Seroprevalence of zoonoses in Nunavik

*What we have learned from the Qanuippitaa Health Survey*

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1. Problem

What is a zoonosis???

An infectious disease transmissible from animals to humans

e.g. → Rabies
     → Avian flu
     → Toxoplasmosis
1. Problem

A study on zoonoses …

- Greater risk for acquiring infections related to wildlife due to Inuit lifestyle and food habits (time spent on the land, consumption of natural water and raw meats)

- Little data available on the distribution of pathogens and their hosts in Nunavik

- Unknown prevalence among wildlife and human populations
1. Problem

Routes of transmission

- Ingestion of contaminated water or food
- Direct contact with an infected animal
- Exposure to aerosolized particles, contaminated water or other material (milk, manure, urine, etc.)
- Insect bites
- Mother to fetus (transplacental)

Source: www.avataq.qc.ca
1. Problem

Zoonoses under study

1. Trichinosis (*Trichinella* sp.)*
2. Toxocariasis (*Toxocara canis*)
3. Echinococcosis (*Echinococcus granulosus*)
4. Toxoplasmosis (*Toxoplasma gondii*)
5. Brucellosis (*Brucella* sp.)*
6. Leptospirosis (*Leptospira* sp.)*
7. Q fever (*Coxiella burnetii)*
8. Tularemia (*Francisella tularensis)*

* Included in Quebec passive surveillance system for reportable diseases (MADO)
1. Problem

Present situation

- No case reported to Quebec passive surveillance system for reportable diseases (MADO) over the last decade - except for trichinosis.

- Infections often underreported due to their non-specific presentation and/or mild manifestations.
2. Study

Source: www.snowgoose.ca

Source: www.snowgoose.ca

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2. Study

Descriptive seroprevalence study

- Verify the presence of antibodies against eight pathogens in human sera
- Determine the exposure of Nunavik Inuit to different microorganisms
2.1 Objectives of the study

- Describe the seroprevalence of eight pathogens in terms of the socio-demographic characteristics of the Nunavik Inuit;

- Identify risk factors for infection in relation with hunting and trapping habits, traditional diet and natural water consumption;

- Identify intervention strategies adapted to Inuit communities.
2.2 Methods

Data collection

Fall 2004, Health Survey of the Inuit of Nunavik - *Qanuippitaa?*

Information gathered on the members of 521 Inuit households

Sample weighed to be representative of the population
2.2 Methods

Household Questionnaire

Questionnaire completed with the household respondent for every member of the household (n=521)

- Demographic characteristics (age, gender, region)
- Way certain food items were eaten
- Supply of drinkable water
2.2 Methods

**Individual Questionnaire**
- **Socioeconomic status** (schooling, personal income, employment status, etc.)
- **Habits** (hunting, fishing, berry picking)

**Food Frequency Questionnaire**
- Frequency of consumption of various food items
2.2 Methods

**Blood sample**

*Inuit Health Survey*
2.2 Methods

Serological analyses

1) Immunoenzymatic methods: ELISA*
   - *Trichinella* sp., *T. canis* and *E. granulosus* (IVD inc.)
   - *T. gondii* (AxSYM, Abbott Diagnostics, Abbott Park, Illinois)
   - *Brucella* sp., *Leptospira* sp. and *C. burnetii*
     (Virion\Serion, Serion Immundiagnostica GmbH, Würzburg)

2) Tube agglutination test
   - *F. tularensis* (Snyder, 1980; Stewart, 1981)

*ELISA*: Enzyme Linked ImmunoSorbent Assay
# Serological analyses

<table>
<thead>
<tr>
<th>Pathogens</th>
<th>Negative</th>
<th>Equivocal</th>
<th>Positive</th>
<th>Lifetime of antibodies</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optical density (OD)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>Trichinella sp.</em></td>
<td>&lt; 0.25</td>
<td>≥ 0.25 et &lt; 0.35</td>
<td>≥ 0.35</td>
<td>9 - 18 months</td>
</tr>
<tr>
<td><em>T. canis</em></td>
<td>&lt; 0.25</td>
<td>≥ 0.25 et &lt; 0.35</td>
<td>≥ 0.35</td>
<td>Indefinite</td>
</tr>
<tr>
<td><em>E. granulosus</em></td>
<td>&lt; 0.35</td>
<td>≥ 0.35 et &lt; 0.45</td>
<td>≥ 0.45</td>
<td>Possibly for life</td>
</tr>
<tr>
<td><strong>IgG Units (IU/ml)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>T. gondii</em></td>
<td>&lt; 2</td>
<td>≥ 2 – &lt; 3</td>
<td>≥ 3</td>
<td>For life</td>
</tr>
<tr>
<td><em>Brucella sp.</em></td>
<td>&lt; 20</td>
<td>≥ 20 – &lt; 30</td>
<td>≥ 30</td>
<td>Indefinite</td>
</tr>
<tr>
<td><em>Leptospira sp.</em></td>
<td>&lt; 5</td>
<td>≥ 5 – ≤ 9</td>
<td>&gt; 9</td>
<td>6 months - &gt;20 yrs</td>
</tr>
<tr>
<td><em>C. burnetii</em></td>
<td>&lt; 20</td>
<td>≥ 20 – &lt; 30</td>
<td>≥ 30</td>
<td>~ 5 yrs</td>
</tr>
<tr>
<td><strong>Titre</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><em>F. tularensis</em></td>
<td>&lt; 1/20</td>
<td>1/20 – 1/40</td>
<td>≥ 1/80</td>
<td>&gt; 10 yrs</td>
</tr>
</tbody>
</table>

