From science to action and from action to science: the Nunavik Trichinellosis Prevention Program

Sylvain Larrat¹,², Manon Simard³, Stéphane Lair¹, Denise Bélanger² and Jean-François Proulx⁴*

¹Centre québécois sur la santé des animaux sauvages/Canadian Cooperative Wildlife Health Center, Saint-Hyacinthe Faculty of Veterinary Medicine, University of Montréal, St-Hyacinthe, QC, Canada; ²International Veterinary Group, Saint-Hyacinthe Faculty of Veterinary Medicine, University of Montréal, St-Hyacinthe, QC, Canada; ³Nunavik Research Centre, Makivik Corporation, Kuujjuaq, QC, Canada; ⁴Department of Public Health, Nunavik Regional Board of Health and Social Services, Kuujjuaq, QC, Canada

Objectives. During the 1980s, walrus-meat consumption caused infections with the parasite Trichinella nativa in Nunavik inhabitants. In response to these events, stakeholders set up the community-based Nunavik Trichinellosis Prevention Program (NTPP). The objectives of the present communication are to review the NTTP, describe how science and action were interwoven in its development and identify its assets and limitations.

Study design. Descriptive study.

Methods. The NTTP relies on a pooled digestion assay of tongue samples taken from each harvested walrus. The public health recommendations depend on the results of the analyses: infected walrus meat should be destroyed; parasite-free meat may be eaten raw or cooked.

Results. All communities involved in the walrus hunt participate in the NTTP and a high percentage of harvested walruses are included in the NTTP. Infected animals account for 2.9% of the walruses tested (20/694) since 1992. The NTTP permitted the early management of a trichinellosis event in 1997. Since then, it prevented the new occurrence of outbreaks related to walruses hunted by Nunavimmiut.

Conclusions. The absence of recent major outbreaks of trichinellosis in Nunavik may reasonably be attributed to the NTTP. The success of the program stands on many facilitating factors such as the nature of the disease and its source, the existence of an efficient analytic method, the strong involvement of the different partners including direct resource users, as well as the comprehensive bidirectional science-to-action approach that has been followed.

Keywords: trichinellosis; prevention; Inuit; walrus; Trichinella nativa

Approximately 10,000 Inuit people live in the 14 isolated communities of Nunavik, the arctic region of Québec (1). They compose 90% of the regional population. Country food represents a significant alimentary resource in the region (16% of energy intake in 2004) (2). Walrus (Odobenus rosmarus) is one of the animals regularly harvested for food in more than half of the communities. Walrus hunting generally takes place between the months of July and September on Ungava Bay and in September and October on Hudson Bay. Hunters travel in community boats to offshore islands (3). Walrus meat, which is widely shared within villages, is either eaten raw, fermented (igunaq) or cooked.

It provides a good source of healthy local food, compared to highly processed commercial food. The walrus hunt is also part of the Inuit culture and plays important socio-economic roles (4).

Despite the positive impact of walrus harvesting on Inuit communities, the consumption of undercooked meat represents a zoonotic hazard since walruses are occasionally infected by Trichinella nativa (5).

Nunavik Inuit and trichinellosis

Trichinella nativa is the most northern species of Trichinella spp. This intracellular nematode parasite is mainly found in carnivores, such as bears, arctic foxes,
wolves and walruses. In Nunavik, the estimated prevalence of *T. nativa* in walruses (2–4%) is lower than in polar bears (*Ursus marinus*) (60%), but is much higher than what has been observed in other marine mammals (3,5,6). As it is often eaten raw, walrus meat is the most frequent source of trichinellosis in the Arctic (5,7–11). After ingestion of infected meat, larvae rapidly develop into adult worms in the host intestine (12,13). First-stage larvae (L1) are shed and then migrate via the intestinal lymphatic vessels and blood circulation to the striated muscular cells (12,14). Since larvae of *T. nativa* are destroyed by heat (in 1 minute at 67°C), the consumption of properly cooked meat does not represent a risk of infection. On the other hand, in contrast to *T. spiralis*, *T. nativa* larvae resist long-term freezing. Consequently, this method of preservation does not prevent transmission of *T. nativa* in people. Infectivity of larvae decreases after meat fermentation, but their inability to survive in iced meat is still equivocal (15,16). Limited evidence suggests that *T. nativa* may be highly infective for humans. Clinical diseases were found in people who had eaten meat containing 1–4 larvae per gram (5,7).

