



Climate change influences on environment as a determinant of Indigenous health: Relationships to place, sea ice, and health in an Inuit community



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ABSTRACT

This paper contributes to the literature on Indigenous health, human dimensions of climate change, and place-based dimensions of health by examining the role of environment for Inuit health in the context of a changing climate. We investigated the relationship between one key element of the environment – sea ice – and diverse aspects of health in an Inuit community in northern Canada, drawing on population health and health geography approaches. We used a case study design and participatory and collaborative approach with the community of Nain in northern Labrador, Canada. Focus groups ($n = 2$), interviews ($n = 22$), and participant observation were conducted in 2010–11. We found that an appreciation of place was critical for understanding the full range of health influences of sea ice use for Inuit. Negative physical health impacts were reported on less frequently than positive health benefits of sea ice use, which were predominantly related to mental/emotional, spiritual, social, and cultural health. We found that sea ice means freedom for sea ice users, which we suggest influences individual and collective health through relationships between sea ice use, culture, knowledge, and autonomy. While sea ice users reported increases in negative physical health impacts such as injuries and stress related to changing environmental conditions, we suggest that less tangible climate change impacts related to losses of health benefits and disruptions to place meanings and place attachment may be even more significant. Our findings indicate that climate change is resulting in and compounding existing environmental dispossession for Inuit. They also demonstrate the necessity of considering place meanings, culture, and socio-historical context to assess the complexity of climate change impacts on Indigenous environmental health.

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1. Introduction

There are approximately 350 million Indigenous people worldwide, with rich cultures, languages, and histories that have developed through Indigenous nations living in relationship with their lands for thousands of years (WHO, 2007). While there is no one understanding of Indigeneity, some Indigenous people view

their fundamental commonality as a worldview that places special significance on the unity of humans and the natural world (Royal, 2002). There are major gaps in health data for Indigenous populations in some areas of the world; however, where health data does exist it demonstrates that the health status of Indigenous people is significantly lower than for their non-Indigenous counterparts, and spanning an array of indicators (e.g., from infant and maternal mortality and morbidity, to infectious disease burdens, to chronic diseases such as diabetes and cardiovascular disease, to mental health outcomes) (Gracey and King, 2009). We can look to the social determinants of health (e.g., income, education, living conditions, employment, health services access) to understand some of this disparity. However, the underlying cause is rooted in

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Indigenous-specific determinants related to colonization, which has and continues to result in losses of culture, autonomy, land, and health (Gracey and King, 2009; King et al., 2009). Given the importance of the environment as a determinant of Indigenous health based on culturally-specific Indigenous epistemologies and ongoing connections to and dependence on traditional lands, it is no surprise that the disruption, degradation, and erasure of relationships with the land has negatively affected the health and well-being of Indigenous peoples (e.g., Richmond and Ross, 2009; Tobias and Richmond, 2014).

As has also been identified in the literature, the environment is not solely a source of health benefit for Indigenous populations, but also health risk. For example, traditional foods are a source of nutritional, economic, and cultural benefits for Inuit in northern Canada at the same time as risks from exposure to environmental contaminants such as lead, PCBs, and mercury in some species and tissues (Donaldson et al., 2010). Also, land-based activities such as hunting can result in increased exposure to environmental hazards (e.g., UV exposure, extreme weather events) and unintentional injuries, but are also a source of multifaceted benefits (Cunsolo Willox et al., 2012; King and Furgal, 2014).

The relationship between the environment and Indigenous health is also changing, related to social and material changes and changes in the environment itself. In Canada as in other parts of the world, government policies of displacement and assimilation, enacted through Canada's *Indian Act* and the residential school system, for example, affected and continue to impact Indigenous peoples' relationship with the land (RCAP, 1996). These impacts are interacting with rapid social changes taking place in Indigenous communities today related to changing technology use, wage economy participation, changing social and cultural norms, and other changes brought on by the influence and imposition of Western culture, social norms, technologies, economic structures, and governance institutions (RCAP, 1996). For example, the erosion of land-based skills among younger generation Inuit has been linked to impacts of assimilationist policies such as residential schooling, which interrupted intergenerational knowledge transfer, as well as broader cultural and economic changes taking place in Inuit communities today (Pearce et al., 2011).

The nature of the environment itself is also changing, related to impacts of large-scale development and anthropogenic climate change (IPCC, 2013, 2007). A great deal has been written about climate change and direct and indirect impacts on health (IPCC, 2014, 2007). Climate change is predicted to pose a greater health risk for Indigenous populations related to their greater dependence on local resources, habitation in regions of the world where the environment is changing rapidly, and socio-economic disadvantage (Ford, 2012; IPCC, 2014). As Ford (2012) notes, despite the greater exposure and sensitivity of Indigenous populations to climatic health risks, the empirical evidence of climate influences on Indigenous health, while growing, remains limited. The majority of research on health influences of climate change for Indigenous populations has taken place in the Arctic and Australia, related to the strength of the climate change signal in these regions (for syntheses, see ACIA, 2005; Furgal, 2008; Green et al., 2009; IPCC, 2014). However, there are still many things we do not know or know little of, for example related to the influence of changing environmental conditions on the mental, social, and cultural well-being of Inuit (Cunsolo Willox et al., 2013, 2012; Furgal, 2008). Given the greater vulnerability of Indigenous populations to climate change (Ford, 2012), there is a critical need to increase our understanding of the changing nature of the environment as a determinant of Indigenous health in the context of a changing climate.

