INCIDENCE AND RISK FACTORS OF ACUTE LOWER RESPIRATORY INFECTIONS AMONG INUIT CHILDREN AND ADOLESCENTS IN THE NORTHWEST TERRITORIES

By

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- Sciences 0714
- Secondary 0533
- Social Sciences 0534
- Sociology of 0340
- Special 0529
- Teacher Training 0530
- Technology 0710
- Tests and Measurements 0288
- Vocational 0747

LANGUAGE, LITERATURE AND LINGUISTICS

- Language
  - General 0679
  - Ancient 0289
  - Linguistics 0290
  - Modern 0291
- Literature
  - General 0401
  - Classical 0294
  - Comparative 0295
  - Medieval 0297
  - Modern 0298
  - African 0316
  - American 0591
  - Asian 0305
  - Canadian (English) 0352
  - Canadian (French) 0355
  - English 0593
  - Germanic 0311
  - Latin American 0312
  - Middle Eastern 0315
  - Romance 0313
  - Slavic and East European 0314

PHILOSOPHY, RELIGION AND THEOLOGY

- Philosophy 0422
- Religion
  - General 0318
  - Biblical Studies 0321
  - Clergy 0319
  - History of 0320
  - Philosophy of 0322
- Theology 0469

SOCIAL SCIENCES

- American Studies 0323
- Anthropology
  - Archaeology 0324
  - Cultural 0326
  - Physical 0327
- Business Administration
  - General 0310
  - Accounting 0272
  - Banking 0770
  - Management 0454
  - Marketing 0338
- Canadian Studies 0385
- Economics
  - General 0501
  - Agricultural 0503
  - Commerce-Business 0505
  - Finance 0508
  - History 0509
  - Labor 0510
  - Theory 0511
- Folklore 0358
- Geography 0366
- Gerontology 0351
- History
  - General 0578
  - Ancient 0579
  - Medieval 0581
  - Modern 0582
  - Black 0328
  - African 0331
  - Asia, Australia and Oceania 0332
  - Canadian 0334
  - European 0335
  - Latin American 0336
  - Middle Eastern 0333
  - United States 0337
- History of Science 0585
- Law 0398
- Political Science
  - General 0615
  - International Law and Relations 0616
  - Public Administration 0617
- Recreation 0814
- Social Work 0452
- Sociology
  - General 0626
  - Criminology and Penology 0627
  - Demography 0938
  - Ethnic and Racial Studies 0631
  - Individual and Family Studies 0628
  - Industrial and Labor Relations 0629
  - Public and Social Welfare 0630
  - Social Structure and Development 0700
  - Theory and Methods 0344
- Transportation 0709
- Urban and Regional Planning 0999
- Women's Studies 0453

THE SCIENCES AND ENGINEERING

BIOLOGICAL SCIENCES

- Agriculture
  - General 0473
  - Agronomy 0285
  - Animal Culture and Nutrition 0475
  - Animal Pathology 0476
  - Food Science and Technology 0359
  - Forestry and Wildlife 0478
  - Plant Culture 0479
  - Plant Pathology 0480
  - Plant Physiology 0817
  - Range Management 0777
  - Wood Technology 0746
- Biology
  - General 0306
  - Anatomy 0287
  - Biostatistics 0308
  - Botany 0309
  - Cell 0379
  - Ecology 0329
  - Entomology 0353
  - Genetics 0369
  - Limnology 0793
  - Microbiology 0410
  - Molecular 0307
  - Neuroscience 0317
  - Oceanography 0416
  - Physiology 0433
  - Radiation 0821
  - Veterinary Science 0778
  - Zoology 0472
- Biophysics
  - General 0786
  - Medical 0760

EARTH SCIENCES

- Biogeochemistry 0425
- Geochemistry 0996
- Geodesy 0370
- Geology 0372
- Geophysics 0373
- Hydrology 0388
- Mineralogy 0411
- Paleobotany 0345
- Paleoecology 0426
- Paleontology 0418
- Paleozoology 0985
- Palynology 0427
- Physical Geography 0368
- Physical Oceanography 0415

HEALTH AND ENVIRONMENTAL SCIENCES

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- Health Sciences
  - General 0566
  - Audiology 0300
  - Chemotherapy 0992
  - Dentistry 0567
  - Education 0350
  - Hospital Management 0769
  - Human Development 0758
  - Immunology 0982
  - Medicine and Surgery 0564
  - Mental Health 0347
  - Nursing 0569
  - Nutrition 0570
  - Obstetrics and Gynecology 0380
  - Occupational Health and Therapy 0354
  - Ophthalmology 0381
  - Pathology 0571
  - Pharmacology 0419
  - Pharmacy 0572
  - Physical Therapy 0382
  - Public Health 0573
  - Radiology 0574
  - Recreation 0575
  - Speech Pathology 0460
  - Toxicology 0383
- Home Economics 0386

PHYSICAL SCIENCES

Pure Sciences

- Chemistry
  - General 0485
  - Agricultural 0749
  - Analytical 0486
  - Biochemistry 0487
  - Inorganic 0488
  - Nuclear 0738
  - Organic 0490
  - Pharmaceutical 0491
  - Physical 0494
  - Polymer 0495
  - Radiation 0754
- Mathematics 0405
- Physics
  - General 0605
  - Acoustics 0986
  - Astronomy and Astrophysics 0606
  - Atmospheric Science 0608
  - Atomic 0748
  - Electronics and Electricity 0607
  - Elementary Particles and High Energy 0798
  - Fluid and Plasma 0759
  - Molecular 0609
  - Nuclear 0610
  - Optics 0752
  - Radiation 0756
  - Solid State 0611
- Statistics 0463

Applied Sciences

- Applied Mechanics 0346
- Computer Science 0984
- Engineering
  - General 0537
  - Aerospace 0538
  - Agricultural 0539
  - Automotive 0540
  - Biomedical 0541
  - Chemical 0542
  - Civil 0543
  - Electronics and Electrical 0544
  - Heat and Thermodynamics 0348
  - Hydraulic 0545
  - Industrial 0546
  - Marine 0547
  - Materials Science 0794
  - Mechanical 0548
  - Metallurgy 0743
  - Mining 0551
  - Nuclear 0552
  - Packaging 0549
  - Petroleum 0765
  - Sanitary and Municipal 0554
  - System Science 0790
- Geotechnology 0428
- Operations Research 0796
- Plastics Technology 0795
- Textile Technology 0994

PSYCHOLOGY

- General 0621
- Behavioral 0384
- Clinical 0622
- Developmental 0620
- Experimental 0623
- Industrial 0624
- Personality 0625
- Physiological 0989
- Psychobiology 0349
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- Enseignement secondaire 0533
- Enseignement spécial 0529
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- Finances 0277
- Formation des enseignants 0530
- Histoire de l'éducation 0520
- Langues et littérature 0279
- Lecture 0535
- Mathématiques 0280
- Musique 0522
- Orientation et consultation 0519
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- Littérature
  - Généralités 0401
  - Anciennes 0294
  - Comparée 0295
  - Mediévale 0297
  - Moderne 0298
  - Africaine 0316
  - Américaine 0591
  - Anglaise 0593
  - Asiatique 0305
  - Canadienne (Anglaise) 0352
  - Canadienne (Française) 0355
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  - Latino-américaine 0312
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  - Culturelle 0326
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- Droit 0398
- Économie
  - Généralités 0501
  - Commerce-Affaires 0505
  - Économie agricole 0503
  - Économie du travail 0510
  - Finances 0508
  - Histoire 0509
  - Théorie 0511
- Études américaines 0323
- Études canadiennes 0385
- Études féministes 0453
- Folklore 0358
- Géographie 0366
- Gérontologie 0351
- Gestion des affaires
  - Généralités 0310
  - Administration 0454
  - Banques 0770
  - Comptabilité 0272
  - Marketing 0338
- Histoire
  - Histoire générale 0578
  - Ancienne 0579
  - Médiévale 0581
  - Moderne 0582
  - Histoire des noirs 0328
  - Africaine 0331
  - Canadienne 0334
  - États-Unis 0337
  - Européenne 0335
  - Moyen-orientale 0333
  - Latino-américaine 0336
  - Asie, Australie et Océanie 0332
- Histoire des sciences 0585
- Loisirs 0814
- Planification urbaine et régionale 0999
- Science politique
  - Généralités 0615
  - Administration publique 0617
  - Droit et relations internationales 0616
- Sociologie
  - Généralités 0626
  - Aide et bien-àtre social 0630
  - Criminologie et établissements pénitentiaires 0627
  - Démographie 0938
  - Études de l' individu et de la famille 0628
  - Études des relations interethniques et des relations raciales 0631
  - Structure et développement social 0700
  - Théorie et méthodes. 0344
  - Travail et relations industrielles 0629
- Transports 0709
- Travail social 0452

SCIENCES ET INGÉNIERIE

SCIENCES BIOLOGIQUES

- Agriculture
  - Généralités 0473
  - Agronomie. 0285
  - Alimentation et technologie alimentaire 0359
  - Culture 0479
  - Élevage et alimentation 0475
  - Exploitation des péturages 0777
  - Pathologie animale 0476
  - Pathologie végétale 0480
  - Physiologie végétale 0817
  - Sylviculture et faune 0478
  - Technologie du bois 0746
- Biologie
  - Généralités 0306
  - Anatomie 0287
  - Biologie (Statistiques) 0308
  - Biologie moléculaire 0307
  - Botanique 0309
  - Cellule 0379
  - Écologie 0329
  - Entomologie 0353
  - Génétique 0369
  - Limnologie 0793
  - Microbiologie 0410
  - Neurologie 0317
  - Océanographie 0416
  - Physiologie 0433
  - Radiation 0821
  - Science vétérinaire 0778
  - Zoologie 0472
- Biophysique
  - Généralités 0786
  - Medicale 0760

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- Géographie physique 0368
- Géologie 0372
- Géophysique 0373
- Hydrologie 0388
- Minéralogie 0411
- Océanographie physique 0415
- Paléobotanique 0345
- Paléoécologie 0426
- Paléontologie 0418
- Paléozoologie 0985
- Palynologie 0427

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- Économie domestique 0386
- Sciences de l'environnement 0768
- Sciences de la santé
  - Généralités 0566
  - Administration des hipitaux 0769
  - Alimentation et nutrition 0570
  - Audiologie 0300
  - Chimiothérapie 0992
  - Dentisterie 0567
  - Développement humain 0758
  - Enseignement 0350
  - Immunologie 0982
  - Loisirs 0575
  - Médecine du travail et thérapie 0354
  - Médecine et chirurgie 0564
  - Obstétrique et gynécologie 0380
  - Ophtalmologie 0381
  - Orthophonie 0460
  - Pathologie 0571
  - Pharmacie 0572
  - Pharmacologie 0419
  - Physiothérapie 0382
  - Radiologie 0574
  - Santé mentale 0347
  - Santé publique 0573
  - Soins infirmiers 0569
  - Toxicologie 0383

SCIENCES PHYSIQUES

Sciences Pures

- Chimie
  - Genéralités 0485
  - Biochimie 487
  - Chimie agricole 0749
  - Chimie analytique 0486
  - Chimie minérale 0488
  - Chimie nucléaire 0738
  - Chimie organique 0490
  - Chimie pharmaceutique 0491
  - Physique 0494
  - PolymÇres 0495
  - Radiation 0754
- Mathématiques 0405
- Physique
  - Généralités 0605
  - Acoustique 0986
  - Astronomie et astrophysique 0606
  - Electronique et électricité 0607
  - Fluides et plasma 0759
  - Météorologie 0608
  - Optique 0752
  - Particules (Physique nucléaire) 0798
  - Physique atomique 0748
  - Physique de l'état solide 0611
  - Physique moléculaire 0609
  - Physique nucléoire 0610
  - Radiation 0756
- Statistiques 0463

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  - Biomédicale 0541
  - Chaleur et ther modynamique 0348
  - Conditionnement (Emballage) 0549
  - Génie aérospatial 0538
  - Génie chimique 0542
  - Génie civil 0543
  - Génie électronique et électrique 0544
  - Génie industriel 0546
  - Génie mécanique 0548
  - Génie nucléaire 0552
  - Ingénierie des systämes 0790
  - Mécanique navale 0547
  - Métallurgie 0743
  - Science des matériaux 0794
  - Technique du pétrole 0765
  - Technique minière 0551
  - Techniques sanitaires et municipales 0554
  - Technologie hydraulique 0545
- Mécanique appliquée 0346
- Géotechnologie 0428
- Matières plastiques (Technologie) 0795
- Recherche opérationnelle 0796
- Textiles et tissus (Technologie) 0794

PSYCHOLOGIE

- Généralités 0621
- Personnalité 0625
- Psychobiologie 0349
- Psychologie clinique 0622
- Psychologie du comportement 0384
- Psychologie du développement 0620
- Psychologie expérimentale 0623
- Psychologie industrielle 0624
- Psychologie physiologique 0989
- Psychologie sociale 0451
- Psychométrie 0632

INCIDENCE AND RISK FACTORS OF ACUTE LOWER RESPIRATORY INFECTIONS AMONG INUIT CHILDREN AND ADOLESCENTS IN THE NORTHWEST TERRITORIES

BY

SOLEMAN ABDULMATI MIRDAD

A Thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements for the degree of

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ABSTRACT

The problem of acute lower respiratory infections (ALRI) among the Inuit population is well known, but it is not well documented. Accurate estimates of both the mortality and morbidity rates due to these infections for this population can not be obtained from official statistics. Nevertheless, previous surveys suggest that ALRI are a public health problem among the Inuit. A number of risk factors influencing the occurrence of these infections have been identified in the literature based on studies in other populations.

The study's objectives were to determine the incidence of ALRI for a random sample of Inuit children 2-17 years old living in eight communities of the Keewatin Region in the Northwest Territories, and to examine the factors which influence the development of these respiratory infections.

Data were collected using individual interviews from child care-providers, and study children's medical records from the community health centers and a referral hospital were reviewed. The study also used data which were part of a data set collected by the 1990 Keewatin Sociodemographic Household and Keewatin Health Assessment Surveys.

The overall incidence of ALRI was 39% for the study period of October, 1990 to October, 1992. The higher incidence of respiratory infection in the first half of the study period may suggest an epidemic.

Univariate analysis revealed significant relationships between the incidence of

ALRI and several risk factors. Multiple regression analyses did not identify redundant factors, outliers nor significant first-order interactive effects. A backward stepwise logistic regression elimination resulted in community and acute lower respiratory infection in early infancy as predictors of the risk of acute lower respiratory infections, and age and breast-feeding as protective factors. In comparison to Rankin Inlet, living in any of the other seven communities is more risky. However, living in Repulse Bay or Sanikiluaq is significantly risky. Acute lower respiratory infection in the first two years of life is found to be a highly significant risk factor for the same infections in childhood.

Homogeneity of the study subjects may be the reason for the absence of relationships between the study outcome and some factors strongly believed to influence its risk (like crowding and passive cigarette smoking).

Both surveillance and health promotion related to respiratory diseases should be increased in the existing health-care delivery system. Awareness of the disease (particularly by the child care-providers) and the community's responsibilities are important for the attainment and maintenance of good health for the children. Active involvement of the community is essential at each stage of health promotion programs: identification of priorities, planning, implementing, and evaluation.

ACKNOWLEDGEMENTS

First and foremost, I must thank GOD for his unlimited help and support without whom this work would not be accomplished. Thank God.

My deepest appreciation to my supervisor Prof. T. Kue Young who accepted me as a graduate student, has tirelessly contributed to my knowledge and skills, gave excellent advice and guidance, and who provided endless support and encouragement through the whole experience.

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TABLE OF CONTENTS

LIST OF FIGURES

Figure

LIST OF TABLES

Table

LIST OF ABBREVIATIONS

ARI	Acute Respiratory Infectious Disease(s)
ALRI	Acute Lower Respiratory Infectious Disease(s)
AURI	Acute Upper Respiratory Infectious Disease(s)
HA	Height-For-Age
HAZ	Height-For-Age Z-Scores
KHSA	Keewatin Health Status Assessment
KRHB	Keewatin Regional Health Board
NO2	Nitrogen Dioxide
NWT	Northwest Territories
RR	Risk Ratio
SES	Socioeconomic Status
SO2	Sulphur Dioxide
WA	Weight-For-Age
WAZ	Weight-For-Age Z-Scores
WH	Weight-For-Height
WHZ	Weight-For-Height Z-Scores
X^2	Chi-Square test

PART 1

INTRODUCTION

1.1 The Problem

ALRI can be considered one of the major public health problems among the Canadian Inuit. The available information reveals that these infections are one of the leading causes of both mortality and morbidity, and a considerable gap still exists between Canadian Inuit and non-Aboriginal people.

A number of factors influencing the risk for these respiratory infectious diseases have been identified in the literature based on studies in other populations. Despite the importance of ALRI as a public health problem among the Inuit, much still remains unknown regarding the incidence and risk factors in this population.

1.2 Objectives

The dissertation reports on a nonconcurrent prospective study (retrospective cohort study) of Canadian Inuit children aged 2 - 17 years living in the eight communities of Keewatin Region, Northwest Territories.

The main objectives are:

1. To determine the attack rate of acute lower respiratory infectious diseases among Inuit children.
2. To examine the factors which influence the development of these respiratory infections.

PART 2

LITERATURE REVIEW

2.1 Description of the Study Area

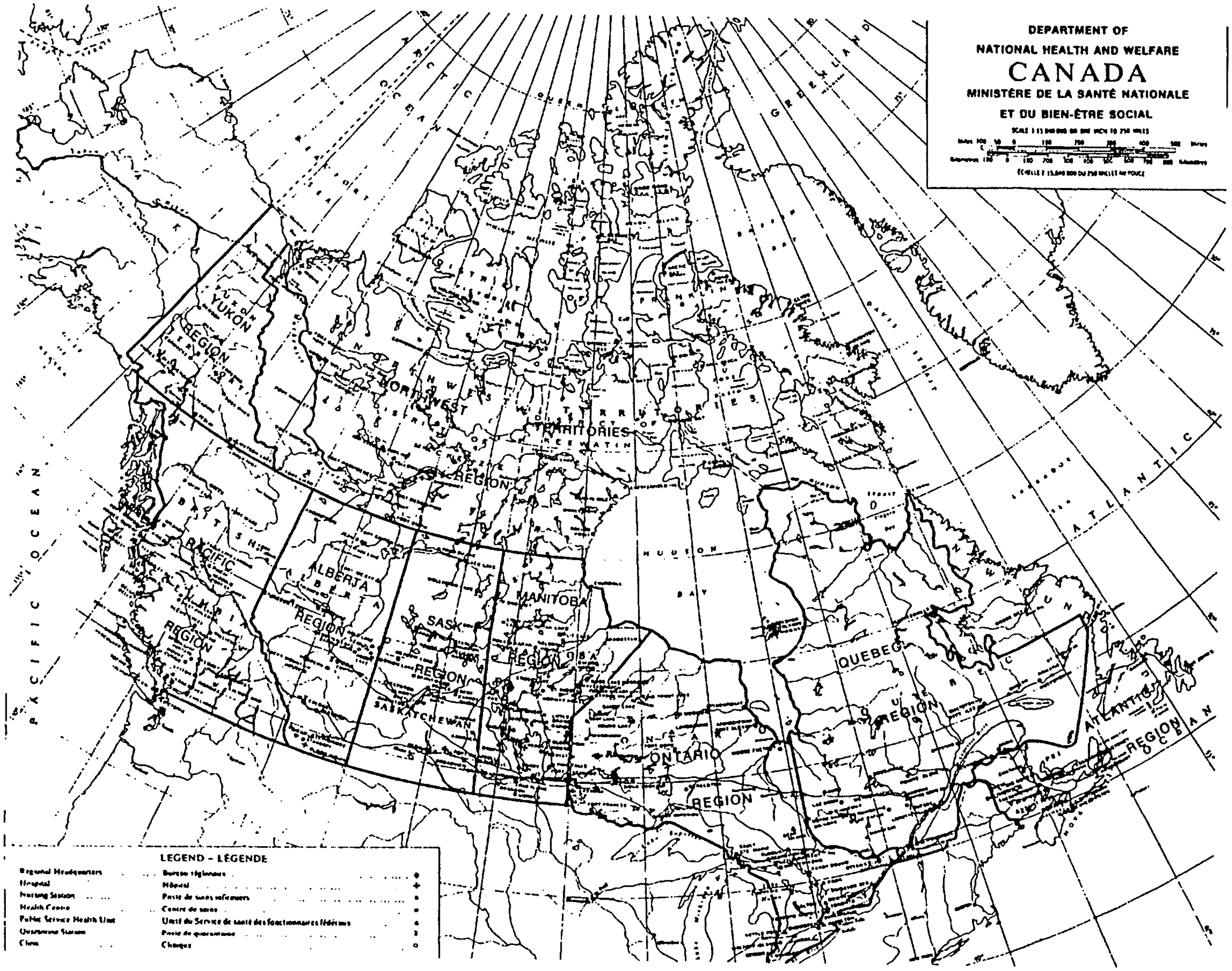
The study area includes all seven communities (hamlets) of the Keewatin Region of the Northwest Territories (NWT) in Canada and the community of Sanikiluaq in the Baffin Region of the NWT.

2.1.1 Population of Northwest Territories

The NWT population was estimated to be 57,649 persons (0.2% of the Canadian population) in 1991. Of these, 61% are Native people. The population is different in many respects from that of the rest of Canada. The population is sparse in relation to the land mass it occupies (area per individual: 64 km^2), and is largely rural and young (Fig 1.1). In 1985, the personal mean annual income of the Inuit people was $11,100 to $13,100 for men and $8,700 for women. This income was well below the Canadian average income of $18,200 to $23,300 for men and $12,600 for women (Siggner, 1989).

The Native people of the NWT can be classified into two main groups: the Inuit and Dene. The Inuit, formerly known as Eskimos, are the people who speak variations of Inuktitut (Eskimo) language and follow a certain style of life. They are the habitants of both the barrens and coast, i.e., the circumpolar world from Siberia to Greenland. The Inuktitut language and culture have maintained a high degree of homogeneity across the circumpolar world.

Fig 2.1 Map of Canada



(Source: National Health and Welfare, Canada)

All Inuit people speak the same language, but with different dialects. There are five distinct dialect areas. These are the Baffin, (Qikiqtaaluk), Keewatin (Kivalliq), Central Arctic (Kitikmeot), the Western (Inuvik), and Fort Smith Region (Fig 2.2).

It is believed that the Asiatic hunters were the ancestors of today's American Native population. They crossed a land-bridge called the Beringia Land-bridge between Alaska and Siberia to reach North America at least 25,000 years ago. During these thousands of years, people moved onto the new continent, and various cultures evolved.

The final major wave of migration from Siberia brought the ancestors of the Inuit Paleo-Eskimo to North America. They occupied the Arctic coast from Alaska to Greenland. However, about 3,500 years ago, they abandoned their northerly areas and moved south because the climate became colder and the treeline shifted to the south. In those areas, they adapted to the pursuit of caribou and to life on the forest edge.

The Paleo-Eskimo culture disappeared in Alaska 2,000 years ago and a new Inuit culture, the Thule culture, arose on the shore of the Bering Sea almost 1,000 years ago. These people were whale hunters. Eight-hundred years ago, the Thule people, ancestors of the today's Inuit, had spread through the Arctic from the Macknzie Delta to Greenland.

The lifestyle of the Inuit has varied with the different animal resources in each region and season. The main activity of the inland people has been the hunting of the caribou during the herd's annual migration in the autumn, while the activity of the

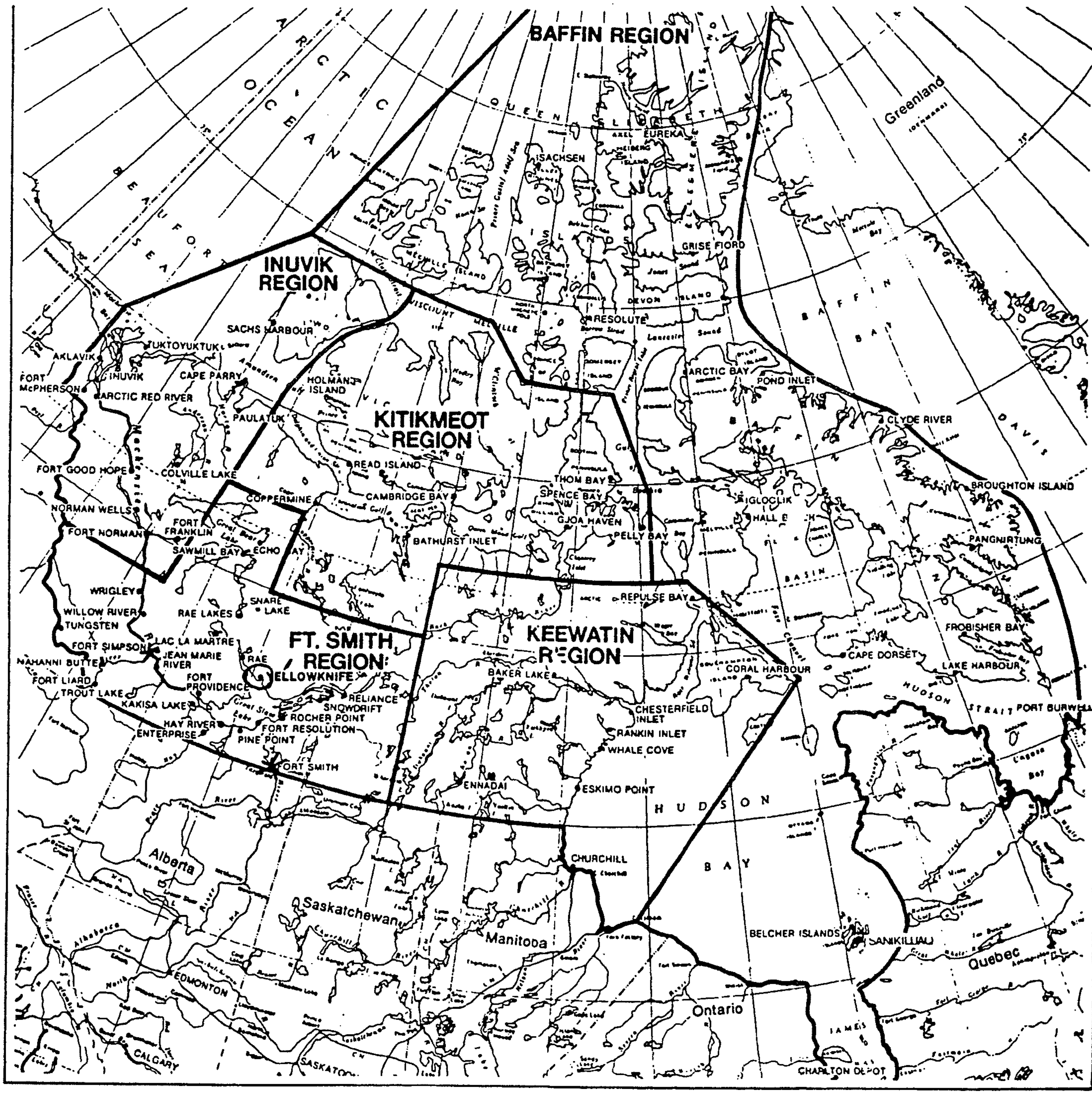


Fig 2.2: Map of Northwest Territories, Canada, showing the Administrative Regions

(Source: National Health and Welfare, Canada) other Inuit has been the hunting of the sea mammals, like whales, walrus, and seal in the spring. The caribou skin tents were used for hides in the summer, while the snowhouses (iglu) were used in the winter. Homes built of sod, whalebone, and stone were also used (NWT Data Book, 1990).

The search for a northwest route to the riches of the Orient was the main reason for the first Europeans to explore the Arctic throughout the 16th and 17th centuries. Moreover, during the 17th and 18th centuries, the fur trade gradually expanded into northern Canada. The fur trade had a stronger impact on Aboriginal people in the NWT. In the late seventeenth century, the rivalry between the Montreal-based North West and Hudson's Bay Companies forced both to seek fur farther north and west. Hence, contact with the Dene tribes of western NWT occurred somewhat later than the first contacts with Inuit (NWT Data Book, 1990).

The exploitation of the eastern Arctic whale began in the early 18th century. By the end of the 19th century, the culture of many Inuit of the western NWT had become interwoven with that of foreign whalers. However, in 1914, whaling became obsolete and was replaced by the white fox and sealskin trade on the eastern side of the Arctic, and muskrat trapping in the western side.

Missionaries followed the tracks of fur traders and whalers. However, unlike fur traders, the missionaries were often scholars who left valuable records of the ways of life and languages of the Inuit and Dene they converted. For instance, one of the Anglican missionaries was responsible for the spread of Inuktitut syllabic in the eastern Arctic. Moreover, missionaries brought the first schools and hospitals to the NWT

(NWT Data Book, 1990).

At the time of World War I, mineral exploration began in the western Arctic. Although this resulted in the establishment of permanent communities, such as Yellowknife and Norman Wells, most Aboriginal people of the NWT continued to follow the nomadic way of life coming in to trading post communities with the furs once or twice a year. Some parts of the NWT experienced great hardship during this era. In 1928, the influenza epidemic had a disastrous effect on the Dene of the Mackenzie Valley. Moreover, many Inuit, particularly those of the Keewatin, suffered from starvation and famine, and chronic outbreaks of foreign diseases, particularly tuberculosis (NWT Data Book, 1990).

World War II and the immediate post-war era brought the NWT into the modern world. The Federal Government constructed schools and nursing centers throughout the 1950s. The Aboriginal people gradually moved into the communities from the land. Furthermore, during that time, spread of diseases such as tuberculosis, high infant mortality, in some cases famine, and the desire to be near the children as they were educated, drove many native people into year-round settlement living (NWT Data Book, 1990).

The Inuit art and craft industries were established and the co-operative movement started in the NWT in the 1960s. Although development and exploration of mineral and petroleum resources continue to provide employment for northerners, many people still hunt, trap, and fish for a living (NWT Data Book, 1990).

2.1.2 Northwest Territories

The NWT is located in the north of Canada within latitudes 60^0 and 84^0 N (Fig 2.3). It is a large but sparsely populated area which occupies about 34% of the total area of Canada.

The NWT is characterized by two major ecological zones: the Arctic and Sub-Arctic zones. The Arctic, in both the geographical and climatical sense, is that part of the NWT north of the tree line. This line, on the western side, runs close to the coast of the Arctic Ocean. East of the Mackenzie Delta, the line starts to slant southeast and crosses the border of Manitoba and runs just below the town of Churchill in the north of Manitoba. Therefore, almost half of the mainland area of the NWT and all islands in the Arctic Archipelago lie in the Arctic with the remainder in the Sub-Arctic zone (NWT Data Book, 1990).

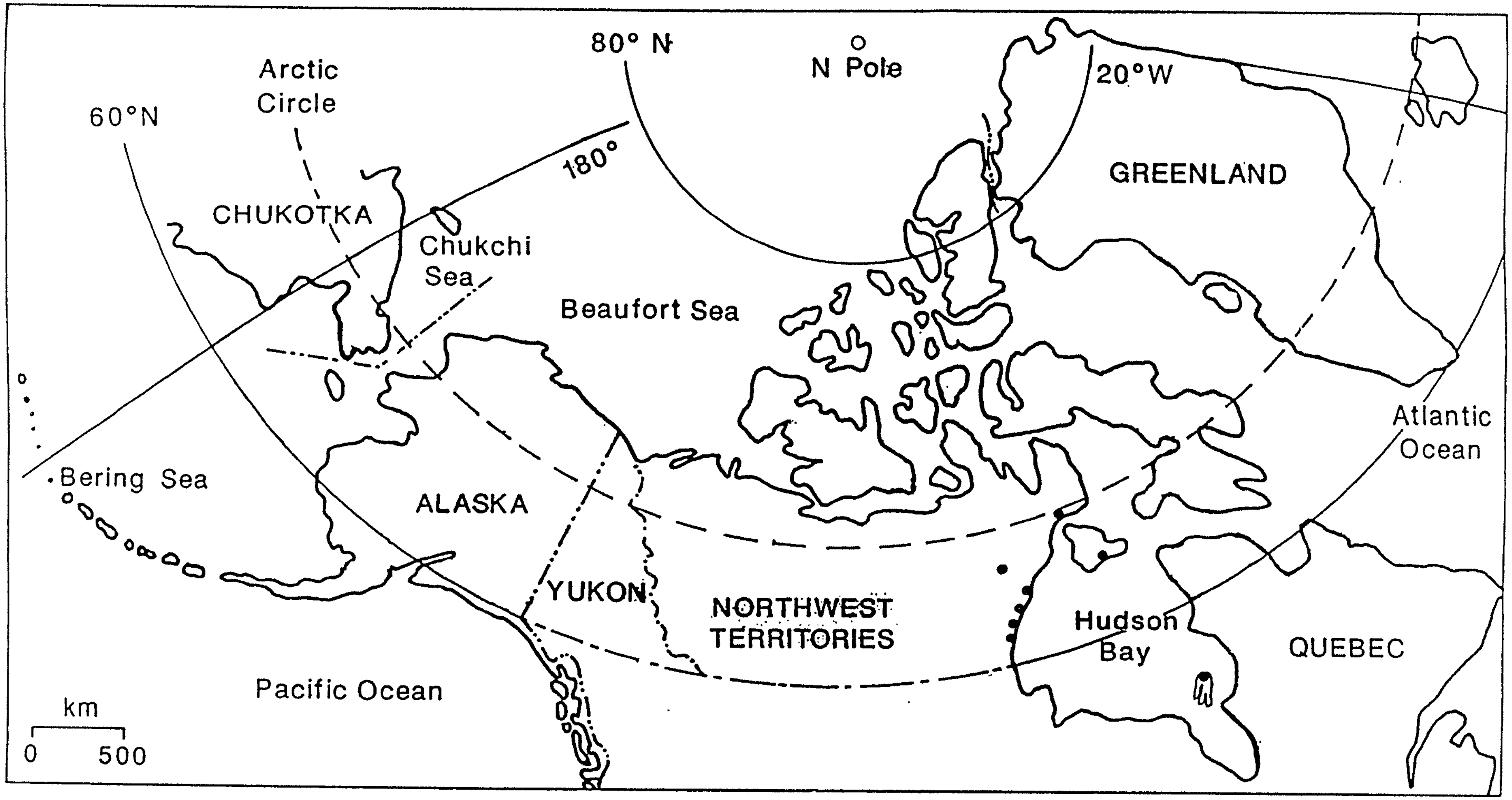
The climate of the Arctic is colder and drier than that of Canada generally. The mean temperature for the month of January ranges from -26 to -33^{0}C. Furthermore, the defining characteristic of the Arctic climate is that the average daily temperature of the warmest month of the year does not exceed 10^{0}C (NWT Data Book, 1990).

The NWT includes five administrative regions. These are the Baffin, Fort Smith, Inuvik, Keewatin, and the Kitikmeot.

2.1.3 Keewatin Administrative Region

The Keewatin Region is over 500,000 km^2, bounded on the east by the Hudson Bay and on the west by the Thelon River. It spreads

Fig 2.3 Map of Northwest Territories, Canada



—··—international boundary

·—·—provincial/territorial boundary

• Communities included in the Keewatin Health Assessment Study from the Sixtieth parallel in the south to the Arctic Circle in the north (Fig 2.3). The treeline cuts across the southern third.

Six of the Keewatin's seven Inuit communities are situated along the coast of the Hudson Bay. These are Arviat, Chesterfield Inlet, Coral Harbor, Repulse Bay, Rankin Inlet and Whale Cove. The seventh one (Baker Lake) is the only inland Inuit community in NWT (Fig 2.4) (NWT Data Book, 1990; Travel Keewatin 1991).

The population of the Keewatin Region is estimated to be 5,835 inhabitants in 1991 (almost 10% of the NWT population). The vast majority (89%) are Inuit. Inuit share a relatively recent past of economic hardship and imported diseases such as tuberculosis. Handicrafts, carving, and small businesses are major components of the Keewatin Region's economy (NWT Data Book, 1990; NWT Health Report, 1990; Statistics Quarterly, 1993).

2.1.4 Keewatin Regional Health Board

The Department of Health of the NWT is responsible for a broad range of insured services. These include medical and hospital care, pharmacare, medical travel, extended medical benefits for seniors and other services. Moreover, the department is responsible for an array of public and community health promotion.