Trichinellosis is classically characterized by an incubation phase of 6–20 days, followed by a short gastro-intestinal phase associated with the adult parasites. Fever, myalgia, facial oedema, rash, increased muscle-enzyme level in blood and eosinophilia are common clinical findings associated with the migrating larvae (10). A chronic gastro-intestinal syndrome, characterized by prolonged diarrhoea without prominent muscular signs, has also been described in Inuit people (9,10). Clinical and serologic evidences suggest that the classical myopathic form occurs at first infection by *T. nativa*, while the chronic gastro-intestinal form affects previously sensitized individuals. Both types are associated with occasionally severe, prolonged and debilitating forms of infection (10).

Diagnosis of trichinellosis is confirmed by parasitological examination of muscular biopsies or by the detection of specific antibodies (17). Medical management relies on the administration of anthelmintics (mebendazole or albendazole) and glucocorticosteroids (17).

From 1982 to 1997, 9 outbreaks of human trichinellosis linked to walrus consumption were documented in Inuit communities of Nunavik (3). In the largest one in 1987, clinical evidence of infection was found in 62% (42/68) of the persons tested among 88 consumers of an infected walrus who participated in the epidemiological investigation that was carried out at the time. Unfortunately, no characterization of the strain or larvae numeration was done. It is believed that these events contributed to the decrease in walrus harvests during the 1980s in the affected communities. Since walrus hunting was viewed as an economically, culturally and socially important activity, stakeholders agreed to collaborate to prevent human trichinellosis and to promote the walrus hunt.

**History of the trichinellosis prevention program in Nunavik**

In response to the initial outbreaks (1982–1983), a first approach to the problem was to educate community members on the importance of cooking walrus meat to prevent trichinellosis. This recommendation was not successful since it did not take into account the cultural specificity of the communities, including the taste of the community members for raw walrus meat (4). First attempts to analyze walrus meat for the presence of *T. nativa* were conducted by sending samples to a southern laboratory, but delays between submission and the results were too long. From 1983 to 1987, a limited number of samples were locally analyzed by trichinoscopy in a few local health clinics. This method was time-consuming, had a relatively low sensitivity, suffered from the high personnel turnover at the clinics and failed to prevent new outbreaks (4).

In 1991, several partners, including the Salluit Municipal Corporation, the Makivik Renewable Resource Development Department, the Inuulitsivik Health Centre and the Laval University Public Health Department decided to conduct and evaluate a local pilot project of trichinellosis prevention in Salluit, one of the most affected communities (4). The Nunavik Trichinellosis Prevention Program (NTPP) began in 1992 in Salluit and was then progressively refined and offered to every walrus-harvesting community in 1996 (3). As will be described below, the NTPP consists of a regionally based screening program for trichinellosis in harvested walrus to achieve disease prevention.

The objective of the present communication is to describe and review the NTPP with a special focus on the interweaving of science and action involved in its development. The effects of this program on the incidence of trichinellosis in Nunavik communities and its assets and limitations will also be discussed.

**Materials and methods**

The NTPP, which started in 1992 in its present form, is a community-based program, involving many local partners such as the Nunavik Public Health Department, the Nunavik Research Centre (NRC) of Makivik Corporation, the Kativik Regional Government (through the Hunter Support Program), the municipal authority of each participating community and the boat captains.

