Hepatitis A Seroprevalence and Risk Factors among Daycare Educators

Cristin J. Muecke
Department of Epidemiology and Biostatistics
McGill University, Montréal
July, 2002

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements of the degree of Master of Science

Your file Votre référence
ISBN: 0-612-85810-3
Our file Notre référence
ISBN: 0-612-85810-3

ABSTRACT

Background: Daycare centres play a role in hepatitis A infection epidemiology; however, there is little information on this infection among daycare educators in Canada.

Objective: To determine hepatitis A seroprevalence and risk factors among daycare educators.

Methods: Directors and educators from randomly selected daycare centres in Montreal completed questionnaires on daycare-level and educator-level characteristics. Sera were collected during on-site visits.

Results: The seroprevalence of hepatitis A among the 492 participating educators was 35.6% (15.9% among Canadian-born educators). Risk factors included: region of birth by income-level (OR=20.8; 95% CI: 9.4, 46.0); report of previous hepatitis A vaccination (OR=6.1; 95% CI: 2.9, 13.0); travel to endemic areas (OR=2.4; 95% CI: 1.3, 4.2); and age ($OR_{5\text{-}yr}$= 1.5; 95% CI: 1.3, 1.7). For Canadian-born educators, a further association was found between seropositivity and years worked in daycare ($OR_{5\text{-}yr}$=1.3; 95% CI 1.0, 1.8).

Conclusion: In a non-outbreak situation, daycare educators share similar risk factors for seropositivity with the general population. Canadian-born educators appear to be placed at additional risk by working in daycare centres, and may benefit from vaccination.

RÉSUMÉ

Contexte : Les garderies sont impliquées dans la transmission de l'hépatite A. Cependant, peu d'information est détenu en ce qui concerne cette infection chez les éducatrices.

Objectifs : Déterminer quels sont les facteurs de risque de transmission et la séroprévalence de l'hépatite A chez les éducatrices en garderie.

Méthodes : Un questionnaire a été rempli par des directeurs et des éducatrices qui provenaient de garderie qui avaient été sélectionnées de manière aléatoire à travers l'île de Montréal. Ces questionnaires comportaient des questions sur des caractéristiques de la garderie et de l'éducatrice. Un prélèvement sanguin était fait durant la visite.

Résultats : La séroprévalence d'anticorps contre l'hépatite A chez les 492 participants était de 35,6% (15,9% chez les éducatrices nées au Canada). Les facteurs de risques incluaient le lieu de naissance par le niveau de revenu (OR=20,8; IC 95% :9,4-46,0); une vaccination antérieure contre l'hépatite A (OR=6,1; IC 95% :2,9-13,0); voyage dans un endroit endémique (OR=2,4; IC 95% :1,3-4,2) et l'âge ($OR_{5\text{-années}}$=1,5; IC 95% :1,3-1,7). Pour les éducatrices nées au Canada, une association supplémentaire existait entre la prévalence d'anticorps et le nombre d'années travaillées à la garderie ($OR_{5\text{-années}}$=1,3; IC 95% :1,0-1,8).

Conclusion : En l'absence d'éclosion, les risques associés à la séroprévalence chez les éducatrices de garderie sont similaires à ceux de la population générale. Les éducatrices nées au Canada semblent plus à risque lorsqu'elles travaillent en garderie. Ce groupe pourrait bénéficier de la vaccination.

PREFACE

This thesis is written as a collection of manuscripts submitted for publication, joined and integrated through supplementary, connecting texts. This conforms to the guidelines and requirements of a thesis-by-manuscript at McGill University, as described below.

> Candidates have the option of including, as part of the thesis, the text of one or more papers submitted or to be submitted for publication, or the clearly-duplicated text of one or more published papers. These texts must be bound as an integral part of the thesis.
>
> If this option is chosen, connecting texts that provide logical bridges between the different papers are mandatory. The thesis must be written in such a way that it is more than a mere collection of manuscripts; in other words, results of a series of papers must be integrated.
>
> The thesis must still conform to all other requirements of the "Guidelines for Thesis Preparation". The thesis must include: a table of contents, an abstract in English and French, an introduction which clearly states the rationale and objectives of the study, a review of the literature, a final conclusion and summary, and a thorough bibliography or reference list.

Additional material must be provided where appropriate (e.g. in appendices) and in sufficient detail to allow a clear and precise judgment to be made of the importance of originality of the research reported in the thesis.

In the case of manuscripts co-authored by the candidate and others, the candidate is required to make an explicit statement in the thesis as to who contributed to such work and to what extent. Supervisors must attest to the accuracy of such statements at the doctoral oral defense. Since the task of the examiners is made more difficult in these cases, it is in the candidate's interest to make perfectly clear the responsibilities of all the authors of the co-authored papers.

Throughout the thesis, all gender-specific pronouns will be given in the feminine form for simplicity and clarity. Thus reference to 'her' or 'she' will be taken to mean 'her/him' or she/he'.

CONTRIBUTION OF AUTHORS

As first author of both manuscripts, I was involved with the organization and design of the larger daycare educator seroprevalence/seroconversion study, which involved development of study instruments and a protocol to measure seropositivity for five infections in daycare educators – hepatitis A, rubella, varicella, cytomegalovirus, and parvovirus B19. I coordinated the daycare selection and contact, questionnaire and sera collection from the centres, data entry and distribution of individual serological results to participants, carried out the statistical analyses, and wrote all scientific manuscripts. Dr. Theresa Gyorkos, as thesis supervisor, contributed to all phases of the research, from study conception and planning to the publication and dissemination of study results. Dr. Elham Rahme provided feedback for and guidance with the statistical analyses, participated in reviewing the manuscripts, and aided in the interpretation of study results. Dr. Julio Soto was involved in study conception and design, participated in reviewing the manuscripts, and provided feedback and advice regarding study interpretation. Dr. Claire Béliveau provided technical expertise regarding the processing of sera and interpretation of the results, and participated in manuscript review. Mme Suzanne Archambault aided with all phases of the data collection, from initial contact of the daycare centres to questionnaire and sera collection, and participated in manuscript review.

ACKNOWLEDGEMENTS

Many people have contributed their time and/or resources to the study that forms the backbone of this thesis, without whom this work would not have been possible. The opportunity to conduct a primary epidemiologic study for my Masters thesis has provided me with an invaluable experience that will greatly influence my future career in public health.

First and foremost, I would like to thank Dr. Theresa Gyorkos for convincing me that conducting all phases of an epidemiological study, from design issues to data collection and analysis, was both feasible and a worthwhile goal for a Masters student. She has provided me with valuable mentorship, while at the same time encouraging a truly collaborative relationship. I will fondly remember her enthusiasm and dedication.

I am indebted to Mme Suzanne Archambault for her enthusiastic and professional approach to the data collection phase of the research. She quickly became an integral part of the research team and a valued resource person for both the study participants and myself.

I would like to thank Dr. Claire Béliveau and the laboratory staff at Hôpital Maisonneuve-Rosemont for their professional and efficient analysis of serum samples. Dr. Béliveau in addition provided us with invaluable support in subsequent interpretation of results. I would also like to acknowledge Evelyne Kokoskin and the staff at the

McGill Centre for Tropical Diseases at the Montreal General Hospital for allowing us to use their facilities for initial serum storage.

Dr. Elham Rahme provided me with valuable guidance on analytical methods and the interpretation of study results. I will fondly remember her patience and helpful explanations.

Dr. Julio Soto was instrumental in the conception and design of the study, and provided guidance during the data collection phase, as well as aiding in the interpretation of study results and reviewing manuscripts.

I am indebted to the staff and students of the McGill Department of Epidemiology and Biostatistics for a solid academic foundation. I would also like to acknowledge my colleagues in the Direction de la santé publique de Montréal-Centre for providing guidance from a public health perspective.

I have received invaluable personal support from my husband, Chris, and from my parents, Anne and Gunter, for which I will always be grateful.

Finally, none of this would have been possible without the enthusiastic participation of Montreal's daycare educators and directors. Their support of the project and welcoming attitude made the data collection phase a very enjoyable experience.

DEDICATION

To the health and continued well being of a hard-working and under-appreciated group of professionals - daycare educators.

TABLE OF CONTENTS

LIST OF TABLES

Section 1 – Introduction

Manuscript #1: Hepatitis A Risk among Daycare Educators

Manuscript #2: Hepatitis A Seroprevalence and Risk Factors among Daycare Educators

Section 5.2 – Supplementary Results

LIST OF FIGURES

Manuscript #2: Hepatitis A Seroprevalence and Risk Factors among Daycare Educators

LIST OF APPENDICES

LIST OF ACRONYMS

CDC – Centers for Disease Control and Prevention

CI – confidence interval

CMV – cytomegalovirus

CPE – 'Centre de la petite enfance'

ECE – early childhood education

HAV – hepatitis A virus

HCV – hepatitis C virus

HIC – high-income country

HMR – Hôpital Maisonneuve-Rosemont

IC – interval de confiance

IVDU – intravenous drug user

LIC – low-income country

MFE – 'Ministère de la famille et de l'enfance'

MGH – Montreal General Hospital

MIC – middle-income country

MSM – men who have sex with men

OR – odds ratio

1. INTRODUCTION

1.1 The Growth of Daycare in Canada and Quebec

With changes in the workforce and family structure, an increasing number of children are attending daycare centres on a regular basis. Approximately 65% of all women with children younger than one year of age are in the work force in the United States (Reves and Pickering, 1992). Canadian statistics reveal that about 70% of mothers of children less than 6 years of age are in the workforce (Canadian Child Care Federation, 2000). Child daycare provision originally arose from attempts to increase women's entry into the workforce, and today most families support themselves on more than one income. The shrinking size of the nuclear family is also a contributing cause for many children being integrated into daycare services for the benefits of early socialization and education. With the increasing mobility of society, many families find themselves with no means of extended family childcare and thus must use regulated services. Table 1 illustrates the distribution of children and caregivers in various forms of childcare in Canada as of 1994-95, the most recent period for which national data are available.

Table 1: Children and caregivers in various forms of childcare in Canada

Type of Child Care	Estimated No. of Children 0-5 years	Estimated No. of Caregivers
Regulated Care		
- *Child Care Centre*	188,000	42,000
- *Family Child Care*	79,800	15,000
Unregulated Care		
- *Family Child Care*	303,000	155,000
- *In Child's Home*	127,600	115,000
Other Early Childhood Service		
- *Kindergarten*	512,900	21,000
- *Early Intervention Program*	14,100	500

Source: 1994-95 Statistics Canada data, as cited in Beach *et al.*, 1998

In Quebec, daycare services have been integrated into the government's family policy since 1997, alongside integrated childhood benefits and paid parental leave. The Quebec government has taken responsibility for the provision of early childhood care services, and has actively approached the problem as part social program, part educational service. It has been estimated that over half of Quebec families not currently using child daycare facilities would take advantage of regulated care if it were available (Bureau de la statistique du Quebec, 1999). This is largely in response to the policy adopted by the National Assembly in 1997 that provides daycare at a cost of $5/day. Quebec is now planning to increase regulated daycare availability by 15,000 spaces annually, to a total of 200,000 spaces by 2005-06 - with the resultant creation of 12,000 new jobs for educators (Canadian Child Care Federation, 2001). This dramatic situation of increased demand for quality regulated daycare spaces, and increased employment opportunities for daycare educators, is also being observed in other Canadian provinces.

These changes in social organization demand a concerted effort on the part of governments, health care professionals, parents, and daycare centres to ensure the health and well being of both the children involved and those charged with their care. Although offering significant benefits, this expanding social program also represents an important challenge to the public's health.

1.2 Occupational risks for daycare educators

There are many occupational risks confronting daycare educators. These include injuries and musculo-skeletal disorders, environmental exposures, psychological/stress-related problems, and exposure to infectious diseases (Table 2).

Table 2: Occupational health hazards in childcare

Health Hazard Category			
Infectious diseases	**Stress**	**Injuries**	**Environment exposure**
Diarrhea Eg. – *Shigella*, *Giardia*, *Salmonella*, rotavirus	Undervalued work	Back injuries	Cleaning and disinfecting solutions
Hepatitis Eg. – A, B, C	Inadequate leave	Bites	Indoor air pollution
Skin Eg. – scabies, lice, impetigo, ringworm	Inadequate pay/benefits	Falls	Noise
Respiratory tract Eg. – influenza, tuberculosis, adenovirus, *Streptococcus*	Insufficient professional recognition	Dermatitis	Odour
Vaccine-preventable Eg. – measles, polio, mumps, pertussis	Inadequate training		Art materials
Meningitis Eg. – bacterial, viral	Fear of liability		
Herpes virus group Eg. – simplex, roseola, varicella-zoster	Responsibility for children's welfare		
Special concern in pregnancy Eg. – rubella, parvovirus B19, cytomegalovirus	Inadequate facilities		
	Working alone		

Source: Adapted from American Public Health Association & American Academy of Pediatrics *et al*, 2002.

Injuries and musculo-skeletal disorders are generally related to strain from lifting children or equipment, from using furniture and equipment that are designed specifically

for children, and from undertaking activities with older children requiring increased physical endurance (Bright and Calabro, 1999).

Environmental exposures are centre-dependent, but can include exposure to noise, insufficient ventilation, dampness and mould ('sick building syndrome'), and chemicals (disinfectants, art supplies) (Bright and Calabro, 1999).

Sources of stress are numerous, not the least of which are those associated with ensuring the safety and security of the children and being isolated from other adults. Organizational and administrative issues include limited resources, low wages, understaffing, work role conflict/ambiguity, lack of benefits, lack of breaks, and unpaid overtime (Bright and Calabro, 1999). Increasingly, educators are bearing the brunt of the inability of the childcare sector to respond to societal demands for high quality care (Beach *et al*, 1998). These issues can lead to low job satisfaction, which in turn causes high turnover rates.

Exposure to infectious diseases occurs as a consequence of grouping larger numbers of susceptible individuals in a common setting. In the case of daycare centres, this results in a significant increase in the risk of acquiring a variety of infections, both for the children and their adult caregivers. The majority of daycare educators are women of child-bearing age. Pregnant women are especially at risk due to several diseases that can seriously affect the unborn fetus.

1.3 Infections in the Daycare Setting

Young children are generally more prone to infections due to the immaturity of their immune systems and their still early introduction to proper hygiene practices (Churchill and Pickering, 1997). After the initial few months of life, children lose the protection provided by maternal antibodies and have yet to develop their own immunological protection. Young children have not yet established good hygiene practices, and can contaminate their environment with respiratory secretions, urine, and feces. As a result, the age-specific attack rates of most infectious diseases are high in the first few years of life (Klein, 1986). The combination of immunological susceptibility, high incidence of infections, and poor hygiene becomes more potent when several children are placed in close proximity in a shared environment.

Group care for children has been associated with increased incidence of various infectious diseases. A prospective study conducted to determine the frequency and severity of infections in three types of child care (home care, group care [2-6 children], or daycare [>7 children]) found that children in group care and daycare were sick longer, more often, and more severely than children in home care (Wald *et al*, 1988). Recent studies continue to illustrate this association (National Institute of Child Health and Human Development, 2001). Studies have also documented the increased risk for specific diseases or disease groupings (Louhiala *et al*, 1997; Nafstad *et al*, 1999; Berg *et al*, 1991). Respiratory tract and enteric infections are the most common infections found

in the childcare setting – others include skin and vaccine-preventable infections (Table 2).

While the grouping of children itself can increase the incidence of infections, physical and environmental features of the childcare facility, such as the amount of space allotted to children, availability of sinks and toilets, and the physical layout, can also favor the transmission of infectious agents. Additionally, there are administrative and organizational features (eg. policies regarding maternity and sick leave, vaccination requirements, mixing children of different age groups) that can contribute to an increased risk of infectious disease.

This increased incidence of infectious diseases poses health risks not only for the children attending the centres, but also for the parents and the staff of the daycare centres. Some respiratory and gastrointestinal infections that are relatively benign or sub-clinical in childhood, such as varicella and hepatitis A infections, can cause significant disease in susceptible adults. In addition, some benign or sub-clinical conditions, such as rubella, cytomegalovirus, and parvovirus B19, pose a risk to the unborn fetus. Daycare centres have also been found to play a role in the spread of infections outside of the daycare setting in epidemic situations, leading to a wider public health concern (Desenclos and MacLafferty, 1993; Venczel *et al*, 2001).

While much literature has been devoted to the control of infection in daycare centres for the benefit of the children, there is a paucity of infection information regarding the adult

caregivers. As a result, infection control measures taken rarely take the specific needs of educators into account. Further research is needed to delineate the infectious disease risks for educators so that daycare centre policies can meet the needs of both the children and adults who share this common environment.

2. LITERATURE REVIEW

The following manuscript describes the current evidence of a link between daycare centre educators and adult hepatitis A infection in North America. It details why daycare educators may be a vulnerable occupational group with respect to risk of certain infectious diseases. It describes the epidemiology of hepatitis A with regard to known demographic, lifestyle, hygiene, and socioeconomic risk factors. It then examines the literature linking the occurrence of hepatitis A to daycare centre populations, and the daycare-specific risk factors related to hepatitis A outbreaks. It suggests that daycare centres as a risk factor for hepatitis A infection in Canada have not been adequately investigated.