Since the transfer of responsibilities of the health services delivery and administration from the Ministry of Health and Welfare of Canada (Federal Government) to the Territorial Government of the Northwest Territories in April 1988, the Territorial Government has further decentralized its system of health services

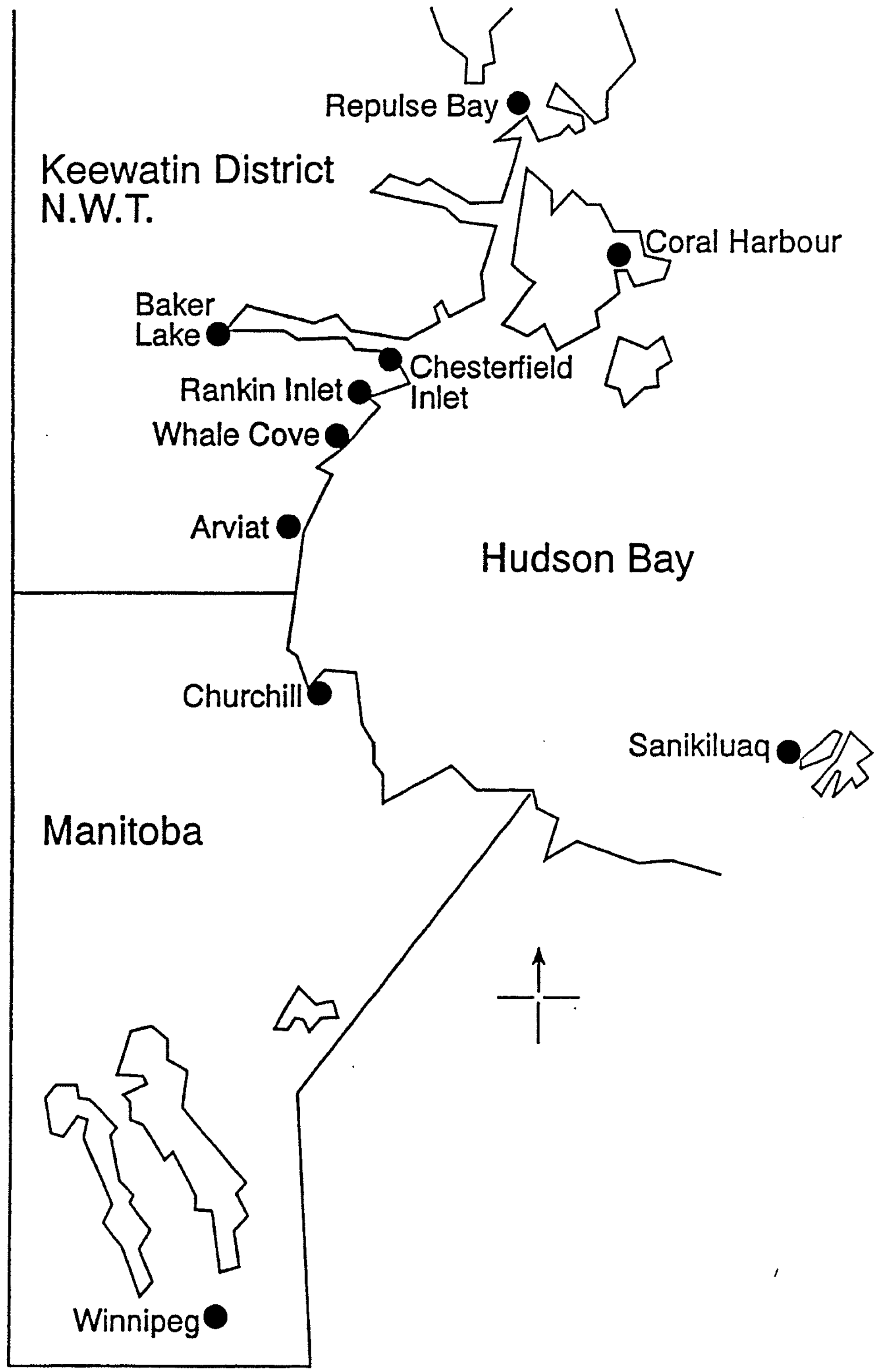


Fig 2.4 Map of Keewatin Region, Northwest Territory, Canada

(Source: Young TK, Unpublished Data)

delivery (NWT Data Book, 1990).

The policy of decentralization of the Department of Health has led the Regional Health Boards to plan, manage, and deliver a full spectrum of community and institutional health services within each region. The Regional Health Boards in the NWT operate 6 hospitals, 41 community health centers, 6 public health centers, 6 satellite health centers, and 5 patient boarding homes, (NWT Data Book, 1990).

The Keewatin Regional Health Board (KRHB) operates the health centers of the seven Keewatin communities and of Sanikiluaq. The KRHB also operates the patient transient centers in Churchill and Winnipeg (NWT Health Report, 1990).

The KRHB provides the following services to residents of the Keewatin Region:

1. Community, environmental and public health services,
2. Health promotion program,
3. Visiting medical specialists program,
4. Emergency preparedness program,
5. Long-term care and psychiatric placement,
6. Dental services,
7. Home care program for respite care, and
8. Medical travel program (NWT Health Report, 1990).

Preventive and curative health services are primarily provided by community health nurses. Moreover, the KRHB contracts with the J.A. Hildes Northern Medical Unit (University of Manitoba), to provide additional medical services such as:

1. Physician services (general practitioners and specialists in obstetrics and

gynecology, paediatrics, ophthalmology, and psychiatry visit twice yearly) to the town of Churchill in Manitoba and to the Keewatin Region in NWT. For the Keewatin Region, general practitioners visit each Inuit community once a month. Specialists visit twice yearly.

2. Audiology services are provided somewhat less frequently.

2.1.5 Communities of the Keewatin Region Health Board

The Keewatin Region includes seven communities: Arviat, Rankin Inlet, Whale Cove, Chesterfield Inlet, Repulse Bay, Coral Harbour, and Baker Lake (Fig 2.4). All hamlets have primary health centers.

The earliest social center of dominance was Chesterfield. At one time it had a residential school and a hospital. However, in the early 1960s these institutions were closed.

Rankin Inlet, a mining center in the 1950s, has increasingly been made the main administrative center. It has attracted many Inuit, and some administrative functions from nearby Chesterfield Inlet and the town of Churchill in Northern Manitoba. The Manitoba harbour of Churchill, at the end of a rail line from Southern Canada, has been the supply center by ship in the summer and by a regular air traffic year round. The nearest hospital for Keewatin patients is also located in the town of Churchill.

Three communities (Arviat, Rankin Inlet, and Whale Cove) had received refugees resettled after starvation afflicted the barren lands during the late 1950s. Between 1958 and 1962, the population of Rankin Inlet increased because of the mining activities. All the communities are overcrowded with poor financial resources, which resulted in large portions of the inhabitants being on welfare.

2.2 Historical Perspectives of Health

Detailed health status of the Inuit is, at best, speculative before and at the time of first contact with the Europeans (before 1890). However, there was a general consensus among the European explorers, missionaries, and traders that Inuit were vigorous and robust (Fortuine, 1971). Since the late 1940s, reliable health statistics became available.

The recent epidemiologic history of the Inuit is characterized by (1) decline but persistence of infectious diseases, stabilizing at levels still higher than non-Aboriginal population; and (2) rise in chronic diseases but at levels still not high as non-Aboriginal people (Broudy and May, 1983; Kunitz, 1983; Young, 1988).

The life expectancy of the Inuit increased from about 32 years in 1941-50 to 66 years in 1978-82. This improvement is attributed to the reduction in death in childhood (Robitaille and Choiniere, 1985).

The overall crude mortality rate among the NWT Inuit fell from 35/1,000 towards the end of the 1940s to almost 6/1,000 during the 1980s (Robitaille and Choiniere, 1985), whereas for all Canada the rate did not change, 8/1,000 in 1963 (Willis, 1963) and 7.3/1,000 in 1988 (Statistics Canada, 1990). Fig 2.5 reveals the mean crude mortality rates for several groups of causes since 1964 and their percent distribution during the period 1979-1988. Mortality due to infectious and parasitic

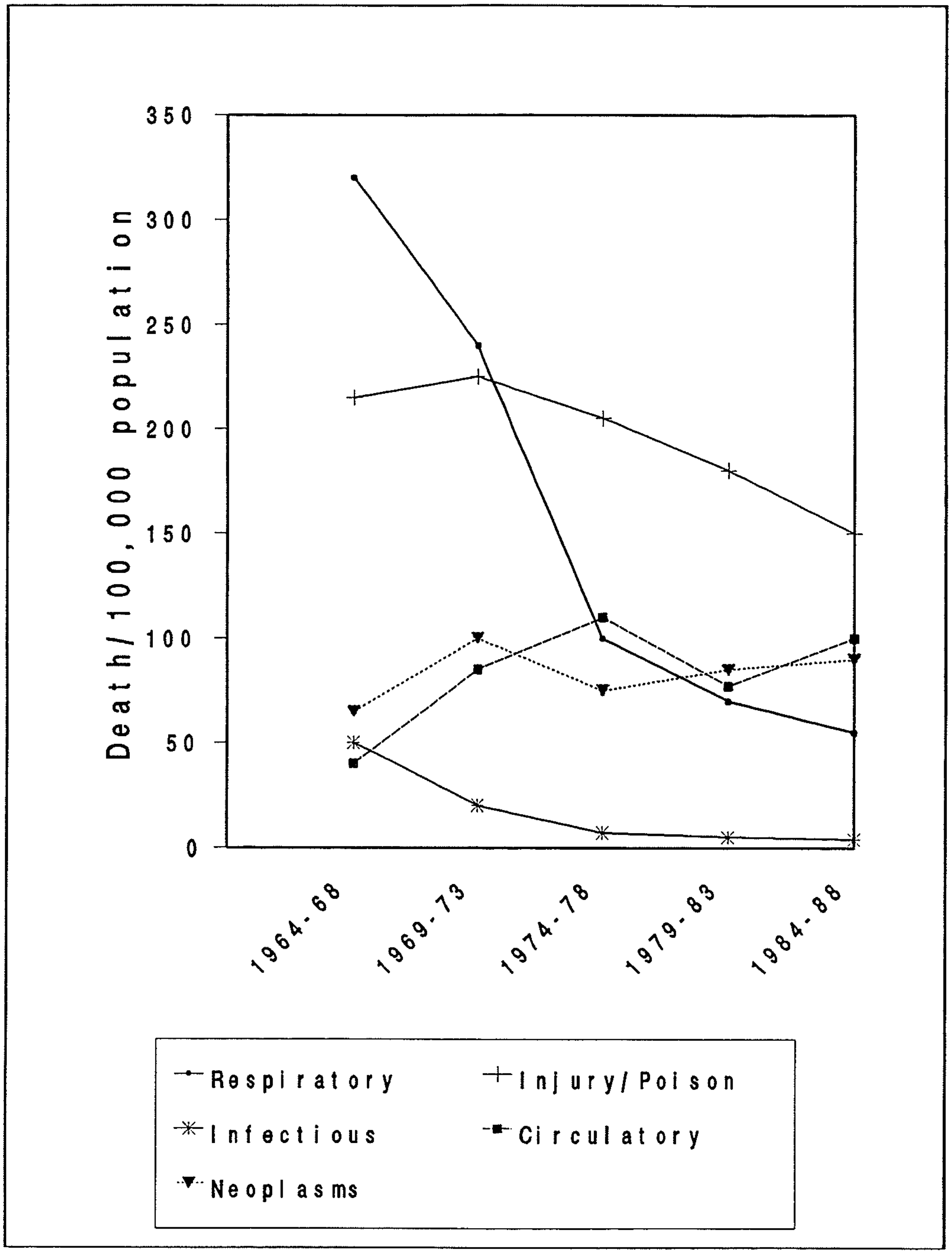


Fig 2.5 Crude Mortality Rate for Selected causes, Inuit of Northwest Territories, 1964-1988

(Source: Young TK, Unpublished Data)

diseases (such as tuberculosis, meningitis and gastroenteritis, ...etc.), perinatal conditions and respiratory diseases (such as pneumonia) declined substantially. On the other hand, chronic diseases (such as neoplasms and circulatory diseases) and injuries and poisoning became the primary causes of mortality in the 1980s (Young TK, Unpublished Data).

An example of the decline of both mortality and morbidity of infections is tuberculosis. Death from tuberculosis remained very high among the Inuit of NWT into the late 1940s, when more than 1% died from the disease annually. Following systematic treatment and chemotherapy that rate declined rapidly during the 1950s and fell to near 0% in the 1970s. The prevalence of tuberculosis infection was reflected in the fact that almost all Inuit children 5 years or younger of a NWT community were infected, while by the late 1960s, most NWT Native children under 15 years tested tuberculin negative (Schaefer, 1993).

A 4-year review of meningitis diagnosed during the mid-1970s in the Keewatin Region found high rates of bacterial meningitis (Wotton, 1981). A review of meningitis cases reported in the NWT during 1983-85 found *Hemophilus influenzae type b* to be the most prevalent causative pathogen. Inuit infants of the Keewatin Region had a 20-30 fold higher risk of having the disease compared with southern Canadian infants (Schaefer, 1985).

Venereal infections showed a dramatic increase in morbidity among all NWT Native (Indian and Inuit) in the 1960s. For instance, the rate for gonorrhea increased from triple the all-Canadian rate in the 1950s, to a 20-fold excess in the 1960s, and to a 30-fold in the early 1970s. In the 1970s, the gonorrhea rates per 100,000 people were 6,000-10,000 for the Indians, 3,800-6,100 for the Inuit and 2,800 to 3,800 for non-Aboriginal people in the NWT. The high rates of venereal diseases among Aboriginal people was related to the new construction and the move to large settlements. Since 1975, the gonorrhea rate among Aboriginal people has showed a slight but steady improvement (Schaefer, 1993).

Schaefer (1993) reported that the changing epidemiology of the NWT Native people appeared to be closely attributed to changes in nutritional habits, lifestyle, occupational, and socio-cultural patterns. For instance, several studies revealed bottle-feeding to be among the factors influencing the risk for respiratory tract infection, otitis media, malnutrition, bottle caries, and iron deficiency anemia. Furthermore, chronic diseases, such as obesity, gallstones, hypertension, diabetes mellitus were unknown or rarely observed among the Indian and Inuit of the NWT. In the last two decades, their morbidity rates increased markedly (Schaefer, 1993; Young, 1986).

2.3 Acute Respiratory Infections

Acute respiratory infectious diseases (ARI) are inflammatory disorders of one or more structures of the respiratory tract. They are characterized by the entry and multiplication of an infectious agent or a multiplication of a microorganism of the existing flora and manifestation of clinical illness.

A number of classification systems have been proposed for ARI. However, there are two basic systems which are commonly used, the clinical and case-management classification systems.

A. Case-Management Classification

The case-management classification of ARI has been developed by the World Health Organization (WHO). It has been used by rural health care workers in the developing world to mainly reduce death related to pneumonia (Table 2.1). This classification is specific to children of all ages except infants aged two months or younger (WHO/ARI, 1988; WHO/ARI, 1989; WHO/ARI, 1989).

B. Clinical Classification

ARI can be arbitrarily classified according to the anatomical site of primary infection into three categories: upper, middle, and lower ARI.

Upper ARI includes common cold (acute nasopharyngitis), acute otitis media, pharyngitis, tonsillitis, and acute sinusitis.

Middle ARI includes croup. Croup is a generic name including the clinical entities: acute epiglottitis, laryngitis, tracheitis, and acute laryngotracheobronchitis.

Acute lower respiratory infections (ALRI) include pneumonia, acute bronchitis, and bronchiolitis.

The clinical classification of ARI can lead to some confusion. Infections are not always limited to one part of the respiratory tract, and clinicians often disagree on what is upper, middle, and lower ARI. Nonetheless, clinical classification of ARI

Table 2.1 Classification of Acute Respiratory Infections

Case-Management Classification			Clinical Classification
Stridor	Wheezing	No Wheezing	
Mild			Upper RTI*
Croup: -hoarseness; -barking cough; -no stridor	Bronchiolitis and Asthma: -improves with bronchodilator; -RR** < 50/min	Cold: -cough; -nasal obstruction; -RR <50/min	Common cold otitis media pharyngitis tonsillitis sinusitis
Moderate			Middle RTI
	Bronchiolitis and Asthma: -improves with bronchodilator; -RR 50-70/min	Pneumonia: -RR > 50/min; -no chest indrawing	Croup (laryngotracheobronchitis, tracheitis, laryngitis, epiglottits)
Severe			Lower RTI
Croup or Epiglottitis: -stridor; -chest indrawing	Bronchiolitis and Asthma: -No effect for bronchodilator; -RR >70/min	Pneumonia: -RR > 50/min; -chest Indrawing	Bronchiolitis Bronchitis Pneumonia
Very Severe			
	Bronchiolitis and Asthma: -cyanosis; -inability to drink	Pneumonia: -cyanosis; -inability to drink	

* Respiratory tract infections ** Respiratory rate
(Source: Graham, 1990).

remains the preferred system for most physicians, and it is compatible with the International Classification of Disease.

2.4 Acute Lower Respiratory Infections

ALRI usually are inflammatory disorders of the lower structures of the respiratory tract. They are mainly viral in etiology among children. However, bacteria and other microorganisms could be the causal agents. ALRI includes acute bronchitis, bronchiolitis, and pneumonia.

2.4.1 Etiology

Both acute bronchitis and bronchiolitis are of viral origin. Bacteria may be isolated from sputum, but their presence does not imply a bacterial origin. Pneumonia can be viral or bacterial in origin (Behrman et al., 1992).

The *respiratory syncytial virus* is the main causative agent of the viral cases of ALRI. The *parainfluenza virus*, some *adenovirus*, *mycoplasma*, and occasionally other viruses produce the remaining cases (Abdul Ghafoor et al., 1990; Behrman et al., 1992; Hortal et al., 1990; Rahman et al., 1990; Suwanjutha et al., 1990; Tupasi et al., 1990; Weissenbacher et al., 1990).

Pneumococcus is the most common bacterial pathogen, accounting for 90% of childhood bacterial pneumonia. The remaining cases of bacterial pneumonia are caused by *streptococcus, staphylococcus, hemophilus influenzae, klebsiella, pseudomonas aeruginosa,* and *tubercle bacillus* (Abdul Ghafoor et al.,1990; Behrman et al., 1992; Hortal et al., 1990; Rahman et al., 1990; Suwanjutha et al., 1990; Tupasi et al., 1990; Weissenbacher et al., 1990).

Virologic pathogens can be detected by isolation of the virus in cell culture and rapid detection of viral antigens with the use of indirect immunofluorescence on the nasopharyngeal aspirate cell smears, while bacterial pathogens are detected by various means of culture and isolation of bacteria in the throat swab and/or blood (Billas, 1990; Behrman et al. 1992).

Several hospital-based studies were carried out in different nations. Young children clinically diagnosed as cases of ALRI were enrolled. They submitted nasopharyngeal aspirate, throat swab and/ or blood for pathogen detection. The percent detection of pathogen varied from 20% to 40% of cases. Viruses accounted for 80% or more of detected pathogens, whereas the remaining 20% included bacteria and a mix of virus and bacteria (Abdul Ghafoor et al., 1990; Hortal et al., 1990; Rahman et al., 1990; Suwanjutha et al., 1990; Tupasi et al., 1990; Weissenbacher et al., 1990).

2.4.2 Clinical Syndromes

A. Acute Bronchitis

Acute bronchitis commonly occurs in association with other clinical entities of the upper or lower respiratory tract of older children and teenagers. It is mainly of viral origin. Some children appear to be more susceptible than others. The reasons are unknown, but allergy, climate, air pollution, and chronic infections of the upper respiratory tract may be contributing factors.

The diagnosis is possible on the basis of symptoms and signs. If symptoms are serious or prolonged, a chest x-ray is indicated to rule out other diseases or complications (Billas, 1990; Behrman et al., 1992).

B. Acute Bronchiolitis

Acute bronchiolitis is a common disease of the infants' lower respiratory tract resulting from inflammatory obstruction of the small airways. It occurs during the first two years of life with a peak incidence at approximately six months of age, and is the most frequent cause of hospitalization among infants. Older children and adults tolerate bronchiolar edema better than infants, and hence do not develop the clinical manifestations of disease even when small airways of the respiratory tract are infected.

It is a viral illness, and the source of infection is a family member with a minor respiratory infection. There is no firm evidence that bacteria cause bronchiolitis.

Acute bronchiolitis could be confused with bronchial asthma. However, the presence of the following factors favors diagnosis of asthma: (1) the disease uncommonly manifests within the first year of life, (2) family history of asthma, (3) repeated attacks in the same infant, (4) markedly prolonged phase of expiration, (5) sudden onset without preceding infection, and (6) an immediate favorable response to the administration of a single dose of epinephrine (Billas, 1990; Behrman et al., 1992).

C. Pneumonia

Pneumonia is an acute infection of the parenchyma of the lung (alveolar spaces and/or interstitial tissue). The various clinical forms can be classified by their etiological agent into bacterial, viral, mycotic, other infectious, postoperative and post-traumatic, and aspiration pneumonia.

Bacterial pneumonia frequently occurs secondary to a viral upper respiratory infection. *Pneumococcal pneumonia* accounts for 90% of bacterial cases.

Diagnosis is possible on the basis of symptoms and signs and is confirmed by chest x-ray, and sputum and blood culture. However, isolation of viruses is difficult and not feasible in many parts of the world. Nevertheless, finding no bacterial pathogens in sputum cultures and mononuclear cells on smears of sputum suggests viral infection. Furthermore, serologic studies may allow retrospective diagnosis by demonstrating a rise in antibody titer (Billas, 1990; Behrman et al. 1992).

2.5 Acute Respiratory Infections in the World

ARI are one of the major public health problems in virtually all nations of the world.

ALRI, particularly pneumonia, are one of the major causes of mortality among children of the developing world (Graham, 1990). In the late 1970s and early 1980s, 25% to 33% of the annual number of deaths of children 5 years or younger were related to ARI (Gwatkin, 1980). Furthermore, mortality from pneumonia alone is 5-fold to 73-fold higher among the children of developing nations (Pan American Health

Organization, 1980).

ALRI are also important causes of morbidity among children. In developed nations, few prospective community-based studies were carried out to determine the epidemiology of ALRI. The Chapel Hill (North Carolina) Study was an 11-year prospective study. It studied the incidence of ALRI in a large child population attending a child ambulatory clinic. The mean incidence rate was 11 episodes per 100 child-years for children 0-15 years old. For children 0-5 years old, the incidence was 15/100 child-years (Glezen and Denny, 1973; Henderson et al., 1979; Denny and Clyde, 1986). Another study was carried out during the first year of life of healthy infants attending a Child Health Maintenance Organization in Arizona. The mean incidence rate was 39 cases per 100 child-years while the cumulative incidence was 33 per 100 children (Wright et al.,1989). A third prospective study of ALRI among children 0-5 years old was conducted in Seattle. The mean incidence rate was 5 attacks per 100 child-years (Foy et al., 1973).

A number of recent longitudinal community-based studies were carried out in various developing nations to study the epidemiology of ALRI among children aged 0-5 years living in lower socioeconomic status families. The research methods and disease definitions of ALRI were the same as or similar to those recommended by the World Health Organization (WHO, 1981; WHO, 1984). Ten of these studies have been funded by the Board on Science and Technology for International Development of the National Research Council (U.S.A.) (1990). The mean incidence rates of ALRI ranged between 10 and 296 episodes per 100 child-years (Selwyn, 1990). Tupasi et al. (1990) found an incidence of 53 attacks of ALRI per 100 child-years among Filipino children 0 to 5 years old living in a depressed community. Furthermore, Borrero et al. (1990) conducted a cohort study among Colombian infants 0 to 18 months old from low-income families. The mean incidence rate of ALRI was 170 attacks per 100 child-years at risk. Hence, the occurrence of ALRI is much higher in developing countries compared to that of the developed ones.

2.6 Acute Respiratory Infections in Canadian Inuit

The problem of ALRI among the Inuit population is well known, but it is poorly documented. Accurate estimates of either the mortality or morbidity rates due to ALRI for this population can not be readily obtained from official statistics. The available surveys revealed ALRI to be the leading causes of the mortality and morbidity among the Inuit, and a considerable gap exists between the Inuit and non-Aboriginal people.

In the Northwest Territories (NWT) in 1962, pneumonia was the leading cause of mortality in all ages and ethnic groups. The rates were 629, 128, and 84 per 100,000 Inuit, Indians, and non-Aboriginal people respectively, whereas the rate for all Canada was 28 per 100,000 people in 1961 (Best, 1963).

Willis (1963) carried out a survey of both the mortality and morbidity in the NWT. Pneumonia was the first and third ranking cause of mortality among the Inuit and non-Aboriginal people respectively. Pneumonia accounted for 27% and 14% of the Inuit and non-Aboriginal deaths respectively. The pneumonia death rate of 629 per 100,000 Inuit was 7.5 times the non-Aboriginal rate of the NWT, and 22 times the

Table 2.2 Mortality of Acute Lower Respiratory Infections in the Northwest Territories

Study	Age Group	Cause of Death	Locality	Ethnic Group	Rank of Cause of Death	Rate
Best (1963)	All	Pneumonia	NWT:	Inuit	1st	629 / 100,000
				Indian	1st	128
				Non-Natives	1st	84
			Canada			28
Willis (1963)	All	Pneumonia	NWT:	Inuit	1st	629 / 100,000
				Non-Natives	3rd	84
			Canada			28
Butler (1969)	All	Pneumonia	Keewatin	Inuit	1st	400 / 100,000
Butler (1973)	All	Pneumonia	NWT	All	2nd	19%
Spady et al. (1979)	Children	Respiratory Diseases	NWT	All	1st	36%
Muir (1987)	All	Respiratory Diseases	Canada:	Inuit	4th	13%
				Indians	4th	9%

NWT Northwest Territories

Table 2.3 Morbidity of Acute Lower Respiratory Infections in the Northwest Territories

Study	Age Group	Cause of Morbidity	Locality	Ethnic Group	Rank of Cause of Morbidity	Rate
Willis (1963)	All	Pneumonia	NWT:	Inuit	1st	204 / 1,000
				Non-Natives	4th	98
Gold et al. (1969)	Children	Adenoviral Pneumonia	Winnipeg	Natives		67%
				Non-Natives		33%
Spady et al. (1979)	Children	Pneumonia	NWT	Inuit	3rd	1,136 / 1,000
				Indians	2nd	992
				Non-Natives	10th	71
Spady et al. (1979)	Children	Bronchitis	NWT	Inuit	8th	365 / 1,000
				Indians	6th	537
				Non-Natives	6th	243
Postl et al. (1981)	Children	Pneumonia	Keewatin	Inuit	10th	

NWT Northwest Territories

Canadian national rate. Willis suggested low resistance to infection, lack of warmth and shelter, lack of urgent medical care, crowding and carelessness as factors that influenced the high death rate for pneumonia among the Inuit.

Pneumonia was the first and fourth leading cause of morbidity among Inuit and non-Aboriginal people respectively. It accounted for 24% and 11% of all Inuit and non-Aboriginal recorded cases respectively. Furthermore, the pneumonia attack rate of 204/1000 Inuit was almost 2.0 times the non-Aboriginal rate of the NWT (Willis, 1963).

Butler (1969) conducted a study of mortality, morbidity and medical care in the Keewatin Region (NWT) in 1967. Both pneumonia and meningitis were the first leading causes of mortality among the Inuit. The Inuit pneumonia mortality rate was 4/1,000.

Furthermore, chronic bronchitis and emphysema were relatively common with all cases reporting previous ALRI. Butler suggested possible causative factors like, (1) tobacco smoking, (2) previous infection with respiratory syncytial virus which can lead to loss of ciliated epithelium, (3) small and overcrowded households, (4) Inuit's proclivity for frequent visiting or meetings in small, crowded halls and spitting, and (5) dry atmosphere.

Gold et al. (1969) carried out a five year follow-up study of adenoviral pneumonia among hospitalized children in the Children's Hospital in Winnipeg. Of the 69 children with adenoviral pneumonia, 67% were Aboriginal people (Indian, Metis, and Inuit), and 78% were aged two years or younger. Of the 54 infected infants two years old or younger, 78% were Natives. Seven children (10%) (six Natives) died from pulmonary disease.

Chronic pulmonary disease developed in 62%, 46% and 27% of the children infected in the first, second, and third and older year of life respectively. Moreover, 52% of the infected Inuit children had developed chronic or complicated chest disease in contrast to only 30% of the other children.

In 1973, Butler described the health care in Northern Canada. Pneumonia was the second leading cause of mortality after injuries, violence and accidents accounting for 19% of all deaths. Butler suggested that many pneumonia deaths were attributed to the harsh climate, poor living conditions, inadequate sanitation, and the lack of maternal knowledge of the principles of good child care.

Spady et al. (1979) carried out a prospective observational study among all infants born in the NWT during a one year period (Perinatal and Infant Morbidity and Mortality, PIMM, Study). The leading cause of infant mortality was respiratory illness. It accounted for 36% of the infant deaths. Seventy-five percent of the infant mortality due to respiratory causes were Inuit.

Pneumonia was the third, second, and tenth most common illness among the Inuit, Indian, and non-Aboriginal people respectively. The incidence rates were 1136, 992, and 71/1,000 infants among the Inuit, Indian and non-Aboriginal infants respectively.

Fifty-four percent of the Inuit infants had pneumonia (26% had one episode and 28% had 2 or more) ($p<0.001$). Spady et al. reported that pneumonia was the third leading cause of illness among Inuit.

Bronchitis was the eighth most common illness among Inuit. It occurred with a frequency of 365/1000 infants. For the Indian and non-Aboriginal infants, it was the sixth and fourth ranking cause of illness with rates of 537 and 243/1000 infants respectively.

Twenty-three percent of Inuit infants had chronic bronchitis (15% had one attack and 8% had two or more) ($p < 0.01$).

In 1982, 76% of the Native children who had taken part in the PIMM survey were retrospectively surveyed. Lower respiratory tract infections (LRTI) were the leading cause of hospitalization. They accounted for 46 and 20 hospitalizations per 1,000 Indian and Inuit children per year respectively (Postl et al., 1984).

In 1982, 90% of the Inuit children of the Keewatin and Baffin Regions who had taken part in the PIMM survey were retrospectively surveyed (James et al., 1984). During the first 8 years of life, 42% of the children had one or more episodes of lower respiratory tract infections (LRTI), and 31% were hospitalized for these infections. Finally, the annual incidence rates were 110, 42 and 11 episodes per 100 children aged <1, 1-2, and >2 years respectively.

A cohort of infants of the Keewatin Region (NWT) were followed up for a year and re-surveyed five to six years later. Pneumonia was the tenth most common disease diagnosed in the nursing stations during those five to six years. Moreover, pneumonia was the first leading cause of hospitalization accounting for 33% of the hospital discharge diagnoses (Postl, 1981).

Table 2.4 Hospitalization Related To Acute Lower Respiratory Infections in the Northwest Territories

Study	Age Group	Cause of Hospitalization	Locality	Ethnic Group	Rank of Cause of Hospitaliz.	Rate
Postl et al. (1981)	Children	Pneumonia	Keewatin	Inuit	1st	33%
Postl et al. (1984)	Children	Lower Respiratory Tract Infections	NWT	Inuit Indians	1st 1st	46 / 1,000 20
Unpublished (1985-1990)	All	Respiratory Tract Infections	Keewatin Canada	Inuit	1st 4th	2,939 / 100,000 1,457

NWT Northwest Territories

In 1987, Muir updated the report of health status of the Canadian Indians and Inuit published by the Department of National Health and Welfare, Canada. Respiratory diseases were the fourth leading cause of mortality among Indians and Inuit (8.7% and 13% respectively) for the period 1980-84. Moreover, when the Canadian age-specific mortality rates were applied to Inuit people for 1983, the standardized death rate was 0.18, four-times or more higher than among the Canadian population.

ALRI were the fourth and second ranking cause of mortality in Inuit infants for the periods 1981-83 and 83-85 (infant death rates were 1.7 and 2.7 deaths per 1,000 live births respectively. The rate was 0.2 per 1,000 Canadian live birth infants for 1984).

Unpublished data of hospitalization in the Keewatin Region for the period 1985 to 1990 reveals that respiratory diseases were the first and fourth leading cause of hospitalization in the Keewatin Region and Canada as a whole respectively, and respiratory diseases hospitalization rate of 2939/100,000 of the Keewatin Region was twice the Canada national rate.

In conclusion, although these surveys and unpublished data can not depict the full picture of the current burden of illness in the Inuit population, they showed ARI, particularly ALRI, as one of the leading causes of both the mortality and morbidity among Inuit. Secondly, both mortality and the incidence of ARI are much higher among Inuit than among their Canadian counterpart. Therefore, ARI, especially ALRI, can be considered as a major public health problem among the Inuit population.

2.7 <u>Risk Factors</u>

The simple idea of a single biological agent as a sufficient explanation for the disease causation is becoming outmoded. This is also true with respect to ARI. Exposure to a biological agent does not necessarily lead to disease. Douglas et al. (1986) found 29% of well children with potentially pathogenic strains of pneumococcus in naso-pharynxes at any one time, and for those children over six months of age up to 60% exhibited the bacteria. Hence, the risk for ARI varies from one individual to another, and over time. There should be other factors influencing the risk of ARI.

A number of risk factors for ARI have been identified in the literature based on studies in other populations. They include the following:

1. Micro-Biological factors: microorganisms.
2. Host factors include:
   - Demographic factors: age; sex; height; and weight.
   - Nutritional factors: breast-feeding; and vitamins.
   - Health status: ALRI in infancy; human immunodeficiency virus infection; and tuberculosis.
   - Genetic factors.
3. Social factors: socio-economic factors.
4. Environmental factors include:
   - Crowding.
   - Outdoor air pollution: suspended respirable particulate; sulfur dioxide;

nitrogen dioxide; and ozone.

- Indoor air pollution: passive smoking (passive inhalation of tobacco smoke); nitrogen dioxide from natural gas cooking and heating stoves; and smoke from wood-burning heating stoves.
- Meteorologic factors: low temperature; humidity; and/or precipitation (Fig 2.6).

The forthcoming discussion will take into account the strength of association between the study's outcome (frequency of ALRI in the previous two years) and the various risk factors.

1. Age

Age has an inverse relationship with the risk for ARI with the maximum incidence of infections being in the first years of life. The incidence of viral respiratory infection peaks in infancy and early childhood and, thereafter, steadily decreases with age (Van Volkenburgh and Frost, 1933; Gwaltney et al., 1966; Fox et al., 1972; Fox et al., 1975; Ledder and Holland, 1978; Fox et al.,1985, Selwyn, 1990). The trend is generally attributed to changing patterns of exposure and the acquisition of specific immunity to an increasingly large array of virus types occurring with age (Graham, 1990).

2. Crowding

Overcrowding seems to be an important risk factor for ALRI.

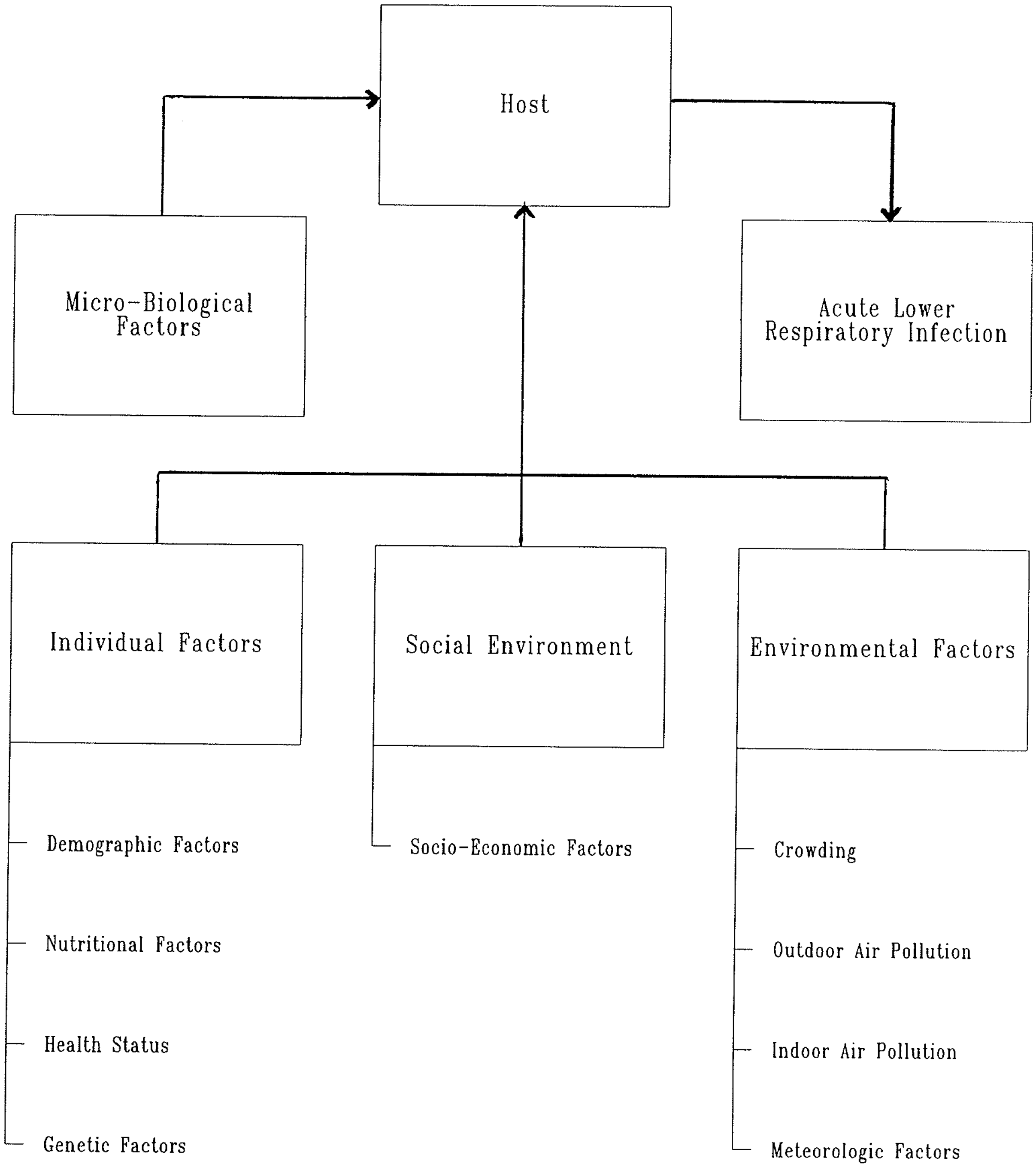


Fig 2.6: Model of Relationship Between Acute Lower Respiratory Infection and Various Risk Factors

A number of studies revealed that crowding, measured as number and age of siblings in the family, density of room and household occupancy, or attendance at day care centers, increased the incidence of ALRI in both infants and children (Leeder et al., 1976; Strangert, 1976; Monto and Ross, 1977; Gardner et al., 1984). However, a follow-up study was conducted among Inuit infants living in the Keewatin and Baffin Regions of the NWT (James et al., 1984). Number of siblings was not found to be among the factors that influenced the incidence of hospitalization for lower respiratory tract infections.