**Sample collection**

Walrus hunters participate in the NTPP on a voluntary basis. They receive protocols and sampling kits (including identification tags, protocols and data sheets) through the NRC. They are asked (a) to securely tag all pieces of meat from each walrus to ensure future traceability,
Laboratory analysis and diagnosis

The Nunavik Research Centre, in charge of the analyses, delivers results within 24 hours after sample reception. The procedure follows a protocol developed in association with the Canadian Food Inspection Agency (CFIA) from a validated method for detection of *T. spiralis* in pork and horse meat. The main differences with the latter method are the type of muscle analyzed, a decreased quantity of muscles tested and an increased digestion time (18). It consists of an enzymatic digestion coupled with a double-funnel separatory procedure (18,19). Briefly, 10 g of muscle tissue from 5 walruses are pooled together and blended in 50–100 mL of 1% HCl. Thirty grams of granular pepsin (1:10,000 US National Formulary) are dissolved in the paste. In a beaker, HCL solution is added to the mix, until it reaches 3 L. The recipient is put on a magnetic stirrer and heated at 45°C in an incubator for 90 minutes. After incubation, the solution is filtered through a 180 μm-pore sieve and it is then allowed to settle for 30 minutes in a 4 L separatory funnel. Larvae gather at the bottom of the funnel, closed by a valve. The lower 150 mL are drained into a second 500 mL separatory funnel, diluted with 350 mL of warm tap water and left to settle for 10 minutes. The lower 25 mL are poured into a Petri dish and examined under a stereomicroscope at 20× magnification (18). If larvae are present, each walrus tongue is individually analyzed with the same protocol to identify the infected animal(s). A PCR assay is later conducted on larvae isolates at the CFIA laboratory to verify which infected animal(s). A PCR assay is later conducted on larvae isolates at the CFIA laboratory to verify which infected animal(s). A PCR assay is later conducted on larvae isolates at the CFIA laboratory to verify which infected animal(s). 

Communication of results and recommendations

The results of the analyses are communicated to the Nunavik Public Health officer who immediately contacts the municipal authorities to inform them and provide proper food-management advice. The municipalities usually inform villagers by local FM radio. The recommendations are as follows: meat of uninfected animals may be eaten raw or undercooked; meat of untested walruses should be thoroughly cooked before consumption (no pink centre); infected meat should not be given to dogs but should be destroyed; *igluag* prepared from uninfected animals can be eaten without risk of trichinellosis. Each piece of tested and negative walrus meat should be marked to that effect.

Recommendations and educative content have been communicated to community members through various strategies, including video documentaries on television, messages on radio, pamphlets, articles in Makivik’s magazine and direct communication in annual hunter meetings.

Trichinellosis surveillance

Passive surveillance of occurrence of human cases of trichinellosis in communities is the responsibility of local health services with the assistance of the Nunavik Public Health Department. Information regarding confirmed and probable cases of trichinellosis has been gathered since 1980 through the Quebec system for mandatory declaration of disease. A confirmed case is defined as follows: “compatible clinical manifestations with one of the following conditions: (a) identification of *Trichinella* in muscular tissue from biopsy OR, (b) detection of specific antibodies by EIA in 2 following sera collections 3 to 4 weeks apart.” A probable case is defined as: “compatible clinical manifestations in a person who has eaten the incriminated meat in an outbreak context where at least one case has been confirmed.” The surveillance system is enhanced through ongoing medical education and transfer of laboratory results showing high levels of eosinophils (>10%) in white blood counts to the Public Health physician, who then contacts the treating physician to ensure that trichinellosis is considered in the differential diagnosis.

Results

For the first 4 years the NTPP was implemented in only 1 community (Salluit), and then extended in 1996 to every community harvesting walruses. Since the extension of the program, members from 5 to 9 communities out of the 14 communities in Nunavik participated in the walrus hunt and the NTPP each year (Fig. 1). An increase in the percentage of hunted animals sampled and tested was documented during the 12 first years after the implementation of the NTPP in 1992, with almost all the harvested walruses being tested from 2000 to 2004. Since the total number of harvested walruses was not recorded from 2004 to 2008, the percentage of tested animals during these years is undetermined, but is believed to have remained very high.