This manuscript was submitted to the Canadian Journal of Public Health on February 14, 2002. Minor grammatical changes have been made to this manuscript following its submission.

Following the manuscript is an additional section that describes the hepatitis A situation in the general population in the study region of Quebec, and Montreal, specifically. There is no documentation to date on hepatitis A infection in daycare educators in Quebec.

2.1 Manuscript #1 -

Hepatitis A Risk among Daycare Educators

Cristin J. Muecke MD, Theresa W. Gyorkos PhD

Department of Epidemiology and Biostatistics
McGill University
and
Division of Clinical Epidemiology
Montreal General Hospital Research Institute

Montreal, Quebec, Canada

Address for Correspondence and Reprints:
Dr. Theresa W. Gyorkos, Division of Clinical Epidemiology
Montreal General Hospital, 1650 Cedar Avenue
Montreal, Quebec, Canada, H3G 1A4
Tel: 514-934-1934 ext. 44721
Fax: 514-934-8293
Email: theresa.gyorkos@mcgill.ca

Abstract

Hepatitis A is the most frequently reported vaccine-preventable disease in North America, and daycare centres play a significant role in its epidemiology. A review of the literature was conducted to assess the scientific evidence of occupational risk of this infection to daycare educators. Risk factors include age, socioeconomic status, foreign birth, employment in large centres (>50 children) or centres with long opening hours (>15 hours/day), regular changing of diapers, contact with children <3 years of age, and working in for-profit centres. Most of this knowledge is based on outbreak investigations conducted in the United States. Research to obtain Canada-specific information on both seroprevalence and seroconversion would contribute to determining the value of a hepatitis A vaccination policy for this occupational group.

Key words: hepatitis A, childcare, daycare centres, epidemiology, occupational risk

Introduction

Approximately 70% of Canadian mothers of children less than 6 years of age are now in the workforce, leading to a significant number of children attending daycare. [1] This has led to increased demand for quality regulated daycare spaces, and increased employment opportunities for daycare educators, in all Canadian provinces. For example, due in part to the policy of $5/day daycare, capacity in Quebec will be increased annually by 15,000 spaces to a total of 200,000 spaces by 2005-06, with the creation of 12,000 new educator jobs. [2]

Child daycare has been associated with increased incidence of various infectious diseases, including otitis media, *H. influenzae* type b, varicella, cytomegalovirus, diarrhea, and hepatitis A. [3] This poses health risks not only for the children attending the centres, but also for parents and daycare staff. [4] Certainly, this risk can simply mean an increase in bothersome but relatively benign infections. However, it is important to consider that certain conditions that are relatively benign or sub-clinical in childhood, such as varicella and hepatitis A infections, can cause significant disease in susceptible adults. In addition, some benign or sub-clinical infections, such as rubella, cytomegalovirus, and parvovirus B19, pose a risk to the unborn fetus.

Daycare Educators: A vulnerable occupational group

Daycare educators in Canada are primarily young women. Approximately 98.3% are female, and 74.3% are in their childbearing years (20-39 years). [5] In comparison, only

43.7% of kindergarten and elementary school teachers are under 40 years of age, and 82.2% are female. [6]

Educational requirements in daycare centres vary and are inconsistent among provinces. Only 68.5% of educators in daycare centres have a post-secondary education, compared to 95.1% of kindergarten and elementary school teachers. Centre-based educators with a post-secondary diploma or certificate, working full time and for the full year, receive less than 60% of the annual income of the average full-time, full-year worker in other occupations with the same education. Data from the 1991 Statistics Canada census showed that the full-time average annual employment earnings of a daycare educator ($18,972) were almost half that of kindergarten/elementary school teachers ($33,747) with the same education. [6] In both Canada and the United States, low wages place many centre-based educators near or below the poverty line.

Working conditions are not ideal. Based on 1991 data, there is a relatively high turnover rate of 29%. Nationally, centre-based daycare educators report working an average of 42 hours per week, even though they are only paid for 37.8 hours. Many do not receive benefits that are routinely given in other workplaces, such as paid sick leave, extended health care, or long-term disability. Generally there are few organized bodies that advocate on behalf of daycare educators – in Canada, only 20% of educators in centre-based programs are members of unions, and only 5% affiliate with professional organizations. [6]

Daycare educators face a variety of occupational health and safety hazards – biological, chemical, and physical. The majority of these hazards are not adequately or consistently addressed by health and safety standards, although protection of the children is clearly addressed. [7] Generally, the responsibility for the health and safety of daycare educators rests with the management of the centres, and the educators themselves. This is problematic since under-funded centres may not maintain adequate standards for their educators, and demands for more funding often depend directly on the ability of parents to pay increased fees.

Hepatitis A Infection

Hepatitis A infection is of particular interest for daycare educators because it is benign in childhood but can cause serious disease in adults. It is highly infectious and easily transmitted in the daycare setting – in fact, daycare centres have been identified as one source of community-wide hepatitis A outbreaks among adults. [8] A vaccine is currently available, offering new opportunities for preventive care.

Although considered one of the more benign viral hepatitides, hepatitis A remains one of the most frequently reported infectious diseases, and it is the most frequently reported vaccine-preventable disease in North America. [9] Notification to the local health authority is mandatory for hepatitis A in Canada, although a high degree of underreporting is presumed. [10]

Hepatitis A has a 2-6 week incubation period during much of which it is infectious – this often leads to delayed diagnosis and control of outbreaks. It is generally asymptomatic or mild in childhood, with less than 10% of children <6 years of age developing jaundice. However, morbidity increases with age, and the incidence of symptomatic disease is highest in the 15-29 year age group. [9] In the adult, the illness is generally of acute onset, with fever, malaise, fatigue, anorexia, nausea/vomiting, and abdominal discomfort, followed within a few days by jaundice in about 75% of cases. It varies in severity from a mild illness lasting 1-2 weeks to a severely disabling disease lasting several months. In the United States about 20% of infected adults aged 15-39 years are hospitalized[11], while in Canada about 25% of all reported adult cases require hospitalization. [10] In 15% of adults, symptoms persist for > 4 months after onset, leading to prolonged and relapsing illness lasting up to one year.[12] Longer chronic infectious states are not known to occur. Although it can occasionally lead to fulminant hepatic failure and death, hepatitis A generally has a low case-fatality rate (< 1%).

Immunoglobulin, when administered before exposure or during the early incubation period, is effective in preventing symptoms. A vaccine is approved for use in persons > 2 years of age. A complete course provides protection for at least 20 years. The Canadian Immunization Guide recommends vaccination for travelers and those likely to be posted abroad, residents of endemic communities or institutions, people with lifestyle determined risks (illicit drug use and male homosexual activity), and people with chronic liver disease. [10] Although there is no Canadian recommendation for vaccination of

daycare staff (due to insufficient data), it has been recommended by investigators in the United States.[27]

Hepatitis A is almost exclusively transmitted through the fecal-oral route, via direct contact, contaminated water and food. It has been associated with daycare centres, international travel to endemic areas, injection drug use, and male homosexuals.[9] Table 1 lists both general and daycare specific risk factors.

Hepatitis A infection is generally associated with poor environmental sanitation, and thus lower socio-economic status and overcrowding. However, the frequency of symptomatic adult infection in developed countries is in fact increasing, since improved sanitation means that many are not exposed until later in life. While seroprevalence estimates approach 100% in adults in developing countries, in the United States they are approximately 30-40%.[12] Travel to and/or birth in endemic areas increases a person's risk of exposure to hepatitis A.

One longitudinal study conducted in the United States from 1983-95 examined patterns of symptomatic hepatitis A disease incidence and trends in sources of infection.[9] This type of information is not readily available for Canada. Information on > 4000 cases, which met both clinical and serologic criteria, was collected through sentinel surveillance. The median age of symptomatic cases was 26 years, and the highest average incidence occurred in the 15-29 year age group. The most frequently reported sources of infection were: history of injecting street drugs (14%), household or sexual

contact with a hepatitis A patient (12%), attending or working in a daycare centre or having someone in the household who does (11%), and history of international travel (4%). Of those who reported no known source of infection, 33% had a child <5 years old in the household. These data suggest that child-adult transmission may account for a significant proportion of unknown sources, and that persons reporting daycare exposure are at increased risk. This is confirmed by CDC national surveillance data from 1983-95 that shows daycare exposure as second only to contact with a hepatitis A case in terms of risk factor attributable cases.[11] In fact, daycare exposure accounts for more cases than international travel, thus putting into question the current policy of recommending vaccination for international travelers but not for daycare educators.

Occupational studies of hepatitis A risk are few. A 2-year historical prospective study in Israel found that daycare centre and kindergarten staff (SIR=5.47; 99% CI: 3.50, 8.57) were at the highest risk of hepatitis A infection after yeshiva students (after controlling for age, gender, ethnicity, and time of immigration to Israel). Twenty-four occupational groups were included in the analysis, including medical (SIR=3.77; 99% CI: 1.78, 8.14), food industry (SIR=5.41; 99% CI: 1.92, 15.25), and sewage workers (SIR=0.88; 99% CI: 0.38, 2.03). [13]

In Germany, hepatitis A was found to rank third among reported infectious occupational diseases. One of every seven hepatitis A infections was severe enough to require compensation, and compensation rates were comparable to that of hepatitis B. Comparisons of the relative risk of hepatitis A immunity in persons < 30 years of age working in various professions showed that daycare centre staff had a relative risk of 3.1

compared to the general population – a value higher than most hospital professions (0.93-1.84) and food handlers (2.49).[14]

A number of studies ascertaining the seroprevalence of hepatitis A have been conducted in Canadians, some of whom are of similar socio-demographic profile to daycare educators (Table 2). [15-22]

Daycare-specific risks

The age-specific incidence of most communicable diseases peaks within the first few years of life. As a result, adults with child contacts acquire infections more frequently than adults without them. This risk is due to both the high frequency of infections in young children and their propensity to transmit microorganisms in their environment, through underdeveloped hygiene and toilet habits. In addition, the incidence of many infectious diseases, including hepatitis A, is higher in children attending daycare than children cared for at home.[23]

Daycare centres with large enrollments of infants and toddlers have been shown to play a major role in the epidemiology of hepatitis A. Prolonged outbreaks can occur due to the poor clinical specificity of disease manifested in children and the virus's relatively long incubation period. While children tend to be asymptomatic, they can have prolonged viral excretion (up to 6 months) and more readily spread infection in their environment. Although there have been temporal changes in the reported incidence of hepatitis A over time, the proportion of hepatitis A cases in the United States in which daycare was

considered to be the primary or only potential source of exposure has remained over 10%. [24]

The most important risk factor for infection in adults is contact with young children in diapers. [23] Larger centres (>50 children) that are open longer hours (>15 hours/day) and that enroll young children (<2 years of age) are at highest risk for the introduction and spread of hepatitis A infection. [8,25,26] Once hepatitis A is introduced into a centre, the rate of spread is related to the number of diapered children, the hygienic adequacy of diaper-changing areas, and practices such as the changing of diapers by food handlers.

A nationwide study in the United States by the CDC showed that hepatitis A was common in daycare only in areas with large numbers of infant/toddler facilities. Also, rates of hepatitis A outbreaks were higher in areas with more daycare facilities for younger children. The risk of disease introduction into a centre was related to the incidence of disease in the community. This indicates that areas with high numbers of daycare centres for younger children are at greater risk of hepatitis A, especially if there is a high baseline incidence rate in the community.[9]

Attack rates as high as 15% among daycare educators have been reported during outbreaks of hepatitis A in childcare facilities. This is the highest attack rate among all affected daycare subgroups (children, parents, other employees, other contacts), thus appearing to be a significant occupational hazard. [23]

Few recent studies have looked directly at seroprevalence and risk factors among daycare workers. In 1995, 122 sera in Toronto, collected for other purposes, suggested a hepatitis A seroprevalence of 21% among daycare educators (Table 2). [17] Those educators who were not born in Canada had a seroprevalence of 44%, while those born in Canada had an estimate of 8%. Unfortunately, the external validity of these figures is uncertain given limitations in study design.

A 1996 study in Washington State tested 360 childcare providers for hepatitis A, B, and C, cytomegalovirus, varicella and measles. [28] The majority were female (97%), white (87%), and born in the US (87%). Fifty-seven percent were between the ages of 18 and 34 years. The study found that 13% of the providers were seropositive for hepatitis A antibodies, and seropositivity was strongly associated with being born outside the United States (RR=9.6; 95% CI: 6.5, 14.3). Seroprevalence was 8% among providers born in the US. Employment characteristics statistically associated with seropositivity were changing diapers 3 days or more per week (RR=2.4; 95% CI: 1.3, 4.3) and working daily with children less than 3 years of age (RR=2.3; 95% CI: 1.1, 4.6). However, when adjusted for age, place of birth, and income, employment characteristics were no longer associated with hepatitis A seropositivity.

Conclusion

There is an increased demand for daycare services across Canada, a trend that is expected to continue over the foreseeable future. With this increased demand come both the benefits and the risks of grouping young children together in one place. Canadian

daycare educators may be at increased risk of hepatitis A, among other infectious diseases, due to their occupational tasks, their low levels of immunity, the ease of spread of communicable diseases among children, and difficulties with disease recognition in the young. The risk of serious clinical outcomes from hepatitis A infection is higher in adults than in children, and the illness tends to be more prolonged. A vaccine is now available for hepatitis A and is routinely recommended for travelers, but has not yet been routinely recommended for daycare educators. Because recent data indicate that an increasing burden of disease may result from hepatitis A infection occurring within the daycare environment, this policy should be reviewed. Accurate information on hepatitis A seroprevalence and seroconversion among daycare educators in Canada is critical to inform this policy review process.

References

1. Canadian Child Care Federation. Press Release, Ottawa, ON: August 15, 2000.

2. Canadian Child Care Federation. News. Interaction 2001 Winter; 14:41.

3. Reves RR and Pickering LK. Impact of child day care on infectious diseases in adults. Infect Dis Clin North America 1992; 6(1): 239-50.

4. Soto JC and Marin-Lira A. Infectious diseases in daycare: a public health perspective. Can J Pediatr 1993; 5(4): 274-79.

5. Doherty G, Lero DS, Goelman H, et al. You bet I care! A Canada-wide study on wages, working conditions, and practices in child care centres. Guelph Centre for Families, Work and Well-being: University of Guelph, 2000.

6. Beach J, Bertrand J, and Cleveland G. Our child care workforce: From recognition to remuneration: A human resource study of child care in Canada. Ottawa: Child Care Human Resources Steering Committee, 1998.

7. Bright KA and Calabro K. Child care workers and workplace hazards in the United States: Overview of research and implications for occupational health professionals. Occup Med 1999; 49(7): 427-37.

8. Venczel LV, Desai MM, Vertz PD, et al. The role of child care in a community-wide outbreak of hepatitis A. Pediatrics 2001; 108(5): E78-82.

9. Bell BP, Shapiro CN, Alter MJ, et al. The diverse patterns of hepatitis A epidemiology in the United States: Implications for vaccination strategies. J Infect Dis 1998; 178: 1579-84.

10. National Advisory Committee on Immunization. Canadian Immunization Guide, 5th Ed. Ottawa, ON: Health Canada, 1998.

11. Centers for Disease Control and Prevention. Hepatitis A Surveillance Report No. 57. Atlanta GA: Centers for Disease Control and Prevention, 2000.

12. Chin J (Ed.). Control of Communicable Diseases Manual, 17th edition. Washington DC: American Public Health Association, 2000.

13. Lerman Y, Chodik G, Aloni H, et al. Occupations at increased risk of hepatitis A: A 2-year nationwide historical prospective study. Am J Epidemiol 1999; 150(3): 312-20.

14. Hofmann F, Wehrle G, Berthold H, Koster D. Hepatitis A as an occupational hazard. Vaccine 1992; 10 (Suppl 1): S82-84.

15. Embil JA, Manley K. Hepatitis A: A serological study in the Canadian Armed Forces. Military Med 1989; 154(9): 461-65.

16. Payment P. Antibody levels to selected enteric viruses in a French-Canadian population in the province of Quebec (Canada). Immunol Infect Dis 1991; 1: 317-22.

17. Ford-Jones EL, Kitai I, Davis L. Seroprevalence of hepatitis A, hepatitis B, human parvovirus B19, and toxoplasmosis in Toronto infant-toddler daycare providers. [Abstract] 35th Interscience Conference on Antimicrobial Agents and Chemotherapy (Washington): American Society for Microbiology, 1995.

18. Kocuipchyk FR, Lightfoot PJ, Stout I, et al. Seroprevalence of hepatitis A antibodies in travellers at the Edmonton Travellers' Health Clinic – Alberta. Can Comm Dis Rep 1995; 21(8): 65-71.

19. Keifer LA, Honish A, Predy G, Talbot JA. The seroprevalence of hepatitis A and B in people testing positive for hepatitis C. Can Med Assoc J 2000; 162(2): 207-08.

