FERTILITY AND REPRODUCTIVE HEALTH DECISIONS CONNECTED TO CLIMATE CHANGE AND ADAPTATION IN GREENLAND

by

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TABLE OF CONTENTS

1. INTRODUCTION 1

Fertility Trends Influence Adaptive Capacity of Kalaallit Communities 2
Research Questions and Design 3
Building on Population Dynamics Greenland 4
Literature Review 5
Global Perspectives on Climate Change and Adaptation Policy, Natural Resource Availability, and Fertility 5
Hunting and Fisheries Management Affect Household Economy and Fertility Decisions 6
Fertility Trends, Demographic Transition, and the Status of Fertility and Reproductive Health in Greenland 7

2. METHODS 10

Theoretical Background 10
Community Based Participatory Research Principles 11
Study Area 13
Ethics 14
Sampling Strategy 14
In-Depth Interviews with Policymakers and Key Stakeholders 15
Semi-Structured Interviews with Individual Men and Women 15
Analysis 16
Community Tailored Results Dissemination 16

3. DEVELOPMENT CONTEXT INFLUENCES FERTILITY AND REPRODUCTIVE HEALTH DECISIONS IN GREENLAND AMID CLIMATE CHANGE 17

Contribution of Authors and Co-Authors 17
Manuscript Information 18
Abstract 19
Introduction 19
Lifestyle Transitions Connected to Natural Resource Economy in Greenland 22
Methods 23
Study Area 23
Methodological approach 25
Ethics 25
Participant Recruitment 25
Data Collection 26
Analysis 26

TABLE OF CONTENTS CONTINUED

Results 28
Immediate Drivers of Fertility Decisions 29
Contraception, Condoms, and Sexuality Education 31
Drivers of Abortion 32
Giving Birth in Paamiut, Nuuk, and Denmark 33
Connection to Place 35
Living Conditions and Disparate Development Trajectories 35
Access to Education 38
Cultural Values and Visions 39
Climate Change and Adaptation Perspectives 41
Discussion 43
Strengths and Limitations 46
Conclusion 46

4. LIVELIHOOD TRANSITIONS AND FERTILITY OUTCOMES IN GREENLAND'S NATURAL RESOURCE ECONOMY: IMPLICATIONS FOR CLIMATE ADAPTATION POLICY 47

Manuscript Information 48
Abstract 49
Introduction 49
Methods 52
Study Area 52
Ethics 53
Sample and Recruitment 54
Data Collection 55
Data Analysis 55
Results 56
Fertility Trends in Greenland 56
Healthcare Characteristics 59
Education and Workforce Challenges 61
Community Capacity to Direct Development 62
Economic Opportunities 65
Climate Change and Adaptation Perspectives 66
Discussion 69
Strengths and Limitations 71
Conclusion 72

5. APPLYING COMMUNITY BASED PARTICIPATORY RESEARCH PRINCIPLES TO BUILD TRUST AND EQUITY IN HEALTH AND SOCIO-ECOLOGICAL STUDIES IN GREENLAND 73

Manuscript Information 74

TABLE OF CONTENTS CONTINUED

Abstract 75
Introduction 75
Challenges of Using CBPR in Greenland 76
Background 77
Methods 79
Define the Contextual Realities of the Research 79
Align Research Tasks and Timelines with Community Priorities 81
Trust-Building in the Community and Research by Invitation 81
Design Instruments with Input from Community Partners Using Local Dialect 82
Transparency About Funding and Bureaucracy 83
Use Existing Social Networks for Participant Recruitment 84
Cooperative Data Collection and Analysis 84
Disseminate Results in a Culturally Valued Way 85
Advocate for Equal Representation in Academic Presentations and Publications 86
Discussion 87

6. LESSONS LEARNED AND STRATEGIES FOR FUTURE RESEARCH INVOLVING HEALTH AND CLIMATE ADAPTATION POLICY IN GREENLAND 95

Purpose 95
Locating Policy Documents 95
Navigating Non-Peer-Reviewed Research 96
Engaging with Press 96

7. CONCLUSION 98

General Summary of Results 98
Key Messages 100

CUMULATIVE REFERENCES CITED 101

APPENDICES 116

KEY STAKEHOLDER/POLICYMAKER INTERVIEW GUIDE 117

INDIVIDUAL MALE/FEMALE INTERVIEW GUIDE 124

LIST OF TABLES

Table Page

1. Table 1. Sociodemographic characteristics of participants 29
2. Table 2. Participant subject matter and policy domain expertise 54
3. Table 3. Actions to guide research activities using community based participatory research principles in Greenland 90
4. Table 4. Implications and recommendations for policy in Greenland 99

LIST OF FIGURES

Figure Page

1. Figure 1. Ecological systems model of climate change and adaptation and fertility and reproductive health. 11

2. Figure 2. Live birth rate and abortion rate per 1,000 women in Greenland (1993-2022) 21

3. Figure 3. Map of Greenland with study sites indicated. 24

4. Figure 4. Grounded theory analytical framework with iterative collaborative analysis to include Kalaallit and non-Indigenous perspectives 27

5. Figure 5. Map of Greenland and study sites, including municipality district boundaries 53

6. Figure 6. Map of Greenland with study sites and site of Population Dynamics Greenland 78

ABSTRACT

The capacity for Kalaallit, the Inuit people of Greenland, to adapt to the effects of climate change will depend on sociodemographic change, population distribution, and existing health inequities in the country. Reproduction in Greenland is influenced by connection to place and access to natural resources, factors that will vary with climate adaptation. Given existing fertility and reproductive health disparities among Kalaallit women, there is a compelling reason to explore how climate change effects and adaptation might influence fertility decisions and population dynamics in Greenland. Rooted in the principles of community based participatory research, this exploratory and comparative study investigated the social, environmental, and economic resources that affect fertility decisions for Kalaallit in Greenland. The research presented contextualizes drivers of fertility decisions within Greenland's climate adaptation policy options and presents strategies to guide health studies in Greenland with principles of community based participatory research. Interviews were conducted with 35 reproductive-aged (18-49 years) men and women and 26 interviews with policymakers and key stakeholders in two communities about climate adaptation, natural resources, economic development, and fertility and reproductive health. Interviews were analyzed using constructivist grounded theory in collaboration with a Kalaallit community research partner. Results indicate that improving community capacity to address existing housing, education, and economic inequities is critical to supporting fertility and reproductive health, irrespective of climate change impacts. Participants observed climate change effects and expressed positive attitudes about Kalaallit ability to adapt and capitalize on benefits of climate change. Evidence from this study indicates that addressing development disparities in Greenland may immediately support fertility and reproductive health for Kalaallit people and facilitate equitable climate adaptation.

CHAPTER ONE

INTRODUCTION

The Arctic has warmed at four times the rate of other global regions since 1979, causing extreme environmental changes (1). Greenland is experiencing profound biophysical effects of climate change, including melting of sea ice and the ice sheet, extreme weather events, increased precipitation, permafrost thaw, habitat degradation, coastal plain erosion, and population decline in plant and animal species (2-4). The social, political, environmental, health, and economic challenges that climate change poses necessitate adaptation planning and policy to support climate resilience in Greenland (5). *Climate adaptation* can be understood as "the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities" (6). *Climate adaptation policy* refers to actions taken by governments, organizations, communities, or individuals to facilitate climate adaptation for a specific region, population, ecosystem, or other unit. Formal government-directed climate adaptation planning is in its nascence in Greenland, though actors across private and public sectors have practiced climate adaptive strategies to manage the country's natural resources for decades. Research into the effects of climate adaptation on human systems in Greenland has documented the importance of natural resource availability and management for livelihood, diet, mental health, cultural continuity, and quality of life for Kalaallit people (Inuit people of Greenland) (2, 3, 7-11). It is critical that natural resource management, especially management of hunting and fisheries, is linked with human health needs under climate adaptation policy in Greenland (12).

