ORIGINAL RESEARCH

Conceptualisation and Operationalisation of a Holistic Indicator of Health for Older Inuit: Results of a Sequential Mixed-Methods Project

Marie Baron[1] · Mylène Riva[3] · Christopher Fletcher[2,4] · Melody Lynch[5] · Marie-Claude Lyonnais[2] · Elhadji A. Laouan Sidi[6]

Abstract

Elder Inuit define health as holistic and multifaceted, which contrasts with health-related research where single factor indicators are usually used to measure health in an Inuit context. As the number of Inuit elders is growing, indicators derived from an Inuit definition of health are important if health systems are to be inclusive of the realities of Indigenous Peoples and culture. This study explored and operationalised a model of Inuit health in aging that draws from physical, emotional, spiritual, and interpersonal components identified as salient by participants in this research. Qualitative data gathered through two workshops with 21 participants were analysed to identify key dimensions of health from an Inuit perspective. Quantitative data were retrieved from Statistics Canada Aboriginal Peoples Survey (APS; 2006) with a weighted sample of 4450 Inuit aged $\geq$ 50 years residing across Inuit Nunangat. Using measures corresponding to the dimensions identified previously, Latent Class Analyses were applied to group survey participants into health profiles to create a holistic indicator of health. Multinomial regressions were conducted with related health and social measures to assess the concurrent validity of the indicator. Health was conceptualised along eight themes: general health balance, mental health, spirituality, not experiencing many activity limitations, being loved and having positive relationships, speaking Inuktitut, and being free of addiction. The holistic indicator grouped participants into three health profiles: (1) good health for most variables; (2) very good perceived and physical health, but poor mental health; and (3) poor health for most variables. Using mixed methods to bridge the concept of health defined in qualitative workshops with quantitative health indicators can contribute to the definition and description of a culturally relevant and sociologically complex understanding of healthy aging in an Inuit context.

Keywords Cultural models of heath · Inuit · Mixed-methods · Holistic indicator of health · Aging

✉ Marie Baron
    marie.baron.1@ulaval.ca

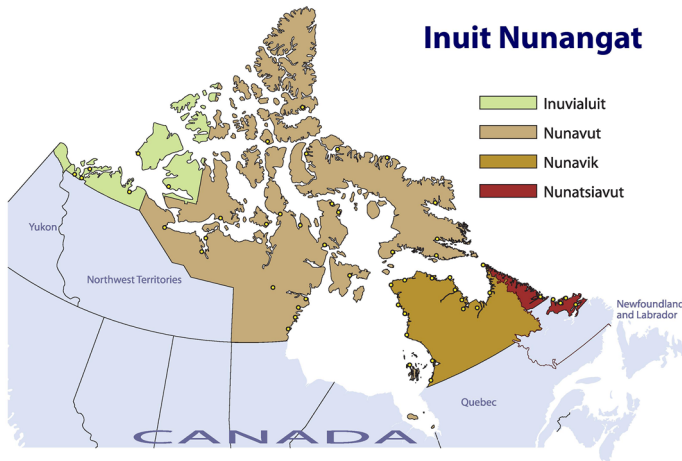Extended author information available on the last page of the article

Inuit Nunangat

Inuvialuit
Nunavut
Nunavik
Nunatsiavut

Fig. 1 Inuit Nunangat Map (2009) Inuit Tapiriit Kanatami. https://www.itk.ca/maps-of-inuit-nunangat/

1 Introduction

1.1 Context

Inuit are the Indigenous Peoples who inhabit the Arctic coast and archipelago from Chukotka to Greenland. As with most Indigenous populations, Inuit have experienced major changes in the past century. While these changes have impacted all Indigenous populations in North America, the rate and nature of social, economic, political, and other changes has been exceptionally intense throughout the Arctic since the end of the Second World War. Across Inuit Nunangat—the Inuit homeland in Northern Canada today composed of four distinct land claims regions (Fig. 1)—settlement, the introduction of a market-based economy, incorporation into the state political and economic structure, and the arrival of new health and education systems are some of the major changes experienced since the 1950s. While Inuit have adapted to and incorporated in their own way much of what they have encountered, some change has been forced, disempowering, and damaging (Damas 2002; Young and Bjerregaard 2008; Richmond and Ross 2009).

Preoccupation with the negative effects of change has been the focus of research since the 1950s (Fletcher 2017) and it is clear that transformations have important consequences on Inuit health and well-being. For example, social transformations contributed, to some extent, to the 30-year gain in life expectancy since the mid-twentieth century (Young and Bjerregaard 2008). While remarkable, substantial health disparities still exist: in 2017 for example, Inuit life expectancy in Canada was 72.4 years compared to 82.9 for the general Canadian population (Inuit Tapiriit Kanatami 2018).

Concomitant to the increase in life expectancy is the aging of the population. Between 1996 and 2016, the number of Inuit aged 65 years and older tripled in Canada, increasing from 1010 (2.5% of the Inuit population) to 3060 peoples (4.7% of the Inuit population) (Statistics Canada 2006, 2017). Despite their growing numbers, little is known about the health profile of older Inuit in Canada. Compared to younger age groups, older Inuit tend to rate their health as poorer (Saudny et al. 2012) and are less likely to report having strong social support (Richmond 2009). As Arctic regions face new public health and

social challenges, the health status and conditions of an increasing aging population need to be more attentively conceptualized.

To assess health and disease, most Inuit health research use single indicators, such as life expectancy or mortality, or unidimensional indicators of disease prevalence, such as rates of tuberculosis (Inuit Tapiriit Kanatami 2008; Tait 2008; Health Canada 2009). However, Inuit conceptualize health within a complex set of social and ecological relations that encompass physical, emotional, interpersonal, and spiritual dimensions. Using single or unidimensional health indicators imposes limits to understanding the complexity of Inuit elders' health as it is lived today.

In this study, we created a holistic indicator of health that measures the multidimensionality of Inuit health. In the next section, we present an older Inuit conceptualisation of holistic health and how it compares to the definition of health in other populations. Then, we discuss the limitations of traditional ways of measuring health and the need to use comprehensive measures of health in an Inuit context.

1.2 Conceptualising Inuit Health

Healthy and successful aging are two concepts used to define good health in older age. However, their definitions differ between populations (Phelan and Larson 2002; Cosco et al. 2013). Older populations' conceptualisations of health and healthy aging are multidimensional and include physical, mental, and social dimensions (Phelan et al. 2004; Cosco et al. 2013). However, definitions of healthy aging vary across older adults of different cultures and countries (Cosco et al. 2013), including between non-Indigenous and Indigenous populations. In comparison to non-Indigenous populations, Indigenous older adults tend to give more weight to social dimensions of health, such as family and community relationships (Collings 2001; Hopkins et al. 2007; Lewis 2011; Waugh and Mackenzie 2011), indicating the need to focus on how older Inuit define health.

Inuit models of health are holistic and dynamic (Svenson and Lafontaine 1997; Kral et al. 2011). The physical, mental, spiritual, and emotional dimensions of health are connected, and evolve in tandem with a person's relationship with the environment. There is a reciprocal dynamic relationship between a person's health and the health of the surrounding social and physical environment; health is created by quality connections to people, communities, and the environment and by a keeping these connections in balance (Richmond et al. 2007; Kirmayer et al. 2009; Kral et al. 2011). For example, the harvest and consumption of "country food" (traditional food species harvested through hunting and fishing activities) promotes health by providing nutritious food, which brings warmth and prevents diseases, while also being dependant on and reinforcing positive social relations. Being healthy is necessary to harvest country food for family and community members (Borré 1994). Contrary to socio-ecological models of health that clearly define the causal relationships between health and factors that have an influence on health, Inuit models of health include interrelationships and complex patterns of causality between the health of a person, other people, and the environment. This way of experiencing and representing health has been termed "ecocentric" (Kirmayer et al. 2009).

Inuit elders hold a definition of health that is holistic and different from that of younger Inuit. The concept of healthy aging among Inuit elders was documented in two studies. Collings (2000, 2001) interviewed 38 Inuit, 14 of whom were aged 40 years and older in the community of Ulukhaktok in the Inuvialuit Region. Lewis (2010, 2011) interviewed 26 Alaska Natives elders, including Inuit, to explore the concept of healthy or successful

aging. In these studies, healthy and successful aging were characterised by strong kin connections and social networks, community engagement, emotional well-being, spirituality, and physical health. As people age, it becomes even more important to be around their children and grandchildren. Sharing knowledge, skills, and wisdom with younger generations is an important part of healthy aging, as are relationships at the community level, including community engagement, which gives older adults a sense of purpose. Mental health and well-being are fostered when people adapt to the aging process by accepting that they are getting older, or in other words, having a 'good attitude.' Older Inuit define physical health as a balance of healthy behaviours, such as being physically active, eating country food, and limiting the consumption of alcohol and drugs. They also characterise physical health as an acceptance of growing physical health challenges, such as living with chronic diseases and having less physical strength (Collings 2000, 2001).

