	$3,907,761
	Mildly impaired				51	463	$77,137	$153,246	$694,233	$1,379,210
	Moderately-to-severely impaired				63	566	$141,418	$280,950	$1,272,761	$2,528,551
	10 to 14 years	198,056	198	1,783	118	1,062	$225,754	$448,498	$2,031,787	$4,036,484
	Mildly impaired				53	478	$79,678	$158,293	$717,101	$1,424,641
	Moderately-to-severely impaired				65	584	$146,076	$290,205	$1,314,686	$2,611,843
	15 to 19 years	238,812	239	2,149	142	1,281	$272,210	$540,790	$2,449,889	$4,867,112
	Mildly impaired				64	576	$96,074	$190,867	$864,667	$1,717,804
	Moderately-to-severely impaired				78	705	$176,136	$349,923	$1,585,222	$3,149,308
Total		**1,555,416**	**1,553**	**13,981**	**926**	**8,333**	**$1,770,661**	**$3,517,714**	**$15,935,951**	**$31,659,423**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Saskatchewan										
Boys	**2 to 4 years**	21,420	21	193	13	115	$24,416	$48,506	$219,740	$436,551
	Mildly impaired				6	52	$8,617	$17,120	$77,555	$154,077
	Moderately-to-severely impaired				7	63	$15,798	$31,386	$142,185	$282,474
	5 to 9 years	33,006	33	297	20	177	$37,622	$74,742	$338,597	$672,679
	Mildly impaired				9	80	$13,278	$26,380	$119,505	$237,416
	Moderately-to-severely impaired				11	97	$24,344	$48,363	$219,092	$435,263
	10 to 14 years	33,899	34	305	20	182	$38,640	$76,764	$347,758	$690,879
	Mildly impaired				9	82	$13,638	$27,093	$122,738	$243,840
	Moderately-to-severely impaired				11	100	$25,002	$49,671	$225,020	$447,039
	15 to 19 years	37,215	37	335	22	200	$42,420	$84,273	$381,776	$758,461
	Mildly impaired				10	90	$14,972	$29,744	$134,744	$267,692
	Moderately-to-severely impaired				12	110	$27,448	$54,530	$247,031	$490,769

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	20,556	21	185	12	110	$23,431	$46,549	$210,877	$418,942
	Mildly impaired				6	50	$8,270	$16,429	$74,427	$147,862
	Moderately-to-severely impaired				7	61	$15,161	$30,120	$136,450	$271,080
	5 to 9 years	31,142	31	280	19	167	$35,497	$70,521	$319,475	$634,690
	Mildly impaired				8	75	$12,528	$24,890	$112,756	$224,008
	Moderately-to-severely impaired				10	92	$22,969	$45,631	$206,719	$410,682
	10 to 14 years	32,217	32	290	19	173	$36,723	$72,955	$330,503	$656,599
	Mildly impaired				9	78	$12,961	$25,749	$116,648	$231,741
	Moderately-to-severely impaired				11	95	$23,762	$47,206	$213,855	$424,858
	15 to 19 years	35,472	35	319	21	190	$40,433	$80,326	$363,895	$722,938
	Mildly impaired				10	86	$14,270	$28,350	$128,433	$255,154
	Moderately-to-severely impaired				12	105	$26,162	$51,976	$235,461	$467,783
Total		**244,927**	**245**	**2,204**	**146**	**1,314**	**$279,180**	**$554,638**	**$2,512,620**	**$4,991,739**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Yukon										
Boys	**2 to 4 years**	672	1	6	0	4	$766	$1,522	$6,894	$13,696
	Mildly impaired				0	2	$270	$537	$2,433	$4,834
	Moderately-to-severely impaired				0	2	$496	$985	$4,461	$8,862
	5 to 9 years	1,106	1	10	1	6	$1,261	$2,505	$11,346	$22,541
	Mildly impaired				0	3	$445	$884	$4,004	$7,956
	Moderately-to-severely impaired				0	3	$816	$1,621	$7,342	$14,585
	10 to 14 years	974	1	9	1	5	$1,110	$2,206	$9,992	$19,851
	Mildly impaired				0	2	$392	$778	$3,527	$7,006
	Moderately-to-severely impaired				0	3	$718	$1,427	$6,465	$12,845
	15 to 19 years	1,061	1	10	1	6	$1,209	$2,403	$10,884	$21,624
	Mildly impaired				0	3	$427	$848	$3,842	$7,632
	Moderately-to-severely impaired				0	3	$783	$1,555	$7,043	$13,992

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	555	1	5	0	3	$633	$1,257	$5,694	$11,311
	Mildly impaired				0	1	$223	$444	$2,009	$3,992
	Moderately-to-severely impaired				0	2	$409	$813	$3,684	$7,319
	5 to 9 years	985	1	9	1	5	$1,123	$2,231	$10,105	$20,075
	Mildly impaired				0	2	$396	$787	$3,566	$7,085
	Moderately-to-severely impaired				0	3	$726	$1,443	$6,538	$12,990
	10 to 14 years	999	1	9	1	5	$1,139	$2,262	$10,248	$20,360
	Mildly impaired				0	2	$402	$798	$3,617	$7,186
	Moderately-to-severely impaired				0	3	$737	$1,464	$6,631	$13,174
	15 to 19 years	1,108	1	10	1	6	$1,263	$2,509	$11,367	$22,582
	Mildly impaired				0	3	$446	$886	$4,012	$7,970
	Moderately-to-severely impaired				0	3	$817	$1,624	$7,355	$14,612
Total		**7,460**	**7**	**67**	**4**	**40**	**$8,503**	**$16,893**	**$76,530**	**$152,039**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
CANADA (All provinces/territories)										
Boys	**2 to 4 years**	588,548		5,297		3,157			$6,037,708	$11,994,913
	Mildly impaired					1,421			$2,130,956	$4,233,499
	Moderately-to-severely impaired					1,736			$3,906,752	$7,761,414
	5 to 9 years	939,635		8,457		5,040			$9,639,387	$19,150,248
	Mildly impaired					2,268			$3,402,136	$6,758,911
	Moderately-to-severely impaired					2,772			$6,237,250	$12,391,337
	10 to 14 years	975,941		8,783		5,235			$10,011,837	$19,890,183
	Mildly impaired					2,356			$3,533,590	$7,020,065
	Moderately-to-severely impaired					2,879			$6,478,248	$12,870,118
	15 to 19 years	1,123,671		10,113		6,027			$11,527,348	$22,900,997
	Mildly impaired					2,712			$4,068,476	$8,082,705
	Moderately-to-severely impaired					3,315			$7,458,872	$14,818,292

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Girls	**2 to 4 years**	560,268		5,042		3,005			$5,747,593	$11,418,552
	Mildly impaired					1,352			$2,028,562	$4,030,077
	Moderately-to-severely impaired					1,653			$3,719,031	$7,388,475
	5 to 9 years	885,964		7,974		4,752			$9,088,795	$18,056,405
	Mildly impaired					2,139			$3,207,810	$6,372,849
	Moderately-to-severely impaired					2,614			$5,880,985	$11,683,556
	10 to 14 years	924,042		8,316		4,957			$9,479,423	$18,832,455
	Mildly impaired					2,230			$3,345,679	$6,646,749
	Moderately-to-severely impaired					2,726			$6,133,745	$12,185,706
	15 to 19 years	1,072,690		9,654		5,754			$11,004,351	$21,861,978
	Mildly impaired					2,589			$3,883,889	$7,715,992
	Moderately-to-severely impaired					3,165			$7,120,463	$14,145,986
TOTAL		**7,070,759**		**63,637**		**37,928**			**$72,536,442**	**$144,105,731**

Sex	Age group; severity level of impairment	Total population (2011)[a]	Number of children with FAS[b]	Number of children with FASD[c]	Number of children with FAS and SLD[d,e]	Number of children with FASD and SLD[d,e]	Total cost of one-to-one speech-language interventions for children with FAS[f,g]		Total cost of one-to-one speech-language interventions for children with FASD[f,g]	
							Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)	Lower boundary (20 hours; $75 per hour)	Upper boundary (30 hours; $149 per hour)
Sensitivity analysis, assuming 43.4% (lower estimate) of children with FAS/FASD have SLD										
	Mildly impaired					12,428			$18,642,459	$37,036,352
	Moderately-to-severely impaired					15,190			$34,177,842	$67,899,979
TOTAL		**7,070,759**		**63,637**		**27,618**			**$52,820,301**	**$104,936,331**
Sensitivity analysis, assuming 74.8% (upper estimate) of children with FAS/FASD have SLD										
	Mildly impaired					21,420			$32,130,321	$63,832,238
	Moderately-to-severely impaired					26,180			$58,905,589	$117,025,770
TOTAL		**7,070,759**		**63,637**		**47,600**			**$91,035,910**	**$180,858,009**

FAS: Fetal alcohol syndrome; FASD: Fetal alcohol spectrum disorder; SLD: Speech-language disorders

a Obtained from Statistics Canada (2012a)

b Calculated based on a prevalence of 1 per 1,000 (PHAC, 2003b)

c Calculated based on a prevalence of 9 per 1,000 (Roberts & Nanson, 2000)

d Based on data by Coggins et al. (2007)

e Calculated based on a prevalence 596 per 1,000

f Calculated using data on the average number of hours adapted from Law et al. (2003)

g Calculated using data on the average cost per hour for a speech-language pathologist obtained from the Canadian Association for Speech-Language Pathologists and Audiologists (CASLPA)

Note. Column numbers may not add up due to rounding error.

Sensitivity analysis

Assuming that 43.4% (as the lower estimate) of children with FASD have SLD, it was estimated that there were 27,618 children with FASD and SLD (12,428 with mild SLD and 15,190 with moderate-to-severe SLD) in Canada in 2011. In turn, it was estimated that the cost of one-to-one speech-language interventions for these children ranged from $52.8 million to $104.9 million. Assuming that 74.8% (as the upper estimate) of children with FASD have SLD, it was estimated that there were 47,600 children with FASD and SLD (21,420 with mild SLD and 26,180 with moderate-to-severe SLD). The resulting estimated cost associated with one-to-one speech-language interventions for these children ranged from $91 million to $180.9 million. The results of the sensitivity analysis are presented in Table 18.

DISCUSSION

The results demonstrate that the number of children with FASD and SLD and the annual cost of one-to-one speech-language interventions in Canada are substantial. However, the presented cost of speech-language interventions may be overestimated, for the following reasons. First, it was assumed that all children with FASD and SLD require and receive one-to-one speech-language interventions. Second, the severity distribution of SLD was taken from the study of Coggins et al. (2007), in which 69% of children with FASD had significant language impairment; however, more than 40% of these children had experienced substantial adverse environmental conditions (e.g., abuse, neglect, negative caregiving). Such environments are likely to have a negative influence on language development, particularly on social communication, in a way that children with FASD who do not experience these adverse environmental conditions, would not encounter. Third, the available literature on the prevalence of SLD among children with FASD, which was used to calculate the pooled FASD prevalence in this module, is dominated by FAS-specific data (Table 17).

Furthermore, there is no agreement as to the number of treatment sessions or the length of the sessions that speech-language pathologists should provide for specific disorders, and it is likely that interventions are client- rather than disorder-specific. As such, the number of hours for speech-language interventions could be much longer or shorter than those used in this module. For example, according to its director Dr. Larry Burd, the North Dakota Fetal Alcohol Syndrome Centre offers therapy to children younger than 2 years of age, as well as intensive therapy that lasts longer than typical SLD interventions. Most children with FASD in this centre receive therapy at least once a week, with many receiving therapy two or more times a week, and and often continuing for two years. At least 15% of children with FASD at this centre will receive therapy for four to six years. Depending on the length of the intervention, the costs could be higher or lower.

Moreover, speech-language interventions can take many forms; for example, they could be clinic-based or parent-administered and may be one-to-one or group sessions. Like all types of disability, there is no cure for SLD; however, there are effective therapies. Children with SLD often qualify for an Individualized Education Plan, as well as other services. These services typically include one-to-one interventions with a speech-language pathologist. Even though one-to-one interventions may work best for some SLD, other treatment models are also used.

The current estimates provide both national and international policy-makers and decision-makers alike with a clear perspective on the magnitude of the burden and cost associated with children with FASD and SLD. The findings of this module are important for various reasons: 1) early intervention may improve the outcome for children with FASD and SLD; 2) early intervention may reduce rates or risk of developing secondary disabilities; 3) speech-language pathologists can play a key role in being one of the first health professionals to recognize risk factors for FASD; 4) speech-language intervention settings may be one of several optimal locations to screen for FASD; 5) supporting the implementation of prevention strategies to reduce or eliminate alcohol consumption during pregnancy could have a cost-saving effect; 6) the presented burden and cost estimates will raise awareness of not only the consequences of consuming alcohol during pregnancy, but also of the wide range of impairments seen in individuals with FASD, and 7) the findings will make speech-language pathologists more aware of the disproportionate number of children with FASD they will likely work with during their careers. The cost estimates presented can also be used to promote the allocation of resources to programs specifically for children with FASD.

Given the high prevalence of SLD among children with FASD, speech-language pathologists will often come into contact with children affected by FASD. They may have high rates of children with FASD in their caseload whenworking in early intervention; when serving children with birth defects, behavioural problems or developmental delays; and/or when seeing children in foster care or juvenile corrections settings. However, unfortunately, FASD is not widely recognized by health care practitioners (Clark & Tough, 2003), so may be largely underdiagnosed (Paintner et al., 2012b). Early screening may lead to early diagnosis, which can lead to early participation in developmental interventions. This in turn, can prevent the development of secondary disabilities and improve the quality of life for people with FASD and their families (see for example, Painter et al., 2012b).

Speech-language pathologists are in a unique position, as they may be one of the first health professionals that children with FASD come into contact with. This circumstance offers several opportunities to have a positive impact. First, it would be useful for speech-language pathologists to review the pre-service training and in-service training to determine if additional information on FASD may be needed, including FASD recognition and the specific needs of children with FASD. Second, improving the capacity for speech-language pathologists to effectively screen children on their caseload for FASD and provide referrals to diagnostic clinics where a diagnosis can be established, if appropriate, would maximize this contact. The Canadian FASD diagnostic guidelines clearly state that speech-language pathologists should be part of the core diagnostic team (Chudley et al., 2005). Third, improved screening and increased training on recognizing the key features of FASD could increase referral rates for other related services (offered by e.g., audiologists, occupational therapists, physical therapists). Other disciplines providing a comprehensive approach to intervention and early participation, where needed, could increase the amount of early intervention, and thus, could potentially improve outcomes (Olson et al., 2007).

Finally, the high rates of SLD among children with FASD suggest an increased need for comprehensive treatment plans for SLD that specifically target individuals with FASD. Designing targeted interventions for children with FASD and SLD may improve learning and behaviour, interpersonal communication and social skill development (Wyper & Rasmussen, 2011).

According to clinical observations, the link between SLD and behaviour problems is common. Children with SLD appear to be overrepresented in the group of children with temper tantrums, sleep disturbance, increased irritability, aggression and attention deficit/hyperactivity disorder. Speech-language pathologists are often the first professionals to begin the process of managing these behavioural problems in SLD therapy. Anecdotal data suggest that this strategy is often effective. Further research may help speech-language pathologists working with this population understand improved management pathways. Efforts to better understand the link between SLD and behavioural disorders may also help in improving early intervention and in decreasing the risk of developing secondary disabilities in this population.

More studies are needed to determine the types of speech-language interventions that children with FASD are currently receiving and whether children with FASD are effectively treated with the same interventions developed for children without FASD. Such information will help determine if children with FASD need program accommodations. In addition, the limitations of the current module draw attention to the need for accurate prevalence estimates of SLD among individuals with FASD, and the need for cost analyses to be conducted using other delivery methods, not only in Canada, but also internationally.

2. Direct Law Enforcement Costs

2.1 Corrections

FASD is associated with organic brain damage, which can impair people's abstracting abilities, memory skills, information processing, comprehension of social rules and expectations, ability to connect cause-and-effect relationships, and the ability to learn from past experiences (LaDue, 1993; Streissguth et al., 1988; Olson et al., 1994; LaDue & Dunne, 1997). People with FASD often display such characteristics as hyperactivity, impulsivity, aggressiveness and poor judgment. If appropriate diagnosis, interventions and support services are not put in place early in life and maintained throughout their life, many people with FASD are at a high risk for becoming involved in the legal system, either as offenders or as victims.

The connection between FASD and involvement with the juvenile/criminal justice system has not yet been rigorously studied. However, the reported high prevalence of individuals with FASD within criminal justice systems supports the link between FASD and criminality (Fast et al., 1999; MacPherson & Chudley, 2007; Murphy et al., 2005; Streissguth et al., 1996, 2004). In a sample of 253 adolescents and adults (12 to 51 years of age) with FASD, 60% reported having ever been in trouble with the law in their lifetime, and 35% having ever been incarcerated for a crime (Streissguth et al., 1996, 2004). The authors of the current module recently estimated, using all available epidemiological data on the prevalence of incarceration among youth with FASD and youth without FASD in the general population of Canada, that youth with FASD are 19 times more likely to be incarcerated than youth without FASD, on any given day in a specific year (Lange, Rehm, Bekmuradov et al., 2012; Popova, Lange, Bekmuradov et al., 2011).

Only a few studies in Canada and the US have attempted to estimate the overall cost associated with FASD, while no studies exist for any other country (Popova, Stade et al., 2011; Popova, Stade, Lange, Bekmuradov et al., 2012).

In the existing analyses (Abel & Sokol, 1987, 1991a,b; Harwood, 2000, 2003; Harwood et al., 1984, 1998; Harwood & Napolitano, 1985; Rice et al., 1990, 1991; Rice, 1993; Weeks, 1989), the cost of law enforcement associated with individuals with FASD has not been included. For this reason, the total cost associated with FASD in the existing studies is likely an underestimation (Fast & Conry, 2009; Lupton et al., 2004).

The primary reason for not including the cost of law enforcement associated with individuals with FASD in previous Canadian studies is that neither Statistics Canada nor any other organization has any official FASD-specific data collected or reported in Canada on the prevalence of FASD in the criminal justice system or the associated law enforcement cost. A further challenge is that there are no widely used or standardized screening and diagnostic tools to identify the number of individuals with FASD within the justice system.

There is also the added difficulty of assessing adults for FASD (Boland et al., 2002; Fast & Conry, 2004). However, there are a few quick and easy-to-administer screening tools that have been developed and validated in this population, including the FASD checklist (Burd et al., 2010) and the Asante Centre for Fetal Alcohol Syndrome Probation Officer Screening & Referral Form (Asante Centre for Fetal Alcohol Syndrome, 2010).

METHODS

Estimated number of youth and adults with FASD and FAS in custody of the criminal justice system in Canada in 2011/12

To estimate the number of youth and adults with FASD and FAS in custody in Canada in 2011/12, the prevalence of youth and adults with FASD and FAS in criminal justice systems, obtained from the available Canadian literature (Popova, Lange, Bekmuradov et al., 2011; Table 19), was applied to the average number of youth and adults in custody in 2011/12 (Statistics Canada, 2013a,b,c).