Potential mechanisms of transmission include increased chance of transmission with crowding, and possibly an increased dose of the infected agent when transmitted.

The association of crowding and the incidence of ALRI seems to be confounded by some factors, like malnutrition and low SES. These factors may contribute individually or perhaps interact to increase susceptibility to respiratory infections in crowded places (Graham 1990). Therefore, future efforts are needed to study the effect of crowding on the incidence of ALRI, adjusting for the confounding factors.

3. Passive Inhalation of Tobacco Smoke

Several studies found passive inhalation of tobacco smoke an important risk factor for ARI in children, particularly those aged two years or younger (Colley et al., 1974; Harlap and Davies, 1974; Leeder et al., 1976; Fergusson et al., 1980; Fergusson et al.,1981; Evers et al., 1985; Fergusson and Horwood, 1985; Woodward et al., 1990). On the other hand, the community-based studies carried out in six developing countries found no consistent association between incidence of ALRI among children aged 0-5 years and smoking in the household (Selwyn, 1990). Selwyn observed that the similarity of the study participants was the reason for the modest or lack of association.

Passive inhalation of maternal tobacco smoke seems to be more important than passive inhalation of paternal smoke (Colley et al., 1974; Fergusson et al.,1981; Fergusson and Horwood, 1985; Ferris et al., 1985; Woodward et al., 1990).

Moreover, Woodward et al. (1990) found that both the prenatal and postnatal maternal smoking were important risk factors for ALRI among infants, whereas Taylor and Wadsworth (1987) found prenatal smoking to be a stronger risk factor than postnatal smoking.

4. Respiratory Infections In Early Infancy

ALRI in the first years of life, particularly the first one or two years of life, may be associated with a subsequent proneness to chronic respiratory illness (Gold et al.,1969; Colley et al., 1973; Herbert et al., 1977; Woolcock et al., 1979; Mok and Simpson, 1984; Weiss et al., 1985; Barker and Osmond, 1986). Although the relationship between early ARI and the subsequent ARI has not been as thoroughly studied, two Australian studies showed that a similar association to that identified with chronic respiratory infection may exist. A 3-year follow-up study of pneumococcal vaccine was conducted in children. The level of acute respiratory morbidity (recorded in the respiratory-symptom diaries by the mothers) in any six month period was the strongest predictor of acute respiratory illness in the subsequent six month period (Douglas and Miles, 1984; Pinnock et al., 1986).

Graham (1985) conducted a case-control study among children. The children who had high levels of respiratory morbidity (cases) were 11-times more likely to have experienced bronchitis, pneumonia or bronchiolitis in the first year of life than those who had low levels of morbidity (controls). The relationship remained strong (odds ratio= 9.5; 95%CI= 5.5-16.6) after adjusting for low birth weight, breast-feeding, sex, use of child care, number of siblings, parental history of respiratory disease, maternal stress levels, parental occupational status, and exposure to gas heating.

These preliminary data from both prospective and retrospective studies suggest that respiratory infections in infancy may predict subsequent respiratory infection morbidity. However, these studies have not entirely disentangled the acute from chronic morbidity, or addressed whether it was infective or not.

5. Breast Feeding

Breast-feeding is advocated to protect against ARI in infants. There is evidence both for and against this protective action. Several studies have found that breast-fed children are at a significantly lower risk of respiratory infection in bivariate analyses (Ellestad-Sayed et al., 1979; Watkins et al., 1979; Pullan et al., 1980; Schaefer et al., 1980; Fergusson et al., 1981; Taylor et al., 1982; James et al., 1984; Forman et al., 1984; Wright et al., 1989; Woodward et al., 1990). When the confounding variables were controlled for, many studies revealed the disappearance of the relationship between breast-feeding and the risk of respiratory illness (Taylor et al., 1982; Forman, 1984; Woodward et al., 1990). However, Ellestad-Sayed et al. (1979), Watkins et al. (1979), Pullan et al., (1980) found the protective effect of breast-feeding against ARI to be independent of crowding in household, family size and income, and parental education. The protective effects lasted after the discontinuation of breast-feeding (Ellestad-Sayed et al., 1979).

Spady et al. (1979) carried out a prospective study among a cohort of 1191 infants from Northwest Territories (NWT), Canada. Breast-feeding was found to be protective against pneumonia and chronic bronchitis. Adjusting for the factors which influence ALRI, duration of breast-feeding predicted 2.5% and 2.3% of the variances in pneumonia and bronchitis respectively. For Inuit infants alone, 2% and 2.7% of the variances in pneumonia and bronchitis respectively were explained by the duration of breast-feeding.

Although the definite answer is not yet at hand, the weight of evidence supports a protective effect.

The protective effect of breast milk can be attributed to:

1. Its conferred anti-infective properties. These properties can provide the infants with protection during the early development of the immune system. Human milk contains numerous anti-infective agents, such as leukocytes, lactoferrin, and antibodies mainly in the IgA fraction of milk protein (Mata & Wyatt, 1971; McClelland et al., 1978), and

2. Its cleanliness and lack of opportunity for infection. Some studies, conducted in societies where child care standards were low, demonstrated the benefits of breast feeding in reducing either the mortality or morbidity due to respiratory infections (Grulee et al., 1934; Douglas, 1950; Robinson, 1951). However, in communities where child care standards were high, bottle-fed children were not found to be at a significantly higher risk for ARI than those who were breast-fed (Douglas, 1950; Fergusson et al., 1978).

The nutritional factors of breast milk are less likely to be as important as its anti-infective properties in the developed nations (Graham, 1990).

6. Tobacco Smoke

Direct tobacco smoking is one of the first factors accepted to increase risk for ARI in teenagers and adults (Holland and Elliott, 1968; Finklea et al., 1969; Colley et al., 1973; Rush, 1974; Monto et al., 1975; Mackenzie et al., 1976; Kark and Lebuish, 1981; Kark et al., 1982; Lipsky et al., 1986; Woodhead et al., 1987).

7. Outdoor Air Pollution

Some outdoor air pollutants seem to be important risk factors for acute respiratory illness, particularly ALRI. Sulfur dioxide (SO2), nitrogen dioxide (NO2), and suspended respirable particulate are the components of air pollution widely studied. Few studies included virological or bacteriological diagnostic tests. Hence, it is not clear whether the reported morbidity can be mainly related to the bronchial reactivity and respiratory tract irritation, or to the effects of infection.

Lunn et al. (1967 and 1970) studied acute respiratory illness in children of Sheffield, United Kingdom. Areas with relatively high and low levels of smoke (suspended particulate matter) and SO2 were compared. Exposure to high levels of smoke and SO2 in air were related to repeated episodes of upper and lower acute respiratory illness, after adjusting for SES.

The study of Colley and Reid (1970) revealed a relationship with air pollution (urban versus rural comparison) in lower but not upper acute respiratory illness in children. This effect was most marked in the lower social classes.

Levy et al. (1977) found high levels of smoke and SO2, but not NO2, carbon monoxide, or pollen, to predict hospital admission for acute respiratory disease in children and adults, adjusting for the effects of temperature.

Recent studies have examined the effects of air pollution at much lower levels than did earlier studies. In 1986, Ware et al. conducted the Six Cities Study. They found that the annual mean between-city differences in particulate and suspended sulfate concentrations of 80 mg/m3 doubled the risk of acute cough and substantially increased the risk of lower acute respiratory illness in children. They also found a significant but weaker association with SO2.

Pope (1989) found that 24-hour fine-particulate levels as low as 50 mg/m^3 were significantly associated with enhanced risk of hospitalization from lower acute respiratory illness in either the children or adults. The associations have persisted controlling for meteorological variables.

Other studies (Dales et al., 1989; Dockery et al., 1989) have confirmed the importance of association between SO2, suspended particulate, and lower acute respiratory illness in children while the importance of NO2 as a risk factor is less certain (Dockery et al., 1989; Goings et al., 1989).

In an abstract, Schwartz et al. (1989) reported that exposure to ozone increased the risk for lower acute respiratory illness in children.

Graham (1990) extensively reviewed the literature on the epidemiology of acute respiratory illness in children and adults. He reported that the overall evidence supports the following: (1) suspended respirable particulate, suspended sulfates, and SO2 at levels currently being measured in ambient air increase the risk for ARI in both children and adults, (2) the available data are less convincing to consider NO2 as an important risk factor, and (3) it is too early to assess the importance of ozone as a risk factor for acute respiratory illness.

8. Sex

The incidence of ARI diseases vary by sex. Male children aged three years or younger appear to be more at risk for ARI than their female counterparts. The reverse appears to be true for those older than three years (Van Volkenburgh and Frost, 1933; Badger et al., 1953; Gwaltney et al., 1966; Fox et al., 1972; Monto and Ullman, 1974; Monto et al., 1975; Schenker et al., 1983). On the other hand, two other studies of respiratory infection in infants found no differences in the incidence by sex (James et al., 1984; Wright et al., 1989).

In adults, it is probable that ARI may be related to exposure rather than to host predisposition because adult females tend to be predominantly mothers of young children. Adult females may be more exposed to their children's respiratory infections compared to male adults.

9. Socioeconomic Status

Socioeconomic status (SES) has been measured in numerous ways, including rankings of occupational prestige, educational status and level of income. Although these measures are intercorrelated, they do not all measure the same thing nor do they tell fully about the components of SES which may act as factors influencing the risk for ALRI.

It is believed that low SES increases the incidence for ALRI. However, the weight of evidence shows that the risk associated with low SES is not always consistent, and the different measures of SES can behave differently in predicting respiratory illness.

In 1984, Gardner et al. employed a combined measure of family income, insurance status, and parental educational level to measure SES. Low SES was found to increase the risk for ALRI, but not to upper respiratory infections.

The differentials in pneumonia mortality observed between the developed and developing countries reflect the relationship of low SES and the higher risk for pneumonia (Graham, 1990). Furthermore, the similar levels of upper respiratory tract infections reported in both the developed and developing nations lends support to the finding that low SES may not increase risk of upper respiratory infections, i.e., low SES may increase the risk for ALRI, but not to upper respiratory infections (Van Volkenburgh and Frost, 1933; Gwaltney et al.,1966; Kamath et al., 1969; Fox et al., 1972; James, 1972; Monto and Ullman, 1974; Fox et al., 1975;).

Monto and Ross (1977) found that low income families had more attacks of ALRI, while low education-level ones had fewer attacks. The researchers reported that the latter finding was unexpected and it was attributed to different symptom reporting rates by high and low educational groups.

In a retrospective study, Schenker et al. (1983) did not find any relationship between ALRI and low SES (occupational status and educational level of parents). Furthermore, the community-based studies conducted in ten developing countries found no consistent association between incidence of ALRI among children 0-5 years and the mother's education (Selwyn, 1990).

Poverty and low SES are associated with several factors, such as large family size, crowded living conditions, higher smoking rates, poorer access to medical care, stressful living environment, lower breast-feeding rates, potential for nutrition deficit, and exposure to environmental pollutants (tobacco smoke, wood smoke, ...etc.). These factors may contribute individually or perhaps interact to enhance susceptibility to respiratory infections in low SES people. In a study of Australian children who were prone and not prone to respiratory infections, low parental occupational status was found to be associated with having a child who was prone to RI by using bivariate analyses. However,this association between social class and proneness to respiratory infections disappeared after adjusting for factors such as sex, maternal smoking, number of siblings, parental history of respiratory illness, use of child day care, maternal stress levels, and breast-feeding (Graham et al., 1990).

10. Human Immunodeficiency Virus Infection

Human Immunodeficiency Virus (HIV) infection is believed to be the newest risk factor for ARI. Pneumonia, particularly *Pneumocystis carinii* pneumonia is the most common respiratory infection in the HIV-infected patients with and without autoimmune deficiency syndrome. Other common pneumonia includes *Pneumococcal, Hemophilus influenza*, and *Cytomegalovirus* pneumonia (Oleske et al., 1983; Rubinstein et al., 1983; Murray et al., 1984; Scott et al., 1984; Centers Disease Control, 1985; White et al., 1985; Hughes W., 1987; Rolston et al.,1987; Witt et al.,1987; Schlamm and Yancowitz,1989).

11. Natural Gas Cooking and Heating Stoves

Natural gas cooking and heating stove increase exposure of household members to mainly nitrogen dioxide (Graham N., 1990). A number of studies were conducted to test the relationship between this pollutant and ARI. However the levels of exposure attained in households are relatively low and, thus, it remains unclear whether exposure to this pollutant significantly increases the risk for ARI (Melia et al., 1977; Keller et al.,1979; Keller et al., 1979; Melia et al., 1979; Ware et al., 1984; Goings et al., 1989; Graham, 1990).

Samet et al. (1987) extensively reviewed the literature on the sources of indoor air pollution and health effects. They concluded that any health effect attributable to nitrogen dioxide exposure is likely to be very small, if it exists at all.

12. Smoke From Wood-Burning Heating Stoves

Smoke from wood-burning heating stoves may be a risk factor for ARI. Three studies showed a significant association between exposure to smoke from wood-burning stoves and ARI in children aged seven years or younger (Honicky et al., 1985; Osborne et al., 1989; Morris et al., 1990). Nevertheless, a fourth study found no such relationship in school-age children, suggesting that younger children may be those most at risk (Tuthill, 1984).

13. Malnutrition

Despite the common belief that malnutrition influences the risk for ALRI, there are a few epidemiological studies that support this view (Aaby, 1988; Aaby et al., 1988; Tupasi et al., 1988). It appears difficult to identify an independent effect on the risk of ARI because malnutrition is closely correlated with crowding, poor education, poor sanitation, poor housing, and poverty.

James (1972) carried out a study in Costa Rica to examine the relationship between malnutrition and respiratory illness among poor children under the age of 5 years. Unadjusted analyses showed that malnourished children experienced 3-times more bronchitis, 19-times more pneumonia, and were far more likely to be hospitalized than normal-weight children.

Escobar et al. (1976) studied children hospitalized with lower respiratory illness and found that mortality increased in relation to the level of malnutrition (weight for age).

In 1983, Berman et al. found a significant association between malnutrition and pneumonia, but not bronchitis or tracheobronchitis in children attending health centers in Cali, Columbia.

Most recently, Tupasi et al. (1988) reported relative risks of death from pneumonia of 27, 11.3, and 4.4 for hospitalized children with third, second and first degree malnutrition respectively. They also reported no relation between malnutrition and the incidence of respiratory morbidity in multivariate analyses, because of strong confounding from socioeconomic status.

14. Vitamins

It has been reported that some vitamins have a protective effect against respiratory illnesses.

Vitamin A deficiency might be a risk factor for ARI. Children who were prone to ARI were more likely to have Vitamin A deficiency than non-prone children (Sommer et al., 1983; Sommer et al., 1984). In a subsequent intervention study, the same group of authors failed to demonstrate that Vitamin A supplement reduces morbidity from ARI (Sommer et al., 1986; Tarwotjo et al., 1987).

Pinnock et al. (1986) carried out a controlled Vitamin A trial among well nourished children with a history of frequent respiratory illness. The respiratory morbidity was reduced by 19% in children taking Vitamin A supplements.

In Thailand, children with deficient serum retinol were four-times more likely to experience respiratory morbidity than non-deficient ones. Moreover, the study found that Vitamin A supplement offered some protection against respiratory illness. However, the protection varied by age and length of follow-up, probably because of the small sample size (Bloem et al., 1990).

It seems likely that Vitamin A supplement is beneficial in populations whose diets are significantly deficient in the vitamin. However, further studies are required to determine conclusively the effects of Vitamin A supplement on both the morbidity and mortality from ARI.

Vitamin C may protect against upper respiratory illness, but the evidence is, at best, marginal (Miller et al., 1977; Tyrell et al., 1977; Pitt and Costrini, 1979).

15. Psychological Factors

The relationship between psychological factors and ALRI has not been adequately studied.

Numerous experimental and epidemiological studies have shown that psychosocial factors, such as stress and anxiety, may increase susceptibility for upper respiratory infections in both adults and children (Meyer et al., 1962; Belfer et al., 1968; Jacobs et al., 1970; Boyce et al., 1977; Kasl et al., 1979; Graham et al., 1986; Foulke et al., 1988). However, whether the association is causal remains debatable.

Psychosocial factors, like stress and anxiety, may predispose respiratory infection by two mechanisms. First, a high stress level might lead to disruption of normal hygiene measures usually used to reduce transmission of respiratory viruses. However, this seems unlikely because transmission factors were controlled in the experimental studies (Totman et al., 1977; Totman et al., 1980; Broadbent et al., 1984). Second, psychosocial factors may suppress many components of the immune function (Graham et al., 1990). This might lead to increased susceptibility to respiratory infections. However, the immune function fluctuations believed to be associated with psychological factors may not have a high clinical relevance. Hence, the importance of psychological factors as risk factors for respiratory infections will remain uncertain until future data are available to address this issue.

16. Meteorologic Factors

It is believed that air temperature and humidity predispose ALRI. Young M. (1924) and Playing-Wright et al. (1945) found that low temperature correlates with an increase in mortality from ALRI. In addition, Pope (1989) found a correlation of low temperature and hospitalization from lower acute respiratory disease. However, the epidemiological evidence is difficult to interpret because of the following:

1. Low temperature is associated with increased time spent indoors either at home or at school and, hence, with crowding, and
2. Low temperature leads to high air pollution levels presumably because condensation, cloud cover, and precipitation act to prevent dispersal of

particulate and gases (Graham, 1990).

Therefore, increased time spent indoors (leading to crowding) and/or high levels of air pollution during winter can confound the relationship between low temperatures and ALRI.

17. Genetic Factors

Family history of asthma is associated with an increased risk of bronchiolitis in infancy and appears to strongly interact with the presence of an older sibling in the household as well as passive smoking. The combined presence of both variables (presence of older sibling and passive smoking) yielded odds ratios of 8.94 and 181.67 for the infants with and without a history of asthma respectively. It has been speculated that a genetic tendency to wheeze is likely to increase the severity of viral respiratory infection, but not its occurrence (McConnochie and Roghmann, 1986).

The proposed genetic susceptibility appears to be supported by other studies reporting high rates of wheeze-related respiratory infection in infants with small airway diameters and higher virus-specific immunoglobulin E responses to respiratory syncytial and parainfluenza viruses (Welliver et al., 1981; Welliver et al., 1982). It seems that there may be a role for immunologic mechanisms in the pathogenesis of severe forms of respiratory illness, and future studies are highly recommended.

In conclusion, the available information is not sufficient to fully describe the burden of illness of ALRI among Inuit. However, it is clear that ALRI are an important public health problem in the Inuit population. Although numerous risk factors for ARI have been identified, the factors specific to the Inuit are still largely unknown. Hence, it appears that it would be necessary to carry out a study to obtain additional information on both the incidence of ALRI among the Canadian Inuit, and on the factors that influence their development.

PART 3

METHODS

3.1 Study Design

A nonconcurrent prospective (retrospective cohort) method is the design selected to meet the objectives of this study. This type of cohort study classifies individuals on the basis of presence or absence of exposure. Moreover, all the relevant events (both the exposure and outcomes of interest) have already occurred when the study is initiated and, thus, participants may not be followed into the future (Hennekens and Buring, 1987). The retrospective cohort design is selected for the following reasons:

1. It elucidates a temporal relationship between the exposure and outcome; and
2. It allows the direct measurement of the risk of developing the disease in the exposed and unexposed groups.

A concurrent prospective (prospective cohort) study can be an alternative method. However, the relatively long period of follow-up, expected high expenses, and the potential attrition in a mobile population do not make the concurrent method a potential candidate.

Another alternative method is a retrospective (case-control) study. However, the major deterrents are that it does not elucidate a temporal relationship between the exposure and the disease nor does it allow a direct measurement of the risk of developing the disease in the exposed and unexposed groups. Hence, a case-control design is not suitable for the objectives of the study.

3.2 Sample Selection

The current study, entitled the "Follow-up Respiratory Survey for Inuit Children and Adolescents of the Keewatin Region", was carried out in association with Prof. T. Kue Young. The study period began in October, 1990 and continued until October, 1992. The current study subjects (2-17 years of age in 1992) had participated in two previous surveys, namely the 1990 Keewatin Sociodemographic Household (KSH) Survey, and the Keewatin Health Status Assessment (KHSA) Survey at which time they were aged 0-15 years. The later surveys were conducted by three co-principal investigators (Drs. M. Moffat, J. O'Neil, and T.K. Young) from the Northern Health Research Unit of the University of Manitoba.

The surveys were collaborative efforts between the Keewatin Regional Health Board (KRHB) and the Northern Health Research Unit (NHRU) of the University of Manitoba to assess the health status of the people in the region and to describe some of their health needs.

The KSH Survey of every household in the Keewatin Region was carried out in the spring and fall of 1990. The hamlets of Arviat, Chesterfield Inlet, and Rankin Inlet were surveyed in the spring, whereas Baker Lake, Coral Harbor, Repulse Bay, Sanikiluaq and Whale Cove were surveyed in the fall. There were 5,731 people living in the region (Table 3.1). The table also reveals the distribution of the population of the eight Keewatin communities by age and sex, and provided the sampling frame for the second study, the KHSA Survey.

Table 3.1 Distribution of the Population of the Inuit Hamlets (Community) of the Keewatin Region for 1990, by Age and Sex

Hamlet	Sex	Age							
		0-4	05-	15-	25-	35-	45-	55+	All
Rankin Inlet	M*	109	181	142	181	89	46	47	795
	F**	125	165	136	182	74	47	35	764
	All	234	346	278	263	163	93	82	1559
Arviat	M	102	165	124	82	43	32	29	577
	F	86	162	134	75	53	29	27	567
	ALL	188	327	259	157	96	61	56	1144
Chester field Inlet	M	22	32	22	25	9	10	7	127
	F	21	28	29	25	7	7	9	126
	ALL	43	60	51	50	16	17	16	253
Repulse Bay	M	42	72	52	37	16	11	13	243
	F	52	62	50	34	17	10	7	232
	ALL	94	134	102	71	33	21	20	475
Coral Harbor	M	51	64	57	39	22	16	16	265
	F	50	66	61	30	28	12	13	260
	ALL	101	130	118	69	50	28	29	525
Whale Cove	M	17	25	30	15	12	5	8	112
	F	21	26	28	18	7	7	5	112
	ALL	38	51	58	33	19	12	13	224
Baker Lake	M	93	109	114	107	47	32	45	547
	F	77	96	101	87	44	34	52	491
	ALL	170	205	215	194	91	66	97	1038
Sanikiluaq	M	42	61	57	33	33	19	17	262
	F	40	55	64	38	24	22	9	252
	ALL	82	116	121	71	57	41	26	514
Total	M	478	709	598	519	271	171	182	2928
	F	472	660	603	489	254	168	157	2803
	ALL	950	1369	1201	1008	525	339	339	5731

* Male
** Female

(Source: Sociodemographic household survey of the Keewatin Region)

The KHSA survey was also carried out during 1990. A random sample of 20% of the individuals living in the region, or 1,330 people (of whom 590 were children and adolescents aged 18 years and younger), were selected and invited to take part in the survey.

The survey for Arviat, Rankin Inlet and Chesterfield Inlet was carried out from March to the end of May, 1990. Baker Lake, Coral Harbor, Repulse Bay, Sanikiluaq, and Whale Cove were surveyed from October to the end of December, 1990. The number of respondents included 459 children and adolescents aged 0 to 15 years (in 1990), yielding a response rate of 83% for this age group. Of the 459, 438 were from the Keewatin communities (providing the study group for the current Follow-up Respiratory Survey) and the other 21 individuals were from the town of Churchill.

In 1992, all 438 children and adolescents aged 2 to 17 years (0 to 15 years old in 1990) who were residents of the Keewatin communities and who had participated in the KHSA study and continued to be residents of the communities, were invited to take part in the Follow-up Respiratory Survey.

A study population of only very young children might not have been appropriate since these subjects are more at risk for ALRI; however, the major deterrents of this selection are:

1. Reduction of the study's sample size to 81 children aged 0-2 years (in 1990). This would restrict the data analyses to the descriptive (univariate) analyses rather than extend them to include the analytical (multivariate) analyses. Recent studies suggest the use of multivariate analyses to adjust for the effects of other factors.

2. Creation of a new study sample of children aged 0-2 years. This would inevitably lead to exclusion of some of the risk factors which were collected in the 1990 Keewatin surveys. These would include weight, height, and socio-economic factors.

3.3 Ethical Considerations

Like all research that involves human beings, the researchers made sure that no individual suffered any adverse consequences as a result of the survey. This was achieved through a consent form which had been approved by the Board of Ethics of the University of Manitoba. The consent form informed the respondent the following:

1. The name of the organization conducting the research.
2. A clear, brief, description of the purposes of the survey.
3. Confidentiality of their answers.
4. Cooperation was voluntary and that no negative consequences would result if they decided not to take part in the study (Appendix C, Part One).

At the beginning of the interview, the interviewers were asked to read the consent form to the respondents, and those who agreed to participate were asked to sign the consent form.

3.4 Study Power

The determination of the study power was a main concern because the following information was not available at the time of study:

1. the proportion of Inuit children exposed to the various risk factors for ALRI, and
2. estimates of the prevalence of ALRI among the children exposed and unexposed to the risk factors.

The study power can be an issue when:

1. the sample size is small;
2. the number of persons exposed or unexposed to a risk factor is limited; and/or
3. the exposure effect (the difference in prevalence of disease between the exposed and unexposed individuals) is relatively small.

Under these circumstances, the larger the sample size, the larger the study power will be and, therefore, more information on the possible response differences between the exposed and unexposed people will be gained.

Cohen (1988) used the means of the normal curve test applied to the arcsine transformation of proportions to test the hypothesis concerning the difference between the proportions of 2 independent populations, and therefore the study power necessary to detect the difference between the two proportions.

It is expected that the study sample size will be around 400 children and adolescents, and a high proportion of these subjects have been exposed to the risk factors for ALRI. If 88% of the study people are exposed to a risk factor, and the proportion of ALRI in the unexposed group is only 1%, the study size of 400 children can detect a significant RR of 10 or more (a significant difference of 9% or more between the incidence of infection of the exposed and unexposed groups) with an 80% power, having accepted a 5% chance that a difference will be found when one does not really exist.

3.5 Data Collection

As already mentioned, three surveys were conducted to collect necessary data.

3.5.1 Sociodemographic Household Survey

The survey included a brief assessment of every household in the Keewatin Region. It provided information on the following:

- household crowding, and
- employment and income level of each household member aged 15 years or older (Appendix A).

3.5.2 Keewatin Health Status Assessment Survey

The KHSA Study was also conducted in 1990. A random sample of 20% of the people living in the region was undertaken. The sampling frame was based on the lists generated by the Household Survey that was performed no more than six weeks prior to the health study with participation of the KRHB members and the research assistants.

Both the paediatric and adolescent questionnaires of the health survey included information on several health indicators (Appendix B). These are:

- demographic data (date of birth and sex), and
- anthropometric data (measurements of weight and height).

3.5.3 Pediatric and Adolescents Follow-Up Respiratory Survey

The proposal of the current study was submitted to the KRHB in 1992. The Health Board approved and, hence, allowed investigators to access and collect the necessary data from the community health centers and child care-providers on voluntary basis.

The survey was conducted from October, 1992 through to April, 1993. All children and adolescents participants of the KHSA Survey were invited to take part. The survey gathered data on frequency of ALRI during the period from October, 1990 to October, 1992, as well as the factors which influence the risk of development of these respiratory infections.

The necessary data were collected employing the following two methods:

1. Individual interview of care-givers of participant children.
2. Review of the medical records of children.

Both the information on the outcome variable (episodes of ALRI during the past two years) and some risk factors (i.e., episodes of ALRI during the first two years of life,..etc.) are recorded in the medical records.

3.5.3.1 Medical Records Review

The list of names of children and adolescents who had taken part in the KHSA Study was updated and amended at the time of data collection with the aid of local Inuit clerks or public health aides in the nursing station in each Keewatin community.

The medical records of the study's population were reviewed at both the nursing stations in the Keewatin hamlets and the referral hospital (Churchill Health Center) in the town of Churchill.

A standardized instrument was developed to gather information from the medical records (Appendix C, Part One). The information included the following :

1. Demographic characteristics including age, and sex.
2. Frequency of ALRI during the period of October, 1990 to October, 1992.
3. Illness characteristics including frequency of ALRI in early infancy (first two years of life), history of croup, whooping cough, emphysema, otitis media, heart diseases, tuberculosis infection and disease, bronchiectasis and asthma.

An alternative approach to gather information on ALRI symptoms and other illnesses was a survey using either a respiratory symptom diary or recall questionnaire. However, the main deterrents were the following:

1. There are no standardized questionnaires or diaries to collect data on the ALRI symptoms or their risk factors. The standardized research instruments developed by both the British Medical Research Council (Fletcher, 1960) and American Thoracic Society (Speizer et al.,1978) were designed to measure the symptoms of chronic respiratory diseases. Although the children's questionnaire of the American Thoracic Society includes questions on the frequency of some acute symptoms, the focus is squarely set upon the symptoms of airway reactivity and allergy, and hence they could not be readily adapted for studies on acute respiratory infections.
2. The person's assessment of health status is a proxy measure for clinically measured health status and is influenced by social, cultural, and emotional factors.

Hence, the person's assessment of health status using recall questionnaires is not useful in order to assess the incidence or prevalence of a specific disease.

3. Proxy reporting is less accurate than self-reporting, as medical relevance and social desirability tend to affect reports on family health. Therefore, proxy reporting, particularly parents reporting for children, is a source of error in studies of the true incidence or prevalence of disease employing recall questionnaires.

4. The salient diseases or episodes (those involving disability or medical consultation) are more accurately reported than those less salient in recall questionnaires.

5. The magnitude of recall errors increases as the recall period is prolonged. Recall periods for illnesses reporting as long as twelve months or more are not sufficiently reliable to provide useful information.

6. Both respiratory symptom diaries and self-administered recall questionnaires require literate populations.

7. Although daily recording of symptom diaries might not be of a concern to the participants in short studies, it can contribute to loss of follow-up in multiyear projects (Kroeger, 1983; Mechanic, 1989).

8. Ethnomedicine (those beliefs and practices relating to disease which are the products of indigenous cultural development and not explicitly derived from the conceptual framework of modern medicine (Hughes, 1968)) might be of a concern. Beliefs about disease, its relation to other aspects of life, its causes, and its cures, exist in all human groups. Furthermore, every culture is responsible for creating a

process with which to recognize and classify illnesses (Nations, 1986). For instance, Gillies (1976) reported that among the Ogori tribes in Africa, curers are not expected to intervene in cases of hepatitis, malaria, and yellow fever. The common cold, seasonal diarrhea, measles, and smallpox are regarded by the Zulu people in South Africa as diseases that "just happen" and, hence, require no outside intervention or consultation by the local healers (Ngubane, 1976).

3.5.3.2 Individual Interview

A questionnaire was developed to gather information on factors believed to influence the susceptibility for ALRI. Trained local Inuit interviewers administered the questionnaire to the care-givers of the study's children. The personal interview was selected for the following:

1. To enhance the response rate. This can be achieved by the fact that (a) Inuit interviewers can persuade other Inuit to take part in the study. Review of epidemiological studies among the Canadian Native population suggests that the response rate for personal interviews is at most 60%, and (b) a high proportion of Inuit adults (child care-givers) have no formal education. Therefore, the response rate would be expected to be lower if self-administered questionnaires were used.
2. To probe for adequate and complete answers to all questions in the questionnaire.
3. To persuade completion of the questionnaire.

4. The availability of household telephones in order to conduct telephone interviews was expected to be low in the Keewatin Region.

A. The Questionnaire

It is necessary to use a suitable, formal, and standardized questionnaire because (1) the study sample size was relatively large, (2) many interviewers were employed, and (3) the collected data were subject to statistical analyses.

A standardized questionnaire should include (1) a prescribed wording for each question, so that each respondent receives the same stimulus, (2) a prescribed order for asking the questions, and for the same reasons (responses to certain kinds of questions vary significantly depending on the items that precede and follow them) and (3) prescribed definitions and explanations to ensure that the questions are handled consistently (Sheatsley, 1983).

Both an extensive review of the literature and discussions with researchers, pediatricians, respirologists and colleagues were employed to determine a suitable way to operationally measure the outcome (ALRI), as well as the factors believed to influence its risk.

A decision was made to employ: (1) a medical record review to gather information on the outcome and the risk factors recorded in the medical records, and (2) the personal interviews from the child care-givers for the following risk factors (Appendix C, Part Two):

1. Demographic characteristics included age, sex, history of breast-feeding,

and duration of breast-feeding.

2. Community characteristic included the eight communities of the KRHB. This variable may be an important influence on ALRI.

3. Crowding characteristics included the number of persons living in the household where the child lived, number of children living in the household where the child lived, number of persons sharing the child's bedroom, and the child's attendance of either a day care center or school.

4. Indoor air pollution characteristics included the number of individuals who were tobacco smokers in the child's house, history of tobacco smoking in the child's bedroom, type of heating stoves, and if the household cooked with natural gas or electricity. It should be mentioned that tobacco smoker was defined as an individual who smoked regularly one or more cigarettes per day.

5. Child care-giver tobacco smoking characteristics include history of tobacco smoking of the first and second child care-givers, and maternal prenatal and postnatal smoking. The first child care-taker was defined as an individual who usually provided care to the child. The second child care-taker was a person who helped the first one to give care to the child.

6. Soapstone carving characteristics included history of soapstone carving at the child's household.

Subsequently, question items that would elicit the necessary information were drafted. Previous research instruments were used as references to generate ideas on question wording, phrasing, and standardizing, as well as questionnaire formatting. These were the standardized questionnaire on respiratory symptoms (Fletcher, 1960), and respiratory disease questionnaires for use with children and adults in the epidemiological research (Speizer and Comstock, 1978). All questions were kept as concise, understandable, and objective as possible.

After deciding on the variables to be measured and after drafting the question items believed to elicit the required information, the generated questions were grouped into a reasonable order, and put into a questionnaire format. For example, opening questions were made easy, pleasant, and nonthreatening, whereas the sensitive questions (such as history of tobacco smoking of the first and second child care-providers, and the child's biological mother) were kept in the middle of questionnaire.

The questionnaire was pretested in Winnipeg, and therefore not under field conditions. A total of six Inuit were employed for this purpose, three were local residents of Winnipeg and the other three were residents of the Keewatin Region who had been referred to a tertiary hospital (Health Sciences Center) in Winnipeg for medical care and treatment.

In each pretest interview, the researcher stated that their comments on the questionnaire are important and valuable to the study and their comments would be seriously considered in order to enable the researcher to correct and reform the questionnaire as well as to make it as perfect as it could be. Immediately after leaving the respondent, the researcher wrote comments and any problems gaining the respondent's consent or holding interest.

After the pretest phase, (1) the administered questionnaires were revised item-by-item, (2) the gathered data were tabulated to determine the frequencies of each item, and thus to obtain an idea of the marginal distributions they may expect as well as the number of vague or no opinion answers, and (3) the comments of both the interviewer (researcher) and the respondents were used to revise the questionnaire.

The results of the pretest were: (1) the questions were easy to read, to understand, and they made sense, (2) the informants answered all questions easily, and (3) there were no mechanical problems such as interviewer instruction errors, inadequate space for recording, or inappropriate sequencing of questions. Hence, a final draft of the questionnaire was ready for the survey (Appendix C, Part Two).

B. The Interviewers and Training

The study interviewers were (1) Inuit, (2) local residents of the Keewatin hamlets, (3) skilled in reading and writing English and the local Inuktitut languages, (4) had positive impression of comfortableness with the local Inuit residents, (5) pleasant, and (6) had no vested interest in the research project.

In each Keewatin community, the interviewer(s) who had been employed with the previous KHSA Survey were contacted and invited to take part in the current survey. Almost 40% of these individuals were not available, and they were replaced by residents who had the appropriate background characteristics.

The use of many interviewers was not expected to affect the precision of measurement because the majority of the items of the questionnaire did not require subjective judgment, reducing the probability of inter-rater error.

The use of one or two common interviewer(s) to administer the questionnaire to all the care-providers of study children in all Keewatin communities was an alternative approach for the personal interview. However, the major deterrents for that approach would be a low response rate, financial, travel, and time constraints.

The response rate was expected to be lower if only one or two interviewer(s) were hired. Local Inuit interviewers enhanced the response rate by persuading Inuit residents of their communities to participate in the study. In fact, of the two interviewers of the KHSA Survey who were recruited in the current survey in one hamlet, one withdrew after the first few interviews because the interviewer was a new resident of the community, and can not persuade the local residents to take part in the study.

The selected individuals undertook a training session. The objectives were:

1. to understand the main objectives of the survey, type of the data to be gathered, and the way the results would be used,
2. to become familiar with the questionnaire and the specific objectives of each question,
3. to develop an interest in and commitment to the study,
4. to deliver the purpose of the survey, to introduce the persons responsible for the study, and to ensure confidentiality,

5. to ask the questions in English or Inuktitut in a clear manner and exactly as they appear on the questionnaire,
6. to record the answers accurately without expressing opinions,
7. to show complete acceptance of any answer,
8. to check the questionnaire immediately after taking leave of the respondent to ensure completeness of the responses and to make additional notations for the researcher, and
9. to abide by the ethics of confidentiality.