This paper examines climate change influences on environment

as a determinant of health among Inuit. Currently, as a definition of Inuit health based on an Inuit worldview is absent from the literature, we draw on available definitions of health and Indigenous health but note our caution in relying on generalities. For the purposes of this paper, we define health as physical, emotional, mental, social, and spiritual well-being, and not just the absence of disease and infirmity (Committee on Indigenous Health, 2002; Reading and Wien, 2009; WHO, 1948). Health is both individual and collective in this context.

In this study, we examined how Inuit sea ice users in the community of Nain in the Labrador Inuit Settlement Area of Nunatsiavut in subarctic Canada view the influence of using sea ice on health and well-being. Collaboration on this project was based on concern expressed by residents of Nain about increasing unintentional injuries and anxiety associated with changing ice and weather conditions (e.g., Furgal et al., 2002), and a history of relationships and collaboration in the region with one of our co-authors (CF). The project involved university-community research collaborations with the Nunatsiavut Government (NG), the Inuit self-government body in Nunatsiavut, and Nain Ground Search and Rescue (NGSAR), a volunteer-based search and rescue team primarily made up of hunters in Nain. We conducted a case study with a sequential mixed methods design. In this paper, we report results from the qualitative stages of our case study, involving two focus groups with expert sea ice travellers and 22 individual interviews with sea ice users.

1.1. Context of Inuit sea ice use in Arctic Canada

While Inuit have a close relationship with their environment, sea ice is an especially critical element of the Arctic environment for Inuit (ICC, 2008). For much of the year it forms an extension of the land that allows Inuit to move freely across their homeland through a network of routes, leading Inuit in this study and elsewhere to refer to sea ice as their highway (Aporta, 2004; Aporta et al., 2011; ICC, 2008). Sea ice routes are used by Inuit to facilitate access to important wild food resources and culturally-significant places (Aporta, 2004; Aporta et al., 2011). In addition to positive health influences, the variable and challenging Arctic environment means travel on sea ice can also bring about negative physical health impacts such as frostbite from cold exposure and hypothermia or drowning from falling through the ice (Durkalec et al., 2014; Furgal, 2008; Giles et al., 2013). The relationship between environmental exposure and injury and trauma in Inuit communities is still poorly understood due to limited injury epidemiology data (GNWT, 2004; Légaré, 2007). This knowledge gap is of significant public health concern, as unintentional injuries are over four times higher in Inuit regions compared to Canada as a whole (ITK, 2010), with environmental exposures potentially contributing to this disparity. For example, rates of drowning for Indigenous Canadians are six times higher than for non-Indigenous Canadians, and eight times higher for snowmobile-related drownings (Canadian Red Cross, 2006; Health Canada, 2001). Hospitalization rates for unintentional injuries from land transportation in high Inuit population areas are greater than in high First Nations areas, high Metis areas, and low Aboriginal population areas in Canada for adults, youth, and children (Finès et al., 2013; Oliver and Kohen, 2012).

While Inuit have been managing environmental risks in a challenging environment for millennia, the changing nature and increasing variability of environmental hazards is predicted to increase the frequency and severity of physical health impacts from environmental exposure (ACIA, 2005; Furgal, 2008; IPCC, 2014). Indeed, communities in the Canadian Arctic have been reporting concerns about increasing injuries and anxiety related to changing ice and weather conditions (Ford et al., 2009, 2008; Furgal et al.,

2002; Nickels et al., 2006). Many individuals and communities are drawing on Inuit knowledge and land-based skills, social networks, and other resources and practices to adapt to changing conditions (Ford et al., 2010). However, socio-economic factors, the impacts of colonization and assimilationist policies, remoteness, and connectivity deficits are also constraining adaptive capacity for some more than others, for example related to the erosion of land-based skills, compromised social networks, existing health burden, and limited time, financial resources, and resource use flexibility (Ford et al., 2010).

Research to date on the human dimensions of climate change for Inuit has been dominated by vulnerability and adaptation approaches (Ford and Smit, 2004; IPCC, 2007) which typically conceive of the environment as a hazard or threat. Thus, while there has been considerable research into Inuit vulnerability and adaptation to sea ice hazards and implications for physical health and food security (e.g., Ford et al., 2009, 2008; Furgal et al., 2002; Laidler et al., 2009), there remain gaps in our understanding of non-physical health implications and meanings of changing sea ice and other environmental conditions for Inuit. Recent studies by Cunsolo Willox et al. (2013, 2012) on climate change implications for Inuit mental health and place attachment and Wolf et al. (2013) on intangible and subjective aspects of climate change impacts for Inuit have begun to address these gaps. However, our understanding of the implications of changing environmental conditions for holistic health and meanings of place for Inuit remains partial and needs to be improved.

1.2. Place-based approaches to environment-health relationships

Our research draws on population health and health geography approaches to understanding the relationship between environment and health. Population health is an approach to investigating disparities in health and disease outcomes for different social groupings (Labonte et al., 2005) that draws on epidemiology and social epidemiology. Population health literature and practice have been key to establishing the importance of the environment as a determinant of health (ACPH, 1994; Lalonde, 1974). Within epidemiology, the social and physical environment is 'context' and its effects are generally considered and measured separately from compositional effects (i.e., characteristics of individuals) (Cummins et al., 2007; Macintyre et al., 2002). As Cummins et al. (2007) note, for the majority of epidemiological research, and particularly quantitative studies employing multi-level regression strategies, the role of place is reduced to an examination of area effects at a single spatial scale, typically local areas or neighbourhoods.