The number of adults with FASD and FAS was then estimated separately for provincial and territorial custody (by province and territory) and federal custody. However, given that youth offenders do not get admitted to federal custody, the number of youth with FASD and FAS was estimated for provincial and territorial custody only.

Estimated number of youth and adults with FASD and FAS in custody by province and territory

The number of youth and adults with FASD and FAS by province and territory was estimated based on the overall distribution of offenders in provincial and territorial correctional services in 2011/12 (Statistics Canada, 2013a,c).

Estimated number of youth and adults with FASD and FAS in custody by sex

To estimate the number of youth and adults with FASD and FAS in custody by sex, a male-to-female ratio of 78% to 22% among youth and 89% to 11% among adults admitted to the correctional system in Canada in 2010/11 (Canadian Centre for Justice Statistics, 2012a,b) was applied to the number of youth and adults with FASD and FAS in custody, respectively.

Table 19.
FASD and FAS prevalence estimates in the Canadian correctional system from the available literature

Reference	Country	Year of study	Total population of offenders/sample size; type of institution	Method	Number of FAS cases	FAS prevalence per 1,000	Number of FASD cases	FASD prevalence per 1,000
Fast et al., 1999	Canada (British Columbia & Yukon)	1995–96	287 youth (12–18 years of age); IAU of Youth Forensic Psychiatric Services	Inpatient assessment	3 (1.0%)	10.45	64 (22.3%) (52 pFAS & 12 ARND)	233.5
Burd et al., 2003	Canada (National)	2001–02	148,797; inclusive of all major correctional facilities	Survey	Actual (based on survey): 13	0.087		
					Estimated (based on existing prevalence estimates in general population): 49 & 417	0.33 (Abel, 1998) & 2.8 (Sampson et al., 1997)	1,354 (FAS & ARND)	9.1 (Sampson et al., 1997)
Murphy et al., 2005	Canada (British Columbia)	2004	137 youth (14–19 years of age); juvenile detention centres	Survey			16 (11.7%) (FAS/FAE)	116.8
MacPherson & Chudley, 2007	Canada (Manitoba)	2005–06	91 Adult male offenders (19–30 years of age); male-only medium-security penitentiary for adults	Interview/ assessment			9 (9.9%) (1 pFAS & 8 ARND)	98.9
Rojas & Gretton, 2007	Canada (British Columbia)	1985–2004	230 youth (12–18 years of age); Youth Sexual Offence Treatment Program	Client files reviewed			25 (10.9%) (FAS/FAE)	108.7

ARND: Alcohol-related neurodevelopmental disorder; FAE: Fetal alcohol effects; FAS: Fetal alcohol syndrome; FASD: Fetal alcohol spectrum disorder; IAU: Inpatient assessment unit; pFAS: Partial fetal alcohol syndrome
Source: Popova et al. (2011a)

Cost of corrections

The Canadian Centre for Justice Statistics (2012a) reports that the average daily cost of imprisoning an inmate in 2010/11 was $171 and $357 for provincial and territorial custody (excluding data from Yukon and Nunavut) and federal custody, respectively. Federal costs are higher than provincial and territorial costs due to the higher levels of security required at these institutions, as well as longer-term specialized programming that is offered (Johnson, 2004).

Because 2011/12 cost data were not available, the 2010/11 cost figures were adjusted for inflation using the Bank of Canada's inflation calculator (www.bankofcanada.ca/rates/related/inflation-calculator/). Based on inflation rates, the cost to imprison a provincial or territorial inmate was estimated to be $172 per day (about $62,930 per year), and the cost to imprison a federal inmate was estimated to be $360 per day (about $131,382 per year). The youth and adults were assumed to be in custody for one year.

RESULTS

Number of individuals in custody

According to Statistics Canada, on average 39,087 adults (18+ years of age; 24,822 in provincial and territorial custody and 14,266 in federal custody; Statistics Canada, 2013a,b) and 1,457 youth (12 to 17 years of age; Statistics Canada, 2013c) were in custody on any given day in 2011/12. However, Quebec data on the average number of youth in custody was unavailable for 2011/2012. Therefore, for the purposes of the current module, 2010/11 data were added and 219 persons were added to the average number of youth in custody in 2011/12, resulting in 1,676 youth in custody. In total, then, there were 40,763 youth and adults in custody on any given day in Canada in 2011/12.

Estimated number of youth with FASD and FAS in custody

By applying a prevalence of 10.9% (the lower reported estimate; Rojas & Gretton, 2007) and 22.3% (the upper reported estimate; Fast et al., 1999) for FASD among youth in custody to the total number of youth in custody (1,676; Statistics Canada, 2013c), it was estimated that the number of youth with FASD in custody in Canada in 2011/12 ranged from 183 to 374 (a midpoint of 278 youth; 16.6%; Table 20).

By applying a prevalence of 1.0% for FAS among youth in custody (Fast et al., 1999) to the total number of youth in custody (1,676), it was estimated that there were 17 youth with FAS in custody in Canada on any given day in 2011/12 (data are not shown in Table 20).

Estimated number of adults with FASD and FAS in custody

By applying a prevalence of 9.9% for FASD among adults in custody (MacPherson & Chudley, 2007) to the total number of adults in custody (39,087; Statistics Canada, 2013a,b), it was estimated that there were 3,870 adults with FASD in custody on any given day in Canada in 2011/12 (Table 21).

There are currently no studies that have estimated the prevalence of adults with FAS in custody in Canada. Therefore, the ratio of 278 to 17 (FASD to FAS) among youth offenders was used to calculate the number of adult offenders with FAS in custody. As such, it was estimated that there were 237 adults with FAS in custody in Canada on any given day in 2011/12 (data are not shown in Table 21).

Cost of corrections among youth with FASD and FAS in Canada in 2011/12

The estimated cost of corrections among youth with FASD in Canada in 2011/12 was approximately $17.5 million (approximately $13.6 million for males and $3.8 million for females; Table 20). The total cost of corrections among youth with FAS was estimated to be approximately $1.1 million (approximately $818,000 for males and $251,000 for females).

The cost of corrections among youth with FASD in Ontario accounted for the highest proportion of the total cost of corrections among youth with FASD—approximately $6 million for FASD and $366,000 for FAS—while the Yukon accounted for the lowest proportion: approximately $24,000 for FASD and $1,500 for FAS.

Cost of corrections among adults with FASD and FAS

The total estimated cost of corrections among adults with FASD in Canada in 2011/12 was $356.2 million (approximately $140 million for provincial and territorial custody and $216.2 million for federal custody; Table 21). The total cost of corrections among adults with FAS was estimated to be $21.8 million (approximately $8.6 million for provincial and territorial custody and $13.2 million for federal custody).

Males affected by FASD accounted for more than $317 million ($124.6 million in provincial and territorial custody and $192.4 million in federal custody), while females affected by FASD accounted for more than $39.2 million ($15.4 million in provincial and territorial custody and $23.8 million in federal custody; Table 21). Males affected by FAS accounted for more than $19.4 million ($7.6 million in provincial and territorial custody and $11.8 million in federal custody), while females affected by FAS accounted for more than $2.4 million ($941,000 in provincial and territorial custody and $1.5 million in federal custody).

Again, the cost of corrections among adults with FASD and FAS in Ontario accounted for the highest proportion of the total cost of provincial and territorial corrections among adults with FASD and FAS—approximately $49.6 million for FASD and $3 million for FAS—while the Yukon accounted for the lowest proportion: approximately $530,000 for FASD and about $32,000 for FAS.

Cost of corrections among individuals (youth and adults) with FASD and FAS

Overall, the cost of corrections for youth and adults with FASD in Canada in 2011/12 was estimated to be $373.7 million ($330.7 million for males and $43 million for females; $157.5 million for provincial and territorial custody, and $216.2 million for federal custody). This includes the cost of corrections for youth and adults with FAS, which was estimated to be $22.8 million ($20.2 million for males and $2.6 million for females; $9.6 million for provincial and territorial custody, and $13.2 million for federal custody).

Table 20.
Estimated average number of youth offenders with FASD and the associated cost of corrections in provincial and territorial custody in Canada in 2011/12

Jurisdiction	Average number of youth offenders on any given day[a]	Average number of youth offenders with FASD on any given day[b]			Cost of corrections among youth offenders with FASD[d]		
		Male[c]	Female[c]	Total	Male	Female	Total
Alberta	163	21	6	27	$1,324,679	$373,627	$1,698,306
British Columbia	101	13	4	17	$820,699	$231,479	$1,052,178
Manitoba	295	38	11	49	$2,402,660	$677,673	$3,080,333
New Brunswick	43	6	2	7	$351,728	$99,205	$450,933
Newfoundland and Labrador	20	3	1	3	$161,209	$45,469	$206,678
Northwest Territories	7	1	0	1	$57,807	$16,305	$74,112
Nova Scotia	43	6	2	7	$346,843	$97,827	$444,670
Nunavut	7	1	0	1	$58,621	$16,534	$75,156
Ontario	574	74	21	95	$4,673,422	$1,318,145	$5,991,567
Prince Edward Island	10	1	0	2	$80,604	$22,735	$103,339
Saskatchewan	192	25	7	32	$1,562,421	$440,683	$2,003,104
Quebec[e]	219	28	8	36	$1,783,065	$502,916	$2,285,981
Yukon	2	0	0	0	$18,726	$5,282	$24,008
Total Canada (provincial and territorial)	**1,676**	**217**	**61**	**278**	**$13,645,741**	**$3,848,799**	**$17,494,540**

FASD: Fetal alcohol spectrum disorder

a Counts are based upon the average number of youth in correctional services on any given day (Statistics Canada, 2012c)

b Based on a prevalence of 16.6% (midpoint)

c Based on a male prevalence of 78% and a female prevalence of 22% among youth in custody

d Based on a cost of $62,930 per year for provincial and territorial custody

e Quebec data on average number of youth offenders were unavailable for 2011/2012, therefore, they were substituted with 2010/2011 data

Note. Due to rounding errors, columns and rows may not add up to the totals reported.

Table 21.
Estimated average number of adult offenders with FASD and the associated cost of corrections in provincial and territorial and federal custody in Canada in 2011/12

Jurisdiction	Average number of adult ffenders on any given day[a]	Average number of adult offenders with FASD on any given day[b]			Cost of corrections among adult offenders with FASD[d]		
		Male[c]	Female[c]	Total	Male	Female	Total
Alberta	3,071	245	30	275	$15,410,688	$1,904,692	$17,315,380
British Columbia	2,634	210	26	236	$13,220,489	$1,633,993	$14,854,483
Manitoba	2,252	180	22	202	$11,304,316	$1,397,163	$12,701,479
New Brunswick	422	34	4	38	$2,116,924	$261,642	$2,378,567
Newfoundland and Labrador	283	23	3	25	$1,420,317	$175,545	$1,595,862
Northwest Territories	273	22	3	24	$1,370,129	$169,342	$1,539,471
Nova Scotia	503	40	5	45	$2,525,956	$312,197	$2,838,152
Nunavut	116	9	1	10	$582,681	$72,017	$654,698
Ontario	8,804	702	87	789	$44,183,898	$5,460,931	$49,644,829
Prince Edward Island	110	9	1	10	$553,070	$68,357	$621,427
Saskatchewan	1,588	127	16	142	$7,970,336	$985,098	$8,955,434
Quebec	4,671	373	46	419	$23,444,261	$2,897,605	$26,341,866
Yukon	94	7	1	8	$471,766	$58,308	$530,074
Total provincial and territorial	**24,822**	**1,980**	**245**	**2,224**	**$124,573,828**	**$15,396,765**	**$139,970,594**
Federal	**14,266**	**1,465**	**181**	**1,646**	**$192,440,225**	**$23,784,747**	**$216,224,972**
Total Canada	**39,087**	**3,444**	**426**	**3,870**	**$317,014,054**	**$39,181,512**	**$356,195,566**

FASD: Fetal alcohol spectrum disorder
a Counts are based upon the average number of adults in correctional services on any given day (Statistics Canada, 2012a,b)
b Based on a prevalence of 9.9% (MacPherson & Chudley, 2007)
c Based on a male prevalence of 89% and a female prevalence of 11% among adults in custody
d Based on a cost of $62,930 per year for provincial and territorial custody, and $131,382 per year for federal custody
Note. Due to rounding errors, columns and rows may not add up to the totals reporte

DISCUSSION

As stated above, the cost of law enforcement is commonly neglected in FASD cost studies, though the current module clearly demonstrates that the cost of corrections associated with individuals with FASD is substantial. However, the cost of corrections is only one facet of the total direct cost of law enforcement associated with individuals with FASD. To fully understand the burden that FASD has on the Canadian criminal justice system, the costs of policing, courts and probation must also be considered.

A portion of these costs could be avoided if standardized screening and diagnostic tools to identify individuals with FASD were standard practice within the criminal justice system. The quantification of the law enforcement costs associated with FASD is crucial to demonstrate to both policy developers and decision-makers the impact that maternal alcohol use has on society, with the ultimate goal of initiating preventive interventions to address FASD.

Estimates of the social costs of corrections associated with crime committed by individuals with FASD are likely underestimated. The main reason for this is that in general, a large portion of crime is not reported to police. To attest to this, the 2009 General Social Survey revealed that the type of crime, the victim's age, the location at which the incident took place, and the value of the damaged or stolen goods all influence the rate at which crimes were reported to police. The most common reasons given for not reporting a crime were that it was seen as not important enough (68%), that it was thought that the police could not do anything about it (59%), that it was addressed in another way (42%) and that it was considered a personal matter (36%; Statistics Canada, 2011)d.

3. Other Direct Costs

3.1 Children in Care

Children[2] and youth in care represent a unique population with disproportionately higher rates of developmental disabilities, congenital malformations, mental health diagnoses and social maladjustment (Chernoff et al., 1994; Fuchs et al., 2008; Harman et al., 2000; Hostetter et al., 1991; Lindblad et al., 2003).

Children are often placed in care due to a number of unfavourable circumstances, such as parental alcohol and/or other drug problems, abuse and/or neglect, abandonment and young maternal age. These circumstances are likely to increase the likelihood of a child being exposed to alcohol in utero (Burd, Cohen et al., 2011; Herrick et al., 2011).

The prevalence of FASD among children in care[3] has been reported to be much higher than among the general population. For example, in Manitoba, of the 1,869 children in care identified as having a disability, 640 (34%) had FASD and an additional 280 (15%) were suspected to have FASD (Fuchs et al., 2005). Based on a total of 5,664 children in care in Manitoba at this time, the prevalence of FASD within this population can be estimated to be 113 per 1,000, which is approximately 13 times higher than the estimated prevalence of FASD among the general population.

A recent analysis, conducted by the authors of this paper, revealed an alarming prevalence of FASD among children in care in different countries (Lange, Rehm, Shield et al., 2012; Lange et al., 2013). For example, in Chile, the prevalence of FAS and FASD among children (1 to 20+ years of age) in the care of child welfare ("protective") services and homes for children with mental deficiencies were reported as 62 per 1,000 and 158 per 1,000, respectively (Mena et al., 1993). In the US, the prevalence of FAS among children (up to 13 years of age) living in foster care was found to be 10 to 15 per 1,000 (Astley et al., 2002). The prevalence of FAS in foster homes and orphanages in Russia was reported to be extremely high—150 per 1,000 (Bubnov et al., 2010)—and in orphanages for children with special needs, the prevalence was even higher—ranging from 427 to 680 per 1,000 (Legon'kova, 2011). In Brazil, the prevalence of FASD among children residing in orphanages was reported as 277 per 1,000 (Strömland et al., 2011).

The severity of FASD and its associated disabilities are a significant and direct predictor of removing children birth homes and placing them in foster care. Kvigne and colleagues (2004) reported that among [3]their sample of

2. The broad term "children" will be used throughout to refer to children and youth.

3. The term "children in care" will be used to refer to all children in out-of-home care (i.e., those in the custody of a child welfare agency, crown wards [foster children who have been made the legal responsibility of the Canadian government], and those in foster care).

Northern Plains American Indian children, the children with FAS were 64 times more likely to be removed from their homes, and children with pFAS were 14 times more likely to be removed from their homes, than children without FAS or pFAS. Further, children with FAS were 28 times more likely to be placed in foster care and 14 times more likely to be living with relatives other than their parents. In addition, children with pFAS were five times more likely to be placed in foster care and twice as likely to be living with relatives other than their parents, when compared with children without FAS or pFAS.

In the existing FASD cost analyses (Abel & Sokol, 1987, 1991a,b; Harwood, 2000, 2003; Harwood et al., 1984, 1998; Harwood & Napolitano, 1985; Rice et al., 1990, 1991; Rice, 1993; Weeks, 1989), the cost of children in care with FASD was not included in the overall estimates. In these studies, the total cost associated with FASD might be underestimated, given that children with FASD are overrepresented in child care systems (Farris-Manning & Zandstra, 2003; Hutson, 2006; Lange et al., 2013).

In Canada, only two studies have estimated the cost of children in care with FASD. Fuchs and colleagues (2008) estimated that in 2006, the total annual cost of 400 children in care with FASD in Manitoba was $9.5 million. The authors found that the average total daily cost of caring for a child with FASD in the child welfare system was $65 (or $23,760 per annum). However, a study by Stade and colleagues (2009) estimated that the average annual direct cost per child with FASD in foster care in Canada is about $2,000. The noticeable disparity between the costs reported by the two studies is likely due to the utilization of different methodologies and the inclusion and exclusion of different cost components.

Until now, an estimation of the number of children in care with FASD and the associated cost, at the national level, has not been undertaken in Canada or in any other country.

The current module was designed to: 1) estimate the number of children in care with FASD by age group, sex and province and territory, and 2) estimate the associated cost of children in care with FASD in Canada in 2011.

An estimation of the cost of FASD for the Canadian child welfare system is central to describing the extent of its impact on this population and the cost to society, and to evaluating the potential benefits of FASD prevention programs. The current economic estimate also has the potential to provide additional policy insights to better address the needs of this unique population and to increase awareness of the problem not only in Canada, but also internationally.

METHODS

The total number and prevalence of children in care in Canada

The latest estimates of the total number of children (0 to 18 years of age) in care and the prevalence estimates of children (0 to 18 years of age) in care per 1,000 among the general population in Canada, by province and territory in 2007, were obtained from the Canadian Child Welfare Research Portal (www.cecw-cepb.ca/statistics; CRCF, 2011; Table 22). The methodology for deriving a national estimate of children in care by province and territory is described in a report by Mulcahy and Trocmé (2010). This study used multiple

ascertainment strategies to compile available statistics presented in federal, provincial and territorial documents and websites, including: 1) placement statistics compiled by Human Resources and Social Development Canada for the federal/provincial/territorial directors of the Child Welfare Committee for the years 1992 to 2004 and Social Security statistics on the number of children in out-of-home care from 1971 to 2003; 2) information from Indian and Northern Affairs Canada tracking on-reserve Aboriginal children in out-of-home care from 1969 to 2007; 3) statistics reported by provincial and territorial authorities in their annual reports and/or their websites; and 4) statistics reported by provincial and territorial associations (e.g., provincial and territorial Children's Aid Societies), or through provincial and territorial reviews or reports. The national estimates of children in care by province and territory were calculated using Statistics Canada population estimates for the year 2007 for children 0 to 18 years of age (Mulcahy & Trocmé, 2010).