The training session consisted of the following:

1. the interviewer read the questionnaire slowly and carefully to become familiar with it,
2. both the researcher and interviewer(s) reviewed the instrument item-by-item,
3. the interviewer underwent supervised training by administering the questionnaire to two or more care-givers of children not included in the study's child population in order to become accustomed to the questionnaire,
4. the first two or more interviews of the care-giver of randomly chosen children were directly supervised to assure familiarity and comfortableness.

3.6 Outcome Variable

The outcome included all episodes of ALRI during the period of October, 1990 to October, 1992 for each study child and adolescent.

The medical records of the study's children were reviewed at both the nursing stations in the eight Keewatin communities and the Churchill Health Center in the town of Churchill. Only medically documented episodes of ALRI (episodes diagnosed by either a nurse or a physician as pneumonia, bronchitis, bronchiolitis, or ALRI) in the past two years were gathered.

In order to differentiate between a new episode and a follow-up visit for the same episode, a decision was made to code (count) an episode as being a "new event" a maximum of once every 14 days. In the case of episodes which lasted longer than 14 days, efforts were made to determine:

1. if the visit was a follow-up of a prolonged disease, in which case no new event was coded, or
2. if the visit was for a recurrence of ALRI and therefore a new episode was counted.

It is acknowledged that, in some cases, this led to some extra episodes being recorded. On the other hand, the rule not to code as a new episode an ALRI persisting for more than 14 days may have led to under recording of morbidity in infants with a tendency to prolonged illness or delayed healing. It was hoped over- and under-counting were at random and canceled each other.

In the nursing health centers of all Keewatin communities, the medical diagnosis of most episodes of ALRI was not confirmed by the laboratory isolation of microbiological agent or the radiological chest report. Therefore, ALRI episodes could not be classified into "confirmed" and "unconfirmed".

The outcome can be used as either a continuous or categorical variable. In the latter form:

1. A certain frequency of ALRI in the past two years can be used to classify study children in infected and noninfected groups, or

2. Each ALRI episode can be rated by frequency into the following categories: (a) "never" (0 attacks of ALRI during the past two years of life), (b) "rarely" (1 to 2 attacks), (c) "sometimes" (3 to 6 attacks), (d) "frequently" (more than 6 attacks), and (e) "constantly" (most of the time). Each category is assigned a score from 0 ("never") to 4 ("constantly").

The appropriate classification was determined at the time of analysis.

3.7 Independent Variables

There were many factors believed to influence the occurrence of ALRI, and they fall into the following categories:

1. Individual Characteristics

(a) age
(b) sex
(c) weight
(d) height
(e) average annual income of the household
(f) type of employment of adults living at the household

2. Breast Feeding Characteristics

(a) type of milk feeding during the first year of life
(b) duration of breast feeding

3. Illness Characteristics

(a) history of asthma
(b) current history of asthma
(c) history of chest surgical operation
(d) history of heart disease
(e) history of tuberculosis infection
(f) date tuberculosis infection diagnosed
(g) history of tuberculosis disease
(h) date tuberculosis disease diagnosed
(i) history of bronchiectasis
(j) attacks of otitis media during the last two years
(k) attacks of ALRI during the first two years of life

4. Residence Characteristics

(a) community
(b) duration of living in current household
(c) type of fuel for cooking in the household
(d) type of heating system in the household
(e) smell from heating system
(f) household member carving soapstone
(g) place for carving soapstones

5. Crowding Characteristics

(a) school attendance
(b) number of individuals in current household
(c) number of children in current household
(d) number of individuals sharing the child's bedroom

6. Smoking Characteristics

(a) smoking in the child's bedroom
(b) current smoke habit of the first child care-taker
(c) smoke habit of the first child care-taker during the last two years of life
(d) current smoke habit of the second child care-taker
(c) smoke habit of the second child care-taker during the last two years of life
(d) smoke habit of mother during pregnancy
(e) smoke habit of mother after delivery
(f) number of smokers in household

7. Outdoor Air Pollution Characteristics

Outdoor air pollutants were excluded from the current study because official data on outdoor air quality for the Keewatin Region was not available. However, the region appears to be free of major sources of outdoor air pollution.

8. Parental Psychological Characteristics

Parental psychological factors are excluded because (1) there is still no firm epidemiological evidence of the relationship between parental psychological factors and ALRI in children, and (2) there are several research instruments to measure psychological factors. However, neither the reliability nor validity of the research instruments have been tested in the Inuit population.

3.8 Coding of Data

The data of the Keewatin sociodemographic household and health status assessment surveys were keypunched and entered into the main frame computer of the University of Manitoba, whereas those of the recent paediatric and adolescent follow-up respiratory survey were keypunched and entered into the personal computer using the Quattro Pro Computer package.

3.9 Data Analysis

3.9.1 Incidence of Acute Lower Respiratory Infections

Either respiratory infected children or frequency of ALRI can be employed to determine disease occurrence. The former is used by cumulative incidence (or incidence proportion), while the later is used by the incidence rate (incidence density).

The overall cumulative incidence for ALRI is the proportion of study subjects who experience the outcome of interest at any time during the follow-up period (Pearce, 1993).

Cumulative Incidence =

$$\frac{NumberofPeopleInfectedAtaPeriodofTime}{TotalNumberofPeopleAtRiskAtThatTime}$$

The incidence was stratified by age, sex, and community. The Chi-square (X^2) test was performed to assess the significance of associations.

The overall incidence rate for ALRI is the rate of development of a disease in a group of people over a period of time; this time is included in the denominator (Friedman, 1987).

Incidence Rate =

$$\frac{NumberofPeopleInfected}{TotalNumberofPeopleAtRisk} PerUnitTime$$

The incidence rate was stratified by age and community.

The incidence rate was mainly used to compare results of the current study with those of previous ones.

3.9.2 Missing Values

Searching for missing values was an important first step prior to analysis. According to Tabachnick and Fidell (1989) the pattern of missing data is more important than the amount missing. If only few data points are missing in a random pattern throughout a large data matrix, the problems are rarely serious. However, if a lot of data are missing from a small- to a moderate-sized data matrix, the problems can be very serious. There are as yet no firm guidelines for how much missing data can be tolerated for a sample of a given size.

On the other hand, non-randomly missing values are serious no matter how few of them there are since they affect generalizability of the results.

Tabachnick and Fidell (1989) suggested two methods to handle missing data. These are (1) deletion of cases or variables, and (2) estimation of missing data.

If few cases have missing data and they seem to be a random subsample of the whole sample, their deletion is a good advice. If missing values are concentrated in a few variables and they are not critical to the analysis, their deletion is a good alternative (Tabachnick and Fidell, 1989).

There are at least three methods for estimating the missing values. These are:

1. Prior Knowledge is used when the missing value is replaced by a value from a well-educated guess.
2. Means are calculated from available data and used to replace missing values.
3. Multiple linear regression expresses the linear function of an outcome (variable with missing data) as a linear function of a set of independent variables (all

other variables including the study outcome).

3.9.3 Comparison of Participants and Non-Participants

In 1992, a total of 416 children and adolescents residents of the eight Keewatin hamlets were contacted and asked to participate in the Paediatric and Adolescent Follow-up Respiratory Survey. Of these, 400 children and adolescents responded.

Comparative analysis between participants and non-participants was conducted in order to assess the similarity of the two groups on the occurrence of ALRI and some of the variables believed to influence the risk for these respiratory illnesses.

For binary variables, the Fisher's test was performed to test the significance of association between participation in the study and the variable under consideration. The level of significance was set at 5% (Fleiss, 1981; Kleinbaum et al., 1982).

For categorical variables having more than two categories, the Mantel-Haenszel Chi-square test was employed to assess the overall association between participation in the study and the variable under consideration. The level of significance was set at 5% level (Fleiss, 1981; Kleinbaum et al., 1982).

3.9.4 Anthropometric Indices

As weight and height measurements are age and sex dependent, various indices such as weight-for-age (WA), height-for-age (HA), and weight-for-height (WH) have been created. The Epi-Info anthropometric software package version 5.0 (1990), which is based upon the NCHS Growth Curves for Children, was used to generate these indices from the row data.

These indices can be expressed in terms of standard deviation (SD), percentiles, and percent of the median. Both Waterlow et al. (1977) and the WHO (1986) favour the use of SD. The SD cutoff point recommended by WHO to classify low levels is < -2 SD units from the reference median for the three indices. In general, the prevalence of malnutrition can be assessed by determining the proportion of the persons that falls below some cutoff value.

The two preferred anthropometric indices to assess nutritional status are WH as an indicator of the present state of nutrition and HA as an indicator of previous nutrition (Waterlow et al.1977; WHO, 1986). The third index, WA, is primarily a composite of WH and HA, and has the disadvantage that it can not distinguish between acute, low WH, and chronic, low HA, malnutrition.

Both HA and WA can be calculated for individuals from birth up to 18 years of age. However, WH indices apply only to prepubescent children (Waterlow et al. 1977; WHO, 1986). Hence, despite the fact that body mass index (BMI) (weight/height^2 ratio) is validated for adults, it was used as an indirect measurement of obesity among the adolescents. Quetelet Index value of <20 was regarded as indicative of underweight, while a value of > 25 was indicative of overweight (Gibson, 1990).

3.9.5 Univariate Analyses

The outcome of interest was frequency of ALRI during the past two years. For most analyses, this was aggregated into: infected and noninfected.

Many univariate methods (histograms, normal probability plots, frequency tables, skewness, kurtosis, cross-tabulations, squared correlation coefficients, and simple linear or logistic regression analyses) were employed to assess the distribution of observations, to verify the appropriateness of regression assumptions, to provide an understanding of some of the relationships between variables, to detect collinearity between variables, and to select the variables suitable for inclusion in multivariate analyses. For instance:

1. Normality distribution was assessed by either a statistical or graphical method. Frequency histograms and normal probability plots are important graphical devices for assessing normality. There are two statistical components to normality, the skewness and kurtosis. In a normal distribution, the values of skewness and kurtosis must be zero. Data transformations, such as the logarithm and square root, may be used as a remedy for deviation from normality. If normality was not achieved, categorization of the continuous variables was performed.

2. The assumption of linearity is that there is a straight linear relationship between two variables. Linearity can be diagnosed from inspection of bivariate scatterplots between pairs of variables.

3. For a continuous explanatory variable, the T-test was employed to assess the significance of observed difference in means between the infected and non-infected groups. The level of significance was set at the 5% level (Fleiss, 1973; Kleinbaum et al., 1982).

For a categorical explanatory variable, the relative risk (RR) was used to measure the degree of association between the outcome and predictor. The likelihood ratio Chi-square X^2 was performed to assess the significance of RR. The level of significance was set at the 5% level (Fleiss, 1973; Kleinbaum et al., 1982).

All univariate analyses were calculated using SAS Software Computer package.

3.9.6 Multivariate Analyses

The main objective of multiple logistic analysis is to examine the interrelationship and association of the variables believed to influence and indicate the occurrence of ALRI. However, outlier and collinearity analyses were first performed.

3.9.6.1 Outliers

An outlier is any rare or unusual observation appearing at one of the extremes of the data range. The method of Cook and Weisberg of multiple linear regression analysis was used to assess outliers. Cook's distance measures the influence of an observation, i.e., it measures the magnitude of changes in the regression coefficients of predictor variables by deleting a particular observation (Kleinbaum et al., 1988). Cook's distance is assessed for every observation. The 50-percentile critical value of 0.94 of the F distribution for Cook's distance was used to identify the outlier(s).

3.9.6.2 Collinearity

Collinearity concerns the relationship between an independent variable and other independent variables included in the multiple regression model. The squared multiple correlation coefficients of the independent variables are used to measure collinearity.

Multiple linear regression between the outcome variable and a set of independent variables was fitted, and the squared multiple correlation coefficients of predictors were determined. A squared multiple correlation value of one indicates a perfect collinearity between the predictor and the others included in the model while a value near one indicates near collinearity. Kleinbaum et al. (1988) suggested that a squared multiple correlation larger than 0.90 can be taken to indicate collinearity.

In cases of collinearity, Kleinbaum et al. (1988) recommended (1) centralization of the variables or (2) elimination of redundant variables. Both outliers and collinearity analyses were assessed by subroutines of the SAS software computer package.

3.9.6.3 Multiple logistic regression

Multiple logistic regression analysis expresses the logistic function of an outcome as a linear function of a set of independent variables. In other words, it expresses the logit of probability of respiratory infection as a linear function of a number of predictor factors (Schlesseman, 1982).

$$\text{Logit (p)} = a + b_1x_1 + b_2x_2 + ... + b_kx_k$$

Multiple logistic regression is used to select the interactive effects and a suitable model able to explain changes in the odds of ALRI.

For interaction analyses, the initial model included all main effects (independent variables) believed to influence and predict ALRI. The model was refitted with all main effects and one first-order interactive effect. The analysis proceeded by substituting one interactive effect with another one until all first-order interactive effects are tested. The likelihood ratio test between the initial model and every model containing all main effects and one of the interactive effects was used to select the interactive effects for further consideration. The likelihood ratio test tests whether the addition of a particular interactive effect to the initial model contributes to the prediction of the odds of ALRI. The level of significance is set at the 5% level.

A backward elimination is employed to select the best-fitting model which describes the relationship of the outcome and a set of predictor factors. The initial model consists of all main and interactive effects. The resulting logistic table provided a summary of multiple logistic analyses and Z-ratio (standardized or normal deviate ratio) for every effect in the model. A Z-ratio tests whether addition of a particular effect, already given others in the model, contributes to the prediction of the odds of ALRI. The effect with the smallest Z-ratio was removed and the model is refitted with the remaining main and interactive effects. The analysis had proceeded by deleting effects one at a time until the best-fitting model is reached. The adequacy of fit of a given model was assessed by both the likelihood ratio test and goodness of fit chi-square.

The likelihood ratio test determines whether the inclusion of a particular effect contributes to the prediction of ALRI. In other words, the test assesses whether the fit of a given model, compared to another model, is adequate. The level of significance is set at the 5% level.

The goodness of fit chi-square test assesses whether a certain model fits the data adequately. A small P-value indicates that the given logistic model may not be the best fitting model.

Multivariate analyses were performed by using a subroutine of the BMDP LR software computer package.

PART 4

RESULTS

4.1 Study Population

In 1990, a total of 438 children and adolescents in the eight Keewatin communities were randomly selected as representatives of the Inuit population 0 to 15 years of age for the KHSA Survey.

The same 438 children and adolescents were selected to be the population for the current study. However, a total of 22 children were excluded from the survey. Of these, 13 were Inuit who moved out of the Keewatin Region, and 9 were Non-Inuit. No information was collected for all excluded 22 children and adolescents.

The remaining 416 children and adolescents were invited to take part in the current study. Four hundred (96%) participated.

It is worth mentioning that the forthcoming parts of the dissertation are based on the age of children at the end of the study period (October, 1992). Hence, the study population included 400 subjects aged 2 to 17 years of which 266 (66.5%) were children aged 2-11 years, and 134 (33.5%) were adolescents aged 12-17 years.

4.2 Outcome Variable

The outcome variable included all medically diagnosed episodes of ALRI during the period from October, 1990 to October, 1992 for each selected child and adolescent.

All respiratory illness episodes identified by either a nurse or a physician as pneumonia, bronchitis, bronchiolitis, or ALRI which had occurred in the past two years within the child's study population were documented.

Figure 4.1 shows a positive skewed frequency distribution of ALRI. Univariate analysis shows a skewness of 3.57 (Z= 29.17, p= 0.000) and a kurtosis of 16.25 (Z= 66.32, p= 0.000).

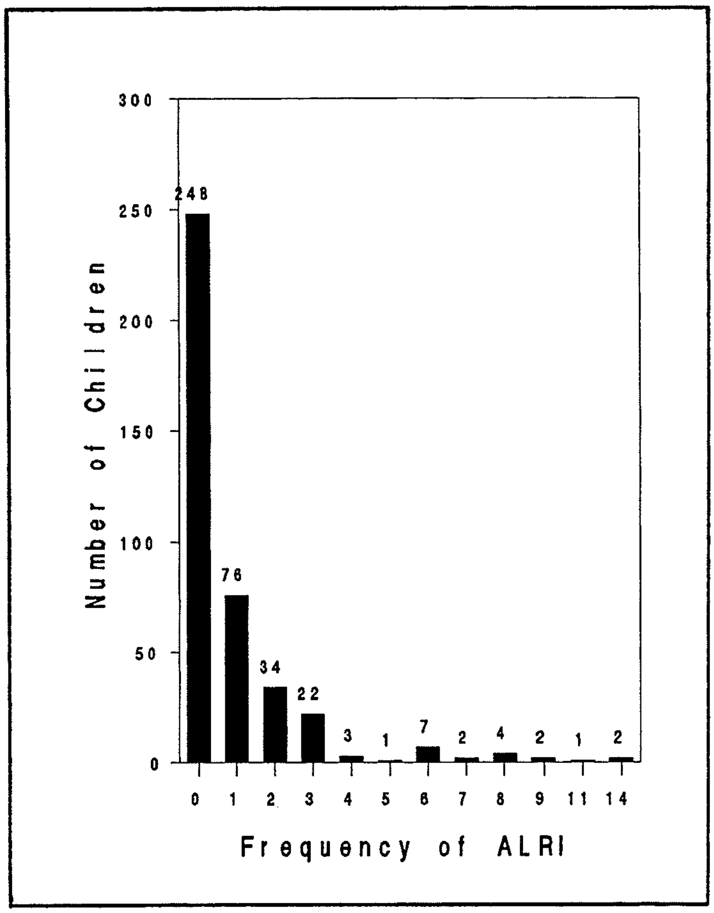


Fig 4.1: Frequency of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992

Moreover, neither a logarithm nor square root transformation of the frequency of ALRI normalize its distribution, and the values of skewness were 1.40 (Z= 11.46, p= 0.000) and 1.34 (Z= 10.96, p= 0.000), while the values of kurtosis were 1.38 (Z= 5.62, p= 0.000) and 1.38 (Z= 5.66, p= 0.000) respectively. Therefore, categorization of the outcome variable would be appropriate.

The figure suggests that multi-level classification of the outcome could not be used because of the expected null or small frequency of children in the cells of some categories in multiple variate analysis. Tabachnick and Fidell (1989) have reported that inadequate expected frequencies can lead to a drastic reduction of study power and, therefore, the results become worthless. Moreover, reduction of power becomes notable as expected frequencies for two-way associations drop below five in some cells (Milligan, 1980). Hence, the outcome variable was classified into the following two categories:

1. The infected group included children and adolescents who had one or more episodes of ALRI during the past two years, i.e., during the period of October, 1990 to October, 1992.
2. The uninfected category included children and adolescents who had no episode of ALRI during the same period of time.

The outcome categories, infected and uninfected, could not be classified into "confirmed" and "unconfirmed" because the medical diagnosis of ALRI was not confirmed by the laboratory isolation of the microbiological agent nor the radiological chest report in the nursing health centers of the Keewatin communities.

Hospitalization due to ALRI was considered another potential candidate for the study outcome. However, only 13 participants had discharge diagnosis of ALRI between October, 1990 and October, 1992

4.3 Comparison of Participant and Non-Participant

A total of 416 children and adolescents were invited to take part in the current study with 400 (96%) participating. The similarity of the two categories "participant and non-participant" was assessed on the outcome variable (the occurrence of ALRI in the past two years), and some of the factors believed to influence the occurrence of the outcome variable.

The attack rate of ALRI for the Inuit children and adolescents of the Keewatin Region during the period October, 1990 to October, 1992 was 39% whether non-participants were included (162/416) or not (155/400).

Table 4.1 reveals the results of comparative analysis between the participant and non-participant children and adolescents. The two groups were similar with respect to these variables: occurrence of ALRI in the past two years, age, sex, history of ALRI in the first two years of life, history of otitis media in the past two years, history of tuberculosis infection and disease, and history of asthma, whereas they differed in the variable community (the Mantel-Haenszel chi-square= 22.88, df= 7, p=0.002).

Ten out of the 16 non-participant children and adolescents did not take part since they had moved within the Inuit communities of Keewatin Region while the care-takers of the remaining 6 refused to be interviewed. The later 6 people were residents of one community, Rankin Inlet.

Table 4.1 Comparison of Participant and Non-Participant Children and Adolescents

Variable	Category	Response (row%)	No Response (row%)	P
Episodes of ALRI in Past Two Years	0	245 (61%)	9 (56%)	0.80
	1+	155 (39%)	7 (44%)	
Age	2-11 yrs	266 (66%)	13 (81%)	0.28
	12-17 yrs	134 (34%)	3 (19%)	
Sex	Male	187 (47%)	9 (56%)	0.61
	Female	213 (53%)	7 (44%)	
Episodes of ALRI in Early Infancy	0	49 (12%)	0	1.23
	1+	359 (88%)	15 (100%)	
Otitis Media in Past Two Years	0	170 (42%)	8 (50%)	0.61
	1+	230 (58%)	8 (50%)	
Current History of Asthma	Yes	12 (3%)	1 (6%)	0.40
	No	388 (97%)	15 (94%)	
Tuberculosis Infection	Yes	19 (5%)	0	1.00
	No	381 (95%)	16 (100%)	
Tuberculosis Disease	Yes	4 (1%)	0	1.00
	No	396 (99%)	16 (100%)	
Community	Whale Cove	11 (3%)	0	0.00
	Chester	21 (5%)	3 (19%)	
	Coral H.	39 (10%)	0	
	Repulse B.	44 (11%)	0	
	Sanikiluaq	47 (12%)	1 (6%)	
	Arviat	76 (19%)	1 (6%)	
	Baker Lake	76 (19%)	1 (6%)	
	Rankin I.	86 (21%)	10 (63%)	

The personal relationship of the interviewer with the local residents may have played an important role in persuading them to take part in the survey. In fact, one of the two interviewers was a new resident of Rankin Inlet. The lack of familiarity with the interviewer may have contributed to the higher rate of refusal in the community.

Tabachnick and Fidell (1989) suggested that if there are no statistical differences in the variable(s) of interest between the participants and non-participants, decisions about how to handle the missing data are not so critical. They added that if only a few cases have missing data and they seem to be a random subsample of the whole sample, a good alternative procedure for handling missing values is deletion. All 16 non-participant children and adolescents were excluded from further analyses because: (1) the incidence of ALRI in the past two years among the children and adolescents was identical whether non-participants were included or not, (2) the occurrence of ALRI was similar among participants and non-participants, (3) the participants and non-participants were similar on some of the variables believed to influence the occurrence of ALRI, (4) the study sample size was moderate to large, and (5) the size of the non-participant group was small (4%).

4.4 Comparison of the 1990 and 1992 Survey's Data

Four variables (age, sex, total number of people living in the household where the study child lived, and total number of children living in the household where the study child lived) were used to compare the data of the 1992 Follow-up Respiratory Survey with that of the 1990 KHSA Survey.

There were high agreements between:

1. The date of birth collected during the individual interviews of the child care-takers in 1992 and that collected from the medical records at the same year

(r=0.99, percent agreement= 96%).

2. The date of birth collected during the personal interviews of the child care-takers in 1992 and that collected during the 1990 KHSA Survey (r=0.97).
3. The sex of the child which was gathered from the child care-takers in 1992 and that gathered from the medical records in the same year (r=0.99, percent agreement=98.5%).
4. The sex of the child which was gathered from the child care-takers in 1992 and that gathered in the KHSA Survey (r=0.91, percent agreement=95%).
5. The number of people living in the household that was recorded during the personal interviews with the child care-takers in 1992 and that gathered in the 1990 KHSA Study (r=0.70, percent agreement=31%). However, the number of persons in the dwelling is not static, and hence varies with time. When the number of individuals was allowed to vary by two (±2) during the period 1990 to 1992, percent agreement increased to 85%.
6. The number of children living in the household collected from the child care-takers in 1992 and that collected in the 1990 KHSA Survey (r=0.70, percent agreement=37%). Obviously, the number of children in the dwelling also varies with time. When the number of children was allowed to vary by two (±2) during the period 1990-1992, percent agreement increased to 91%.

4.5 Incidence of Acute Lower Respiratory Infections

Both the cumulative incidence and incidence rate were used to measure the disease occurrence. The overall cumulative incidence of ALRI for the children and adolescents of the Keewatin Region during October, 1990 to October, 1992 was 39% (155/400). The age-specific incidence were 47% and 21% for children aged 2 to 11 years and teenagers 12 to 17 years respectively (Likelihood Ratio $X^2 = 26.37$, DF = 1, p = 0.000). The sex-specific incidence were 41% and 36% among males and females respectively (Likelihood Ratio $X^2 = 0.84$, p = 0.36). Finally, the community-specific incidence are shown in Figure 4.2 (Mantel-Haenszel $X^2 = 32.29$, DF = 7, p = 0.000).

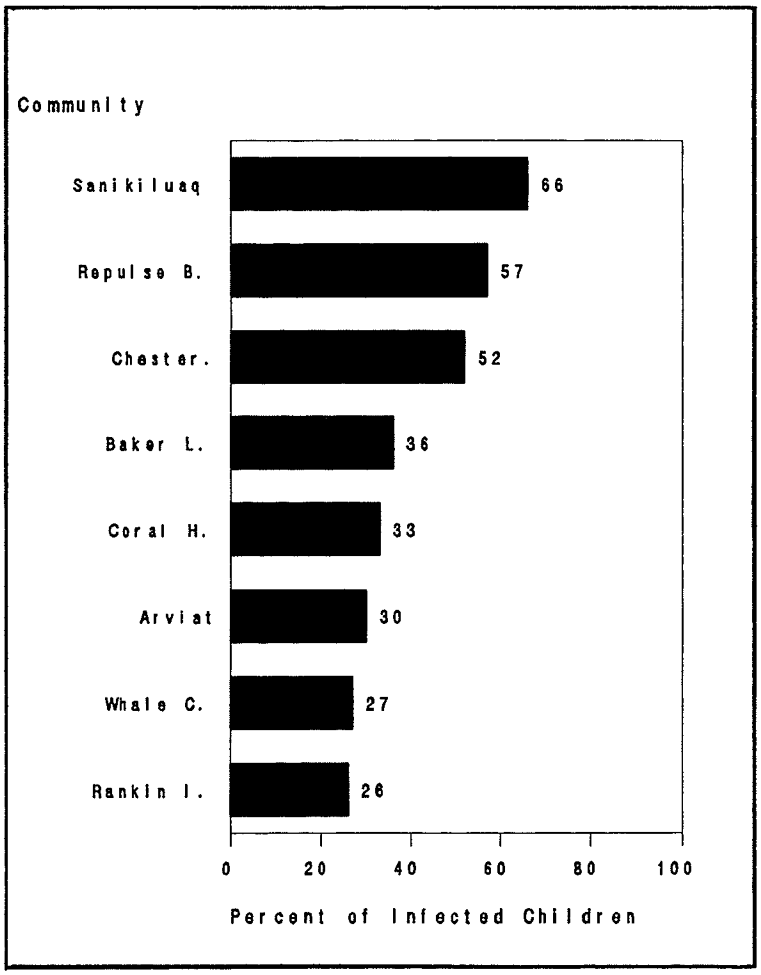


Fig 4.2: Incidence of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992, by Community

The overall mean incidence rate of ALRI was 48 (384/800) cases per 100 child-years at risk. Figure 4.3 shows the age-specific mean incidence rates of ALRI. The highest incidence rates were observed among infants aged 2 years. With increasing age, the mean incidence of ALRI declined. For children aged 2-5, and 6-11, and adolescents 12-17 years, the mean incidence rates were 116, 28 and, 14 attacks per 100 child-years at risk respectively.

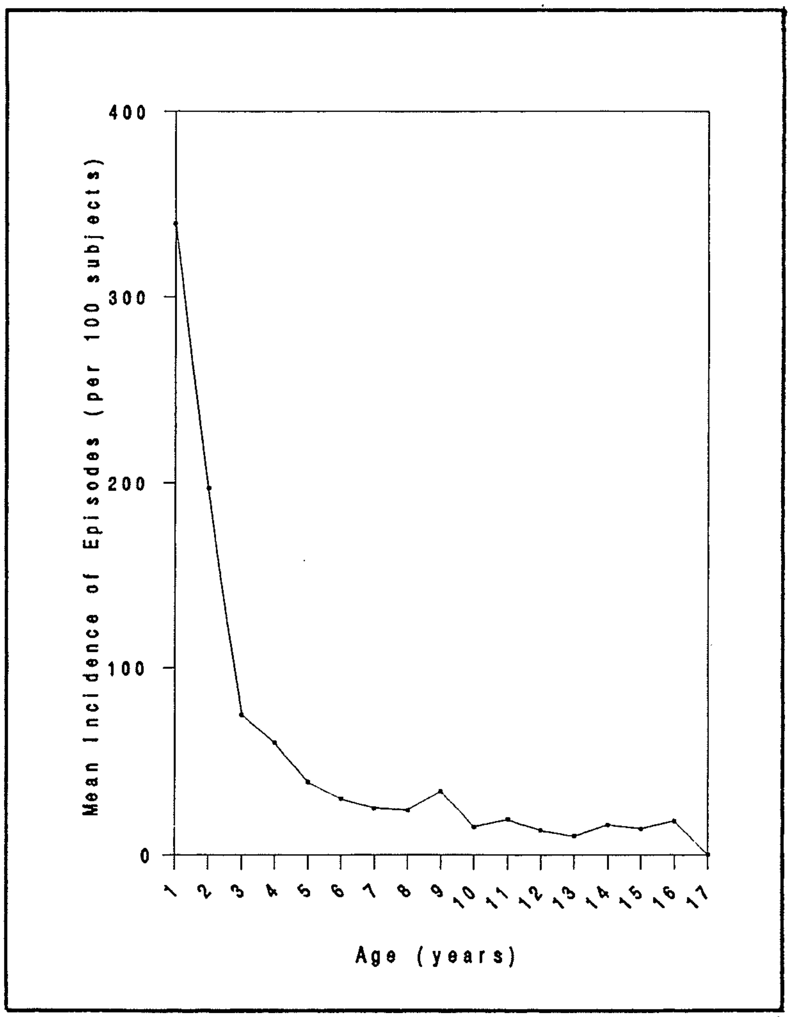


Fig 4-3: Age-Specific Mean Incidence of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992.

The hospitalization rate for ALRI was 3.5% (14/400) during the study period from October, 1990 to October, 1992. It should be said that the hospitalization cases included the participants who were discharged from the Churchill Health Center or a tertiary hospital with the diagnosis of ALRI. Moreover, hospitalization admission to more than one hospital for the same episode of ALRI was coded once.

4.6 Time Trend of Acute Lower Respiratory Infections

The cumulative incidence of ALRI among the participants were 31% and 20% for the periods of October, 1990 to September, 1991 and October, 1991 to October, 1992 respectively. The Likelihood Ratio X^2 of 13.9 (DF= 1 ,p= 0.00) indicated that children and adolescents were at a significantly higher risk for ALRI during the period 1990-91 than during 1991-92. However, the two annual incidence can not make an informative pattern of infection occurrence in time in order to assess whether an epidemic of ALRI had occurred during the period from October, 1990 to September, 1991. Nevertheless, the following descriptive analyses may suggest its occurrence:

1. When the children 4 years old and younger were excluded, the cumulative incidence decreased to 19% and 13% for the periods 1990-1991 and 1991-1992 respectively. Moreover, the difference between the two incidence became "not significant" (likelihood Ratio X^2=4.41, DF=1, p=0.05).
2. The incidence rates for the periods 1990-91 and 1991-92 were 64 (255/400), and 32 (127/400) cases of ALRI per 100 child-years respectively.
3. Figure 4.4 reveals the annual cumulative incidence of ALRI for children two

years old and younger from 1976 to 1990. The incidence was high in 1990.

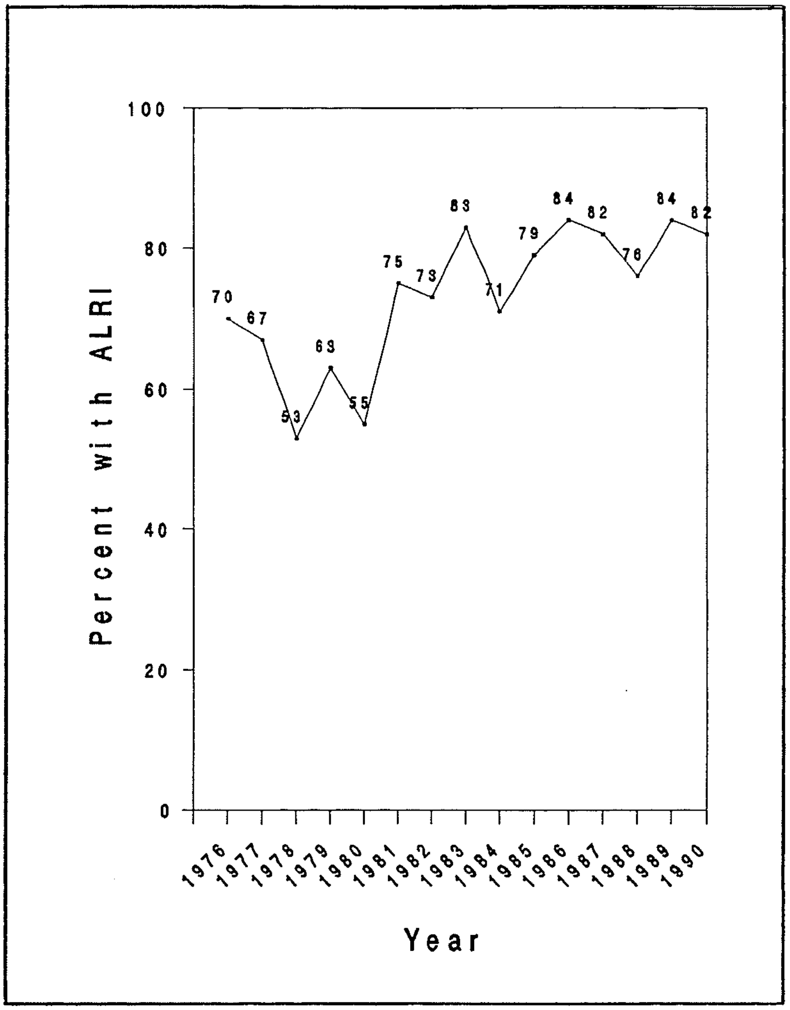


Fig 4-4: Incidence of Acute Lower Respiratory Infection Among Children Aged 1 to 2 years for the Period 1976 to 1990

4. Figure 4.5 reveals the community-specific cumulative incidence of ALRI for the periods 1990-91 and 1991-92. For all hamlets except Coral Harbor, the community-specific incidence for the period 1990-91 were higher than those

for the period 1991-92. Within each hamlet, the differences between incidence of the two periods were significant for Sanikiluaq (Likelihood Ratio $X^2=7.3$, $DF=1$, $p=0.007$), Rankin Inlet (Likelihood Ratio $X^2=6.3$, $DF=1$, $p=0.01$) and Repulse Bay (Likelihood Ratio $X^2=5.8$, $DF=1$, $p=0.02$), while the differences were not significant for the other five communities.

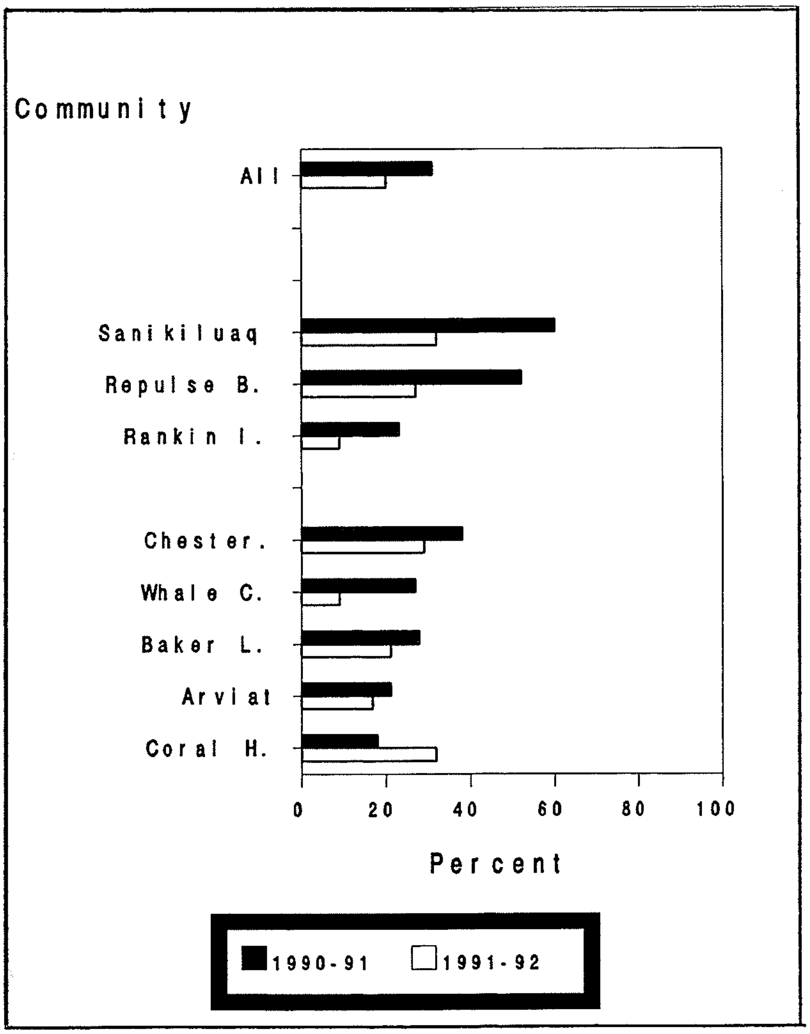


Fig 4-5: Community-Specific Incidence of Acute Lower Respiratory Infection For the Periods of October, 1990 to September, 1991 and October, 1991 to October, 1992

4.7 Anthropometric Indices

Of the 400 participants, 2 (0.5%) had no height measurements, 1 (0.3%) had no weight measurement, and 4 (1%) were outliers. These were deleted, as their values were presumed to represent incorrect data entry (for example, a fourteen years old girl with a height of 99 cm, and weight of 15.2 kgs).