1.3 Measuring Health: From Partial to Holistic Indicators

In contrast with conceptualisation of health held by Inuit, empirical studies have mostly relied on unidimensional indicators of Inuit health, such as the incidence of chronic diseases like cancer (Fribord et al. 2003), diagnosis of diabetes (Tait 2008), incidence of infectious diseases such as tuberculosis (Bjerregaard et al. 2004; Inuit Tapiriit Kanatami 2008), suicide rates (Bjerregaard et al. 2004), and psychological distress (Gray et al. 2016; Lucas et al. 2010). Self-rated health is often used to assess people's health in population surveys as it is a strong predictor of future morbidity (May et al. 2006) and mortality (Idler and Benyamini 1997). It is hypothesized that in rating health, people take into account several dimensions of their physical health (e.g. diabetes, cardiovascular diseases) (Chandola and Jenkinson 2000; Jylhä et al. 2006), mental health (Christian et al. 2011; Goldman 2004), or bodily dysregulation not yet clinically detected (Delpierre et al. 2009; Haseli-Mashhadi et al. 2009). Self-rated health was associated with several dimensions of physical health in Inuit populations (Saudny et al. 2012), but has not been validated to capture other dimensions of health for Inuit. To date, no indicator has been developed to capture the multiple dimensions of health as conceptualised by older Inuit.

Holistic indicators summarize the information of several partial indicators that measure unidimensional concepts into one multidimensional variable. Different holistic indicators have been developed to assess quality of health care (Coma et al. 2013), general health status (Stewart et al. 1988; Horsman et al. 2003), cognitive functioning (Hlatky et al. 1989), subjective well-being (Bernini et al. 2014), health and wellness (Martin et al. 2012), and quality of life (Somarriba and Pena 2009). In the creation of a holistic indicator, the selection of partial indicators is generally guided by existing theory and scientific evidence (Bringsen et al. 2009), or by experts opinion, for example using a Delphi method (Martin et al. 2012; Coma et al. 2013). In Sweden, Bringsen et al. (2009) used factor analysis to create a holistic indicator of health, combining twelve partial indicators to measure a range of health concepts selected from existing theory on holistic health: illness and physical function, morale, feelings, cognitive abilities, social capacities (defined by the ability to function with others), and self-realizations. The resulting scale was shown to better capture and measure holistic health than previous partial indicators available in surveys (Bringsen et al. 2009).

Using partial or holistic indicators that are not congruous to Indigenous conceptualisations, here Inuit conceptualisations, or that have not been validated by the people in question has been criticized on the basis that the indicators may be inadequate to characterize

and address specific health and social issues experienced by indigenous communities (Walker et al. 2002; Marks et al. 2007; Taylor 2008). These limitations often result from a lack of incorporation of historical context or indigenous knowledge and experience in research. In Australia, for example, some have criticised epidemiological models of diabetes focusing on individual risk factors that do not include family, community, and social health dimensions salient in Aboriginal Peoples' meanings of diabetes (Thompson and Gifford 2000). The authors advocated for the use of more comprehensive indicators that would reflect Indigenous models of health and illness. Walker et al. (2002: 33) suggest that the inadequacy of social and health indicators used in Indigenous research might "underestimate the real level of disadvantage and therefore obfuscate the causes of disadvantages" lived by Indigenous people in Australia. Measuring Indigenous realities by Western-built indicators does not capture the historical context of Indigenous communities and the causes of social disadvantage. For example, indicators of social disadvantage that do not include the role of discriminatory and culturally inappropriate policies underestimate the real level of social disadvantage experienced by Indigenous populations. Including Indigenous concepts and knowledge is thus imperative for the creation of a holistic indicator of health.

1.4 Objectives and Design of the Study

In this paper, we aim to create a holistic indicator of health that reflects the lived experience, understanding, and multidimensionality of health for older Inuit. This study follows three objectives: (1) to conceptualize health with a specific attention to aging-related concepts using Inuit definitions of health and well-being; (2) to operationalize this definition into a holistic indicator using population health survey data; and (3) to assess the concurrent validity of the indicator by testing its associations with related measures.

Research drawing from both qualitative and quantitative methodologies enables a comprehensive approach to complex research questions (Tariq and Woodman 2010) and for findings that are nuanced, textured, and representative (Morgan 1998; Tariq and Woodman 2010). This design is appropriate in Indigenous research to build quantitative indicators that reflect indigenous concepts of health (Oster et al. 2014).

1.5 Structure of the Paper

This study employed a two-phase, sequential, exploratory mixed-method design (Creswell and Plano Clark 2007; Stoller et al. 2009): The quantitative phase was conducted using results developed during the initial qualitative phase. The structure of this paper follows the steps of this sequential design.

In the first qualitative phase, the objective was to conceptualise health as perceived by older Inuit. Data collected during workshops in Nunavik, one of the four Inuit regions of Canada, were used to conceptualise health within a conceptual model familiar to older Inuit. Secondary analyses of the transcripts of the workshops allowed for the identification of concepts central to the definition of health. In the second, quantitative phase, the objectives were to operationalise and validate a holistic health indicator. (a) Building on the conceptualisation of health developed in the first phase, we created a holistic indicator using Latent Class Analyses applied to survey data. (b) We then proceeded to the validation of the indicator using multinomial regressions.

Keeping in line with the sequential design, the methods and results for each of these two phases are described in turn. In the following section, we present the methods and results of the qualitative phase, followed by the methods and results of the quantitative phase.

The holistic indicator created and developed in this study was used in a related article designed to identify social determinants of healthy aging in the Canadian Arctic. That article (reference withheld) summarizes the methodology and results that are the focus of the study presented here.

2 Conceptualisation of Inuit Health and Well-Being for Older Adults in Nunavik

2.1 Settings and Participants

Qualitative data were collected during workshops conducted in 2016 in two communities in Nunavik (the Inuit land claims and traditional territory of Northern Quebec, Canada) in preparation for the 2017 *Qanuilirpitaa?* Nunavik Inuit Health Survey. The objectives of the workshops were to understand health and well-being from the perspective of Nunavimmiut, and to describe community conditions supportive of health and well-being. The 1.5-day workshops were conducted in Inuktitut and English. Three questions guided the discussions: (1) What is health and well-being? (2) What does health and well-being mean to you? (3) What in the community makes people healthy and well? The questions led the discussions during the first day, and the half day was used to validate some key ideas, themes, and preliminary indicators that emerged during the discussions. Two researchers (CF, MR), a research assistant (MCL), and one Inuit interpreter in each community led the discussion. A total of 21 Inuit participated in the workshops. Approximately half of the participants were 50 years and older and the majority were women. Participants provided oral consent prior to the beginning of the workshops. Discussions were audio-recorded and transcribed. The study was approved by the CHU de Québec Research Ethics Committee. This project was initiated by the Inuit-run regional health authority, authorized and supported by the municipalities where the workshops were conducted.

2.2 Methods

During the workshops, participants defined concepts of individual and community health. For the present study, secondary analysis of the transcripts was undertaken to focus on concepts related to individual (as opposed to community) health, with specific attention to aging-related concepts. We used inductive thematic analyses to identify components of the definition of holistic health (Hashemnezhad 2015). First, the lead author coded the transcripts to identify individual health and well-being themes emerging from the workshops. Twenty-four themes were identified, relating to diverse concepts of health and well-being. Second, we compared individual and community health analyses. This step was useful to identify themes that related specifically to individual health and well-being and themes relating to being an elder and aging. Several themes were defined as both individual and community health. After comparing and discussing the results, we identified a total of 15 themes relating only to individual health and aging.

Triangulation with the literature on Inuit definitions of healthy aging was used to improve the validity and credibility of our analysis (Golafshani 2003; Humble 2009). We

systematically compared themes coming from the workshops to the themes in four key articles on healthy and successful aging in the Arctic (Collings 2000, 2001; Lewis 2010, 2011). After this step, eight final themes were generated that, together, define holistic health.

2.3 Results

2.3.1 Conceptualisation of Individual Health and Well-Being

Discussions were wide ranging and covered a number of topics, needs, determinants, and concepts related to health in the communities of Nunavik. As is the case in many cultures, the concept of *health* resists a singular definition and, as workshop participants said, is normally contextual and particular. During the workshops, participants represented health and well-being in concentric circles with linkages to multiple conditions and contexts. When focusing on bodily health, the term *ilusiq* emerged as the most resonant in Inuktitut. The meaning of *ilusiq* suggests that things are in their intended, expected, and proper form. The term also carries a developmental connotation in that the form is one in which the body and its capacities come together or "unfold" from an initial condition at birth across the life course. Similarly, when faced with illness or a physical problem like a tooth ache or a cold, *ilusiq* is the return to the regular form and the concept is used as an equivalent to "bodily health" in English although with meanings specific to Inuit.