The cost of caring for children in care with FASD in Canada

The cost of care per day, by age group and sex, for children in care was obtained from Fuchs et al. (2008). These cost figures were for 2006, but in the current module, the figures are reported as inflation adjusted costs for 2011, using the Bank of Canada's inflation calculator (www.bankofcanada.ca/rates/related/inflation-calculator/; see Table 23).

The total cost of care per day included basic maintenance, special rate/special needs and exceptional circumstances. Basic maintenance refers to the funds required for the everyday costs of providing for children in care (e.g., food, utilities, childcare, replacement clothing); special rate/special needs funds are those that cover costs that exceed or were not intended to be covered by basic maintenance (e.g., fees for service, therapy, medical expenses); and exceptional circumstances are funds that cover expenses that are above and beyond those required for normal care (e.g., support services, criminal legal fees, renovations required to the foster home for a disabled child).

Data analysis

Estimated number of children in care with FASD, by age group, sex, and province and territory. To calculate the total number of children in care for each province and territory, the respective prevalence estimates of children in care, obtained from the Canadian Child Welfare Research Portal (CRCF, 2011), were applied to the number of children in the general population for each province and territory in Canada in 2011 (obtained from Statistics Canada 2012a).

Only two estimates exist on the prevalence of children in care with FASD for Canada. The first estimate is 33 per 1,000 (reported for the province of Ontario; Burge 2007) and the second estimate is 113 per 1,000 (reported for the province of Manitoba; Fuchs et al., 2005). To estimate the total number of children in care with FASD for each province and territory, these prevalence estimates were applied (as the lower and upper estimates, respectively) to the total number of children in care for each province and territory.

The age and sex distribution of children in care with FASD was obtained from Fuchs et al. (2008; Table 23) and was applied to the total estimated number of children in care for each province and territory.

Estimated cost associated with caring for children in care with FASD by age group, sex, and province and territory. The estimated cost figures for children in care with FASD for each age group, sex and province and territory are reported in 2011 Canadian dollars. The cost per day (adjusted for inflation for 2011) for each age group was multiplied by 365 (number of days in the year), and applied to the estimated number of children in care with FASD.

RESULTS

The total number and prevalence of children in care in Canada

The highest prevalence of children in care in 2011 was in the Northwest Territories (30.8 per 1,000; 1 out of every 32 children in the territory), followed by the Yukon Territory (24.7 per 1,000; 1 out of every 41 children) and Manitoba (24.4 per 1,000; 1 out of every 41 children), as reported by the Canadian Child Welfare Research Portal (www.cecw-cepb.ca/statistics; CRCF, 2011; Table 22). The province with the lowest prevalence of children in care was Prince Edward Island (5.2 per 1,000; 1 out of every 192 children in the province), followed by Ontario (6.4 per 1,000; 1 out of every 156 children) and Newfoundland (7.5 per 1,000; 1 out of every 133 children). However, due to differences in base population sizes, Ontario had the largest number of children in care (18,546), followed by Quebec (12,674) and Alberta (9,377). In 2011, the total number of children in care in Canada was estimated to be 67,433.

The number of children in care with FASD, by age group, sex, and province and territory. The three provinces with the highest number of children in care with FASD were Ontario (612 [lower estimate] to 2,096 [upper estimate]), Quebec (418 to 1,432) and Alberta (309 to 1,060). Overall, the total number of children in care with FASD in Canada, in 2011, ranged from 2,225 to 7,620.

The estimated number of children in care (0 to 18 years of age) with FASD and FAS by age group, sex, and province and territory and the associated cost in Canada in 2011 are presented in Table 24.

The cost of caring for children in care with FASD by age group, sex, and province and territory. In Canada in 2011, the overall cost attributable to FASD among children in care ranged from $57.9 million to $198.3 million (boys $36.0 million to $123.4 million; girls $21.9 million to $75.0 million), and for FAS ranged from $6.5 million to $22.1 million (boys $4.0 million to $13.8 million; girls $2.5 million to $8.4 million; Table 24). These FASD-associated costs include FAS-associated costs.

The age group associated with the highest overall cost was 11 to 15 years of age, followed by children 6 to 10 years of age. The 0 to 5 years age group was associated with the lowest overall cost. See Figure 14 for the FASD-attributable cost of children in care with FASD by sex and age group in Canada in 2011.

Table 22.
The number of children (0–18) in the general population and in care, as well as the prevalence of children in care per 1,000, by province and territory in Canada in 2007

Jurisdiction	Number of children in the general population	Number of children in care	Prevalence of children in care in the general population per 1,000[a]
Alberta	841,392	8,891	10.6
British Columbia	915,168	9,271	10.1
Manitoba	297,004	7,241	24.4
New Brunswick	154,395	1,388	9.0
Newfoundland and Labrador	102,857	768	7.5
Northwest Territories	12,810	395	30.8
Nova Scotia	194,389	1,706	8.8
Nunavut[b]	12,839	197	15.3
Ontario	2,931,745	18,763	6.4
Prince Edward Island[c]	31,713	166	5.2
Quebec	1,625,581	12,750	7.8
Saskatchewan	251,271	5,447	21.7
Yukon	7,212	178	24.7
Canada	**7,378,376**	**67,161**	**n/a**

n/a: not available
a Source: CRCF, (2011)
b Nunavut data are from 2006 because no data on children in care were available for 2007.
c Prince Edward Island data are a monthly count.

Table 23.
The age, sex distribution and cost of care per day for children with FASD in Canada in 2006 and 2011

Age distribution				Cost of care	
Age group (years)	Boys[a]	Girls[a]	Overall[a]	Average cost per day for children in care with FASD in 2006[a]	Inflation-adjusted average cost per day for children in care with FASD in 2011[b]
0–5	2.8%	2.3%	5.0%	$49.0	$53.7
6–10	19.8%	10.5%	30.3%	$57.0	$62.4
11–15	29.3%	17.5%	46.8%	$71.0	$77.7
16–18	10.5%	7.5%	18.0%	$68.0	$74.5

FASD: Fetal alcohol spectrum disorder
a Data from Fuchs et al. (2008)
b Adjusted for inflation, from 2006 to 2011, using the Bank of Canada inflation calculator (http://www.bankofcanada.ca/rates/related/inflation-calculator/

Table 24.
The number of children (0–18) in care with FAS and FASD[a] and the associated cost by age group, sex, and province and territory in Canada in 2011

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Alberta			**10.6**									
Boys	0 to 5				1	3	9	29	$18,684	$63,627	$166,642	$570,622
	6 to 10				7	23	61	209	$156,096	$531,569	$1,392,204	$4,767,245
	11 to 15				10	35	91	310	$287,965	$980,638	$2,568,338	$8,794,610
	16 to 18				4	12	32	111	$98,997	$337,126	$882,949	$3,023,432
Total for boys					**22**	**74**	**193**	**660**	**$561,742**	**$1,912,960**	**$5,010,133**	**$17,155,910**
Girls	0 to 5				1	3	7	24	$15,287	$52,058	$136,343	$466,873
	6 to 10				4	12	32	111	$82,988	$282,606	$740,159	$2,534,485
	11 to 15				6	21	54	185	$172,287	$586,706	$1,536,612	$5,261,733
	16 to 18				3	9	23	79	$70,712	$240,804	$630,678	$2,159,594
Total for girls					**13**	**45**	**117**	**400**	**$341,274**	**$1,162,175**	**$3,043,793**	**$10,422,684**
Total		**884,645**		**9,377**	**35**	**118**	**309**	**1,060**	**$903,016**	**$3,075,135**	**$8,053,926**	**$27,578,594**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
British Columbia			**10.1**									
Boys	0 to 5				1	3	8	28	$18,204	$61,991	$162,357	$555,951
	6 to 10				7	23	60	204	$152,082	$517,902	$1,356,409	$4,644,673
	11 to 15				10	34	88	302	$280,561	$955,425	$2,502,302	$8,568,490
	16 to 18				4	12	32	108	$96,452	$328,458	$860,247	$2,945,696
Total for boys					**21**	**72**	**188**	**643**	**$547,299**	**$1,863,775**	**$4,881,316**	**$16,714,810**
Girls	0 to 5				1	3	7	23	$14,894	$50,720	$132,838	$454,869
	6 to 10				4	12	32	108	$80,854	$275,340	$721,129	$2,469,320
	11 to 15				6	20	53	181	$167,857	$571,622	$1,497,104	$5,126,447
	16 to 18				3	9	23	77	$68,894	$234,613	$614,462	$2,104,068
Total for girls					**13**	**43**	**114**	**390**	**$332,499**	**$1,132,294**	**$2,965,533**	**$10,154,704**
Total		**904,568**		**9,136**	**34**	**115**	**301**	**1,032**	**$879,798**	**$2,996,070**	**$7,846,849**	**$26,869,515**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Manitoba			**24.4**									
Boys	0 to 5				1	3	7	23	$14,831	$50,504	$132,274	$452,937
	6 to 10				5	19	49	166	$123,902	$421,938	$1,105,075	$3,784,045
	11 to 15				8	27	72	246	$228,575	$778,390	$2,038,642	$6,980,804
	16 to 18				3	10	26	88	$78,580	$267,597	$700,849	$2,399,877
Total for boys					**17**	**58**	**153**	**524**	**$445,888**	**$1,518,430**	**$3,976,839**	**$13,617,662**
Girls	0 to 5				1	2	6	19	$12,134	$41,322	$108,224	$370,585
	6 to 10				3	10	26	88	$65,872	$224,321	$587,508	$2,011,771
	11 to 15				5	16	43	147	$136,754	$465,704	$1,219,700	$4,176,549
	16 to 18				2	7	18	63	$56,129	$191,141	$500,606	$1,714,198
Total for girls					**10**	**35**	**93**	**318**	**$270,889**	**$922,488**	**$2,416,039**	**$8,273,102**
Total		**305,052**		**7,443**	**28**	**94**	**246**	**841**	**$716,777**	**$2,440,917**	**$6,392,878**	**$21,890,765**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
New Brunswick			**9.0**									
Boys	0 to 5				0	0	1	4	$2,686	$9,148	$23,959	$82,042
	6 to 10				1	3	9	30	$22,443	$76,427	$200,166	$685,418
	11 to 15				1	5	13	45	$41,403	$140,993	$369,267	$1,264,459
	16 to 18				1	2	5	16	$14,233	$48,471	$126,947	$434,699
Total for boys					**3**	**11**	**28**	**95**	**$80,765**	**$275,039**	**$720,340**	**$2,466,618**
Girls	0 to 5				0	0	1	3	$2,198	$7,485	$19,603	$67,125
	6 to 10				1	2	5	16	$11,932	$40,632	$106,418	$364,400
	11 to 15				1	3	8	27	$24,771	$84,355	$220,929	$756,514
	16 to 18				0	1	3	11	$10,167	$34,622	$90,677	$310,499
Total for girls					**2**	**6**	**17**	**58**	**$49,067**	**$167,094**	**$437,626**	**$1,498,538**
Total		**149,803**		**1,348**	**5**	**17**	**44**	**152**	**$129,833**	**$442,132**	**$1,157,966**	**$3,965,156**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Newfoundland and Labrador			**7.5**									
Boys	0 to 5				0	0	1	2	$1,475	$5,024	$13,159	$45,060
	6 to 10				1	2	5	17	$12,326	$41,976	$109,938	$376,454
	11 to 15				1	3	7	24	$22,740	$77,438	$202,813	$694,482
	16 to 18				0	1	3	9	$7,817	$26,622	$69,724	$238,751
Total for boys					**2**	**6**	**15**	**52**	**$44,359**	**$151,060**	**$395,634**	**$1,354,747**
Girls	0 to 5				0	0	1	2	$1,207	$4,111	$10,767	$36,867
	6 to 10				0	1	3	9	$6,553	$22,317	$58,448	$200,140
	11 to 15				0	2	4	15	$13,605	$46,330	$121,341	$415,502
	16 to 18				0	1	2	6	$5,584	$19,016	$49,803	$170,536
Total for girls					**1**	**4**	**9**	**32**	**$26,949**	**$91,773**	**$240,358**	**$823,046**
Total		**98,732**		**740**	**3**	**9**	**24**	**84**	**$71,308**	**$242,833**	**$635,992**	**$2,177,792**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Northwest Territories			**30.8**									
Boys	0 to 5				0	0	0	1	$740	$2,521	$6,603	$22,609
	6 to 10				0	1	2	8	$6,185	$21,062	$55,161	$188,886
	11 to 15				0	1	4	12	$11,410	$38,854	$101,761	$348,456
	16 to 18				0	0	1	4	$3,922	$13,357	$34,984	$119,793
Total for boys					**1**	**3**	**8**	**26**	**$22,257**	**$75,794**	**$198,509**	**$679,743**
Girls	0 to 5				0	0	0	1	$606	$2,063	$5,402	$18,498
	6 to 10				0	0	1	4	$3,288	$11,197	$29,326	$100,420
	11 to 15				0	1	2	7	$6,826	$23,246	$60,883	$208,478
	16 to 18				0	0	1	3	$2,802	$9,541	$24,988	$85,566
Total for girls					**1**	**2**	**5**	**16**	**$13,522**	**$46,047**	**$120,600**	**$412,963**
Total		**12,063**		**372**	**1**	**5**	**12**	**42**	**$35,779**	**$121,842**	**$319,109**	**$1,092,706**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Nova Scotia			**8.8**									
Boys	0 to 5				0	1	1	5	$3,238	$11,026	$28,878	$98,886
	6 to 10				1	4	11	36	$27,051	$92,119	$241,263	$826,143
	11 to 15				2	6	16	54	$49,903	$169,940	$445,082	$1,524,068
	16 to 18				1	2	6	19	$17,156	$58,422	$153,011	$523,948
Total for boys					**4**	**13**	**33**	**114**	**$97,347**	**$331,508**	**$868,234**	**$2,973,045**
Girls	0 to 5				0	0	1	4	$2,649	$9,021	$23,628	$80,907
	6 to 10				1	2	6	19	$14,381	$48,974	$128,266	$439,215
	11 to 15				1	4	9	32	$29,857	$101,674	$266,288	$911,835
	16 to 18				0	2	4	14	$12,254	$41,730	$109,294	$374,248
Total for girls					**2**	**8**	**20**	**69**	**$59,141**	**$201,400**	**$527,476**	**$1,806,206**
Total		**184,663**		**1,625**	**6**	**20**	**54**	**184**	**$156,489**	**$532,908**	**$1,395,710**	**$4,779,250**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Nunavut			**15.3**									
Boys	0 to 5				0	0	0	1	$399	$1,357	$3,555	$12,172
	6 to 10				0	0	1	4	$3,330	$11,339	$29,698	$101,693
	11 to 15				0	1	2	7	$6,143	$20,919	$54,787	$187,604
	16 to 18				0	0	1	2	$2,112	$7,191	$18,835	$64,495
Total for boys					**0**	**2**	**4**	**14**	**$11,983**	**$40,807**	**$106,875**	**$365,964**
Girls	0 to 5				0	0	0	1	$326	$1,110	$2,908	$9,959
	6 to 10				0	0	1	2	$1,770	$6,028	$15,789	$54,065
	11 to 15				0	0	1	4	$3,675	$12,515	$32,779	$112,242
	16 to 18				0	0	0	2	$1,508	$5,137	$13,453	$46,068
Total for girls					**0**	**1**	**2**	**9**	**$7,280**	**$24,791**	**$64,929**	**$222,333**
Total		**13,074**		**200**	**1**	**3**	**7**	**23**	**$19,263**	**$65,598**	**$171,804**	**$588,298**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Ontario			6.4									
Boys	0 to 5				2	6	17	58	$36,954	$125,842	$329,587	$1,128,587
	6 to 10				14	46	121	414	$308,729	$1,051,347	$2,753,527	$9,428,744
	11 to 15				20	68	179	613	$569,543	$1,939,524	$5,079,705	$17,394,141
	16 to 18				7	25	64	220	$195,799	$666,774	$1,746,313	$5,979,799
Total for boys					**43**	**145**	**381**	**1,305**	**$1,111,024**	**$3,783,487**	**$9,909,132**	**$33,931,271**
Girls	0 to 5				2	5	14	47	$30,235	$102,962	$269,662	$923,389
	6 to 10				7	25	64	220	$164,134	$558,944	$1,463,900	$5,012,750
	11 to 15				12	41	107	367	$340,752	$1,160,399	$3,039,140	$10,406,751
	16 to 18				5	18	46	157	$139,856	$476,267	$1,247,366	$4,271,285
Total for girls					**26**	**88**	**231**	**791**	**$674,977**	**$2,298,572**	**$6,020,069**	**$20,614,175**
Total		**2,897,886**		**18,546**	**69**	**234**	**612**	**2096**	**$1,786,001**	**$6,082,059**	**$15,929,201**	**$54,545,447**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Prince Edward Island			**5.2**									
Boys	0 to 5				0	0	0	1	$325	$1,108	$2,902	$9,936
	6 to 10				0	0	1	4	$2,718	$9,256	$24,241	$83,006
	11 to 15				0	1	2	5	$5,014	$17,075	$44,719	$153,130
	16 to 18				0	0	1	2	$1,724	$5,870	$15,374	$52,643
Total for boys					**0**	**1**	**3**	**11**	**$9,781**	**$33,308**	**$87,236**	**$298,716**
Girls	0 to 5				0	0	0	0	$266	$906	$2,374	$8,129
	6 to 10				0	0	1	2	$1,445	$4,921	$12,888	$44,130
	11 to 15				0	0	1	3	$3,000	$10,216	$26,755	$91,616
	16 to 18				0	0	0	1	$1,231	$4,193	$10,981	$37,602
Total for girls					**0**	**1**	**2**	**7**	**$5,942**	**$20,236**	**$52,998**	**$181,478**
Total		**31,399**		**163**	**1**	**2**	**5**	**18**	**$15,723**	**$53,544**	**$140,234**	**$480,194**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Quebec			7.8									
Boys	0 to 5				1	4	12	39	$25,252	$85,993	$225,220	$771,208
	6 to 10				9	32	83	283	$210,967	$718,427	$1,881,595	$6,443,036
	11 to 15				14	47	122	419	$389,191	$1,325,354	$3,471,165	$11,886,109
	16 to 18				5	17	44	150	$133,797	$455,633	$1,193,325	$4,086,235
Total for boys					**29**	**99**	**260**	**891**	**$759,207**	**$2,585,407**	**$6,771,304**	**$23,186,588**
Girls	0 to 5				1	4	9	32	$20,661	$70,358	$184,271	$630,989
	6 to 10				5	17	44	150	$112,159	$381,949	$1,000,341	$3,425,412
	11 to 15				8	28	73	251	$232,849	$792,947	$2,076,765	$7,111,347
	16 to 18				4	12	31	107	$95,569	$325,452	$852,375	$2,918,739
Total for girls					**18**	**60**	**158**	**541**	**$461,239**	**$1,570,706**	**$4,113,753**	**$14,086,487**
Total		**1,624,813**		**12,674**	**47**	**160**	**418**	**1432**	**$1,220,446**	**$4,156,113**	**$10,885,057**	**$37,273,075**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Saskatchewan			**21.7**									
Boys	0 to 5				1	2	5	17	$11,196	$38,127	$99,856	$341,932
	6 to 10				4	14	37	125	$93,537	$318,530	$834,245	$2,856,658
	11 to 15				6	21	54	186	$172,556	$587,624	$1,539,015	$5,269,960
	16 to 18				2	7	19	67	$59,322	$202,015	$529,086	$1,811,719
Total for boys					**13**	**44**	**115**	**395**	**$336,611**	**$1,146,295**	**$3,002,202**	**$10,280,268**
Girls	0 to 5				0	2	4	14	$9,160	$31,195	$81,700	$279,762
	6 to 10				2	7	19	67	$49,728	$169,345	$443,523	$1,518,729
	11 to 15				4	12	32	111	$103,239	$351,570	$920,778	$3,152,967
	16 to 18				2	5	14	48	$42,373	$144,296	$377,919	$1,294,085
Total for girls					**8**	**27**	**70**	**240**	**$204,500**	**$696,406**	**$1,823,920**	**$6,245,544**
Total		**258,944**		**5,619**	**21**	**71**	**185**	**635**	**$541,111**	**$1,842,701**	**$4,826,122**	**$16,525,812**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
Yukon			**24.7**									
Boys	0 to 5				0	0	0	1	$376	$1,281	$3,356	$11,491
	6 to 10				0	0	1	4	$3,143	$10,704	$28,035	$95,999
	11 to 15				0	1	2	6	$5,799	$19,747	$51,719	$177,099
	16 to 18				0	0	1	2	$1,994	$6,789	$17,780	$60,884
Total for boys					**0**	**1**	**4**	**13**	**$11,312**	**$38,522**	**$100,890**	**$345,472**
Girls	0 to 5				0	0	0	0	$308	$1,048	$2,746	$9,402
	6 to 10				0	0	1	2	$1,671	$5,691	$14,905	$51,037
	11 to 15				0	0	1	4	$3,469	$11,815	$30,943	$105,957
	16 to 18				0	0	0	2	$1,424	$4,849	$12,700	$43,488
Total for girls					**0**	**1**	**2**	**8**	**$6,872**	**$23,403**	**$61,294**	**$209,884**
Total		**7,645**		**189**	**1**	**2**	**6**	**21**	**$18,184**	**$61,925**	**$162,184**	**$555,356**