*a* Faine (1998)  
*b* Virion\Serion, Serion Immundiagnostica GmbH, Würzburg  
*c* Young *et al.* (1969)
2.2 Methods

Serological analyses

- Sensible and specific methods
- Possible interpretations for equivocal results
  - Old infections
  - Cross reactions
2.2 Methods

Statistical analyses

- Univariate analyses using the Khi-square Test
  - to verify the association between seroprevalence, sociodemographic characteristics and risk factors
- Variables potentially associated with seroprevalence were included in a Logistic Regression Model to control for confounding factors (multivariate analyses)
2.3 Results

Inuit Health Survey

Source: www.avataq.qc.ca
2.3.1 Seroprevalence

- **Trichinella sp.**
  - Positive: 98.9%
  - Negative: 1.0%

- **T. canis**
  - Positive: 95.2%
  - Negative: 0.9%

- **E. granulosus**
  - Positive: 89.6%
  - Negative: 3.9%

- **T. gondii**
  - Positive: 37.2%
  - Negative: 8.3%

- **Brucella sp.**
  - Positive: 59.8%
  - Negative: 2.9%

- **C. burnetii**
  - Positive: 81.7%
  - Negative: 12.4%

- **Leptospira sp.**
  - Positive: 81.1%
  - Negative: 5.9%

- **F. tularensis**
  - Positive: 16.3%
  - Negative: 2.6%

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*a* Coefficient of variation between 16.6 and 33.3%, to be interpreted with caution.

*b* Coefficient of variation higher than 33.3%, insufficient precision.
2.3.2 Multivariate analyses

Avataq Cultural Institute

Inuit Health Survey

Avataq Cultural Institute
2.3.2 Multivariate analyses

*T. canis* (p≤0.05)
- **Age** (≥50 yrs ↑); **region of residence** (Hudson ↑)

*E. granulosus* (p≤0.05)
- **Gender** (♀ ↑); **schooling** (≥high school ↓);
  frequent **cleaning of water reservoir** (once a month ↑)

*Leptospira* sp. (p≤0.05)
- **Age** (≥50 yrs ↑)

*F. tularensis* (p≤0.05)
- **Age** (≥50 yrs ↑); **region of residence** (Ungava ↑)
2.3.2 Multivariate analyses

*T. gondii* (p≤0.05)

- **Age** (≥30 yrs ↑); **gender** (♀ ↑); **schooling** (high school completed ↓);

  Annual consumption of **seal meat** and **feathered game**;

  Frequent **cleaning of water reservoir** (once a month ↑);

  **water exposure index** (high risk ↑)

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**Water exposure index**

- **Low risk**: bottled water OR boiled / filtered water
- **High risk**: natural water OR water from municipal system / water plant – no treatment
2.4 Discussion

Source: inuk-www.civilisations.ca
2.4 Discussion

- **First study on a representative sample of the Inuit population**
- **Importance of the problem**
- **Identification of potential risk factors**

**Limits**

- Tranversal study: not designed to identify causal factors or confirm the etiology of the infections (formulation of hypotheses)
- Other factors not investigated – e.g. hygiene
2.4 Discussion

No or infrequent exposure to *Brucella* sp., *C. burnetii* and *Trichinella* sp. (≤1%)

- Outbreaks of trichinosis in the ‘80s and ‘90s – Importance of surveillance program (walrus meat)

Low seroprevalence of *T. canis* (3.9%), *E. granulosus* (8.3%), *Leptospira* sp. (5.9%) and *F. tularensis* (2.6%)

- No declaration to surveillance system (MADO)
- No acute infection detected with strongly reactive serologies
2.4 Discussion

High seroprevalence of *Toxoplasma gondii* (60%)

- North-South gradient (data not shown)
- Consumption of seal meat and feathered game
  - Seal: 14%
  - Goose: 4.2%
  - Ptarmigan: 2.5%

- Supply of drinkable water
  - Unfiltered surface water
  - Parasites resistant to chlorination
  - Potential re-circulation after cleaning of water tank
2.4 Discussion

However,

- Definitive hosts, cats and wild felines, rarely seen in Nunavik
- Prevalence is much lower in Cree people
- Importance of hygiene and other factors (not evaluated in this study)
2.4 Discussion

- Identification of the best way to clean the water reservoir
- Need for microbiological characterization studies of surface and drinking water

Pilot project in 5 communities to identify *T. gondii* in natural and drinking water

- Negative results -

Report sent to the Public Health Direction of Nunavik
Conclusion

- Population exposed to microorganisms from the fauna (particularly to *T. gondii*)
- Continue to supply information on zoonoses and safe procedures for handling animals (population, HFTA)
- Continue to support clinicians and medical staff in the management of zoonoses
- Pursue research efforts to identify the sources (animals, water, etc.) of *T. gondii* in Nunavik

Project on the identification of *T. gondii* reservoirs
Thanks to the communities of Nunavik that participated in this study and to the staff of the Qanuippitaa Health Survey!

Thank you for your attention!