Inuktitut is a polysynthetic language where meanings are developed out of the juxtaposition of root concepts followed by modifying and contextualising infixes and suffixes. Thus individual words for "health" are abstractions from how language is actually used. Thus in one workshop participants used the root *ilusiq* in the term *Ilusirsituq*—s/he is in a normal and expected condition. This was placed at the center of a series of concentric circles Related concepts and their relationship to *ilusiq* were then discussed and drawn in the diagram. As one participant explained:

> The well-being at the middle, it's the individual. And then, healthy, around it, it starts to connect the individual with his surroundings, in a way that it shapes his or her health. And then, it goes to community relations, from the individual, outwards. Everything is connected.

Ilusirsituq encompassed and intersected with (1) concepts related to internal sensations such as health of the body, mental health, spirituality, and general perceived health balance and (2) concepts about the quality of relations between people such as being loved, having positive interactions with others, speaking Inuktitut, and being free of addiction.

2.3.2 Internal Sensations and Emotions

The four concepts related to internal sensations and emotions are described in this section: (1) health of the body, (2) mental wellbeing, (3) spirituality, and (4) general perceived health balance.

First, participants defined health of the body, or physical health, as a positive concept: "To be healthy, it's when you are born, you are healthy in your body, everything is OK with you." Being physically healthy mostly meant that older adults did not suffer from disease, pain or conditions that limited their activity. For example, one participant stated: "Well rested, capable, they take care of their body, sleep well, capable. Many things with the

blood, diabetic or not a heart problem. Good care of self." The condition of having "good blood" is an important part of an Inuit conceptualisation of health that is felt and expressed through capacity, strength and endurance (Borré 1994). The body was the central location of *ilusiq* for all age groups. Older participants identified the significance of health located in functional capacity, an absence of activity limitations, and mobility as important aspects of physical health for older adults who have less strength than younger ones and need help to move or do activities.

Age, related changes in physical capacity are normally relieved by the help of others in the community and family. "[About helping elders], that was what elders was telling us, never to see elders [carry] something heavy… don't let them see or keep them heavy things, that is too hard for them." Activity limitations were also pointed out in the literature as an important concept for healthy aging because becoming older is associated with less physical fitness and slowing down (Collings 2000). Keeping active and being physically fit means aging successfully, even if physical decline is an inevitable part of aging (Collings 2000). Physical health of elders is thus closely connected to social and interpersonal dimensions of health that are also prominent in our discussion. Specifically, the roles of family members, particularly youth, in their interactions with elders are prescribed and known. Elders require assistance with cleaning the house, getting groceries, providing rides, and helping with other needs that increase as ageing progresses. Individual members of the family have the role of helping with a specific need. The help provided to elders is not one-sided as they use the occasions where they are helped to give lessons, advice, encouragement, and direction about a range of subjects. These interactions are characterised by warmth and love and are special times for sharing between generations. The gradual decline of physical capacity is less troubling as this is expected and part of the normal course of things. A distance and disconnection between young and old is a sign of more profound social change and problems. Thus, for older Inuit, *ilusiq* is impacted by social relations *and* physical limitations, disease, and injury.

Secondly, participants described being mentally well as experiencing no stress or no mental illness and having positive emotions: "Like, when a person goes through a stress in life, they are more vulnerable to become, having mental health problems." People who did not have mental illness symptoms or negative emotions were mentally healthy. This concept was close to what has been reported previously by elderly Inuit who defined being mentally healthy as experiencing positive emotions, such as not worrying, relaxing, and taking it easy (Collings 2000; Lewis 2011). In Collings' work (2001, p. 145), Inuit defined mental health more specifically as the "ability of the individual to remain emotionally stable over time," an approach that is reflected in earlier work on models of mental health where the social responsibility and individual capacity to manage the burden of distress were emphasised over disease and individual psychological makeup (Kirmayer 1994; Kirmayer et al. 1997). This concept related to the idea of balance as well-being in our workshops in Nunavik.

Thirdly, spirituality was an important concept related to *Ilusirsituq* and was defined as a person's soul and as the link between mental and physical health.

> If you are really angry, hurting your emotions, you show it in your body because you are angry and mad. It's coming from your soul. If you're gonna talk about well-being, it has to be the whole person.

In Alaska, elders described spirituality as having a positive effect on their health and well-being because it "alleviated their worry, which is known to cause adverse effects on a person's health" (Lewis 2011, p. 546).

The fourth concept related to internal sensations and emotions, was described as an inner state of balance experienced by the individual. It was compared to the well-being state of a newborn baby. This idea was closely linked with other components of health and well-being and was used to describe the overall health status of an individual. This concept was not specifically defined in Collings' or Lewis' articles; however, in those studies healthy aging was possible when older adults were able to maintain overall good physical and mental health (Lewis 2010).

2.3.3 Connectedness and relationship concepts

The four concepts related to connections and relationships with other people were: (1) being loved, (2) having positive interactions with others, (3) speaking Inuktitut, and 4) being free of addiction. Firstly, being loved was related to positive emotions coming from the affection given by others.

> Having a good family time, laughter, communicate, tell your children that you love them and they tell you back they love me, I tell my sister I love her, I tell my brother I love him, and they tell me I love you too. It makes me happy. Sometimes, we need to hear that. Our grandparents telling us I love you. It's a good feeling. Knowing that someone loves you.

Secondly, participants defined having positive relationships by helping and being helped by others, communicating well, the family being together, and gatherings.

> I thought about it, being in a healthy world. To have a house. To have my grandchildren and my children to be more happy, in a healthy way with less… I'm making word… to have less alcohol involved, drug involved less. To be together as a family like it used to, in a community too. Have good gatherings like they used to.

Being loved and having positive relationships were defined by connections with family and friends and were important for older people who stressed the importance of being with their children and grandchildren. For elders, having good social support was very important, as they require more help and more companionship than younger people to keep them from loneliness.

> When we have time and a small budget, we go out with elders who don't have a husband or wife. It's mostly those who don't have husband and don't have a vehicle, we go out with them and it's good for them. We get some elders, so they should do better in their mind, their head.

According to the literature on Inuit healthy aging, elders who have social support are more likely to age successfully, and be happier and healthier (Collings 2001; Lewis 2011). In Alaska, receiving company and help is a key element to successful aging and a good quality of life in later years (Lewis 2011). These themes are very close to the results of our analysis.

Thirdly, language was also an important part of health because it was linked to both relations with others and individual well-being. However, there was a strong age difference in the relationship between language and health. Participants stated that younger Inuit, who sometimes didn't speak Inuktitut well, were occasionally bullied or belittled. On the contrary, most older Inuit spoke Inuktitut well, which gave a sense of pride and strengthened links to culture:

> As for me, I have lost my Inuktitut. When I got… 20, 30, mid 20, 30, I started to learn how to talk my mother tongue because I was not able to have all words, real Inuktitut. Like, even though I cannot talk in real Inuktitut way, for me, I'm very proud I am able to talk in my mother tongue. I've been very ashamed of myself because it had affected me a lot, because the way we were treated in school. Not allowed to talk. I'm not gonna be shy anymore, I'm not gonna be ashamed anymore. But in the beginning, to see who I am, a real Inuit, not Qallunaaq, not something you don't want to be.

Language was a key element in the definition of health as it is deeply linked to people's connection to their culture. The ability to use language to express oneself and share with others was closely associated with pride and coherent identity, mental health, positive relationships, and experience of the surrounding environment.

A final theme that was discussed by workshop participants was being free from addiction. While this theme overlaps with those of mental and physical health, it was given special attention. Being free of addiction led to a better life: "When you are well, you are not a slave of alcohol or drugs, or all these things all around you that don't control you." To be tempted by substances that undermine one's person and social coherence is a feature of mental health conceptualization (Kirmayer 1994). Those who are free from alcohol and drug addiction have better relationships with people in the community and with their family. Addiction is also an important theme in the literature. Aging unsuccessfully is defined in Lewis' articles (2010, 2011) as not being able to handle alcohol. For Inuit in the Inuvialuit Region, being free of addiction is seen as particularly important for the health of younger people (Collings 2001). Being free of addiction was one of the most developed themes in the workshops, as it is strongly linked with the possibility of having balance in life and positive family relationships.

2.3.4 Getting Old

Participants did not describe a clear age as the threshold between being young or old. They stated that people knew they were getting old when they required assistance from younger people. They described several social changes occurring between 50 and 60 years old, as a sign that people were getting old, such as changes in financial aid or in social assistance. At 60, participants experienced elders' advantages such as being invited to feasts dedicated to elders and receiving financial support including discounted or free local transportation. However, several participants were considered "old" as they turned 50.

> Once you reach 60, they start blessing you even more. Our elders, there's an annual, one time a year meeting, with elders, going different places, this is beautiful. And Avataq [an Inuit cultural institute in Nunavik] that have AGM [Annual General Meeting] with elders meeting, big meeting. There's an elder van in town. Once you are 50, you go free.

> Sometimes, when we do a feast, it's for 55 and older. The younger complains that they want to join.