The prevalence of *Trichinella* in walrus varied from 0 to 12% with peaks in 1997 and 2001. All positive walruses during those peaks were all harvested in Eastern Hudson Bay. Since 2001, the community going at that location is...
going hunting every few years at a farther location in
Hudson Strait. Some hunters also choose the younger
walruses since they seem less infected. Figure 2 presents
the results of the screening for *Trichinella* sp. larvae in
walrus and walruses harvested each year. From 1992 to
2009, 20 positive animals were found in the 694 walruses
tested (2.9%).

From 1982 to 2009, a total of 15 trichinellosis incidents
were recorded in 7 communities in Nunavik, nine of
which were linked to the consumption of walrus meat.
Five of these 9 walrus-associated incidents occurred
prior to the implementation of the NTPP, over a period
of 10 years. Two incidents occurred at the beginning of
the generalization of the NTPP and were linked to

![Figure 1](image1.png)

**Fig. 1.** Number of communities involved in the Nunavik Trichinellosis Prevention Program from 1992 to 2009. There are 14 communities in Nunavik in total. Some of the communities never participate to walrus hunt. The number of communities hunting walrus varies according to year because of several factors, including weather conditions and availability of boats.

![Figure 2](image2.png)

**Fig. 2.** Number of walruses harvested since 1974 and results of the screening for *Trichinella* sp. in walrus since the beginning of the Nunavik Trichinellosis Prevention Program. The total number of walrus harvested is not available from 2004 to 2008, but it is believed to be close to the number of walruses tested. The black line with open circles stands for the proportion of positive walruses.
walruses that had not been tested under this screening program. One outbreak occurred in 1997 after the consumption of an infected walrus while the meat was still in quarantine pending the results of analyses. The 2 cases recorded in 2006 were infected during travel in the adjacent territory of Nunavut after eating meat from a walrus not tested and associated with a large outbreak in that jurisdiction.

Other animals involved in cases of trichinellosis in Nunavik are fox (1996), polar bear (1998) and black bear (2004). The epidemiological investigations were not successful in identifying trichinellosis sources in 3 cases (1999, 2004, 2009).

Discussion

Assets of the NTPP

The 2 main goals of the NTPP are to prevent human trichinellosis and to promote the walrus hunt. As shown in Table I, no locally acquired walrus-linked trichinellosis outbreaks have occurred in Nunavik since 1997, even though infected walruses have been detected almost yearly since then (Fig. 2). In 1997, community members ate an infected walrus prior to the quarantine release. Even if human exposures occurred in that event, the results of the analyses performed under the NTPP were communicated to the regional health services and were instrumental in the treatment of these consumers before the onset of clinical signs. The medical management of the 1997 outbreak, as described by Proulx et al. (2002), is the first report of a successful trichinellosis secondary-prevention initiative in the Arctic (3). Only 2 other incidents of walrus-linked trichinellosis were recorded since the implementation of the NTPP, both during the period of generalization of the program to all walrus-hunting communities. The 2 walruses associated with these outbreaks had not been tested. The rare occurrence of walrus-linked trichinellosis since 1992 contrasts with the situation observed in the 1980s where outbreaks occurred every other year or so on average. In addition, it was noticed that walruses from some locations seemed to be more frequently infected. This observation is supported by the apparent decrease in prevalence associated with the avoidance of those locations by hunters. Walrus trichinellosis geographical variations would warrant further studies.

The numbers of harvested walruses over the years are highly variable. These inter-year changes are probably driven by variations in the availability of boats and financial resources, as well as weather conditions. Due to this high annual variability, it is difficult to assess the impact of the NTPP on the walrus-hunting effort, even though the number of walruses harvested in Nunavik appears to have stabilized over the last 10 years after an apparent decrease. Nevertheless, in general, field workers and hunters feel that the NTPP has favoured the perpetuation of the hunt.