The way in which environment is conceptualized and operationalized in epidemiological and population health research is not without criticism, regarding the undertheorization of environment as a 'place'; overemphasis on generalizable findings that overlook the specificity and variability of place; and lack of consideration of how culture shapes health beyond socioeconomic status (Cummins et al., 2007; Cutchin, 2007; Macintyre et al., 2002). It has been argued that geographic thinking needs to be incorporated into epidemiology to address these limitations (Cummins et al., 2007; Cutchin, 2007; Macintyre et al., 2002). We suggest that these concerns are especially salient in the context of Indigenous health-environment connections, given that Indigenous populations have unique historical, cultural, and social contexts and connections with their environment.

We drew on recent developments in health geography to integrate a consideration of place and the way culture shapes health-environment interactions into our investigation of Inuit health-environment relationships (Kearns and Collins, 2010; Kearns and Moon, 2002). Health geography literature focuses on the

importance of place to health and has made an ongoing theoretical project of illuminating an understanding of place as a context for the intersections of cultural, political, social, and economic influences on health (Kearns and Collins, 2010; Kearns and Moon, 2002).

Place-based approaches have been used to explore Indigenous health, for example for exploring the significance of the land for health and health meanings (e.g., Panelli and Tipa, 2007; Wilson, 2003) and the negative health impacts of environmental dispossession (Richmond and Ross, 2009). A growing body of research is also employing a relational view of place and space to capture the emotional and affective aspects of disruptions to relationships with places due to climate change (e.g., Cunsolo Willox et al., 2012; Tschakert et al., 2013), although it has been argued that there is a need for expansion (Curtis and Oven, 2012).

Inuit health and environment relationships have been explored in various bodies of literature, for example in anthropological and geographic studies regarding aspects of Inuit life that matter to health in the context of the environment (e.g., food sharing, identity, subsistence hunting, wayfinding, traditional Inuit knowledge) (e.g., Aporta, 2004; Condon et al., 1995; Laidler and Elee, 2007), climate change vulnerability and adaptation studies of environmental hazards and health implications (e.g., Ford et al., 2008; Furgal et al., 2002; Giles et al., 2013; Laidler et al., 2009), and epidemiological studies regarding water quality and contaminants (e.g., Donaldson et al., 2010; Harper et al., 2011). While consideration of the role of location is inherent in these studies related to the unique Arctic environment, few studies have explicitly investigated the relationship between Inuit health and place (for an exception, see Cunsolo Willox et al., 2012).

Similar to Richmond and Ross (2009), in our view, integrating key developments from health geography, particularly the recognition of the importance of place and the way culture shapes health-environment interactions (Kearns and Collins, 2010; Kearns and Moon, 2002) into a determinants of health approach and population health framework creates a flexible theoretical space for understanding and interpreting place-specific health perspectives and experiences. This integrated theoretical approach informs our discussion of the case study results.

2. Research design and methods

To explore the role of sea ice for Inuit health, we employed a case study approach (Yin, 2009) with a sequential mixed methods design (Creswell, 2009). Our participatory and collaborative approach followed Pearce et al. (2009) and included early and ongoing communication with the NG and NGSAR, involvement of the NG in research design and development (e.g., regarding decisions on project scope, methodologies, fieldwork timing and duration), opportunities for local employment and bidirectional capacity-building (e.g., research training, co-presentation at conferences), and dissemination of results to partners and the wider community throughout the study and in a variety of mediums. Our approach was informed by the ongoing critical dialogue taking place in Canada and elsewhere on the need for ethical and decolonizing research and reciprocal research relationships with Indigenous communities (e.g., Castleden et al., 2012). As non-Inuit researchers, we used community engagement as a strategy to help ensure that the project addressed community needs and goals, and prioritized reflexivity. While the nature and extent of our community research relationships are described briefly here, details can be found in Durkalec (2013) and further reflections by author AD on conducting this study as a non-Inuit researcher can be found in Durkalec (2012).

In this paper, we are reporting results specific to the qualitative

stages of the study, involving focus groups and interviews that explored the perspectives of sea ice users regarding the influences of sea ice use on health (see Durkalec, 2013; Durkalec et al., 2013, 2014 for results from other phases of the study). Ethics approval for this research was granted by the Trent University Research Ethics Board and the Nunatsiavut Government Research Advisory Committee. In all cases, participants provided their informed consent, including for the publication of their identities, words, and ideas.

2.1. The study location: Nain, Nunatsiavut, Canada

Nain is the northernmost community on the east coast of Labrador (56°32'N, 61°41'W), in the Labrador Inuit Settlement Area of Nunatsiavut (Fig. 1). The population of the town was 1188 in 2011, with 91% of the population identifying as Aboriginal (Statistics Canada, 2012, 2013). Nain is a fly-in community located on an inlet on the Atlantic Ocean protected by islands and surrounded by hilly and rocky terrain. The climate is classified as subarctic, and land-based activities are important for the traditions, livelihoods, and health of residents.