Table 4-2 reveals the distributions of height-for-age Z-scores (HAZ) for all participants and weight-for-height Z-scores (WHZ) for only children (participants who were aged 11 years and younger in 1990).

Table 4.2 Observed and Expected Distribution of Standard Deviation Scores of Height-for-Age (HAZ) of Participants Aged 2-17 years and Weight-for-Height (WHZ) of Participants Aged 2-11 years

SD Score	Obs. HAZ*	Obs. WHZ*	Expected**
≤ -2 SD	62 (16%)	1 (.4%)	2.3 %
-1.99 TO -1.00 SD	92 (23%)	0 (0%)	13.6 %
-0.99 TO 0.99 SD	213 (54%)	72 (21%)	68.2 %
1.00 TO 1.99 SD	22 (6%)	83 (25%)	13.6 %
≥ 2 SD	4 (1%)	181 (53%)	2.3 %
Total	393	337	

* Adopted from Waterlow classification (Waterlow et al., 1977)
** Based on Values of Standard Deviations Above and Below the NCHS Medians

The distribution of HAZ was skewed to the left of the normal distribution of a reference population with 40% of the children and teenagers ≤ -1 SD as compared to the expected value of 15.9%, while the distribution of WHZ was shifted to the right with 78% of the children ≥ 1 SD as compared to the expected value of 15.87% (Figure 4.6).

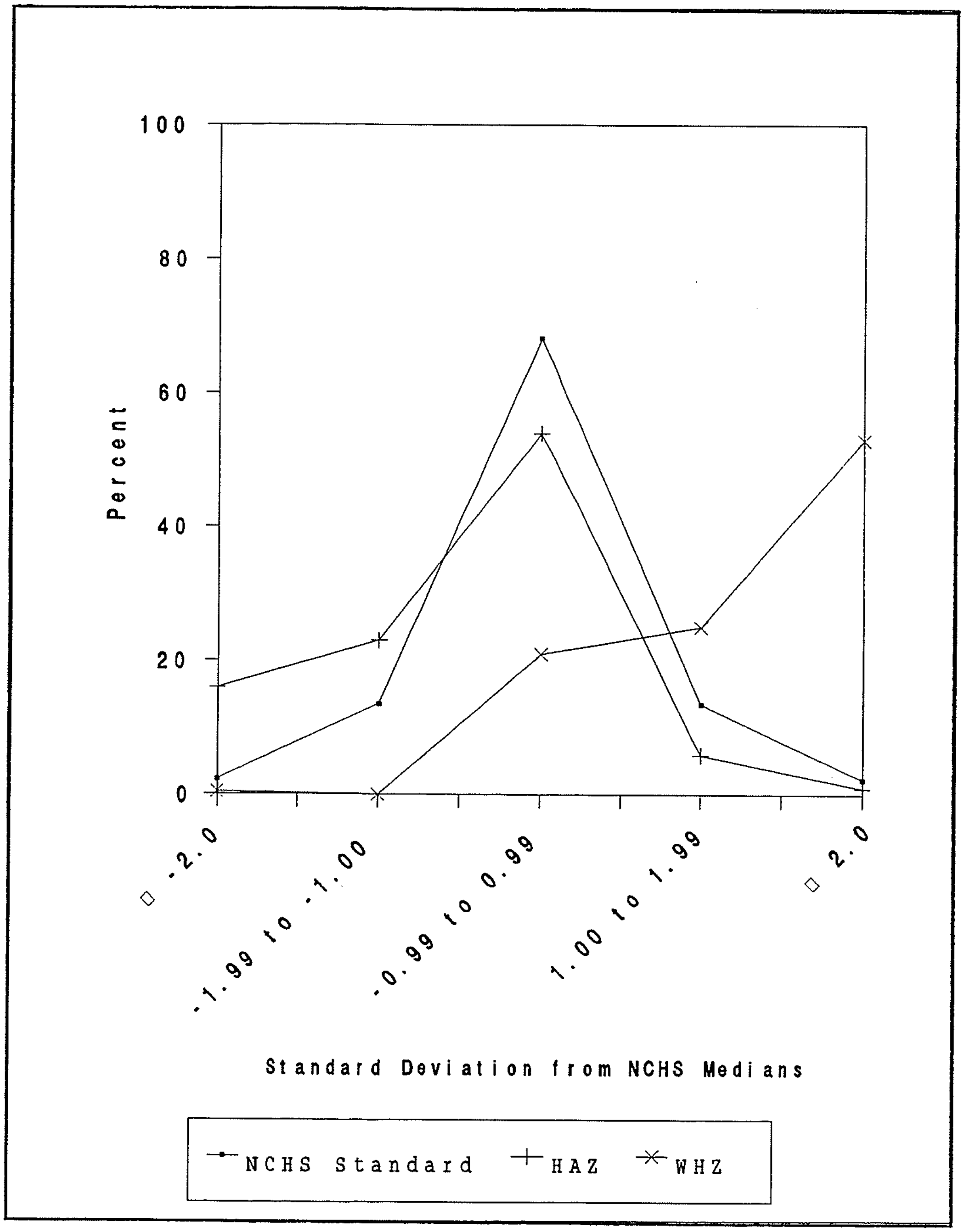


Fig 4-6: Standard Deviation Scores of Height-for-Age (HAZ) of Participants Aged 2-17 years and Weight-for-Height (WHZ) of Participants Aged 2-11 years

Table 4.3 represents the classification of nutritional status proposed by Waterlow et al. in which the independent distributions of HAZ and WHZ of the children 2-11 years old in 1990 were combined in a cross tabulation.

When ≤ -2 SD of the reference median is employed as a cutoff point for undernutrition in relation to both indicators, no child was found to be both stunted and wasted. On the other hand, when high WHZ (≥ 1 SD) was considered as overnutrition, a large number of children, i.e., 266 (78%), fell into this category; 182 (53%) of these children could have been considered obese (WHZ ≥ 2 SD), and the remaining 84 (25%) appeared to be overweight (1 to 1.99 SD).

Table 4.3 Cross Tabulation of Weight-for-Height (WHZ) and Height-for-Age (HAZ) for Children Aged 2 to 11 years

SD Score of WHZ	SD Score of HAZ (%)					Total
	≤ -2	-1.99 to -1.00	-0.99 to +0.99	1.00 to 1.99	≥ 2	
≤ -2	0	1(.4%)	0	0	0	1
-1.9 - -1	0	0	0	0	0	0
-0.9 - 0.9	6(9%)	12(18%)	52(71%)	2(3%)	0	72
1.0 - 1.9	4(5%)	24(29%)	52(63%)	1(1%)	2(2%)	83
≥ 2	41(23%)	33(18%)	88(48%)	17(9%)	2(1%)	181
Total	51	70	192	20	4	337

4.8 Univariate Analysis

4.8.1 Factors Influencing the Incidence of Acute Lower Respiratory Infections

There were many variables believed to influence the occurrence of ALRI and for which a significant association was found. These included:

1. **Age**

Age was inversely related to the incidence of ALRI in the past two years ($r = -0.43$, $p = 0.0001$). Hence, the occurrence of ALRI was stratified by age (Figure 4.7).

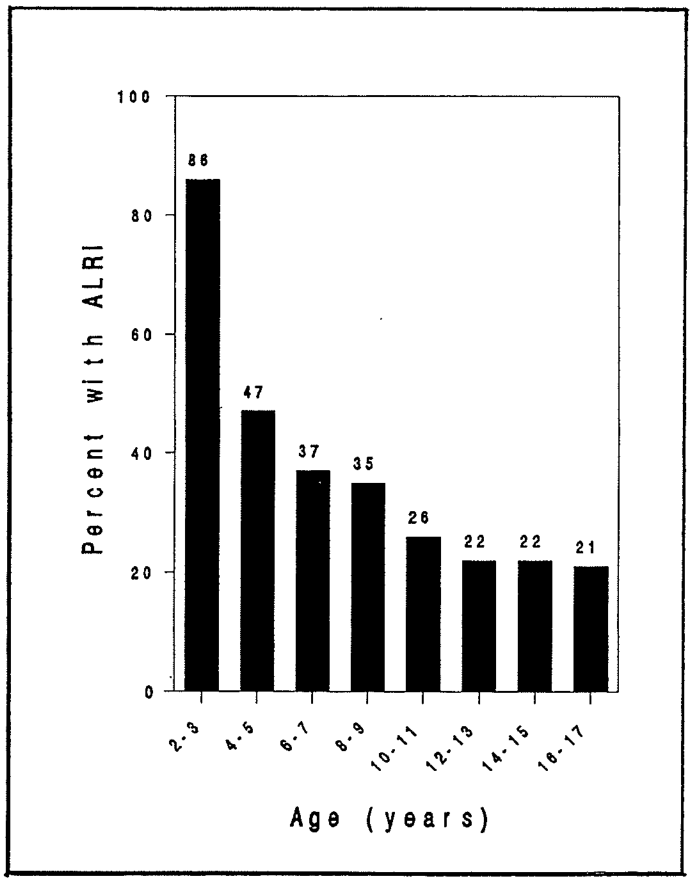


Fig 4-7: Age-Specific Incidence of Acute Lower Respiratory Infection During the Period of October, 1990 to October, 1992

Testing for a relation between the incidence of ALRI and the various age categories, it was found that the proportions differed significantly (Likelihood Ratio

$X^2=85.0$, DF= 15, $p=0.000$). One would next proceed to identify the age categories which contributed to the significant difference. The age variable was classified, on the basis of the proportion similarity of the age categories, into three age groups:

1. group 2 to 3 years old (Likelihood Ratio $X^2=0.49$, DF=1, $p=0.48$);
2. group 4 to 10 years old (Likelihood Ratio $X^2=4.86$, DF=6, $p=0.56$); and
3. group 11-17 years old (teenagers) (Likelihood Ratio $X^2=3.37$, DF=6, $p=0.76$).

Using adolescents as a reference category, Table 4.4 showed that the incidence of respiratory infection declined from almost 400% to 120% as the age increased from 2 - 3 to 4 - 10 years.

Table 4.4 Relative Risk of Acute Lower Respiratory Infection During the Period of October, 1990 to October, 1992, by Age

Age (yrs)	N*	Proportion of Infected	Relative Risk	95% Confidence Limits	
11-17	158	22%	1.00	-	
4-10	186	39%	1.75	1.24	2.46
2-3	56	86%	3.87	2.83	5.28

* Number of Individuals in each Category

2. Community

The participants of both Sanikiluaq and Repulse Bay appeared to have higher proportions of ALRI during the past two years than those of other communities (Figure 4.2). Hence, the eight original communities were categorized into three categories.

One category included Sanikiluaq, N=47 (11.75%), the second Repulse Bay, N=44 (11%), and the third one included the other six communities, N=309 (77.25%). The incidence of ALRI were 66% for Sanikiluaq, 57% for Repulse Bay, and 32% for the other 6 communities combined. The RR of 2.1 (95%CI= 1.58-2.68) for Sanikiluaq and 1.8 (95%CI=1.31-2.41) for Repulse Bay compared to the remaining six communities indicated highly significant differences in risk for ALRI between Sanikiluaq and Repulse Bay on one hand and the other 6 hamlets combined on the other hand. However, there were no significant differences between the proportions of the other six communities (Likelihood Ratio X^2= 6.09, DF=5, p=0.30).

3. Duration of Residence in Current Household

The incidence of ALRI during the past two years was inversely correlated to the duration of living in the current household (r= -0.18, p=0.003). Fig 4.8 shows that the incidence of ALRI increased steadily from 37% among the participants living in their current household 1 to 2 years to 58% among those living 3 to 5 years, and hence the incidence declined to 17% for those living 12 to 17 years in the household (Likelihood Ratio X^2=34.80, DF=3, p=0.000) (Figure 4.8).

Using the category of living 12 to 17 years in their current household as a reference group, the RR of ALRI was 1.78 (95%CI=0.94 -3.36) for participants living 6-11 years, 3.41 (95%CI=1.90-6.11) for those living 3-5 years, and 2.21 (95% CI=1.20-4.14) for those living 2 years or less in their current household.

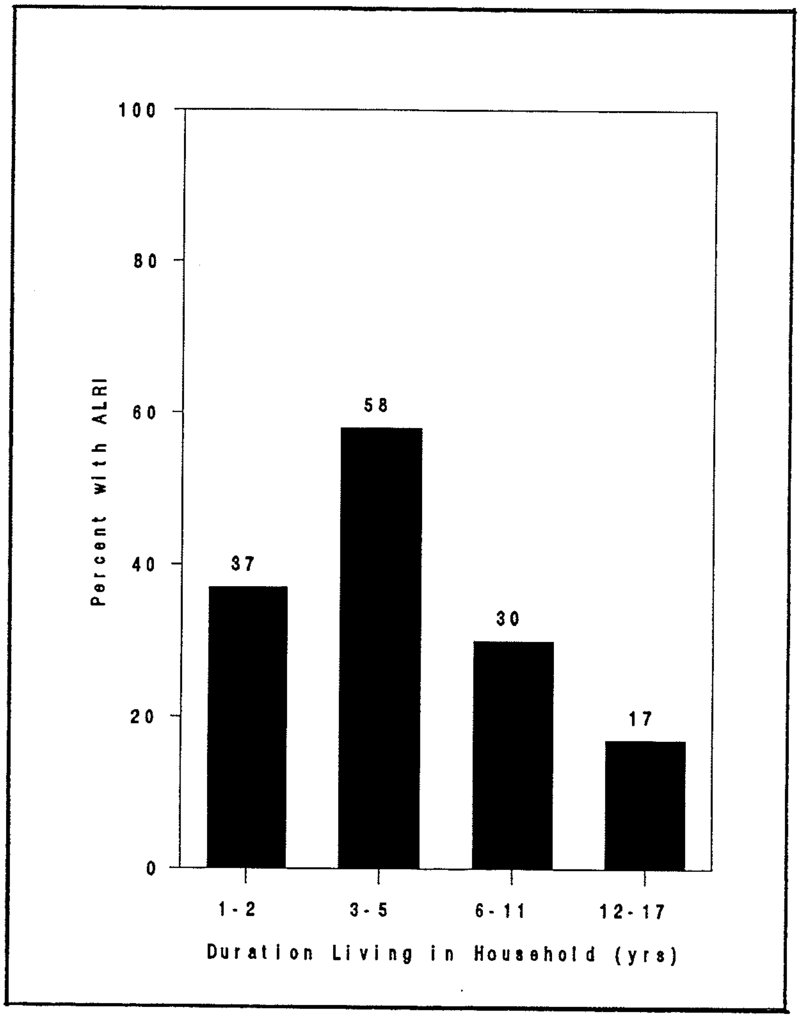


Fig 4-8: Incidence of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992, by Duration of Living in the Current Household

4. Presence of Soapstone Carving

Out of the 400 participants, 23% had a history of a household member carving soapstones. The incidence of ALRI was 52% for those who had such a history, and 35% for those who did not (Likelihood Ratio $X^2 = 8.34$, DF= 1, p= 0.004). The RR of 1.49 (95%CI= 1.2-1.9) indicated a 49% higher significant occurrence of ALRI among the participants with a history of a household member carving soapstone than among those who did not.

The participants with a history of carving soapstones can be classified according to the place where such activity takes place into: inside, outside, or both inside and outside the household. Each of these groups had higher proportions of ALRI during the past two years than those with no history of household member carving soapstone (Likelihood Ratio $X^2 = 8.98$, $DF = 3$, $p = 0.03$) (Table 4.5).

Table 4.5 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Place of Carving Soapstone

Place for Carving Soapstones	N*	Observed of Infected (%)	Expected of Infected
No Carving	314	110 (35%)	122
Inside House	12	7 (58%)	5
Outside House	46	25 (54%)	18
In & Outside House	28	13 (46%)	11
Total	400	155 (39%)	

* Number of Individuals in each Category

5. School Attendance

The proportions of ALRI in the past two years were 14%, 31%, and 68% for participants who attended day-care centers, regular schools, and who did not attend schools respectively (Table 4.6). However, only a small number of children attended day-care centers.

Table 4.6 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by School Attendance

School Attendance	N*	Number Infected (%)
Day Care Center	7	1 (14%)
Regular School	303	93 (31%)
No	90	61 (68%)
Total	400	155 (39%)

* Number of Individuals in each Category

The school attendance variable was reclassified into: (1) "School Attendance", including participants who attended day-care centers and regular schools, N= 310 (78%), and (2) "No School Attendance", N= 90 (22%). The incidence of respiratory infection were 30% and 68% for participants who attended school and those who did not attend respectively. (Likelihood Ratio X^2= 40.54, DF= 1, p= 0.000). The direction of the relationship between occurrence of ALRI and school attendance was opposite to that expected. Therefore, one would next proceed to control for one or more variables which may have contributed to this unexpected relationship.

Investigation of the raw data showed that the study subjects can be classified into three groups:

1. The "Pre-school Group" included children aged 2-4 years. Only 17% (14/81) of these children attended a pre-school program in one of the eight hamlets (similar to a day-care center).
2. The "Child School Group" which included 161 children aged 5-10 years. Only one child did not attend school.

3. The "Adolescent School Group" which included 158 teenagers 11-17 years old. Of these, 86% attended schools, while the remaining 14% did not attend.

Table 4.7 is a cross tabulation between occurrence of ALRI in the past two years and school attendance, controlling for age. The table shows the following: (1) attending school did not influence significantly the risk for respiratory infections among adolescents (RR=0.78, 95%CI= 0.37 - 1.66), (2) almost all children aged 4-10 years attended school, and the incidence of infections was 37%, and (3) for pre-school children, attending school appeared to be protective against ALRI because the RR was 0.44 (95%CI= 0.22 - 0.90). However, the small number (17%) of young children who attended a pre-school program in one of the communities, and the high susceptibility of respiratory infections among young children may lead to the spurious relationship between the occurrence of ALRI and the variable "School attendance".

Table 4.7 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by School Attendance, Adjusting for Age

Age (years)	School Attendance	N*	Number Infected (%)
2-4	Yes	14	5 (36%)
	No	67	54 (81%)
5-10	Yes	160	60 (37%)
	No	1	1 (100%)
11-17	Yes	136	29 (21%)
	No	22	6 (27%)
	Total	400	155 (39%)

* Number of Individuals in each Category

6. First Child Care-Taker

Table 4.8 reveals the proportions of ALRI stratified by the first child care-provider. However, some categories included few children.

Table 4.8 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by First Child Care-Taker

First Child Care-Taker	N*	Number Infected (%)
Natural Mother	276	97 (35%)
Natural Father	4	0 (0%)
Adoptive Mother	99	50 (51%)
Adoptive Father	4	1 (25%)
Grand Mother	11	6 (55%)
Others	6	1 (17%)
Total	400	155 (39%)

* Number of Individuals in each Category

The various categories were combined into group (1) "Natural Parents" which included the natural mother and father categories, N=280 (70%), and group (2) "Others" which included the other four categories, N= 120 (30%). The proportions of ALRI were 35% and 48% in these two groups respectively. The RR of 1.40 (95%CI = 1.1-1.8) indicated that having been cared by individuals other than natural parents increased significantly the risk of ALRI by 40% (Likelihood Ratio $X^2=6.56$, DF= 1, p=0.01).

However, the relationship between the child care-provider and occurrence of

ALRI may be attributed to the effect of a confounding variable. In fact, when the variable of breast-feeding in infancy (breast-fed and not breast-fed) was adjusted for, the relationship between the two variables lost its statistical significance (Mantel Haenszel RR=1.04, 95%CI= 0.76-1.42) (Mantel-Haenszel $X^2=0.07$, DF=1, p=0.80).

7. Duration of Breast-Feeding in Infancy

Overall, 59% of mothers initiated breast-feeding, 12% breast-fed for 3 months or less, and 44% for 6 months or more.

The occurrence of ALRI during the past two years was inversely correlated to duration of breast-feeding in infancy (r= -0.15, p= 0.004). This is shown in Table 4.9.

Table 4.9 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992 by Duration of Breast-Feeding in Infancy

Duration Breast-Fed (Months)	N*	Proportion Infected
0	158	51%
1-6	73	36%
7-12	55	25%
13-18	14	29%
19-24	51	33%
25+	38	29%
Total	389	39%

N* Number of Individuals in each Category

The table also shows that study subjects can be divided into one group called "No Breast-Feeding", N= 158 (40.6%), and another group called "Breast-Feeding" composed of five subcategories with similar infection risks, N=231 (59.4%). The risk of ALRI was 51% for the former and 31% for the later group. The Likelihood Ratio X^2 of 15.9 (DF= 1, p= 0.000) (RR= 1.65, 95%CI= 1.3-2.1) indicated a statistically significant difference in the risk of ALRI between children who were and were not breast-fed in infancy.

There were no significant differences between the proportions of ALRI in the 5 categories of the Breast-Feeding Group (Likelihood Ratio X^2 = 1.77, DF=4, p=0.78).

At this point, a decision was made to determine whether there was an association between duration of breast-feeding and the occurrence of ALRI in early infancy (Table 4.10).

Table 4.10 Incidence of Acute Lower Respiratory Infection in the First Two Years of Life by Duration of Breast-Feeding in Infancy

Duration Breast-Fed (Months)	N*	Proportion Infected
0	158	89%
1-3	47	77%
4-6	26	81%
7-9	21	95%
10-12	34	85%
13-18	14	100%
19-72	89	87%
Total	389	87%

N* Number of Individuals in each Category

Eighty-seven percent of the participants had ALRI in the first two years of life. The incidence of ALRI in early infancy was 89% among the participants who were not breast-fed, and varied between 77% and 100% for those who did so. The Mantel-Haenszel X^2 of 8.93 ($DF = 6$, $p = 0.178$) indicated no influence of breast-feeding on the occurrence of ALRI in infancy.

8. Type of Milk Feeding in Infancy

The incidence of ALRI during the past two years increased from 30% for exclusively breast-fed participants, to 33% for breast and bottle-fed ones and to 51% for those bottle-fed alone (Figure 4.9).

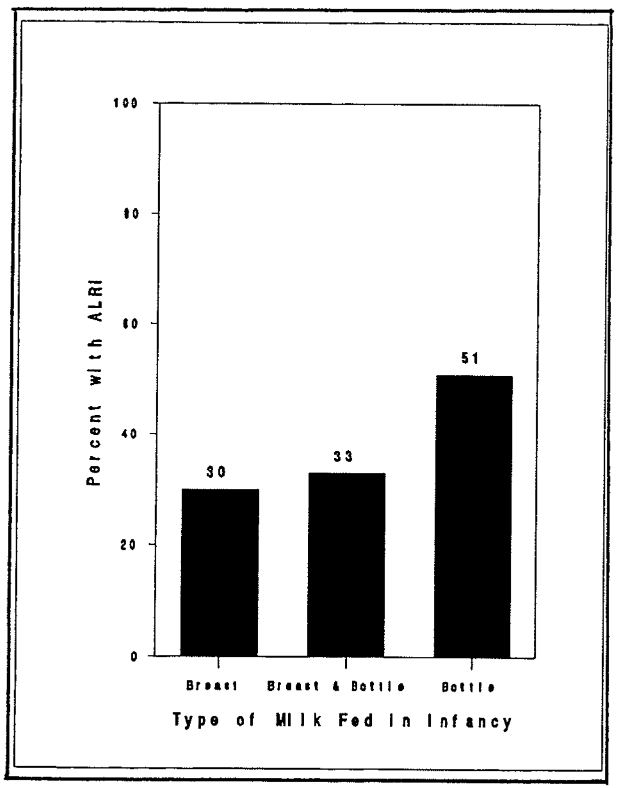


Fig 4-9: Incidence of Acute Lower Respiratory Infection During the Period of October, 1990 to October, 1992, by Type of Milk Fed in Infancy

There was a significant association between occurrence of ALRI and types of milk feeding (Likelihood Ratio $X^2 = 17.4$, DF=2, p=0.00). The bottle-fed category contributed to the significant difference:

1. There was no significant difference in the incidence of ALRI between exclusively breast-fed participants and those who were both breast and bottle-fed (RR=1.10, 95%CI= 0.74-1.63).
2. The risk for ALRI was 73% higher among the bottle-fed children and adolescents than for the breast-fed ones (RR=1.73, 95%CI= 1.31-2.29).
3. The risk was 39% higher among the bottle-fed participants than among those who were both breast and bottle-fed (RR= 1.39, 95%CI= 1.11-1.73).

9. Weight-for-height (WHZ)

Of the 400 participants, 84% had WHZ values. An inspection of the cross tabulation of the 5 SD score of WHZ and the occurrence of ALRI (Table 4.11) reveals that:

1. There was one child in the first category (i.e., ≤-2 SD).
2. None was found in the second category (i.e.,-1.99 to -1 SD).
3. There was a borderline statistical significant association between the three remaining categories and occurrence of ALRI (Likelihood Ratio $X^2 = 6.51$, DF=2, p=0.04).

Table 4.11 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Distribution of SD score of Weight-for-Height (WHZ) of the Participants Aged 2-11 yrs

SD Score of WHZ*	N**	Number Infected (%)
≤ -2 SD	1 (0.4%)	100%
-1.99 to -1.00 SD	0 (0.0%)	0%
-0.99 to 0.99 SD	72 (21.0%)	29%
1.00 to 1.99 SD	83 (25.0%)	46%
≥ 2 SD	181 (53.0%)	45%
Total	337	

* Adopted from Waterlow Classification (Waterlow et al., 1977)
** Number of Individuals in each Category

10. Acute Lower Respiratory Infection in Early Infancy

Frequency of ALRI in the first two years of life was directly related to the occurrence of ALRI in the past two years ($r = 0.49$, $p = 0.0001$). Hence, the occurrence of ALRI in the past two years was stratified by the frequency of ALRI in early infancy (Figure 4.10).

Testing for a relationship between occurrence of ALRI during the past two years and the different categories of ALRI in early infancy, it was found that the proportions differed significantly (Likelihood Ratio $X^2 = 50.9$, $DF = 5$, $p = 0.000$).

One would next proceed to identify the categories of ALRI in early infancy which contributed to the significant difference. The occurrence of ALRI during the past two years was stratified by the frequency of the same infections during the first two years of life (table 4.12).

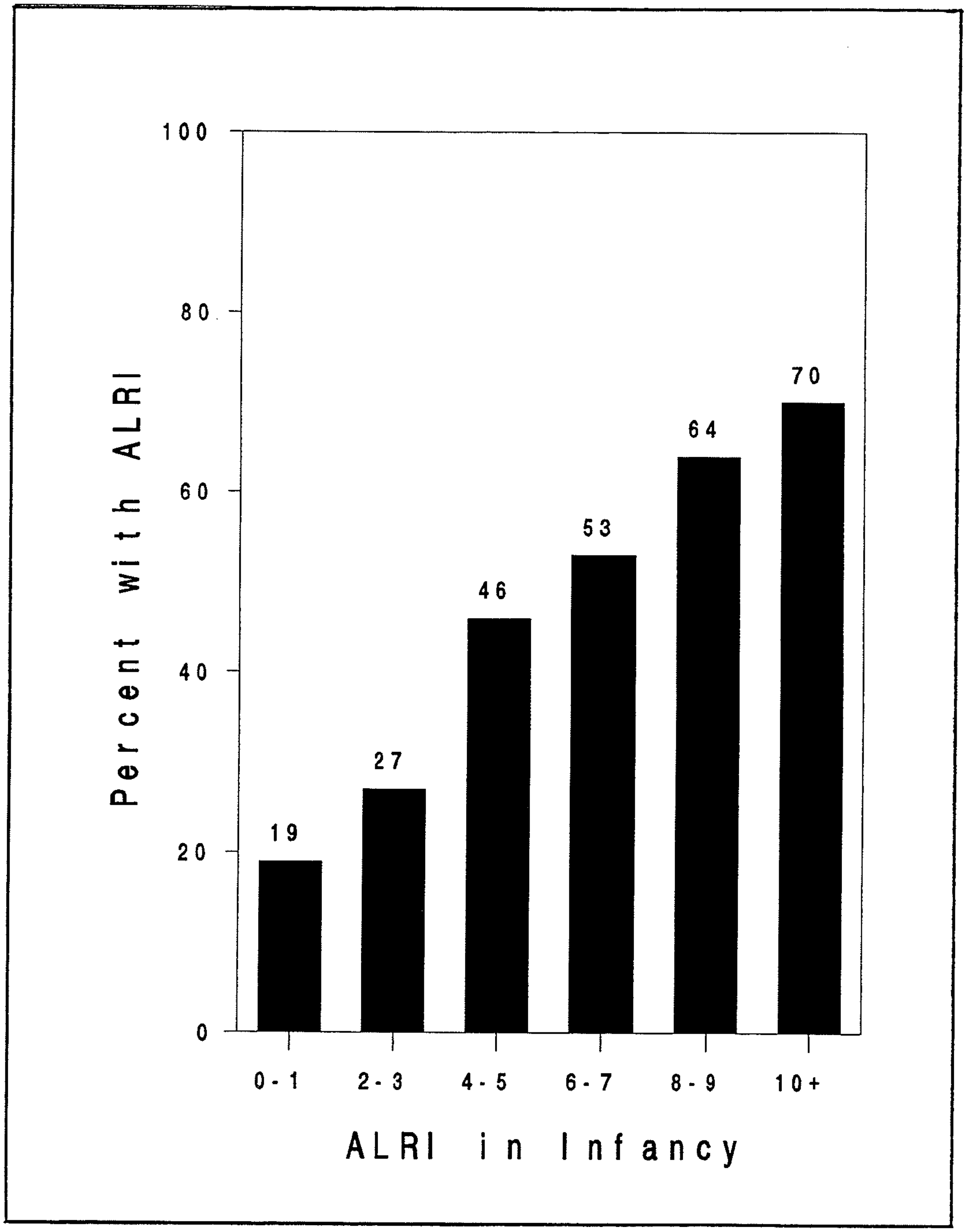


Fig 4-10: Incidence of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992, by Acute Lower Respiratory Infection During the First Two Years of Life

Table 4.12 Relative Risk of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Acute Lower Respiratory Infection in the First Two Years of Life

ALRI*	N**	Proportion of Infected	Relative Risk	95% Confidence Limits	
0-1	98	19%	1.00	-	
2-3	110	27%	1.41	0.85	2.33
4-5	80	46%	2.39	1.49	3.81
6-7	40	53%	2.71	1.64	4.46
8-9	25	64%	3.30	2.00	5.44
10+	40	70%	3.61	2.30	5.67

* Frequency of acute lower respiratory infection during the first two years of life

** Number of Individuals in each Category

Using the group 0-1 attacks of ALRI in early infancy, the risk ratio of ALRI in the past two years significantly enhanced steadily from 1.4 to 3.6 as the frequency of ALRI in infancy increased from 4-5 to 10 or more episodes.

11. Otitis Media

The occurrences of otitis media and ALRI in the past two years were directly related ($r=0.47$, $p=0.0001$). Hence, the occurrence of ALRI was stratified by the frequency of otitis media (Figure 4.11). Testing for a relationship between the incidence of ALRI and the different categories of otitis media, it was found the proportions differed significantly (Likelihood Ratio $X^2=38.81$, $DF=5$, $p=0.000$).

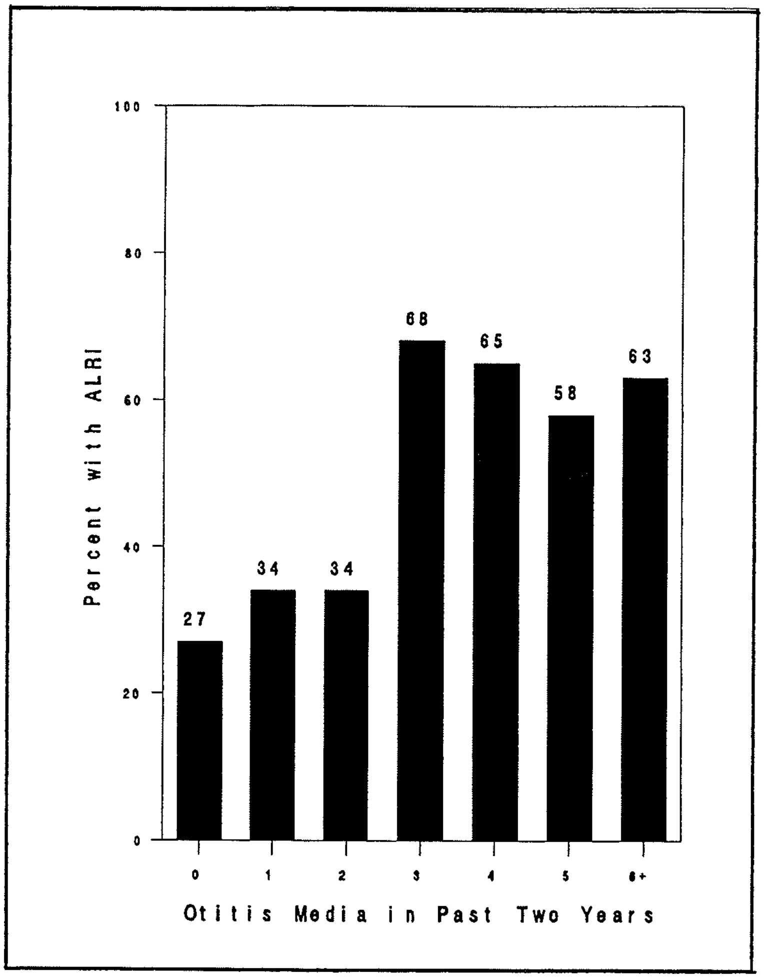


Fig 4-11: Incidence of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992, by Otitis Media in the Same Period of Time

On the basis of proportion similarity, the various categories of otitis media can be regrouped into three groups: (1) 0 attacks, (2) 1 to 2 attacks, and (3) 3 or more attacks of otitis media. The cumulative incidence of ALRI were 27% among the participants with 0 attacks of otitis media, 34% for those with 1-2 attacks, and 64% for those with 3 or more attacks. Using the category 0 attacks of otitis media as a reference, the risk ratio of ALRI was 1.26 (95%CI = 0.89-1.78) for the children and adolescents with 1-2 episodes of otitis media during the past two years, and 2.38 (95%CI= 1.79-3.17) for those with 3 or more episodes.

12. Number of Tobacco Smokers in the Household

Eighty-six percent of the participants were living in houses where there was one or more smokers. The incidence of respiratory illness increased from 14% among participants living in households with no smokers to a range of 33% to 58% for those living in houses with 1-8 smokers (Table 4.13). Moreover, the relationship between the incidence of ALRI and number of smokers in their households was statistically significant (Likelihood Ratio $X^2=21.9$, $DF=6$, $p=0.001$).

Table 4.13 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Number of Tobacco Smokers in the Household

Number of Smokers in Household	N*	Observed Infected (%)	Expected Infected
0	56	8 (14%)	22
1	71	31 (44%)	28
2	125	55 (44%)	48
3	78	30 (38%)	30
4	35	15 (43%)	14
5	16	5 (31%)	6
6-8	19	11 (58%)	7
Total	400	155 (39%)	

* Number of Individuals in each Category

The study subjects can be dichotomized into two groups: (1) "No Smokers in the Household", N=56 (14%), and (2) "Smokers in the Household", N=344 (86%), (Likelihood Ratio X^2= 3.35, DF=5, p=0.65). The incidence of ALRI was 14% among the participants living in the former and 43% for the later (Likelihood Ratio X^2= 18.57, DF= 1, p= 0.000). The RR of 2.99 (95% CI= 1.56-5.75) means that participants living in households with smokers had 200% higher significant risk for ALRI than those living in households with no smokers.

13. Smoking Habit of the Second Child Care-Taker

Two variables were used: current smoking habit of the second child care-taker, and smoking habit of the second child care-taker in the past 2 years.(Table 4.14). Out of the 400 participants, 221 (55%) had information on the second child care-taker. The percent agreement was 94% (Likelihood Ratio X^2= 251.7, DF= 4, p= 0.000).

Table 4.14 Smoke Habit of Second Child Care-Taker Currently and during the Past Two Years

Current Smoke Habit of Child Care-Taker	Smoke Habit of Care-Taker During Past Two Years			Total
	Yes	Occasional	No	
Yes	131	1	3	135(61%)
Occasional	1	8	1	10(5%)
No	4	4	68	76(34%)
Total	136(62%)	13(6%)	72(33%)	221

Hence, the variable "current smoking habit of the care-taker" was used to test for the relationship with the occurrence of ALRI (Table 4.15). There were statistically significant differences between the proportions of ALRI of the three categories of the variable "current smoking habit of the second child care-provider (Likelihood Ratio $X^2 = 10.68$, DF=2, p=0.005).