20. Cook D, Wilton L, Patrick D, et al. Prevalence of antibodies to hepatitis A virus in a cohort of women of child-bearing age. [Abstract] 68th conjoint meeting of infectious disease (Ottawa): Canadian Association for Clinical Microbiology and Infectious Disease, 2000.

21. Levy I, Chen D, Sherman M, et al. Hepatitis A virus seroprevalence in 1,000 university students in Toronto. Can Comm Dis Rep 2001; 27(11): 93-96.

22. Ochnio JJ, Patrick D, Ho M, et al. Past infection with hepatitis A virus among Vancouver street youth, injection drug users and men who have sex with men: Implications for vaccination programs. Can Med Assoc J 2001; 165(3): 293-97.

23. Hadler SC and McFarland L. Hepatitis in day care centers: Epidemiology and prevention. Rev Infect Dis 1986; 8(4): 548-57.

24. Hurwitz ES, Deseda CC, Shapiro CN, et al. Hepatitis infections in the day-care setting. Pediatrics 1994; 94(Suppl): 1023-24.

25. Hadler SC, Erben JJ, Francis DP, et al. Risk factors for hepatitis A in day-care centers. J Infect Dis 1982; 145(2): 255-61.

26. Shapiro CN, Hadler SC. Hepatitis A and hepatitis B virus infections in day-care settings. Pediatr Ann 1991; 20(8): 435-41.

27. Churchill RB and Pickering LK. Infection control challenges in child-care centers. Infect Dis Clin North America 1997; 11(2): 347-65.

28. Jackson LA, Stewart LK, Solomon SL, et al. Risk of infection with hepatitis A, B, or C, cytomegalovirus, varicella or measles among child care providers. Pediatr Infect Dis J 1996; 15(7): 584-89.

Table 1: Risk factors associated with hepatitis A seropositivity

Risk Factor	Exposure category associated with an increased risk
General factors	
Age	Increasing age
Socioeconomic status	Lower status
Travel	To developing countries
Foreign birth	In endemic areas
Male homosexuality	Homosexual activity
Injection drug use	Intravenous drug use
Daycare attendance/contact	Child attending daycare or daycare worker in household
Daycare specific factors	
Changing diapers	≥3 days/week, inadequate facilities, associated with food preparation
Age of children	Younger than 3 years
Enrollment size	> 50 children
Opening hours	> 15 hours per day
Centre operations	For profit

Table 2: List of Canadian hepatitis A seroprevalence studies*

Reference #	Year of Publication	Location	Population	Sample size	Seroprevalence (%)	Range (%-%)	Variable explaining wide range
14	1989	Nova Scotia, Quebec Syria, Cyprus	Armed Forces recruits, peacekeepers	3958	23.5	15.1-60.4	Age, overseas posting
15	1991	Montreal	City residents	600	36	1-82	Age
16	1995	Toronto	Daycare educators	122	21	8-44	Place of birth
17	1995	Edmonton	Travelers	505	47	20-80	Age, place of birth, # siblings
18	2000	Edmonton	HCV positive	343	53.1	17.0-85.7	Age
19	2000	British Columbia	Pregnant women	1206	23.5	3.8-40.6	Age
20	2001	Toronto	University students	1000	14	2-39	Age, place of birth
21	2001	Vancouver	Street youth, IVDU, MSM	494	27.9	6.3-42.6	Age, place of birth, IVDU

HCV – hepatitis C virus
IVDU – intravenous drug users
MSM – men who have sex with men

*Several of these studies have design limitations, thereby restricting their generalizability.

2.2 Hepatitis A trends in the study region of Quebec

Hepatitis A accounted for 3.6% of all reported viral hepatitis cases in Quebec in 1999. The age-specific incidence rates from 1996-99 were highest among 20-39 year olds (Direction générale de la santé publique, 2001).

Data available between 1990-99 from the Direction générale de la santé publique (Ministère de la santé et des services sociaux) indicate that there have been two outbreaks of hepatitis A during this time period (Direction générale de la santé publique, 2001). The first outbreak peaked in mid-1991 with a rate of less than 10 cases per 100,000 population, and the second occurred over a 2-year period between 1995 and 1997, with a peak incidence rate of 8 cases per 100,000. The baseline incidence rate outside of outbreak time periods was just over 2 cases per 100,000. [In comparison, data from Canada as a whole indicates that the incidence rate per 100,000 population varies between 5 and 10 cases, while in the United States the incidence rate is generally slightly higher, with a tendency towards over 10 cases per 100,000 (Unité maladies infectieuses, 2000).] In both Quebec outbreaks, the majority of cases were among men. The majority of cases in both outbreaks originated in the region of 'Montréal-Centre', comprising the island of Montreal (Unité maladies infectieuses, 2000).

In 1999, a non-outbreak period, the highest standardized incidence rates were from the region of 'Nord-du-Québec', with the region of 'Montréal-Centre' having the third highest incidence rate. The majority of cases were reported from the eastern central part of the island.

In 'Montréal-Centre', a similar distribution with regard to age and sex of cases as for Quebec in general is found. Risk factors for hepatitis A in 'Montréal-Centre' for 1998 included travel to endemic areas, male homosexual relations, and intravenous drug use (Unité maladies infectieuses, 1999). However, in 37% of cases none of these risk factors were identified. It has been found in the United States that a significant proportion of cases in which there was no known source of infection reported having children <5 years old in the household, suggesting that child-adult transmission might account for these cases (Bell *et al.*, 1998). To what extent child-adult transmission, and specifically daycare transmission, plays an important role in the epidemiology of hepatitis A infection in Quebec is unknown.

3. STUDY OBJECTIVES

3.1 Research question

What is the seroprevalence of hepatitis A infection among Montreal Island adult daycare educators, and does their work with young children present significant risk factors that could put them at risk of hepatitis A?

3.2 Study Objectives

- To calculate the point prevalence of hepatitis A seropositivity in a random sample of Montreal Island daycare educators

- To determine daycare-level characteristics that are associated with hepatitis A seropositivity

- To determine educator-level characteristics that are associated with hepatitis A seropositivity

4. STUDY METHODOLOGY

4.1 Study Design

A seroprevalence study was conducted for hepatitis A infection in a population of daycare educators on the island of Montreal between September and December 2001. Data collection occurred over a 10-week period from October to December 2001.

4.2 Study Population

The sampling frame consisted of all daycare centres on the Island of Montreal. All for-profit and not for-profit daycare centres enrolling 7 children or more outside of the educator's home (defined as 'centre de la petite enfance' or 'garderie' (Ministère de la santé et des services sociaux, 2002)) are registered with the Ministère de la Famille et de l'Enfance (MFE). A list of these centres was obtained from MFE, and was up to date as of December 31, 2000. This list was numbered sequentially; daycare centres were then randomly selected for participation using a computer-generated random number sequence. All eligible daycare educators employed at selected centres constituted the study population.

4.3 Sample size determination

Seroprevalence was estimated using 95% confidence intervals calculated from the binomial distribution. Since seroprevalence estimates of hepatitis A in the literature include the most conservative value of 50%, for sample size purposes, the binomial sample size formula with 0.5 as the probability of infection was used. To estimate

seroprevalence to within 5% (worst case scenario) of its true value using 95% confidence intervals, 384 educators were required. However, the possible correlation between educators within the same daycare was also taken into account. There is no published estimate of the degree of correlation of seropositivity between educators at the same daycare centre. In the absence of any further information, it was assumed that a 25% increase in the sample size would be sufficient to account for any clustering effects. Therefore, the final sample size was determined to be 480 educators.

4.4 Questionnaire development and pre-testing

Separate questionnaires for daycare educators and for directors were developed in consultation with a panel of experts who had previous experience in data collection in the daycare setting in Quebec. The original questionnaires were developed for the larger seroprevalence/seroconversion study which would look at five infectious diseases of epidemiologic importance in the daycare setting – varicella, rubella, hepatitis A, cytomegalovirus, and parvovirus B19. They were further modified to address known general and daycare-specific risk factors for hepatitis A identified from the literature. Questionnaires were originally developed in French and then translated into English. Both the director and educator questionnaires were pre-tested for comprehension at a daycare centre in Brossard, south of the island of Montreal. (See Appendices 1 and 2 for English version of director and educator questionnaires)

4.5 Study timeline

Preparation for data collection began in August 2001 with finalization of the protocol, translation of questionnaires, creation of telephone scripts and methods for dealing with refusals, random selection of daycare centres to contact, and the hiring of a full-time research nurse to assist in the data collection process. Initial telephone contact with the daycare centres began on September 19, 2001 and the first on-site centre visit was conducted on October 9, 2001. Phoning and on-site visits continued throughout the data collection period, with the last centre visit taking place on December 19, 2001. Results of the hepatitis A serology were available on February 6, 2002. Complete serological results were available as of April 10, 2002, and individual report cards were mailed back to all educator participants between April 18 and 25, 2002.

4.6 Selection of participating daycare centres

Based on data provided by MFE, it was estimated that approximately 167 daycare centres would need to be contacted in order to meet the sample size requirement of 480 educators, taking into account participation rates and centre eligibility.

The director of each centre was contacted by telephone and given comprehensive information about the study. The eligibility of the centre for the study was then determined. Inclusion criteria for the centres were: 1) they were registered with MFE as of December 31, 2000; 2) they were currently in operation; 3) they enrolled children under the age of 36 months; and 4) they employed at least six educators.

With the director's initial consent, more detailed information for the director and each educator was then sent by courier to the daycare centre. The director was asked to distribute the information to each educator and to respond to any queries about the study. The director was then contacted by phone a second time to determine the number of educators who had expressed interest in participating in the study. If more than three educators in a given centre expressed interest, a visit by the research team (the research nurse and/or the primary author (a community medicine resident with epidemiology training)) was arranged. The director also completed a separate written, self-administered questionnaire that collected variables on the administrative organization and the physical characteristics of the centre itself (opening hours, number of licensed daycare spaces, number of rooms and bathrooms, etc).

4.7 Participant recruitment

Daycare educators were eligible for participation in the study if they met the following criteria: 1) they were employed at a centre that was randomly chosen to participate in the study; 2) they were currently employed 15 or more hours per week at the daycare centre; 3) they cared regularly for children under 60 months of age; and 4) they consented to participate in the study.

All educators received a package of information including a letter of invitation, an informed consent form, and a baseline questionnaire. The written, self-administered educator-level questionnaires were completed either prior to the on-site visit or on the day of the visit. The questionnaire collected information on the individual workplace

characteristics of the educator, socio-demographic information, and information on past vaccinations and illness experience.

4.8 Data Collection – Centre Visits

In centres where there was sufficient educator interest (>3 educators), an on-site visit to the centre was arranged with the daycare director. The visits were conducted by the research team. At this time, any questions regarding the study were answered, the informed consent forms were reviewed and signed, questionnaires were collected (or administered if not previously completed), and blood samples were drawn. Blood samples were transported in an ice-packed cooler from the centre to the Montreal General Hospital (MGH), where they were spun and stored in a refrigerator at 4° C. At the end of each week of data collection, the blood samples were transported in ice-packed coolers from the MGH to Hôpital Maisonneuve-Rosemont, where they were processed and analyzed.

4.9 Refusal Information

When possible, information on the nonparticipating centres was gathered in order to determine the representativeness of the final sample.

Those who refused participation on the first phone call were asked the following questions:

1. How many hours per week is your daycare centre open?
2. Does your centre operate for profit?

3. How many full-time and part-time educators do you have working at your centre?
4. How many children currently attend your daycare centre?
5. How many of these children are under the age of 36 months?

In those centres where there was insufficient educator participation, daycare directors were asked to complete the director questionnaire and return it by mail to the principal investigator.

In those centres where a visit was arranged, questionnaires of educators who refused to provide a blood sample or who were otherwise unavailable for blood sampling were also collected for comparison to those from whom a blood sample was obtained.

4.10 Serological Procedures

For hepatitis A serology, samples were assayed at the microbiology laboratory of Hôpital Maisonneuve-Rosemont by a competitive microparticle enzyme immunoassay (AxSYM HAVAB 2.0, Abbott Laboratories, Illinois) according to the instructions of the manufacturer. Samples with an index value in the range of 1.001 to 3.000 were considered non-reactive. Samples with an index value in the range of 0.000 to 1.000 were considered reactive. Indeterminate results were to be coded as 'gray zone'.

4.11 Dissemination of Results

Serological results were recorded on a confidential serology report that was sent to each participating daycare educator. The report included a brief explanation of the meaning

of seropositivity and seronegativity, together with information on respective actions to be taken (see Appendix 3).

4.12 Outcome Measure

The principal outcome measure in this study was the hepatitis A serological status of the participant. This was expressed as a binary variable: 1 = seropositive and 0 = seronegative.

4.13 Data Management

Data from educator and director questionnaires were entered manually into separate database files using Excel. Serological results were entered separately by technical personnel at Hôpital Maisonneuve-Rosemont. These serological results were then merged with the educator database by unique participant codes. Director and educator databases were imported into SAS version 8e (The SAS Institute, 1999-2001), and merged by unique daycare centre codes for analysis. Variable frequencies (categorical variables) and ranges (continuous variables) were used to screen for impossible or unlikely values.

4.14 Analysis

Frequency and univariate procedures were used to generate descriptive statistics for both centre and educator-level variables. A Spearman's correlation matrix was constructed with all variables to examine possibly significant correlations between variables. Bivariate analyses were then conducted for each covariate with the outcome (binary

seropositivity) to determine significant relationships in the data. Centre and educator-level covariates whose relationship with the outcome was statistically significant were then used to construct multivariate logistic regression models.

In order to determine if the effect of clustering of educators into daycare centres was significant in explaining the variation in seropositivity rates, a nonlinear mixed effects model was constructed. Daycare centres were grouped by several different administrative criteria and the variance between these groups was included in the regression model to determine if they significantly influenced the seropositivity rates.

4.15 Sub-analysis

Several multiple regression models were constructed for stratified groupings of educators based on their region or country of birth, in order to take into account the influence of geographic variation in hepatitis A endemicity. Educators were categorized into being born in one of three country-income levels based on World Bank criteria (World Bank, 2001) (Appendix 4), which can be used to approximate endemicity patterns of hepatitis A (see Figure 3 in Manuscript #2, page 60). They were also separately categorized into being Canadian or foreign-born. In those groups of educators that were born in low-endemicity countries, daycare and educator-level variables that referred to daycare work were reintroduced to check for significance in these sub-groups.

4.16 Ethics

Ethics approval (Appendix 5) for the study was obtained from the Research Ethics Committee - McGill University Health Centre – in June 2001. The hepatitis A seroprevalence study was part of a larger daycare study of seroprevalence/seroconversion to five infections (hepatitis A, rubella, cytomegalovirus, parvovirus B19, varicella).

5. RESULTS

We designed a primary epidemiologic study to determine hepatitis A seroprevalence in a population of daycare educators on the Island of Montreal. The following manuscript describes the results of this research. The article will be submitted to the Canadian Medical Association Journal in July 2002.

A supplementary results section (Section 5.2) describes additional data that were collected and analyses that were performed.

5.1 Manuscript #2 -

Hepatitis A Seroprevalence and Risk Factors among Daycare Educators

Cristin J. Muecke, MD [1], Theresa W. Gyorkos, PhD [1,2], Claire Béliveau, MD [3], Elham Rahme, PhD [1,2], Suzanne Archambault, MSc [2], Julio C. Soto, MD, PhD [4]

1 - Department of Epidemiology and Biostatistics, McGill University
2 - Division of Clinical Epidemiology, Research Institute, McGill University Health Centre
3 – Hôpital Maisonneuve-Rosemont, Montréal
4 – Unité de risques biologiques, environnementaux et occupationnels, Institut national de santé publique du Québec

Address for Correspondence and Reprints:
Dr. Theresa W. Gyorkos, Division of Clinical Epidemiology
Montreal General Hospital, 1650 Cedar Avenue
Montreal, Quebec, Canada, H3G 1A4
Tel: 514-934-1934 ext. 44721
Fax: 514-934-8293
Email: theresa.gyorkos@mcgill.ca

Abstract

Background: Daycare centres play a significant role in the epidemiology of hepatitis A; however, there is a lack of documentation on its seroprevalence and potential risk factors among daycare educators in Canada.

Objective: To determine the seroprevalence of hepatitis A among daycare educators in Montreal and associated individual and daycare-level risk factors.

Methods: A total of 84 centres from 167 randomly selected centres in Montreal participated. Directors and educators completed questionnaires on daycare-level and educator-level risk factors. Sera were collected during on-site visits.

Results: The seroprevalence of hepatitis A among the 492 participating educators was 35.6%. Educator risk factors of importance in multivariate analysis included: region of birth – high or moderate income vs. low income (OR = 20.8; 95% CI: 9.4, 46.0); report of previous vaccination for hepatitis A (OR = 6.1; 95% CI: 2.9, 13.0); travel to endemic areas (OR = 2.4; 95% CI: 1.3, 4.2); and age ($OR_{5\text{-yr}}$ = 1.5; 95% CI: 1.3, 1.7). When Canadian-born educators were analyzed separately, a further association was found between seropositivity and years worked in the daycare centre ($OR_{5\text{-yr}}$ = 1.3; 95% CI: 1.0, 1.8).