The total cost of the program is difficult to evaluate since most of it is supported by in-kind participation of the different partners. Nevertheless, because of the very high human and financial costs associated with the

Table I. Chronology and characteristics of individual trichinellosis incidents in Nunavik from 1982 to 2009

| Date/Month | Community       | Clinical | Requiring hospitalization | Source of infection* |
|------------|-----------------|----------|--------------------------|----------------------|
| 1982/12 - 1983/03 | Salluit         | 10       | 4                        | Walrus (epid)         |
| 1983/10    | Ivujivik        | 4        | 1                        | Walrus (epid)         |
| 1984/02    | Salluit         | 8        | 2                        | Same walrus as 1983/10|
| 1984/04    | Ivujivik        | 15       | 4                        | Walrus (epid)         |
| 1987/10 - 11 | Salluit        | 41       | 5                        | Walrus (epid + lab)   |
| 1995/11    | Inukjuak        | 1        | 0                        | Walrus (epid)         |
| 1996/10    | Ivujivik        | 1        | 1                        | Walrus (epid)         |
| 1996/11    | Puvirnituq      | 1        | 1                        | Fox (epid)            |
| 1997/10    | Inukjuak/Puvirnituq | 5       | 2                        | Walrus (epid + lab)   |
| 1998       | Inukjuak        | 1        | 1                        | Polar bear (epid + lab)|
| 1999       | Puvirnituq      | 1        | 1                        | Undetermined          |
| 2004       | Kuujuuaq        | 3        | 1                        | Black bear (epid + lab)|
| 2004       | Kuujuaraapik    | 1        | 1                        | Undetermined          |
| 2006       | Kangiqsjuuaq    | 2        | 1                        | Walrus* (epid + lab)  |
| 2009       | Kangiqsjuuaq    | 1        | 1                        | Undetermined          |

*Epid: based on epidemiologic investigation; lab: based on laboratory testing.

5The walrus involved in this outbreak was harvested and consumed in Nunavut, outside the Nunavik territory, and was not tested at the NRC prior to consumption.
management of a single outbreak of trichinellosis in this remote and isolated arctic territory, the investment in the NTPP is considered economically sound.

The NTPP can thus be considered as a successful and rational program, based on the absence of recent cases of trichinellosis acquired from walrus meat and the positive effect of the program on the continuation of the hunt. The motivation and empowerment of participating communities constitute another positive spin-off of the NTPP.

Many factors can account for this success. First, the NTPP participates in the public mission of ensuring health in diverse ways: directly by trichinellosis prevention and indirectly because increasing food diversity is considered as a component of nutritional-diseases prevention (2,21). The program also has positive impacts on the economic, social and cultural role of the hunt, especially because it values hunters as skilful food providers. This convergence of interest, shared by the Inuit community members, the local and regional organizations and the public health authorities, is probably a major asset as regards the perpetuation of the NTPP (22).

In addition, it is recognized that effective community participation, which involves the sharing of responsibilities, contributes to the achievement of sustainable health objectives and could lead to the appropriation of research outcomes by the community (23,24). The fact that the technical operations of the program are supported by an Inuit entity (Makivik Corporation) with trained personnel (wildlife specialists and laboratory technician) actually facilitated communications and may have contributed to community empowerment (24). The communication strategies used to educate the public are also

![Figure 3](image-url). Timeline of the development and implementation of the NTPP involving interwoven science and action.

Sylvain Larrat et al.
believed to have helped the understanding of trichinellosis and involvement of the community members in the NTPP.

The second factor contributing to this success: trichinellosis is caused by an agent that can be relatively easily detected in the meat. The analytic method is simple, inexpensive and rapidly provides results. Furthermore, it has proven to be reliable: Leclair et al. (2002) established that the digestion and double-funnel separatory procedure enables consistent detection of larvae at the level of 0.3 larvae per gram of tongue muscle. This level of sensitivity is considered sufficient to ensure that the walrus meat is safe for consumption (18). Timeliness of the communication of the results to the targeted population is an important aspect of an efficient prevention program.