In our results, we found that participants felt 'old' when they were 50 years or older. In the literature, 50 is also considered as a shifting point. At this age, people were considered, or considered themselves, as old. We used 50 years as the threshold to create a holistic indicator of health for older Inuit.

3 Operationalisation of Inuit Definitions of Health into a Holistic Indicator and its Validation

In this section, we operationalised the holistic definition of health in a multidimensional indicator of health for Inuit aged 50 years and older using survey data. We then assessed the concurrent validity of the indicator by examining its association with sociodemographic and health measures.

3.1 Description of the Survey Data and the Measures

To operationalise the indicator, we used data from the 2006 Aboriginal Peoples Survey (APS 2006) (Statistics Canada 2009). This wave of the APS included key variables related to a holistic definition of health such as connectedness and relationships. Such variables were not available in the more recent cycles of the APS. The APS sample is selected from participants aged 6 years and older living in a private dwelling (i.e. not in institutions) who self-reported Indigenous identity and/or ancestry, i.e. First Nations, Inuit, Métis, at the 2006 Canadian Census (n = 48,921). The sampling frame excludes people living in First Nations communities (reserves) (Statistics Canada 2009). The design and implementation of the APS was developed in collaboration with representatives from Indigenous organizations. The APS provided self-reported data on health, sociodemographic characteristics, and living conditions. It included four core questionnaires and additional information retrieved from the census: an adult questionnaire (for those aged 15 years and older), a children and youth questionnaire (for children 6–14 years), a Métis supplement, and an Arctic supplement. The Arctic supplement included themes such as household and harvesting activities, personal wellness, community wellness, and social participation. Some variables from the census are included in the APS, such as household characteristics, income, and marital status. The APS was administered through face-to-face interviews in communities across the four regions of Inuit Nunangat, yielding a total sample of 6012 and a 87.1% response rate. (Statistics Canada 2009). For our analysis, the sample was restricted to Inuit aged 50 years and older living in one of the four regions of Inuit Nunangat.

Measures corresponding to the health concepts described in the previous section were first selected. Variables related to all but one of the eight health concepts were available in the APS; spirituality was not included in the 2006 APS. Details about the measures of the partial indicators are presented in Table 1.

Physical health was measured by grouping participants who never, sometimes, or often experienced activity limitations. Mental health was measured using the 5-item Mental Health Inventory (MHI) which assesses depressive symptoms (Ware et al. 1993); higher scores on the MHI indicate better mental health. This variable was categorized into tertiles. General perceived health was measured using self-rated health, categorized into poor, good, or excellent health.

Four variables of social support were available to measure being loved and positive relationships: one pertaining to affection and intimacy, and three related to positive social interactions (Richmond et al. 2007). These four variables were summed into a scale because of their high correlation. As the scale was not normally distributed, we created three categories for weak, moderate, and strong social support following natural breaks in the distribution. To measure the ability to speak Inuktitut, participants were categorized into three groups: those who reported not speaking, speaking relatively well, or speaking

Table 1 Dimensions of the definition of health (Qanuilirpitaa 2017 workshops) and related APS measures, APS 2006

Dimension and description from the workshops	APS measure	Measure transformation
Taking the right shape: State of inner balance, resulting from a general balance in health and well-being	Self-rated health: In general, would you say your health is… *Excellent/ Very Good/Good/Fair/Poor/*	3 categories variables created from the 5-items likert scale 1 Poor health (fair, poor) 2 Good health 3 Excellent health (very good, excellent)
Mental health: Experiencing no stress or mental illness and having positive emotions	5-item Mental health inventory (depressive symptoms scale): On a scale of 1–6, with 1 being always and 6 being never, how much of the time, during the last month, have you… been a very nervous person?/felt calm and peaceful?/felt downhearted and blue?/been a happy person?/felt so down that nothing could cheer you up? *Never/Almost never/sometimes/Fairly often/Very often/Always* Final MHI-5 score is calculated by summing up the item scores (answers for questions 2 and 4 are reversed) and transforming the scores into a scale varying from 0 to 100	Final 0–100 scale transformed into tertiles 1 poor mental health 2 moderate mental health 3 good mental health
Physical health: Defined as an absence of or few physical limitations and ability to keep up with social activities	Frequency of experiencing activity limitation: Do you have any difficulty hearing, seeing, communicating, walking, climbing stairs, bending, learning or doing any similar activities? *Yes, sometimes/Yes, often/No/* Does a physical condition or mental condition or health problem reduce the amount or the kind of activity you can do… At work, school, home, for leisure? *Yes sometimes/Yes often/No*	Indicator created by Statistics Canada, derived from the two questions to describe the "impact of conditions or health problems on principal domains of life" used with no transformation 1 Never 2 Sometimes 3 Often

Table 1 (continued)

Dimension and description from the workshops	APS measure	Measure transformation
Being loved: Knowing that your family and your kin loves you	Affection and intimacy: How often is this available to you? Someone who shows you love and affection. *All of the time/Most of the time/Some of the time/Almost none of the time*	Addition of the four variables of affection and intimacy and positive social interactions to create a social support scale with scores from 4 to 16. Transformation of the scale into three categories following natural breaks in the distribution. 1: weak social support (10–16) 2: moderate social support (6–9) 3: high social support (4 and 5)
Having positive relationships: Helping and being helped by other people, having a good communication and being together as a family	Positive social interaction: How often is this available to you? Someone to have a good time with. Someone to get together with for relaxation. Someone to do something enjoyable with. *All of the time/Most of the time/Some of the time/Almost none of the time*	
Being free of addiction: Not being a slave of drug and alcohol consumption	Frequency of alcohol consumption: During the past 12 months, how often did you drink alcoholic beverages? *Less than once a month/Once a month/2 to 3 times a month/Once a week/2 to 3 times a week/4 to 6 times a week/Every day*	3 categories variables created from the 7-items likert scale 1: Once a month or more 2: Less than once a month 3: Never
Speaking Inuktitut: Knowing your language	Ability to speak an aboriginal language Do you speak an aboriginal language? *Yes/No* How would you rate your ability to speak this aboriginal language *Speak very well?/Speak relatively well?/Speak with effort?/Speak a few words?*	Two questions combined in a three category variables 1 doesn't speak 2 speak relatively well (a few words, with efforts, relatively well) 3 Speak very well

very well an aboriginal language. While there was no specific measure of addiction to alcohol or drug addiction in the survey, one variable related to the frequency of alcohol consumption. Frequency of alcohol consumption has been used in other studies to assess alcohol use in Inuit populations (Muckle et al. 2007; Fortin et al. 2015). We categorized alcohol consumption over the 12 months as not drinking; drinking less than once a month; or drinking more than once a month.

Age, sex, and region (Nunavut, Nunavik, Nunatsiavut, and Inuvialuit) were used to describe the distribution of the holistic indicator. To assess the concurrent validity of the health indicator, i.e. whether the indicator correlates with other measures of health and social determinants, relevant variables were selected. Number of chronic diseases such as heart, kidney or liver diseases was categorised into being diagnosed with 0, 1 or ≥ 2 diseases. We used a binary measure of overnight hospitalisation in the last year. Social participation was measured by having participated in 0, 1–2, or ≥ 3 types social activities in the last year (volunteered, worked at a community event, attended a local committee meeting, board meeting, or public meeting, or participated in/ attended a local sport event). Annual household income was categorised to contrast those reporting an annual household income below $40,000, between $40,000 and $59,000, or $60,000 or more per year.

3.2 Analyses

To create the indicator, we conducted Latent Class Analysis (LCA). LCA is used when an underlying unobservable variable, here holistic health, cannot be directly measured (Schreiber and Pekarik 2014). Instead, in LCA, indicators measuring the observable dimensions of the latent variable are analysed. For example, LCA has been previously used to measure risky sexual behaviour patterns (Stuart and Hinde 2010), or HIV knowledge profiles (Maslovskaya et al. 2018) that cannot be elicited by direct observations. In our study, LCA are used to measure holistic health through observed measures of physical, mental, general perceived health, social support, language, and drinking behaviours. LCA statistical method allows for the identification of classes of observations, here the APS participants, sharing similar patterns on observed indicators (McCutcheon 1987). With this method, participants are grouped into *n* classes, where n is not set a priori. We started by examining 2 to 6-class model solutions. The best model was selected according to statistical and theoretical best fits. First, goodness of fit statistics indicated better model fit for two models. To chose between these two models, we compared them to older Inuit holistic definition of health. This last step informed on the most appropriate class solution, which was transformed into a categorical indicator of holistic health. The maximum likelihood method was used to perform the LCA without excluding cases containing missing values.

To assess concurrent validity, we tested the associations between the holistic indicator and selected measures from the APS using bivariate multinomial regressions, using bootstrap weights provided by Statistics Canada to account for the complex sampling frame of the survey. We hypothesized that younger participants within our sample, those with better physical health, who participated more in social activities, and who had a higher income would be in better holistic health. We also tested for possible sex and regional differences in the distribution of the indicator.