Jurisdiction; sex	Age group (years)	Number of children in the general population[a]	Prevalence of children in care in the general population[b] (per 1,000)	Number of children in care[c]	Number of children in care with FAS		Number of children in care with FASD		Total cost of children in care with FAS[h]		Total cost of children in care with FASD[h]	
					Lower estimate[d]	Upper estimate[e]	Lower estimate[f]	Upper estimate[g]	Lower estimate	Upper estimate	Lower estimate	Upper estimate
CANADA (all provinces/territories)												
Boys	0 to 5				7	23	61	210	$134,360	$457,551	$1,198,348	$4,103,433
	6 to 10				49	168	439	1,505	$1,122,508	$3,822,595	$10,011,558	$34,282,001
	11 to 15				73	249	651	2,229	$2,070,802	$7,051,920	$18,469,315	$63,243,411
	16 to 18				26	89	234	800	$711,905	$2,424,326	$6,349,425	$21,741,969
Total for boys					**155**	**529**	**1385**	**4,743**	**$4,039,575**	**$13,756,392**	**$36,028,645**	**$123,370,814**
Girls	0 to 5				6	19	50	171	$109,931	$374,360	$980,466	$3,357,354
	6 to 10				26	89	234	800	$596,776	$2,032,266	$5,322,600	$18,225,874
	11 to 15				44	149	389	1,333	$1,238,941	$4,219,098	$11,050,017	$37,837,938
	16 to 18				19	64	167	571	$508,504	$1,731,661	$4,535,303	$15,529,978
Total for girls					**94**	**321**	**840**	**2,877**	**$2,454,153**	**$8,357,384**	**$21,888,387**	**$74,951,144**
Total		**7,373,287**		**67,433**	**250**	**850**	**2,225**	**7,620**	**$6,493,728**	**$22,113,776**	**$57,917,032**	**$198,321,959**

FASD: Fetal alcohol spectrum disorder
a Source: Statistics Canada (2012)
b Source: CRCF (2011)
c Estimated based on the respective provincial and territorial prevalence rates
d Estimated based on a prevalence of 3.7 per 1,000 (assuming that the ratio of FAS:FASD is 1:9, as in the general population, and the prevalence of FASD is 33 per 1,000; Burge, 2007)
e Estimated based on a prevalence of 12.6 per 1,000 (assuming that the ratio of FAS:FASD is 1:9, as in the general population, and the prevalence of FASD is 113 per 1,000; Fuchs et al., 2005)
f Estimated based on prevalence 33 per 1,000; Burge (2007)
g Estimated based on prevalence 113 per 1,000; Fuchs et al. (2005)
h Estimated based on the 2011 inflated cost per day; Fuchs et al. (2008)
Note 1. FASD-associated costs are inclusive of the FAS-associated costs.
Note 2. Due to rounding errors, columns may not add up to the totals reported.

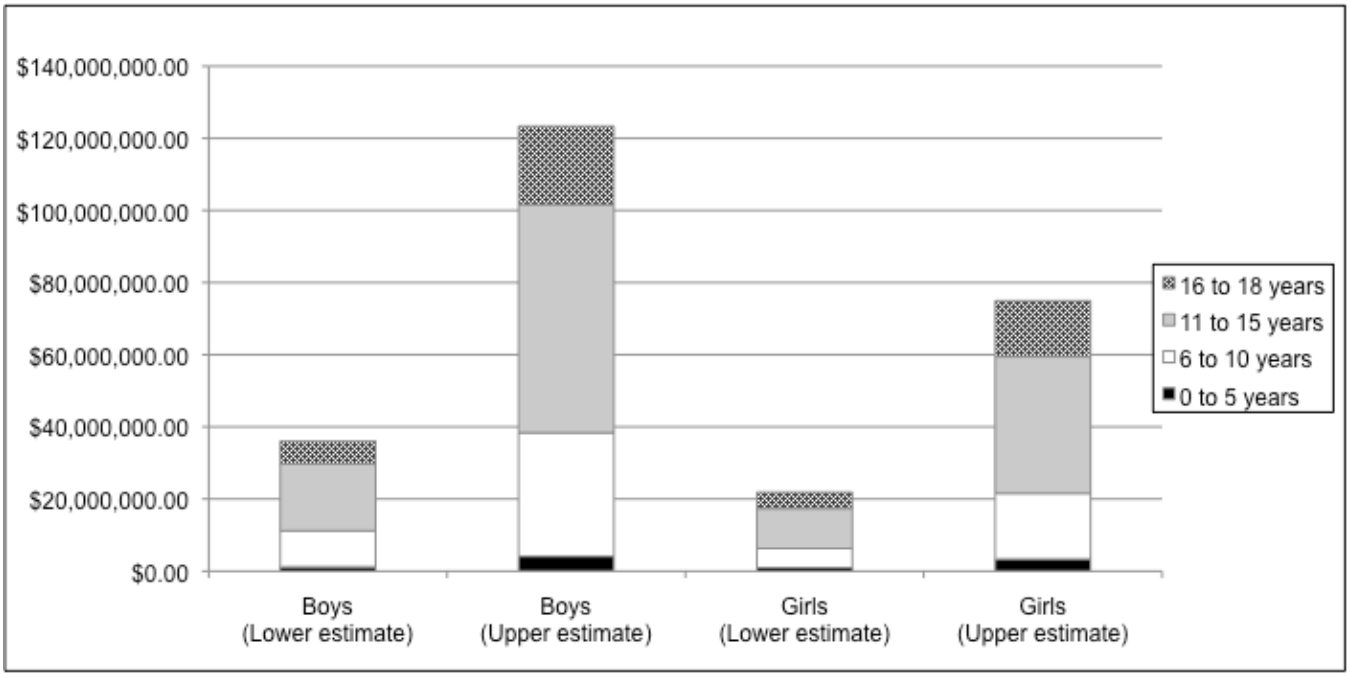

Figure 14. The cost of children in care with FASD by age group and sex in Canada in 2011

DISCUSSION

These results suggest that, in Canada, the annual cost for children in care with FASD is likely to range from $57.9 million to $198.3 million. This is clearly a cost component that should not be overlooked in FASD cost studies, especially when considering the overall burden of FASD on society.

Despite the substantial cost for children in care with FASD, it is likely still underestimated for the following reasons. First, raising children with FASD is a challenging undertaking that many foster parents may not be fully prepared for; caregivers may instead choose to put a child with FASD back into provincial and territorial custody, necessitating another foster family placement, potentially associated with additional costs. Second, fostering children with FASD requires special accommodations, such as training for both staff and foster parents, which is also likely to result in additional costs.

There are several limitations to the current estimates. First, the estimated number of children in care in Canada in 2011 was based on the prevalence estimates reported by the Canadian Child Welfare Research Portal for 2007 (the most recent available year; CRCF, 2011), and was assumed to remain constant during the year, which may not be accurate. Second, the prevalence of FASD among children in care is currently available for only two Canadian provinces—Ontario (Burge, 2007) and Manitoba (Fuchs et al., 2005)—and these figures were used to estimate the prevalence of children in care with FASD in the other provinces and territories. Therefore, possible variations between the provinces and territories were not accounted for. Third, due to a lack of respective provincial and territorial data, the age and sex distribution of children in care with FASD, as well as the costs of care per day, were obtained from a study based on the child welfare system in

Manitoba (Fuchs et al., 2008). These data were applied to the other provinces and territories, but the costs may not be generalizable to them. Finally, the age at which youth are no longer permitted to be in care varies by province and territory (i.e., some provinces and territories may only allow youth up to the age of 16 to be in care, while others may permit youth up to the age of 18 or even 21). These provincial and territorial differences were not considered in the current cost estimate.

Unfortunately, no other national estimates exist on the cost of children in care with any other conditions or disorders. Such data would be useful to put the current estimate into context. However, the average per diem special rate/special needs cost for a child with FASD is approximately 20% higher than that of children in care without FASD ($43 versus $35; Fuchs et al., 2008). There is also documentation that children with FASD enter care at an earlier age and are more likely to become permanent wards, therefore spending more of their lives in care than children in care without FASD (Fuchs et al., 2008). Thus, not only are daily special rate/special needs costs of children with FASD higher, but those costs are also extended over a longer period.

Important public policy findings of this module include: 1) a priority should be made for funding for FASD prevention (e.g., educating women of childbearing age about the detrimental consequences of consuming alcohol while pregnant)—if 10% of the cost of care for children with FASD were instead devoted to prevention, Canada could allocate as much as $20 million each year to this objective; 2) data collection on PAE needs to be improved, especially for at-risk populations—this would facilitate early and accurate diagnostic evaluations; 3) improving access to substance abuse treatment programs for the mothers of children with FASD should be made possible—this could have substantial benefits not only for the mother and her current and future children, but also for society as a whole; and 4) increasing the effectiveness of substance abuse treatment programs for women of childbearing age should be a principal goal—this could provide an important opportunity to prevent the occurrence and/or recurrence of FASD within families. It is well known that FASD is highly recurrent within siblings (Abel, 1988). Taking a long-term perspective toward this issue would suggest that increasing access to and the effectiveness of substance abuse treatment could improve the lives of several thousand children and their families (Gelb & Rutman, 2011; Popova, Lange, Burd, Urbanoski et al., 2013).

It is also important to identify strategies that may be able to prevent affected children from needing to be placed in care. Multiple efforts will be required to address the needs of this unique population and, by increasing awareness, to reduce the overall prevalence and incidence of FASD both in the childcare population and in the general population in Canada and internationally. The development and implementation of programs aimed at reducing or preventing secondary disabilities, if successful, could result in large cost savings.

With the substantial rate at which FASD is occuring among children in care, workers, caregivers and service providers need specialized training to improve FASD recognition and the understanding of the specific needs of children with FASD. In addition, there is a need for more comprehensive service plans that will support

children with FASD and their adoptive families. Based on the high prevalence of FASD reported in child care systems around the world (Lange, Rehm, Shield et al., 2012; Lange et al., 2013), children in care must be routinely screened for FASD and be referred to diagnostic services where, if necessary, a formal diagnosis can be made. Such an approach has the potential to facilitate early diagnosis, which has several noteworthy benefits (Popova, Lange, Burd, Chudley et al., 2013).

The limitations of the current module draw attention to the need for accurate prevalence estimates for children in care with FASD in Canada's provinces and territories. There is also a need for cost analyses to be conducted within provincial and territorial child welfare systems. Such analyses will help in making informed decisions on the programs, policies and funding support for the numerous activities required to improve the lives of children in care with FASD and to prevent further alcohol-exposed births in Canada. Research is also needed to identify the unique medical, educational and social needs of children in care with FASD, and their current patterns of service use (versus service needs).

The burden on society of children in care with FASD is not measurable simply by cost of care, but also by the lifelong hardships faced by these children and their families. A strategy that could change the lives of several thousand of Canada's most vulnerable people surely deserves consideration. Prevention of FASD should be one of Canada's priorities for the future. For many children and their families, the cost of not acting to prevent FASD and to improve the treatment of individuals with FASD may be too great to bear. If we do not act, children in care with FASD will likely not have their needs adequately addressed, and thus will likely experience negative outcomes, such as secondary disabilities, that will affect them well into adulthood, as well as affecting the society in which they live (Bueller et al., 2000; Quinton et al., 1984). The substantial number of children in care with FASD, the high associated cost, and their dependence on the childcare system in general, emphasizes the urgency of strategically addressing their needs.

3.2 Special Education

FASD is associated with learning and behavioural problems, developmental disabilities and speech-language deficits, which increase the need for special education services. Kvigne and colleagues (2004) have reported that among their sample of 78 children with FAS/pFAS, 74% of children with FAS had a developmental delay (as did 40% of children with pFAS), 70% had a speech-language deficit (43%, pFAS), 23% had a learning disability (20%, pFAS), and 14% suffered from developmental disabilities (23%, pFAS). Additionally, Burd, Klug and colleagues (2003) reported that 35% of their sample of children with FASD had a learning disability, and 26% had a developmental delay.

Given the delays and deficits commonly experienced by children with FASD, most of these children require special education services. Special education is the instruction of students with additional needs, executed in a way that caters to the student's individual differences and needs. If such support is not provided, children with FASD are likely to experience learning and literacy problems. For example, Streissguth and colleagues (2004) reported that among their sample of individuals with FASD, 14% of school children and 61% of adolescents and adults had disrupted school experiences. About 53% of the adolescents with FASD had been suspended from school, 29% had been expelled and 25% had dropped out. The most frequently mentioned learning difficulties were attention problems (70%) and repeatedly incomplete schoolwork (58%; Streissguth et al., 2004). Further, Kvigne and colleagues (2004) reported that among their sample of 78 children with FAS/pFAS, 16% of those with FAS and 11.4% of those with pFAS reported school failures.

A recent Canadian study reported that children with FASD were more than 3 times more likely to repeat a grade, and more than 9 times more likely to receive special education funding for special needs, than the general population (Brownell et al., 2013). However, no data are available on the proportion of children with FAS/FASD in Canada requiring and receiving special education, or the associated cost.

The current module was designed to: 1) estimate the number of children with FAS/FASD receiving special education by sex, age group, and province and territory; and 2) estimate the cost associated with special education for children with FAS/FASD in Canada in 2011/12.

METHODS

A short survey was sent to the Minister of Education for each province and territory in January 2012 requesting the following information:

1. number of children with FAS/FASD enrolled in special education classes or programs in the province or territory;

2. number of children with disabilities or special needs enrolled in special education classes or programs in the province or territory; and

3. cost of special education per child per year in the province or territory.

In this module, the estimate was restricted to elementary and middle school children (5 to 14 years of age) due to unavailability of data on the number of children with disabilities receiving special education above 14 years of age.

Estimated total number of children in elementary and middle school

The total number of children in elementary and middle school by sex, age group (5 to 9 and 10 to 14 years of age), and province or territory in Canada in 2011/12 was obtained from Statistics Canada (2012a).

Estimated number of children with disabilities in elementary and middle school

To estimate the number of children with disabilities, the proportion of children with disabilities by sex and age group, obtained from the *Participation and Activity Limitation Survey 2006: A Profile of Education for Children with Disabilities in Canada* (Statistics Canada, 2008a), was applied to the total number of children in each Canadian province and territory in 2011/12.

Estimated number of children with disabilities receiving some form of special education in elementary and middle school

To estimate the number of children with disabilities in Canada receiving some form of special education, the proportion of children with disabilities receiving some form of special education by sex and age group, obtained from the 2006 survey mentioned above (Statistics Canada, 2008a), was applied to the number of children with disabilities in each Canadian province and territory in 2011/12.

Estimated number of children with FAS/FASD receiving some form of special education in elementary and middle school

Two strategies were employed to obtain the number of children with FAS/FASD receiving some form of special education in Canada. First, a comprehensive literature search was conducted on the prevalence of children with FAS/FASD receiving some form of special education in Canada or in any other country. Second, as stated above, a short survey was sent to the Minister of Education for each province and territory.

Estimated cost of special education for children with FAS/FASD in elementary and middle school

Two strategies were used to obtain the average cost of special education per child by province and territory: first, as stated above, a short survey was sent to the Minister of Education for each province and territory, and second, a search of the readily available published reports found on the Ministry of Education website was conducted for each province and territory. Three provinces (Ontario, Manitoba and Nova Scotia) provided the cost of special education per child via the survey, and the cost data for British Columbia and Prince Edward Island was obtained from the respective Ministry of Education websites.

For some provinces, the cost of special education per child was reported by funding levels, which depend on the severity of the disability. In such cases, the lowest cost per child was used to obtain the most conservative estimate.

When cost data were not available for a province or territory, the average overall cost of special education per child (estimated based on the data for British Columbia, Manitoba, Nova Scotia, Ontario and Prince Edward Island) was used.

To estimate the cost of special education for children with FAS/FASD, the average estimated cost of special education per child for each province and territory was applied to the estimated number of children with FAS/FASD receiving some form of special education by sex and age group for each respective province and territory.

Table 25 presents the average cost of special education per child for each province and territory.

Table 25.
The average cost of special education per child in elementary and middle school by province and territory in Canada in 2011/12

Jurisdiction	Average cost of special education per child per year
Alberta	$7,976[a]
British Columbia	$9,200[b]
Manitoba	$9,220[c]
New Brunswick	$7,976[a]
Newfoundland and Labrador	$7,976[a]
Northwest Territories	$7,976[a]
Nova Scotia	$5,564[d]
Nunavut	$7,976[a]
Ontario	$8,208[e]
Prince Edward Island	$7,761[f]
Quebec	$7,976[a]
Saskatchewan	$7,976[a]
Yukon	$7,976[a]

a Based on the average overall cost of special education per child using data from British Columbia, Manitoba, Nova Scotia, Ontario, Prince Edward Island
b Based on level 3 funding (British Columbia Ministry of Education, 2011)
c Based on level 2 funding (Blais, J., Director, Education Program and Student Services Branch, personal communication, August 2012)
d Based on 22,597 students receiving funding and a total grant of $125,734,200 (Jennex, R., Minister of Education, personal communication, August 2012)
e Based on 307,020 students receiving funding (2009/10) and a total grant of $2.52 billion (2012/13; Finlay, B., Director, Special Education Policy and Program Branch, personal communication, July 2012)
f Based on 309 students receiving funding (estimated in the current module) and a total of $2.4 million for special education funding (Prince Edward Island Department of Education and Early Childhood Development, n.d.)