Third, the target species, walrus, itself was a factor of success. As walruses are large animals, one single analysis is enough to know the status of a large amount of meat. Furthermore, the analyses are concentrated between July and October and these animals are harvested in limited numbers by a few captains and their crews in the same period. Consequently, the time invested in the testing is relatively limited. This program might have been more challenging to set up and maintain for small animal species that would be hunted in large numbers over a large part of the year.

The timeline of the development and implementation of the NTPP and the bidirectional interleaving between science and action involved in this exercise are schematized in Fig. 3.

The scientific characterization of the first outbreaks was essential in the development of a pilot program that evolved into the current NTPP. The new scientific knowledge generated by the program has been used as a base to continuously refine the protocols. Besides scientific knowledge, the feedback of the hunters has been recorded through annual surveys, and relevant suggestions have been implemented.

Limitations of the NTPP

Although successful, the NTPP had its shortcomings at the beginning of the project. Firstly, the program fully relies on hunters for proper sampling and identification of each animal. Sampling problems occurred in the beginning of the extension of the NTPP, making some of the samples unfit for determination of Trichinella status. These difficulties were resolved by enhanced communication with the hunters and by the modification of the sampling protocol to reduce the number of needed samples per animal. This change in the protocol was supported by program-generated scientific knowledge. Traceability of meat during the quarantine period could still be improved. Tags, used to identify walrus meat, are sometimes unavailable or lost, which makes tracking back infected meat pieces complicated. This problem with the tag availability is overcome by experienced hunters, who will use handmade marks. Luckily, so far the occasional failures in traceability have not hampered the elimination of infected meat.

Secondly, compliance with the prescribed quarantine for the meat until results of analyses are known might not be optimal. At the beginning of the program, in 1997, several people ate improperly cooked or raw meat from an infected walrus during the quarantine period. Discussion with community members suggests that compliance with the quarantine has been improved since then, although this most likely remains variable between communities (Simard, personal observation). Some boat captains leave the meat on the boat and anchor it away from the community until results are known. In some cases the meat is quarantined in a locked building or a household freezer or shack. In other cases, community members gather when boats return from a hunt and take pieces of walrus meat that they consume, presumably cooked, prior to the release of the quarantine. Unfortunately, no reliable data are available regarding people's perception of and compliance with the ban period on freshly landed meat. The absence of recent outbreaks is indirect evidence that the NTPP is well understood and accepted by the communities; however, more precise insight on Inuit perception of the NTPP would help document and improve how people deal with meat during the quarantine period.

Promptness of the communication of the results is an important aspect of an efficient prevention program. The time elapsed between the landing of a walrus and the release of the results is a limitation of the NTPP. On-site analysis is not feasible because of difficulties to maintain the equipment and keep ongoing expertise in multiple local testing centres. Transport of samples to established parasitology laboratories in the South was done in the 1980s but led to unacceptably long delays and did not favour implication of the population concerned in the process. Consequently, the centralization of the analyses in a regional laboratory in Kuujjuaq appears to be the optimal compromise, even if aerial transport of samples from local communities is still highly dependent on weather conditions. To minimize delays, samples are processed and results communicated within 24 hours of reception (6).

Future prospects

The different stakeholders involved in the NTPP feel strongly that the program should be perpetuated. As suggested above, there is a need to better evaluate compliance with quarantine and traceability and come up with measures to further limit the risks inherent to the quarantine period. Increasing our comprehension of the epidemiology and geographic distribution of T. nativa
in walrus and marine wildlife may also help to improve the prevention of this disease in the Arctic and should therefore be supported. Further studies on other regional sources of the parasite such as polar bear, black bear, wolf and fox meat are currently being conducted. The further prevention of trichinellosis may require either the testing of the new species involved in trichinellosis incidents or additional education. The development of tourism in the Arctic will also require informing tourists on trichinellosis. Two incidents linked to bear meat have indeed been identified in tourists (25,26). It will be essential to involve community leaders in such programs.