All analyses were conducted using Stata 15 (StataCorp. 2017) at Statistics Canada Research Data Centre (RDC) at Laval University. Results of analyses conducted in RDCs must follow specific displaying rules to protect the confidentiality of survey participants. For example, all descriptive results were calculated with weighted

frequencies and then rounded to 50. Descriptive statistics of variable categories with too few missing cases could not be displayed.

3.3 Results

3.3.1 Selection of the Best Model

The final sample of the study represents a weighed population of 4450 Inuit aged ≥ 50 years in Inuit Nunangat. This weighed sample size is displayed in our results according to RDCs' guidelines. Descriptive statistics of the partial indicators included in the holistic indicator are presented in Table 2. Estimates are calculated with weighted frequencies rounded to 50. Among Inuit aged 50 and older, there was a roughly equal distribution of participants who had poor, good or excellent self-rated health; poor, moderate or good mental health; 0, 1 or 2 or more chronic health diagnoses. Most participants did not experience activity limitations, did not drink alcohol, had a high social support, and spoke Inuktitut very well.

Across the 2 to 6-class model solutions examined, LCA models with 5 and 6 classes were excluded as they did not produce standard errors for several parameters, indicating poor model fit (results not displayed). Models with 2 and 3 classes had the smallest AIC and BIC values, compared to the model with 4 classes (Table 3). Compared to the 3-class model, the 2-class model mostly contrasted participants with good health for all variables to those with poor health for all variables; as such it did not represent the variety of health situations experienced by older Inuit. We retained the classification of participants in the 3-class model solution, which was more nuanced and closer to the complexity of health as defined by older Inuit in the scientific literature.

Conditional probabilities for each variable included in the LCA models are the probabilities for each variable category to be classified in each of the three classes (Table 4). The first class comprised the 36.7% of participants having the best health overall. In this 'Good health' profile, most participants reported their health as excellent, their mental health as good, never experiencing activity limitations, having a high social support, abstaining from alcohol in the past year and speaking Inuktitut very well.

The second profile comprised 30.0% participants, with a contrasted health profile. In this 'intermediate health' profile, most participants reported their health as good, and sometimes or never experiencing activity limitations. Most participants reported having a high social support and speaking Inuktitut very well, but in a lower proportion than for participants categorized in the first and third profiles. Most participants in this profile reported a poor mental health and drinking alcohol once a month or more.

The third profile comprised the 33.3% of participants with the poorest health overall, but not for all indicators. In this 'poor health' profile, most participants reported their health and mental health as poor, and reported often experiencing activity limitations. Most had high social support, but lower than for participants in the 'good health' profile. However, most participants reported never drinking alcohol and speaking Inuktitut very well.

Based on the results of the LCA, we created a categorical variable grouping participants in 'good health', 'intermediate health', and 'poor health' based on the classification profiles above.

Table 2 Descriptive statistics of partial indicators and validation measures, APS 2006 (N = 4450), weighted estimates rounded to 50

Measures	N (%)
Holistic indicator	
Self-rated health	
Poor	1400 (31.8)
Good	1550 (35.2)
Excellent	1450 (33.0)
Mental health inventory	
Poor	1650 (37.1)
Moderate	1300 (29.2)
Good	1150 (25.8)
Missing	350 (7.9)
Activity limitations	
Often	1350 (30.3)
Sometimes	1200 (27.0)
Never	1800 (40.4)
Missing	100 (2.2)
Frequency of alcohol consumption	
≥ 1 a month	1300 (29.2)
< 1 a month	750 (16.9)
Never	2200 (49.4)
Missing	200 (4.5)
Social support	
Weak	850 (18.9)
Moderate	1000 (22.2)
High	2250 (50.0)
Missing	400 (8.9)
Ability to speak an aboriginal language	
Doesn't speak	350 (7.9)
Speak	600 (13.5)
Speak very well	3350 (75.3)
Missing	150 (3.4)
Validation indicators	
Sex	
Man	2300 (51.7)
Woman	2150 (48.3)
Social participation	
0 activities	1000 (22.5)
1–2 activities	1200 (27.0)
≥ 3 activities	2050 (46.1)
Missing	200 (4.5)
Hospitalisation overnight	
Yes	800 (18.0)
No	3500 (78.7)
Missing	150 (3.4)
Number of health diagnostics	
≥ 2	1650 (37.1)
1	1100 (24.7)

Table 2 (continued)

Measures	N (%)
0	1250 (28.1)
Missing	450 (10.1)
Household income	
< $40,000	1500 (33.3)
$40,000-$59,999	900 (20.0)
≥ $60,000	2100 (46.7)
Region	
Nunavik	950 (21.1)
Nunatsiavut	400 (8.9)
Inuvialuit	550 (12.2)
Nunavut	2600 (57.8)

Table 3 Goodness of fit statistics of latent class analyses models, APS 2006 (N=4450)

Model	AIC	BIC
2-class	9415.638	9533.884
3-class	9364.940	9544.673
4-class	9370.080	9611.301

3.3.2 Concurrent Validation: Associations Between Better Holistic Health Categories and Sociodemographic and Health Measures

Descriptive statistics of the validation indicators are presented in Table 2. Most participants were not hospitalised in the last year and lived in a household with an income of $60,000 or more per year. Most participants lived in Nunavut, followed by Nunavik. There was an equal representation of men and women.

Results of the multinomial regressions are presented in Table 5, using the 'poor health' profile as the reference category. In comparison to participants in the poor health profile, those in the good and intermediate health profiles were younger, had fewer health diagnostics and were less likely to have been hospitalised overnight in the last year. They were more likely to have participated in three or more different types of social activities (e.g. sports, community or other types of social activities) over the previous year and to have a higher income. Compared to those in the poor health profile, participants in the good health profile were also more likely to have participated in one or two different types of activities in the last year. These results were expected as participants in the good health profile had the best physical health, measured by the ability to participate in social activities. Whereas women were less likely to be in the good health profile, there was no sex differences between the intermediate health and poor health profiles.

Finally, we observed regional variations in the health indicator. Nunavik was the reference category as qualitative workshops were conducted in this region. In comparison to participants living in Nunavik, those in the good health profile were more likely to live in Nunatsiavut and Nunavut, whereas participants in the intermediate health profile were more likely to live in Nunatsiavut and Inuvialuit.

Table 4 Conditional probabilities of the 3-class model, APS 2006 (N = 4450)

Partial indicators	1—Good health (N = 1650)	2—Intermediate health (N = 1350)	3—Poor health (N = 1500)
Self-rated health			
Poor	0.004	0.235	0.741
Good	0.273	0.524	0.259
Excellent	0.723	0.242	0.000
Mental health inventory			
Poor	0.184	0.608	0.460
Moderate	0.358	0.273	0.284
Good	0.459	0.119	0.256
Activity limitations			
Often	0.164	0.215	0.589
Sometimes	0.224	0.336	0.312
Never	0.612	0.449	0.098
Frequency of alcohol consumption			
≥ 1 a month	0.181	0.529	0.130
< 1 a month	0.209	0.178	0.128
Never	0.610	0.293	0.741
Social support			
Weak	0.070	0.317	0.222
Moderate	0.205	0.255	0.303
High	0.726	0.428	0.474
Ability to speak inuktitut			
Doesn't speak	0.111	0.117	0.038
Speak	0.085	0.285	0.081
Speak very well	0.804	0.598	0.881

4 Discussion

In this study, we used an exploratory and sequential mixed-methods design to create a holistic indicator of health congruous with a multidimensional definition of health, as perceived and experienced by older Inuit. The multidimensional definition of health conceptualised during the workshops in Nunavik is very similar to Inuit models of health described elsewhere in the Arctic (Collings 2001; Lewis 2011). While we have not investigated the integrity of the Inuktitut terminology across the different Inuit regions, we are confident the conceptual frame has broad salience. Good health is the result of a balance between physical health, mental health, well-being, social relationships, and health behaviours. This is the case in both our results and in the literature on successful aging in Inuit communities (Collings 2001; Lewis 2011).