2.2. Data collection

Before data collection was initiated, a preliminary trip to Nunatsiavut was made in February 2010 to consult on the study plan with the NG and NGSAR and build relationships. Based on these discussions, the study scope was broadened from a focus on injury during sea ice travel to include non-physical health influences of sea ice use and changing environmental conditions. After reviewing the drafted focus group guide with NG collaborators, we conducted two focus groups in July 2010 with nine expert sea ice users to explore perspectives on what sea ice use means to health. We recruited participants through a multi-step peer-recommendation process to identify local experts (Davis and Wagner, 2003). Local research assistants and NG collaborators generated lists of individuals who would be able to identify sea ice expert users in the community. After cross-referencing, three individuals were selected that identified people that were: 1) Nain residents for 20 years or more; 2) frequent sea ice users and experts on the local environment as recognized by others; and 3) beneficiaries of the Labrador Inuit Land Claims Agreement. Individuals with more than one mention were prioritized for recruitment, carried out by local research assistants. Male and female focus

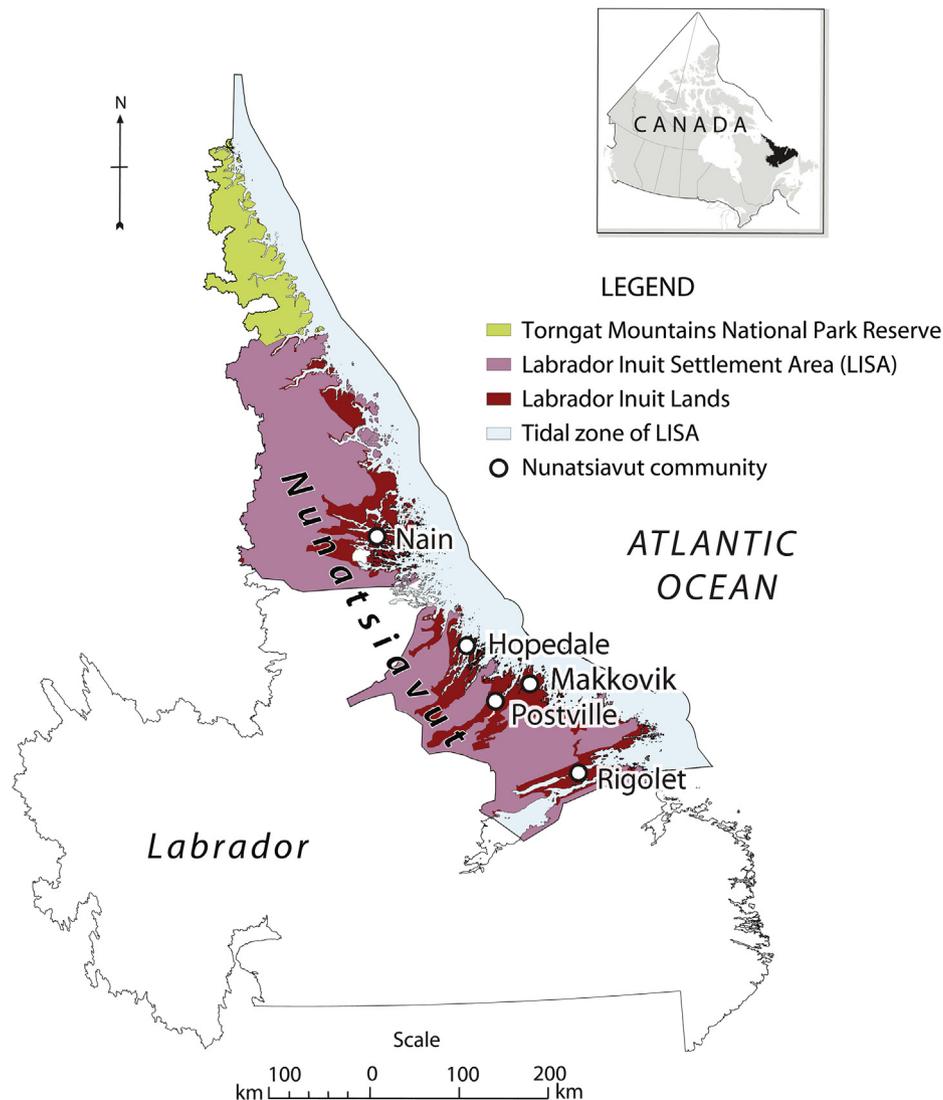


Fig. 1. Location of Nain and other Nunatsiavut communities in the Labrador Inuit Settlement Area of Nunatsiavut in Labrador, Canada (adapted from Nunatsiavut Government, 2005).

groups were conducted separately to increase participant comfort and facilitate a gendered analysis, reported on elsewhere (see Durkalec, 2013; Durkalec et al., 2013). Focus groups were co-led by local research assistants. The male focus group had five participants and the female focus group had four. In addition, we conducted one unstructured interview with an Elder from the male focus group as a follow-up to explore health terms and concepts in Inuttitut in the context of using sea ice. ‘Elder’ is a term of respect in Inuit culture accorded to certain individuals, usually but not necessarily older, based on their leadership, expert Inuit knowledge, and role as culture-bearers (Owlijoot, 2008).

We then conducted 22 semi-directed interviews with community members in Nain in November 2010 that use sea ice for travel and hunting to explore perspectives on health benefits and impacts of sea ice use. Findings from the focus groups informed interview questions. We used a non-proportional quota sampling method (Miles and Huberman, 1994) to ensure representation of different health perspectives (Table 1). Lists for each category were generated by NGSAR searchers and pooled, and participants were selected from each list randomly and recruited by local research assistants. We were unable to recruit participants successfully for two of the categories due to a very small sampling pool of moderately experienced travellers who had received SAR assistance, possibly because younger people are participating in hunting less frequently or taking shorter trips (Laidler et al., 2009).

Focus groups and interviews were recorded by digital audio recorder and note-taking, and financial compensation in accordance with regional standards was provided. We also employed participant observation to improve our understanding of sea ice travel experiences and practices. The lead author participated in four single and multi-day trips on the sea ice in March and May, 2011 and recorded reflections and observations from these trips and other events and interactions.