Table 4.15 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Current Smoke Habit of Second Child Care-Taker

Current Smoke Habit of Second Child Care-Taker	N*	Number Infected (%)
No	76	22 (29%)
Occasionally	10	4 (40%)
Yes	135	70 (52%)
Total	221	96 (43%)

14. Maternal Tobacco Smoking During Pregnancy

Table 4.16 is a cross-tabulation of the incidence of ALRI in the previous two years and the maternal history of smoking during pregnancy.

The Likelihood Ratio X^2 of 13.58 (DF= 3, p= 0.004) means that there were significant differences between the proportions of ALRI of the various categories of maternal smoking during pregnancy.

On the basis of the proportion similarity, the categories of maternal smoking and occasional smoking during pregnancy can be combined to form a group called "Maternal Smoking During Pregnancy" N=297 (75%), whereas the other two categories (those who stopped smoking and non-smokers) can be combined into a "No

Maternal Smoking during Pregnancy", N=98 (25%). The incidence of ALRI was 43% for the former group, and 24% for the later group (Likelihood Ratio $X^2 = 11.3$, DF=1, $p=0.001$). The RR of 1.76 (95% CI=1.2-2.55) indicated a significant difference in the risk of ALRI between participants with a history of maternal smoking during pregnancy and those with no such history.

There were no statistically significant differences among the subcategories within either the group of "Maternal Smoking during Pregnancy" (Likelihood Ratio $X^2 = 1.85$, DF=1, $p=0.17$) or the group of "No Maternal Smoking during Pregnancy" (Likelihood Ratio $X^2 = 0.45$, DF=1, $p=0.50$).

Table 4.16 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Smoke Habit of the Mother During Pregnancy

Smoke Habit of Mother During Pregnancy	N*	Observed Infected (%)	Expected Infected
Yes	263	117 (44%)	101
Occasional	34	11 (32%)	13
No	77	20 (26%)	30
Stop Smoke	21	4 (19%)	8
Total	395	152 (38%)	

* Number of Individuals in each Category

15. Maternal Smoking Habit After Delivery

Of the 400 participants, 214 (53%) had information on smoking of the natural mother after delivery. Of these 214 participants, 133 (62%) had a history of maternal smoking after the delivery, and 81 (38%) had no such history. The proportion of ALRI was almost 2-fold higher among the participants who had mothers who smoked after delivery (47%) than among those who had mothers who did not (28%). The RR of 1.67 (95%CI=1.13-2.46) (Likelihood Ratio X^2= 7.71, DF=1, p=0.006) indicated a highly significant difference in the incidence of ALRI between the two groups.

In summary, univariate analyses have revealed the following variables to influence the risk for ALRI:

- age,
- community,
- duration of residence in current household,
- presence of soapstone carving,
- first child care-taker,
- duration of breast-feeding in infancy,
- type of milk-fed in infancy,
- frequency of ALRI in the first two years of life,
- frequency of otitis media in the past two years,
- number of smokers in the household, and
- maternal smoking during pregnancy (Table 4.17).

While there are additional variables which also influenced significantly the risk, they will not be considered for further analyses. These include: school attendance, weight for height (WHZ), smoking habit of the second child care-taker, and maternal smoking habit after delivery. Confounding was the reason for excluding the first factor, and missing values for excluding the other three factors.

4.8.2 Factors Not Influencing the Incidence of Acute Lower Respiratory Infections

There were many variables believed to influence the occurrence of ALRI but for which no significant association was found in this study. These included:

1. Sex

There were 53% (213/400) participant females and 47% (187/400) males. The incidence of ALRI were 36% and 41% for males and females respectively (Likelihood Ratio $X^2 = 0.84$, $DF = 1$, $p = 0.36$). Using the male gender as the reference, the RR for females was 0.88 (95%CI= 0.69-1.14).

2. Socioeconomic Status (SES)

The Sociodemographic Household Survey collected information on many variables. These were (1) the main employment status of all adults in each household of the Keewatin Region over the 12 months prior to the survey, and (2) the mean annual income from any source of all adults in each household in the region (Appendix B). The two variables can only be used as proxy measures to measure the SES of the study subjects because of the following:

a. The 1990 data of the Keewatin Sociodemographic Household Study did not provide direct information on either the employment status or the annual income of the care-taker(s) of each child or adolescent.

b. The two variables do not reflect the family SES of each study subject since the KHSA Study found 13% of housing units contained 2 or more nuclear families.

c. For each participant in the current study, the highest ranking employment status of all adults living in the household was assumed to be the employment status of the main wage earner of household.

d. For each child or adolescent in the current study, the mid-point categories of the average annual income of all adults living in the household were added up, and total was assumed to be the average annual income of the household.

Table 4.17 is a cross tabulation of ALRI in the past two years and the employment status of the main wage earner of the household.

Table 4.17 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Employment Status of the Main Wage Earner of the Household

Employment Status	Number of Participants	Number Infected (%)
No Information	61	21 (34%)
Do Not Know	3	1 (33%)
Full Time	233	82 (35%)
Unemployed	5	2 (40%)
Homemaker/Housewife	33	15 (45%)
Casual/Part Time	40	19 (48%)
Disabled	2	1 (50%)
Seasonal	18	10 (56%)
Retired	5	3 (60%)

In view of the number of categories with few cases in them, they were arbitrarily regrouped into four groups (Table 4.18). The Likelihood Ratio X^2 of 5.95 (DF=3, p=0.11) indicated no significant difference in the risk of ALRI in the groups.

Table 4.18 Incidence of Acute Lower Respiratory Infection For October, 1990, to October, 1992, by Employment Status of the Primary Wage Earner of Household

Employment Status	Number of Participants	Number Infected (%)
No Information, Do Not Know	64	22 (34%)
Full Time	233	82 (35%)
Housemaker/Housewife, Unemployed, Retired, Disabled	45	21 (47%)
Casual/Part Time, Seasonal	58	29 (50%)

Figure 4.12 showed the incidence of ALRI in the past two years by categories of assumed average annual income of household.

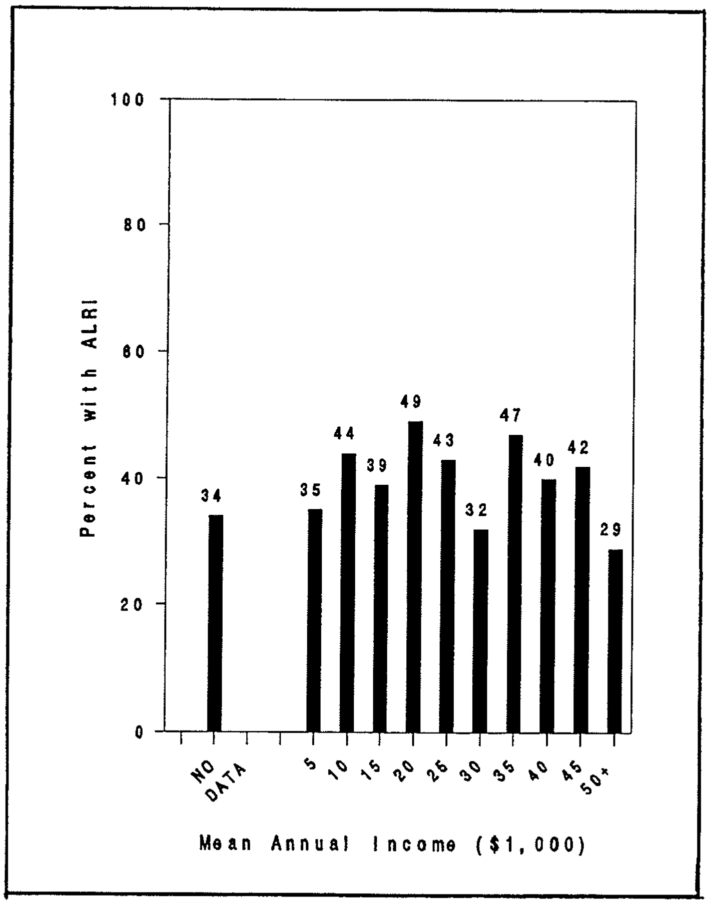


Fig 4-12: Incidence of Acute Lower Respiratory Infection for the Period of October, 1990 to October, 1992, by Household Average Annual Income

The incidence varied from a low of 29% for the study subjects residents of households with an average annual income of $50,000 to $105,000 Canadian to a high of 49% for those residents of houses with an average annual income of $20,000. The figure includes the category of children who had no information on the annual income of the adults living in the household. The Likelihood Ratio X^2 of 7.34 (DF = 10, p = 0.69) indicated no significant differences between the proportions of ALRI of the various categories of income.

The survey respondents were further classified into six income groups based on both the household income and the number of persons living in the household (Table 4.19). This classification was used by the Canada's Health Promotion Survey of 1990 (Manga, 1990).

Table 4.19 requires precaution in interpretating the results because more than 50% of the cells have small frequencies. However, the striking points are:

a. All categories with five or more individuals in the household where the study children and teenagers lived had the highest frequencies of respondents.

b. Thirty-five percent of the participants were living in "Poor" income households, 35% in "Lower Middle" income households, 8% in "Upper Middle" income households, and 2% were living in "Rich" households.

Two possibilities may account for such a distribution of the participants among the categories: (1) small study's sample size, and/or (2) the classification was not accurate for the Inuit.

Table 4.19 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Mean Annual Income of Household and Number of Individuals Living in the Household

	Mean Annual Income Home (x $1,000)	Number of People At Household	Number of Persons	Number Infected (%)
Very Poor	< $10	1-4	10	4 (40%)
	< $15	5+	44	19 (43%)
Other Poor	$10 to 15	1-2	0	
	$10 to 20	3-4	10	2 (20%)
	$15 to 30	5+	76	36 (47%)
Lower Middle	$15 to 30	1-2	2	0
	$20 to 40	3-4	16	9 (56%)
	$30 to 60	5+	123	42 (34%)
Upper Middle	$30 to 60	1-2	1	1 (100%)
	$40 to 80	3-4	14	8 (57%)
	$60 to 80	5+	17	4 (24%)
Rich	$60 +	1-2	0	
	$80 +	3+	8	2 (25%)
Not Known			79	27 (34%)
	Total		400	154 (39%)

To test for association between the occurrence of ALRI and income, the various categories of income shown in Table 4.19 were reclassified into six categories (Table 4.20). The Mantel-Haenszel X^2 of 3.17 (DF = 5, p = 0.67) indicated no statistically significant difference in the incidence of ALRI in the six categories. It should be pointed out that the table included the category of participants who had no knowledge on the average annual income of adults living in the household.

Table 4.20 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Mean Annual Income of Household and Number of Individuals Living in the Household

Income	Number of Participants	Number Infected (%)
Very Poor	54	23 (43%)
Other Poor	86	38 (44%)
Lower Middle	141	51 (36%)
Upper Middle	32	13 (41%)
Rich	8	2 (25%)
Not Known	79	27 (34%)
Total	400	154 (39%)

3. Height for Age (HAZ)

Of the 400 children and adolescent, 98.3% had HAZ values. The risk of ALRI in the past two years increased from 33% for the study subjects who had ≤ -2 SD scores (undernourished ones) to 75% for those who had ≥2 SD scores (Table 4.21).

Table 4.21 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Distribution of SD score of Height-for-Age (HAZ)

SD Score of HAZ*	N**	Percent Infected
≤ -2 SD	62 (16%)	32%
-1.99 to -1.00 SD	92 (23%)	37%
-0.99 to 0.99 SD	213 (54%)	40%
1.00 to 1.99 SD	22 (6%)	50%
≥ 2 SD	4 (1%)	75%

* Adopted from Waterlow Classification (Waterlow et al., 1977)
** Number of Individuals in each Category

When the relationship between occurrence of ALRI in the past two years and the five different SD score categories were tested (Waterlow et al., 1977), no significant differences between the proportions were found (Likelihood Ratio $X^2 = 4.4$, DF= 4, p= 0.36).

4. Body Mass Index (BMI)

Those for whom the WHZ scores could not be used (Waterlow et al., 1977) , BMI was calculated instead. Only 16% (56/400) of the participant adolescents had BMI values (Table 4.22).

Table 4.22 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by the Distribution of Body Mass index

Body Mass Index*	N**	Percent Infected
< 20	10 (18%)	10%
20 - 25	42 (75%)	21%
> 25	4 (7%)	50%
Total	56	

* Adopted from Waterlow classification (Waterlow et al., 1977)

** Number of Individuals in each Category

To test statistically for the relationship between the risk of ALRI and BMI, values for BMI of less than 20 Kg/cm² were regarded as indicative of underweight. Thus, the BMI variable was classified into two categories < 20 and ≥ 20 Kg/cm². The incidence of ALRI for the former and later groups were 10% and 22% respectively. However, the Fisher's Exact Test ($p=0.43$) indicated no association between the occurrence of ALRI and BMI.

5. Second Child Care-Taker

Table 4.23 reveals the occurrence of ALRI stratified by the second person who had taken care of the participant. Of the 400 study people, only 55% had information on the second care-provider.

Table 4.23 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Second Child Care-Taker

Second Child Care-Taker	Number of Participants	Number Infected (%)
Natural Mother	7	4 (57%)
Natural Father	126	48 (38%)
Adoptive Father	32	26 (81%)
Grand Mother	12	6 (50%)
Grand Father	5	3 (60%)
Others	30	9 (23%)
Total	221	96 (43%)

The various categories were reclassified into: (1) "Natural Parents" included natural mother and father categories, N=88 (40%), and (2) "Others" included the other 4 categories, N=133 (60%). The proportions of ALRI were 50% and 39% among the participants who had been taken care of by natural parents and others respectively. The participants of whom the second care-taker was a natural parent had 28% higher risk for ALRI than those of whom the second care-taker was not a natural parent (RR = 1.28, 95%CI = 0.95-1.72). However, there was no significant relationship (Likelihood Ratio $X^2 = 2.56$, DF = 1, p = 0.11).

6. History of Tuberculosis

Histories of tuberculosis infection and disease were used to collect information on the tuberculosis status of the participants:

1. An infectious case was defined as a subject who had a positive reaction to the tuberculin test, negative bacteriologic tests (if done), no clinical or radiographic evidence of the disease and may or may not received chemoprophylaxis.
2. A diseased patient had clinical and/or radiographic evidence of tuberculosis, positive bacteriologic and tuberculin tests, and may or may not received chemotherapy (Bass et al., 1990).

Of the 400 children and adolescents, 19 (5%) had tuberculosis infection. The incidence of ALRI were 42% and 39% for those who had and had not have the infection respectively (RR = 1.09, 95%CI = 0.64-1.88) (Likelihood Ratio $X^2 = 0.09$, DF = 1, p = 0.76).

Furthermore, 4 (1%) of the 400 participants had tuberculosis disease. Of these 4 patients, 2 had ALRI in the past two years.

7. History of Asthma

Twelve of the 400 study subjects (3%) had a history of asthma. While the incidence of ALRI in the past two years were higher (58%) among children and adolescents who had a history than those who had no asthma history (38%), the excess is non-significant (RR= 1.83, 95%CI= 0.93-2.51).

8. History of Heart Disease

Ten of the 400 participants (2.5%) had a heart illness. The proportion of ALRI for participants who had heart disease was lower (30%) than those who had no such disease (39%). However, there was no statistical significant association between the risk of ALRI and the history of heart disease (RR=0.77, 95%CI=0.30-2.00).

9. Number of Individuals Living in the Household

Table 4.24 is a cross tabulation of ALRI during the past two years and the number of individuals living in the household. The incidence of ALRI varied between 25% and 45% (Likelihood Ratio X^2= 9.66, DF=11, p=0.56).

Degree of crowding was indicated by the number of individuals per room. Households with more than one person per room were defined as crowded (Statistics Canada, 1986). In 1990, the Sociodemographic Household Survey showed that the average number of rooms (excluding bathrooms and kitchen) per household was four. Hence, five persons per dwelling was used as the cut-off point: "Not Crowded" 2 to 4, N=67 (17%), and "Crowded" 5 or more, N=333 (83%). The proportions of ALRI were 46% in the former and 37% in the later group. The RR of 0.80 (95%CI=0.60-1.08) indicated that the risk of ALRI decreased by 25% as the number of persons living in the household increased. However, degree of crowding, defined as the number of people living in the household, was not statistically a risk factor in developing ALRI (Likelihood Ratio $X^2 = 1.89$, $DF = 1$, $P = 0.17$).

Table 4.24 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Number of Persons Living in the Household

Number of People in House	N*	Number Infected (%)
2	5	2 (40%)
3	22	10 (45%)
4	40	19 (47%)
5	50	18 (36%)
6	77	24 (31%)
7	75	36 (48%)
8	47	17 (36%)
9	19	8 (42%)
10	16	4 (25%)
11	18	8 (44%)
12	19	6 (32%)
13 - 18	12	3 (25%)
Total	400	155 (39%)

* Number of Individuals in each Category

10. Number of Children Living in the Household

Number of other children living in the household was inversely correlated to the occurrence of ALRI during the past two years ($r = -0.03$, $p = 0.52$).

Table 4.25 reveals that the proportion of ALRI varied between 27% and 50%, and decreased as the number of children living in the household increased. This finding is not expected because the risk for ALRI increases as the number of children in the house increase. However, the Likelihood Ratio X^2 of 7.60 (DF= 7, p= 0.37) indicated no significance influence of the number of other children living in the household on the occurrence of ALRI.

Table 4.25 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Number of Other Children Living in the Households

Number of Other Children	Number of Participants	Number Infected (%)
0	7	3 (43%)
1	36	17 (47%)
2	70	35 (50%)
3	92	33 (36%)
4	90	30 (33%)
5	47	18 (38%)
6	36	13 (36%)
7 - 11	22	6 (27%)
Total	400	155 (39%)

11. Number of Individuals Sharing the Child's Bedroom

The proportion of ALRI in the past 2 years increased gradually from 32% among participants who did not share a bedroom, to 34% for those who shared a bedroom with one individual, and to an average of 48% for those who shared a bedroom with two or more individuals. However, there were no significant statistical associations between the incidence of ALRI and the number of persons sharing the child's bedroom (Likelihood Ratio $X^2 = 4.99$, DF=5, p=0.42) (Table 4-26).

Table 4.26 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Number of Persons Sharing the Study Child or Adolescent Bedroom

Number of Individuals	Number of Participants	Number Infected (%)
0	99	22 (32%)
1	99	34 (34%)
2	131	52 (40%)
3	63	30 (48%)
4	25	12 (48%)
5 - 8	15	5 (33%)
Total	400	155 (39%)

12. History of Smoking in the Child's Bedroom

Of the 400 participants, only 12% had a history of smoking in the bedroom. The smoker could be the participant or person(s) who shared the bedroom. The incidence of ALRI were 38% and 39% for the participants with and without a history of smoking in the bedroom respectively (Likelihood Ratio $X^2 = 0.005$, DF=1, p=0.95). Therefore, smoking in the child's bedroom may not be considered a risk factor for ALRI in the current study.

13. Smoking Habit of the First Child Care-Taker

Two variables were employed:

- smoking habit of the first child care-provider currently, and

- smoking habit during the past two years.

Table 4.27 reveals a 94.5% agreement between the two variables (Likelihood Ratio X^2 = 444.13, DF = 4, p = 0.000). Therefore, the variable current smoking habit of the child care-provider was used to test for the association with occurrence of ALRI.

Table 4.27 Smoke Habit of First Child Care-Taker Currently and during the Past Two Years

Current Smoke Habit First Care-Taker	Smoke Habit of First Care-Taker During Past Two Years			Total
	Yes	Occasional	No	
Yes	264	2	4	270(61%)
Occasional	5	15	1	21(5%)
No	4	6	99	109(34%)
Total	273(68%)	23 (6%)	104(26%)	400

Table 4.28 shows that the incidence of ALRI increased from 32% for the participants who had no first care-provider smoker, 38% for those who had an occasional smoker as a first care-provider, and to 41% for those who had a regular first care-taker smoker. However, there was no significant association between the occurrence of ALRI in the past two years and smoking habit of the first care-provider (Likelihood Ratio X^2=2.92, DF=2, p=0.23).

Table 4.28 Incidence of Acute Lower Respiratory Infection For October, 1990 to October, 1992, by Current Smoking Habit of the First Child Care-Provider

Current Smoke Habit of First Child Care-Taker	Number of Participants	Number Infected (%)
No	109	35 (32%)
Occasionally	21	8 (38%)
Yes	270	112 (41%)
Total	400	155 (39%)

14. Fuel for Cooking

Of the 400 participants, 97.25% lived in households where an electric stove was used for cooking, and 2.75% in houses where an oil or diesel oil stove was used. The incidence of ALRI during the past two years were 39% in the former group and 36% in the later one, not significantly difference (RR=1.07, 95%CI=0.48-2.36).

15. Household Heating System

There were similarities in the risk of ALRI for the different types of household heating systems (Table 4.29).

Table 4.29 Incidence of Acute Lower Respiratory Infection For the Period of October, 1990 to October, 1992, by Household Heating System

Household Heating System	Number of Participants	Number of Infected (%)
Water Boiler	72	25 (35%)
Oil Boiler	49	18 (37%)
Air Furnace	266	105 (39%)
Space Heater	13	7 (54%)

The Likelihood Ratio X^2 of 1.85 (DF= 3, p= 0.6) indicated no statistical significant relationship between the occurrence of ALRI and the type of heating system in the household.

4.9 Multivariate Analyses

4.9.1 Factors Included in Multivariate Analyses

Univariate analysis was employed to select the variables which were able to predict the occurrence of ALRI. The explanatory factors which revealed significant associations with the occurrence of ALRI were the following:

I. Continuous Variables

These included: frequency of ALRI during the first two years of life, frequency of otitis media in the past two years, duration of breast-feeding in infancy, duration of residence in the current household, and number of smokers in household.

II. Categorical Variables

1. Each community was considered one category.
2. Age was classified into the age groups: 2-3, 4-10, and 11-17 years old.
3. Type of milk-fed during infancy included 3 categories: breast-feeding, both breast and bottle-feeding, and bottle-feeding.
4. Maternal smoking during the pregnancy was included as a binary variable (yes, no).
5. Carving soapstone in the household was dichotomized into two categories. The two categories were a household member carving soapstone or no one.
6. First child care-taker was also included as a binary variable: natural parents, and others (Table 4.30).

Table 4.30 Factors Influencing the Incidence of Acute Lower Respiratory Infections using Univariate Analyses

Effect	ß*	OR**	X^2-value	DF	P-value
Age			72.77	2	0.0000
11-17 years		1.00			
4-10 years	0.7973	2.22	10.69	1	0.0000
2-3 years	3.049	21.10	50.98	1	0.0000
Milk Fed in Infancy			14.12	2	0.0009
Breast		1.00			
Breast-Bottle	0.1322	1.14	0.19	1	0.66
Bottle	0.8523	2.35	12.46	1	0.0000
Duration of Breast-Feeding	-0.0201	0.98	6.18	1	0.013
ALRI in Infancy	0.2007	1.22	43.54	1	0.0000
Otitis Media	0.1823	1.20	23.21	1	0.0000
First Child Care-Taker					
Natural Parents		1.00			
Others	0.4844	1.62	4.43	1	0.04
Community			29.49	7	0.0001
Rankin Inlet		1.00			
Coral Harbor	0.3934	1.48	0.85	1	0.36
Baker Lake	0.5356	1.71	2.28	1	0.13
Whale Cove	0.0665	1.07	0.01	1	0.93
Arviat	0.187	1.21	0.27	1	0.60
Chesterfield	1.143	3.13	5.06	1	0.02
Repulse Bay	1.147	3.15	7.84	1	0.005
Sanikiluaq	1.809	6.11	19.01	1	0.0000
Duration Living in Household	-0.0085	0.99	17.38	1	0.0000
Carving Soapstones Yes		1.00			
No	-0.6700	0.51	6.87	1	0.009
Number Smokers at House	0.1708	1.19	6.50	1	0.01
Mother Smoking in Pregnancy					
Yes and Occasional		1.00			
No and Stop Smoke	-0.7451	0.47	8.34	1	0.004

* Coefficient ** Odds Ratio

X^2-value Chi-Square Value DF Degrees of Freedom

4.9.2 Collinearity

Multiple linear regression was used to test for collinearity (the relationship of the predictor variables to one another). The model included the independent variables to be used to select the predictors of the occurrence of ALRI. None of the predictors had a squared multiple correlation coefficient larger than 0.68 (Table 4.31). Kleinbaum et al. (1988) suggested that a squared multiple correlation larger than 0.90 can be taken to indicate collinearity.

Table 4.31 Collinearity Analysis

Predictors	Tolerance	R^{2*}
Community	0.81	0.19
Age	0.63	0.37
Otitis Media in Past Two yrs	0.76	0.24
ALRI in Early Infancy	0.88	0.12
Type of Milk Fed in Infancy	0.32	0.68
Duration of Breast Fed	0.41	0.59
Duration Living in Current Household	0.70	0.30
First Child Care-Taker	0.62	0.38
Maternal Smoke in Pregnancy	0.86	0.14
Number Smokers at Household	0.72	0.28
Household Carve Soapstones	0.82	0.18

* Squared Multiple Correlation Coefficient

4.9.3 Redundancy

It is possible that for the children aged 2 to 3 years, there is redundancy between the study's outcome "ALRI during the past two years" and the predictor "ALRI in the first two years of life". To test for possible redundancy, the initial multiple logistic model to select the predictors of ALRI was fitted. Table 4.32 reveals the result of fitting the model with all the 400 participants aged 2-17 years, whereas Table 4.33 reveals the result of the model refitted and included all the participants except those aged 2 to 3 years.

Exclusion of the children aged 2 to 3 years (N=80) led to the following:

1. A decrease in the odds of all main effects.
2. The odds of the main effect "age" became statistically insignificant.
3. The odds of the main effect "ALRI in early infancy" decreased only a little, and continued to be a highly significant predictor for "ALRI in the past two years".

Hence, it appears that frequency of ALRI in the infancy of the children aged 2 to 3 years did not lead to redundancy between the study outcome and the predictor "ALRI in infancy".

4.9.4 Outliers

Multiple linear regression was used to test for outliers. The model included the eleven main effects which were used to identify the predictors influencing the occurrence of ALRI. All the observations had Cook's Distances of 0.19 or less.

The 50-percentile critical value for Cook's Distance to identify outlier(s) was

Table 4.32 Factors Used to Identify the Factor Predictors of the Incidence of Acute Lower Respiratory Infections in the Past Two Years for All Participants

Effect	ß*	OR**	X^2-value	DF	P-value
Age			34.62	2	0.0000
11-17 years		1.00			
4-10 years	0.5007	1.65	2.64	1	0.10
2-3 years	2.7980	16.41	27.48	1	0.0000
Milk Fed in Infancy			8.24	2	0.02
Breast		1.00			
Breast-Bottle	0.4384	1.55	0.79	1	0.37
Bottle	1.3994	4.05	7.09	1	0.008
Duration of Breast-Feeding	0.0258	1.03	2.62	1	0.11
ALRI in Early Infancy	0.1738	1.19	23.00	1	0.0000
Otitis Media	0.0442	1.05	0.70	1	0.40
First Child Care-Taker					
Natural Parents		1.00			
Others	-0.081	0.92	0.04	1	0.83
Community			23.69	7	0.0013
Rankin Inlet		1.00			
Coral Harbor	-0.0165	0.98	0.00	1	0.98
Baker Lake	0.5368	1.71	1.48	1	0.22
Whale Cove	0.5629	1.76	0.50	1	0.48
Arviat	0.6348	1.89	1.81	1	0.18
Chesterfield	1.1082	3.03	3.05	1	0.08
Repulse Bay	1.1472	4.36	7.70	1	0.006
Sanikiluaq	2.6494	14.15	17.12	1	0.0000
Duration Living in Household	-0.004	1.00	2.01	1	0.16
Carving Soapstone Yes		1.00			
No	0.5365	1.71	1.67	1	0.20
Number Smokers in House	-0.026	0.97	0.06	1	0.80
Mother Smoking in Pregnancy					
Yes and Occasional		1.00			
No and Stop Smoke	-0.250	0.78	0.52	1	0.47

* Coefficient ** Odds Ratio
X^2-value Chi-Square Value DF Degrees of Freedom

Table 4.33 Factors Used to Identify the Factor Predictors of the Incidence of Acute Lower Respiratory Infection in the Past 2 Years for Participants 4-17 years Old

Effect		ß*	OR**	X^2-value	DF	P-value
Age						
11-17 years			1.00			
4-10 years		0.5642	1.76	3.46	1	0.06
Milk Fed in Infancy				7.56	2	0.02
Breast			1.00			
Breast-Bottle		0.4086	1.51	0.65	1	0.42
Bottle		1.3672	3.92	6.63	1	0.009
Duration of Breast-Feeding		0.0252	1.03	2.52	1	0.11
ALRI in Early Infancy		0.1576	1.17	17.60	1	0.0000
Otitis Media		0.0431	1.04	0.57	1	0.45
First Child Care-Taker						
Natural Parents			1.00			
Others		-0.271	0.76	0.46	1	0.50
Community				17.64	7	0.01
Rankin Inlet			1.00			
Coral Harbor		0.4468	1.56	0.62	1	0.43
Baker Lake		0.4524	1.57	0.92	1	0.34
Whale Cove		0.4475	1.56	0.31	1	0.58
Arviat		0.5411	1.72	1.24	1	0.27
Chesterfield		0.9229	2.52	1.82	1	0.18
Repulse Bay		1.3599	3.90	6.15	1	0.01
Sanikiluaq		2.4517	11.61	13.70	1	0.0002
Duration Living in Household		-0.004	1.00	1.61	1	0.20
Carving Soapstone	Yes		1.00			
	No	0.3654	1.44	0.69	1	0.41
Number Smokers in House		-0.033	0.97	0.10	1	0.75
Mother Smoking in Pregnancy						
Yes and Occasional			1.00			
No and Stop Smoke		-0.312	0.73	0.81	1	0.37

* Coefficient ** Odds Ratio

X^2-value Chi-Square Value DF Degrees of Freedom

0.95 (Kleinbaum et al., 1988). Hence, all 400 observations were used in further analyses.

4.9.5 Interactions

Multiple logistic analysis was used to select the first-order interactive effects included in the initial logistic model employed to identify the variables influencing the risk for ALRI. The model included the main effects selected by univariate analyses to be used to determine the predictors of the occurrence of ALRI. These are age, type of milk-fed in infancy, duration of breast-feeding in infancy, frequency of ALRI in infancy, frequency of otitis media in the past two years, first child care-giver, community, duration of residency in the current household, number of smokers in the household, maternal smoking during pregnancy, and household member carving soapstone (Table 4.32).

When multivariate analysis is used to test all possible first order interactive effects, Tabachnick and Fidell (1989) recommended a conservative level of significance. Hence, a decision was made to use a level of significance of 0.01 or less. All sixty-six first-order interactive effects were tested separately. None of the interactive effects were associated with the incidence of ALRI (Table 4.34).

Table 4.34 Interaction Analysis

First-Order Interactive Effect	X^2-value	DF	P-value
Community			
* Age	21.31	14	0.09
* Otitis Media	0.74	7	1.00
* ALRI in First Two Years of Life	4.94	7	0.67
* Type of Milk Fed In Infancy	19.99	14	0.13
* Duration of Breast Fed In Infancy	9.76	7	0.20
* Duration of Living In Current House	6.30	7	0.50
* First Child Care-Taker	6.55	7	0.48
* Maternal Smoking During Pregnancy	7.93	7	0.34
* Number of Smokers In the Household	6.84	7	0.45
* Household Member Carving Soapstone	9.56	7	0.21
Age			
* Otitis Media	1.16	2	0.56
* ALRI in First Two Years of Life	6.25	2	0.04
* Type of Milk Fed In Infancy	2.04	4	0.73
* Duration of Breast Fed In Infancy	2.10	2	0.35
* Duration of Living In Current House	0.46	2	0.80
* First Child Care-Taker	5.20	2	0.07
* Maternal Smoking During Pregnancy	2.02	2	0.36
* Number of Smokers In the Household	2.42	2	0.30
* Household Member Carving Soapstone	5.75	2	0.06
Otitis Media			
* ALRI in First Two Years of Life	1.78	1	0.18
* Type of Milk Fed In Infancy	1.92	2	0.38
* Duration of Breast Fed In Infancy	0.05	1	0.82
* Duration of Living In Current House	0.06	1	0.80
* First Child Care-Taker	0.37	1	0.54
* Maternal Smoking During Pregnancy	1.94	1	0.16
* Number of Smokers In the Household	0.07	1	0.79
* Household Member Carving Soapstone	0.62	1	0.43
ALRI in First Two Years of Life			
* Type of Milk Fed In Infancy	5.72	2	0.06
* Duration of Breast Fed In Infancy	0.06	1	0.81
* Duration of Living In Current House	1.25	1	0.26
* First Child Care-Taker	2.50	1	0.11
* Maternal Smoking During Pregnancy	0.01	1	0.91
* Number of Smokers In the Household	0.39	1	0.53
* Household Member Carving Soapstone	0.85	1	0.36

Table 4.34 Interaction Analysis

First-Order Interactive Effect	X^2-value	DF	P-value
Type of Milk Fed In Infancy			
* Duration of Breast Fed In Infancy	0.36	2	0.84
* Duration of Living In Current House	0.87	2	0.65
* First Child Care-Taker	0.00	2	1.00
* Maternal Smoking During Pregnancy	1.19	2	0.55
* Number of Smokers In the Household	0.25	2	0.88
* Household Member Carving Soapstone	0.98	2	0.61
Duration of Breast Fed In Infancy			
* Duration of Living In Current House	0.83	1	0.36
* First Child Care-Taker	0.02	1	0.88
* Maternal Smoking During Pregnancy	0.44	1	0.51
* Number of Smokers In Household	0.44	1	0.51
* Household Member Carving Soapstone	0.01	1	0.93
Duration of Living In Current House			
* First Child Care-Taker	0.75	1	0.39
* Maternal Smoking During Pregnancy	0.34	1	0.56
* Number of Smokers In the Household	4.58	1	0.03
* Household Member Carving Soapstone	0.13	1	0.72
First Child Care-Taker			
* Maternal Smoking During Pregnancy	0.22	1	0.64
* Number of Smokers in the Household	0.56	1	0.45
* Household Member Carving Soapstone	0.62	1	0.43
Maternal Smoking During Pregnancy			
* Number of Smokers in the Household	0.00	1	0.96
* Household Member Carving Soapstone	0.02	1	0.88
Number of Smokers in the Household			
* Household Member Carving Soapstone	0.14	1	0.71

4.9.6 Final Model

The initial model (Table 4.32) was developed as a result of univariate, outlier, collinearity, and interaction analyses. The backwards stepwise elimination procedures resulted in the final model shown in Table 4.35. The main effects found to influence the risk for ALRI are the following: age, type of milk-fed during infancy, ALRI during the first two years of life, and community.

It should be mentioned that the main effect "duration of breast feeding in infancy" was not identified among the main effects that significantly influenced the occurrence of ALRI. However, it was left in the final model since its elimination led to the fact that the model lost its adequate fit to the data.

4.9.7 Factors Influencing the Incidence of Acute Lower Respiratory Infection

Multiple logistic regression identified the risk factors for ALRI in the past two years for children and adolescents 2-17 years (Table 4.35).

Age was identified as a highly significant protective factor. Using adolescents as a reference group, young children aged 2-3 years were at a very high risk of ALRI, and the risk decreased but remained statistically significant among children 4-10 years old.

Breast-feeding was also found to be a significant protective factor. The study subjects who were both breast and bottle-fed or only bottle-fed during infancy were at higher risk of having ALRI than their counterparts who were exclusively breast-fed. However, the difference in risk between the breast-fed and mixed bottle and breast-fed groups were not significant.

For duration of breast-feeding in infancy, the risk for ALRI during the past two years increased by 2% per each month increase in breast-feeding. However, the association was not statistically significant.

Table 4.35 Factors Influencing the Incidence of Acute Lower Respiratory Infection

Effect	ß*	OR**	X^2-value	DF	P-value
Age			57.25	2	0.0000
11-17 years		1.00			
4-10 years	0.6823	1.98	5.66	1	0.02
2-3 years	3.1610	23.59	42.51	1	0.0000
Milk Fed in Infancy			8.83	2	0.01
Breast		1.00			
Breast-Bottle	0.4590	1.58	0.89	1	0.35
Bottle	1.2582	3.52	7.03	1	0.008
Duration of Breast Feeding During Infancy	0.0239	1.02	2.25	1	0.13
ALRI in Early Infancy	0.180	1.20	25.00	1	0.0000
Community			28.59	7	0.0002
Rankin Inlet		1.00			
Coral Harbor	0.0745	1.08	0.02	1	0.89
Baker Lake	0.6014	1.83	1.93	1	0.16
Whale Cove	0.7691	2.16	0.96	1	0.33
Arviat	0.4893	1.63	1.30	1	0.25
Chesterfield	0.9360	2.55	2.25	1	0.14
Repulse Bay	1.2872	3.62	6.88	1	0.009
Sanikiluaq	2.2268	9.27	20.90	1	0.0000

*	Coefficient	**	Odds Ratio
X^2-value	Chi-Square Value	DF	Degrees of Freedom

The children and teenagers of both Repulse Bay and Sanikiluaq were at a significantly higher risk of developing ALRI than their counterparts in Rankin Inlet. The children and adolescents of the other four communities were also at higher risk, but such differences were not statistically significant.

A history of ALRI in the first two years of life was also found to be a highly significant predictor of the same infections in later childhood. The risk for ALRI in the previous two years increased by 19% for each episode of ALRI in infancy.