Conclusion: This represents the first study in Quebec designed to examine risk factors for hepatitis A infection among adult daycare educators. In a non-outbreak situation, this occupational group shares similar risk factors for seropositivity with the general population. Canadian-born educators however appear to be placed at some additional risk by working in daycare centres, and may benefit from vaccination.

Introduction

Although considered among the more benign hepatitis viral infections, hepatitis A is the most frequently reported among all reportable vaccine-preventable disease in North America [1]. The morbidity of hepatitis A increases with age, and in Canada about 25% of all reported adult cases require hospitalization. [2] The main risk factors for hepatitis A identified in Canada include residence in certain communities lacking adequate sanitation, residence in institutions (eg, correctional facilities), illicit drug use, male homosexual behaviours, and travel to or residence in countries with inadequate sanitation [2]. In the United States, attendance or work in a child daycare centre has also been identified as a risk factor [1]. Hepatitis A infection is of particular concern for daycare educators because it can cause significant clinical disease in susceptible adults. It is highly infectious and easily transmitted in the daycare setting – in fact, daycare centres have been identified as sources of community-wide hepatitis A outbreaks among adults [3]. A vaccine is currently available, offering new opportunities for preventive care.

In the United States, daycare centre contact is considered to be an important risk factor for adult hepatitis A infection, accounting for more cases than foreign travel (Figure 1) [4]. However, one seroprevalence study among daycare educators (in a non-outbreak situation) was unable to find an association between seropositivity and employment characteristics, suggesting that occupational exposure to hepatitis A may not be important under non-outbreak circumstances [5].

In Canada, almost no data exist on occupational risk of hepatitis A for daycare educators. In 1995 in Toronto, results from 122 sera collected for other purposes suggested a hepatitis A seroprevalence of 21% among daycare educators [6]. Those educators who were not born in Canada had a seroprevalence of 44%, while those born in Canada had a seroprevalence of 8%. Unfortunately, the external validity of these figures is uncertain given limitations in study design. The 2002 Canadian Immunization Guide offers no vaccination recommendations for daycare workers due to a lack of data supporting an association in the Canadian population [2].

In order to address the lack of information on hepatitis A infection among Canadian daycare educators, we collected epidemiologic data and performed serologic testing for hepatitis A in a representative sample of daycare educators in Montreal, Quebec.

Methods

- *Recruitment*

A list of registered daycare centres (centres outside the home enrolling a minimum of 7 children) on the Island of Montreal was obtained from the Ministère de la Famille et de l'Enfance (MFE). We selected a random sample of these centres using a computer-generated random number sequence, with the goal of recruiting the predetermined sample size of 480 educators. Centres were considered eligible if: 1) they were registered with MFE as of December 31, 2000; 2) they were currently in operation; 3) they enrolled children under the age of 36 months; and 4) they employed at least six educators.

The director of each centre was contacted by telephone and given comprehensive information about the study. With the director's initial consent, more detailed information for the director and each educator was then sent by courier to the daycare centre. The director was asked to distribute the information to each educator and to determine the number of educators who expressed interest in participating in the study.

- *Data Collection*

If more than three educators in a given centre expressed interest, a visit by the research team (CM and SA) was arranged. The director also completed a separate written, self-administered centre-level questionnaire that collected information on the administrative organization and physical characteristics of the centre itself (opening hours, number of licensed daycare spaces, number of rooms and bathrooms, etc).

The educator's package of information included a letter of invitation, an informed consent form, and a baseline questionnaire. Daycare educators were eligible for participation in the study if they met the following criteria: 1) they were employed at a centre that was randomly chosen to participate in the study; 2) they were currently employed 15 or more hours per week at the daycare; 3) they cared regularly for children under 60 months of age; and 4) they consented to participate in the study. The written, self-administered educator-level questionnaires collected information on the individual workplace characteristics of the educator, socio-demographic information, and information on past vaccinations and illness experience.

During the on-site visit by the research team, any questions regarding the study were answered, the informed consent forms were reviewed and signed, questionnaires were collected (or administered if not previously completed), and blood samples were drawn.

All blood samples were transported in ice-packed coolers to the laboratory for analysis. Samples were assayed at the microbiology laboratory of Hôpital Maisonneuve-Rosemont by blinded technicians using a competitive microparticle enzyme immunoassay (AxSYM HAVAB 2.0, Abbott Laboratories, Illinois) according to the instructions of the manufacturer. Samples with an index value in the range of 1.001 to 3.000 were considered non-reactive. Samples with an index value in the range of 0.000 to 1.000 were considered reactive.

- *Statistical Analysis*

The estimated sample size was determined using the binomial distribution formula and the most conservative estimate of 0.5 for the probability of infection. It was further increased by 25% to take possible clustering into account.

Frequency and univariate procedures were used to generate descriptive statistics for both centre and educator-level variables. A Spearman's correlation matrix was constructed to examine correlations between variables. Bivariate analyses were conducted for each centre and individual level variable with the outcome to determine their relative importance in explaining seropositivity. Covariates whose relationship with the outcome was statistically significant ($p< 0.05$) were then used to construct multivariate logistic

regression models. Several multiple regression models were constructed for different groupings of educators based on their region or country of birth. A mixed effects model was developed to take into account the clustering effect of educators within daycare centres.

Ethics approval for the study was obtained from the Research Ethics Committee - McGill University Health Centre – in June 2001.

Results

The study was conducted from September to December 2001, with sera collection occurring during a 10-week period from October to December. A total of 167 centres were randomly selected from the list of all registered daycare centres on the Island of Montreal (n=481) in order to reach the desired sample size. Of these centres, 15 (9%) did not meet the inclusion criteria because they either had an insufficient number of staff or they did not enroll children under the age of 36 months. Among the 152 eligible centres, 12 (7.9%) refused participation at the centre level, 40 (26.3%) provided no further information, 16 (10.5%) agreed at the centre level but had insufficient educator participation, and 84 (55.3%) centres had participation at both the centre and educator levels (Figure 2).

Of all variables collected and analyzed, missing values constituted less than 5% of cases, with the exception of two variables in the educator questionnaire. There were 53 (10.8%)

missing values for the question regarding travel to a developing country, and 49 (10.0%) missing values for the question regarding annual household income.

Daycare centre characteristics

Table 1 describes the characteristics of the daycare centres (n = 84) in which both the director and the educators participated. Among these centres, 67.1% classified themselves as a 'centre de la petite enfance' or publicly funded daycare centre. On average, the centres enrolled 61.4 children, and 6.2 of those children were in the nursery (<6 months of age). The average minimum age of enrollment for children at the centres was 11 months. The centres had been operating for an average of 18.9 years (range 1-42 years) and were open 55.6 hours per week. Most of the children at the daycare centres (52.9%) were over the age of 36 months, with 36.3% between 18 and 35 months of age, and 10.8% under 18 months of age.

Other information collected (data not shown) included the number of educators working with each age group and child:educator ratios, the number of rooms used for the children, the number of sinks and bathrooms available, hygiene training and routines, meal preparation, and reports of illness among children or educators in the previous two weeks.

In cases where the director was unable to elicit sufficient educator interest, s/he was asked to complete the director questionnaire and mail it to the principal investigator. Table 1 also compares the characteristics of centres that participated in the study (n=84)

with those where the director provided information but had insufficient educator participation (n=16). Daycare centres with insufficient educator participation were slightly more likely to be private centres, tended to be slightly larger and have a larger percentage of older children, and were more likely to accept part-time attendance of children.

Educator characteristics

There were 544 educator questionnaires completed, of which 492 educators also provided a blood sample. Table 2 describes the characteristics of the daycare educators who participated by completing both the questionnaire and providing blood. The majority of participating educators were young Canadian women – two-thirds were between the ages of 20 and 39 years. Of those who were not born in Canada, 52.4% were born in middle-income countries, 26.7% in high-income countries, and 20.9% in low-income countries. The classification of countries by income levels was obtained from World Bank documentation [7], and can be used to approximate endemicity patterns of hepatitis A. High-income countries have low levels of hepatitis A, low-income countries (often referred to as 'developing countries') are highly endemic for hepatitis A, and middle-income countries have an intermediate level of hepatitis A endemicity.

Although relatively few (13.4%) reported having previously received hepatitis A vaccination, 47.9% of educators answered "Don't know" to this question. A very small proportion of educators reported having previously been ill with hepatitis A infection (1.5%) – the timing of the illness in relation to working in daycare is not known.

The majority of educators have certification in early childhood education. Most live in nuclear families, and almost one-third of them report an annual household income of less than $20,000.

Educators cared for an average of 10 children, with variation in the child:educator ratio depending on the age of the children and whether the educators worked in teams. The child:educator ratio was 8.3:1 for children older than 36 months, 6.5:1 for children aged 18-35 months, and 3.7:1 for children less than 18 months old. Approximately half of the educators (45.6%) spent more than 50% of their time with children under the age of 36 months, and as a result a similar proportion (44.7%) changed diapers more than 10 times per week.

Of all educators who completed the questionnaires (n = 544), a small proportion (n=52 or 9.6%) did not provide a blood sample. Reasons were: refusal to give blood (fear of needles, etc) (n=16); absence at the time of the on-site visit (n=10); and failure to draw blood after repeated attempts (n=26). Table 2 compares those who fully participated in the study with those who completed a questionnaire only. Educators who completed the questionnaire only were slightly older, more likely to have been born in Canada, less likely to have traveled to a developing country, and were less likely to have a diploma in early childhood education.

Seroprevalence

Hepatitis A seroprevalence among the participating daycare educators was 35.6%. This estimate varied considerably by World Bank income region and country of birth (Tables 3 and 4).

Analysis by Region of Birth

When countries of birth were grouped according to World Bank criteria into high, middle, and low income countries, a large variation in the seroprevalence estimate was seen: 19.7% of participants born in high income/low endemicity countries (n=380) were seropositive; those born in middle income/moderate endemicity countries had an estimate of 85.0% (n=80); and those born in low income/high endemicity countries had an estimate of 100% (n=32) (Table 3).

The data were also divided into Canadian-born and foreign-born groupings for analysis (Table 4). It was found that those born in Canada had a seroprevalence estimate of 15.9% (n=339), compared to those born outside of Canada who had an estimate of 79.1% (n=153).

Vaccination Self-report

Vaccination status for hepatitis A was obtained by self-report, and was not confirmed by written records or physician report. Those who said they had been vaccinated were subsequently found to test seropositive only 58.5% of the time, indicating that self-report of hepatitis A vaccination was not always reliable in this population.

Bivariate Analyses

Significant bivariate results are shown in Table 5. Variables that were *not* significant at the bivariate level included:

Educator-level variables - highest level of schooling completed, number of years spent in school, certification in early childhood education, presence of children attending daycare in the household, number of hours worked per week in daycare, number of children educator cares for at the daycare, age group of children cared for at the daycare, frequency of diaper changing per week.

Daycare-level variables – number of licensed places for children, number of nursery places, number of educators, number of years of operation, number of hours open per week, proportion of children under 36 months of age, number of children on social assistance, minimum age of child at registration, ratio of rooms/bathrooms/sinks to people, educator or child involvement in meal preparation, catering of meals.

Multiple Regression Analyses

In every multivariate model constructed, increasing age (categorized into five-year groupings) was found to be significant (Tables 6 and 7). A history of travel to a developing country was found to be a significant predictor among foreign-born educators but not among Canadian-born educators. Region of birth was found to have a large influence on seroprevalence estimates, with some attenuation among foreign-born participants, possibly due to the correlation of region of birth and travel history. Report of past HAV vaccination was an important predictor in all cases except those born in a

foreign country. Having a household income of less than $20,000 was an important risk factor among foreign-born participants. Occupational factors (number of years worked in daycare, ratio of children to bathrooms) became important only among those born in low endemicity (high income) areas, including Canada. For Canadian-born educators, number of years worked in daycare replaces travel to endemic areas as the third most important risk factor.

Discussion

This is the first Canadian study to look specifically at hepatitis A seroprevalence and risk factors among daycare educators. In 1995, a seroprevalence estimate of 21% (8% among Canadian-born) was obtained on a convenience sample of 122 sera from daycare educators in Toronto [6]. In 1996, a seroprevalence study using similar methods to our study was conducted in Washington, USA (n = 360 educators), and attained a seroprevalence estimate of 13% (8% among US-born)[5]. Our study has an overall seroprevalence of 35.6%, and 15.9% among Canadian-born educators. Possible explanations for the higher seropositivity found in our study population, particularly among locally-born participants, include restriction of our study population to centres having more than five educators, a difference in the demographics of daycare educators (their origin, where and how often they travel), a change in the overall epidemiological situation of HAV infection in Montreal, a change in the occupational risk of hepatitis A infection in daycare, and the introduction of a hepatitis A vaccine in 1995. Although it has not been specifically recommended for daycare educators in Canada [2], participants may nonetheless have received the vaccine for this or other reasons.

Multivariate analyses revealed that the most important factor predicting seropositivity among daycare educators is their country or region of birth. This correlates with the global epidemiology of hepatitis A (Figure 3), where the chances of becoming immune to hepatitis A early in life is high for those born in endemic countries – generally middle and low income countries. Exposed persons would then be effectively 'immunized' against the disease later in life, and be unaffected by risk factors present in their workplace.

The next most important factor is reported history of vaccination. In the foreign-born group, vaccination is not a significant risk factor. In these cases, vaccination is likely country and region-dependent, with those in endemic countries being least likely to have been vaccinated but also most likely to be seropositive from other exposure. Also in this foreign-born subgroup, reported travel to a developing country takes on strong significance. In the case of those coming from endemic regions, this reflects the strong correlation between birth in a middle or low-income country and subsequent travel to these areas. If not already exposed as a child in these countries, the educator may be more likely to seroconvert when she returns later in life, since she is likely to stay in similar conditions to the general population.

In Canadian daycare educators, travel to a developing country was found not to predict seropositivity (Table 7). This could reflect some misunderstanding as to what constitutes a 'developing country'. It could also reflect the fact that the Canadians in our sample

who traveled abroad stayed in environments that are more reflective of low endemicity, rather than local environments that would provide increased exposure to hepatitis A. Although one might expect a high correlation between traveling to a developing country and having been vaccinated, this is not in fact the case (r_s=0.14). This could reflect the relatively recent introduction of the vaccine, or perhaps a low level of pre-travel health consultation.

Income appears to have an important effect for those born in moderate endemicity countries (Table 6). These are countries where hepatitis A risk is likely more stratified by socioeconomic status and sanitation standards. Alternatively, in high-income countries, the risk is likely uniformly low and in low-income countries the risk is likely uniformly high.

Daycare-specific risk factors became important only when educators of middle and low-income country origin were excluded from the analysis (Table 6). This likely reflects the fact that educators born in moderate and highly endemic countries are essentially removed from the risk pool early in life, and thus their serological status is not affected by any environment encountered in adulthood. For those who are brought up relatively protected from other sources of increased risk, an introduction into the daycare environment appears to carry some risk. In fact, among Canadian educators, this appears to be more important than travel to hepatitis A endemic areas.

When educator characteristics are stratified according to region of birth, it becomes clear that a constellation of factors in addition to regional endemicity patterns themselves may explain why educators from moderate and high endemicity countries are more likely to be seropositive. These educators tend to be older, earn less money, have more people in their household, and travel more to endemic countries. Educators whose origin is a high income country, and Canadian educators in particular, tend to be younger, earn higher salaries than their foreign-born counterparts, travel less to endemic countries, and are less likely to report having been vaccinated against hepatitis A. As a result, their seropositivity rate is below 20%. Thus, both the exposure to endemic countries and accompanying characteristics contribute to the differences in seropositivity rates between these groups.

Jackson *et al* (1996) concluded that occupational exposure to hepatitis A in the United States is uncommon under non-outbreak circumstances, but that vaccination may be warranted in areas where outbreaks in childcare facilities are frequent [5]. There have been outbreaks of hepatitis A related to childcare facilities in several states in the US, making daycare attendance and/or contact an important risk factor on a national level [4]. In Canada, the Canadian Immunization Guide (2002) suggests that childcare facilities have not been the source or focus of outbreaks [2]. It does, however, advocate post-exposure prophylaxis to all children and employees when a child or staff member of a facility becomes infected. Our results suggest that there may be some additional risk of hepatitis A among Canadian-born daycare educators due to their occupation. This risk does not become apparent until foreign-born educators are removed from the analysis, a step that

had not been performed in the analysis of previous studies. Further cost-effectiveness studies should be carried out to determine whether this additional risk warrants routine vaccination among Canadian-born daycare educators. It would also be useful to investigate in more detail the differences between Canadian and American daycare contexts that have resulted in apparently different levels of risk of childcare-linked outbreaks. The low levels of seropositivity among Canadian-born educators and educators from high-income countries (the majority in our sample) suggest the potential for morbidity among educators should an outbreak occur in this setting.