2.3. Analysis

Focus group and interview transcripts were reviewed for accuracy and reliability by the researchers and participants (Baxter and Eyles, 1997) and a translator-interpreter for translation verification where appropriate. Transcripts were analyzed using thematic content analysis (Esterberg, 2002) using QSR International’s NVivo 8 software.

Member checking (Baxter and Eyles, 1997) was employed by conducting four meetings with participants in March and May, 2011 to review the validity of constructs and interpretations. Participants who attended relayed general agreement with representations of their knowledge, but also made corrections or added new data. Participants edited and approved the use of selected quotes and chose to be identified by their name or initials, or remain anonymous. Focus group results are presented as presence/absence. The scale for representation of interviewees ($n = 22$) reporting on various themes is: few, 1–20%; some, 20–40%; many, 40–60%; most, 60–80%; nearly all, 80–100%. Findings are presented according to health themes (mental, emotional, and spiritual; physical; economic/material; cultural; and social) and place-meanings and are based on the coding structure developed during analysis.

Table 1
Number of interview participants according to quota sampling grid.

	Not assisted by SAR		Assisted by SAR	
	Male	Female	Male	Female
<20 years travel experience	4	4	0	0
>20 years travel experience	3	3	4	4

3. Results

Focus groups and nearly all interview participants described a strong positive link between travelling on sea ice and their health (Table 2). Forms of health and well-being that participants reported as being influenced by using sea ice included mental/emotional, spiritual, physical, economic/material, cultural, and social. Further, focus groups and nearly all interviewees reported on the importance of hunting and just being on the ice to their overall health related to the freedom that it provides. To differentiate these reports from those that reported on specific forms of health influenced by sea ice use, we have grouped them as ‘emerging place themes’.

Many interview participants said that they had never had an experience where “going off” on the ice had been “bad” for them or their health. Further, a few interviewees struggled with how we framed the question of whether travel on sea ice had ever been bad for their health. As one participant explained:

It’s just living for us, we love it. We love the bad weather and we love the fine weather and we love the danger. We love the bad ice, we love the bad land and good land ... In order to love the land, you got to accept the bad things that comes with it. (MD)

To convey what the sea ice means to their health, the female focus group and a few interviewees reframed the question, describing what it would mean for their health if they could not go on the ice or if there was no ice in the future. Participants described how they would “have no health”, feel like they “can’t breathe”, “get sick”, “be very sad”, “be lost”, “go crazy”, and that their “appetite and mind would go”.

3.1. Physical health

Nearly all interviewees and focus groups reported on physical health influences from using sea ice, predominantly describing negative health impacts (Table 3). Focus groups and some interviewees reported that changing sea and freshwater ice and weather conditions have negatively impacted their physical health or the physical health of others. Focus groups and some interviewees reported changes in the quality and strength of the sea ice and impacts on their safe navigation, and two participants described these changes as the reason for having fallen through the ice in the recent past. For example, a male focus group member reported that the ice where he used to collect wood used to be thick, but in recent years it has been unstable and unsafe, leading to two people perishing there after falling through the ice in the spring.

3.2. Mental, emotional, and spiritual health

Focus groups and all interviewees reported on mental, emotional, and spiritual influences from sea ice travel. Of interviewees reporting on this theme, many reported benefits. Participants reported that going off on sea ice is “good for your spirit”, makes your “soul feel better”, lets you “be freely who [you are]”, “clears your mind”, “is relaxing”, provides “relief from all the stressors”, “calms your nerves”, and makes you feel “rejuvenated”. One interviewee explained that it provides motivation and a sense of purpose. As another interview participant explained:

I think it does a lot for my health because it means I can get away from the everyday things that’s going on here in Nain, get away by myself and meditate ... When you’re going out on a snow machine, your mind is not worried about what’s happening in

Table 2
Summary of reporting on the relationship between sea ice, health and place aspects.

	Focus group health references (n = 88) ^a	Representation of interviewees reporting on health (n = 22)
<i>Forms of health</i>		
Mental, emotional, and spiritual	Some – primarily benefits, some impacts	All – primarily benefits, some impacts
Physical	Some – primarily impacts, few benefits	Nearly all – primarily impacts, some benefits
Economic/material	Few – some benefits, some impacts	Most – primarily benefits, some impacts
Social	Few – all benefits	Many – all benefits
Cultural	Few – all benefits	Some – all benefits
<i>Emerging place themes</i>		
Experiences of (being on) the sea ice as place	Many – all benefits	Nearly all – all benefits
Sea ice as a platform for hunting	Few – all benefits	Nearly all – all benefits

^a Scale: few, 1–20%; some, 20–40%; many, 40–60%, most, 60–80%, nearly all, 80–100%.

Table 3
Reported physical health influences from using sea ice.

Physical influences	Focus group physical health references (n = 32) ^a	Representation of interviewees reporting on physical health (n = 22)
Strain or discomfort from physical exertion	Some	Most
Discomfort or hypothermia from falling through the ice	Many	Some
Injuries from unintentional impacts	Few	Few
Impacts from cold exposure	–	Some
Physical activity benefits/"good" for body	Few	Some

^a Scale: few, 1–20%; some, 20–40%; many, 40–60%, most, 60–80%, nearly all, 80–100%.

town or who's going to kill themselves or who's going to be working next fall. There's no phone and there's nobody bugging you about this and that. You're just out having a nice day out on the land. (HB)

Many interviewees reported that they had never been worried about their safety on the ice. However, nearly half of these same participants also reported past experiences where they were scared or unnerved while travelling on sea ice. This seeming contradiction may be related to cultural approaches to environmental risk (Durkalec, 2013).