Fertility Trends Influence Adaptive Capacity of Kalaallit Communities

The capacity for Kalaallit communities to adapt to the effects of climate change will depend in-part on sociodemographic change and population distribution within Greenland (5). In 2023 Greenland had a population of 56,609 people with 89 percent of the population ethnically Kalaallit (13, 14). Based on current fertility, mortality, and migration trends, Greenland's population is projected to decline below 50,000 by 2050 (15). With limited jobs for women in small communities, Kalaallit women more frequently leave their hometown to pursue education, while men are more likely to remain in traditional hunting and fishing trades (15-17). Fertility is necessarily predictive of population dynamics in Greenland, with high fertility rates in settlements and lower fertility rates in towns (15). Kalaallit women experience marked disparities in fertility and reproductive health relative to women in other Arctic countries and in Denmark. Greenland also has the highest abortion rate in the world, reaching 66 abortions per 1,000 women of childbearing age in 2018, nearly 5 times the abortion rate in the United States and 6 times the abortion rate in Denmark in the same year (15, 18, 19). Abortion rates in Greenland have increased for the past decade and have consistently exceeded live birth rates since 2017, indicating a need for family planning methods that match Greenland's sociocultural and geographic context (15, 20, 21). Globally, climate-related threats exacerbate fertility and reproductive health disparities related to gender and socioeconomic status (12, 22). Pregnant women and women of childbearing age are vulnerable to adverse health consequences of climate change, including food insecurity related to reduced availability of locally harvested animals, supply and service disruption due to extreme weather events, and emotional distress (23-25). Given existing fertility and reproductive health disparities among Kalaallit women, there is a

compelling reason to explore how climate effects and adaptation might influence fertility outcomes and population dynamics in Greenland.

For Kalaallit communities, fisheries, hunting, and other aspects of nature provide cultural and material resources that are linked to fertility and reproductive health, including food security, income, and social cohesion (16, 26). Research suggests that reproduction in Greenland is influenced by connection to place and access to natural resources, factors that will vary with climate adaptation (16, 20, 21). *Fertility decisions* describes a range of actions individuals perform that preclude experiences of planned and unplanned pregnancy, childbirth, induced abortion, childrearing, and adoption. Historically in Greenland, migration, fertility decisions, and subsequent population shifts have been linked to transition from traditional hunter livelihoods, and pursuit of improved socioeconomic opportunities (7, 16, 27, 28). There is a need to investigate linkages between natural resource availability and determinants of fertility outcomes in Greenland to inform gender-sensitive climate adaptation policy.

Research Questions and Design

This dissertation reports on a 2.5-year, cross-sectional, exploratory and comparative study designed with Ecological Systems Theory (29). We explored how people in the communities of Nuuk and Paamiut make fertility decisions based on the social, environmental, and economic resources available that may vary with current and expected climate change and adaptation. Focusing on climate adaptation policies related to natural resource management, this study asks the following research questions:

1. How do Greenlandic policies pertaining to climate adaptation, including fisheries and hunting management, economic development, and healthcare, affect fertility decisions in Greenland?
2. How do policymakers and key stakeholders in Greenland include FRH within climate adaptation planning and policy?
3. How do perceptions and observations of climate change and adaptation affect fertility decisions for reproductive-aged men and women in Greenland?

This study was rooted in the principles of community based participatory research (CBPR) to improve equity and include local Kalaallit interests throughout the research process (30). Constructivist grounded theory guided data collection and analysis. Constructivist grounded theory is a methodological approach that complements CBPR by accounting for researcher positionality and influence on the type of data collected and the construction of study findings (31, 32).

Building on Population Dynamics Greenland

This study built upon the findings of *Population Dynamics Greenland* (NSF Arctic Social Science Program Award # 1319651, PI: Elizabeth Rink). *Population Dynamics Greenland* used ecological systems theory to examine determinants of fertility and reproductive health outcomes for hunters and their wives in the northwest settlement of Kullorsuaq from 2013 to 2017. The compounding effects of climate change, natural resource extraction, and centralization affected fertility and reproductive health in Kullorsuaq, contributing to a high number of pregnancies and subsequent abortions (20). Among many influential factors, *Population Dynamics Greenland* found that connection to place, understanding of where to hunt and fish, and family relationships

strongly influenced fertility decisions (20, 21). Families in Kullorsuaq prioritized finding ways to remain in their community even if economic conditions deteriorate, emphasizing the need for climate adaptation policies that realistically reflect Kalaallit priorities. This study expanded upon the recommendations of *Population Dynamics Greenland* by 1) using Ecological Systems Theory to investigate how access to natural resources and connection to place may influence fertility decisions in Nuuk and Paamiut; and 2) utilizing CBPR principles to strengthen community engagement and voice.

Literature Review

Global Perspectives on Climate Change and Adaptation

Policy, Natural Resource Availability, and Fertility

Many studies linking climate adaptation and fertility have centered around population growth as a driver of climate change and calls for policies to reduce global fertility (33-40). In this body of literature, fertility and natural resource management are linked through the demand for natural resources to support the growing global population (39, 41, 42). Under projected population conditions, natural resources are anticipated to be overexploited and regeneration will be inhibited due to climate change (39-41). Policy solutions converge on two types of climate adaptation strategies: a) strategies to maintain biodiversity via sustainable natural resource management, and b) strategies to mediate natural resource demand by reducing global human fertility (36-39, 43-45). Accordingly, climate adaptation policy considerate of access to family planning and drivers of fertility decisions have drawn increasing international attention.

Countries with existing gender disparities are more vulnerable to adverse fertility and reproductive health effects due to climate change (43, 44, 46, 47). Climate change risks are

experienced unequally and are location-dependent, exacerbating inequities related to gender, race, ethnicity, socioeconomic status and other intersections of identity (44, 48). Research addressing the effects of climate change and natural resource availability on fertility has primarily occurred in countries in the Global South experiencing high fertility, agricultural challenges, and extreme weather events (43-45, 49-51). Natural resource availability is critical for food security, which heavily influences maternal and child health outcomes, fertility planning, miscarriage and stillbirth, and gender-based violence (43, 49-51). Food insecurity is exacerbated by extreme weather and natural disasters associated with climate change. Extreme weather events can disrupt access to reproductive health services and contraception, which is consequential for fertility planning (23-25). Furthermore, male migration related to climate-driven natural resource loss has been linked to reduced access to contraception, increased sexual violence, and increased number of sex partners, which are all proximate determinants of fertility (52).

Hunting and Fisheries Management Affect Household Economy and Fertility Decisions

Access to nature and natural resources affects household economy and living conditions for Greenlandic families that directly influence a family's fertility decisions (16, 26, 53). Hunting, offshore fisheries, and coastal fisheries are critical to supporting essential Arctic Social Indicators of fate control, cultural continuity, and contact with nature in Greenland (54). Sixteen percent of the Greenlandic workforce is employed in fisheries and hunting, and fisheries products account for 93 percent of Greenland's exports (15). Hunting is important for material resources, social cohesion, and cultural identity in Greenland (21, 26). Participation in full-time hunting has decreased in Greenland due to centralization, urbanization, and the implementation

of the licensing and quota system (7). For some Kalaallit families, the transition from the traditional hunting lifestyle has been linked to food insecurity and reduced household income and undermines Kalaallit cultural continuity (9, 26, 55). Hunters have reported that reduced access to hunting has increased feelings of isolation, travel time for harvest, need for modern equipment, and frustration with government (27, 56). In several accounts, wives of hunters have reported that their husbands' feelings of compromised identity have contributed to intimate partner conflict, which is a direct driver of abortion choices for some Kalaallit women (16, 27). To adapt, hunters have increased participation in the fisheries industry for supplemental income (16, 56). However, economic dependence on fisheries makes individuals and communities vulnerable as climate change threatens oceanic biodiversity and fish stock (57). Modern equipment has reduced the demand for labor and fishermen have reported their earning potential is limited by low allowable catch, as quotas favor offshore vessels (56, 58). As climate change threatens strained fisheries-dependent economies in small communities, the ability to provide for additional children is limited, possibly affecting fertility decisions.

Fertility Trends, Demographic Transition, and the Status of Fertility and Reproductive Health in Greenland

Urbanization has affected socio-economic and cultural dynamics in Greenland (59). The capital, Nuuk, accounts for 30 percent of the country's population and is projected to increase to 40 percent of the population by 2030 (59). Kalaallit women often leave their home settlement to pursue education, while men are more likely to remain in local hunting and fishing trades (16, 17). As the cost-of-living increases in settlements, many Greenlanders relocate to Nuuk and other larger towns. The migratory dynamics of Greenlanders between outer settlements and urban centers may affect fertility decisions based on education opportunities, skewed gender ratio, and

availability of health services (17, 60, 61). Greenland has a total fertility rate of 2.02 births per woman, which is below replacement (2.1 births per woman) (62). Fertility trends in Greenland must be contextualized within the history of Danish colonial authority. Between 1966 and 1975 Danish officials initiated a birth control campaign in Greenland that included inserting *spirals* (intrauterine devices) in approximately half of the fertile women in Greenland, often involuntarily and without parental consent for minors (63). Between 1966 and 1976 the country's total fertility rate decreased by over 50 percent (64). Given the recent emergence of details of the spiral campaign, past research into demographic transition in Greenland has not addressed the role of gender and race-based medical coercion in the observed fertility decline, nor has it accounted for lasting effects on contraceptive trust among Kalaallit women (65).