Conclusions

The results of this study may be generalized to daycare educators in large urban centres in Canada. However, due to the geographic variation of hepatitis A, the results should be interpreted with caution in other countries. Seropositivity rates were not found to vary between groups of daycare centres, indicating that in this study daycare-level risk factors are not important in determining individual risk of hepatitis A infection. Canadian and foreign-born daycare educators have different individual risk related to their country of origin, and to other individual characteristics pertinent in the acquisition of hepatitis A infection. Foreign-born educators appear to have been exposed to hepatitis A infection early in life. Due to their high levels of seropositivity, this group may benefit more from serological testing for hepatitis A status than routine vaccination. Alternatively, Canadian educators may be at increased risk of hepatitis A infection by their work in daycare centres, largely due to their lack of earlier exposure to other important risk factors for hepatitis A. As a result, future policy may consider vaccination of daycare

educators, particularly those who are Canadian-born or from other high income/low HAV prevalence countries, to prevent hepatitis A morbidity in this occupational group.

References

1. Bell BP, Shapiro CN, Alter MJ, *et al.* The diverse patterns of hepatitis A epidemiology in the United States: Implications for vaccination strategies. J Infect Dis 1998; 178: 1579-84.
2. National Advisory Committee on Immunization. Canadian Immunization Guide, 6th Ed. Ottawa, ON: Health Canada, 2002.
3. Venczel LV, Desai MM, Vertz PD, *et al.* The role of child care in a community-wide outbreak of hepatitis A. Pediatrics 2001; 108(5): E78-82.
4. Centers for Disease Control and Prevention. Hepatitis A Surveillance Report No. 57. Atlanta GA: Centers for Disease Control and Prevention, 2000.
5. Jackson LA, Stewart LK, Solomon SL, *et al.* Risk of infection with hepatitis A, B, or C, cytomegalovirus, varicella or measles among child care providers. Pediatr Infect Dis J 1996; 15(7): 584-89.
6. Ford-Jones EL, Kitai I, Davis L. Seroprevalence of hepatitis A, hepatitis B, human parvovirus B19, and toxoplasmosis in Toronto infant-toddler daycare providers. [Abstract] 35th Interscience Conference on Antimicrobial Agents and Chemotherapy (Washington): American Society for Microbiology, 1995.
7. World Bank. World Development Indicators. New York: Oxford University Press, 2001.
8. Centers for Disease Control and Prevention, National Center for Infectious Diseases - Division of Viral Hepatitis. Available: www.cdc.gov/ncidod/diseases/hepatitis/slideset/index.htm , 2002.

Figure 1: Trends in Selected Risk Factors for Reported Cases of Hepatitis A in the United States, 1983-1995 [4]

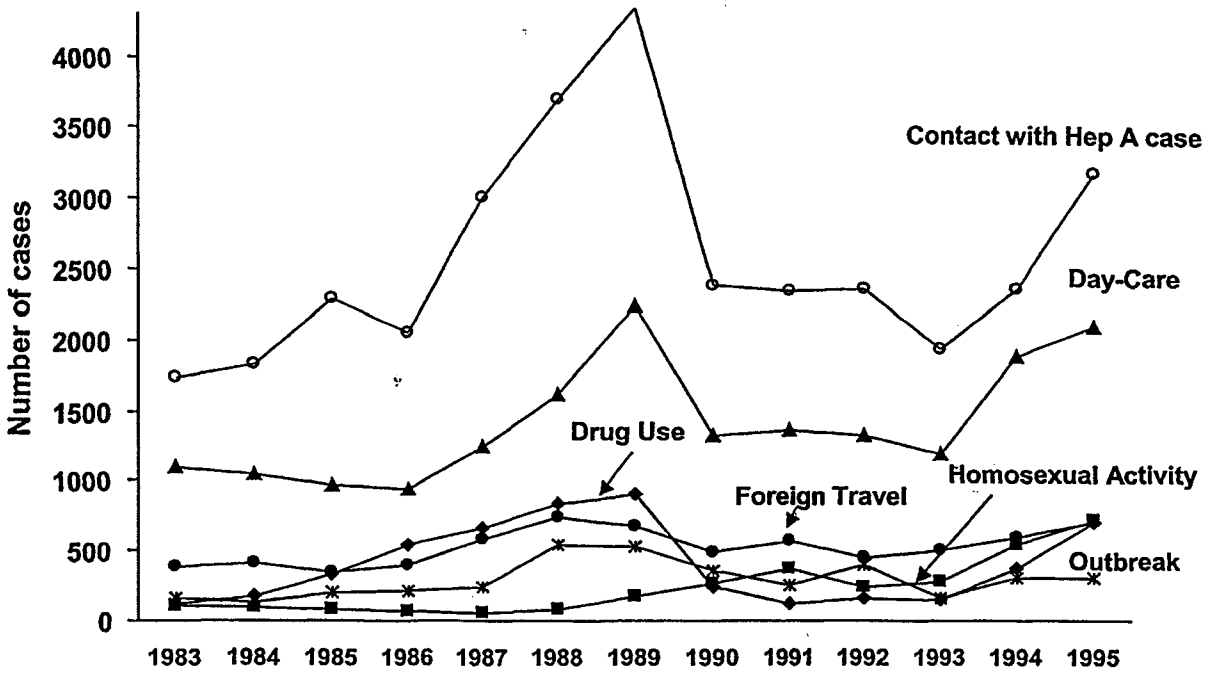


Figure 2: Flowchart of Daycare Centre Selection and Participation, Montreal, Quebec, 2001

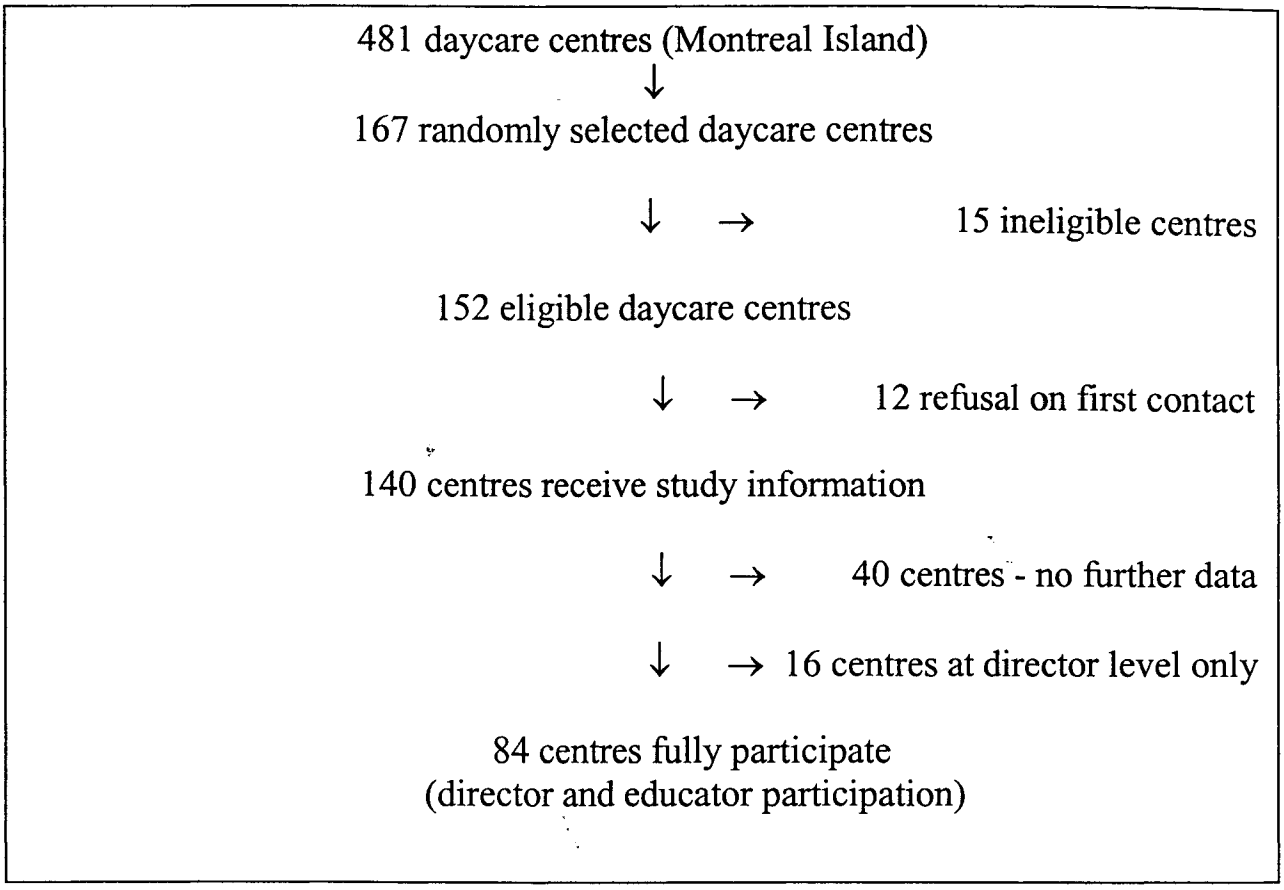


Figure 3: World map of geographic distribution of hepatitis A seropositivity [8]

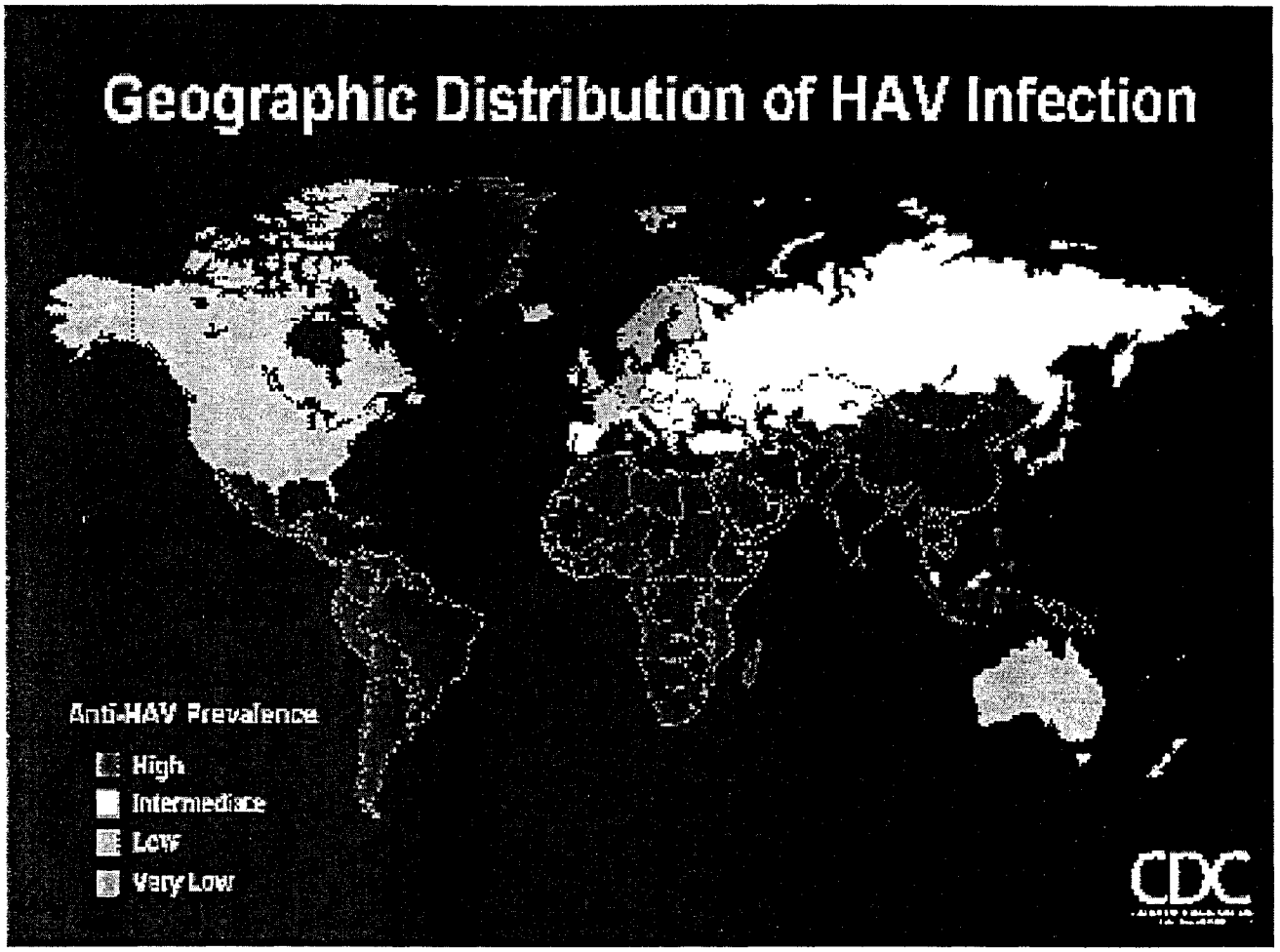


Table 1: Characteristics of daycare centres with director participation who had sufficient (n = 84) vs insufficient (n=16) educator participation, Montreal, Quebec, 2001

Daycare Centre Characteristic	Participating daycare centres (n=84) [percent or mean (SD)]	Non-participating daycare centres (n=16) [percent or mean (SD)]
Status		
- Public	67.1	62.5
- Private	32.9	37.5
# licensed daycare places	61.4 (22.4)	69.3 (29.1)
# nursery places	6.2 (6.7)	4.0 (5.5)
Minimum age at admission	11.0 (8.6)	13.3 (8.8)
# hours open per week	55.6 (6.1)	54.3 (3.5)
# years in operation	18.9 (9.0)	17.9 (9.3)
# educators/centre	11.2 (4.5)	12.6 (5.9)
Children < 18 months of age	10.8	7.9
Children 18-35 months of age	36.3	33.9
Children >= 36 months of age	52.9	58.2
Accept part-time attendance	61.0	73.3

Table 2: Characteristics of educators who completed a questionnaire and gave a blood sample (n=492) versus educators who completed the questionnaire only (n=52), Montreal, Quebec 2001

Educator Characteristic	Educators who gave blood and completed questionnaire (n=492) [percent or mean (SD)]	Educators who completed questionnaire only (n=52) [percent or mean (SD)]
Sex – female	98.0	98.1
Mean age (years)	35.7 (9.8)	37.5 (11.0)
Place of birth – Canada	68.9	74.5
Ever traveled to a developing country	35.5	23.8
Current income* < $20,000	27.3	34.8
# people in household	2.6 (1.6)	2.5 (1.3)
ECE† diploma	63.5	41.2
# years working in daycare	8.2 (6.3)	8.8 (6.4)
# hours worked per week	35.0 (6.0)	35.6 (7.2)
# children cared for regularly	10.4 (5.2)	10.8 (5.2)
Diapering >10 times per week	44.7	41.2
Report of past HAV‡ vaccination	13.4	8.0

* Annual household income
†ECE = early childhood education
‡ HAV = hepatitis A virus

Table 3: Comparison of educator characteristics by region of birth (World Bank classification), Montreal, Quebec, 2001

Educator Characteristic	Region of birth		
	High income countries (n=380)	Middle income countries (n=80)	Low income countries (n=32)
Seropositivity rate	19.7	85.0	100.0
Mean age (years)	34.5	40.1	40.0
Ever traveled to a developing country	23.9	72.6	81.5
Current income* <$20,000	22.8	45.6	39.3
# people in household	2.5	3.0	3.6
ECE† diploma	66.6	49.4	62.5
# years working in daycare	8.5	7.5	6.9
# hours worked per week	34.8	35.4	36.5
# children cared for regularly	10.3	10.8	9.8
Diapering >10 times per week	43.3	51.3	45.2
Report of past HAV‡ vaccination	12.8	15.4	15.6

* Annual household income
†ECE = early childhood education
‡ HAV = hepatitis A virus

Table 4: Comparison of educator characteristics by place of birth, Canada versus foreign, Montreal, Quebec, 2001

Educator Characteristic	Place of birth	
	Canada (n = 339)	Foreign (n = 153)
Seropositivity rate	15.9	79.1
Mean age (years)	34.0	39.7
Ever traveled to a developing country	22.9	63.5
Current income* <$20,000	22.3	39.1
# people in household	2.4	3.0
ECE† diploma	66.7	56.6
# years working in daycare	8.5	7.6
# hours worked per week	34.7	35.6
# children cared for regularly	10.2	10.8
Diapering >10 times per week	45.6	42.8
Report of past HAV‡ vaccination	12.1	15.7

* Annual household income
†ECE = early childhood education
‡ HAV = hepatitis A virus

Table 5: Significant bivariate results for educator and daycare-level variables, Montreal, Quebec, 2001