Overall, focus groups and many interviewees expressed stress or emotional impacts from personal sea ice use or the travel of others, such as worry about the safety of family members that had gone off, or emotional or mental health impacts from losing family or community members through the ice. However, one individual described how the spiritual aspect of being on the land can help heal emotional wounds from the loss of loved ones through the ice.

A portion of the aforementioned experiences of stress related specifically to changes in ice conditions. The male focus group and an interviewee reported feelings of nervousness, confusion, or lack of confidence related to changes in their ability to predict ice and weather conditions, while the female focus group and a few interviewees reported feelings of disappointment, unhappiness, and lack of motivation stemming from restricted travel ability because of changing ice conditions. One interviewee characterized his relationship with sea ice as one of loss, because of emotional impacts of a tragedy where two people drowned in 2006 near Nain after falling through ice that had been safe at that time of year in the past. He sold his skidoo and has rarely travelled on the sea ice since.

3.3. Social well-being

Focus groups and many interviewees reported that going off on the sea ice increases desirable social connections with friends and family. The male focus group and a few interviewees also gave examples of trips that were "good for them" where they described bonding time with friends or family members. For example, one interviewee described enjoyment from travelling with and sharing

knowledge with his grandsons, while another described his most special trip as one where all his children joined him one spring.

A few interviewees reported that going off decreases social connections that are not desired, discussing how going on the sea ice allows them to remove themselves from exposure to social stress factors in the town of Nain, or simply have time alone.

I think it's good for your health because you can go off and get away from Nain – there's so much drinking going on in Labrador, in Nain now anyway. So sometimes it's good to get away from it and to feel the nature work on you. (Anonymous)

However, impacts of changing sea ice conditions on social well-being were only reported by one interviewee, who reported that changing conditions could affect his ability to spend time with his grandchildren at his cabin and on the land.

3.4. Economic/material well-being

Many interviewees and focus groups reported material or economic benefits from using sea ice, and of these reports, the majority related to how using the sea ice for hunting improves people's food supply with healthy wild foods. The male focus group and a few interviewees reported that going off on sea ice also provides them with access to firewood that they or their families use for fuel.

A few interviewees and the male focus group also described the significant expense of travelling on the ice, including the cost of gas, lubricant, food, bullets, and the base costs of snowmobile purchase and maintenance. A few interviewees described how they or family members used to make a living from selling furs, but that the political economy of hunting has changed dramatically over the past several decades, making travel on the land more economically challenging:

People were able to make money trapping and sealing. And that can't be an economic activity anymore, and it costs a lot more nowadays just to go out on the land. I mean, I'd probably go to England just as cheaply for a week as it would cost me to go up to the cabin for a week. But going up to the cabin is far more important. (William Andersen)

Female focus group members and a few interviewees also reported material impacts from changes in sea ice conditions, including changing conditions restricting harvesting access and duration, and the material impact of losing snowmobiles through the ice. We also observed that detours on land to avoid bad ice conditions, particularly those including rough or low-snow terrain, tended to be harder on snowmobiles (e.g., collisions with rocks, overheating), slower, and more gas-intensive than typical travel on sea ice.

3.5. Cultural well-being

Influences from going out on the sea ice on cultural well-being (connections to identity, history, traditions, and ancestors) were reported by focus groups and some interviewees. The female focus group and a few interviewees discussed how travelling on the sea ice is their way of life – that it is living – and that it is important to them because that is how they were raised. Some of the participants also described a strong positive relationship between going off on sea ice, eating wild foods, and their cultural way of life. A few interviewees and female focus group members reported how different places connect them to traditions and history:

There's a lot of history in all the areas and everywhere you go you have a different sense of some things and just awareness of certain things. It's just good to reconnect with those areas ... Connect to different things, like historical, connections with family, with community, with people, with events. (EW)

Focus groups and a few interviewees discussed how changing environmental conditions have impacted or could impact their culture in terms of access to hunting grounds and sea ice itself. One female participant described how if she could not go out on the ice, she would be losing part of her culture and “wouldn't feel good as an Inuk”.

3.6. Emerging place themes

3.6.1. Sea ice as a key platform for hunting and fishing

Focus groups and nearly all interview participants reported the importance of hunting as a key activity facilitated by using sea ice, explaining that travel by sea ice is the primary way they get to their traditional hunting grounds to access wildlife. Many interviewees and focus groups also reported holistic health benefits from their practices of harvesting and eating wild foods:

I think if we got good sea ice we can go and get the proper wild [foods] what we likes, like fish, you can go fishing, or caribou hunting, go seal hunting, get partridges, get your geese, your ducks, your eggs. For me, I love that food, and it's really healthy ... and it's also good for your body and your spirit, like, you feel good about going out on the land and being able to do that. (ERM)

Focus groups and a few interviewees reported impacts from changing environmental conditions on access to wild foods because of reduced ability to use sea ice routes to access harvesting places.

3.6.2. Experience of place: being on the land and ice

Focus groups and most interview participants described the importance of just being on the land to their health in ways that were integrated and holistic. Focus groups and some interviewees described how going off on sea ice is “medicine”, a “better way of living”, and something that is “good” for them; described the land as a place they “love” and “live for”; and explained how “just being

on the land is healthy”. However, when asked what sea ice meant to health, the most frequent response from participants was “freedom”. Specifically, many interviewees and focus group members reported that sea ice allows them: 1) freedom of movement, because it forms a network of highways that allows them to access all the places they want to travel; 2) freedom of decision-making and autonomy for determining their activities and movements, including the freedom to be themselves; and 3) freedom from the pressures, routines, and social issues in town.