Language is an important dimension of Inuit health as it brings a person closer to her/his culture: In the literature, connectedness to culture—including transferring wisdom to younger generations—was a cornerstone of successful aging. In other studies, language was not specifically identified (Collings 2001; Lewis 2011). Generational differences identified by workshop participants in the definition of physical health have also been discussed

Table 5 Results of multinomial regressions examining the association of good physical health and very good health with selected measures, APS 2006, (N = 4450)

	Intermediate health (N = 1350)		Good health (N = 1650)	
	RRR (95% CI)	*p* value	RRR (95% CI)	*p* value
Women	0.83 (0.56;1.24)	0.365	0.58 (0.41;0.83)	*0.002*
Age	0.91 (0.89;0.94)	*< 0.001*	0.94 (0.92;0.95)	*< 0.001*
Social participation				
0 activities	*Ref*		*Ref*	
1–2 activities	1.41 (0.86;2.31)	0.177	1.64 (1.01;2.66)	0.048
≥ 3 activities	1.74 (1.06;2.85)	0.027	3.15 (2.01;4.96)	*< 0.001*
Number of health diagnostics				
≥ 2	*Ref*		*ref*	
1	2.59 (1.60;4.19)	*< 0.001*	2.69 (1.69;4.30)	*< 0.001*
0	5.20 (3.03;8.91)	*< 0.001*	8.26 (4.99;13.65)	*< 0.001*
Has been hospitalised				
No	2.78 (1.63;4.73)	*< 0.001*	3.05 (1.89;4.92)	*< 0.001*
Household income				
< 40,000	*Ref*		*Ref*	
40,000–59,999	1.96 (1.12;3.42)	0.019	1.69 (1.05;2.69)	0.029
≥ 60,000	1.68 (1.11;2.53)	0.013	2.33 (1.58;3.43)	*< 0.001*
Region of living				
Nunavik	*Ref*		*Ref*	
Nunatsiavut	3.30 (1.65;6.60)	0.001	4.48 (2.34;8.59)	*< 0.001*
Inuvialuit	2.39 (1.32;4.30)	0.004	1.60 (0.88;2.88)	0.122
Nunavut	0.97 (0.58;1.60)	0.895	1.67 (1.09;2.57)	0.018

elsewhere (Collings 2000; Lewis 2010). To older people, poor physical health was related to having activity limitations. Activity limitations were also important to Inuit and Indigenous Peoples in other Arctic regions, because they can lead to social isolation and prevent people from participating in cultural activities (Collings 2000; Lewis 2010). Whereas older adults' health is often measured by the presence or absence of diseases in research (Ryff and Singer 2008; Kuh et al. 2013), Inuit focus more on activity limitations and less on disease. This is similar to what is observed in European and North-American populations where older adults define healthy aging by being socially active, experiencing few physical limitations, and aging at home (Phelan and Larson 2002; Cosco et al. 2013). For older people, including Inuit, social limitations as a result of poor physical health are more important than physical health status in itself. The evolution of the definition of health concepts with age indicates the necessity to acknowledge age-specific definitions when using holistic health indicators.

LCA enabled the creation of a holistic indicator of health that captures complex health profiles. Instead of dividing participants between those who report good versus poor health, results of LCA yielded three contrasting health profiles. In all profiles, there were participants reporting positive outcomes for several dimensions of health, while reporting poor outcomes for others. For example, in the 'poor health' profile, most participants reported poor general, physical, and mental health, but most reported never drinking alcohol and

speaking Inuktitut very well. This complex health profile, including good and poor health dimensions, resonates with models of health defined by older Inuit. As people age, it is expected that they experience poorer physical health while still enjoying good mental and social health (Collings 2001). The holistic indicator seems to capture in part this non-linear process.

The associations between the holistic indicator and related sociodemographic and health measures indicated that the profiles identified through the indicator are adequate to compare participants with different health profiles. Overall, participants who had better holistic health also had better ratings of physical health and social connectedness, higher incomes, and were younger. The distribution of the indicator varied with region of residence. However, results of the qualitative analyses of this project indicated that definitions of health varied very little between Nunavik, as defined in our workshops, and in other regions of the Arctic (Collings 2001; Lewis 2011). These statistical variations are more likely influenced by regional differences in health than by regional variations in the definition of health. Further investigation is needed to understand the magnitude and causes of these variations. Given the small sample of population in Nunatsiavut, and to some extent in Inuvialuit, regional variations between Nunavik and these regions should be interpreted with caution.

This holistic indicator synthesises the multiple dimensions of Inuit health. It contrasts with previous unidimensional indicators used in Inuit health research. Synthetic indicators such as the holistic indicator developed in this study require more complex methods and development than single indicators of health, such as scores. However, using LCA to develop complex indicators allows for the identification of nuanced health, or social, profiles. A study comparing the use of scores vs. LCA approaches to measure HIV knowledge showed that LCA profiles elicited complex patterns of HIV knowledge types that were not measured with linear scores (Maslovskaya et al. 2018). The same situation applies here. Using a single measure of holistic health would require linearly ranging participants from poor to good health. In contrast, the holistic indicator developed in this study grouped participants according to more complex health profiles. These complex profiles would not be observable with a single measure or a score, and they represent the complexity of health for older Inuit as described in the workshops and elsewhere (Collings 2001; Lewis 2011).

Moreover, identifying complex health profiles can guide health and social interventions. In a related study, the authors of this manuscript analysed the associations between the holistic health indicator and selected social determinants of health (SDH). SDH associations with the holistic indicator of health varied with each health profile. Social factors and connectedness were only associated with the health of the participants in the good health profile; participants in this profile were more likely to have stronger family relationships in the community and to have participated in land-based activities (such as hunting and fishing) than participants in the poor health profiles. There were no associations between the SDH investigated and the intermediate health profiles. In comparison, participants in the intermediate health profile were more likely to live in a house that was not overcrowded and in a community with a higher socioeconomic level than those in the poor health profile. There were no associations between these SDH and the good health profile. Using synthetic health indicators such as the one developed in this study is helpful to identify complex health and social profiles and target groups of individuals with adapted health and social interventions.

Using mixed-methods, this indicator was specifically developed to represent older Inuit conceptualisation of health. Using health indicators closer to Indigenous representations of health is necessary to adequately and ethically characterize health as experienced by Indigenous populations (Walker et al. 2002; Daniel et al. 2009). In consequence, this indicator

cannot be used without being adapted and validated for other populations, as the definition of health varies across cultures and countries. For example, older Inuit definitions of health include dimensions of language and health-related behaviours that are not included in non-Indigenous older adults' definition of health (Cosco et al. 2013). However, non-Indigenous older adults populations also describe the complexity of health profiles and healthy aging, and include physical, mental and social dimensions in their definitions of health (Phelan et al. 2004). Using holistic indicators of health is a relevant approach for both Indigenous and non-Indigenous populations. However, the dimensions included in the indicator should be adapted to each population's conceptualisation of health. Developing holistic indicators of health such as the one created here would be helpful to address specific health issues and develop adapted social interventions.

4.1 Limitations

Results presented in this paper must be interpreted in light of certain limitations. Whereas the lead author conducted the complementary qualitative analysis from the workshops, she did not participate in the data collection nor in the primary analyses process. However, she was involved in other aspects of the preparation of the *Qanuilirpitaa?* 2017 Nunavik Inuit Health Survey, and had a good understanding of the context of the project. Moreover, the analyses were realised in collaboration with the researchers who participated in the data collection and/or primary analysis to ensure the reliability and validity of the analysis.

We used an exploratory sequential mixed-method design to define health and its related concepts with Inuit elders before selecting the indicators in the survey to ensure that they would respect Inuit definitions of health. We used data from the 2006 APS cycle to operationalize constructs developed in 2016. It is possible that the definition of health and concepts related to health have varied during this 10-year period. The workshops were held in Nunavik, whereas the indicator was created using data from all four regions of Inuit Nunangat. Using mixed-methods data collected at different places and times might limit the generalisability of our results to other Inuit population. Nevertheless, there were few differences between the models of health in Collings' and Lewis' work on healthy aging in the Inuvialuit region and in Alaska (Collings 2000; Lewis 2011), published between 2000 and 2011, and the concepts developed in the workshops in Nunavik in 2016. This continuity in space and time of Inuit models of health support the validity of our results.

Our selection of partial indicators was limited by those available in the APS. For example, there was no measure of spirituality and there were only limited measures of health behaviors defined by participants of the workshops as important components of health and healthy aging. Using secondary quantitative data limits the operationalisation of health-related concepts defined by Inuit elders. Nonetheless the health indicator was associated, in the expected direction, with selected determinants of health suggesting concurrent validity. In the future, using primary data developed and collected specifically to measure the dimensions of health as defined by Inuit elders would increase the validity and generalisability of holistic indicators of health.

In socio-ecological models of health, in both in Indigenous (Loppie Reading and Wien 2009; Inuit Tapiriit Kanatami 2014) and other contexts (World Health Organization 2010), there is a distinction made between health and the factors that influence health, i.e. the social determinant of health such as social support, health-related behaviours, and culture. However, Inuit hold an ecocentric definition of health, by which health is defined by the connections between a person and the surrounding social and physical environment (Borré

1994; Kirmayer et al. 2009; Kral et al. 2011). In this ecocentric model of health, the distinction between health as a bodily, individual concept and social factors is blurred. In our study, several factors generally described as social determinants of health were included in the holistic indicator such as connectedness, alcohol consumption, and language. The holistic indicator we operationalised is closely related to the ecocentric model of health. Future research will strive to better understand the relationships between holistic health and the surrounding social environment in an ecocentric perspective.