RESULTS

The overall response rate from the Ministers of Education was 61.5% (8 out of 13: Alberta, British Columbia, Manitoba, Newfoundland and Labrador, Northwest Territories, Nova Scotia, Ontario and Quebec). However, some of the above provinces responded that the data were not collected or available. In addition, only one province, Newfoundland and Labrador, provided FASD-specific data.

Total number of children in elementary and middle school

According to Statistics Canada (2012a), there were 3.7 million children between the ages of 5 and 14 years (1.9 million boys and 1.8 million girls) in Canada in 2011/12. There were 1.8 million children 5 to 9 years of age (928,000 boys and 882,000 girls) and 1.9 million children 10 to 14 years of age (987,000 boys and 931,000 girls).

The number of children in elementary and middle school by sex, age group, and province and territory is presented in Table 26.

Number of children with disabilities in elementary and middle school

The *Participation and Activity Limitation Survey 2006* (Statistics Canada, 2008a) revealed that 4.2% of Canadian children between the ages of 5 and 9 years had one or more disabilities (5.3% for boys and 3.0% for girls), and that 4.9% of Canadian children between the ages of 10 and 14 years had one or more disabilities (6.0% for boys and 3.7% for girls).

Using the above proportions, it was estimated that there were 169,300 children with disabilities between the ages of 5 and 14 years (108,400 boys and 60,900 girls) in Canada in 2011/12. There were 75,700 children with disabilities between the ages of 5 to 9 years (49,200 boys and 26,500 girls) and 93,700 children with disabilities between the ages of 10 to 14 years (59,200 boys and 34,500 girls).

The number of children with disabilities by sex, age group, and province and territory is presented in Table 26.

Number of children with disabilities receiving some form of special education in elementary and middle school

In 2006, 43.1% of children with disabilities between the ages of 5 and 14 years were receiving some form of special education (36.2% of children 5 to 9 years of age and 48.1% of children 10 to 14 years of age; Statistics Canada, 2008a).

Based on these proportions, it was estimated that 73,700 children with disabilities between the ages of 5 and 14 years of age were receiving some form of special education (46,300 boys and 26,200 girls) in Canada in 2011/12. There were 27,400 children with disabilities 5 to 9 years of age receiving special education (17,800 boys and 9,600 girls) and 45,100 children with disabilities 10 to 14 years of age receiving special education (28,500 boys and 16,600 girls).

The number of children with disabilities receiving some form of special education by sex, age group, and province and territory is presented in Table 26.

Number of children with FAS/FASD receiving some form of special education in elementary and middle school

The comprehensive literature search for publications reporting on the prevalence of children with FAS/FASD who were receiving some form of special education in Canada or in any other country did not yield any results.

The surveys on the number of children with FAS receiving special education, which were distributed to the Minister of Education for each province and territory yielded data only from Newfoundland and Labrador. The data showed that out of 11,342 students receiving special education support in Newfoundland and Labrador in 2011/12, 117 had FAS (Newfoundland and Labrador, Department of Education, n.d.). Therefore, the prevalence of FAS among children with disabilities who were receiving some form of special education was estimated to be approximately 1% (i.e., 10 per 1,000).

To estimate the number of students with FASD receiving some form of special education, a 1:9 (FAS:FASD) ratio (PHAC, 2003b; Roberts & Nanson, 2000) was applied to the above-mentioned prevalence (i.e., 1% for FAS). This resulted in a finding of 9% (i.e., 90 per 1,000) of students with FASD receiving special education. These estimated proportions (1% for FAS and 9% for FASD) were assumed to be the same for each province and territory.

Based on a prevalence of 1% for FAS, it was estimated that in Canada in 2011/12, there were 724 children with FAS between the ages of 5 and 14 years of age receiving some form of special education (463 boys and 262 girls). There were 274 children with FAS between the ages of 5 and 9 years receiving special education (178 boys and 96 girls) and 451 children with FAS between the ages of 10 to 14 years receiving special education (285 boys and 166 girls).

Based on a prevalence of 9% for FASD, it was estimated that there were 6,520 children between the ages of 5 and 14 years receiving some form of special education (4,166 boys and 2,354 girls) in Canada in 2011/12. There were 2,465 children with FASD between the ages of 5 and 9 years receiving special education (1,603 boys and 862 girls) and 4,055 children with FASD between the ages of 10 and 14 years receiving special education (2,563 boys and 1,492 girls).

The figures reported for FASD include those for FAS. The number of children with FAS/FASD receiving some form of special education by sex, age group and province and territory is presented in Table 26.

Cost of special education for children with FAS/FASD in elementary and middle school

It was estimated that in Canada in 2011/12, the cost of special education for children with FAS in elementary and middle school (i.e., children 5 to 14 years of age) was $5.9 million ($3.8 million for boys with FAS and

$2.1 million for girls with FAS). The cost for children 5 to 9 years of age with FAS was $2.2 million ($1.5 million for boys and $786,000 for girls), and the cost for children 10 to 14 years of age with FAS was $3.7 million ($2.3 million for boys and $1.4 million for girls).

It was estimated that the cost of special education for children with FASD in elementary and middle school was $53.5 million ($34.2 million for boys with FASD and $19.3 million for girls with FASD). The cost for children 5 to 9 years of age with FASD was $20.2 million ($13.2 million for boys and $7.1 million for girls), and the cost for children 10 to 14 years of age with FASD was $33.3 million ($21.0 million for boys and $12.2 million for girls).

The cost figures presented for FASD include those for FAS. The cost of special education for children with FAS/FASD in elementary and middle school by sex, age group and province and territory are presented in Table 26.

Table 26.
Number of children with FAS/FASD receiving special education and the associated cost in elementary and middle school by age group, sex and province and territory in Canada in 2011/12

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Alberta									
Total number of children[a]	113,474	108,009	221,483	114,842	108,104	222,946	228,316	216,113	444,429
Number of children with one or more disabilities[b]	6,014	3,240	9,254	6,891	4,000	10,890	12,905	7,240	20,145
Number of children with disabilities receiving special education[c]	2,177	1,173	3,350	3,314	1,924	5,238	5,491	3,097	8,842
Number of children with FAS receiving special education[d]	22	12	34	33	19	52	55	31	88
Cost of special education of children with FAS	$173,646	$93,557	$267,203	$264,352	$153,452	$417,804	$437,998	$247,009	$685,007
Number of children with FASD receiving special education[e]	**196**	**106**	**302**	**298**	**173**	**471**	**494**	**279**	**773**
Cost of special education of children with FASD	**$1,562,818**	**$842,010**	**$2,404,829**	**$2,379,166**	**$1,381,072**	**$3,760,238**	**$3,941,984**	**$2,223,082**	**$6,165,066**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
British Columbia									
Total number of children[a]	113,351	106,927	220,278	124,099	116,098	240,197	237,450	223,025	460,475
Number of children with one or more disabilities[b]	6,008	3,208	9,215	7,446	4,296	11,742	13,454	7,503	20,957
Number of children with disabilities receiving special education[c]	2,175	1,161	3,336	3,581	2,066	5,648	5,756	3,227	8,984
Number of children with FAS receiving special education[d]	22	12	33	36	21	56	58	32	90
Cost of special education of children with FAS	$200,077	$106,833	$306,910	$329,498	$190,090	$519,588	$529,575	$296,923	$826,498
Number of children with FASD receiving special education[e]	**196**	**105**	**300**	**322**	**186**	**508**	**518**	**290**	**809**
Cost of special education of children with FASD	**$1,800,695**	**$961,496**	**$2,762,191**	**$2,965,480**	**$1,710,810**	**$4,676,290**	**$4,766,175**	**$2,672,307**	**$7,438,481**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Manitoba									
Total number of children[a]	38,591	36,510	75,101	41,147	38,558	79,705	79,738	75,068	154,806
Number of children with one or more disabilities[b]	2,045	1,095	3,141	2,469	1,427	3,895	4,514	2,522	7,036
Number of children with disabilities receiving special education[c]	740	396	1,137	1,188	686	1,874	1,928	1,083	3,011
Number of children with FAS receiving special education[d]	7	4	11	12	7	19	19	11	30
Cost of special education of children with FAS	$68,266	$36,557	$104,823	$109,488	$63,269	$172,757	$177,753	$99,826	$277,580
Number of children with FASD receiving special education[e]	**67**	**36**	**102**	**107**	**62**	**169**	**174**	**97**	**271**
Cost of special education of children with FASD	**$614,390**	**$329,015**	**$943,404**	**$985,390**	**$569,423**	**$1,554,812**	**$1,599,779**	**$898,437**	**$2,498,216**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
New Brunswick									
Total number of children[a]	18,648	17,612	36,260	20,794	19,096	39,890	39,442	36,708	76,150
Number of children with one or more disabilities[b]	988	528	1,517	1,248	707	1,954	2,236	1,235	3,471
Number of children with disabilities receiving special education[c]	358	191	549	600	340	940	958	531	1,489
Number of children with FAS receiving special education[d]	4	2	5	6	3	9	10	5	15
Cost of special education of children with FAS	$28,537	$15,255	$43,792	$47,865	$27,107	$74,972	$76,402	$42,362	$118,764
Number of children with FASD receiving special education[e]	**32**	**17**	**49**	**54**	**31**	**85**	**86**	**48**	**134**
Cost of special education of children with FASD	**$256,829**	**$137,299**	**$394,128**	**$430,786**	**$243,959**	**$674,745**	**$687,616**	**$381,258**	**$1,068,873**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Newfoundland and Labrador									
Total number of children[a]	12,894	12,280	25,174	13,871	13,245	27,116	26,765	25,525	52,290
Number of children with one or more disabilities[b]	683	368	1,052	832	490	1,322	1,516	858	2,374
Number of children with disabilities receiving special education[c]	247	133	381	400	236	636	648	369	1,017
Number of children with FAS receiving special education[d]	2	1	4	4	2	6	6	4	10
Cost of special education of children with FAS	$19,731	$10,637	$30,368	$31,929	$18,801	$50,730	$51,661	$29,438	$81,099
Number of children with FASD receiving special education[e]	**22**	**12**	**34**	**36**	**21**	**57**	**58**	**33**	**92**
Cost of special education of children with FASD	**$177,582**	**$95,732**	**$273,314**	**$287,364**	**$169,210**	**$456,574**	**$464,946**	**$264,942**	**$729,888**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Northwest Territories									
Total number of children[a]	1,450	1,435	2,885	1,456	1,428	2,884	2,906	2,863	5,769
Number of children with one or more disabilities[b]	77	43	120	87	53	140	164	96	260
Number of children with disabilities receiving special education[c]	28	16	43	42	25	67	70	41	111
Number of children with FAS receiving special education[d]	0	0	0	0	0	1	1	0	1
Cost of special education of children with FAS	$2,219	$1,243	$3,462	$3,352	$2,027	$5,379	$5,570	$3,270	$8,840
Number of children with FASD receiving special education[e]	**3**	**1**	**4**	**4**	**2**	**6**	**6**	**4**	**10**
Cost of special education of children with FASD	**$19,970**	**$11,187**	**$31,157**	**$30,164**	**$18,243**	**$48,407**	**$50,134**	**$29,430**	**$79,564**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Nova Scotia									
Total number of children[a]	22,702	21,507	46,057	25,598	23,950	49,548	48,300	45,457	93,757
Number of children with one or more disabilities[b]	1,203	645	1,848	1,536	886	2,422	2,739	1,531	4,270
Number of children with disabilities receiving special education[c]	436	234	669	739	426	1,165	1,174	660	1,843
Number of children with FAS receiving special education[d]	4	2	7	7	4	12	12	7	18
Cost of special education of children with FAS	$24,235	$12,996	$37,230	$41,105	$23,716	$64,820	$65,339	$36,712	$102,051
Number of children with FASD receiving special education[e]	**39**	**21**	**60**	**66**	**38**	**105**	**106**	**59**	**165**
Cost of special education of children with FASD	**$218,111**	**$116,961**	**$335,072**	**$369,941**	**$213,443**	**$583,384**	**$588,052**	**$330,404**	**$918,455**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Nunavut									
Total number of children[a]	1,760	1,650	3,410	1,645	1,533	3,178	3,405	3,183	6,588
Number of children with one or more disabilities[b]	93	50	143	99	57	155	192	106	298
Number of children with disabilities receiving special education[c]	34	18	52	47	27	75	81	45	126
Number of children with FAS receiving special education[d]	0	0	1	0	0	1	1	0	1
Cost of special education of children with FAS	$2,693	$1,429	$4,123	$3,787	$2,176	$5,963	$6,480	$3,605	$10,085
Number of children with FASD receiving special education[e]	**3**	**2**	**5**	**4**	**2**	**7**	**7**	**4**	**11**
Cost of special education of children with FASD	**$24,240**	**$12,863**	**$37,103**	**$34,079**	**$19,585**	**$53,664**	**$58,319**	**$32,448**	**$90,766**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Ontario									
Total number of children[a]	368,686	349,730	718,416	395,799	373,569	769,368	764,485	723,299	1,487,784
Number of children with one or more disabilities[b]	19,540	10,492	30,032	23,748	13,822	37,570	43,288	24,314	67,602
Number of children with disabilities receiving special education[c]	7,074	3,798	10,872	11,423	6,648	18,071	18,496	10,446	28,943
Number of children with FAS receiving special education[d]	71	38	109	114	66	181	185	104	289
Cost of special education of children with FAS	$580,597	$311,743	$892,340	$937,573	$545,697	$1,483,269	$1,518,170	$857,440	$2,375,610
Number of children with FASD receiving special education[e]	**637**	**342**	**978**	**1,028**	**598**	**1,626**	**1,665**	**940**	**2,605**
Cost of special education of children with FASD	**$5,225,375**	**$2,805,686**	**$8,031,061**	**$8,438,153**	**$4,911,272**	**$13,349,425**	**$13,663,528**	**$7,716,958**	**$21,380,487**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Prince Edward Island									
Total number of children[a]	3,738	3,698	7,436	4,330	4,067	8,397	8,068	7,765	15,833
Number of children with one or more disabilities[b]	198	111	309	260	150	410	458	261	719
Number of children with disabilities receiving special education[c]	72	40	112	125	72	197	197	113	309
Number of children with FAS receiving special education[d]	1	0	1	1	1	2	2	1	3
Cost of special education of children with FAS	$5,566	$3,117	$8,683	$9,698	$5,617	$15,315	$15,264	$8,734	$23,998
Number of children with FASD receiving special education[e]	**6**	**4**	**10**	**11**	**7**	**18**	**18**	**10**	**28**
Cost of special education of children with FASD	**$50,092**	**$28,051**	**$78,143**	**$87,283**	**$50,555**	**$137,838**	**$137,375**	**$78,606**	**$215,981**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Quebec									
Total number of children[a]	199,113	190,838	389,951	208,231	198,399	406,630	407,344	389,237	796,581
Number of children with one or more disabilities[b]	10,553	5,725	16,278	12,494	7,341	19,835	23,047	13,066	36,113
Number of children with disabilities receiving special education[c]	3,820	2,073	5,893	6,010	3,531	9,540	9,830	5,603	15,433
Number of children with FAS receiving special education[d]	38	21	59	60	35	95	98	56	154
Cost of special education of children with FAS	$304,698	$165,303	$470,000	$479,321	$281,625	$760,947	$784,019	$446,928	$1,230,947
Number of children with FASD receiving special education[e]	**344**	**187**	**530**	**541**	**318**	**859**	**885**	**504**	**1,389**
Cost of special education of children with FASD	**$2,742,279**	**$1,487,724**	**$4,230,003**	**$4,313,893**	**$2,534,626**	**$6,848,519**	**$7,056,172**	**$4,022,350**	**$11,078,523**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Saskatchewan									
Total number of children[a]	32,860	31,054	63,914	33,970	32,337	66,307	66,830	63,391	130,221
Number of children with one or more disabilities[b]	1,742	932	2,673	2,038	1,196	3,235	3,780	2,128	5,908
Number of children with disabilities receiving special education[c]	630	337	968	980	576	1,556	1,611	913	2,524
Number of children with FAS receiving special education[d]	6	3	10	10	6	16	16	9	25
Cost of special education of children with FAS	$50,285	$26,899	$77,184	$78,195	$45,902	$124,097	$128,479	$72,801	$201,280
Number of children with FASD receiving special education[e]	**57**	**30**	**87**	**88**	**52**	**140**	**145**	**82**	**227**
Cost of special education of children with FASD	**$452,564**	**$242,089**	**$694,653**	**$703,752**	**$413,118**	**$1,116,870**	**$1,156,315**	**$655,207**	**$1,811,522**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
Yukon									
Total number of children[a]	980	936	1,916	1,027	970	1,997	2,007	1,906	3,913
Number of children with one or more disabilities[b]	52	28	80	62	36	98	114	64	178
Number of children with disabilities receiving special education[c]	19	10	29	30	17	47	48	27	76
Number of children with FAS receiving special education[d]	0	0	0	0	0	0	0	0	1
Cost of special education of children with FAS	$1,500	$811	$2,310	$2,364	$1,377	$3,741	$3,864	$2,188	$6,051
Number of children with FASD receiving special education[e]	**2**	**1**	**3**	**3**	**2**	**4**	**4**	**2**	**7**
Cost of special education of children with FASD	**$13,497**	**$7,297**	**$20,794**	**$21,276**	**$12,392**	**$33,668**	**$34,773**	**$19,689**	**$54,462**

Jurisdiction	5–9 years of age			10–14 years of age			TOTAL		
	Boys	Girls	Both	Boys	Girls	Both	Boys	Girls	Both
CANADA (all provinces/territories)									
Total number of children[a]	928,249	882,186	1,810,435	986,810	931,354	1,918,164	1,915,059	1,813,540	3,728,599
Number of children with one or more disabilities[b]	49,197	26,466	75,663	59,209	34,460	93,669	108,406	60,926	169,331
Number of children with disabilities receiving special education[c]	17,809	9,581	27,390	28,479	16,575	45,055	46,289	26,156	72,445
Number of children with FAS receiving special education[d]	178	96	274	285	166	451	463	262	724
Cost of special education of children with FAS	$1,462,049	$786,379	$2,248,428	$2,338,525	$1,360,857	$3,699,382	$3,800,574	$2,147,235	$5,947,809
Number of children with FASD receiving special education[e]	**1,603**	**862**	**2,465**	**2,563**	**1,492**	**4,055**	**4,166**	**2,354**	**6,520**
Cost of special education of children with FASD	**$13,158,442**	**$7,077,408**	**$20,235,851**	**$21,046,726**	**$12,247,709**	**$33,294,435**	**$34,205,168**	**$19,325,117**	**$53,530,285**

a Source: Statistics Canada (2013)
b Based on disability rates of 5.3% for boys 5 to 9 years of age, 3.0% for girls 5 to 9 years of age, 6.0% for boys 10 to 14 years of age, and 3.7% for girls 10 to 14 years of age (Statistics Canada, 2008a)
c Based on rate of 36.2% for students with disabilities between the ages of 5 to 9 years, and 48.1% for students with disabilities between the ages of 10 to 14 years receiving some form of special education (Statistics Canada, 2008a)
d Based on a prevalence of 1% for FAS
e Based on a prevalence of 9% for FASD
Note: FASD figures are inclusive of those for FAS. Due to rounding errors, columns and rows may not add up to the totals reported.