I feel that I'm able to be freely who I am when I'm out there ... Just free to eat anytime you want, you can just sleep, get up when you're rested. Don't have plans, you have no phone to answer, no computer to go to ... It's just the high mountains and snow. You are free to turn anywhere you want to. You're just so free. (MD)

Further, informal discussions and participant observation during trips on the sea ice indicated that for a few, their places on the land are where they and their families have traditionally not been within as easy reach of Eurocentric institutions and policies, so they feel freer here from the legacies of colonization and its impacts. For example, a participant described the freedom she feels when she is north, and her dread of returning to Nain and the world it represents, later informally describing it as one where Inuit lives are not equally valued to white peoples' lives, and outside authorities control Inuit.

A few interview participants described how having the knowledge and capacity to survive on the land makes them feel good or brings them a sense of well-being. A male focus group member and Elder, Lucas Ittulak, described the well-being that emerges from his expert knowledge of how to use the ice as *ippigusutsianik*, which translates to being aware and conscious of your surroundings, being of sound mind, having knowledge of what could happen, and being prepared for what may occur. Ittulak described how knowledge prevents health impacts and promotes benefits, like the feeling of freedom:

There's a lot of freedom when you go out on the land, especially by yourself, without nobody telling you what to do or what not to do, especially if you know the land ... That's one of the biggest part of freedom in a person's life, in an Inuk's life. As long as you know the land, if you've been gone for a few days all on your own, you know the land and you feel so free. (Lucas Ittulak)

As focus groups emphasized, the relationship to the land all depends on the person; if an individual did not grow up on the land learning how to survive, then the land may not be a source of good health for them.

Focus groups and nearly all interviewees described impacts of changing sea ice conditions on their ability to safely access places and the duration of their access, and a few participants also reported changes in the quality of their experience:

At that time when I was younger, the sea ice was safer, it was not in the condition that it is today ... today it's different so the sea ice is not so good for the people anymore. (Lucas Ittulak)

An interviewee reported climate change impacts on Inuit knowledge, describing how Inuit used to be able to predict ice and weather conditions because “that was their place”, but changing conditions mean that predictions are now less accurate, a sentiment reported by a few other interviewees and focus groups.

4. Discussion

This study investigated the role of climate influences on environment as a determinant of Indigenous health, using a case study of the relationship between sea ice, a critical element of the environment for Inuit that is currently being affected by climate change, and health in a Canadian subarctic community. Our findings show that impacts of climate and environmental variability on Inuit health are more complex and far reaching than was previously understood (ACIA, 2005; Cunsolo Willox et al., 2012; Ford et al., 2010; Furgal, 2008; IPCC, 2014, 2007; Nickels et al., 2006), related to changes to place meanings of sea ice and implications for mental/emotional, spiritual, social, and cultural health. These findings have implications for how we think about climate influences on environment as a determinant of Indigenous health more broadly, and suggest that without attention to how climate interacts with Indigenous place-relationships and meanings in their socio-cultural and historical context, the extent and complexity of climate change impacts on Indigenous health will be underrepresented and insufficiently addressed (Cunsolo Willox et al., 2012; Ford, 2012). Our results lead to several points of discussion.

First, the notion of place as a nexus where physical, social, cultural, and symbolic environments intersect to influence health (Kearns and Collins, 2010; Kearns and Moon, 2002) is critical for understanding multifaceted health influences of sea ice. Consistent with the epidemiology, hazards, and human dimensions of climate change literature, we found that sea ice can be an agent of physical health impacts such as frostbite from cold exposure, unintentional injuries, and hypothermia (Ford et al., 2009; Furgal, 2008; Giles et al., 2013; GNWT, 2004). However, participants reported in greater frequency on non-physical health influences of sea ice use, which were predominantly positive. Our findings suggest that health benefits outweighed impacts for those interviewed. Most non-physical health influences reported in this study are consistent with benefits of being the land for subsistence hunting and cultural connections that have been well-documented for Inuit (e.g., Aporta, 2004; Condon et al., 1995), but are enhanced or extended through 1) the physical qualities of sea ice that facilitate ease and extent of land-based travel and access to hunting and fishing grounds and 2) the experience of sea ice as freedom based on the intersection of its physical properties and cultural and social meanings related to its use. Our findings illustrate the specificity of environment-health influences, and add to the growing body of literature that integrates an appreciation of place into understandings of environment as a determinant of Indigenous health (Cunsolo Willox et al., 2012; Panelli and Tipa, 2007; Richmond and Ross, 2009; Wilson, 2003).

Second, the notion of freedom as a place meaning associated with sea ice for Inuit is a novel contribution of this study, and is intimately tied to the mental/emotional, spiritual, social, and cultural health benefits reported by participants. Participants reported that sea ice allows them: 1) freedom of movement, 2) freedom of decision-making and autonomy, and 3) freedom from social pressures and obligations. After freeze-up, continuous snow and ice cover means that Inuit can travel to whatever places they choose almost from their doorstep with more ease than at any other time of year. This mobility heightens the freedom of decision-making associated with going off on the land in general, where travellers are empowered to make decisions on every aspect of their daily life – where to go, what to do, when, with whom, etc. Our findings demonstrate that health-enhancing aspects of this freedom are contingent on knowledge of how to stay safe on the ice, encompassed by the Inuit concept of *ippigusutsianik*, which combines knowledge, skills, preparation, and mindset (Durkalec et al., 2013).