Provision of adequate FRH services is complicated by cultural and linguistic disconnect for healthcare providers, supply and service limitations for remote communities, and high healthcare worker turnover (66, 67). Physical complications due to pregnancy including stillbirths, neonatal deaths, and postpartum hemorrhaging are higher among Kalaallit women than other Arctic populations (66, 68). Greenland's sexually transmitted infection (STI) rates have been the highest among Arctic Indigenous populations for the past 20 years (69-72). To reduce perinatal and maternal mortality, the health system in Greenland requires pregnant women in small towns to travel to centralized hospitals to give birth, isolating women from their families in the weeks before delivery (66, 73, 74). There is little research into contraceptive acceptability among Kalaallit women, but *Population Dynamics Greenland* demonstrated preference for contraceptive implants, IUDs, and sterilization due to challenges receiving consistent healthcare.

Research in Greenland linking climate change and fertility and reproductive health has primarily explored the effect of exposure to persistent organic pollutants (POPs) on fertility and maternal health (75-80). Several cohort studies including Adaptation to Climate Change, Environmental Pollution, and Dietary Transition (ACCEPT) and Climate Change, Environmental Contaminants and Reproductive health (CLEAR) have used blood contaminant levels and population surveys to monitor epidemiological indicators among mother-child cohorts (76, 79-83). Traditional Kalaallit diets of marine animals are associated with increased exposure to POPs, which can affect fetal development and reproductive health (76, 84-86).

CHAPTER TWO

METHODS

Theoretical Background

This study used Ecological Systems Theory to investigate and explain the effects of climate change and adaptation on environmental, community, relational/interpersonal, and individual determinants of fertility decisions (29). The ecological systems model in **Figure 1** was used to guide interview topics and select policy domains that may influence fertility and reproductive health outcomes. Represented as concentric systems, the ecological systems model differentiates proximate and remote levels of the environment that affect individual behavior and outcomes within temporal and spatial contexts (29, 87). By using ecological systems theory, this study responded to recommendations of prior fertility and reproductive health research in Greenland for methodologies that incorporate Greenlandic cultural values, realistically match the healthcare environment of towns and settlements, and reflect collectivism over individualism (16, 21, 66, 88). A key component of ecological systems theory is relationality, which appeals to relational and collective aspects of Kalaallit knowledge systems and ontologies (21, 89).

This study's proposed ecological systems model of climate change and adaptation and fertility and reproductive health was adapted from findings of *Population Dynamics Greenland* to predict how individual fertility decisions are influenced by relations (partner, family, kin, and nature), community (connection to place, food security, educational opportunity, etc.), and natural resource access and availability from the biophysical environment (animal populations, management decisions, land and sea access, etc.) (16). Each level of the ecological systems

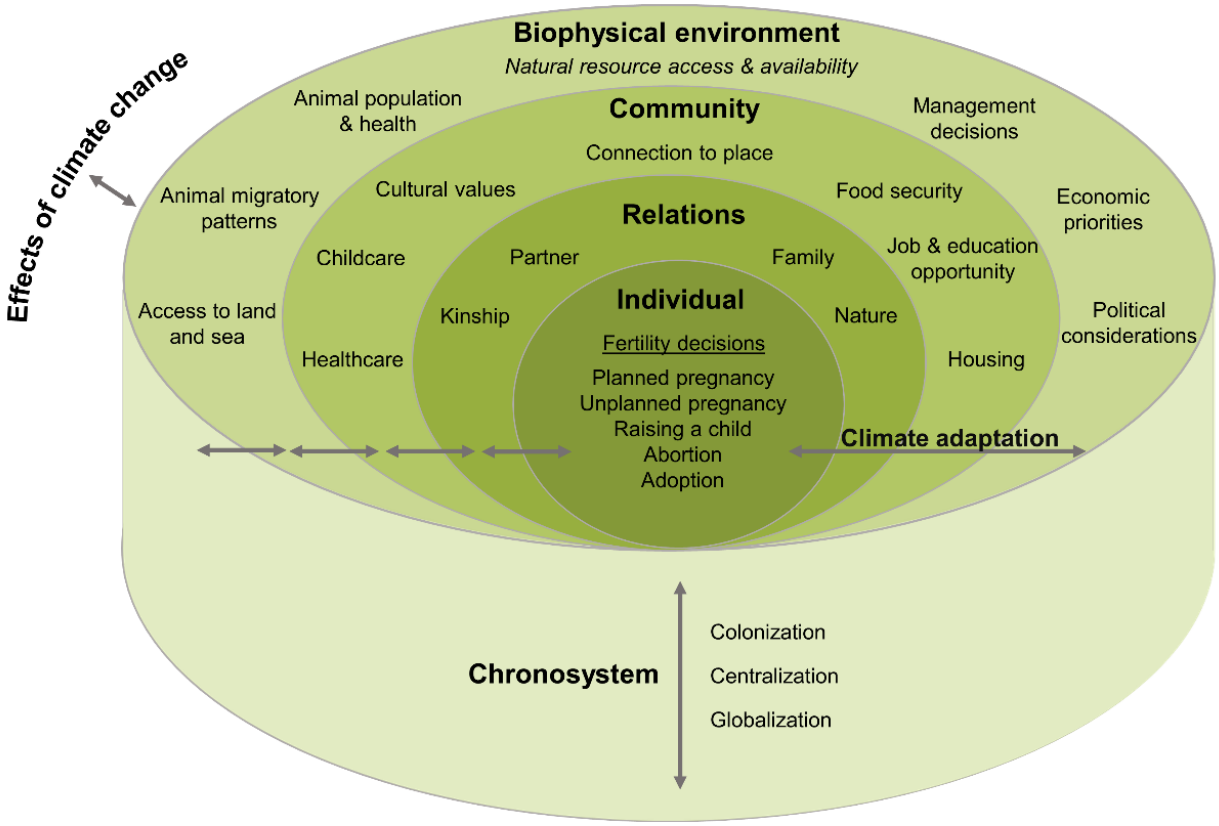

Figure 1. Ecological systems model of climate change and adaptation and fertility and reproductive health.

model reciprocally interacts with the other levels to affect individual fertility decisions and health outcomes. The effects of climate change are represented bidirectionally, positing that biophysical effects of climate change influence human systems, which reciprocally drive climate change. Climate adaptation occurs through individual, household, and community adaptations, and through natural resource management decisions.

Community Based Participatory Research Principles

Community based participatory research (CBPR) is a framework to improve social and health equity in research by partnering with communities in all aspects of research (90). Through participatory engagement with partners in Paamiut and colleagues in Nuuk, this study adopted a

collaborative and equitable approach to instrument design, data collection, analysis, and results dissemination. We built on community strengths by incorporating local knowledge, existing social networks, and community-identified interests into the research process (90). Co-researcher Augustine Rosing (AR) contacted Dr. Elizabeth Rink about participating in fertility and reproductive health research in her home community of Paamiut. Through our mutual relationships with Dr. Rink and our mutual interest in supporting fertility outcomes in Greenland, AR and MP were able to connect and initiate a research relationship to address the questions of this study. True adherence to CBPR necessitates ample time building relationships with community members, identifying local priorities, and developing a Community Advisory Board (CAB). Based on the funding and timeline limitations of this doctoral level study, it was not possible to conduct true CBPR. However, it provided an opportunity to assess the logistics, merits, and challenges of conducting health and socioecological research guided by the principles of CBPR. This study facilitated co-learning through the reciprocal transfer of knowledge across Kalaallit and Western research paradigms (90). We spent over 3 weeks in the Paamiut community, working from the Paamiut museum to conduct interviews and analysis. A significant component of this study was co-designing a results dissemination strategy with AR that would be valued by the community. By customizing results dissemination for a Kalaallit community context and with the direction of a Paamiut community member, this study aimed to increase public scientific literacy and promote local implementation of the findings. Results were delivered in venues across Paamiut, and hand-delivered to local residents and key stakeholders. Through this community-centered dissemination, we learned that there are many young adults who are interested in future research in the Paamiut community. CBPR strengthened this study

and may lead to improved researcher trust, and future opportunities to address local priorities in Paamiut. For a complete discussion of how principles of CBPR were used to guide this study, refer to **Chapter 5**.