DISCUSSION

Despite having used the most conservative assumptions, the estimated annual cost of special education for children with FASD in elementary and middle school in Canada is high. It was estimated that of the 169,331 school-age children 5 to 14 years of age with a disability, 6,520 have FASD and are receiving some form of special education.

However, these estimates have important limitations that should be considered in the interpretation of this data. First, the number of children with FASD receiving special education in each Canadian province and territory was unavailable (with the exception of Newfoundland and Labrador, which, as stated above, disclosed the number of children identified with FAS receiving special education). As such, the prevalence of children with FAS receiving some form of special education was estimated based on the data from Newfoundland and Labrador, which may not reflect the actual prevalence in the other provinces and territories.

Second, the prevalence of FASD among children receiving some form of special education was not available, and a 1:9 (FAS:FASD) ratio was assumed. This ratio reflects the most commonly cited prevalence among the general population of Canada (PHAC, 2003b; Roberts & Nanson, 2000) and while the true prevalence is currently unknown in Canada, it may not be reflective of the special education population.

Third, the cost of special education was available for only a few provinces and territories, and since special education funding is typically determined by level of need (i.e., severity of the deficits and disabilities), it is unknown whether the cost figures per child with disabilities used in this module reflect of the costs for children with FASD specifically.

The estimated cost of special education for children with FASD presented here are likely an underestimation for many reasons. First, it is likely that the estimated prevalence of children with FAS/FASD receiving some form of special education is underestimated, given that FASD is largely underdiagnosed (Paintner et al., 2012b). Second, children in private schools, home-schooled children and those in residential care were not accounted for. Third, the cost of special education for children with FASD was estimated for elementary and middle school only (due to data limitations): high school students were not included. For older students who are not in school but are served by other programs, the costs of serving them may simply be transferred to another agency. This could include students who have dropped out of school and those in juvenile corrections care, residential care or adult prisons. These students may conceivably receive special education services not included in the cost calculations in this module. Finally, the costs of specialized training for teachers providing special education services and programs were not included.

The cost data in this module should provide a baseline for funding agencies and school systems. This should be considered as a first step in an incremental process to improve the available data on cost and utilization of special education services by children and families affected by FASD.

3.3 Supportive Housing and Long-Term Care

Adults with FASD may face multiple mental and physical disabilities, along with many other problems, such as addiction and poverty. As a result, many cannot live independently. One study reported that in its sample of adults with FASD (20+ years of age) approximately 80% could not live independently, regardless of their IQ (Streissguth et al., 1996). Despite this, many adults with FASD do not have suitable resources for housing, and the burden is placed on the shoulders of their caregivers—the biological, adoptive or extended family. These relatives may or may not be able to provide these resources. Therefore, it is not uncommon for members of this population to be living on the streets, in correctional facilities and in short-lived stays with family or friends (Burns, 2009). This increases their vulnerability to victimization, especially when they have children or become pregnant.

The housing needs of adults with FASD vary according to the degree of their primary and secondary disabilities. However, there are no epidemiological data on the prevalence of adults with FASD in Canada who need or use supportive housing or long-term care.

The purpose of this module was to estimate the burden and cost of supportive housing and long-term care associated with adults with FASD.

METHODS

Estimation of the number of adults with FASD

Using data on the number of individuals 19 to 64 years of age among the general population of Canada in 2012 (Statistics Canada, 2012a), and assuming a prevalence of 9 per 1,000 for FASD (Roberts & Nanson, 2000), the number of individuals with FASD, by age group (19 to 64 years of age), in Canada in 2012 was estimated.

The upper age limit was restricted to 64 years because it is believed that individuals with FASD have a shorter life expectancy than the general population, due to their general health and other problems associated with risky behaviour (e.g., addictions, criminal activities, promiscuous sexual behaviour). However, there are no reliable epidemiological data to support this.

Estimation of the number of adults with FASD who use supportive housing or long-term care services

In order to calculate the number of adults with FASD who use supportive housing or long-term care services, the following assumptions were used:

1. 80% of adults with FASD are not able to live independently (Streissguth et al., 1996).

2. Based on expert opinion, only 5% of those who are not able to live independently receive supportive housing or long-term care services.

3. Based on expert opinion, of the 5% assumed to receive supportive housing or long-term care services:

   a. 40% (mildly impaired) require supportive housing with low support
   b. 40% (moderately impaired) require supportive housing with high support
   c. 20% (severely impaired) require long-term care (Burd, L., personal communication, March 2013).

Estimated cost associated with supportive housing and long-term care among adults with FASD

The daily cost of supportive housing and long-term care per person was obtained from the *Turning the Key* report (Trainor et al., 2013) as follows: $19 to $44 for supportive housing with low supports, $82 to $115 for supportive housing with high support, and $134 for long-term care. The respective daily costs were applied to the estimated number of adults with FASD in each respective service category/facility.

Sensitivity analysis

The assumption that 10% of those who are not able to live independently receive supportive housing or long-term care services was used.

RESULTS

There were approximately 199,798 adults (19 to 64 years of age) with FASD in Canada in 2012. It was estimated that 159,838 of these adults with FASD (80%) are not able to live independently. Assuming that only 5% of those who require such services actually receive them, it was estimated that 7,992 adults with FASD are in supportive housing or long-term care. Out of these 7,992 adults with FASD, 40% (3,197) resided in supportive housing with low supports, 40% (3,197) resided in supportive housing with high supports, and 20% (1,598) resided in long-term care (Table 27).

The cost of supportive housing for adults with FASD in Canada in 2012 was estimated to range from $22.2 million to $134.2 million ($22.2 million to $51.3 million for supportive housing with low support, and $95.7 million to $134.2 million for supportive housing with high support), and the cost of long-term care for adults with FASD was estimated to be approximately $78.2 million (Table 27).

Sensitivity analysis

As a sensitivity analysis, the costs were computed under the assumption that 10% of adults with FASD who are not able to live independently receive supportive housing or long-term care services. With this assumption, the costs doubled—the cost of supportive housing was estimated to range from $44.3 million to $268.4 million ($44.3 million to $102.7 million for supportive housing with low support, and $199.4 million to $268.4 million for supportive housing with high support), and the cost of long-term care was estimated to cost $156.4 million (the respective data are not presented in Table 27).

Sensitivity analysis

As a sensitivity analysis, the costs were computed under the assumption that 10% of adults with FASD who are not able to live independently receive supportive housing or long-term care services. With this assumption, the costs doubled—the cost of supportive housing was estimated to range from $44.3 million to $268.4 million ($44.3 million to $102.7 million for supportive housing with low support, and $199.4 million to $268.4 million for supportive housing with high support), and the cost of long-term care was estimated to cost $156.4 million (the respective data are not presented in Table 27).

DISCUSSION

The costs presented above for supportive housing and long-term care should be considered rough estimates due to epidemiological data limitations.

It should be noted that the capacity of such services in Canada is very limited, and so not all individuals with FASD who require such services are able to access them (Forchuck et al., 2011). Therefore, parents or caregivers often incur the cost of supportive housing and long-term care either partially or fully.

Adults with FASD face a number of noteworthy challenges related to supportive housing and long-term care. First, some individuals with FASD may not be officially diagnosed or may be considered to be "higher functioning" (based on IQ) than others; therefore, they may not qualify for these services. However, as reported above, 80% of adults with FASD are not able to live independently, regardless of their IQ (Streissguth et al., 1996). Second, children with FASD are overrepresented in child-care populations (Lange et al., 2013) and, in general, inadequate housing is a common issue when youth exit the child welfare system (generally at 18 years of age) and transitional supports are not readily available. Third, group homes are a common solution, but they are often not appropriate and do not cater to the specific needs of individuals with FASD (Burns, 2009). Clearly, this is a sector in which awareness of the needs of individuals with FASD must be increased, in order to develop an appropriate response.

Table 27.
The estimated costs of supportive housing (with low and high supports) and long-term care among adults (19 to 64 years of age) with FASD in Canada in 2012

Age group (years)	Total population in 2012	Number of adults with FASD (based on a prevalence of 9 per 1,000[a])	Number of adults with FASD that cannot live independently (based on 80%[b])	Number of adults with FASD that receive services (based on 5%)	Number of adults with FASD that receive low support (based on 40%[c])	Number of adults with FASD that receive high support (based on 40%[c])	Number of adults with FASD in long-term care facilities (based on 20%[c])	Cost of supportive housing with low support[d]		Cost of supportive housing with low support[d]		Cost of long-term care (based on $134 per day per person)[d]
								Lower estimate (based on $19 per day per person)	Upper estimate (based on $44 per day per person)	Lower estimate (based on $82 per day per person)	Upper estimate (based on $115 per day per person)	
19–24	2,873,914	25,865	20,692	1,035	414	414	207	$2,870,005	$6,646,328	$12,386,339	$17,371,086	$10,120,546
25–29	2,393,195	21,539	17,231	862	345	345	172	$2,389,940	$5,534,598	$10,314,479	$14,465,428	$8,427,684
30–34	2,380,651	21,426	17,141	857	343	343	171	$2,377,413	$5,505,589	$10,260,415	$14,389,607	$8,383,510
35–39	2,295,888	20,663	16,530	827	331	331	165	$2,292,766	$5,309,562	$9,895,094	$13,877,265	$8,085,016
40–44	2,379,617	21,417	17,133	857	343	343	171	$2,376,381	$5,503,197	$10,255,959	$14,383,357	$8,379,869
45–49	2,652,583	23,873	19,099	955	382	382	191	$2,648,975	$6,134,470	$11,432,421	$16,033,273	$9,341,124
50–54	2,723,816	24,514	19,611	981	392	392	196	$2,720,112	$6,299,206	$11,739,429	$16,463,833	$9,591,973
55–59	2,429,163	21,862	17,490	874	350	350	175	$2,425,859	$5,617,780	$10,469,498	$14,682,833	$8,554,346
60–64	2,070,943	18,638	14,911	746	298	298	149	$2,068,127	$4,789,346	$8,925,599	$12,517,608	$7,292,867
Total	**22,199,770**	**199,798**	**159,838**	**7,992**	**3,197**	**3,197**	**1,598**	**$22,169,578**	**$51,340,076**	**$95,679,233**	**$134,184,290**	**$78,176,934**

FASD: Fetal alcohol spectrum disorder
a Source: Roberts & Nanson (2000)
b Source: Streissguth et al. (1996)
c Based on the expert opinion of Burd, L.
d Source: Trainor et al. (2013

3.4 Prevention and Research

Prevention initiatives and research are policy costs and expenditures, usually by governments, to provide programs aimed at preventing even higher costs (in this case due to FASD) than would otherwise be incurred.

There are no sources that report systematically on the direct costs of prevention and research associated with FASD in Canada. Thus, we attempted to identify and request data from as many different federal and provincial agencies and key informants as possible. While the largest agencies could be covered with this procedure (included within this section), several agencies, which did not respond to our survey, have been missed. Therefore, the costs presented below are likely underestimated.

Table 28 presents the estimated direct costs for prevention and research attributable to FASD in Canada, from the agencies listed below in alphabetical order.

Table 28.
Funding awarded for FASD-specific prevention and research in Canada

Agency	Duration of funding	Total funding awarded (year)	Source
Canada FASD Research Network (Can FASD)	n/a	$4.2 million (2012/2013) [on average $4.2 million per year]	CanFASD, 2013
Canadian Foundation on Fetal Alcohol Research (CFFAR)	2 years	$1.3 million (2007-2013) [on average $216.7 thousand per year]	CFFAR, n.d.
Canadian Institute of Health Research (CIHR)	1 year: 16 grants (51.5%) 2 years: 2 grants (6.9%) 3 years: 8 grants (27.6%) 5 years: 4 grants (13.8%)	$5.1 million (2008–2013) [on average $1.02 million per year]	CIHR, n.d.
NeuroDevNet	n/a	$2.9 million (2010–2015) [on average 571.3 thousand per year]	Reynolds, J., personal communication, February 2014
Public Health Agency of Canada (PHAC)	n/a	$1.5 million per year	PHAC

n/a: not available

Canada FASD Research Network

Canada FASD Research Network (CanFASD), a not-for-profit organization, is a collaborative and interdisciplinary research network that has collaborators, researchers and partners across Canada. It is Canada's first comprehensive national FASD research network.

CanFASD's operational funding comes from the member provinces and territories (Alberta, British Columbia, Manitoba, New Brunswick, Northwest Territories, Nunavut, Saskatchewan, and Yukon), and amounted to $594,153 in 2012/13 (CanFASD, 2013). Funding for specific projects led by CanFASD researchers is obtained from grants and contracts from governments, foundations and other funding agencies, and amounted to $4,210,475 in 2012/13 (CanFASD, 2013). Therefore, the total funds held by CanFASD in 2012/13 was $4.8 million (CanFASD, 2013).

Canadian Foundation on Fetal Alcohol Research

Another major FASD-specific research funding agency in Canada is the Canadian Foundation on Fetal Alcohol Research (CFFAR). The CFFAR was established in September 2007 and is an independent, non-profit foundation. Its purpose is to promote interest and fund research related to the short- and long-term biomedical, psychological and social effects of alcohol consumption during pregnancy, and the prevention of FASD. The CFFAR provides 5 grants per year with a maximum of $40,000 per year for two years; therefore, on average the CFFAR provides $200,000 per year for FASD research (CFFAR, n.d.). Since 2007, approximately $1.3 million has been awarded to FASD-related research projects by the CFFAR (CFFAR, n.d.).

Canadian Institute of Heath Research

Funding for current FASD-related studies provided by the Canadian Institute of Heath Research (CIHR) amount to $5,090,799 (CIHR, n.d.). It must be noted that this funding amount is not completely independent of the external funding obtained from CanFASD, as some research members belonging to CanFASD obtained their external funding from the CIHR. Further, the $5.1 million provided by the CIHR is not for a specific year; it is the total amount awarded to studies that are ongoing, including some studies that received funding for up to 5 years. However, out of the 29 FASD-related studies that are currently being funded, the majority received funding for one year (16; 51.5%), followed by funding for 3 years (8; 27.6%), then funding for 5 years (4; 13.8%), and lastly, funding for 2 years (2; 6.9%; CIHR, n.d.).

NeuroDevNet

NeuroDevNet is an organization that provides innovative training opportunities to foster a new generation of Canadian researchers dedicated to the same objectives, and to empower communities with tools and information to promote earlier diagnoses and better treatment, and improve outcomes for children, both today and in the future. NeuroDevNet's current research projects focus on autism spectrum disorder, cerebral palsy and FASD. The projects are supported by collaboration with core services in neuroethics, neuroinformatics and knowledge translation. NeuroDevNet spent $2,856,600 to support FASD research

projects in a 5-year period (2010–2015; Reynolds, J., personal communication, February 2014). There are additional funds for trainee fellowships and the Opportunities Initiative, which were not possible to quantify.

Public Health Agency of Canada

The Public Health Agency of Canada (PHAC) is a division of the Canadian Government that aims to promote and protect the health of Canadians, and as such, PHAC leads the FASD Initiative in partnership with Health Canada. PHAC's FASD Initiative is the lead for FASD within the Government of Canada. The Initiative collaborates with federal, provincial and territorial governments, researchers, health organizations and community groups, with the goal to prevent FASD and improve outcomes for individuals already affected by it. Through its National Strategic Projects Fund, the Initiative allocated $1.5 million yearly for FASD activities. This fund provides national, time-limited funding to help organizations to create and enhance capacity to prevent and address FASD. It helps to enhance the knowledge base for effective policy and programs by ensuring national access to tools, resources and evidence to better support those at risk of having a child with FASD, as well as those already affected.

PHAC provides additional prevention resources for women to help them make healthy choices during pregnancy. The publication *Sensible Guide to a Healthy Pregnancy* (Government of Canada, 2008) addresses a number of common questions regarding alcohol use in pregnancy and clearly states that there is no safe amount or safe time to drink alcohol while pregnant or planning to become pregnant.

PHAC also invests $27.2 million annually in the Canada Prenatal Nutrition Program (CPNP). CPNP provides support to pregnant women who are facing challenging life circumstances, including poverty, teen pregnancy, social or geographic isolation, abuse or neglect, and alcohol or substance use/abuse. CPNP aims to improve the health of pregnant women and their infants, reduce unhealthy birth weights, and promote and support breastfeeding. There are 279 CPNP projects serving over 59,000 participants (pregnant women and parents/caregivers) annually in over 2,000 communities across Canada.

It should be noted that the funds set forth for the CPNP are program costs that support, inter alia, the reduction of alcohol use in pregnancy. However, the exact portion for FASD prevention cannot be established, as this program is focused on promoting healthy pregnancies in general. Therefore, it was not included in the total estimated cost for prevention and research attributable to FASD in Canada.

Overall, based on the available data, it was estimated that approximately $7.5 million was spent on FASD prevention and research in Canada in 2013.

This cost figure reflects data from the largest Canadian agencies only; therefore, the total cost of FASD prevention and research is underestimated.

4. Indirect Costs

4.1 Productivity Losses Due to Disability

A significant portion of the societal economic burden of FASD results from lost productivity and reduced participation in the workforce. Surprisingly, given their significance, the existing cost estimates of FASD have neglected to examine the productivity losses caused by reduced participation in the workforce (Abel & Sokol, 1991a,b; Credé et al., 2011; Harwood, 2000; Klug & Burd, 2003; Lupton et al., 2004; Rice et al., 1990).

The purpose of this module was to estimate the productivity losses of individuals with FASD due to disability, an indirect cost, which is one dimension of the total cost of FASD in Canada.

METHODS

Population estimates of individuals with FASD

Canadian data on population by provinces, the labour force, unemployment rate and the average weekly wage were obtained from Statistics Canada for the most recent available year (i.e., 2011; Statistics Canada, 2010, 2012b,c,d,e).

For the purpose of this analysis, three groups of individuals were analyzed separately: 1) those with FAS (the most severe form of FASD); 2) those with other forms of FASD (pFAS, ARND and ARBD); and 3) those with FASD overall (FAS, pFAS, ARND or ARBD).

To estimate the number of individuals with FAS and other-FASD, the only available and most commonly cited prevalences of FAS (0.1%; PHAC, 2003b) and FASD (0.9%; Roberts & Nanson, 2000) were applied to the general population of Canada in 2011 (Statistics Canada, 2012b).

A counterfactual scenario

All cost estimates involve a counterfactual scenario, which compares the actual state of affairs with an alternative one, with the costs reflecting the economic differences between them (Single et al., 2003). This report adopts a counterfactual scenario in which no individual in the population suffers from FASD. This counterfactual scenario was chosen because it is readily understandable, and because its consequential estimation method involve fewer—potentially contentious—assumptions.