A sense of competence and autonomy have been linked to well-being and self-determination in the psychology literature (Deci and Ryan, 2000), including in collectivist cultures (Chirkov et al., 2003). Our findings demonstrate that autonomy is not only related to the individual; travel on sea ice also creates cultural autonomy (Larsen and Schweitzer, 2010), through the increased valuation and privileging of Inuit knowledge on the land as it is adaptive for surviving and living well in that place, and as well as increased freedom from colonizing and assimilationist Eurocentric societal structures that are closely tied to town-life through a history of settlement and sedentarization (RCAP, 1996). This creates space for culturally and spiritually-significant relationships with the land to flourish. Further, our results demonstrate that sea ice provides greater access to health-enhancing social support while on the land and a means for avoiding health-damaging social support in town. According to Richmond and Ross (2008), material circumstances in Indigenous communities can contribute to conformity pressures and social obligations to behave in health-damaging ways. Social support during sea ice travel manifests differently; a higher level of autonomy in choosing social associations is possible, and a need for reliance on each other to survive travelling in challenging winter conditions reinforces positive social support norms (Durkalec et al., 2013; Laidler et al., 2009). These findings suggest that the culture-knowledge-autonomy nexus is the pathway through which sea ice leads to the mental and emotional health benefits that the large majority of participants reported on, and which have also been documented by others related to Inuit land use (Cunsolo Willox et al., 2013, 2012).

Some participants reported that changing environmental conditions are already contributing to increased negative health impacts on physical health and mental and emotional health. These results corroborate existing literature on current or future impacts of changing conditions on health related to sea ice travel, including increases in unintentional impacts and injuries and increased stress related to the unpredictability of conditions (Furgal, 2008; Furgal et al., 2002; Nickels et al., 2006). However, our findings demonstrate that the most substantive impact from changes in environmental conditions on sea ice-Inuit health relationships is the loss of health benefits and disruption to place-relationships, including place attachment and the freedom that sea ice provides. Changes in the accuracy of sea ice travel knowledge affect the ability of Inuit to be on the ice safely, which transforms place-meanings themselves. These changes are transforming sea ice for Inuit from a place that is “theirs”, a place that means cultural and individual freedom and autonomy and is an important source of health, to a place that is less accessible, less known, and, in some places and times of year, literally disappearing. Our findings extend research on impacts of environmental change on benefits of environmental use for Inuit, such as food security, social cohesion, and intergenerational transfer of knowledge (Furgal et al., 2002; Nickels et al., 2006; Pearce et al., 2011), and make a novel contribution to the nascent understanding of impacts of changing environmental conditions on mental/emotional, spiritual, social and cultural health and place attachment for Inuit (Cunsolo Willox et al., 2013, 2012). This study also adds evidence for the emerging body of literature documenting disruptions to place attachment and ‘solastalgia’, or distress from loss of place-based solace from the deterioration of one’s home environment, due to environmental change (e.g., Albrecht et al., 2007; Cunsolo Willox et al., 2012; Tschakert et al., 2013).

Based on the evidence from this study, we argue that climate change is an agent of environmental dispossession for Inuit (Tobias and Richmond, 2014; Trainor et al., 2007), compounding existing impacts of environmental dispossession related to disruption and denigration of Inuit knowledges and ways of life (e.g., relocation of Inuit of Hebron to Nain and other communities in Labrador in the

1950s) (RCAP, 1996; Richmond and Ross, 2009). We note the environmental injustice of these significant and harmful impacts relative to the presumably negligible contribution of Inuit to the large-scale industrial activity and greenhouse gas emissions over the last two centuries that have led to global climatic change (Trainor et al., 2007; IPCC, 2014, 2013). Canada's contributions to global greenhouse gas emissions and climate change (Matthews et al., 2014) and thus to another iteration of environmental dispossession of Inuit needs to be recognized and addressed by government in the interests of equity and the rights of Indigenous people to environmental self-determination and health (Tsosie, 2007; Watt-Cloutier, 2005).

We have not in this paper investigated how other social determinants of health (e.g., income, education, gender) and frequency of going off on the land may influence environmental health influences and place-meanings, although we conduct a preliminary exploration of this in Durkalec (2013). Our study does not employ an Inuit conception of health; more Inuit health research that is grounded in Inuit methodologies and conceptions of health is needed (Ford, 2012). Nonetheless, this study contributes to our understanding of the relationship between sea ice as an essential and changing element of the environment and Inuit health, with implications for our understanding of Indigenous health and environment relationships more broadly.

5. Concluding comments

This case study of Inuit health and sea ice relationships found that sea ice means freedom for Inuit, and this place meaning is associated with mental/emotional, cultural, spiritual, and social health benefits for sea ice users. Further, results demonstrate that increased environmental variability and unpredictability of ice and weather conditions, in addition to contributing to increasing injuries and stress, is affecting place meanings and resulting in losses of health benefits derived from sea ice use. The findings presented in this case study clearly demonstrate that investigations of health impacts of climate change on Indigenous communities need to incorporate an notion of place to comprehend the complexity of how climate change interacts with placed-based socio-cultural meanings and uses of the environment, as well as legacies of colonization, to affect Indigenous individual and community health (Cunsolo Willox et al., 2012; Rigby et al., 2011). These results also provide a foundation for subsequent research assessing impacts of climate change on Inuit mental and cultural health for different groups (e.g., for different generations), for example by investigating impacts on competence and autonomy. They also point to the potential utility of exploring place meanings for informing adaptation strategies and understandings of how they may themselves influence health. For example, future research could assess how land-based programs or mental health support strategies addressing disruptions to land-based health benefits for Inuit interact with people's sense of competence, autonomy, freedom, and ultimately well-being.

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