PART 5

DISCUSSION

The main findings of the current study determined that the incidence rate of ALRI among the children and adolescents of the Keewatin Region for the period October, 1990 to October, 1992 was 48 cases per 100 child-years at risk, and 110 cases per 100 child-years at risk for those aged 2 to 7 years alone. Furthermore, the overall cumulative incidence was 39%. These risk values for ALRI are perceived as being high. In developing countries, the mean incidence varied from 21 - 296 attacks of ALRI per 100 child-years at risk for children aged 0 to 5 years (Borrero et al., 1990; Selwyn, 1990; Tupasi et al., 1990), while in developed countries, the mean incidence ranged from 3 to 11 episodes per 100 child-years at risk (Glezen and Denny, 1973; Henderson et al., 1979; Pio et al., 1985; Denny and Clyde, 1986).

The incidence of ALRI was influenced by age, type of milk fed in infancy (breast-feeding or both breast and bottle-feeding versus bottle-feeding), frequency of ALRI in early infancy, and by community (Sanikiluaq and Repulse Bay exhibited higher risk of ALRI compared to the other six communities). Other factors were also selected by univariate analyses to influence the risk for ALRI. These were frequency of otitis media during the past two years; type of child care-provider (others versus natural parents); duration of living in the current household; history of household member carving soapstone (yes versus no); number of smokers in the household where the study subject lived; and maternal smoking during pregnancy (yes and occasional versus no and stopped smoking).

Since there is a high prevalence of ALRI among very young children; restriction of the study population to this group of children was not attempted do to the high possibility of not finding an adequate non-infected group.

5.1 Generalizability of the Study

When interpreting the results of a study, the emphasis must be on the following main question, "How well does the study population represent the children and adolescents of the same age group of the eight selected Inuit communities of the Keewatin Region?".

Subjects were selected at random to produce a sample that was representative of the Inuit children and teenagers of the Keewatin Region. In this way, the observed results could be generalized to provide estimates of the incidence of ALRI among the Inuit of that region and the factors influencing the risk of those infections.

There does not appear to be a case for bias among the non-response group of randomly selected children and adolescents. Several factors were employed to compare participants and non-participants, these were the study outcome (episodes of ALRI in the previous two years) and the many factors believed to influence that outcome. The statistical analysis showed no differences between the two groups in all selected factors.

It must be pointed out that most of the non-participants were residents of the community of Rankin Inlet. However, the major reason for non-response was the lack of a relationship between the new-comer interviewer and the permanent residents of the community. Therefore, sampling bias may not have played a primary role, and generalizability of the study results is justified.

Generalizability is limited by the nature of the study method. The data set is a random sample and, hence, it represents only the children and adolescents aged 2 to 17 years living in the Keewatin Region. Therefore, any extrapolation beyond these variables (age, ethnicity, and community) should be treated with caution.

5.2 Limitations of the Study

The limitations of the study results will be highlighted to allow a more objective judgment of the quality of the data being used, and to prevent misinterpretation and misuse of the study's results.

5.2.1 Assessment of Medical Diagnoses

The validity of the medical diagnoses of all diseases included in the current study could not be always assured because:

1. Episodes of most of the illnesses were not confirmed by the appropriate diagnostic tests. For instance, respiratory infections were not confirmed by radiological or microbiological tests unless they were severe or referred to the Churchill Health Center or a tertiary health center for further care and treatment. Furthermore, the accuracy of diagnostic tests at the community health centers may be questionable since they were not performed by the qualified laboratory personnel.
2. The diagnoses of all illnesses in the current study were made and recorded in

the medical records by many individuals with wide differences in training and experience.

3. The diagnoses of all diseases were not made under standardized conditions. There were no official standardized medical guidelines for classification, diagnosis and management of illness; especially the frequent illnesses like respiratory infections, diarrhoea, and other illnesses included in the current survey. For instance, an episode of ALRI can be misdiagnosed and recorded as AURI, and vice versa. In fact, some episodes of ALRI were recorded as AURI only because the rales, crepitations or other pathological sounds were heard at the upper pulmonary lobes. Another example would be that bronchiolitis was recorded under many medical terms. Some physicians recorded it as bronchiolitis, whereas others recorded it as asthma or by using other terms (one of the terms was not found in medical textbooks).

All the above factors would inevitably lead to diagnostic bias and systematic error. The biases were bi-directional in the current study, i.e., they may cause either over- or under-estimation of the diagnosis. This does not mean that biases were eliminated, since it could not be assumed that errors in opposite directions necessarily cancel each other. Biases in opposite directions do not always compensate each other. Nevertheless, one can only hope that biases introduced in this study canceled each other.

There was also an element of randomness in diagnosing which was dictated by circumstance. The time of day, availability of a language interpreter, the characteristics of the person providing the information, the information which the respondent believes is important to tell the physician or nurse, quality of the Inuktitut translation into the English language, and many other factors which are accidental in nature and might affect the determination of the diagnosis. Hence, some diagnoses were accidentally over-estimated while others were accidentally under-estimated. This random element is compensating (random errors cancel each other) on a probability basis.

No attempt was made to assess the accuracy of the diagnoses because of the following:

1. The retrospective nature of current study did not allow for validation at the time of occurrence.
2. The episodes of most illnesses in the current study were diagnosed by nurses in the primary care setting.
3. Episodes of most illnesses in the current study were not confirmed by radiological or laboratory tests unless they were severe and/or referred to the Churchill Health Center or for further care and treatment in a tertiary health center.

5.2.2 Completeness of Medical Records

Uncompleted medical records may be considered as a possible case of error. For instance, some children and teenagers had moved between the communities within the Keewatin Region. This had mainly lead to underestimation of the incident cases. For instance, the medical information of a child who moved temporarily to one hamlet for one year is usually kept in the nursing station of that hamlet. Attempts were made to gather the medical history from the health centers where they resided during their lifetime.

Secondly, certain Inuit cultural traditions made the task of reviewing the medical records difficult. Because of the wide spread practice of adoption, a child might have more than one name or surname. Administrative practices of government agencies sometimes result in different spellings of the same names, or concurrent use of a Western name and Inuit name by the same person. As a result, completing the medical files of some children was not an easy task. It was necessary to rely on the local staff in the health center's who were familiar with the local families in order to determine if a child or adolescent had been adopted/moved to another community and/or had a name change. Another problem related to the use of two or more names was the identification of the medical records in both the community health center(s) and the Churchill Health Center. Hence, the risk of missing data must not be neglected. However, it should be said that a high percentage of the medical records of the study subjects at community health centers had been kept updated.

Finally, community health centers' medical records were often completed by busy nurses and physicians who were under stress. Thus the risk of unintentional misrecording or failure to record attacks of illness in the medical records might be high.

Although all possible efforts were performed to minimize the effects of the first two factors; it could not be guaranteed that missing data occurred particularly because the effects of the third factor are unknown, and could not be adjusted for or determined in the current study. Incomplete medical records may have led to an under-estimation of the disease rates.

5.2.3 Utilization of Health Care Facilities

When interpreting the results of the current study, the emphasis should also be on the following major question "How well do the frequencies of ALRI and other diseases which were collected from the medical records of the study population represent the frequencies among the children and adolescents of the Inuit hamlets of the Keewatin Region?". Two factors might act to influence the data: (1) utilization of health care facilities by the residents, and (2) their perception of what constitutes an "infection or disease" requiring medical consultation. Either factor can lead to bias which could be in the form of over- or under-reporting. For instance, the propensity of some parents to utilize the community health care facility excessively could led to an over-estimation of the incidence of the illness. On the other hand, the tendency of other parents not to seek any help for their offspring, even when they were seriously sick may led to an under-estimation of the incidence.

Furthermore, the current study showed indirectly that children and teenagers of crowded households (those with large families) did not seek health care for ALRI during the past two years compared to those of less crowded (those with small families). This can be due to the fact that child care-providers of crowded dwellings compared to those of less crowded ones:

1. Do not have enough time to seek medical attention for all illness episodes.
2. Have more knowledge and/or experience regarding ALRI of older children and adolescents and, therefore, they sought medical care less frequently.
3. Are more likely to seek traditional ways of healing certain medical conditions.

However, it is not possible to determine if any of these speculations are valid.

Although no attempt was made to assess the influence of health care utilization, the frequencies of the episodes of illnesses collected at the nursing health centers may resemble those in the communities at large. Spady et al. (1979) revealed that the Inuit of the NWT utilized health care facilities significantly more often than Indian and non-Aboriginal people. The Inuit had the highest average number of prenatal care visits, well baby care visits, and morbidity visits.

5.2.4 Assessment of Interview Data

Data were gathered from several individuals who had different degrees of interest in the study. This can lead to concern about the quality of the collected data. Financial constraint did not allow for the appropriate assessment of the accuracy of the data. Although inaccurate data is a serious concern, there does not appear to be a case of bias. Firstly, some variables (date of birth, sex, total number of persons and children in the household where the study children lived) were selected to compare the data collected in the 1990 KHAS Survey and the 1992 Respiratory Follow-up Survey. The data collected on both occasions were highly correlated. Secondly, most of the items of the 1992 individual interview questionnaire did not require subjective judgment and were not highly intrusive in nature. Finally, efforts were made to minimize response bias. These included the use of a standardized questionnaire for personal interviews of child care-takers, and training the interviewers.

Although the response bias may not have played a major role in the current study, error can not be totally neglected. Time of the interview; the route followed by the interviewer; characteristics of the respondent; weather conditions; and many other factors are accidental in nature and may have affected the study results. Hence some responses were accidentally under-reported, while others were over-reported. As a result, the error may be eliminated (canceled each other).

5.2.5 Assessment of Interviewers

Data had been collected from child care-takers by interviewers with different degrees of interest, education, expertise and social beliefs. This could obviously lead to concern about the quality of collected data.

Although no attempt was made to assess the interviewer bias, it seems that this kind of bias did not play a key role in the study results; as most of the items included in the individual interview questionnaire did not require the subjective judgment or influential probes of the interviewers. Efforts were also made to minimize the bias and variations arising from the interviewers. These included:

1. Hiring the interviewers who had participated in the 1990 KHSA Survey,
2. Description of the study and its purposes to the interviewers,
3. training of the interviewers,

4. Field supervision of the first interviews, and
5. Financial incentives for the interviewers.

One can only hope that errors introduced here were random, and tended to eliminate each other.

5.2.6 Obscurities in the Questionnaire

This may led to inaccuracies in the collected data. This was evident in the questions related to carving soapstone. Since the study population consisted of children and teenagers, the place for carving soapstone was more important than the history of carving the soapstone at the household.

The place for carving soapstone was not selected among the factors influencing the risk of ALRI. This can be attributed to one of the following reasons:

1. Chance alone.
2. Carving soapstone had no influence on the risk for ALRI.
3. Obscurities in the interview questionnaire. It is possible that questions of place for carving were not appropriately formulated (Appendix C). Some Inuit carvers carved soapstone inside small storage houses (porches) beside the main house. Although the porch was detached from the house, some people consider it part of the house, while others did not. This can lead to misunderstanding and bias. Overestimation of exposure may happen, for instance, a carver who carved alone inside a porch may have answered that carving took place inside the household. On the other hand, underestimation may also have occurred. A

carver carving inside the porch may have answered "no" correctly to carving soapstone inside the house, however, the study child or adolescent may stay with the carver inside the porch. Therefore, a caution should be exercised in the interpretation of the observed results of carving soapstone.

5.2.7 Limitations in Assessing Socioeconomic Status

Accuracy of the selection of the two indicators of SES (annual average income and the employment status of all adults living in the households where the study children and adolescents lived) is questionable.

It is believed that ALRI is more prevalent among children from a family with low SES (Monto and Ross, 1977; Gardner et al.,1984; Graham,1990). However, the current study did not find significant association between the occurrence of ALRI among the children and teenagers and measures of SES (employment status of the adult assumed to be the main wage earner of the household and the average annual income of the household). The findings are intriguing and warrant further reasoning.

Firstly, the two variables employed were only proxy indicators of the SES of the actual child care-taker(s). It is possible that these proxy indicators did not measure the true employment status and/or the annual income of the care-takers of all or part of the study's child population.

Secondly, chance can be implicated to explain the findings of "no associations" between the occurrence for ALRI and SES in the current study.

Thirdly, the components of SES that can influence the risk for ALRI were still unknown or not included in the study. For instance, the relationship between risk for ALRI and education status of the child care-takers was not assessed in the current study because (1) the 1990 data of Keewatin Sociodemographic Household Survey did not directly point out the care-taker(s) of each child or adolescent, and (2) controversy still clouds the relationship. Education of the child's care-taker was found to be the most important component of SES which influenced the occurrence of ALRI (Margolis et al., 1992). On the other hand, Selwyn (1990) reviewed recent community-based studies conducted in ten developing nations. No consistent association was found between the risk of ALRI among the children and the mother's level of education.

Fourthly, the components of SES which can act to influence the risk for ALRI among the Inuit are different from those of other ethnic communities. The same indicators for SES can behave differently in different communities. In 1990, ten community-based studies were carried out in ten developing countries. No consistent association was found between the risk for ALRI among children and the mother's education (Selwyn, 1990). This could suggest that the influence of ethnicity should be seriously taken into account. For instance, a herd of cattle or a terrain have more SES information than the annual income in many developing countries. The current study revealed that the classification of people, according to the annual household income and number of people in the household, which was used in the Canada's Health Promotion Study (Manga, 1990), should not be applied to other ethnic groups without caution; since almost 84% of the children and teenagers were distributed in various categories with five or more people in the household. This could lead to say that either the SES indicators(s) should not be assumed accurate for all societies or rearrangement (e.g., reclassification) of indicators must be taken into account before being applied to other societies.

Finally, the lack of enough variance. The study's children and teenagers were relatively homogeneous regarding SES. Of the 321 participants who had information on income, 88% were habitants of lower-middle SES and poor households. Moreover, of the 339 participants who had information on the main wage earner of the household, almost 70% were habitants of households where the main wage earner was a full-time employee. The remaining 30% were habitants of households where the main wage earners were distributed in several job occupation categories. This may lead to another explanation, that is there was enough variation, but there was an inadequate sample size in order to explain the lack of association with the risk for ALRI. Hassard (1991) reported that the variability of sample means increases as the heterogeneity of the subject observations increases, and sample size decreases.

Therefore, one or more of the above reasons could have led to the lack of significance between SES and the occurrence of ALRI.

In conclusion, it should not to be inferred from the foregoing discussion that there are grounds for either discouragement or that the situation is entirely hopeless with regard to attainment of useful accuracy. The point is that the accuracy required for the current survey was not attainable. For instance, the method (retrospective cohort) of the current survey did not allow to control for or block the effects of some of the errors.

Fortunately the errors in a survey are not always additive. It should also be remembered that often it is the ratios between the frequencies that are of interest and not the absolute values of the frequencies themselves. Many of the biases cancel out the ratios, which are thus determined as more accurate than the absolute frequencies.

Although the impact of biases on the study results were not either determined or fully controlled for, and it is a mistake to take refuge in the assumption that each kind of bias had canceled each other partially or totally, it might be said with caution that biases did not act heavily on the study results because the results aligned with those of previous studies.

5.3 Problems in Collection of the Data

Some of the difficulties which were encountered in the data collection phase were mentioned during the discussion of the limitations of the study results. These were:

1. The effects of Inuit cultural values on data collection.
2. Movement of some children between the Keewatin communities.

This created a real challenge in order to gather the necessary information for some children and teenagers who participated in the current study.

Other difficulties were:

1. The use of a new-comer resident (a person who recently moved to a community) as an interviewer. This led to the refusal of some of the child care-

providers taking part in the study.

2. The use of one interviewer per large community. This happened unintentionally as one of the two interviewers withdrew after being trained and had conducted the first interviews. This led to a delay in gathering the necessary information from the child care takers in one of the large communities. On the other hand, the training of two or more interviewers in the other two large hamlets created an atmosphere of competition.

5.4 Epidemiologic Importance of the Occurrence of Acute Lower Respiratory Infections

Of the 400 children and teenagers, 155 (39%) met the criteria for infected subjects, i.e., each had one or more medically (nurse or physician) reported attacks of ALRI. Furthermore, the average incidence rate was 48 episodes per 100 child-years for all study children and adolescents, while for children aged 2 to 7 years, the average incidence rate was 110 cases per 100 child-years. Although dissimilarities in the research methods and disease definitions make comparisons with many previous studies of ALRI difficult, the incidence of ALRI was perceived as being high in the current study. The average incidence rates of ALRI ranged from 20 to 114 episodes per 100 child-years among the Inuit children (Willis, 1963; Spady et al., 1979; James et al., 1984), and from 21 to 296 attacks per 100 child-years for the children of developing countries (Borrero et al., 1990; Selwyn, 1990; Tupasi et al., 1990). In the developed countries, the mean incidence of pneumonia varied from 3 to 11 attacks per 100 child-years (Glezen and Denny, 1973; Henderson et al., 1979; Pio et al., 1985; Denny and Clyde, 1986).

The hospitalization rate was 3.5% for the study period from October, 1990 to October, 1992. In 1984, the annual hospitalization rate for ALRI was 22 per 1,000 Inuit children (Postl et al., 1984). Unfortunately, the two hospitalization rates can not be compared because the 1984 rate also included cases of ALRI admitted to the community health centers.

5.5 Time Trend of Acute Lower Respiratory Infection

The occurrence of ALRI among the children and adolescents was significantly higher in the period October, 1990 to September, 1991 than in the period October, 1991 to October, 1992. The pattern of ALRI occurrence over time for the Inuit can not be readily obtained from either the literature or from official statistics. Therefore, it seems difficult to determine the occurrence of an epidemic in the period October, 1990 to September, 1991. However, the following findings may support the notion of an epidemic:

1. Morbidity measurement values (both the cumulative incidence and the average incidence rate of ALRI) were much higher in the period October, 1990 to September, 1991 than from October, 1991 to October, 1992.
2. The incidence pattern of ALRI over time for the infants 1 to 2 years of age reveal a high incidence of infections for the period 1990-1991.
3. When the children 4 years old and younger were excluded, the incidence of ALRI declined from 31% to 19% for 1990-1991 and from 20% to 13% for

1991-1992, and the difference in risk for ALRI became insignificant. This supports the notion of an epidemic because infants are at a greater risk of developing ALRI than older children and adolescents (Graham, 1990).

4. A speculative, systematic diagnostic bias from nurses can not explain the epidemic because of (1) the high turn-over of the nurses, and (2) two or more nurses are assigned to work in the nursing stations in all eight communities except Whale Cove where there is usually one nurse.

5. Of the eight Keewatin hamlets, seven had a higher occurrence of ALRI in 1990-91 than in 1991-92. Furthermore, the incidence of ALRI was significantly higher in 1990-91 than 1991-92 in three communities (Sanikiluaq, Rankin Inlet, and Repulse Bay). Both the past and current directors of the Northern Medical Unit of the University of Manitoba, pediatricians, and a senior physician who practiced medicine in the Keewatin Region confirmed anecdotally that an epidemic occurred, particularly in Sanikiluaq and Repulse Bay.

Unfortunately, the available data on microbiological tests from the Provincial (Cadham) Laboratory could not be used to support the occurrence of an assumed outbreak. Diagnostic tests were usually ordered for referred severe cases and/or hospitalized cases in the Churchill Health Center or the Health Sciences Center in Winnipeg.

5.6 Factors Influencing the Incidence of Acute Lower Respiratory Infections

The variables age, type of milk-fed in infancy, duration of breast-feeding, ALRI in early infancy, otitis media in the past two years, first child care-taker, community, duration of residence in current dwelling, household member carving soapstone, number of cigarette smokers in household, maternal smoking during pregnancy, and school attendance were selected as variables which significantly influenced the incidence of ALRI by univariate analyses alone. However, multiple logistic regression selected only age, type of milk-fed in infancy, ALRI in early infancy, and community as predictors for the risk of ALRI.

1. Age

Both univariate and multivariate analyses revealed an inverse relationship between the risk for ALRI and age. Children aged 2-3 years were found to be at a greater risk of having ALRI, and hence the risk decreased as age increased. These findings were expected because several studies showed an inverse relationship between age and the risk for ALRI with the maximum incidence of infection being in infancy and early childhood, and thereafter steadily decreases with age (Van Volkenburgh and Frost, 1933; Gwaltney et al., 1966; Fox et al., 1972; Fox et al., 1975; Ledder and Holland, 1978; Fox et al.,1985). This trend is generally attributed to the changing patterns of exposure and the acquisition of specific immunity to an increasingly large array of virus types occurring with age (Graham, 1990).

2. Breast Feeding in Infancy

Two variables were included: type of milk fed, and duration of breast-feeding in infancy. Multivariate analyses captured the former among the factors that significantly influenced occurrence of ALRI. The children and teenagers who were breast and bottle-fed or bottle-fed alone had higher risks for ALRI than those who were breast-fed alone. The difference in risk between breast-feeding and bottle-feeding was statistically significant, whereas that between breast-feeding and both breast and bottle-feeding was not significant.

Duration of breast-feeding had a small, not significant effect on the risk for ALRI in the past two years. Moreover, univariate analyses showed that when participants who were not breast-fed were excluded, the length of breast-feeding was found to have no effect on the risk for ALRI either in early infancy or during the past two years.

The selection of the type of milk feeding during infancy as a factor that significantly influenced the occurrence of ALRI, while length of breast-feeding was not selected is open for explanation.

First, collinearity cannot be implicated for explanation since multicollinearity analysis showed squared correlation coefficients of 0.68 and 0.59 for type of milk fed and length of breast-feeding in infancy respectively. When the initial full multiple logistic model was refitted excluding the main effect "type of milk-fed during infancy", the main effect "duration of breast-feeding in infancy" lost almost all its risk for ALRI.

The second possibility is that bias, most likely recall bias, could not be ruled out as an explanation. The child care-provider can recall more accurately the type of milk the child had in infancy than duration of milk feeding. An inspection of raw data revealed that many child care-takers answered the questions on duration of breast-feeding and bottle-feeding in terms of months 1, 2, 3, 6, 12, 18, 24, ... etc. This could led to end-digit preference bias.

A third explanation is that confounding variables influenced the relationship between the occurrence of ALRI and breast-feeding. Breast-feeding is less prevalent among the less educated mothers, young aged mothers, unmarried mothers, and the low income families (Yeung et al., 1981; Acheson and Danner, 1993; Freed, 1993). Many past studies found the social and financial factors of the child care-providers among the confounding variables which influenced the association between the risk for ALRI and breast-feeding (Ellestad-Sayed et al., 1979; Watkins et al., 1979; Pullan et al., 1980; Fergusson et al., 1981; Taylor et al.,1982; Forman et al., 1984; Wright et al., 1989; Woodward et al., 1990). In the current study, the effects of the social and financial status of the child care-givers on the relationship between the duration of breast-feeding and the risk for ALRI can not be assessed because the available data from the Sociodemographic Household Survey does not provide enough information on the actual child care-providers of the study subjects.

A fourth and more plausible explanation is that the quality of breast milk (its anti-infective properties and/or improved hygiene) seems to be more effective than the length of feeding.

The highly significant risk of ALRI among bottle-fed children and teenagers compared to those who were breast-fed was also found in past studies (Ellestad-Sayed et al., 1979; Watkins et al., 1979; Pullan et al., 1980; Fergusson et al., 1981; Taylor et al., 1982; Forman et al., 1984; Wright et al., 1989; Woodward et al., 1990).

When confounding factors were adjusted for, many studies revealed the disappearance of the relationship between breast-feeding and the risk for respiratory illness (Fergusson et al., 1981; Taylor et al., 1982; Forman, 1984; Woodward et al., 1990). However, Ellestad-Sayed et al. (1979), Watkins et al. (1979) and Pullan et al., (1980) found that the protective effect of breast-feeding persisted even after adjusting for confounding variables, such as crowding in the household, family size and income, and parental education.

The highly significant protective effect of human milk than human milk and formula or formula alone and the highly significant protective effect of human milk and formula compared to formula alone seemed to be attributed to the protective effect of breast-feeding in terms of:

a. Its anti-infective substances which provide the infants with protection during the early development of the immune system. Breast milk has a number of anti-infective agents, such as leukocytes, lactoferrin, and antibodies found predominantly in the IgA fraction of the milk protein (Mata and Wyatt, 1971; McClelland et al., 1978).

b. Its cleanliness and lack of opportunity for infection. Some studies, conducted in societies where the child care standards were low, revealed the benefits of breast-feeding in reducing the mortality and morbidity related to respiratory infections (Grulee et al., 1934; Douglas, 1950; Robinson, 1951). However, in societies where the child care standards were high, bottle-fed children were not found at a significant higher risk for respiratory infection than those who were breast-fed (Douglas, 1950; Fergusson et al., 1978).

It is worth mentioning that the small, and statistically not significant difference in risk for ALRI in early infancy (first two years of life) between breast-feeding and not breast-feeding can be due to the lack of enough variability of the variable frequency of episodes of ALRI in early infancy.

3. Lower Acute Respiratory Infection In Early Infancy

The incidence of ALRI was found to increase significantly as episodes of ALRI during early infancy (the first two years of life) increased. This was one of the expected results since previous work found that ALRI in the first two years of life were associated with a subsequent proneness to ALRI, and chronic respiratory disease in later life as well (Colley et al., 1973; Douglas and Miles, 1984; Graham, 1985; Pinnock et al., 1986). However, the current and past studies did not disentangle acute from chronic morbidity nor did they address the etiology, i.e., whether it was infective or noninfective. Another central issue is whether ALRI in early life acts as an early marker for genetically preprogrammed subsequent respiratory morbidity or whether it acts as a true risk factor by causing long-term damage to the lower respiratory tract.

4. Community

The children and adolescents of Sanikiluaq and Repulse Bay had a higher incidence of ALRI than their counterparts in the other six communities combined. In multivariate analyses, the children and teenagers of Sanikiluaq and Repulse Bay were 9-times and 3.6-times higher and had a statistically significant risk for ALRI than those of Rankin Inlet, adjusting for the other main effects included in the analyses. The children and adolescents of the other five communities were also at a higher but not statistically significant risk for ALRI than those of Rankin Inlet.

The epidemic of acute respiratory infection which is stated anecdotally regarding the Keewatin Region during 1991, particularly in Sanikiluaq and Repulse Bay, may be accounted for as the primary reason for the differences in risk for ALRI between the communities of Keewatin Region.

5. Number of Smokers in the Household and Maternal Smoking Habit During Pregnancy

Both variables "total number of smokers in the household" and "maternal smoking during pregnancy" were selected as significant risk factors for ALRI in univariate analysis alone. The incidence of ALRI increased 200% among children and adolescents living in a household with one or more smokers (RR = 2.99, 95%CI = 1.56, 5.75) than those living with non-smokers in the household. Furthermore, the risk was 76% higher among children and teenagers who had a history of maternal smoking during pregnancy than among those who had no such history (RR = 1.76, 95%CI = 1.21-2.55).

Plausible reasons for excluding both variables from being risk factors for ALRI in multivariate analysis could be:

1. Confounding. Multiple logistic analysis (see the initial model used to select the

predictors of ALRI) showed non-significant protective effects of both factors. The risk of ALRI decreased by 3% for each increase of one smoker in the dwelling. Furthermore, the risk was 28% lower among the children and adolescents who had a history of maternal smoking during pregnancy than among those who had no such a history.

2. Homogeneity of the study population on both factors, i.e., lack of enough variance for both factors. For instance, only 14% of the participants have lived in dwellings with no smokers in them, and 24% had a history of maternal no smoking or who stopped smoking during pregnancy. In other words, the effects of both factors on the risk of ALRI were less evident. This is presumably because most study participants lived in households with one or more smokers and had a history of maternal smoking during pregnancy, hence making both factors poor predictors of ALRI occurrence.

There is ample evidence in the literature for and against both factors as predictors of ALRI. Several studies found passive inhalation of smoke an important risk factor for ARI in children (Colley et al., 1974; Harlap and Davies, 1974; Leeder et al., 1976; Fergusson et al., 1980; Fergusson et al.,1981; Evers et al., 1985; Fergusson and Horwood, 1985; Woodward et al., 1990). On the other hand, the community-based studies carried out in ten developing countries found no consistent association between the incidence of ALRI among children and smoking in the household (Selwyn, 1990). Selwyn observed that the similarity of the study children (not enough variance) was the reason for the modest or no association.

Moreover, Woodward et al. (1990) found prenatal and postnatal maternal tobacco smoking to be important risk factors for ALRI in infants whereas Taylor and Wadsworth (1987) found that prenatal smoking was a stronger risk factor than postnatal smoking.

6. School Attendance

School attendance was found to be among the predictors of ALRI in univariate analyses. However, the trend was not in the expected direction. The risk for ALRI was higher among the children and adolescents who did not attend school than among those who did. Therefore, the relationship between occurrence of ALRI and school attendance is of interest and open to explanation.

One possible explanation is that there was not enough children aged 2 to 4 years who attended day care centers and the association might be spurious.

Another possible explanation is that the variable age may have played a role as a confounder because univariate analyses revealed that:

1. Seventy-four percent of the children who did not attend school were aged 2-4 years.
2. The infections were more prevalent among young children (the incidence of ALRI were 73% and 30% among the children aged 2 to 4 years and 5 years or older respectively).
3. When age was adjusted for and children aged 2 to 4 years were excluded, the association between the occurrence of infection and school attendance lost its

statistical significance.

Although past studies implicated school attendance as a cause of increased ALRI in children, especially infants (Strangert, 1976; Gardner et al., 1984), its influence on the occurrence of ALRI is questionable in the current study. However, it can also be said that the current study's finding of no association between school attendance and the occurrence of ALRI for children aged 4 years and older confirms the results of previous studies (Graham, 1990).

5.7 Factors Not Influencing the Incidence of Acute Lower Respiratory Infections

Many variables, which were included in the current study, were not selected statistically as predictors of ALRI. The forthcoming discussion will highlight the possible reasons for not selecting some of these variables.

1. Crowding

The total number of individuals and the number of children in the household where the study children and adolescents lived were not found to be among the factors which influenced the risk of ALRI in either univariate or multivariate analyses. Nevertheless, it must be mentioned that the risk of infection tended to decrease as the total number of persons or children in the household increased. Therefore, the association was in the opposite direction of what was expected. Past studies found a positive significant association between crowding and the occurrence ALRI (Leeder et al., 1976; Strangert, 1976; Monto and Ross, 1977; Gardner et al. 1984).

Both general knowledge and life experience of the child care-takers regarding health and disease may account for the unexpected result:

1. The child care-takers of crowded households (large families) may possibly have accumulated enough knowledge and experience for treating ALRI within the household and, hence, they did not seek medical care for their offsprings as frequently as those of less crowded (small and possibly young families) households.
2. The child care-takers of large families were usually busy and, therefore, they sought health care and treatment for seriously sick offspring.
3. The child care-takers of crowded dwellings are expected to be older and/or living with elderly people. They may rely on traditional healing and, therefore, cause a decreased demand on the health care system.

Therefore, both variables (number of people and number of children in the household where the study population lived) may also have reflected the relationship between utilization of health care facilities and the family size.

2. Indoor Air Quality

Three factors were used to assess the influence of the indoor air quality on the risk for ALRI. The factor "number of smokers in the household" was selected among the risk factors for ALRI in the univariate analysis alone, while the other two variables "fuel for cooking" and "household heating system" were not selected.

One of the possibilities for not selecting statistically these factors was the homogeneity of the study subjects on these factors. For example, 86% and 97% of the children and teenagers were living in households where there was one or more smokers and an electric stove was used for cooking respectively.

Another reason could be that other indicators for indoor air quality can be used to assess the relationship between the risk for ALRI and indoor air quality. The Northwest Territories Housing and the Canada Mortgage and Housing Corporations conducted a survey to assess the indoor air quality in households in selected communities in the NWT in 1989 (Unpublished report). Four Keewatin communities were among those selected ones. The salient findings were that:

1. The levels of the particulate exceeded the Canadian Health and Welfare Acceptable Long-term Exposure Range in 77% of the tested dwellings. The potential sources for the particulate were hair and the particles from animal fur, cigarette smoke, carving soapstone, and the residual summer dust from the road. Several studies found a relationship between the occurrence of ALRI and suspended respirable particulate (Lunn et al., 1967; and 1970; Levy et al., 1977; Dales et al., 1989; Dockery et al., 1989 Pope, 1989; Graham, 1990.
2. Several households had air change rates below the recommended rate. This can, obviously, lead to increased levels of indoor air pollutants.
3. The microbial contamination levels of some households affected the nematode bioassay organisms. The detection of any toxic effect in the nematode bioassay is considered a flag of poor indoor air quality.
4. The results of the interviews with the households' residents did not show

relationships between indoor air quality and the respiratory diseases and symptoms. However, some biases and errors (such as recall bias) may hindered the accuracy of the relationship.

Hence, it appears clear that future research may include the above and other indicators of the indoor air quality to assess the relationship between indoor air quality and the incidence of ALRI.

5.8 Recommendations

The Inuit children and adolescents of the Keewatin Region experienced a high incidence of ALRI from October, 1990 to October, 1992. This high morbidity may have occurred over a long period of time in the past. Moreover, the individual, their lifestyle, and the environmental factors assumed great importance by influencing the risk for these acute respiratory infections. Therefore, it seems appropriate to advocate surveillance and prevention of these respiratory infections.

5.8.1 Surveillance

Surveillance is defined as a systematic regular ascertainment of the incidence of an illness using methods distinguished by their practicability, uniformity, and rapidity, rather than by complete accuracy (Last and Wallace, 1992). In the case of ALRI, the main goals of such a system would be to detect both the distribution of respiratory infections and the changes in their trends over time and place in order:

1. To intensify the control and preventive measures,

2. To assist current and future control and preventive measures,
3. To help make health policy decisions regarding utilization of health personnel, equipment, and financial resources,
4. To initiate investigative measures, and
5. To allow the health care system to cope with the epidemics (Mandell et al., 1989).

It must be said that surveillance of ALRI should be viewed in the context of a broad registry system for the surveillance of the prevalent diseases among the Native population.

5.8.2 Health Promotion

The Inuit children and adolescents suffered a high incidence of ALRI from October, 1990 to October, 1992. Furthermore, several factors were found to influence the occurrence of these infections. Therefore, a health promotion strategy is highly recommended, and its' aim should be to develop an increased awareness of both the individual (particularly the child care-takers) and the community's responsibilities for the attainment and maintenance of good health for their offsprings.

The above objectives could be achieved by developing health promotion program(s) with the Inuit communities. At each stage of the program(s), the active involvement of community members is essential by identifying the priorities, planning, implementing, and evaluating the programs.

However, it must be mentioned that the following three issues were not among the objectives of the current study, and hence they will not be discussed in detail.

1. To introduce health promotion programs.

Almost all available programs are designed for non-Natives and for city residents. It is not acceptable to continue to introduce programs into other communities in which the circumstances are radically different and whose members have different conceptions of health and illness. Moreover, the review of the literature showed that the introduction of the programs into other societies was not effective, and sometimes counterproductive.

2. To priories the types of health promotion activities that can be undertaken.

It is not unrealistic that the priorities the present study will recommend would be partially or totally different than those recommended by the community.

3. To suggest the way(s) future health promotion activities can be introduced into the current Inuit health programs.

The forthcoming discussion will focus on the health promotion recommendations aimed to decrease the incidence of ALRI among Inuit children. Thereafter, it is expected that the community and its' planners become actively involved in the following:

1. To identify priorities, i.e., the potential risk factors for ALRI and hence candidates for intervention.
2. To identify or to plan and develop a suitable health promotion program.
3. To implement the program.
4. To evaluate the program.

It is important to repeat that the active involvement of the community in identifying priorities, and planning, implementing and evaluating the health promotion program is essential.

The health promotion strategy includes the following types of interventions:

- primary prevention,
- secondary prevention, and
- tertiary prevention.

5.8.2.1 Primary Prevention

Primary prevention means preventing the occurrence of disease or injury. In the case of ALRI, primary intervention should focus on the reduction or elimination of exposure to the risk factors and promote exposure to the protective ones. For instance, a health promotion program to promote breast-feeding and to stop smoking should continue to be a priority for the Inuit communities.

A. Community Education

One of the primary preventions must be comprised of strenuous health promotion efforts to educate the Inuit population about:

1. The way in which ALRI's spread.
2. The possible permanent damage to the respiratory tract system (i.e., bronchiectasis, chronic bronchitis, ... etc.) in later life, and hence permanent disabilities. Carson et al. (1984) reported that ALRI's are suspected antecedents

of chronic lung conditions in those children severely affected in childhood.

3. The means for preventing them.

It is important to have the participation of all the members of the Inuit community in this education program.

B. <u>Breast-Feeding</u>

It is incumbent upon the health sector to give a high priority for the promotion of breast-feeding for all infants in the Inuit communities because:

1 Breast-feeding was found to have protective effect(s) against ALRI. This effect was independent of the child's age, hamlet where the child resided, ALRI during early infancy, and school attendance.

2. Breast-feeding was found to be protective against other infectious diseases (such as diarrhea and otitis media) which are highly prevalent among Inuit children.

3. Human milk fosters bonding between mother and infant which is beneficial to both of them (Lozoff et al., 1977).

4. Human milk is nutritionally superior to any type of store-bought formula milk (Nutrition Committee, Canadian Paediatric Society, 1978).

5. The economic advantages of breast-feeding are considerable, to both the family (human milk costs less to produce than store-bought formulas cost to buy) and to society as a whole (breast feeding reduces utilization of health services, and therefore its cost). In Saskatchewan, the average annual cost of formula

feeding in the first year of life was between $1275 and $3055 (as of February 1991), depending on whether powder, ready-to-use, or concentrate formula was used (Frank and Newman, 1993).