Study Area

Paamiut and Nuuk are in the municipality of Kommuneqarfik Sermersooq in southwest Greenland **(Figure 2)**. Nuuk is the capital city with a population of 19,604 people in 2023, and is the location of government administration, scientific organizations, and natural resource management and healthcare authorities in Greenland (15). Paamiut had a population of 1,173 inhabitants in 2023 and an economy centered around the local fish factory (13, 15). Paamiut has experienced significant population and economic decline in recent decades (91). Paamiut once had the largest fish factory in Greenland, but when the West Greenland cod fishery collapsed in the 1980's many community members were forced to leave for other employment (91). Nuuk was selected as a site because it is the headquarters for government, scientific institutions, and most commercial fishing organizations in Greenland. Paamiut was selected as a study site for three reasons: 1) consistent with the principles of CBPR, site selection was reflective of the existing participatory research relationship with AR; 2) Paamiut's history as a fisheries-based community provides comparative context to build on the findings of Population Dynamics Greenland, which occurred in a hunting community; and 3) the social, environmental, and economic conditions in Paamiut differ from urbanized conditions in Nuuk, lending to comparison of fertility decisions related to different community settings. Importantly, Paamiut and Nuuk differ only marginally in climactic conditions; their distinction lies in levels of human

capital, economic diversity, effective local institutions, and participatory decision-making to facilitate climate adaptation.

Ethics

Ethical approval for this study was provided by the Greenland Science Ethics Committee and the Montana State University Institutional Review Board in 2022.

Sampling Strategy

Our sampling strategy was consistent with CBPR and constructivist grounded theory, meaning participants were selected based on existing community relationships (purposive sampling) and their experience with emerging concepts (theoretical sampling) (31). Key stakeholders and policymakers (n=26) were contacted in-person during fieldwork in Nuuk and Paamiut, via email, and via phone. Inclusion criteria were professional participation in a field related to our research questions, including healthcare, hunting and fisheries management, tourism, economic development, local and national government. Reproductive-aged (18-49 years) male and female participants from Nuuk (n=13) were recruited through institutional connections, messenger app, and during community engagement. Participants from Paamiut (n=22) were recruited via AR's local knowledge (purposive sampling) as she lives in the community and speaks Kalaallisut. Interview participants were offered chocolates and teas as a thank you for their time. All interviews completed in English were transcribed with Rev audio transcription services (92). Interviews conducted in Kalaallisut with real-time English translation were transcribed manually.

In-Depth Interviews with Policymakers and Key Stakeholders

In-depth interviews were conducted with policymakers and key stakeholders to explore thier personal and professional experiences related to climate adaptation, natural resource management, economic development, and fertility decisions. Interview guides were developed based on existing climate adaptation and fertility and reproductive health policies and were modified as relevant data was collected. Interviews included questions about professional experience and education; socioeconomic conditions and lifestyle in Greenland; climate change and adaptation attitudes; observed effects of climate change; hunting policy and lifestyle; fisheries policy; personal beliefs about drivers of fertility decisions in Greenland; and healthcare policy. Interviews with key stakeholders were conducted in English, as most professionals in Greenland speak English. See **Appendix A** for complete policymaker/key stakeholder interview guide.

Semi-Structured Interviews with Individual Men and Women

Semi-structured interviews were conducted with 35 reproductive aged men and women (18-49 years old) in Paamiut (n=22) and Nuuk n=13) to explore perceptions and observations of climate change and adaptation, drivers of fertility decisions, and personal social, environmental, and economic resources. Interview guides were developed based on materials from *Population Dynamics Greenland* and related studies from the Global South, and adapted based on recommendations from AR and colleagues in Greenland (16, 21, 50). Interviews included questions about personal education and work history; living conditions; family and partner relationships; relationship with nature; hunting lifestyle; fisheries; local economy; personal

fertility decisions and experiences; local healthcare; observations of climate change; attitudes about climate change; and hopes for the future of Greenland. See **Appendix B** for complete individual male/female interview guide.

Analysis

We used constructivist grounded theory and iterative collaborative analysis to interpret data through Kalaallit and Western perspectives (31, 93, 94). Our analytical framework depicted in **Figure 4** (see page 28) was adapted from a process published by Chun et al. 2019 and studies that included Indigenous and non-Indigenous perspectives in qualitative analysis (93, 95, 96). Constructivist grounded theory allows researchers to use a diverse qualitative data set to analyze actions, meanings, and processes, and to compare phenomena across individuals, collectives, and settings (31, 94, 97). For complete descriptions of analytical methods, refer to **Chapter 3** and **Chapter 4**.

Community Tailored Results Dissemination

Informed by CBPR, results were disseminated in the Paamiut community in a culturally relevant style to encourage local implementation of findings (30). Results were written in a clear format and translated to Kalaallisut and Danish, and distributed individually in the Paamiut community. Results were also presented at local establishments. AR and MP collected feedback from community members about the research process, accuracy of the findings, and their preferred policy actions. For complete description of results dissemination, see **Chapter 5.**

CHAPTER THREE

DEVELOPMENT CONTEXT INFLUENCES FERTILITY AND REPRODUCTIVE HEALTH DECISIONS IN GREENLAND AMID CLIMATE CHANGE

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Contributions: Methodology, Resources, Writing-Original Draft, Supervision.

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Population and Environment

Abstract

The capacity for communities in Greenland to adapt to the effects of climate change will depend in-part on sociodemographic change, population distribution, and existing health inequities in the country. Given existing fertility and reproductive health disparities among Kalaallit women, there is a compelling reason to explore how climate change effects and adaptation might influence fertility decisions and population dynamics in Greenland. We report on interviews with 35 reproductive-aged (18-49 years) men and women from two communities about social, environmental, and economic resources that affect fertility decisions in Greenland. Results indicate that improving community capacity to address existing housing, education, and economic inequities is critical to supporting fertility and reproductive health, irrespective of climate change impacts. Participants observed climate change effects and expressed positive attitudes about Kalaallit ability to adapt and capitalize on benefits of climate change. Evidence from this study indicates that addressing development disparities in Greenland may immediately support fertility and reproductive health for Kalaallit people and facilitate equitable climate adaptation.

Introduction

Greenland is experiencing profound biophysical effects of climate change, including melting of the ice sheet, decreased formation of sea ice, extreme weather events, increased precipitation, and population decline in some plant and animal species (2-4). For *Kalaallit*, Inuit people of Greenland, climate change has impacted subsistence and cultural activities, food security, mental health, and local livelihoods, warranting investigation into long term

implications for population health (2, 3, 7-11). *Climate adaptation* can be understood as "the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities" (6). Individuals and institutions across Greenland have incorporated climate adaptation strategies into daily life, development, and economic planning to support socio-ecological systems (5). To facilitate equitable climate adaptation, researchers and government in Greenland must consult with Kalaallit communities on their desired climate adapted futures, and contextualize climate risks or benefits within existing cultural and social resources that support individual wellness (5).

The capacity for Kalaallit communities to adapt to the effects of climate change will depend in-part on sociodemographic change and population distribution within Greenland (5). In 2023, Greenland had 56,609 inhabitants, with 89 percent ethnically Kalaallit (13). Based on current fertility, mortality, and migration trends, Greenland's population is projected to decline below 50,000 by 2050 (15). Kalaallit women have limited opportunity in Greenland's male-dominated industries, contributing to a higher out-migration of women to pursue education and neglect of women's needs in social policies (15, 98, 99). Fertility is necessarily predictive of population dynamics in Greenland, with high fertility rates in remote settlements and lower fertility rates in towns (15). Greenland has a total fertility rate (TFR) slightly below replacement at 2.02 births per woman (15). Kalaallit women experience marked disparities in fertility and reproductive health relative to women in other Arctic Indigenous populations, including the highest rates of sexually transmitted infections (STIs) for the past 20 years (69-72). Greenland also has the highest abortion rate in the world, reaching 66 abortions per 1,000 women of childbearing age in 2018, nearly 5 times the abortion rate in the United States and 6 times the

abortion rate in Denmark in the same year (15, 18, 19). Abortion rates in Greenland have increased for the past decade and have consistently exceeded live birth rates since 2017, indicating a need for family planning methods that match Greenland's sociocultural and geographic context **(Figure 2)** (15, 20, 21).