Direct implication of the Inuit in the scientific process of the NTPP and other health initiatives should be increased. This will greatly contribute to the appropriation of these programs by Nunavimmiut and will hopefully increase the interest of Inuit students in the scientific and health professions. The need to be involved in wildlife research has been expressed by native people in other regions (27).

The authors consider that the NTPP can be used as a model for a successful health-related prevention program in the Arctic. The success of the program relies on many facilitating factors such as the nature of the disease and its source, the existence of an efficient analytic method, the strong involvement of the different partners including direct resource users, as well as the comprehensive bidirectional science-to-action approach that has been followed.

Acknowledgements

The writing of this manuscript was funded by the Nasivvik Centre for Inuit Health and Changing Environments. The authors would like to thank the hunters, boat captains and mayors for their involvement in the program, Peter May and Sandy Suppa of the Nunavik Research Center for their comments for this manuscript, and Sandy for his long-time commitment as a laboratory technician in the NTPP. Thanks to the nurses, doctors and human health laboratory technicians for their vigilance and collaboration to case notification and outbreaks control. Thanks as well to Daniel Leclair, veterinarian who worked on setting up the laboratory for the NTPP and to Lorry Forbes and Alvin Gadjadhar from the Centre for Food-borne and Animal Parasitology, CFIA, who collaborated on the diagnostic-techniques development. Finally thanks to the Hunter Support Program of the Kativik Regional Government, the Public Health Department of the Nunavik Regional Board of Health and Social Services and Makivik Corporation for their ongoing financial commitment to the program. This paper is dedicated to the memory of Dr. Dick MacLean, medical specialist in infectiology and parasitology, who pioneered the public-health work on this issue of importance for the Inuit of Québec and Canada.

Conflict of interest and funding

The authors have not received any funding or benefits from industry or elsewhere to conduct this study.