Educator Variable	**Explanatory Notes**	**OR (95% CI)**
Region of birth	High vs middle/low income country region (approximating low, middle, high HAV endemicity)	24.2 (12.7, 46.0)
Ever traveled	To a developing country (yes/no)	6.1 (3.9, 9.3)
Past HAV* vaccination	Vaccinated vs not vaccinated/don't know	3.0 (1.7, 5.1)
Have children	Have own children vs no children	2.5 (1.7, 3.7)
Low Income	Less than $20,000 vs more than $20,000	2.0 (1.3, 3.2)
Marital status	Married/common-law vs single	1.7 (1.2, 2.6)
ECE† diploma	Having an ECE diploma vs not	1.6 (1.1, 2.4)
Age	Grouped by standard 5-year categories	1.4 (1.3, 1.6)
Size of household	# people in home other than educator	1.2 (1.1, 1.4)
Current smoker	Smoking currently vs non smoker	0.4 (0.2, 0.6)
Daycare-level variable		
Daycare status	Private/for profit vs Publicly funded	2.2 (1.5, 3.3)
Hours open	# hours the daycare is open per week	1.04 (1.01, 1.07)

* HAV = hepatitis A virus
† ECE = early childhood education

Table 6: Multivariate logistic models for daycare educator seropositivity by region of birth, Montreal, Quebec, 2001

Variable	Model (OR and 95% confidence interval)		
	All – HIC‡, MIC§, LIC‖ (n= 492)	***HIC‡ and MIC§ (n=460)***	***HIC‡ (n=380)***
Region of birth	20.8 (9.4, 46.0)	14.2 (5.8, 34.8)	NA**
Age (5 yr grps)	1.5 (1.3, 1.7)	1.6 (1.4, 1.9)	1.4 (1.2, 1.6)
Past HAV* vaccination	6.1 (2.9, 13.0)	7.6 (3.4, 17.2)	6.5 (3.0, 14.3)
Ever traveled to developing country	2.4 (1.3, 4.2)	2.9 (1.6, 5.4)	2.0 (1.1, 3.8)
Current income† <$20,000	NS††	2.6 (1.2, 5.3)	NS††
Married or common law	NS††	2.2 (1.2, 4.3)	NS††
Years working in daycare (5yr grp)	NS††	NS††	1.3 (1.0, 1.7)
Ratio # children to # bathrooms	NS††	NS††	1.0 (1.0, 1.1)

* HAV = hepatitis A virus
† Annual household income
‡ HIC = high income countries (low endemicity)
§ MIC = middle income countries (moderate endemicity)
‖ LIC = low income countries (high endemicity)
** N/A = not applicable
†† NS= not statistically significant (p> 0.05)

Table 7: Multivariate logistic models for daycare educator seropositivity by place of birth, Canada versus foreign, Montreal, Quebec, 2001

Variable	Model (OR and 95% confidence interval)		
	All (n= 492)	***Canada (n=339)***	***Foreign‖ (n=153)***
Region of birth	20.8 (9.4, 46.0)	NA‡	4.6 (1.7, 12.2)
Age (5 yr grps)	1.5 (1.3, 1.7)	1.4 (1.2, 1.7)	1.5 (1.1, 2.1)
Past HAV* vaccination	6.1 (2.9, 13.0)	8.8 (3.7, 21.1)	NS§
Ever traveled to developing country	2.4 (1.3, 4.2)	NS§	8.1 (2.3, 29.0)
Current income† <$20,000	NS§	NS§	5.3 (1.2, 24.2)
Married or common law	NS§	NS§	NS§
Years working in daycare (5yr grp)	NS§	1.3 (1.0, 1.8)	NS§

* HAV = hepatitis A virus
† Annual household income
‡ N/A = not applicable
§ NS= not statistically significant (p> 0.05)
‖ Foreign = born outside of Canada

5.2 Supplementary Results

The following section contains additional data and analyses that complement those found in the previous manuscript. They establish the representativeness of the study population and examine the effect of clustering of educators by daycare centres.

5.2.1 Reasons for Non-participation

5.2.1.1 Daycare centres

In some cases (7.9%), the daycare director refused participation of the centre on the first phone call. Reasons for this initial refusal included lack of time, involvement in other studies, and logistical changes in the daycare (moving, change of director). Table 1 compares the characteristics of centres that participated fully in the study with those who refused any level of participation.

Table 1: Daycare directors who refused on first phone call (n = 12) versus those who fully participated (centre and educator-level) (n = 84), Montreal Quebec, 2001

Daycare Centre Characteristic	Participating daycare centres (n=84) [percent or mean]	Refusal on first phone call (n=12)* [percent or mean]
Status – public daycare	67.1%	9.1%
# licensed daycare places	61.4	64.0
# hours open per week	55.6	55.5
Total number of educators	11.2	11.5
# children < 36 months	27.9	37.0

*The denominator for these figures is n = 11 because one director refused to answer all study questions.

It was observed that a much smaller percentage of daycares who refused participation were public daycares, and that they tended to have a larger number of children under the age of 36 months.

Even if the director was interested in study participation, the centre could be found ineligible for participation. Of the 15/167 (9.0%) randomly selected centres that were found to be ineligible, 7 only enrolled children older than 36 months, and 8 had an insufficient number of staff (less than 6 educators).

Once the study information was sent out to the centres, nonparticipation was related to insufficient director and/or educator interest. In cases where the director was unable to elicit sufficient educator interest, s/he was asked to complete the director questionnaire and mail it to the principal investigator. Although one hundred directors (65.8%) completed the daycare-level questionnaire, there was insufficient educator participation in 16 centres. Table 2 compares the characteristics of centres that participated fully in the study with those where the director provided information but there was insufficient educator participation.

Table 2: Characteristics of daycare centres with director participation who had sufficient (n = 84) vs insufficient (n=16) educator participation, Montreal Quebec, 2001

Daycare Centre Characteristic	Participating daycare centres (n=84) [percent or mean (SD)]	Non-participating daycare centres (n=16) [percent or mean (SD)]
Status – public daycare	67.1	62.5
# licensed daycare places	61.4 (22.4)	69.3 (29.1)
# nursery places	6.2 (6.7)	4.0 (5.5)
Minimum age of admission	11.0 (8.6)	13.3 (8.8)
# hours open per week	55.6 (6.1)	54.3 (3.5)
# years in operation	18.9 (9.0)	17.9 (9.3)
Total number of educators	11.2 (4.5)	12.6 (5.9)
# children on social assistance	2.1 (3.4)	4.0 (5.2)
Children < 18 months of age	10.8	7.9
Children 18-35 months of age	36.3	33.9
Children >= 36 months of age	52.9	58.2
Accept part-time attendance	61.0	73.3

Daycare centres with insufficient educator participation were slightly less likely to be public centres, tended to be slightly larger and have a larger percentage of older children, and were more likely to accept part-time attendance of children.

5.2.1.2 Educators

Of all the educators that completed questionnaires (n = 544), a small proportion of them (n=52 or 9.6%) did not provide a blood sample. Reasons for not giving a blood sample were documented as refusal to give blood (fear of needles, etc) (n=16), absence at the time of the on-site visit (n=10), and unsuccessful attempt at drawing blood (n=26). Table 3 compares those who fully participated in the study with those who completed a questionnaire only.

Educators who completed the questionnaire only were slightly older, were more likely to have been born in Canada and less likely to have traveled to a developing country, were more likely to live in a household with an annual income of less than $20,000/year, were less likely to have a diploma in early childhood education, and were less likely to report having received a vaccination for hepatitis A.

Table 3: Characteristics of educators who completed a questionnaire and gave a blood sample (n=492) versus educators who completed the questionnaire only (n=52), Montreal Quebec 2001

Educator Characteristic	Educators who gave blood and completed questionnaire (n=492) [percent or mean (SD)]	Educators who completed questionnaire only (n=52) [percent or mean (SD)]
Sex – female	98.0	98.1
Mean age (years)	35.7 (9.8)	37.5 (11.0)
Place of birth – Canada	68.9	74.5
Ever traveled to a developing country	35.5	23.8
Current income - < $20,000	27.3	34.8
# people in household	2.6 (1.6)	2.5 (1.3)
ECE* diploma	63.5	41.2
# years working in daycare	8.2 (6.3)	8.8 (6.4)
# hours worked per week	35.0 (6.0)	35.6 (7.2)
# children cared for regularly	10.4 (5.2)	10.8 (5.2)
Diapering >10 times per week	44.7	41.2
Report of past HAV vaccination	13.4	8.0

*ECE = early childhood education
** Annual household income

5.2.2 Analysis

5.2.2.1 Correlation Analysis

Many centre and educator variables exhibited a high degree of correlation with one another. A list of variables with statistically significant and high magnitude correlation values is provided in the Appendix 6.

The most significant correlation, in terms of interpretation of the subsequent analyses, was between region of birth and history of travel to a developing country ($r_s = 0.43$, p <0.001). Another important correlation was that between the number of years worked in daycare and age ($r_s = 0.55$, p <0.001).

Other high magnitude correlation values were (Table 4):

- total years worked in daycare and years worked in the current daycare;

- age group of children worked with and the frequency of diaper changing;
- number of children the educator has and the size of her household;
- the number of places in the daycare with the number of younger children at the daycare (reflected in the number of children less than 36 months, and the minimum age of entry).

Table 4: Spearman correlations for selected variables

Variables	Spearman correlation (r_s)	p-value
Region of birth and past travel	0.43065	<0.001
Years worked in daycare and age	0.54582	<0.001
Total years worked in daycare vs years in current daycare	0.84961	<0.001
Age group of children and frequency diaper changing	-0.60985	<0.001
# children (educator) and size of household	0.50272	<0.001
# of daycare places and # children <36 months	0.81278	<0.001
# daycare places and minimum age of entry	-0.33698	<0.001

5.2.2.2 Daycare Centre Clustering

Initial multivariate modeling attempted to take clustering of daycares into account by constructing a nonlinear mixed effects model, in which the model looked for variation between groups of daycares as well as within the groups. Daycares were grouped according to several different administrative criteria to determine if there was a significant variation between these types of daycares. The criteria used to group the daycares were:

- status of the daycare (reflecting different organizational practices)
- number of licensed places in the daycare (reflecting daycare size)
- number of nursery places (reflecting the proportion of diapered children in the daycare)

- the number of children under 36 months old at the daycare (reflecting the proportion of diapered children in the daycare)
- number of years the centre has been in operation (reflecting daycare experience)
- number of hours the daycare is open per week (reflecting amount of exposure time available)
- total number of educators employed at the daycare (reflecting size, pool of at-risk candidates)
- minimum age of children at registration (reflecting the proportion of diapered children)

In all cases, the variation between different groupings of daycares was not found to be significant in explaining the outcome in a multivariate model. As a result, it was concluded that clustering of educators in daycare centres did not help to explain who had been exposed to hepatitis A, or who had more risk factors for that exposure, and a multiple logistic model was then developed. The multiple logistic model also examined both centre and educator level variables, but now in terms of individual risk of seropositivity.

6. DISCUSSION AND CONCLUSION

This study was conducted in order to provide hepatitis A seroprevalence estimates and examine associated risk factors for daycare educators. This information was not previously available in Canada for this occupational group. Children attending daycare have long been known to be at increased risk for infectious diseases, and adults working in this environment may also experience increased morbidity. The results of our study demonstrate that daycare educators (generally Canadian-born) who are not exposed to hepatitis A risk factors such as travel or residence in a highly endemic country, may be placed at increased risk of symptomatic infection by working in daycare centres. The role of previous hepatitis A vaccination is important, despite the fact that vaccination is not routinely recommended for daycare educators. Age has a consistent influence on seropositivity, likely representing changes in hepatitis A epidemiology over time, and acting as a proxy measure for a variety of nonspecific factors since increasing age is not biologically associated with increased risk of infection.

Discussion of the study results and interpretation in light of previous research has been provided in the second manuscript. The following sections extend the manuscript's discussion to include recruitment issues, representativeness of the sample, the role of clustering, and limitations of certain variables. These issues should be considered in future research conducted within the daycare setting.

6.1 Recruitment issues

Various methods of recruitment have been used when eliciting participation of daycare educators. Past studies have approached recruitment by introducing the study to the educators at an on-site visit by the research team, with the initial approval of the director obtained by phone. In the study by Jackson *et al* (1996), the research team was able to recruit 29.7% of eligible centres, with an average of 7.3 educators per centre. Our study was able to produce a good participation rate, compared to these previous studies, at both the centre and educator level (55.3% of eligible centres, 5.9 educators per centre), without the extra step of an on-site introductory visit.

In our study, daycare directors were contacted first by phone to elicit their support for the study. The director then essentially acted as an intermediary between the research team and the educators, informing the educators of the study and using various means to determine staff interest. While most directors were willing to take on this role (only 7.9% of eligible centres refused participation at the director level), there were clearly differences in the means used to determine staff interest. The means used could be either passive (for example, placing educator packages in mail slots and waiting for positive responses) or active (for example, discussing the study at an organized meeting), and likely reflected the director's own enthusiasm and interest in the study - as well as practical aspects such as time and manpower constraints. These factors likely explain why some centres with director participation had insufficient numbers of interested educators. Future studies that utilize the director as an intermediary could make explicit recommendations to the directors as to how educators are to be recruited, although such measures may paradoxically increase director refusal or reduce director enthusiasm.

Alternatively, future studies could simply conduct a short post-participation survey of directors, to determine if the above-mentioned factors were indeed important.

6.2 Representativeness of the sample

Daycare centres that participated in the study were found to be somewhat different from both those who refused on the first phone call and those who had insufficient educator participation.

Those who refused on the first phone call were almost all (90.9%) private or for-profit centres and tended to care for more children under the age of 36 months. Although their number was small (n = 11), this does suggest that these types of daycare centres may have been underrepresented in our sample. On the surface, this seems worrisome; however, the poor participation of this group may be of minor concern for a few reasons. First, Quebec is moving steadily towards a public system of childcare, and thus the number of private for-profit centres is likely to decrease. Second, descriptive analysis reveals that private for-profit daycares are more likely to employ non-Canadian educators, who are known to have high hepatitis A seropositivity, likely unrelated to their occupational environment.

Daycare centres with insufficient educator participation were also slightly less likely to be publicly funded and more likely to have higher numbers of children – however, this was compensated by having more staff, and the children were older. A more problematic difference is that the daycare centres with insufficient educator participation were more

likely to accept part-time attending children. This could mean that these educators would be exposed to more children in an average week than those who participated in the study.

Some differences were also found between educators who participated in blood collection versus those who did not. Compared to those who fully participated (gave blood and completed a questionnaire), educators who only completed a questionnaire were more likely to be born in Canada and have an income less than $20,000. They were less likely to have traveled to a developing country, have gotten their ECE diploma, or to have reported receiving a hepatitis A vaccination. Since region of birth, vaccination history, and travel to a developing country are strong predictors of seropositivity, this suggests that the seroprevalence estimate obtained could be an overestimation of the Montreal educator population - if the above profile is representative of the non-sampled educator population. The implications of this are clearly greatest for Canadian-born educators.

6.3 Importance of daycare-level risk factors

The use of a mixed effects model to account for clustering within daycare centres showed that variation between groups of daycares was not found to be significant in explaining the outcome of the multivariate model. This result could be interpreted in one of two ways. It could mean that the hepatitis A risk for an individual educator is not significantly influenced by her occupational environment. Alternatively, it could mean that the occupational environment does not vary significantly between daycare centres with regard to hepatitis A risk (all daycare centres expose their workers to a similar degree of risk). When the mixed effects model results are combined with the results of the multivariate regression, it would seem that the former explanation is likely. However,

it should be recalled that this study was conducted in the absence of an ongoing outbreak of hepatitis A.

6.4 Past travel to a developing country

The travel variable may have contained some false negative answers. The educators were asked if they had ever traveled to a developing country. Although this question posed no comprehension problems during the pre-testing phase, it is possible that some educators did not understand or had not heard the term 'developing country', and thus assumed that they had not visited one. It is also possible that some educators did not consider a resort trip to the Caribbean as 'travel to a developing country'. It has been noted on tourist information websites, however, that people who stay in developing countries at conventional tourist destinations with 'five-star' facilities are still considered at risk for hepatitis A (Health Canada – www.hc-sc.gc.ca/hpb/lcdc/osh/info/hepa_e.html and CDC – www.cdc.gov/travel/diseases/hav.htm). Thus it is possible that the proportion of people traveling to developing countries may have been underreported, and therefore positive results that would have been attributed to travel was attributed to other factors. It seems less likely that there would be false positive reporting of travel to developing countries (people reported travel to a developing country when in fact the country does not fall in this category). This source of information bias may explain why travel to a developing country was a less important risk factor in Canadians that would have been expected.

6.5 Report of past HAV vaccination

The vaccination variable is based on self-report only, and was not confirmed by vaccination records. It is possible that both false negatives and false positives occurred.

False negatives (reporting that you were not vaccinated when in fact you were) may have occurred due to the option of answering 'Don't know'. These answers were not included in the analysis, although it was noted that there was a positive association between answering 'Don't know' and being seropositive (although not as strongly positive as when answering 'Yes'). False positives (reporting that you were vaccinated when in fact you weren't) could occur because the educator assumed that she had been vaccinated against this disease as part of routine childhood vaccinations, or that her health care provider had vaccinated her against 'all vaccine-preventable diseases'. Given that the vaccine was only licensed for use in the mid-1990s, and that recommendations for vaccination are fairly specific, it is clearly not the case that most educators would be routinely vaccinated against this disease. In fact, it was found that those who said they had been vaccinated were subsequently found to be seropositive only 58.5% of the time. Given that the chances for false positive and false negative reporting both seem reasonably likely, it is difficult to say if the report of vaccination variable was strongly biased in one direction or the other.