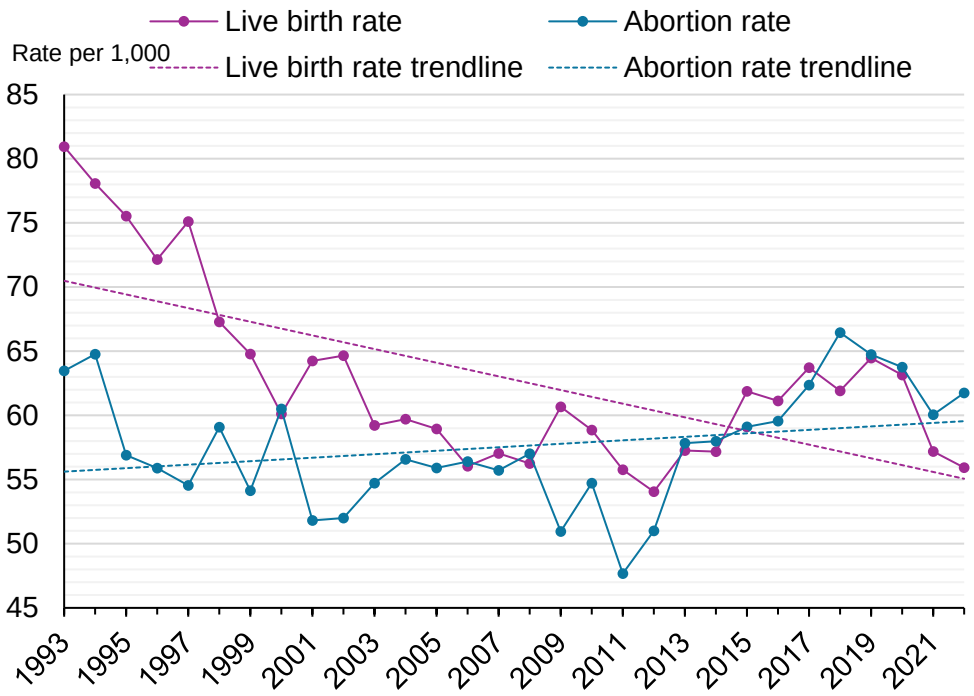

Figure 2. Live birth rate and abortion rate per 1,000 women in Greenland (1993-2022). (A) abortion rate calculated using mean population of all women aged 12-49 years. (B) live birth rate calculated using mean population of all women aged 14-49 years. (C) no live birth data available for women under the age of 14. (D) linear trendlines reported. (E) publicly available data source: Statistics Greenland bank.stat.gl

Provision of fertility and reproductive health services in Greenland is complicated by supply and service limitations for remote communities, and high medical staff turnover (66, 67). Pregnant women from small towns and settlements are required to travel to five centralized hospitals to give birth, separating women from their families in the weeks before delivery (66, 73, 74). Due to low medical workforce in Greenland many providers are temporarily assigned

from Denmark, leading to cultural and linguistic disconnect that affects patient experiences (16, 66, 68, 74). While there is limited understanding of fertility and reproductive health phenomena in the country, research suggests that reproduction in Greenland is influenced by connection to place and access to natural resources, factors that will vary with climate adaptation (16, 20, 21). *Fertility decisions* describes actions individuals perform that preclude experiences of planned and unplanned pregnancy, birth, induced abortion, and adoption. Given existing fertility and reproductive health disparities among Kalaallit women, there is a compelling reason to explore how climate change effects and adaptation might influence fertility decisions and population dynamics in Greenland.

Lifestyle Transitions Connected to Natural Resource Economy in Greenland

Historic fertility trends and population shifts in Greenland have been connected to a transition from traditional hunter livelihoods to participation in wage labor, relocation to centers of natural resource industry, and development (7, 16, 27, 28). Hunting is a critical activity for Kalaallit families, important for material resources, social cohesion, and cultural identity (21, 26). Participation in full-time hunting has decreased due to centralization and the introduction of a licensing and quota system (7, 100).To adapt, hunters have increased participation in the fisheries industry for supplementary income (16, 56). Sixteen percent of the Greenlandic workforce is employed in fisheries and hunting, and fisheries products account for 93 percent of Greenland's exports (15). However, economic dependence on fisheries makes individuals and communities vulnerable as climate change threatens oceanic biodiversity and fish stock (57). The capital, Nuuk, is projected to increase to 40 percent of the Greenlandic population by 2030 as cost-of-living increases in small towns (59). The migratory dynamics of Greenlanders between

small towns and urban centers may affect fertility decisions based on education opportunities, skewed gender ratio, and availability of health services (17, 60, 61).

The purpose of this study was to explore how people living in Greenland make fertility decisions based on the social, environmental, and economic resources available to them. Specifically, we examine how current and projected climate change affects proximate drivers of fertility and reproductive health. Through interviews with reproductive-aged (18-49 years) men and women from two communities, we explore how perceptions, observations, and effects of climate change and adaptation influence fertility decisions in Greenland.

Methods

Study Area

This study took place in Paamiut and Nuuk in Sermersooq Municipality in southwest Greenland **(Figure 3)**. Nuuk had a population of 19,604 inhabitants in 2023, and is the urban center of the country (15). Paamiut had a population of 1,173 inhabitants in 2023 and an economy centered around the fishing industry. Kalaallisut (Greenlandic) and Danish are the primary languages in Greenland, with English as a third language for many Greenlanders. Nuuk was selected as a site because it is the headquarters for government, scientific institutions, and commercial fishing organizations in Greenland. Paamiut has experienced significant population and economic decline in recent decades (91). Paamiut once had the largest fish factory in Greenland, but when the West Greenland cod fishery collapsed in the 1980's many community members were forced to leave for other employment (91). Researchers have attributed the cause of the fishery collapse surrounding Paamiut to a combination of commercial overfishing and warming sea temperatures (101). Paamiut was selected as a site to provide comparative social,

Figure 3. Map of Greenland with study sites indicated.
(A) inset shows Arctic countries. (B) service layer credits: ESRI, TomTom, Garmin, NOAA, USGS.

environmental, and economic context relative to urbanized conditions in Nuuk, lending to comparison of fertility decisions related to different community settings. Paamiut and Nuuk differ marginally in climactic conditions; their distinction lies in levels of economic diversity, effective local institutions, and participatory decision-making to facilitate climate adaptation.

Methodological approach

This study applied the principles of community based participatory research (CBPR), a methodological framework to advance health equity by engaging community members as equal partners in all phases of research (90). We adopted an equitable approach to instrument design, data collection, analysis, and results dissemination by working closely with a community research partner in Paamiut and with Kalaallit colleagues in Nuuk. In Paamiut, we built upon community strengths by incorporating local knowledge and existing social networks into the research process, and presenting the study throughout the community to foster transparency (90). In Nuuk, Kalaallit colleagues were iteratively consulted on instrument design, recruitment strategies, and dissemination priorities. Collaboration between Kalaallit and American research team members facilitated co-learning through the reciprocal transfer of knowledge across Indigenous and Western paradigms (90).

Ethics

Ethical approval for this study was provided by the Montana State University Institutional Review Board and the Greenland Science Ethics Committee.

Participant Recruitment

The study sample included reproductive-age (18-49 years) men and women living in Paamiut or Nuuk who speak Kalaallisut or English. Consistent with CBPR, participants were purposively selected based on existing community relationships and experience with our study objectives (90, 94, 97). Participants in Paamiut were contacted by our community research partner via text message, messenger app, and in-person. Participants in Nuuk were identified through connections with local institutions, social media, and community engagement. Because

participants in Nuuk were interviewed in English, they were contacted via email, messenger app, and in-person to confirm comfort using English.

Data Collection

Semi-structured interviews were conducted to explore perceptions and observations of climate change and adaptation, drivers of fertility decisions, and personal social, environmental, and economic resources. Interview guides were developed from a prior study of fertility in North Greenland, two studies of climate change and fertility in countries of the Global South and adapted based on recommendations from Kalaallit colleagues (16, 21, 50). Interview guides included questions about personal education and work history; living in Greenland; work; fertility decisions; healthcare; natural environment; climate change perspectives; hunting; fisheries; and hopes for the future of Greenland. Interviews in Nuuk were conducted in-person and virtually in English, as English is spoken by many people in Nuuk. Interviews in Paamiut were conducted in-person and translated from Kalaallisut to English in real-time to allow follow-up questions. Interview participants were offered chocolates and tea as a thank you for their time. Interview guides and consent forms were provided to participants in their preferred language of Kalaallisut, English, or Danish. Interviews completed in English were transcribed with Rev audio services (92). Interviews conducted in Kalaallisut with English translation were transcribed manually.