As a consequence of this choice of counterfactual scenario, the estimation method uses the “demographic” approach rather than the “human capital” approach; the latter would be more applicable if the alternative scenario involved phasing out FASD (e.g., as an effective prevention program was introduced over time). In effect, the counterfactual scenario used here assumes an effective program was introduced many decades ago; the estimate represents the long-term equilibrium. It may be taken as an indication of the eventual long-term productivity gains from effective prevention.

Severity levels of intellectual impairment attributable to FASD

Population estimates of individuals with FASD were stratified by the severity levels of intellectual impairment attributable to FASD, to account for the impact of the severity on the level of participation in the workforce and productivity of individuals with FASD. The disabilities attributed to birth defects, vision or hearing problems, or other physical disabilities were not accounted for.

Individuals with FAS and with other-FASD can be classified into four groups according to severity level of intellectual impairment (Harwood et al., 1984):

1. Broad cognitive impairment (does not meet criteria for intellectual disability). The term minimal brain dysfunction (MBD) has also been used previously to describe this population. This category might include individuals with learning disabilities, speech and language disorders, attention-deficit/hyperactivity disorder and other similar disorders.

2. Mild intellectual disability. This category was previously known as mild mental retardation, and includes individuals with an IQ and adaptive behaviour scores between 50 and 75. Individuals within this category can often acquire academic skills up to a grade six level. They can become fairly self-sufficient and in some cases live independently, with episodic or ongoing community and social support.

3. Moderate intellectual disability. This category of individuals has an IQ and adaptive behaviour score of 35 to 49. They can typically carry out work and self-care tasks with ongoing moderate levels of supervision. They typically acquire communication skills in childhood and are able to live and function successfully within the community in a staffed and supervised environment, such as a group home.

4. Severe intellectual disability. These are individuals who have an IQ and adaptive behaviour score below 35. They may master very basic self-care skills and some communication skills. Their intellectual disability is often accompanied by neurological disorders, and they most commonly require continuous supervision, assistance and high levels of structure.

Based on expert opinion, it was assumed that 100% of individuals with FAS are intellectually impaired and only about 25% of individuals with other-FASD are intellectually impaired (Chudley, A., personal communication, March 2013). As a result, levels of reduction in productivity would vary among these individuals due to their varied intellectual impairment.

The distribution of the levels of mental impairment severity among individuals with other-FASD was assumed to be the same as that for individuals with FAS (50% with broad cognitive impairment, 33% with mild intellectual disability, 12% with moderate intellectual disability and 5% with severe intellectual disability) (Burd, L. & Chudley, A., personal communication, March 2013).

The percentage of reduction in productivity of individuals with FAS and other-FASD was adapted from Harwood et al. (1984) and modified based on experts' opinion (Burd, L. & Chudley, A., personal communication, March 2013).

Population estimates of individuals with FASD

Using data on the general population in Canada—34.5 million individuals in 2011 (Statistics Canada, 2012b)—and assuming a prevalence of 0.1% for FAS and 0.9% for other-FASD, the number of individuals with FASD was estimated as follows: 34,483 individuals with FAS and 310,345 with other-FASD, for a combined total of 344,828 individuals with FASD in Canada in 2011 (Table 29).

According to Statistics Canada, approximately 54.2% (18.7 million) of individuals in Canada participated in the paid labour force in 2011 (Statistics Canada, 2012c). By applying this percentage to the number of individuals with FASD (344,828), it was estimated that about 186,994 individuals with FASD were in the Canadian workforce in 2011. Based on the assumption that all individuals with FAS and 25% of individuals with other-FASD have some level of intellectual impairment, it was estimated that 60,742 individuals with FASD who are in the workforce have reduced productivity (Table 30).

Table 29.
Model parameters for the calculation of productivity losses due to FASD-attributable disability in Canada in 2011

Parameters	Number of individuals	Source
Total population in Canada	34.5 million	Statistics Canada (2012a)
Population participating in paid labour force in Canada (54.2%)	18.7 million	Statistics Canada (2012b)
Population with FAS (0.1% of the total population of Canada)	34,483	PHAC (2003)
Population with other-FASD (0.9% of the total population of Canada)	310,345	Roberts & Nanson (2000)
Population with FASD (1% of the total population of Canada)	344,828	
Population with FAS participating in paid labour force (54.2% of the total population with FAS)	18,690	
Population with other-FASD participating in paid labour force (54.2% of the total population with other-FASD)	168,206	
Population with FASD participating in paid labour force (54.2% of the total population with FASD)	186, 994	
Compromised productivity of the workforce with FAS (100% of the population with FAS participating in paid labour force)	18,690	Expert opinion
Compromised productivity of the workforce with other-FASD (25% of the population with other-FASD participating in paid labour force)	42,052	Expert opinion
Compromised productivity of the workforce with FASD (sum of population with FAS and other-FASD participating in paid labour force with compromised productivity)	60,742	

FAS: Fetal alcohol syndrome; FASD: Fetal alcohol spectrum disorder

Table 30.
Percentage and number of individuals with FAS and other-FASD by level of intellectual impairment and their percentage of reduction in productivity in Canada in 2011

Impairment category	Percentage of individuals with FAS and other-FASD[a, b]	Estimated number of individuals with FAS and other-FASD in Canada	Percentage reduction in productivity of individuals with FAS and other-FASD: lower boundary[c]	Percentage reduction in productivity of individuals with FAS and other-FASD: upper boundary[d]
Broad cognitive impairment	50%	30,371	10%	40%
Mild intellectual impairment	33%	20,045	25%	50%
Moderate intellectual impairment	12%	7,289	50%	70%
Severe intellectual impairment	5%	3,037	100%	100%
Total		60,742		
Weighted average			24.2%	49.9%

FAS: Fetal alcohol syndrome; FASD: Fetal alcohol spectrum disorder
a Estimated based on expert opinion (Burd, L., & Chudley, A.)
b Assumption was used that 100% of individuals with FAS are intellectually impaired and only about 25% of individuals with other-FASD are intellectually impaired (Chudley, A., expert opinion)
c Based on Harwood et al. (1984)
d Estimated based on expert opinion (Burd, L., & Chudley, A.)

Productivity losses of individuals with FASD due to disability

It was assumed that the level of intellectual impairment was directly related to the magnitude of productivity losses of individuals with FASD. Table 30 presents the proportions of individuals with FASD by the levels of intellectual impairment, as well as the lower and upper boundaries for their percentage reduction in productivity by categorical level of impairment. In order to estimate a weighted average of the lower and upper boundaries (rounded to 24.2% and 49.9%, respectively), the percentage reductions in productivity were combined across severity levels and weighted by the number of individuals in each respective group (Table 30).

Because 7.4% of the labour force was unemployed (Statistics Canada, 2012d), the estimated loss of productivity by the effective workforce was applied only to the 92.6% of those with FASD who were assumed to be in the labour force (the workforce equals the labour force, less those unemployed).

Estimating the effect of the counterfactual scenario of no FASD in Canada

If there were no cases of FASD in Canada (the counterfactual scenario), then the effective workforce would increase by the equivalent of 14,738 to 30,325 workers (these numbers are derived by applying a weighted average of reduction in productivity (24.2% and 49.9%; Table 30) to the number of individuals with FASD with compromised productivity within the workforce (60,742; Table 29). The additional (effective) workers represent a boost to the existing Canadian labour force of 18.7 million individuals, equivalent to an increase in the labour force of between 0.08% and 0.16%.

To adjust for the likelihood that some of these additional effective potential workers would be unemployed, the aggregate in the labour force was scaled down by 7.4% (the Canadian unemployment rate in 2011; Statistics Canada, 2012d) to refine the employment estimates. It was then estimated that the unemployment-adjusted Canadian workforce would increase by 13,647–28,082 individuals if the counterfactual scenario (assuming no FASD in Canada) were reality (Table 31).

Table 31.
Model of potential increases in wages using a counterfactual scenario (i.e., no one is born with FASD) in Canada in 2011

	Lower boundary	Upper boundary
Number of productivity-compromised individuals with FASD in labour force (estimated based on weighted average reduction in productivity—24% for lower and 50% for upper boundaries)	14,738	30,325
Number of productivity-compromised individuals with FASD in labour force (estimated based on weighted average reduction in productivity adjusted for unemployment rate 7.4%)	13,647	28,082
Average annual wage in general population of Canada (Statistic Canada, 2010).	$30,159	$43,804
Loss of annual income per person with FASD in labour force	$2,238	6,578
Loss of annual income per productivity-compromised person with FASD in labour force	$6,885	$17,868
Productivity losses due to FASD-attributable disability (additional economy-wide income)	**$418 million**	**$1.08 billion**

FASD: Fetal alcohol spectrum disorder

Estimated value of the productivity losses of individuals with FASD due to disability

The estimates of productivity losses resulting from reduced labour force participation can be converted into a dollar value by multiplying the effective reduction in the number of participating workers with FASD by their marginal dollar product (Single et al., 2003). The standard assumption is that a worker's marginal product is comparable to the average wage (Single et al., 2003).

The average weekly wage in Canada in 2011 was $840.07, which is equivalent to $43,804 per year (Statistics Canada, 2012e). However, it could be argued that the average worker with FASD comes from a more socially deprived background with a lower average wage than a typical member of the labour force. In order to provide the most conservative estimate, it was assumed that, as a "low" estimate, the actual wages for a person from a background that generates FASD is 30% lower than average, or $30,663 annually. This discount was calculated by noting that the Canadian minimum wage is approximately 40% of the average wage, and by taking the midpoint between the two (70% of the average wage; Statistics Canada, 2010). This amounts to an average annual reduction of $2,238 to $6,578 for each worker with FASD (including those who were unemployed). This represents 7.8% to 16.2% of the wages they would earn if they did not have FASD. When this wage is applied to the difference in the effective workforce, the estimated national income of Canada would increase between

$418 million and $1.08 billion, if Canada had no cases of FASD. The compromised work productivity of individuals with FASD (including deceased individuals) resulted in an average annual loss of $6,885 to $17,868 (or 24.2% to 49.9% of potential wages) for each person with FASD.

The productivity loss due to FASD-attributable disability by provinces in Canada was calculated based on the same assumptions as the national average, after adjustments for the different sizes of their labour forces and wage rate differences (Table 32).

Table 32.
Estimated productivity losses due to FASD-attributable disability by province in Canada in 2011

Provinces	Lower boundary (millions)	Upper boundary (millions)
Newfoundland & Labrador	$4.9	$12.6
Prince Edward Island	$1.4	$3.6
Nova Scotia	$9.3	$24.0
New Brunswick	$6.9	$17.8
Quebec	$89.4	$231.0
Ontario	$167.0	$431.4
Manitoba	$13.5	$34.9
Saskatchewan	$12.8	$33.0
Alberta	$57.9	$149.6
British Columbia	$55.0	$142.0
Canada	**$418.0**	**$1,080.0**

FASD: Fetal alcohol spectrum disorder

DISCUSSION

Approximately 0.03% of the Canadian workforce experiences a loss of productivity because of FASD-attributable disability. As measured by these workers' reduced remuneration, the productivity losses to the Canadian economy are quite sizeable. Although the immediate effect of FASD-attributable disability is confined to a small proportion of the population, the estimated aggregate loss in Canada in 2011 ranged from $418 million to $1.08 billion. Without the cost pressures of FASD, these resources could be diverted to other areas of private and public spending to benefit Canada as a whole. Policy-makers could use the estimates of productivity losses because of FASD-attributable disability to evaluate the potential benefits of FASD prevention programs in Canada. A prevention effort to eliminate FASD in Canada that costs less than $418 million a year would, if successful, produce an economic benefit from productivity gains alone over the long term. However, the benefits would not accrue in total immediately because the newly born do not immediately enter the workforce.

These estimates likely underestimate both the actual costs of FASD and the potential cost savings from effective prevention efforts. Even so, there is some level of confidence that the estimates of the aggregate productivity losses from FASD are within the correct range. These estimates are, by design, conservative in terms of the total social costs of FASD. They do not include the additional productivity losses of those caring for individuals with FASD who are unable to work in the paid labour force because of their caregiving. Further, these estimates account for intellectual disabilities only, while in reality people with FASD often also suffer from a number of physical disabilities. A recent review of the medical and epidemiological literature revealed that FASD is associated with approximately 300 disease conditions (Popova, Lange, Shield et al., 2013). However, FASD-attributable fractions of these disease conditions are unknown; therefore, it was not possible to include them in the model. In addition, these estimates do not cover the losses from premature mortality of those with FASD or the considerable social benefits from the elimination of FASD.

In terms of the productivity losses alone, Canada could ultimately spend up to $1.0 million per day on prevention programs to prevent new cases of FASD. The cost of the prevention effort would need to be modified to reflect the efficacy of the prevention program. In Canada, $1.0 million a day is a breakeven point for return on the narrow productivity measure. However, it is important to note that this cost/benefit ratio does not reflect the total costs attributable to FASD, which are substantial (Popova, Stade et al., 2011; Popova, Stade, Lange, Bekburadov et al., 2012; Stade et al., 2006, 2009; Thanh and Jonsson, 2009). An effective program would almost certainly cost much less, in which case the Canadian economy would be considerably better off. Cost estimates for prevention programs may be pooled with additional cost benefits from prevention including health-related costs, cost reductions in special education, and reduced burden on corrections systems.

This figure for the productivity loss due to FASD-attributable disability suggests that an effective public health campaign to eliminate (or substantially reduce) FASD, costing up to $1,000 per birth, would ultimately pay for itself in productivity gains alone. In areas where the prevalence rates of FASD are high, increased funding for FASD prevention could have important additional regional economic benefits.

4.2 Productivity Losses Due to Premature Mortality

The purpose of this module was to estimate the productivity losses of individuals with FASD due to premature mortality, as one dimension of the total cost attributable to FASD in Canadian society.

METHODS

This method compares the current actual situation in Canada to a counterfactual scenario in which nobody is born with FASD. It uses the demographic method (Single et al., 2003), and focuses only on the impact of market production (the productivity loss) from the premature mortality of individuals with FASD.

The number of FASD-related deaths coded according to ICD-10 were estimated based on "Causes of Death" tables from Statistics Canada (2008b) and pooled prevalence estimates of the major disease conditions associated with FASD obtained from the meta-analysis conducted by Popova, Lange, Shield and colleagues (2013). A list of these disease conditions with the pooled prevalence estimates is available from the authors.

Estimated number of deaths by age group with FASD in Canada in 2011 was used to project past deaths in previous years for individuals with FASD, and hence the total number who would have been alive in 2011 had they not had FASD. The estimate of 2011 FASD-related working life years lost was used to calculate productivity losses for 2011. The value of that loss was estimated according to our estimates of productivity due to disability (see the previous module).

Canadian data on the labour force, unemployment rate and average weekly wage were obtained from Statistics Canada for the most recent available year (i.e., 2011; Statistics Canada 2010; 2012 b,c,d,e).

RESULTS

Estimated number of deaths and years of potential employment lost of individuals with FASD

In Canada in 2011, there were an estimated 280 deaths of individuals with FASD among the population aged 20 to 69, and 327 of individuals with FASD aged 0 to 69 (Table 33). The rate of mortality from FASD-related conditions is almost twice as high for men as for women.

Table 34 presents the years of potential employment lost of individuals with FASD as a result of premature mortality. We totalled the number of years from the premature death to retirement age (62 years, the median age for retirement; Statistics Canada, 2012c) to obtain an estimate of 5,739 years of potential life lost as a result of the premature mortality of individuals with FASD.

These 5,739 years of potential life lost are spread out over the 62 years following 2011, a loss of 92.6 years from the cohort in an average year. However, each of the 61 previous years (before 2011) had some premature mortality that would contribute to the loss of potential employment in 2011. Because of population growth, the earlier cohorts are smaller, so the average 92.6 years' loss of employment for 2011 was scaled back in line with

the smaller population. The total loss of years of potential employment in 2011 from all the past cohorts would be 3,774 years (2,276 years for men and 1,498 years for women).

Table 33.
Estimated number of deaths from FASD-related conditions in Canada in 2011

Age group (years)	Males	Females	Total
0–19	26.9	20.0	46.9
20–29	16.7	12.5	29.3
30–44	32.0	23.4	55.4
45–59	79.5	30.3	109.8
60–69	54.4	31.4	85.7
Overall (0–69)	**209.4**	**117.6**	**327.1**

Table 34.
Estimated years of potential employment lost in Canada in 2011

Age group (years)	Males	Females	Total
0–19	1,246	927	2,173
20–29	619	464	1,083
30–44	784	574	1,358
45–59	795	303	1,098
60–69	17	10	27
Overall	**3,461**	**2,278**	**5,739**

Potential years of actual employment lost

Men spend on average 84% of the years between the ages of 15 and 62 in the paid labour force and women 80% (Statistics Canada, 2012c). Applying these ratios to the years of potential employment lost, the actual years of lost time in the labour force amounts to 3,107 years. This leaves 677 years when individuals were not in paid employment, though they may have been involved in contributions to the non-market economy (which are not included in these calculations). The unemployment rate in Canada in 2011 was 7.4 percent (Statistics Canada, 2012d). This gives the years of potential employment lost from premature mortality in 2011 as 2,877 (i.e., 3,107 x 92.6%).

The value of the productivity loss

The estimates of productivity loss in worker number terms can be converted into market value by multiplying the effective reduction in workers by their marginal dollar product. The standard assumption is that a worker's marginal product is the average wage.

The average weekly wage in Canada in 2011 was $840.07, equivalent to $43,804 annually (Statistics Canada, 2012e). However, as described in the previous module, to provide a more conservative estimate consistent with the assumption that average worker with FASD comes from a more socially deprived background with a lower average wage than a typical member of the labour force, it was assumed that in the "low" estimate the actual wages for a person from a background that generates FASD are 30% lower than average, or $30,663 annually. The discount was calculated by noting that the Canadian minimum wage is about 40% of the average wage, and by taking the midpoint between the two (Statistics Canada, 2010).

This gives a range for the 2011 productivity loss from the premature mortality of individuals with FASD of $88 million to $126 million. Thus, the national income of Canada would have been this much higher had there been no premature mortality from FASD and had the workers with FASD been typical members of the labour force (without compromised productivity due to FASD). This loss from premature mortality due to FASD is equivalent to 0.012–0.017% of wages and salaries paid to all employees in Canada in 2011.

DISCUSSION

These economic estimates of the monetary burden associated with premature mortality due to FASD may help policy-makers to determine the allocation of funds for FASD prevention. As previous research has noted, failure to include these costs in decision making (mostly due to a lack of available data) leads to an underestimation of societal costs (Lupton et al., 2004; Popova, Stade et al., 2011; Popova, Stade, Lange, Bekmuradov et al., 2012). Moreover, combined with other direct costs, such estimates provide an important measure of the total economic burden of FASD on society.