6. Breast-feeding promotes child care by the natural parents.

Re-identification of the Aboriginal persons with their culture is a fundamental step to good health (Todd, 1975). Breast-feeding was traditional among Native Canadians. However, when bottle-feeding became popular among the Canadian women in the 1960s and 1970s, the impact of this trend was felt among the Native women as well (Schaefer and Spady, 1982). Therefore, re-establishment of a cultural act, such as breast-feeding, must be a primary objective. The current study found that 59% of the mothers initially breast-fed, 12% were breast-feeding for 3 months or less, and 44% for 6 months or more. The breast-feeding rates at birth and at three months were lower than those for Canada as a whole, while the rates at six months were higher (the Canadian breast-feeding rates were 76% at birth, 56% were breast-feeding for 3 months, and 33% for 6 months) (Langner and Steckle, 1990).

The following factors were found to influence the Aboriginal mother's decision to breast-feed as well as duration of breast-feeding. These include: maternal age, parity, past experience of breast-feeding, maternal smoking status, and family support (the child's father and grand-mother supports) (Goodine and Fried, 1984; Langner and Steckle, 1991; Macaulay, 1981; Macaulay et al., 1991; Mackey and Fried, 1981; Simopoulos and Grave, 1984; Yeung et al., 1981). However, legal custom adoption, an enduring cultural trait of the Inuit society, is the primary reason for not breast-feeding (Dufour, 1984). Dufour found that adoption accounted for not breast-feeding in 57% and 68% of the infants on the Ungava Coast and the Hudson Coast (two Inuit communities in the province of Quebec) respectively. Therefore, the health promotion strategy should aim to maintain the current rate of breast-feeding and to emphasize the quality of nourishment of the adopted infants.

Currently, health personnel at the Keewatin Region's health centers have promoted breast-feeding to pregnant women and to the occasional husband or boyfriend who accompanies them to the health center. However, the results of infant feeding counselling which was received either pre- or postnatally are yet unknown. Therefore, future promotion interventions should include:

a- Accept the return of breast-feeding and delay the introduction of solids. This may be seen by the Inuit as a positive expression of cultural identity and a healthy lifestyle choice.

b- Extend the role of health personnel by having them act as facilitator to assist the community to recreate a supportive environment for breast-feeding mothers.

c- Reemphasize the recommendations on breast-feeding for hospital care of the mother and newborn which was reported in "Issues for Health Promotion in Family and Child Health" (Indian and Inuit Health Services, Medical Services Branch, 1986).

d- Disseminate information to advocate not only the initiation of breast-feeding, but also on the benefits of exclusive breast-feeding and the late introduction of solids. Ideally, all infants must be nourished according to the recommendations of the Canadian Pediatric Society and should, first of all, be breast-fed and secondly, not receive solid food until the age of 3 to 4 months. Education must reach all levels of society. This includes:

- health personnel providing health care and treatment to the Inuit people,
- Native Association of Nurses,
- Community Health Representatives,
- Native Women's Group,
- politicians,
- teachers, and
- the community members at large.

This might be achieved through information sessions and local radio talk shows.

e- Implement elementary and secondary educational school programs to encourage young children and adolescents, of both genders, to accept breast-feeding as natural and ideal for the infant's health.

f- Ensure that all breast-feeding mothers, especially primiparas, have support in the early postpartum period from (1) group of successful breast-feeding mothers who act as role-models and give practical help, and/or (2) a well-trained public health nurse or local Inuit health aide. This will aim to increase the mother's confidence and lessen the frequent premature termination of breast-feeding or introduction of regular bottles and solids.

g- Ensure all bottle-feeding mothers know the appropriate use of the bottle, and that with improper bottle-feeding, serious infections and illness may result. It should be emphasized the importance of sanitary preparation and storage of milk, good water storage and treatment, bottle hygiene, hand washing, ... etc.

h- Ensure that promotion campaigns for breast-feeding do not lead to conflict with the another cultural heritage, the adoption, and Inuit are advocated to find a solution within their socio-cultural environment.

C. Immunization

The preventable diseases against which children are routinely immunized include diphtheria, pertussis, tetanus, measles, mumps, rubella, and poliomyelitis. ***Hemophilus Influenzae*** is one of the causes of ALRI. The few recent studies show that the development of ***Hemophilus Influenzae type b*** conjugate vaccine is expected to be a medical milestone in preventing an important cause of death and, particularly, morbidity related to ALRI (Greenberg et al., 1991; Lehmann et al., 1991; Dagan, 1992; Murphy et al., 1992; Murphy et al., 1993).

Although immunization rates are generally good, there remains room for improvement. This can be achieved by:

1. Encouraging child care-takers to accept immunization for the health benefits to their children.
2. Enforcing proper vaccination schedules at the recommended age.

For other vaccines:

1. Pneumococcal vaccine currently available is the 23-valent one (i.e., it incorporates the capsular antigens of 23 different serotypes). In other words,

the vaccine encompasses over 80% of the strains causing bacteremic pneumococcal disease (Morris and Lang, 1989).

The duration of immunity is not known. However, the antibody levels generally remain elevated for 5 to 9 years (Morris and Lang, 1989; Butler et al., 1993). The vaccine is not effective among children aged two years and younger, because this age group of children do not develop an adequate antibody response to the polysaccharide vaccine. The vaccine efficacy for people older than 2 years varied from 57% to 70% (Health and Welfare Canada, 1984; Butler et al., 1993).

The vaccine is currently recommended for: (1) individuals aged 65 years and older, and (2) those older than two years who are at increased risk of pneumococcal infection because of chronic disease and hyposplenism (Health and Welfare, Canada, 1984; Morris and Lang, 1989; Butler et al., 1993).

Davidson et al. (1989) found the attack rates of the confirmed pneumococcal bacteremia to be 34-times higher among the Alaska Native children younger than 2 years and 6-times higher among the Alaska Native adults than those of the other U.S. people. Furthermore, more than 96% of those infections were caused by the pneumococcal types that are represented in the 23-valent vaccine. Hence, Davidson et al. suggested that a wider use of the current pneumococcal vaccine in this Alaskan population is indicated. A parallel recommendation (i.e., the routine use of the vaccine for people older than two years) for the Canadian Inuit should await until: (1) the age-specific incidence rates of the confirmed pneumococcal disease are at hand, and (2) the cost effectiveness of the vaccine is defined [current estimate of the cost of delivery of the vaccine by the public health providers in rural Alaska is almost $50 per dose (Davidson et al., 1993)].

2. Influenza vaccine must be administered to debilitated children as indicated in the national manual on vaccination procedures, and

3. The respiratory syncytial virus (RSV) vaccine is not yet ready for use. It has been hindered by clinical studies with inactivated vaccines which resulted in an increase in the severity of RSV disease. The pathogenesis and protective antigens of RSV are yet incompletely understood. Nevertheless, vaccine development is still under laboratory study (Robbins and Feery, 1985).

D. Tobacco Smoking

The variables "number of smokers in the household and "history of maternal smoking during pregnancy" were found to influence the risk for ALRI. The health hazards of smoking on the individual and fetus are well known, and need not to be dealt with here. The following recommendations reiterate the important role of prevention:

- Ensure self-esteem and positive self-image of smokers.
- Educate all members of the Inuit community on the health hazards of smoking on smokers themselves, passive smokers, and the fetus of a smoking pregnant woman.

- Availability of smoking cessation programs.
- Good air ventilation in the households.

It should be reemphasized that solutions to this health issue should start from the fact that the Inuit community must become aware of smoking as a health hazard, and the need to prevent smoking. Thereafter, solutions must be found and implemented by the Inuit people themselves.

5.8.2.2 Secondary Prevention

Secondary prevention includes action(s) to minimize or interrupt the progress of a disease or the irreversible damage from that disease. The main action consists of educating the community (particularly the child care-takers) and the health personnel about:

1. The possible danger of ALRI in infancy and childhood upon the child's future health (i.e., susceptibility to frequent ALRI and/or chronic respiratory disease). This might be achieved through information sessions and local radio talk shows.
2. The necessity of treating cases at the early infection stage.

5.8.2.3 Tertiary Prevention

Tertiary prevention includes actions to slow down the progress of disease and/or to reduce the resultant disability to a minimum. This can be achieved by ensuring:

1. Emergency transportation for the life-threatening and severe cases of ALRI.

2. Rehabilitation facilities for respiratory disabled people.

5.8.2.4 Treatment

Treatment is composed of actions to cure the disease or injury. An active treatment may result in: (1) rapid return to full health, (2) slow return to full health, (3) improvement but with residual disability and (4) no improvement with residual disability.

Effective treatment is based on the availability of both well-trained health personnel and appropriate drug treatment.

The Indian and Inuit Health Services, Medical Services Branch, can adopt "The Program for Controlling Acute Respiratory Infections in Children" recommended by the World Health Organization (WHO, 1976). Although the program has been implemented in many developing countries since the late 1970's, its effectiveness is yet to be determined. It is safe to say that Canada has a prominent part to play because it has all the ingredients to make such a program successful. It is obvious that the program will not only include the control and prevention of ARI, but also for other prevalent and preventable infectious diseases such as otitis media and diarrhea.

Considerable progress has been made in our understanding of ALRI and its susceptibility to intervention. In particular:

1. The importance of different kinds of microbiological agents as the principal cause of mortality and morbidity from ALRI,
2. The importance of individual, socioeconomical, environmental factors in

influencing the risk for ALRI,

3. Effective antimicrobial and supportive treatment are available and therefore many cases of ALRI can be prevented. Supportive treatment includes breast-feeding for infants or ensuring adequate quantities of liquid and food for older children during illness and recovery phases of the infection, clearing the child's nose, increasing moisture in the air, ... etc.), and

4. The clinical experience consolidated into a simple case management whereby ARI cases are stratified in order to decide on management. The management decisions for the treatment of the cases of ARI are not based on the anatomical diagnosis, but on the severity of illness. A number of decision trees and flow charts based upon selected, easily recognizable symptoms and signs of ARI have been developed for the primary health care workers to facilitate the process of discrimination and timely decision making. The critical decisions are:

   (1) Whether or not to treat with antibiotics,

   (2) Whether to treat as an outpatient or refer for inpatient care (WHO, 1976) (WHO/ARI/88.2) (WHO/ARI/89.3) (WHO/ARI/89.4), and

5. The health services infrastructure in remote and sparsely populated areas must be based on a community health service in which the local residents co-operate (Haraldson, 1974; WHO, 1976).

Furthermore, extreme limitation of resources (financial, manpower, ...etc.) and/or low population density could lead to maldistribution of health services. The low population density can also lead to very expensive health care services, and therefore a poor cost/benefit ratio (Haraldson, 1974). In 1981, Ruderman and Weller conducted a study of Inuit Health and Health Services in the Keewatin Region. The estimated expenditure on health services was $1,094 per capita, compared with a Canadian average (excluding the Yukon and NWT) of $588. Ruderman and Weller added that travel and underutilization of the health manpower were the leading factors for the high cost of health in the Keewatin Region. Therefore, it could be said that although a full geographical equalization of the medical care will continue to be the ideal, compromises should be accepted when planning and providing the health care services under extreme conditions as well as the importance of setting a lower limit to planned services.

For the Canadian Natives, the main goals of such a program for the prevention and control of ALRI could be:

1. Control and prevention of ARI and other prevalent infectious diseases among Native children and adolescents.
2. Circumvent the high turnover of the non-Aboriginal nursing staff. Turnover of health care personnel exceeded 50% per year in the 1980's (Spady et al., 1979).
3. Take-over part of the health care provider's workload (busy and highly stressed nurses). In 1984, Postl et al. retrospectively reviewed the medical records of 584 children living in the NWT for the first 8 years of life. Of the 584 children, 60% were Inuit. The "well child visits" accounted for 30% of all nursing station visits. Furthermore, 80% of all "illness visits" were of an infectious

nature (upper respiratory tract infections, otitis media, skin disease, and gastroenteritis). Inuit children had the highest percentages of the "well child visits" and "illness visits". Some developing nations have successfully adopted an ARI Control Program whereby local health aides provide case management and treatment (Chaulet, 1990; Khan, 1990; Moteetee et al., 1990; Pio, 1990; Padney et al., 1990; Roesin et al., 1990; Steinhoff, 1990). Hence, the local health aides, who will deliver the program to the community, will take over part of the nurse's workload.

4. Decrease utilization of the health care facilities, and hence control the health care costs,
5. Meet one of the commitments of the Canadian government to the Native people which is "transfer of control of Native Health Services to Native people".
6. Encourage health professional training programs to establish a stable professional indigenous work force.
7. Increase training and evaluation of frontier outpost nursing programs.

5.9 Future Research

Research is an essential component to prevent and control ALRI among children. Epidemiological, clinical, and laboratory studies may represent parts of that component.

Future research are recommended for the following:

1. Address the etiology of ALRI, i.e., whether they are infective or noninfective.

2. Ethnographic studies to assess Inuit beliefs and practices related to ALRI which are the products of indigenous cultural development.

3. Clarify the effects of some factors like breast-feeding, SES, carving soapstones, ALRI during early infancy, and crowding.

4. Determining how the Inuit could be influenced to take more individual responsibility for the health of their bodies and for reducing the risks which they are imposing on themselves by either neglecting important lifestyle health factors or exposure to risk factors. For instance, studies are needed to assess the factors influencing the maternal decision for both breast-feeding and its duration.

5. After a health promotion strategy for prevention and control of ALRI has been implemented, its effectiveness in terms of morbidity reduction must be determined.

5.10 Conclusion

Overall, there appeared to be a high incidence of ALRI for the Inuit children and adolescents of the Keewatin Region (NWT) during the period of October, 1990 to October, 1992. It was also perceived that this high morbidity might have occurred over a long period of time in the past.

The two-fold higher incidence of ALRI during the period from October, 1990 to September, 1991 compared to the period of October, 1991 to October, 1992 may suggest an epidemic of ALRI. Furthermore, the available data and the anecdotal information were sufficient to support the notion of an epidemic.

The impacts of biases on the study results were not determined or fully controlled for. Nevertheless, it may be said with caution that biases did not act heavily on the results, because the results aligned with those of previous studies.

Several variables influenced significantly the occurrence of ALRI. These included age, type of milk-fed in infancy, length of breast-feeding, ALRI in early infancy, otitis media, first child care-taker, community, duration of living in the current household, school attendance, household member carving soapstone, number of smokers in the dwelling, and maternal smoking during pregnancy. However, multiple logistic regression selected only age, type of milk-fed in infancy, ALRI in early infancy, and community as those which influenced the occurrence of ALRI.

Children aged 2 to 3 years were found to be at a greater risk of having ALRI, and therefore the risk decreased as age increased. Furthermore, the incidence of infection was not distributed evenly across the eight Keewatin communities. ALRI was twenty-fold and six-fold higher among the children and adolescents of Sanikiluaq and Repulse Bay respectively than among those of Rankin Inlet. The children and adolescents of the other five communities were also at a higher but not statistically significant risk for ALRI than those of Rankin Inlet.

Infections of the lower respiratory tract in infancy predicted subsequent lower respiratory infection morbidity. However, future research is highly recommended to determine whether the subsequent respiratory morbidity is acute or chronic in nature. Secondly, whether ALRI in early life acts as an early marker for genetically preprogrammed subsequent respiratory morbidity or whether it acts as a true risk factor by causing a permanent damage to the lower respiratory tract.

Breast-feeding was a protective factor against ALRI. Using the breast-fed children and adolescents as a reference category, those who were both breast and bottle-fed were 58% more at risk of ALRI, while those who were bottle-fed alone were 252% more at risk of the infection. However, the relationship between breast-feeding and the occurrence of ALRI deserves further research to address whether the quality of breast milk is more effective than the length of feeding and secondly whether the protective effect of breast milk is from its conferred anti-infective properties or improved hygiene.

Although school attendance was found to be a predictor of ALRI, the trend of the association was in the opposite direction from the expected. The likelihood is high that the age variable could be accounted for this spurious finding. The children highly susceptible to infection (children aged 2 to 4 years) were kept at home. This could led to the reverse of the association between the school attendance and occurrence of ALRI.

The lack of enough variance of certain predictor factors among the children and teenagers was plausible to explain the absence of relationships between the study outcome and these predictors (such as number of individuals in the dwelling, number of other children in the household, number of smokers in the household, history of smoking in the child's bedroom, maternal smoking during pregnancy, fuel for cooking in the household, and annual average income of the household).

Although obscurities in the questions related to the household member carving soapstone have led to a careful interpretation of the result, the finding of a significant relationship between the household member carving soapstone and the risk for ALRI highlights the importance of future research in this regard.

The accuracy of the frequently used socioeconomic indicators (annual income, employment status, and educational status of the child care-giver) is still not determined. Future research should be directed toward other indicators. Cross-cultural issues should be taken into consideration during future selection of the socio-economic indicators.

Both surveillance and health promotion strategy to prevent and control ALRI are highly advocated to develop an increased awareness of the child care-provider and the community's responsibilities for the attainment and maintenance of good health for children. At each stage of the health promotion programs, the active involvement of the Native society is essential by identifying its' priorities, and planning, implementing, and evaluating the programs.

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APPENDIX A

SOCIODEMOGRAPHIC HOUSEHOLD SURVEY

CHURCHILL HEALTH ASSESSMENT
HOUSEHOLD SURVEY
FACE SHEET

Name	Age	Sex	Household #	Individual #
MALES				
1. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
2. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
3. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
4. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
5. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
6. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
7. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
8. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
9. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
10. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
FEMALES				
1. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
2. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
3. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
4. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
5. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
6. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
7. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
8. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
9. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _
10. ____________	___	___	_ - _ _ _ _	_ - _ _ _ _

CONSENT FOR KEEWATIN COMMUNITY NEEDS' SURVEY

The Keewatin Regional Health Board now has the full responsibility for planning our health care programs. One of their first steps is to document the level of health in our communities. They are also interested in knowing how the people feel about the health services which are presently being offered, and what changes you would like to see which may affect the health of our people.

I have a group of questions which I would like to ask you regarding your house and the people who live here. The information will be helpful in assessing the quality and availability of housing. All information which you give me will be strictly confidential and will only be used to create a summary picture. Your name will not be a part of the data or any reports from it. You are free to choose not to participate or, if you agree to assist us in this survey, you are free to not answer certain questions if you so choose. Your participation in this survey will be of great assistance in helping our community leaders to better understand the wishes of the people, before they embark on any large scale planning for our communities.

Household Number: __ - __ __ __ __

Household Member Signature: ____________________

Print Name: ____________________

Date: ____________________

Interviewer Signature: ____________________

Date: ____________________

HOUSEHOLD DATA

1. HOUSEHOLD #

____ - ___ ___ ___ ___
comm.#

2. Type of Housing ______

Public Housing (after 1974)	= 1
Northern Rentals (before 1974)	= 2
Private Owned	
Home Ownership Assisttance	= 3
Totally Private	= 4
Private Rented	= 5
Government Staff Housing	= 6
Private Staff Housing	= 7

3. Date of Present Interview |__|__|__|__|__|__|
d d m m y y

4. Total # of people living in house (fill in number)

female |__|__|

male |__|__|

5. How many rooms are there in your house? (not counting bathroom or kitchen) |__|

6. How many rooms in your house are regularly used for sleeping? |__|

7. How many people sleep in each bed (or on each sleeping surface, eg. couch, mattress, floor area)?

"bed" 1 |__|
"bed" 2 |__|
"bed" 3 |__|
"bed" 4 |__|
"bed" 5 |__|
"bed" 6 |__|
"bed" 7 |__|
"bed" 8 |__|

(If there are more than eight "beds", write them in the space above.)

8. How many families live in this house? |__|

9. Household possessions:
(mark with an X)

	YES	NO
refrigerator that works	___	___
freezer	___	___
washer and/or dryer	___	___
telephone	___	___
television How many? ____	___	___
video cassette recorder (VCR)	___	___
Atari game computer	___	___
personal (home) computer	___	___
microwave oven	___	___
car/truck/van that works	___	___
snowmobile that works List year and make of each one, eg.1976 Elan ____ ____.	___	___
3 or 4 wheeler that works	___	___
motorbike that works	___	___
boat and motor that work List year and make of each one: ____________ ____.	___	___
rifles	___	___
dog teams How many dogs? _____	___	___

10. Please answer each question below, regarding what type of water system and sewage disposal your house has: (mark with an X)

	YES	NO
pressurized water system (from a tap)	___	___
water barrel (no water at the taps)	___	___
sewage pumpout tank	___	___
honey bucket	___	___
sinks drain onto the ground under the house	___	___
sinks drain into the Hamlet sewage system	___	___
bathtub or shower that works	___	___

11. What is the primary way in which money is earned by each of the adults (over age 15 years) in this household?

ON THE LINE PROVIDED, WRITE IN EXACTLY WHAT EACH ADULT TELLS YOU THEIR WORK IS (eg. truck driver, store clerk, housewife, student, etc). Also write in the identifying # of that person (from the Face Sheet)
For example, if on the Face Sheet "male #3" is 42 years old and their job is a store clerk, below you would write for MALES # "3 - store clerk".

	# from Face Sheet		# from Face Sheet
MALES	#__-________________	FEMALES	#__-________________
	#__-________________		#__-________________
	#__-________________		#__-________________
	#__-________________		#__-________________
	#__-________________		#__-________________

FOR CODER'S USE ONLY:

MALES	#__- |__|__|	FEMALES	#__- |__|__|
	#__- |__|__|		#__- |__|__|
	#__- |__|__|		#__- |__|__|
	#__- |__|__|		#__- |__|__|
	#__- |__|__|		#__- |__|__|

12. What has been the main employment status of the adults of this household over the past 12 months?

unemployed = 1
seasonal = 2
casual / part time = 3
full time = 4
disabled = 5
retired = 6
homemaker/housewife/mother = 7
other = 8
don't know = 9

ENTER ONLY ONE CODE NUMBER FROM THE ABOVE LIST FOR EACH ADULT IN THIS HOUSEHOLD - THE NUMBER WHICH BEST DESCRIBES THE PAST YEAR'S EMPLOYMENT OF THE INDIVIDUAL. IF THE ANSWER IS #8 "OTHER", PLEASE WRITE IN EXACTLY WHAT THEY GAVE YOU FOR AN ANSWER (beside that block). Here again, please add the identifying # which was used on the Face Sheet

		code			code
MALES	#|__| -	|__|	FEMALES	#|__| -	|__|
	#|__| -	|__|		#|__| -	|__|
	#|__| -	|__|		#|__| -	|__|
	#|__| -	|__|		#|__| -	|__|
	#|__| -	|__|		#|__| -	|__|

13. What is the average annual income from any source for each adult over age 15 years in this household (after deductions have been taken from any pay cheques)?

less than $10,000. = 1
10,000. - 19,999. = 2
20,000. - 29,999. = 3
30,000. - 39,999. = 4
40,000. and up = 5
don't know = 6

Here again, please add the identifying # which was used on the Face Sheet

		code			code
MALES	#|__|	- |__|	FEMALES	#|__|	- |__|
	#|__|	- |__|		#|__|	- |__|
	#|__|	- |__|		#|__|	- |__|
	#|__|	- |__|		#|__|	- |__|
	#|__|	- |__|		#|__|	- |__|

14. What amount of costs must be paid per month for your house, averaged over a one year period (eg. rent or mortgage, utilities, property taxes)? Please tell me just what house bills must be paid after the income has come into the house.

If some of these costs are familiar to you as a yearly amount eg. taxes, you can quote that amount and we will compute the monthly amount later. (Write any yearly amounts in the available empty space, with clear instructions as to how the final calculations should be done.)

monthly average in $ __________

15. Are there presently any foster children placed in your home?

no ___ (GO TO #18)
yes ___

16. How many foster children are presently placed in your home?

|__| children

17. For each foster child who is presently placed in your home, please give me their present age (in years and months) and for how long (in years and months) they have been staying with you.

	present age	how long has stayed here
foster child 1	___________	______________
foster child 2	___________	______________
foster child 3	___________	______________
foster child 4	___________	______________
foster child 5	___________	______________

18. How many families living in this house are "single parent"? |__|

WE ARE VERY INTERESTED IN KNOWING HOW MANY PEOPLE IN THE COMMUNITY KNOW HOW TO DRIVE AN ATV. BECAUSE WE ARE NOT ASKING QUESTIONS TO CHILDREN UNDER THE AGE OF 15 YEARS, WE WOULD APPRECIATE IT IF YOU WOULD ANSWER FOR THOSE LIVING IN YOUR HOUSE AND UNDER THE AGE OF 15 YEARS.

19. How many children under the age of 15 years live in the same house with you? |__|__| children

(If none, enter "00" and END OF QUESTIONS - THANK YOU!) Otherwise,

20. How many children under the age of 15 years, living with you, know how to drive an ATV?

____ children

21. How many children under the age of 15 years, living with you, do drive an ATV?

____ children

22. Of those children under 15 years who do <u>drive</u> an ATV (as the driver, not a passenger), please tell me how often they wear a helmet.

never = 1
sometimes = 2
always = 3

CHILD 1 ___
CHILD 2 ___
CHILD 3 ___
CHILD 4 ___
CHILD 5 ___
CHILD 6 ___

THAT IS ALL OF THE QUESTIONS WHICH I HAVE TO ASK YOU AT THIS TIME. THANK YOU VERY MUCH FOR YOUR TIME AND ATTENTION.

APPENDIX B

KEEWATIN HEALTH STATUS ASSESSMENT SURVEY

KEEWATIN

HEALTH

ASSESSMENT

ADOLESCENT QUESTIONNAIRE - ENGLISH

DATE OF APPOINTMENT: ___ - ___ - 1990

ID NUMBER: ___ - ___ ___ ___ ___

HOUSEHOLD #: ___ - ___ ___ ___

Contents:

(1) Nurse/Lab Form

(2) Audiology Form

(3) Adult Dental

(4) Pediatric Dental

(5) Adolescent English Interview

EXAMINATION AND LABORATORY DATA FORM

DATE: __ __ - __ __ - 1990

INDIVIDUAL MEMBER NUMBER: __ - __ __ __ __

HOUSEHOLD NUMBER: __ - __ __ __ __

AGE ________

Does the individual have any chronic diseases or handicaps? If yes, please list:

____

____

____

Blood Pressure

1. First blood pressure reading (after at least five minutes of rest):

   Systolic __ __ __

   Diastolic (5th) __ __ __

2. Second blood pressure reading:

   Systolic __ __ __

   Diastolic (5th) __ __ __

Anthropometrics

3. Standing height (without shoes) ________ (cm)

4. Weight (without shoes and light indoor clothes) ________ (kg)

5. Waist circumference ________ (cm)

6. Hip circumference ________ (cm)

7. Skin Fold Measurements
   Arm ________ (cm)

   Scapula ________ (cm)

Glucose Tolerance Test

8. Fasting plasma glucose ________ (mmol/litre)

9. 2-Hour post-challenge plasma glucose ________ (mmol/litre)

COMMUNITY MEMBER SURVEY
KEEWATIN COMMUNITY NEEDS' SURVEY
ADOLESCENTS

1. Date of present interview

day ____ month ____ Year ____

2. ID Number (MEMBER master list)

__ - __ __ __ __
comm.#

3. ID Number (HOUSEHOLD master list)

__ - __ __ __ __

4. Date of Birth

day ____ month ____ Year ____ [ ]

5. Sex [MALE=1, FEMALE=2] [ ]

6. (a) Are you presently attending school (including correspondence courses)?
[CHECK ONE]

No= 1
Part time= 2
Full time= 3

[ ]

6. (b) How confident are you that you will be able to find a good job in your community? would you say,
[LIST]

1. very confident
2. Somewhat confident
3. not at all confident

[ ]

7. Please tell me how well you think you speak and understand English. Would you say,
[LIST]

1. very well
2. moderate
3. very little
4. not at all

[ ]

APPENDIX C

FOLLOW-UP RESPIRATORY SURVEY

DATA COLLECTION FORM

STUDY OF LOWER ACUTE RESPIRATORY INFECTIOUS DISEASES AMONG THE KEEWATIN ABORIGINAL INUIT CHILDREN and ADOLESCENTS

PART ONE: INDIVIDUAL INTERVIEW OF THE CHILD CARE-GIVER

CHILD'S NAME: (First Name) ______________________________

(Last Name) ______________________________

COMMUNITY: ____

DATE OF INTERVIEW: Day _ _ Month _ _ Year 1 9 _ _

CONSENT FORM

KEEWATIN INUIT CHILDREN and TEENAGERS RESPIRATORY INFECTIONS STUDY

I would like to explain to you what this study involves. If you agree to take part, I would like you to sign this consent form.

In 1990 your child took part in the Keewatin Health Study sponsored by the Keewatin Regional Health Board and conducted by University of Manitoba. We would like to ask you additional questions about your child.

This study tries to find out the proportion of the children in your community who have been infected in the chest and lung during the last two years and the factors which promote these infections. The purpose is to provide health professionals with accurate information on the extent of the problem of infections of the chest and lung in your community, and what steps could be taken to prevent them.

A qualified interviewer will ask you questions regarding the health of your child, your lifestyle (such as smoking), and the conditions of the home (such as method of heating and cooking, and number of occupants).

A university student will review your child's medical record in the Nursing Station to find out what sort of illnesses he/she has had in the past.

All information contained in this questionnaire will be kept strictly confidential. Your name and your child's name will not appear at any time on the questionnaire, or kept in the computer, or appear in the publications that may result from this study.

This study is entirely voluntary. If you do not take part, it will not affect your obtaining care at the clinic here. If you are willing to participate in this study, please sign below. If further questions should arise, please contact me (Dr. Soleman Mirdad) or my supervisor Dr Kue Young at (204) 788-6644 at the Northern Health Research Unit, University of Manitoba.

____________________ Witness

____________________ Parent / Guardian

.. / .. / 19 . .
Date

CHILD ID NUMBER: ___ - ___ ___ ___ ___

I would like to obtain some information about **(<u>NAME OF CHILD</u>)** yourself, and the house where **(<u>NAME OF CHILD</u>)** usually lives in.
Please, answer the following questions as accurate as you can

---

Q-1 Please, check the person responding to the questionnaire:

1. Natural Mother
2. Natural Father
3. Adoptive Mother
4. Adoptive Father
5. Guardian
6. Other

___
___

Q-2 Sex of the child:

1. Male
2. Female

___
___

Q-3 Date of birth of the child:

Day ___ ___

Month ___ ___

Year 1 9 ___ ___

___ ___
___ ___
___ ___
___ ___
___ ___
___ ___

Q-4 Does the child attend a day care center, or a school?

1. Day care center
2. Regular school
3. No

___
___

Q-5 In the first 1 year of life of the child, is (was) he/she breast-fed only?

1. Yes **[ASK Q-6 THEN SKIP TO Q-10]**
2. No **[SKIP TO Q-7]**

___
___

Q-6 For how long was (is) the child breast-fed?

___ Months **[LEAVE BLANK IF DOES NOT KNOW]**

___
___

Q-7 In the first 1 year of life of the child, is (was) he/she breast-fed and given the bottle?

1. Yes **[ASK Q-8]**
2. No **[SKIP TO Q-10]**

___
___

Q-8 For how long was (is) the child breast-fed?

___ Months **[LEAVE BLANK IF DOES NOT KNOW]**

___
___

Q-9 For how long was (is) the child bottle-fed?

____ Months **[LEAVE BLANK IF DOES NOT KNOW]** ___ ___

Q-10 Is this house the place where the child usually lives in?

1. Yes
2. No

___ ___

Q-11 For how many years has the child lived in this house?

________ Years ___ ___

Q-12 How many people usually live in the same house where the child lives?
[ANSWER MUST INCLUDE THE CHILD]

________ Persons ___ ___

Q-13 How many children 15 years or younger live in the same house where the child lives?

________ Children ___ ___

Q-14 How many people share the child's bedroom?

________ Persons ___ ___

Q-15 Do any of those people smoke cigarettes in the child bedroom?

1. Yes
2. No

___ ___

Q-16 Who is the person that usually takes care of the child?
[DO NOT READ ANSWER - CIRCLE AND/OR WRITE ANSWER]

1. Natural Mother
2. Natural Father
3. Adoptive Mother
4. Adoptive Father
5. Other: ________________________________ ___
________________________________ ___

Q-17 Does ________________________________
[NAME FIRST PERSON WHO USUALLY TAKE CARE OF THE CHILD]
smoke cigarettes or pipe now?

1. Yes, regularly
2. Occasionally
3. No, never

___ ___

Q-18 Did ______________________________
[NAME FIRST PERSON WHO USUALLY TAKE CARE OF THE CHILD]
smoke cigarettes or pipe in the last two years?

1. Yes, regularly
2. Occasionally
3. No, never

Q-19 Does ______________________________
[NAME SECOND PERSON WHO USUALLY TAKE CARE OF THE CHILD]
smoke cigarettes or pipe now?

1. Yes, regularly
2. Occasionally
3. No, never

Q-20 Did ______________________________
[NAME SECOND PERSON WHO USUALLY TAKE CARE OF THE CHILD]
smoke cigarettes or pipe in the last two years?

1. Yes, regularly
2. Occasionally
3. No, never

Q-21 When the mother was pregnant with the child, did she smoke?

1. Yes, regularly **[SKIP TO Q-23]**
2. Occasionally **[SKIP TO Q-23]**
3. No, never **[ANSWER Q-22]**
4. Stopped smoking **[ANSWER Q-22]**

Q-22 After the delivery of the child, did she start smoking?

1. Yes
2. No

Q-23 How many smokers in the house in total?
[ANSWER MUST INCLUDE: 1) ALL SMOKERS IN THE HOUSE WHERE THE CHILD LIVES IN. 2) CHILD CARE-TAKER(S) LIVING IN THE HOUSE WHERE THE CHILD LIVES IN].

________ Smokers

Q-24 What fuel is usually used for cooking in the house?

1. ______________________________
2. ______________________________

Q-25 How is the house heated?

1. ______________________________
2. ______________________________

Q-26 Are there smells from your heating system?

1. Yes **[ASK Q-27]** ___
2. No **[SKIP TO Q-28]** ___

Q-27 How often are you bothered by those smells?

1. Regularly ___
2. Occasionally ___

Q-28 Does anyone in the house make soapstone carvings?

1. Yes **[ASK Q-29]** ___
2. No **[SKIP Q-29]** ___

Q-29 Where does this person or those people make soapstone carvings?
[CIRCLE AND/OR WRITE ANSWER]

1. Inside the house ___
2. Outside the house ___
3. ______________________________

DATA COLLECTION FORM

STUDY OF LOWER ACUTE RESPIRATORY INFECTIOUS DISEASES AMONG THE KEEWATIN ABORIGINAL INUIT CHILDREN and ADOLESCENTS

PART TWO: MEDICAL RECORD REVIEW

CHILD'S NAME: (First Name) ______________________

(Last Name) ______________________

COMMUNITY: ________________________________

DATE: Day _ _ Month _ _ Year 1 9 _ _

CHILD ID NUMBER: ___ - ___ ___ ___ ___

Q-1 Sex of the child:

1. Male
2. Female

Q-2 Date of birth of the child:

Day ___ ___

Month ___ ___

Year 1 9 ___ ___

Q-3 Has the child ever had asthma?

1. No
2. Yes

Q-4 When asthma was diagnosed?
month ___ ___

year ___ ___

Q-5 Does the child still have asthma? 1. No
2. Yes

Q-6 Has the child ever had an operation on the chest?

1. No
2. Yes

Q-7 Which operation on the chest the child has had?
1. ______________________________

Q-8 When chest surgery was done?
month ___ ___

year ___ ___

Q-9 Has the child ever had heart disease?

1. No
2. Yes

Q-10 Which heart disease the child has had?

1. ______________________________

2. ______________________________

Q-11 When heart disease was diagnosed?
month ___ ___
year ___ ___

Q-12 Current status of the child's heart?

1. ______________________________

2. ______________________________

Q-13 Has the child ever had tuberculosis infection?
(i.e. diagnosed as a T.B. convertor)

1. No
2. Yes

Q-14 When TB conversion was diagnosed?
month ___ ___
year ___ ___

Q-15 Has the child ever had pulmonary tuberculosis disease?

1. No
2. Yes

Q-16 When TB disease was diagnosed?
month ___ ___
year ___ ___

Q-17 Current status of TB disease?

1. ______________________________

2. ______________________________

Q-18 Has the child ever had bronchiectasis?

1. No
2. Yes

Q-19 When bronchiectasis was diagnosed?
month ___ ___
year ___ ___

Q-20 How many attacks of the following illnesses the child had in the period from JULY 1990 until now?

A. Croup ___ attacks ___
B. Whooping Cough ___ attacks ___
C. Otitis Media ___ attacks ___
D. Hay Fever ___ attacks ___
E. Emphysema ___ attacks ___

Q-21 Has the child ever had lower respiratory infections before the age of 2 years?

------------- 1. No ___
---------- 2. Yes ___

Q-22 How many attacks the child had before the age of 2 years?

___ attacks in the first year of life ___

___ attacks in the second year of life ___

Q-23 How many attacks of acute lower respiratory infections the child had in the period from JULY 1990 until now?

ATTACK	DATE		PATIENT COMPLAINS	MEDICAL-STAFF FINDINGS	AUSCOLTATION	DIAGNOSIS	HOSPITALIZATION				X-RAY	
	MM	YY					NO	HCH	HSC	OTHER	YES	NO