Analysis

Constructivist grounded theory was used to interpret data through Kalaallit and Western perspectives (31, 93, 94). Constructivist grounded theory allows researchers to use a diverse qualitative data set to analyze actions, meanings, and processes, and to compare phenomena

across individuals, collectives, and settings (31, 94, 97). Our analytical framework depicted in **Figure 4** was adapted from a process published by Chun et al. 2019 and studies that included Indigenous and non-Indigenous perspectives in qualitative analysis (93, 95, 96). Data was

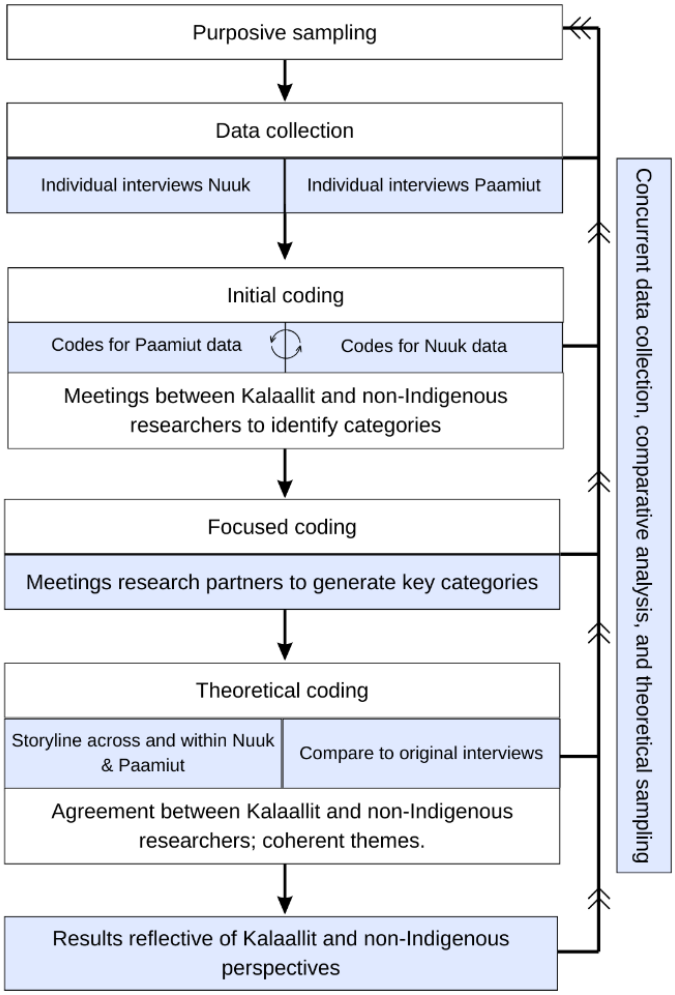

Figure 4. Grounded theory analytical framework with iterative collaborative analysis to include Kalaallit and non-Indigenous perspectives

collected in Nuuk and Paamiut concurrently. Authors AR and MP discussed and documented initial interpretations after each interview in Paamiut. MP documented recurring concepts after interviews in Nuuk. Next, MP developed initial codes through line-by-line review of the Paamiut transcripts and Nuuk transcripts respectively using Atlas.ti software (102). AR and MP discussed

and refined initial codes from the Paamiut dataset, and MP compared codes in the Paamiut dataset against codes in the Nuuk dataset for convergence and divergence. Third, MP developed focused codes for the Paamiut dataset and Nuuk dataset respectively. MP and AR discussed focused codes of the Paamiut dataset to develop key categories. MP compared key categories of the Nuuk dataset against key categories of the Paamiut dataset. Next, theoretical coding was conducted to organize and explain linkages between key categories across Nuuk and Paamiut datasets, and to produce coherent themes. Finally, themes were compared against participant transcripts to confirm relevance (31, 94).

Results

Results are organized into four themes that capture material, cultural, and structural factors that participants associated with fertility decisions and prospects about climate adaptation. Results include (1) immediate drivers of fertility decisions, (2) connection to place, (3) cultural values and visions, and (4) climate change and adaptation perspectives.

In total, 35 men and women agreed to participate in semi-structured interviews in Nuuk (n=13) and Paamiut (n=22) (**Table 1**). Interviews lasted an average of 37 minutes in Paamiut, and 50 minutes in Nuuk. Participants in Nuuk generally reported higher levels of education than participants in Paamiut, consistent with education trends between Nuuk and small towns throughout Greenland (15).

Table 1. Sociodemographic characteristics of participants

Site	Paamiut (*n*=22)		Nuuk (*n=13)*		Total (*n*=35)	
	n	%	*n*	%	*n*	%
Gender						
Male	8	36	8	62	16	46
Female	14	64	5	38	19	54
Age						
18-24	3	14	1	8	4	11
25-34	11	50	3	23	14	40
35-44	6	27	8	62	14	40
45-50	2	9	1	8	3	9
Number of children				0		
None	2	9	3	23	5	14
1 to 2	10	45	6	46	16	46
3 to 4	7	32	4	31	11	31
5 to 8	3	14	-	-	3	9
Marital status						
Married	8	36	6	46	14	40
Partnered	10	45	2	15	12	34
Divorced/separated	2	9	3	23	5	14
Single	2	9	2	15	4	11
Highest level of education				0		
Master's degree	-		5	38	5	14
Bachelor's degree	1	5	5	38	6	17
Some college	5	23	1	8	6	17
Maritime or Trade school	6	27	2	15	8	23
Public school	7	32	-	-	7	20
No education	1	5	-	-	1	3
Unclear	2	9	-	-	2	6
Language of interview						
Kalaallisut (Greenlandic)	13	59	-	-	13	37
English	7	32	13	100	20	57
Kalaallisut & English	2	9	-	-	2	6

Immediate Drivers of Fertility Decisions

Participants in Paamiut described imagining a child in the future of their family before and during pregnancies, with some knowing they wanted a child since they were children. In this

way, ‘planned’ pregnancies was rarely a term participants resonated with, for while becoming pregnant may have been unplanned, their decision to carry a pregnancy had been envisioned within their family dynamic. Participants in Nuuk characterized fertility decisions as natural and conditional rather than planned. Partcipants emphasized the importance of education in delaying fertility, though interviewees from Nuuk described better lifetime access to education than participants in Paamiut. Having an education was a necessary benchmark to permit themselves or their children to become parents, and lack of education was cited as a reason why young people in Greenland elect abortions. Relative to Paamiut, participants in Nuuk described more ambitions related to travel, recreation, and career that led them to delay childbearing. Female participants in Nuuk emphasized their desire to have independent income, education, and experience life outside of Greenland before becoming pregnant. A man in Nuuk described contemporary opportunities that lead to delaying childbearing:

> I think I was 26 when we got our son, that was quite early. We had imagined that when we are 35 we’ll get our first kid… I think [having kids early] used to be maybe survival, or maybe you were growing up earlier back in the day. Now you have a lot of opportunities for education and fun stuff and rock and roll. We felt educated when we got our first kid and we also had full-time jobs so we could pay our bills. That was quite important for us when we decided to keep the kid.

In Paamiut, emotional health and addressing substance use was important to people before parenthood. Familial and individual alcohol misuse was cited as a reason that people choose abortions in Greenland, and simultaneously served as a driver to be a good parent. People described being raised in alcoholic households as a reason why they avoid substance use as a parent. For some people, parenting aspirations guided them away from drinking or smoking. A man from Paamiut stated:

> It’s been very important for me to say no to alcohol, drugs, and smoking. I used them before, before I got children. But I said to myself that I don’t want to use them.

> When I started to prepare to have children I stop with all of it because I want to be a good example for my children.

Contraception, Condoms, and Sexuality Education Participants in Paamiut reported mixed perceptions of contraceptive use and trust. While participants reported using contraceptives at some point in their life, they were not always used correctly or consistently, and in some cases participants were vague about their understanding of how contraceptives worked. Personal contraceptive use was mentioned less frequently in Nuuk, though several women described wariness about long term effects of hormonal contraception. A woman in Nuuk described negotiating childbearing and contraception with her partner, with surprise at how fast she became pregnant after stopping birth control pills:

> We spoke a little bit about having a child, but I think he was more ready than I was because he already had a child from another relationship and and he already had his education, and I was under my education. I think he was more ready than I was. So we talked about it and then we decided that I should- I took, like prevention? Well, we heard that if you take these pills then maybe they will go some months before your hormones will be normal again, and it can take a long time before you can get pregnant. Then we decided, okay, I will stop taking them. It was during winter, and in my head I was like, I will be ready to be pregnant in the summer…But when I stop them I get pregnant just right away. Just right away. I wasn't ready for having a kid, a child. So I was a little bit in shock and he was very happy.