6.6 Generalizability

The results of this study are expected to be applicable to daycare educators in large urban centres in Canada. Our daycare educator population was very multicultural and came from a variety of backgrounds, several characteristics of which likely put them at greater risk of exposure to hepatitis A outside of the daycare setting than educators in smaller urban or rural areas. The children that they care for may likewise be more likely to carry hepatitis A for the same reasons.

The epidemiology of hepatitis A is such that its distribution and certain risk factors may vary between countries, and thus the results should not be generalized to other countries. Alternatively, this fact reinforces the importance of these results in the Canadian context, as similar studies from other countries are not necessarily applicable in Canada.

6.7 Conclusions

Although the link between work in daycare centres and seropositivity appears to be relatively small in this study, there are several interesting conclusions that can be reached:

- Seroprevalence does not vary significantly between groups of daycare centres, indicating that daycare-level risk factors are likely not important in determining individual risk of hepatitis A infection;
- Canadian and foreign-born daycare educators form distinct groups in Montreal, both in terms of their individual risk related to their country of origin, and in other characteristics pertinent to risk of hepatitis A infection;
- Canadian educators may be put at some increased risk of hepatitis A infection by their work in daycare centres, largely due to their lack of exposure to other important risk factors for hepatitis A;
- Future policy may consider vaccination of daycare educators, particularly those who are Canadian-born, to prevent hepatitis A morbidity in this occupational group. Foreign-born educators may benefit more from antibody testing prior to vaccination.

7. REFERENCES

American Academy of Pediatrics, American Public Health Association, National Resource Center for Health and Safety in Child Care. Caring for our Children: National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care Programs (2nd ed.). United States: American Academy of Pediatrics, 2002.

Beach J, Bertrand J, and Cleveland G. Our child care workforce: From recognition to remuneration: A human resource study of child care in Canada. Ottawa: Child Care Human Resources Steering Committee, 1998.

Bell BP, Shapiro CN, Alter MJ, *et al.* The diverse patterns of hepatitis A epidemiology in the United States: Implications for vaccination strategies. J Infect Dis 1998; 178: 1579-84.

Berg AT, Shapiro ED, Capobianco LA. Group day care and the risk of serious infectious illnesses. Am J Epidemiol 1991; 133(2): 154-63.

Bright KA and Calabro K. Child care workers and workplace hazards in the United States: Overview of research and implications for occupational health professionals. Occup Med 1999; 49(7): 427-37.

Bureau de la statistique du Québec. Enquête sur les besoins des familles en matière de services de garde. Rapport d'analyse descriptive. Québec:Bureau de la statistique du Québec, 1999.

Canadian Child Care Federation. Press Release, Ottawa, ON: August 15, 2000.

Canadian Child Care Federation. News. Interaction 2001 Winter; 14:41.

Centers for Disease Control and Prevention. Hepatitis A Surveillance Report No. 57. Atlanta GA: Centers for Disease Control and Prevention, 2000.

Centers for Disease Control and Prevention, National Center for Infectious Diseases – Division of Viral Hepatitis. Website : www.cdc.gov/ncidod/diseases/hepatitis/slideset/index.htm , 2002.

Chin J (Ed.). Control of Communicable Diseases Manual, 17th edition. Washington DC: American Public Health Association, 2000.

Churchill RB and Pickering LK. Infection control challenges in child-care centers. Infect Dis Clin North America 1997; 11(2): 347-65.

Cook D, Wilton L, Patrick D, *et al.* Prevalence of antibodies to hepatitis A virus in a cohort of women of child-bearing age. [Abstract] 68th conjoint meeting of infectious disease (Ottawa): Canadian Association for Clinical Microbiology and Infectious Disease, 2000.

Desenclos JA and MacLafferty L. Community wide outbreak of hepatitis A linked to children in day care centres and with increased transmission in young adult men in Florida 1988-9. J Epidemiol Comm Health 1993; 47: 269-73.

Direction générale de la santé publique. Surveillance des maladies infectieuses et des intoxications chimiques à déclaration obligatoire au Québec, de 1990 à 1999. Québec: Ministère de la santé et des services sociaux, 2001.

Doherty G, Lero DS, Goelman H, *et al.* You bet I care! A Canada-wide study on wages, working conditions, and practices in child care centres. Guelph Centre for Families, Work and Well-being: University of Guelph, 2000.

Embil JA, Manley K. Hepatitis A: A serological study in the Canadian Armed Forces. Military Med 1989; 154(9): 461-5.

Ford-Jones EL, Kitai I, Davis L. Seroprevalence of hepatitis A, hepatitis B, human parvovirus B19, and toxoplasmosis in Toronto infant-toddler daycare providers. [Abstract] 35th Interscience Conference on Antimicrobial Agents and Chemotherapy (Washington): American Society for Microbiology, 1995.

Hadler SC, Erben JJ, Francis DP, *et al.* Risk factors for hepatitis A in day-care centers. J Infect Dis 1982; 145(2): 255-61.

Hadler SC and McFarland L. Hepatitis in day care centers: Epidemiology and prevention. Rev Infect Dis 1986; 8(4): 548-57.

Hofmann F, Wehrle G, Berthold H, Koster D. Hepatitis A as an occupational hazard. Vaccine 1992; 10 (Suppl 1): S82-4.

Hurwitz ES, Deseda CC, Shapiro CN, *et al.* Hepatitis infections in the day-care setting. Pediatrics 1994; 94(Suppl): 1023-4.

Jackson LA, Stewart LK, Solomon SL, *et al.* Risk of infection with hepatitis A, B, or C, cytomegalovirus, varicella or measles among child care providers. Pediatr Infect Dis J 1996; 15(7): 584-9.

Keifer LA, Honish A, Predy G, Talbot JA. The seroprevalence of hepatitis A and B in people testing positive for hepatitis C. Can Med Assoc J 2000; 162(2): 207-8.

Klein JO. Infectious diseases and day care. Rev Infect Dis 1986; 8(4): 521-6.

Kocuipchyk FR, Lightfoot PJ, Stout I, *et al.* Seroprevalence of hepatitis A antibodies in travellers at the Edmonton Travellers' Health Clinic – Alberta. Can Comm Dis Rep 1995; 21(8): 65-71.

Lerman Y, Chodik G, Aloni H, *et al.* Occupations at increased risk of hepatitis A: A 2-year nationwide historical prospective study. Am J Epidemiol 1999; 150(3): 312-20.

Levy I, Chen D, Sherman M, *et al.* Hepatitis A virus seroprevalence in 1,000 university students in Toronto. Can Comm Dis Rep 2001; 27(11): 93-6.

Louhiala PJ, Jaakkola N, Ruotsalainen R *et al.* Day-care centers and diarrhea: a public health perspective. J Pediatr 1997; 131(3): 476-9.

Ministère de la Santé et des Services sociaux. Prévention et contrôle des infections dans les centres de la petite enfance : Guide d'intervention. Québec : Les publications du Québec, 2002.

Nafstad P, Hagen JA, Oie L *et al.* Day care centers and respiratory health. Pediatrics 1999; 103(4 Pt 1): 753-8.

National Advisory Committee on Immunization. Canadian Immunization Guide, 5th Ed. Ottawa, ON: Health Canada, 1998.

National Advisory Committee on Immunization. Canadian Immunization Guide, 6th Ed. Ottawa, ON: Health Canada, 2002.

National Institute of Child Health and Human Development, Early Child Care Research Network. Child care and common communicable illnesses: results from the National Institute of Child Health and Human Development Study of Early Child Care. Arch Pediatr Adol Med 2001; 155(4): 481-8.

Ochnio JJ, Patrick D, Ho M, *et al.* Past infection with hepatitis A virus among Vancouver street youth, injection drug users and men who have sex with men: Implications for vaccination programs. Can Med Assoc J 2001; 165(3): 293-7.

Payment P. Antibody levels to selected enteric viruses in a French-Canadian population in the province of Quebec (Canada). Immunol Infect Dis 1991; 1: 317-22.

Reves RR and Pickering LK. Impact of child day care on infectious diseases in adults. Infect Dis Clin North America 1992; 6(1): 239-50.

SAS Institute. SAS version 8e. Cary, NC: The SAS Institute, 1999-2001.

Shapiro CN, Hadler SC. Hepatitis A and hepatitis B virus infections in day-care settings. Pediatr Ann 1991; 20(8): 435-41.

Soto JC and Marin-Lira A. Infectious diseases in daycare: a public health perspective. Can J Pediatr 1993; 5(4): 274-9.

Unité maladies infectieuses. Rapport sur les maladies infectieuses à déclaration obligatoire: Région de Montréal-Centre 1998. Montréal Québec: Direction de la santé publique, 2000.

Unité maladies infectieuses. Rapport sur les maladies infectieuses à déclaration obligatoire: Région de Montréal-Centre 1997. Montréal Québec: Direction de la santé publique, 1999.

Venczel LV, Desai MM, Vertz PD, *et al.* The role of child care in a community-wide outbreak of hepatitis A. Pediatrics 2001; 108(5): E78-82.

Wald ER, Dashefsky B, Byers C, *et al.* Frequency and severity of infections in day care. J Pediatr 1988; 112(4): 540-6.

World Bank. World Development Indicators . New York : Oxford University Press, 2001.

Appendix 1

Daycare Director Mailing

Centre universitaire de santé McGill
McGill University Health Centre

McGill

SEROEPIDEMIOLOGICAL STUDY OF INFECTIONS IN DAY CARE EDUCATORS

LETTER OF INVITATION FOR DAY CARE DIRECTORS

Dear Director,

The risk of infectious diseases is of particular concern to day care centers, due to the potential for outbreaks among the children. While the health of the children is certainly an important concern, there is also a need for information on the health risks for educators. The day care environment presents several unique and significant health challenges to its employees, one of the most important being the risk of infections. In order to consider appropriate preventive interventions, it is important to know the degree of risk that exists amongst these workers. This information is not as yet available in Quebec.

We would like to invite you to consider involving your day care in a valuable university-based research study, investigating the risk of infectious diseases among day care educators. Your name and address were provided to us by the Ministere de la famille et de l'enfance for research purposes.

Specifically, this study will look at hepatitis A, varicella (chicken pox), cytomegalovirus (CMV) infection, parvovirus B19 (fifth disease), and rubella (German measles). Day care educators are placed at relevant risk of infections due to their proximity to groups of young children. As you well know, children tend to have higher than average numbers of infections, and are prone to spreading microorganisms through their relatively poor hygiene habits. Most of these infections, such as the common cold, are bothersome but relatively harmless. But certain infections, such as chicken pox and hepatitis A, while usually benign in children, can cause serious disease in adults. Other conditions, such as rubella, CMV, and fifth disease, are usually benign in both children and adults, but can cause birth defects when contracted during pregnancy. This is important considering that the vast majority of day care educators are women of childbearing age.

The study consists of two phases – an initial information phase and a follow-up phase. For the first phase, you will be asked to discuss participation in the study with your staff. If there is interest on their part in participating, a visit to the centre will be arranged. Informed consent forms and baseline questionnaires for the educators will be

SEROEPIDEMIOLOGICAL STUDY OF INFECTIONS IN DAYCARE EDUCATORS

INFORMED CONSENT FORM FOR DAYCARE DIRECTORS

Principal Investigators : Dr. Theresa Gyorkos (Division of Clinical Epidemiology, Montreal General Hospital Research Institute) and Dr. Julio Soto (Direction de la sante publique de Montreal Centre)

Project Sponsor :

Background Information :
The infections in this study – cytomegalovirus, varicella-zoster (chickenpox), parvovirus B19, hepatitis A, and rubella - are of public health importance because of their potential disease implications and because of the occupational risk that they may incur among adult staff, particularly pregnant women. Hepatitis A and varicella-zoster are known to cause more severe disease in adults, while cytomegalovirus, rubella, and parvovirus B19 can cause significant damage to the unborn fetus. The risks of these infections in day care educators in Quebec are not known.

Research Objectives :
This study aims to measure the occurrence of these infections in daycare educators. We will measure the number of educators who are at risk at a given point in time, as well as their risk of contracting some of the infections over one year. This will help us to understand the frequency of these infections among adult educators in the daycare setting. It will therefore contribute to improving existing preventive measures.

What will happen should you decide to participate in this study?
Participation in the study includes completing a questionnaire, and informing your staff of the study and its objectives.

What if I decline to participate?
Refusal to participate is your right. If you agree to participate or refuse to participate in this study, this would not affect your employment at the day care centre or your health care at the McGill University Health Centre.

Will the results be confidential?
During the study, all information collected through questionnaires will be kept strictly confidential. A study code will be used to identify each participating day care so that analyses will be performed anonymously. No descriptive information will be used in any documentation of this study. Once the study is complete, all codes and descriptive information will be destroyed.

Benefits and risks :
You will have the opportunity to learn more about the study infections, and protective measures that can be instituted at your day care. There are no risks involved in participation in this study.

Compensation :
I understand that I will not be compensated in any way for my participation in this study.

SERO-EPIDEMIOLOGY STUDY OF INFECTIONS IN CHILD DAYCARE

DAYCARE DIRECTORS QUESTIONNAIRE

1. **Centre code** |__|__|__|

2. **Centre status**
   ☐ CPE (Centre de la petite enfance)
   ☐ For profit daycare centre
   ☐ Other (please specify).....

3. **Number of licensed places** |__|__| places

4. **Number of places in the nursery** |__|__| places

Please answer **ALL** of the questions to the best of your knowledge. These questions are important for accomplishing the study objectives. Please remember that your answers will be kept **ANONYMOUS AND STRICTLY CONFIDENTIAL.**

The following questions concern the organization of the daycare:

5. **In what year did the centre open?** |__|__|__|__|

6. **Please record the opening hours of your centre.**

Monday	|__:__| to |__:__|	Friday	|__:__| to |__:__|
Tuesday	|__:__| to |__:__|	Saturday	|__:__| to |__:__|
Wednesday	|__:__| to |__:__|	Sunday	|__:__| to |__:__|
Thursday	|__:__| to |__:__|		

7. **Please indicate the total number of children registered in your daycare centre, according to age groups:**

Less than 18 months of age	|__|__| children
18 to 35 months of age	|__|__| children
36 months of age or older	|__|__| children

8. **How many of these registered children come from families on social assistance**
..... children

9. **Please indicate the number of educators working in your daycare centre, according to child age groups:**

Children less than 18 months of age	|___|___| educators
Children aged 18 to 35 months	|___|___| educators
Children aged 36 months and older	|___|___| educators

10. **What is the minimum age at registration for children in your daycare?**
..... (please specify months or weeks as necessary)

11. **In your daycare, do you accept children who are:**

still in diapers?	☐ Yes	☐ No
disabled?	☐ Yes	☐ No
part time?	☐ Yes	☐ No

12. **Please indicate the following building characteristics:**

Number of rooms dedicated to children	|___|___| rooms
Number of bathrooms for use by children	|___|___| bathrooms
Number of sinks for use by children	|___|___| sinks

13. **Please indicate who in your daycare is responsible for preparing meals and snacks for the children (check as many as apply to your centre):**

☐ Only the kitchen staff prepare food
☐ All educators are involved in food preparation
☐ Certain educators prepare food (please specify .....)
☐ Children participate in food preparation
☐ Other (please specify .....)

The following questions concern health issues in your daycare:

14. **In the past two weeks, how many cases of absenteeism due to illness have there been among:**

educators?	|___|___| cases
children?	|___|___| cases

15. **In the past two weeks, how many cases of DIARRHEA (liquid stools or doubling of usual stool frequency) were present among:**

educators?	|___|___| cases
children?	|___|___| cases

16. **In the past two weeks, how many cases of COLDS (runny nose accompanied by at least one of the following symptoms: fever, dizziness, cough, sore throat, earache, tearing) were present among:**
    educators? |___|___| cases
    children? |___|___| cases

17. **In your daycare centre, how many educators have taken an infection control training session?**
    ..... educators
    ☐ Don't know

18. **In your daycare centre, do the staff practice a particular hand washing technique?**
    ☐ Yes ☐ No ☐ Don't know
    If YES, where did they learn this technique?
    .....

19. **In your daycare centre, do you have a routine for the washing of toys and surfaces?**
    ☐ Yes (please indicate the frequency ie, daily, weekly, etc. .....)
    ☐ No
    ☐ Don't know

20. **In your daycare centre, what type of disinfectant do you use for cleaning the toys?**
    (specify the name) .....
    ☐ Don't know

Thank you for your cooperation!

Appendix 2

Daycare Educator Mailing

Centre universitaire de santé McGill
McGill University Health Centre

McGill

SEROEPIDEMIOLOGICAL STUDY OF INFECTIONS IN DAY CARE EDUCATORS

LETTER OF INVITATION FOR DAY CARE EDUCATORS

Dear Educator,

Thank you for taking the time to learn more about this valuable research study. In your occupation, you have no doubt become highly familiar with issues related to early childhood health and education. But have you spent time becoming familiar with your own health issues as an early childhood educator? The day care environment presents several unique and significant health challenges to its employees. While the health of the children is certainly an important concern, there is also a need for information on workplace health risks for educators.