5 Conclusion

In Canada and elsewhere, it has been argued that older Indigenous and non-indigenous adults define health in a holistic way (Hopkins et al. 2007; Waugh and Mackenzie 2011; Cosco et al. 2013) without giving much empirical depth to the notion of holism. This study provides an example of the creation of a holistic quantitative indicator based on the Inuit definition of health. This indicator also represents the multidimensionality of the aging process, as there is a variety of health profiles for older people. Some people can thrive in good physical health as they age, whereas some will experience more physical and social limitations but will have excellent mental health. This indicator can be used, and adapted, in future research to study health status among older Inuit and identify protective and risk factors for Inuit health. The use of mixed-methods to create an appropriate health indicator, as was done in this study, would also be a relevant approach in other Indigenous and non-Indigenous populations.

Compliance with Ethical Standards

Conflict of interest No potential conflict of interest was reported by the authors.

References

Bernini, C., Guizzardi, A., & Angelini, G. (2014). Developing a composite indicator of residents' well-being: The case of the Romagna Area. In F. Crescenzi & S. Mignani (Eds.), *Statistical methods and applications from a historical perspective, studies in theoretical and applied statistics* (pp. 337–345). Suisse: Springer. https://doi.org/10.1007/978-3-319-05552-7.

Bjerregaard, P., et al. (2004). Indigenous health in the Arctic: An overview of the circumpolar Inuit population. *Scandinavian Journal of Public Health, 32*(5), 390–395. https://doi.org/10.1080/14034940410028398.

Borré, K. (1994). The healing power of the seal: The meaning of Inuit health practice and belief. *Arctic Anthropology, 31*(1), 1–15.

Bringsen, A., Andersson, H. I., & Ejlertsson, G. (2009). Development and quality analysis of the Salutogenic Health Indicator Scale (SHIS). *Scandinavian Journal of Primary Health Care, 37,* 13–19. https://doi.org/10.1177/1403494808098919.

Chandola, T., & Jenkinson, C. (2000). Validating self-rated health in different ethnic groups. *Ethnicity & Health, 5*(2), 151–159.

Christian, L. M., Glaser, R., Porter, K., Malarkey, W. B., Beversdorf, D., & Kiecolt-Glaser, J. K. (2011). Poorer self-rated health is associated with elevated inflammatory markers among older adults. *Psychoneuroendocrinology, 36*(10), 1495–1504. https://doi.org/10.1016/j.psyneuen.2011.04.003.

Collings, P. (2000). Aging and life course development in an inuit community. *Arctic Anthropology, 37*(2), 111–125.

Collings, P. (2001). "If you got everything, it's good enough": Perspectives on successful aging in a Canadian Inuit community. *Journal of Cross-Cultural Gerontology, 16,* 127–155.

Coma, E., et al. (2013). Creation of a synthetic indicator of quality of care as a clinical management standard in primary care. *SpringerPlus, 2*(1), 51. https://doi.org/10.1186/2193-1801-2-51.

Cosco, T. D., et al. (2013). Lay perspectives of successful ageing: A systematic review and meta-ethnography. *British Medical Journal Open, 3,* 1–9. https://doi.org/10.1136/bmjopen-2013-002710.

Creswell, J. W., & Plano Clark, V. L. (2007). *Designing and Conducting Mixed Methods Research*. Thousand Oaks, London, New Delhi: Sage Publications Inc.

Damas, D. (2002). *Arctic migrants/Arctic villagers: The transformation of Inuit settlement in the central Arctic*. Montreal: McGill-Queen's University Press.

Daniel, M., Cargo, M., Marks, E., Paquet, C., Simmons, D., Williams, M., Rowley, K., O'Dea, K. (2009). Rating health and social indicators for use with indigenous communities: A tool for balancing cultural and scientific utility. *Social Indicators Research*, *94*(2), 241–256. https://doi.org/10.1007/s11205-008-9420-7.

Delpierre, C., Lauwers-Cances, V., Datta, G. D., Berkman, L., & Lang, T. (2009). Impact of social position on the effect of cardiovascular risk factors on self-rated health. *American Journal of Public Health, 99*(7), 1278–1284. https://doi.org/10.2105/AJPH.2008.147934.

Fletcher, C. (2017). Measuring Inuit health from Ungava to Nunavik via Nouveau Québec: Episodes in the history of researcher-subject relations. *American Review of Canadian Studies, 47*(2), 206–224. https://doi.org/10.1080/02722011.2017.1323944.

Fortin, M., et al. (2015). Temporal trends of alcohol and drug use among Inuit of Northern Quebec, Canada. *International Journal of Circumpolar Health, 74,* 1–9. https://doi.org/10.3402/ijch.v74.29146.

Fribord, J., et al. (2003). Cancer in Greenlandic Inuit 1973–1997: A cohort study. *International Journal of Cancer, 107,* 1017–1022. https://doi.org/10.1002/ijc.11502.

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 597–607.

Goldman, N. (2004). The role of clinical risk factors in understanding self-rated health. *Annals of Epidemiology, 14*(1), 49–57. https://doi.org/10.1016/S1047-2797(03)00077-2.

Gray, A. P., Richer, F., & Harper, S. (2016). Individual-and community-level determinants of Inuit youth mental wellness. *Canadian Journal of Public Health, 107*(3), 251–257. https://doi.org/10.17269/CJPH.107.5342.

Haseli-Mashhadi, N., Pan, A., Ye, X., Wang, J., Qi, Q., Liu, Y., et al. (2009). Self-Rated Health in middle-aged and elderly Chinese: Distribution, determinants and associations with cardio-metabolic risk factors. *BMC Public Health, 9,* 368. https://doi.org/10.1186/1471-2458-9-368.

Hashemnezhad, H. (2015). Qualitative content analysis research: A review article. *Journal of ELT and Applied Linguistics (JELTAL), 3*(1), 54–62.

Health Canada. (2009). A Statistical Profile on the Health of First Nations in Canada: Self-rated Health and Selected Conditions 2002 to 2005. Health Canada. http://www.hc-sc.gc.ca/fniah-spnia/alt_formats/pdf/pubs/aborig-autoch/2009-stats-profil-vol3/2009-stats-profil-vol3-eng.pdf.

Hlatky, M. A., et al. (1989). A brief self-administered questionnaire to determine functional capacity (The Duke Activity Status Index). *The American Journal of Cardiology. Excerpta Medica, 64*(10), 651–654. https://doi.org/10.1016/0002-9149(89)90496-7.

Hopkins, S. E., et al. (2007). Keeping busy: A Yup'Ik/Cup'Ik perspective on health and aging. *International Journal of Circumpolar Health, 66*(1), 42–50.

Horsman, J., et al. (2003). The Health Utilities Index (HUI): Concepts, measurement properties and applications'. *Health and Quality of Life Outcomes, 1,* 1–13.

Humble, Á. M. (2009). Technique triangulation for validation in directed content analysis. *International Journal of Qualitative Methods, 8*(3), 34–52. https://doi.org/10.1177/160940690900800305.

Idler, E. L., & Benyamini, Y. (1997). Self-rated health and mortality: A review of twenty-seven community studies. *Journal of Health and Social Behavior, 38*(1), 21–37.

Inuit Tapiriit Kanatami. (2008). Inuit Statistical Profile. ITK

Inuit Tapiriit Kanatami. (2014). Social Determinants of Inuit Health in Canada. https://doi.org/10.1097/01.aog.0000453605.35883.a0.

Inuit Tapiriit Kanatami. (2018). Inuit Statistical Profile.

Jylhä, M., Volpato, S., & Guralnik, J. M. (2006). Self-rated health showed a graded association with frequently used biomarkers in a large population sample. *Journal of Clinical Epidemiology, 59*(5), 465–471. https://doi.org/10.1016/j.jclinepi.2005.12.004.

Kirmayer, L. J. (1994). Suicide among Canadian aboriginal peoples. *Transcultural Psychiatric Research Review, 31,* 3–58.

Kirmayer, L. J., Fletcher, C., Corin, E., Boothroyd, L. (1997). Inuit concepts of mental health and illness: An ethnographic study. Culture and Mental Health Unit, Institute of Community and Family Psychiatry, Sir Mortimer B. Davis—Jewish General Hospital. Montréal.

Kirmayer, L. J., Fletcher, C., & Watt, R. (2009). 13: Locating the ecocentric self: Inuit concepts of mental health and illness. In L. J. Kirmayer & G. G. Valaskakis (Eds.), *Healing traditions: The mental health of Aboriginal Peoples in Canada* (pp. 289–314). Vancouver: UBC Press.

Kral, M. J., et al. (2011). Unikkaartuit: Meanings of well-being, unhappiness, health, and community change among Inuit in Nunavut, Canada. *American Journal of Community Psychology, 48,* 426–438. https://doi.org/10.1007/s10464-011-9431-4.

Kuh, D., et al. (2013). Life course epidemiology, ageing research, and maturing cohort studies: A dynamic combination for understanding healthy ageing. In D. Kuh, et al. (Eds.), *A life course approach to healthy ageing* (pp. 3–15). Oxford: Oxford University Press. https://doi.org/10.1093/acprof:oso/9780199656516.001.0001.