Participants expressed that many people in Greenland have negative attitudes about condom use, citing influence by 'Greenlandic masculinity' culture. A man in Nuuk described his dissapointment in his male friends for bragging that they were 'proud' to never use a condom. In Paamiut, a man expressed that free sexual and reproductive health services negatively impact peoples' attitudes about contraception and condoms in Greenland, because they believe there are no consequences if they contract an STI or get pregnant. Participants described reluctance to use contraception as a reason why many people in Greenland elect abortions. They distinguished that

even when people are educated about contraception and condoms, they choose not to use them. Sexuality education was regarded as valuable, and parents expressed their intention to talk to their children about sex, and that they will support their children no matter the age that they begin having kids. Participants in Nuuk described low communication about sex as contributing to high STI and abortion rates in Greenland, with particular reference to the influence of Western colonialism. A participant in Nuuk described:

> Unfortunately we still have a lot of STDs going around, especially in Nuuk, and it seems like people don't really listen whenever we have sex education classes. I guess it's because of people here-we're not that open with all that stuff. It's because of the Western culture and it's still a big, big taboo. I guess some people can feel a little bit ashamed to talk about sexual interactions, which probably also something to do with why we have some STDs and they don't really learn about how to prevent all that stuff.

Several male participants in Nuuk described their teenage friendships as important in learning how to speak openly about sexuality, describing meeting open-minded people as critical to improving their personal communication about sexuality.

Drivers of Abortion Perspectives on drivers of abortion differed between participants in Nuuk and Paamiut. Participants described being too young, not using contraception, and not having an education as reasons why Greenlanders choose abortion. However, in Paamiut many more participants described personal experiences of electing abortion due to pressure from healthcare workers, stress from existing children, or inadequate housing. One woman in Paamiut described electing an abortion because a healthcare worker instructed her that daycares were overcrowded, so she should not have another child. Another woman in Paamiut described wanting to get an abortion, but being delayed and not believed by clinicians:

> I didn’t want to have a child, I really didn’t want to. I keep going to the hospital and saying, ‘I’m pregnant,’ and they keep saying, ‘How could you know that?’ And then

> when they finally said, 'You're pregnant,' they were like 'What are you going to do?' And I said, 'I want an abortion, so I can have a high school degree.' And they said, 'If you get an abortion that will be like killing the baby,' because it was way over the limit like, you have three months to decide… Even though I didn't want to get pregnant, I have the loveliest son you would ever imagine. I will do anything to give the best for the child.

Unmet housing needs were repeatedly cited as a driver of abortion in Paamiut. Participants explained that due to Paamiut's low housing availability, young people may live with their parents and grandparents through their 20's without the space to bring another child into the household.

Comparatively, no participants in Nuuk described a personal experience of abortion. Most participants in Nuuk attributed abortion decisions to young age, unfinished educational goals, and consequenes of unprotected sex and alcohol use. Participants said it is not taboo to seek abortion services in Greenland. Several participants expressed their belief that having free abortion services in Greenland makes it too easy for people to not use protection, though they simultaneously expressed that they support free abortion access. Participants in Nuuk frequently used language distinguishing income level as a correlate with abortions, as 'not everyone can afford to have a kid.' One man in Nuuk described:

> Unfortunately it's like that for a lot of the ladies here, but also for all the people. I think they want to keep the baby but they don't have the economy to raise the kids, or they don't have a place for themselves that's not with their parents or grandparents.

Giving Birth in Paamiut, Nuuk, and Denmark Descriptions of birthing experiences diverged between participants from Nuuk and Paamiut. In Paamiut some women had fine birthing experiences, but many described experiencing complicated or isolated births. Because mothers from Paamiut must be flown to Nuuk for delivery, many women reported experiencing

fear of an emergency birth. One woman described her fear while laboring in a plane for hours during a storm. Another participant described birthing alone in her hospital room in Nuuk because her medical staff didn't speak Kalaallisut and couldn't understand her calls for help. Participants from Paamiut reported difficult logistics and expenses of travel to birth without their partner, and that it is not 'healthy' for families. One man in Paamiut recounted his partner's birth experience:

> It's been quite difficult for us because we weren't believed by the doctor that she was losing the water inside the fetus, and the doctor said I had to get the women's pads to prove it and show it. Instead of believing us. So then I had to go home to get them, and my wife called and she had to leave anyways to Nuuk. But I couldn't be there. It's not a good experience.

Participants expressed wishing for midwives or the option to birth in Paamiut so they can be with their families. Furthermore, participants expressed frustration at the frequency of clinician turnover and inconsistent medical attention.

By comparison, participants in Nuuk described more positive experiences of giving birth. A theme among participant descriptions was feeling like women are told too many things to fear during pregnancy, but that it can be an empowering experience. One woman in Nuuk described:

> I feel like I got a lot of scary stories about women giving birth and oh, it's like 'you'll die!' Except, you'll survive! I had a great experience giving birth. I loved it. And then 12 hours later I was like, 'I want to do it again!' It was so empowering. And for first three months I felt like a superhuman. I've never felt so beautiful and amazing in my life. And when I look back, I'm like, 'I looked amazing!'

Because many participants in Nuuk had spent some time of their reproductive life in Denmark, they compared the relative merits of birthing conditions between Greenland and Denmark. People described Denmark as having more advanced equipment and staff capable of handling difficult births, but that they felt more at-home birthing in Nuuk rather than a Danish 'baby factory' as one man put it. Nonetheless, participants described the challenge of inconsistent

healthcare workers in Nuuk, and having to repeat information every time they had an appointment. One woman described wishing she had a Greenlandic midwife while she was in labor, because her Danish midwife could not connect to her the way a Greenlandic woman could. Participants noted that the financial and material support provided to new parents in Denmark is better than what they received in Greenland. Negative perceptions of the healthcare system were not specific to birthing. Participants from both communities stressed that the Greenlandic healthcare system is understaffed and lacks specialized services, with one man describing illness in Greenland as 'a death sentence'. Several participants connected healthcare to Greenland's education system, describing a need to expand higher education opportunities to increase Greenlandic medical profesisonals and reduce reliance on Danish healthcare workers.

Connection to Place

Living Conditions and Disparate Development Trajectories Participants described development disparities that impact living conditions for Greenlanders in small towns, especially lack of adequate housing. The most commonly referenced challenges of living in Paamiut were lack of housing, low job availability, and high cost of living. Many participants described their disappointment watching physical infrastructure deteriorate throughout Paamiut within their lifetime, often connecting the physical deterioration of the town with a deterioration of community empowerment. Nine vacant block apartments have fallen into disrepair, standing as relics of a once thriving local economy. Participants in Paamiut described the dilapidated block apartments as an eyesore and a symbol of how their town has been forgotten by the Government of Greenland. Unmet housing needs put pressure on participants' family relationships, and in some cases affected their employment. Household overcrowding forced participants to make

difficult choices about family relationships. One woman described the challenge of trying to raise her child in an apartment surrounded by family members who struggle with alcohol use, but that she has no option to move.

Participants in Paamiut wished for the town to have places to shop, eat, and activities and playgrounds for children. Participants connected Paamiut's depopulation to lack of new industry:

> I'm dreaming that they're going to build lots of apartments that are new and affordable, and new stores that you can afford… Buildings. New buildings, apartment buildings, when they tear all these [cement block apartments] down. And children, a lot of children need playgrounds. There is only one place where you can just push the child [on a swing] and there is nothing else.

Housing availability and affordability was also a frequently cited challenge of living in Nuuk, with paticipants forecasting that housing will get worse as vacation rentals become popular and Nuuk's population grows. People described three general conditions of aquiring housing, including through an employer, the municipal housing service, or private ownership. The price difference between municipal housing and privately-owned housing is egregious, but some participants described no option but to pay high prices to secure an apartment. One participant waited to qualify for a municipal apartment for 15 years before earning enough to rent through a realty firm. Another participant described having to leave Nuuk when she lost her employer-sponsored housing. Still, many Nuuk participants expressed security in their current housing.

Participants in Nuuk described 'exploding' local development with mixed feelings. Many listed benefits of increased construction, including new houses, improved schools, fitness centers, and restaurants. Participants described coming to Nuuk exactly for the activities and opportunities afforded by new development. However, others expressed that the rapid development immulates Western design standards and does not reflect Greenlandic lifestyle or environment. Others expressed concern over reliance on foreign investors and workers to support

rapid construction. Many expected Nuuk's international population to increase within the decade, especially as climate refugees move north.