References

1. Statistics Canada. Table 8: size and growth of the Inuit population, Canada and regions, 1996 and 2006. Ottawa: Statistics Canada; 2009 [cited 2009 Dec 28]. Available from: http://www12.statcan.gc.ca/census-recensement/2006/as-sa/97-558/table/8-eng.cfm.
2. Blandech C, Rochette L. Nutrition and food consumption among the Inuit of Nunavik. Nunavik Inuit Health Survey 2004, Qanuippitaa? How are we? Quebec: Institut national de santé publique du Québec (INSPQ) & Nunavik Regional Board of Health and Social Services (NRBHSS); 2008. 143 p.
3. Proulx J, MacLean JD, Gyorkos TW, Leclair D, Richter A, Serhir B, et al. Novel prevention program for trichinellosis in Inuit communities. Clin Infect Dis. 2002;34:1508–14.
4. Proulx J, Olpiniski S. Pilot project for the monitoring and analysis of the parasite Trichnema spiralis in walrus meat harvested by Sallumit: a local initiative to protect the community against trichinosis. Sainte-Foy: CHUL & Makivik; 1993. p. 2–11.
5. Forbes LB. The occurrence and ecology of Trichinella in marine mammals. Vet Parasitol. 2000;93:321–34.
6. Proulx J, Leclair D, Suppa S. Preventing trichinellosis in Nunavik. Makivik Magazine 1998:18–22.
7. Margolis HS, Middaugh JP, Burgess RD. Arctic trichinosis: two Alaskan outbreaks from walrus meat. J Infect Dis. 1979;139:102–5.
8. Coffey JE, Wigleworth FW. Trichinosis in Canadian Eskimos. Can Med Assoc J. 1956;75:295–9.
9. Maclean JD, Viallet J, Law C, Staadt M. Trichinosis in the Canadian Arctic: report of five outbreaks and a new clinical syndrome. J Infect Dis. 1989;160:513–20.
10. MacLean JD, Poirier L, Gyorkos TW, Proulx JF, Bourgeault J, Corriveau A, et al. Epidemiologic and serologic definition of primary and secondary trichinosis in the Arctic. J Infect Dis. 1992;165:908–12.
11. Möller LN, Petersen E, Kapel CM, Melbye M, Koch A. Outbreak of trichinellosis associated with consumption of game meat in West Greenland. Vet Parasitol. 2005;132:131–6.
12. Gadjadhar AA, Forbes LB. A 10-year wildlife survey of 15 species of Canadian carnivores identifies new hosts or geographic locations for Trichinella genotypes T2, T4, T5, and T6. Vet Parasitol. 2010;178:76–83.
13. Gadjadhar AA, Pozio E, Gamble HR, Nöckler K, Maddox-Hyttel C, Forbes LB, et al. Trichinella diagnostics and control: mandatory and best practices for ensuring food safety. Vet Parasitol. 2009;159:197–205.
14. Pozio E, Hoberg E, La Rosa G, Zarlenla DS. Molecular taxonomy, phylogeny and biogeography of nematodes belonging to the Trichinella genus. Infect Genet Evol. 2009;9:606–16.
15. Leclair D, Forbes LB, Suppa S, Proulx J, Gadjadhar AA. A preliminary investigation on the infectivity of Trichinella larvae in traditional preparations of walrus meat. Parasitol Res. 2004;93:507–9.
16. Leclair D, Forbes LB, Suppa S, Gadjadhar A. Infectivity of Trichinella larvae in aged walrus meat. Kuujjuaq: Nunavik Research Centre, Makivik Corporation; 2002. p. 18
17. Dupouy-Camet J, Kociecka W, Bruschi F, Bolas-Fernandez F, Pozio E. Opinion on the diagnosis and treatment of human trichinellosis. Expert Opin Pharmacother. 2002;3:1117–30.
18. Leclair D, Forbes LB, Suppa S, Gadjadhar AA. Evaluation of a digestion assay and determination of sample size and tissue for the reliable detection of Trichinella larvae in walrus meat. J Vet Diagn Invest. 2003;15:188–91.
19. Forbes LB, Gadjadhar AA. A validated Trichinella digestion assay and an associated sampling and quality assurance system.
for use in testing pork and horse meat. J Food Prot. 1999;62:1308–13.
20. Appleyard GD, Zarlinga D, Pozio E, Gajadhar AA. Differentiation of Trichinella genotypes by polymerase chain reaction using sequence-specific primers. J Parasitol. 1999;85:556–9.
21. Kuhnlein HV, Receveur O. Dietary change and traditional food systems of indigenous peoples. Annu Rev Nutr. 1996;16:417–42.
22. Robinson AR, Mainzer H, Chomel B, Bender J. Surveillance methodologies for zoonotic disease at community level. In: Expert consultation on community based veterinary public health system. Rome: Food & Agriculture Organization of the United Nations; 2004. p. 38–48.
23. Ortiz LM. Toward authentic participatory research in health: a critical review. Pimatisiwin. 2003;1:1–26.
24. Ndiaye SM, Quick L, Samba O, Niandou S. The value of community participation in disease surveillance: a case study from Niger. Health Promot Int. 2003;18:89–98.
25. Houzé S, Ancelle T, Matra R, Boceno C, Carlier Y, Gajadhar AA, et al. Trichinellosis acquired in Nunavut, Canada, in September 2009: meat from grizzly bear suspected. Euro Surveill. 2009;14:726–7.
26. Gaulin C, Picard I, Côté N, Huot M, Proulx JF. Outbreak of trichinellosis in French hunters who ate Canadian black bear meat. Can Commun Dis Rep. 2006;32:109–12.
27. Brook RK, Kutz SJ, Veitch AM, Popko RA, Elkin BT, Guthrie G. Fostering community-based wildlife health monitoring and research in the Canadian north. Ecohealth. 2009;6:266–78.

*Jean-François Proulx
Department of Public Health
Nunavik Regional Board of Health and Social Services
P.O. Box 900
Kuujjuaq
Québec J0M 1C0
Canada
Email: jean-francois.proulx@ssss.gouv.qc.ca