There are several limitations of this module. First, the *International Guidelines for Estimating the Costs of Substance Abuse* recommended using relative etiological fractions in estimates of social costs (Single et al., 2003). However, these fractions do not exist for FASD. Therefore, the etiological fractions were proxied by using deaths caused by FASD-related conditions. Second, the number of deaths of individuals with FASD was calculated by using mortality data for a single year (2008). Because the numbers are small, the numbers of deaths are likely to be volatile from year to year, and the standard errors of the resulting estimates large. Third, the larger labour force would have induced additional investment, further adding to Canadian output (gross domestic product [GDP]). The estimates do not include this effect. Thus, the estimate of the productivity loss from premature mortality from FASD is a conservative one, but it is also subject to a wide margin of error.

Further, only deaths among individuals with FASD of productive age were considered, as all computations were performed based on a prevalence-based model. Thus, many FASD-related infant deaths were not included. In

addition, deaths of individuals with FASD whose labour market participation was close to null (i.e., those over 69) were not included in this analysis.

Despite these limitations, the results of this module have confirmed that FASD is a significant burden to Canadian society. The sum of these productivity losses due to premature mortality and due to disability of individuals with FASD totals between $506 million and $1.36 billion in 2011, reinforcing our conclusion that there is likely to be a good return from measures that reduce the incidence of FASD.

Analyses and Approaches

As indicated in the theoretical model developed for estimating the economic impact of FASD in Canada (Popova, Stade, Lange, Mihic et al., 2012; Popova, Stade, Lange & Rehm, 2012), it is important that, wherever possible, all cost estimations should involve specific analyses, which include severity of the disability, sex-based analyses, and the diversity of Aboriginal communities and other cultural communities.

In the model, it was also specified that each life/developmental stage should be analyzed separately if there is reason to believe that the component cost would differ depending on the age of the individual.

As can been seen in the estimates presented throughout, specific analyses and life/developmental stages were incorporated in each estimate wherever possible (i.e., wherever data would allow, and if it was logical to do so). For instance, the cost of speech-language interventions was estimated by severity of the SLD, age group and sex. Also, the cost of productivity losses due to disability was estimated based on severity level of intellectual impairment of individuals with FASD.

The estimates of the burden and costs attributable to FASD were calculated for each province and territory of Canada wherever possible.

Unfortunately, it was not possible to take into consideration of the diversity of Aboriginal communities and/or other cultural communities due to the absence of data on the prevalence of FAS and FASD, as well as other necessary parameters, in these communities.

Gaps and Limitations

There were many challenges associated with estimating the burden and cost associated with FASD in Canada.

The first and most important gap in data is that the prevalence of FASD is currently unknown both in the general population and in particular communities of Canada. Therefore, for the purpose of this study, the most commonly cited rough estimates of the prevalence of FAS (1 per 1,000; PHAC, 2003b) and FASD (9 per 1,000; Roberts & Nanson, 2000) in the general population of Canada were used, which may not be accurate.

Furthermore, the prevalence of FASD in isolated Northern communities is thought, based on a handful of small and outdated studies (Asante & Nelms-Maztke, 1985; Robinson et al., 1987; Square, 1997; Williams et al., 1999), to be up to 20 times higher than the prevalence among the general population of Canada. However, all of these existing studies have numerous acknowledged limitations, such as being conducted in small communities and excluding individuals who did not meet the criteria for a diagnosis of FAS. Therefore, the use of such methods has likely resulted in inaccurate estimates of the prevalence of FAS and FASD. For this reason, it was deemed inappropriate to conduct a separate analysis on the burden and cost associated with FASD among Aboriginal communities.

This significant gap in the data highlights the need for accurate FASD prevalence and incidence data for Canada, which would facilitate accurate epidemiological and cost estimates in future.

Second, whenever prevalence estimates were available for the populations under study, the economic estimates made were dependent on the definitions and criteria used for diagnosing FASD, which were not always specified. It is unlikely that the estimates of the prevalence of FAS/FASD in the different service sectors were made using the same criteria/diagnostic guidelines. This could result in an error in estimating the number of individuals with FAS/FASD serviced within each sector, an error that is dependent on the specificity and sensitivity of the criteria/diagnostic guidelines used. Even though this potential error is unavoidable, it must be recognized.

Third, there are several cost drivers that it was not possible to include in the study, because the minimum data required to make a comprehensive or reliable cost estimate are currently not available. For instance, data on FASD within specific service sectors of interest (i.e., the number of individuals with FASD utilizing specific services) were completely absent.

Fourth, FASD captures only a portion of people affected by PAE. This is important, because a diagnosis of FASD sets a severity threshold that does not include a substantial number of people with adverse outcomes as a result of PAE. The implication of this is especially important for the current study, as the costs during pregnancy and prior to diagnosis cannot be captured.

Fifth, using a diagnosis of FASD as the criterion for obtaining utilization data has multiple constraints, including its infrequent use in admission and discharge notes, as well as the difficulty of identifying diagnostic evaluations and linking them with other cost sources.

Sixth, FASD is a familial disorder with high rates of recurrence. Referrals to diagnostic centres are typically made for individuals rather than sibships. The impact on the cost of several family members with FASD was also not considered in this study, but clearly has important implications on productivity losses, for example.

In general, the lack of empirical methods for collecting cost and utilization data needs to be overcome before any additional estimates can be made. Since FASD affects multiple systems, calculating the economic impact requires collaboration across many sectors and jurisdictions across Canada.

Due to data limitations, there were a number of cost components that could not be reliably estimated (in alphabetical order):

- administrative costs for transfer payments
- courts and policing
- crisis intervention
- family physician visits
- home support services
- job skills training
- parent/caregiver skills programs
- productivity losses of parents and other caregivers
- respite care
- social assistance for children with disabilities
- training of employers to adapt and accommodate staff with FASD
- transition into adulthood and independent living.

Additionally, several cost components were excluded from the study for various reasons:

- Private costs: The *International Guidelines for Estimating the Costs of Substance Abuse* (Single et al., 2003) do not recommend including “private cost” in social cost estimates. Even though the family burden

and costs associated with caring for a person with FASD are high, they should be estimated in a separate analysis (see Collins & Lapsley [2002] and Markandya & Pearce [1989] for a discussion of private and social costs).

- Welfare costs: It is assumed that a certain percentage of individuals with FASD require social services, such as physical support services (e.g., the provision of supported accommodation) or income support (e.g., unemployment or disability benefits, sickness benefits). The costs of such services are referred to as welfare costs, and are borne by the province or territory in which the individual lives. As with all cost components estimated in the current study, it is important to ensure that double counting does not occur (Collins & Lapsley, 2002; Single et al., 2003). For instance, if an individual with FASD receives welfare benefits it would be inaccurate to include both the productivity losses of that individual and the cost of welfare benefits. Therefore, the *International Guidelines* (Single et al., 2003) recommends not including welfare payments to individuals with FASD in the estimation of the economic cost associated with FASD.
- Intangible costs: Intangible costs or non-monetary costs, when reduced or eliminated, do not yield resources available for other uses (unlike tangible or monetary costs). Examples of intangible costs are emotional stress, pain, suffering and bereavement, which affect not only individuals with FASD but also their family or other caregivers. These costs represent a significant burden, but are difficult to quantify. However, though this task was not within the scope of the current project, it will be important in the future to assess the intangible impact of FASD on caregivers, patients, siblings and society.

Finally, the costs associated with FASD are, in theory, largely avoidable and can be reduced by effective social policies and intervention programs. Nevertheless, it must be noted that this cost study did not estimate potential savings, since the estimates include both avoidable and unavoidable costs. Also, this study should not be confused with a cost-benefit or cost-effectiveness analysis. However, the estimates of the burden and costs associated with FASD presented here can serve as a basis for meaningful cost-effectiveness analyses and, eventually, cost-benefit analyses of FASD policies and programs.

Thus, the scope and accuracy of the cost figures presented in this study are contingent on the current data availability. As more data become available, this study has the potential to be expanded, in which case some of the current assumptions may change, improve, or be omitted as necessary.

Conclusion

The cost associated with FASD in Canada in 2013 (based on the cost drivers included in this study) totalled approximately $1.8 billion (from about $1.3 billion as the lower estimate up to $2.3 billion as the upper estimate). A summary of the cost components estimated in the current study is presented in Table 35.

Table 35.
A summary of the costs attributable to FASD in Canada in 2013

Cost component	Year	Cost (as originally estimated)		Cost (adjusted for inflation for 2013)[a]	
		Lower estimate	Upper estimate	Lower estimate	Upper estimate
Direct costs					
Direct health care costs					
Speech-language interventions	2011	$72,536,442	$144,105,731	$74,410,300	$147,828,462
Prescription drug use	2012	$41,137,253	$41,137,253	$41,646,377	$41,646,377
Acute inpatient care, psychiatric care, emergency department visits and day surgery visits (FAS only)	2008/09	$6,671,861	$24,018,700	$7,092,453	$25,532,832
Screening and diagnosis	2011	$3,557,840	$7,319,312	$3,649,751	$7,508,394
Specialized addiction treatment	2010/11	$1,646,571	$3,594,456	$1,735,384	$3,788,335
Total		**$125,549,967**	**$220,175,452**	**$128,534,266**	**$226,304,401**
Direct law enforcement costs					
Corrections: youth	2011/12	$17,494,540	$17,494,540	$17,711,057	$17,711,057
Corrections: adults	2011/12	$356,195,566	$356,195,566	$360,603,927	$360,603,927
Total		**$373,690,106**	**$373,690,106**	**$378,314,984**	**$378,314,984**
Other direct costs					
Children and youth in care	2011	$57,917,032	$198,321,959	$59,413,222	$203,445,276
Supportive housing	2012	$22,169,578	$134,184,290	$22,279,783	$134,851,320
Long-term care	2012	$78,176,934	$78,176,934	$78,565,552	$78,565,552
Special education	2011/12	$53,530,285	$53,530,285	$54,192,788	$54,192,788
Prevention and research	Various years	$7,508,000	$7,508,000	$7,508,000	$7,508,000
Total		**$219,301,829**	**$471,721,468**	**$221,959,345**	**$478,562,936**

Cost component	Year	Cost (as originally estimated)		Cost (adjusted for inflation for 2013)[a]	
		Lower estimate	Upper estimate	Lower estimate	Upper estimate
DIRECT COSTS					
Productivity losses due to disability	2011	$418,000,000	$1,080,000,000	$428,798,333	$1,102,462,562
Productivity losses due to premature mortality	2011	$101,000,000	$126,000,000	$103,100,666	$128,620,632
Total		**$519,000,000**	**$1,206,000,000**	**$531,898,999**	**$1,231,083,194**
OVERALL					
		$1,237,541,902	**$2,271,587,026**	**$1,260,707,594**	**$2,314,265,515**

a Adjusted for inflation, to 2013 cost figures, using the Bank of Canada inflation calculator (http://www.bankofcanada.ca/rates/related/inflation-calculator/

The highest contributor to the overall FASD-attributable cost was the cost of productivity losses due to disability and premature mortality, which ranged from about $532 million to $1.2 billion. The second highest contributor to total cost was the cost of corrections, which accounted for $378.3 million, and the third highest contributor was the cost of health care, ranging from $128.5 million to $226.3 million.

Overall, productivity losses due to disability and premature mortality, which resulted in 42% of the total FASD-attributable cost in Canada, constituted the largest part of the social costs of FASD. This is a common finding of all social cost studies in the field of substance abuse and within the field of cost-of-illness studies in general. Figure 15 provides an overview of the relative proportions (based on the lower estimates, whenever available) for each of the cost components estimated.

The two major categories of direct costs attributable to FASD were the cost of corrections and the cost of health care. The cost of corrections was by far the largest component of the overall direct cost, which accounted for 30% of the total cost of FASD. However, it should be noted that the direct cost of law enforcement includes two other major components, the cost of policing and courts, which were not possible to quantify in a reliable manner due to data limitations.

Health care costs were the third largest category, accounting for 10% of the total cost attributable to FASD. The overall cost of health care included the cost of speech-language interventions, prescription drug use, acute inpatient care, psychiatric care, emergency department and day surgery visits, screening and diagnosis, and specialized addiction treatment.

The cost of corrections and other direct costs such as the cost of children and youth in care, estimated in the current study, can serve as an important indication that FASD is a major public health and social problem. It is evident that FASD consumes a huge amount of resources, both economic and societal, in Canada.

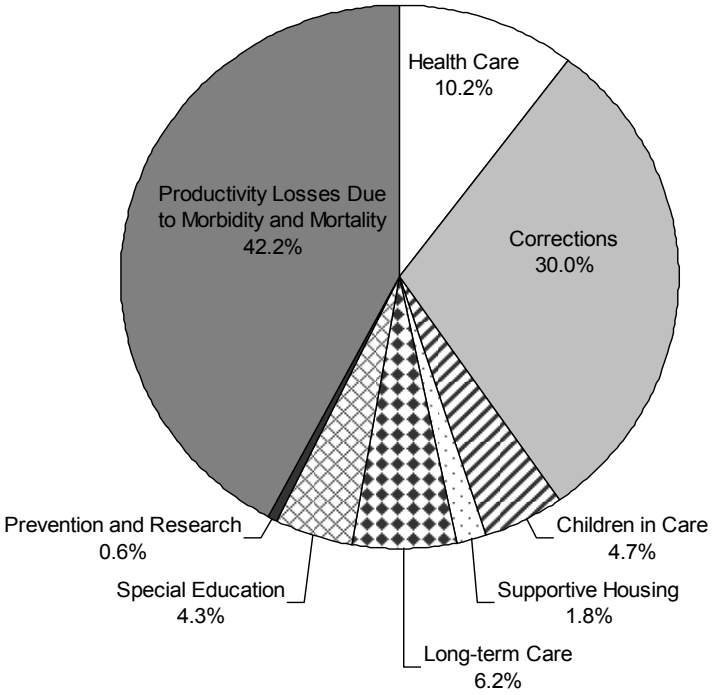

Figure 15. Percentage of main cost components attributable to FASD in Canada in 2013

Behind the cost figures is the dramatic toll on individuals with FASD themselves, measured in years lost due to premature mortality, years of productive life lost due to primary disabilities (such as health problems), and low quality of life due to secondary disabilities (such as unemployment, poverty, homelessness, incarceration). In addition, there are non-monetary (or intangible) costs such as pain, suffering and stress, associated with the numerous disabilities of individuals with FASD, which are very difficult to quantify. The intangible costs are borne not only by individuals with FASD themselves, but also by their parents/caregivers, siblings and other family members (for example, guilt of mother, bereavement, stigmatization).

Even though this study used the most conservative assumptions (meaning that the estimated costs are the minimal costs associated with FASD for Canadian society), it is clear that the cost of FASD in Canada is enormous. However, these costs represent only part of the full picture—that is, there are a number of other cost components (see economic model in Popova, Stade, Lange, Mihic et al., 2012; Popova, Stade, Lange & Rehm, 2012) that need to be estimated in the future, when data become available. Also, it must be recognized that more children with FASD are born every year—thus, the costs presented here as certainly not "one-time" costs.

The major challenges faced in estimating the cost of FASD in Canada are that either there are no FASD-specific data, or data are not readily available for many cost drivers (see the section "Data Gaps and Limitations"). Therefore, there is an urgent need for a centralized reporting system in which FASD-specific data from various sectors can be stored and shared. Furthermore, FASD should be officially recognized as a

medical diagnosis and, as such, included in the DSM and the ICD (currently, FAS is the only FASD-related diagnosis that is defined and assigned an ICD-9 and ICD-10 diagnostic code).

Only very recently, after a long battle, Neurodevelopmental Disorder associated with Prenatal Alcohol Exposure (ND-PAE) was included in the Appendix of the fifth edition of the DSM (APA, 2013) as a condition warranting future research before it can be considered for clinical use and inclusion in future editions of the DSM as a formal disorder.

The formal recognition of FASD will trigger its inclusion in medical school curricula and other professional licensing or certification examinations, and knowledge of FASD will be recognized as necessary and made a mandatory component of the training of health care providers, psychiatrists, psychologists, social workers and justice system personnel, among other professionals. If such training were standard practice, the diagnosis and monitoring of FASD would be improved. In addition, the inclusion of all FASD diagnostic entities in the DSM and the ICD would form the impetus for further research, the development of new and more effective treatment methods, and an increase in the number of diagnostic clinics or the capacity of existing ones.

FASD has emerged relatively recently as a public health priority in Canada. This is due in part to the recognition of the substantial costs associated with the care and services required by individuals with FASD, but is also due to the increased awareness of the potential to reduce these costs by implementing effective prevention programs. Prevention efforts need to focus on reducing the number of affected individuals, the severity of the resulting impairments, and the premature mortality due to PAE (Burd et al., 2004; Conry & Fast, 2000; Habbick et al., 1997). These efforts could be accomplished by eliminating PAE or, at the very least, by reducing the number of women who drink heavily during pregnancy. While no safe level of alcohol exposure during pregnancy has been identified, it is widely accepted that heavy maternal drinking confers the greatest risk of having a child with FASD (Abel, 1998; Stratton et al., 1996). As such, a cost-savings approach would be to focus on improving substance abuse treatment programs for women. Another particularly compelling strategy would be to reduce or eliminate the secondary disabilities that occur among individuals with FASD, which are impairments that manifest after the birth of an affected individual (Streissguth et al., 2004; Burd et al., 2009).

Quantifying the overall cost associated with FASD is crucial for depicting the substantial impact that PAE has on society to policy developers and decision-makers alike, with the ultimate goal being to initiate preventive interventions that address FASD. The authors of this study truly hope that the burden and cost associated with FASD, presented in this report, will increase awareness of the detrimental effects of alcohol consumption during pregnancy, inform policies and program development to benefit those living with FASD and their families, and facilitate prevention initiatives targeting pregnant women and women of childbearing age in order to prevent alcohol-affected births, not only in Canada, but around the world.

We will act, won't we?

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Appendix A

The following is a list of peer-reviewed publications from this project, which are available either from the links provided below or from the authors:

Easton, B., Burd, L., Sarnocinska-Hart, A., Rehm, J. & Popova, S. (2014). Productivity losses because of morbidity attributable to Fetal Alcohol Spectrum Disorder in Canada: A demographic approach. *Journal of Studies on Alcohol and Drugs, 75*(6), 1011–1017. Available from http://www.jsad.com/jsad/article/Productivity_Losses_Because_of_Morbidity_Attributable_to_Fetal_Alcohol_Spec/5012.html

Easton, B., Sarnocinska-Hart, A., Burd, L., Rehm, J. & Popova, S. (2015). The cost of lost productivity due to Fetal Alcohol Spectrum Disorder-related premature mortality. *Journal of Population Therapeutics and Clinical Pharmacology, 22*(1), e3–e8. Available from www.jptcp.com

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Popova, S., Lange, S., Burd, L., Chudley, A., Clarren, S. & Rehm, J. (2013). Cost of Fetal Alcohol Spectrum Disorder diagnosis in Canada. *PLoS ONE 8* (4), e60434. doi: 10.1371/journal.pone.0060434. Available from www.plosone.org/article/fetchObject.action?uri=info%3Adoi%2F10.1371%2Fjournal.pone.0060434&representation=PDF

Popova, S., Lange, S., Burd, L., Nam, S. & Rehm, J. (In press.) Special education of children with Fetal Alcohol Spectrum Disorder. *Exceptionality.*

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