Lewis, J. P. (2010). Successful aging through the eyes of Alaska natives: Exploring generational differences among Alaska natives. *Journal of Cross-Cultural Gerontology, 25,* 385–396. https://doi.org/10.1007/s10823-010-9124-8.

Lewis, J. P. (2011). Successful aging through the eyes of Alaska Native elders. What it means to be an elder in Bristol Bay, AK. *The Gerontologist, 51*(4), 540–549.

Loppie Reading, C., & Wien, F. (2009). *Health inequalities and social determinants of aboriginal peoples' health*. Vancouver: National Collaborating Center for Aboriginal Health.

Lucas, M., et al. (2010). Erythrocyte N-3 is inversely correlated with serious psychological distress among the Inuit: Data from the Nunavik Health Survey. *Journal of the American College of Nutrition, 29*(3), 211–221. https://doi.org/10.1080/07315724.2010.10719836.

Marks, E., Cargo, M. D., & Daniel, M. (2007). Constructing a health and social indicator framework for indigenous community health research. *Social Indicators Research, 82,* 93–110. https://doi.org/10.1007/s11205-006-9016-z.

Martin, G., Keller, C. P., & Foster, L. T. (2012). Constructing a composite adolescent health and wellness index for British Columbia, Canada using a spatial multi-criteria analysis approach. *Child Indicators Research*, 5(2), 215–234.

Maslovskaya, O., Smith, P. W. F., & Padmadas, S. S. (2018). A comparison of simple score and latent class approaches: Application to HIV knowledge data in Chinese and multi-country contexts. *International Journal of Social Research Methodology, 21*(2), 243–261. https://doi.org/10.1080/13645579.2017.1367555.

May, M., Lawlor, D. A., Brindle, P., Patel, R., & Ebrahim, S. (2006). Cardiovascular disease risk assessment in older women: Can we improve on Framingham? British Women's Heart and Health prospective cohort study. *Heart (British Cardiac Society), 92*(10), 1396–1401. https://doi.org/10.1136/hrt.2005.085381.

McCutcheon, A. L. (1987). *Latent class analysis (No. 64)*. Thousand Oaks, CA: Sage Publications.

Morgan, D. L. (1998). Practical strategies for combining qualitative and quantitative methods: Applications to health research. *Qualitative Health Research, 8*(3), 362–376.

Muckle, G., et al. (2007). Alcohol, drug use and gambling amont the Inuit of Nunavil: Epidemiological profile. Retrieved from 11 April 2018, https://www.cpha.ca/sites/default/files/uploads/resources/cannabis/nunakvik_qanuippitaa_2005.pdf.

Oster, R. T., et al. (2014). Cultural continuity, traditional Indigenous language, and diabetes in Alberta First Nations: A mixed methods study. *International Journal for Equity in Health, 13*(92), 1–11.

Phelan, E. A., & Larson, E. B. (2002). "Successful aging"—Where next? *Journal of the American Geriatrics Society, 50*(7), 1306–1308.

Phelan, E. A., et al. (2004). Older adults' views of "successful aging"—How do they compare with researchers' definitions? *Journal of the American Geriatrics Society, 52*(2), 211–216.

Richmond, C. A. M. (2009). The social determinants of Inuit health: A focus on social support in the Canadian Arctic. *International Journal of Circumpolar Health, 68*(5), 471–487.

Richmond, C. A. M., & Ross, N. A. (2009). The determinants of First Nation and Inuit health: A critical population health approach. *Health & Place, 15,* 403–411. https://doi.org/10.1016/j.healthplace.2008.07.004.

Richmond, C. A. M., Ross, N. A., & Egeland, G. M. (2007). Social support and thriving health: A new approach to understanding the health of indigenous Canadians. *American Journal of Public Health, 97*(9), 1–7. https://doi.org/10.2105/ajph.2006.096917.

Ryff, C. D., & Singer, B. (2008). Understanding healthy aging: Key componentes and their integration. In V. L. Bengston, et al. (Eds.), *Handbook of Theories of Aging* (2nd ed., pp. 117–144). New York: Springer.

Saudny, H., Cao, Z., & Egeland, G. M. (2012). Poor self-reported health and its association with biomarkers among Canadian Inuit. *International Journal of Circumpolar Health, 71*(21), 1–7. https://doi.org/10.3402/ijch.v71i0.18589.

Schreiber, J. B., & Pekarik, A. J. (2014). Technical note: Using latent class analysis versus k-means or hierarchical clustering to understand museum visitors. *Curator: The Museum Journal, 57*(1), 45–59. https://doi.org/10.1111/cura.12050.

Somarriba, N., & Pena, B. (2009). Synthetic indicators of quality of life in Europe. *Social Indicators Research, 94*(1), 115–133. https://doi.org/10.1007/s11205-008-9356-y.

StataCorp. (2017). *Stata Statistical Software: Release 15*. College Station, TX: StataCorp LLC.

Statistics Canada. (2006). *2006 Census Inuit Tables*. Ottawa: Statistics Canada.

Statistics Canada. (2009). *Aboriginal Peoples Survey, 2006: Concepts and methods guide*. Ottawa: Statistics Canada.

Statistics Canada. (2017). Aboriginal Peoples Highlight Tables, 2016 Census. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hlt-fst/abo-aut/Table.cfm?Lang=Eng&T=101&S=99&O=A.

Stewart, A., Hays, R., & Ware, J. (1988). The MOS Short-form General Health Survey. *Medical Care, 26,* 724–735.

Stoller, E. P., Webster, N. J., Blixen, C. E., McCormick, R. A., Hund, A. J., Perzynski, A. T., Kanuch, S. W., Thomas, C. L., Kercher, K., Dawsonet, N. V. (2009). Alcohol consumption decisions among nonabusing drinkers diagnosed with hepatitis C: An exploratory sequential mixed methods study. *Journal of Mixed Methods Research*, *3*(1), 65–86. https://doi.org/10.1177/1558689808326119.

Stuart, B., & Hinde, A. (2010). Identifying individuals engaging in risky sexual behaviour for chlamydia infection in the UK: A latent class approach. *Journal of Biosocial Science, 42*(1), 27–42. https://doi.org/10.1017/S0021932009990289.

Svenson, K. A. and Lafontaine, C. (1997) The search for wellness. In *First Nations and Inuit regional health survey Committee* (pp. 181–216).

Tait, H. (2008) Aboriginal Peoples Survey, 2006: Inuit Health and Social Conditions. doi: 89-637-X.

Tariq, S., & Woodman, J. (2010). Using mixed methods in health research. *Journal of the Royal Society of Medicine Short Reports*. https://doi.org/10.1177/2042533313479197.

Taylor, J. (2008). Indigenous peoples and indicators of well-being: Australian perspectives on United Nations Global Frameworks. *Social Indicators Research, 87*(1), 111–126.

Thompson, S. J., & Gifford, S. M. (2000). Trying to keep a balance: The meaning of health and diabetes in an urban Aboriginal community. *Social Science and Medicine, 51,* 1457–1472.

Walker, R., Ballard, J., & Taylor, C. (2002) Investigating appropriate evaluation methods and indicators for Indigenous housing programs.

Ware, J. E., et al. (1993). *SF-30 health survey manual & interpretation guide*. Boston: Massachusetts.

Waugh, E., & Mackenzie, L. (2011). Ageing well from an urban Indigenous Australian perspective. *Australian Occupational Therapy Journal, 58,* 25–33. https://doi.org/10.1111/j.1440-1630.2010.00914.x.

World Health Organization. (2010). A conceptual framework for action on the social determinants of health, Social Determinants of Health Discussion Paper 2. Geneva. ISBN 978 92 4 150085 2.

Young, T. K., & Bjerregaard, P. (2008). *Health transitions in Arctic populations*. Toronto: University of Toronto Press.

Affiliations

Marie Baron[1] · **Mylène Riva[3]** · **Christopher Fletcher[2,4]** · **Melody Lynch[5]** · **Marie-Claude Lyonnais[2]** · **Elhadji A. Laouan Sidi[6]**

1   Vitam – Centre de recherche en santé durable, Centre intégré universitaire de santé et services sociaux de la Capitale-Nationale, Québec, Canada

2   Axe Santé des Populations et Pratiques Optimales en Santé, Centre de Recherche du CHU du Québec - Université Laval, Hôpital St-Sacrement, bureau JSI-13, 1050, Ch Ste-Foy Québec, QC G1S4L8, Canada

3   Canada Research Chair in Housing, Community, and Health, Institute for Health and Social Policy and Department of Geography, McGill University, Montreal, Canada

4   Département de Médecine Sociale et Préventive, Laval University, Quebec City, Canada

5   Department of Geography, McGill University, Montreal, Canada

6   Unité Gestion, analyse et diffusion de l'information – Soutien méthodologique et Infocentre, Institut national de santé publique du Québec, Québec, Canada