This study will investigate one of the important health concerns of day care educators – the risk of infectious diseases. Specifically, this study will look at hepatitis A, varicella (chicken pox), cytomegalovirus (CMV) infection, fifth disease (parvovirus B19), and rubella (German measles). Day care educators are placed at relevant risk of infections due to their proximity to groups of young children. As you well know, children tend to have higher than average numbers of infections, and are prone to spreading microorganisms through their relatively poor hygiene habits. Most of these infections, such as the common cold, are bothersome but relatively harmless. But certain infections, such as chicken pox and hepatitis A, while usually benign in children, can cause serious disease in adults. Other conditions, such as rubella, CMV, and fifth disease, are usually benign in both children and adults, but can cause birth defects when contracted during pregnancy. This is important considering that the vast majority of day care educators are women of childbearing age.

The study consists of two phases – an initial information phase, that will include a blood test, and a follow-up phase. During the first phase, you will be asked to provide a 5cc (one teaspoon) blood sample from your arm, taken by the research team on a visit to your centre, in order to detect evidence of past infection and immunity to the five study diseases. You do not need to fast prior to the blood sample. You will also fill out a questionnaire to determine whether you are at risk for these infections.

Please keep in mind that due to the nature of the study, testing of the blood and subsequent notification may be delayed. You are free to seek medical advice at any time

SEROEPIDEMIOLOGICAL STUDY OF INFECTIONS IN DAYCARE EDUCATORS

INFORMED CONSENT FORM FOR DAYCARE EDUCATORS

Principal Investigators : Dr. Theresa Gyorkos (Division of Clinical Epidemiology, Montreal General Hospital Research Institute) and Dr. Julio Soto (Direction de la sante publique de Montreal Centre)

Project Sponsor :

Background Information :
The infections in this study – cytomegalovirus, varicella-zoster (chickenpox), parvovirus B19, hepatitis A, and rubella - are of public health importance because of their potential disease implications and because of the occupational risk that they may incur among adult staff, particularly pregnant women. Hepatitis A and varicella-zoster are known to cause more severe disease in adults, while cytomegalovirus, rubella, and parvovirus B19 can cause significant damage to the unborn fetus. The risks of these infections in day care educators in Quebec are not known.

Research Objectives :
This study aims to measure the occurrence of these infections in daycare educators. We will measure the number of educators who are at risk at a given point in time, as well as their risk of contracting some of the infections over one year. This will help us to understand the frequency of these infections among adult educators in the daycare setting. It will therefore contribute to improving existing preventive measures.

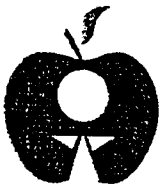
What will happen should you decide to participate in this study?
Participation in the study includes 1) completing a baseline questionnaire and up to two other questionnaires and 2) providing a 5 ml (one teaspoon) blood sample during the baseline visit to the centre, and if you continue to be at risk for one or more of the study infections, two more times, in 6 months and in 12 months (to be individually arranged with the researchers). Participants will be informed of their risk status for the infections for which vaccines are currently available (varicella-zoster, rubella, and hepatitis A), and will be encouraged to discuss their risk with their family physician or local CLSC physician. Those who are at risk of infections for which no vaccines are available (parvovirus B19 and cytomegalovirus), or who decide not to obtain a vaccine, will be followed for up to one year to determine if they become infected during that time.

What if I decline to participate?
Refusal to participate is your right. If you agree to participate or refuse to participate in this study, this would not affect your employment at the day care centre or your health care at the McGill University Health Centre.

Will the results be confidential?
During the study, all information collected through questionnaires and all results obtained from blood samples will be kept strictly confidential. A study code will be used to identify each participating educator so that laboratory work and analyses will be performed anonymously. No descriptive information will be used in any documentation of this study. Once the study is complete, all codes, descriptive information, and blood samples will be destroyed. Your employer will not be informed of your results.

SERO-EPIDEMIOLOGY STUDY OF INFECTIONS IN CHILD DAYCARE

BASELINE EDUCATOR'S QUESTIONNAIRE



Code |___|___|___|___|___|___|

Please answer **ALL** questions to the best of your knowledge. These questions are important for accomplishing the study objectives. Please remember that your answers will be kept **ANONYMOUS AND STRICTLY CONFIDENTIAL.**

The following questions concern your work in child daycare:

1. **How many TOTAL years of experience do you have in child daycare?**
   ..... years of experience
   If less than one year of experience, please check here ☐

2. **How many years of experience do you have in THIS daycare centre?**
   ..... years of experience
   If less than one year of experience, please check here ☐

3. **How many hours per week do you work in this daycare centre?**
   .....hours/week

4. **In this daycare centre, how many children do you have under your supervision?**
   ..... children

5. **With which group of children do you spend 50% or more of your time?**
   ☐ Children less than 18 months of age
   ☐ Children aged 18 to 35 months
   ☐ Children aged 36 months or older
   ☐ No particular group of children

6. **Please indicate your involvement in the changing of diapers:**

Frequency	*Wearing gloves*
☐ 0 (never)	
☐ 1-2 times/week	☐ Yes
☐ 3-10 times/week	☐ No
☐ 11 or more times/week	

7. **Please indicate your involvement in the tasks of diaper changing and food preparation:**

Routine tasks

☐ Diaper changing without involvement in food preparation
☐ Food preparation without involvement in diaper changing
☐ Diaper changing and food preparation
☐ Other (Please specify).....

8. **Please indicate the frequency with which you wash your hands in the two following situations:**

	Frequency				
After diaper changing:	☐ always	☐ often	☐ sometimes	☐ occasionally	☐ never
Before food preparation:	☐ always	☐ often	☐ sometimes	☐ occasionally	☐never

We would now like to ask some questions regarding your personal characteristics. They are very important for making statistical comparisons and for future recommendations. We would like to remind you that your answers will be kept ANONYMOUS AND STRICTLY CONFIDENTIAL.

9. **What is your date of birth?** |__|__| **day** |__|__| **month** |__|__| **year**

10. **What is your gender?**
☐ Female
☐ Male

11. **Where were you born?**
☐ Canada
☐ Other (please specify).....

12. **What language did you FIRST learn as a child that you still understand today?**
☐ French
☐ English
☐ Other (please specify).....

13. **How many years of school have you COMPLETED in:**

Primary and secondary school	..... years
Community college or CEGEP	..... years
University	..... years

14. **What was your total household income for the year 2000, from all sources and before taxes or deductions?**
    - ☐ $0 (no income)
    - ☐ $1 to $9 999
    - ☐ $10 000 to $19 999
    - ☐ $20 000 to $39 999
    - ☐ more than $39 999

15. **Have you obtained a diploma or certificate in early childhood education?**
    - ☐Yes (please specify year obtained).....
    - ☐No

16. **What is your current marital status?**
    - ☐Single
    - ☐Living with a spouse or common law partner

17. **Do you currently smoke cigarettes?**
    - ☐ Yes (please indicate how many cigarettes you smoke per day).....
    - ☐ No

18. **Do you have children?**
    - ☐ Yes (please indicate the ages of your children).....
    - ☐ No

19. **Do you have children that attend some form of daycare?**
    - ☐ Yes
    - ☐ No

    If yes, please indicate the type of daycare:
    - ☐ Centre-based with 10 or more children
    - ☐ Family-based with less than 10 children and
    - ☐ Home-based with parents

20. **How many people live with you in your household?** ..... people

Questions 21 and 22 refer specifically to women; male participants may move directly to Question 23.

21. **Are you currently pregnant?**
    - ☐ Yes
    - ☐ No
    - ☐ Don't know

22. Do you have the intention of getting pregnant in the NEXT 12 MONTHS?

☐ Yes
☐ No
☐ Don't know

23. Have you already been vaccinated against:

Hepatitis A	☐ Yes	☐ No	☐ Don't know
Varicella (Chicken pox)	☐ Yes	☐ No	☐ Don't know
Rubella (German measles)	☐ Yes	☐ No	☐ Don't know

24. Have you already been ill with any of the following infections:

Hepatitis A	☐Yes	☐No	☐Don't know
Varicella (Chicken pox)	☐ Yes	☐ No	☐ Don't know
Rubella (German measles)	☐ Yes	☐ No	☐ Don't know
Fifth disease (Parvovirus)	☐ Yes	☐ No	☐ Don't know
Cytomegalovirus infection	☐ Yes	☐ No	☐ Don't know

25. **Have you ever travelled in a developing country?** ☐ Yes ☐ No

Your participation in two follow-up phases through questionnaire and blood sampling is very important to the results of this study. In order to contact you in six months, please provide your contact information below.

26. **Name** ..... Code |___|___|___|___|___|___|

27. **Address** .....

.....

.....**Postal code**.....

28. **Telephone number** |___|___|___| |___|___|___|-|___|___|___|___|

Thank you very much for your participation!

Appendix 3

Serological Results Report Card

SEROEPIDEMIOLOGICAL STUDY OF INFECTIONS IN DAYCARE EDUCATORS

Results of Blood Test

Name:
Daycare Centre:
Study Code:

Hepatitis A	☐ Seropositive	No follow-up required
	☐ Seronegative	Discuss vaccination with your physician. Eligible for follow-up.
Varicella (Chicken Pox)	☐ Seropositive	No follow-up required
	☐ Seronegative	Discuss vaccination with your physician. Eligible for follow-up.
Rubella (German measles)	☐ Seropositive	No follow-up required.
	☐ Seronegative	Discuss vaccination with your physician. Eligible for follow-up.
Cytomegalovirus	☐ Seropositive	No follow-up required.
	☐ Seronegative	No vaccine available. Eligible for preventive leave if pregnant. Eligible for follow-up.
Parvovirus (Fifth disease)	☐ Seropositive	No follow-up required.
	☐ Seronegative	No vaccine available. Eligible for follow-up.

What does seropositive mean?

Seropositive means that you have antibodies to this infection. You have therefore either 1) had the infection in the past (you might not remember having it) or 2) had a vaccine for this infection in the past. You can only get this infection once, so being seropositive means you are NOT AT RISK of getting it again.

What does seronegative mean?

Seronegative means that NO antibodies to this infection were detected in your blood. You have therefore NOT had the infection in the past, and you are AT RISK of getting this infection in the future. A vaccine is available for hepatitis A, rubella, and varicella, but there is currently no vaccine available for cytomegalovirus or parvovirus.

Will I be contacted for follow-up with the study?

If you are SERONEGATIVE to any of the above infections, you may be contacted for further follow-up. At this time you will be asked once again for your consent to participate and the study objectives will be reviewed with you. The purpose of the follow-up is to determine if you have contracted the diseases in question during the time since the last blood test.

How can I contact the study investigators?

Dr. Cristin Muecke, study coordinator 514-934-1934 x 44729
Dr. Theresa Gyorkos, principal investigator 514-934-1934 x 44721

Division of Clinical Epidemiology, Montreal General Hospital, 1650 Cedar Avenue, Montreal, QC H3G 1A4

Appendix 4

List of countries by income group – World Bank classification

APPENDIX 4

List of countries by World Bank classification – Income group

LOW INCOME

Afghanistan
Angola
Armenia
Azerbaijan
Bangladesh
Benin
Bhutan
Burkina Faso
Burundi
Cambodia
Cameroon
Central African Republic
Chad
Comoros
Congo
Côte d'Ivoire
Eritrea
Ethiopia
Gambia
Georgia
Ghana
Guinea
Guinea-Bissau
Haiti
India
Indonesia
Kenya
Korea, Democratic Republic
Kyrgyz Republic
Lao
Lesotho
Liberia
Madagascar
Malawi
Mali
Mauritania
Moldova
Mongolia
Mozambique
Myanmar
Nepal
Nicaragua
Niger
Nigeria
Pakistan
Rwanda
Sao Tomé/Principe
Senegal
Sierra Leone
Solomon Islands
Somalia
Sudan
Tajikistan
Tanzania
Togo
Turkmenistan
Uganda
Ukraine
Uzbekistan
Vietnam
Yemen
Zambia
Zimbabwe

MIDDLE INCOME

Albania
Algeria
American Samoa
Antigua and Barbuda
Argentina
Bahrain
Barbados
Belarus
Belize
Bolivia
Bosnia/Herzegovina
Botswana
Brazil
Bulgaria
Cape Verde
Chile
China
Colombia
Costa Rica
Croatia
Cuba
Czech Republic
Djibouti
Dominica
Dominican Republic
Ecuador
Egypt
El Salvador
Equatorial Guinea
Estonia
Fiji
Gabon
Grenada
Guatemala
Guyana
Honduras
Hungary
Iran
Iraq
Isle of Man
Jamaica
Jordan
Kazakhstan
Kiribati
Korea, Republic
Latvia
Lebanon
Libya
Lithuania
Macedonia
Malaysia
Maldives
Mali
Malta
Marshall Islands
Mauritius
Mayotte
Mexico
Micronesia
Morocco
Namibia
Oman
Palau
Panama
Papua New Guinea
Paraguay
Peru
Philippines
Poland
Puerto Rico
Romania
Russian Federation
Samoa
Saudi Arabia
Seychelles
Slovak Republic
South Africa
Sri Lanka
St Kitts and Nevis
St Lucia
St Vincent and the Grenadines
Suriname
Swaziland
Syrian Arab Republic
Thailand
Tonga
Trinidad and Tobago
Tunisia
Turkey
Uruguay
Vanuatu
Venezuela
West Bank and Gaza
Yugoslavia (Serbia/Montenegro)

HIGH INCOME

Andorra
Aruba
Australia
Austria
Bahamas
Belgium
Bermuda
Brunei
Canada
Cayman Islands
Channel Islands
Cyprus
Denmark
Faeroe Islands
Finland
France
French Polynesia
Germany
Greece
Greenland
Guam
Hong Kong
Iceland
Ireland
Israel
Italy
Japan
Kuwait
Liechtenstein
Luxembourg
Macao
Monaco
Netherlands
Netherlands Antilles
New Caledonia
New Zealand
Northern Mariana Islands
Norway
Portugal
Qatar
San Marino
Singapore
Slovenia
Spain
Sweden
Switzerland
United Arab Emirates
United Kingdom
United States
Virgin Islands (US)

Appendix 5

Ethics Approval

Appendix 6

Spearman correlation matrix for daycare and educator-level variables

Results of Correlation Matrix

High correlation (>0.40)

Variables	Pearson correlation	Interpretation
Twork and Cwork	0.84961	Total number of years worked in daycare and total number in current daycare – relatively little job movement?
Agegrp and Dfreq	-0.60985	Age of supervised children determines how often the educator changes diapers
Cwork and Age	0.45862	How long you have worked at the current daycare is related to how old you are
Twork and Age	0.55403	How long you have worked in daycare is related to how old you are
Twork and Income	0.40313	How long you have worked in daycare is related to how much you earn
Dccode and Status	-0.83068	Coding of daycares is related to status (2 lists provided by MFE were already divided into CPE vs garderie)
Kids and Age	0.43418	Whether you have kids is related to how old you are
Kids and Daycare	0.49952	Whether you have kids in daycare is related to whether you have kids
Kids and Marital	0.41114	Whether you have kids is related to whether you are married
School and Syears	0.71049	Highest level reached in school is related to the number of years spent in school
Nkids and House	0.50272	Number of children is related to the total number of people in the household
Travel and Bdevelop	0.44580	Whether you have travelled to a developing country is related to whether you were born in a developing country
Lplaces and Nplaces	0.72121	Number of licensed places is related to the number of nursery places
Lplaces and Child36	0.80522	Number of licensed places is related to the number of children less than 36 months old
Ldichot and Child36	0.40820	Number of children less than 36 months is related to the dichotomized number of places
Nplaces and Child36	0.70021	Number of nursery places is related to the number of children under 36 months
Min_age and Child36	-0.47815	Minimum age of entry to centre is related to the number of children under age 36 months
Diaper and Min_age	-0.41153	Whether centre accepts diapered children is related to the minimum age at entry to centre
Nplaces and Min_age	-0.76555	Number of nursery places is related to the minimum age of entry into the center
Sratio and Mratio	0.53846	Ratio of children to teachers in groups less than 18 months old is related to ratio for 18-36 mos
Sratio and Lratio	0.67306	Ratio of children to teachers in groups less than 18 months old is related to ratio for > 36 mos
Sratio and Sratio1	0.43833	Ratio of children to teachers in groups less than 18 months old is related to the ratio of sinks
Cratio and Diaper	-0.56384	Ratio of number of licensed places to number of rooms is related to whether the center

		accepts diapered children
Cratio and Nchild	0.45819	Ratio of number of licensed places to number of rooms is related to number of children educators are responsible for
Earatio and DCCode	0.43479	Ratio of educators absent due to illness is related to daycare centre code
MealsE and Earatio	-0.50907	Educator involvement in meal preparation is related to the ratio of educators absent due to illness
Twash and Swash	0.86295	Frequency of washing of toys is related to frequency of washing of surfaces