Employment opportunities motivated participant relocation from their hometowns to Nuuk, and from Nuuk to Denmark, and were associated with improved financial mobility and personal fulfillment. Most participants in Paamiut were economically connected to the local fish factory through their employment or a household member, while participants in Nuuk reported a more diversified household economy. Participants in Paamiut described limited local job opportunities, hoped for diverse employment in the future. They described visible indicators of unemployment in Paamiut and noted that lack of purpose contributes to alcohol problems for some people in the town. Participants frequently mentioned having no option but to move to Nuuk for employment.

By contrast, participants from Nuuk described opportunities for rewarding careers and diverse cultural experiences. Some participants in Nuuk described switching careers to feel more fulfilled in their work, indicating a higher level of opportunity relative to people in Paamiut. Especially for participants who held positons in tourism or arts, their career was central to their identity and a desire to represent Greenlandic culture. Many participants in Nuuk characterized worklife as stressful because the low workforce in Greenland creates extra burden for employees. Several participants described undergoing a transformation whereby they realized the stress their career was causing and chose an alternative position to preserve their health.

Almost all participants cited centralization as a challenge, leaving young people in small communities without opportunities while Nuuk grows crowded. Participants in Paamiut remarked that the government only focuses on developing Nuuk, while Paamiut is slowly

‘stagnating’ and being ‘forgotten’. Paamiut participants described reliance on central government to improve local housing. For some residents, the poor development galvanized their motivation to join together as a community to improve local infrastructure.

Access to Education Participants posed access to quality education for themselves, their children, and the broader workforce in Greenland as a challenge that will shape the country’s development future. Several participants expressed that without a more educated workforce, Greenland will be vulnerable to foreign interests dictating the development trajectory of the country by giving Greenland-sponsored jobs to foreign workers. Education in Nuuk compared to the rest of Greenland was described as uneven. Participants who had moved between Paamiut and Nuuk described their children falling behind in school in Paamiut, particularly because they lost Danish and English-speaking skills. In Nuuk, some parents described hesitancy about overreliance on Danish in schools, and hopes that their children would retain Kalaallisut. Participants placed intergenerational education opportunities within the context of traditional Greenlandic lifestyles and overcoming social problems. One man in Nuuk described how having children pushed him to seek an education instead of being a hunter:

> My first daughter was born at the time, she always yelled or screamed my name when I'm leaving town so I couldn't bear it. So I decided I need some kind of education. So always, I'm the kind of a person who takes the challenges... I’m always daydreaming about if I’m going to be finishing the education I want. That is going to be a breakthrough, because my generation is kind of a hardworking life with no education at all. So I’m only doing this for my family and my future, but at the same time, it’s quite a changing history. At this time in Greenland we have difficultes about cultural inheritance, the usual problems in Greenland about violence and alcohol and anything like that. That’s a huge problem in my family… It’s a huge step that I chose to have an education.

Many participants sought higher education internationally and easily found employment when they returned to Greenland. Participants described hoping to strengthen the economy by creating

opportunities for education with Greenlandic cultural values. One man in Nuuk described having to choose between a good life and a good education in Greenland:

> Growing up in Greenland right now, you have to choose between a good education or a good, amazing upbringing. It's hard to get both here. The education system is very bad. But growing up as a person, it's amazing because you're so much out in nature. That's what I love the most. We were out sailing every month, every week, basically. And I could do a lot of stuff that the people that I studied with in Denmark couldn't, like just naturally being in the wilderness.

Cultural Values and Visions

Hunting and sailing with friends and family was a key component of connectivity, identity, and food security in Nuuk and Paamiut. Participants characterized nature as important for physical and mental health. Participants attributed values of self-sufficiency and independence to the traditional Greenlandic hunting lifestyle and described carrying the value into their broader life perspective. They described learning about nature from their grandparents and parents, and feeling intergenerational connectivity when in nature with their own children. One mother in Nuuk described taking her child everywhere with her so he could learn not to fear nature, but to be safe in it. Many participants described going into nature for peace, healing, and introspection. Participants characterized subsistence activities of hunting, gathering berries, fishing, and preparing food as connecting them to their heritage. They described hunting and nature as bringing them energy, strength, and happiness. They described hunting for many animals, including reindeer, muskox, seal, whale, ptarmigan, and sea birds. They described fishing for capelin and cod, and gathering bird eggs, berries, and herbs. In Paamiut, participants described the importance of subsistence activities to provide for elders in the community who can no longer hunt themselves. A man in Paamiut described the importance of hunting for mental health in Greenland:

> Many people who hunt and go to nature, they live a greater life, a better life, and have more positive things in their lives. In winter, there's some kind of season for other things. In summer there's others, in fall there's reindeer season, and so it's a season divided culture…when the season is over they have another season to get excited for. It means very much for identity.

Participants in Nuuk described ways that hunting has changed with modern values and work schedules. More women participating in hunting was described as improving gender equality, and for some participants practicing hunting brought them a sense of cultural revitalization that allowed them to distance themselves from a hectic work life.

Self-sufficiency was characterized as an important skill in nature, and a paradigm to view Greenland's political strength. Participants stressed the Greenlandic value of sustainable natural resource use. Sustainability was described as 'everything' for participants, that sustainability is the future, the past, the way of life in Greenland. The growing tourism industry was described as a great financial opportunity, but it requires a sacrifice of Greenland's natural capital in some way. Participants described concern that tourism could threaten sensitive natural spaces and lead to increased carbon emissions due to air travel. Simultaneously, people recognized the benefit of increased investment in tourism as opposed to mining and other industries viewed as more environmentally risky. A man in Nuuk described the balance of upholding Greenlandic values of sustainability amid rapidly changing population and environmental conditions:

> If you want to be independent, we have to sacrifice. Because right now we can't be sustainable with everything. Sustainability is a lot of different things. It's not only nature, it's about economic wellbeing and social health. If we can increase our social health and our economic wellbeing with tourism by sacrificing our nature, that's a balance act that we are kind of crossing.

In Nuuk participants discussed Greenland's natural resource economy in the context of desired independence from Denmark, and the need for a diversified national economy. For most, the desire for independence from Denmark was referenced as an aspiration for decades to come,

with some supporting the use of the Danish Block Grant as a permanent payment to Greenland since Denmark had exploited Greenlandic natural resources. Others described themselves as outsiders for not wanting independence from Denmark, citing existing social and educational disparities in Greenland as indicative that the country is not prepared for independence. Many participants described a vision of the country that embraced traditional Inuit values while modernizing, including Indigenizing health and education systems in the country. A woman in Nuuk described her future hopes for her children:

> My hope is that they will grow up in an independent Greenland and they will be proud Inuit, not hiding and not being scared of speaking out because of fear of repercussions; that we are in a country that supports each other and empowers each other against the rest of the world that keeps trying to put us down.

Relative to Nuuk, participants in Paamiut focused on sustainable fishing practices, including reducing waste from trawlers and developing products that use all parts of the catch. The fish factory is a critical social and economic resource for the community. Fishing was described as a difficult livelihood due to regulations, expensive equipment, and more frequent storms. The economic strength of the fishing industry was described as directly impacting participants household economy.

Climate Change and Adaptation Perspectives

Almost all participants described obvious effects of climate change in Greenland. Participants in Paamiut noticed increased storms and rain, unpredictable weather, decreased snowfall, warmer days, sea ice forming later and melting earlier, the ice sheet receding from nearby fjords, and changes to animal migration and populations. Participants in Nuuk described warmer weather, less snowfall, unseasonable rainstorms, exposed land mass, changes to fish populations, and sea ice forming later, melting earlier, or not forming at all. In both communities,

participants emphasized that the effects of climate change have been more damaging for hunters and fisherman than for other Greenlanders. They described unstable sea ice conditions as preventing hunters in North Greenland from using sled dogs and affecting harvests. Few participants described climate change directly impacting themselves or their family in a negative way.

Participants primarily expressed ambivalent or optimistic attitudes towards climate change, citing myriad ways Greenland can capitalize on the change. People in Paamiut characterized climate adaptation as a normal part of life, citing historic adaptations to changing environmental conditions and species. They described transitioning from harvesting cod, to shrimp, to halibut and crab, expressing confidence that the fishing industry will adapt to climate change. Participants in Nuuk described positive and negative climate impacts but emphasized the cultural value to greet environmental changes positively. Several participants described frustration that other countries have largely caused climate change, yet Greenland is suffering disparate consequences. Participants described ways climate change can benefit the Greenlandic economy, including prospective agriculture, and reduced sea ice permitting transportation industry and cruise tourism. Several participants described using climate change as a political tool, emphasizing that Greenland should be granted increased participation in international policy related to climate change. Some participants in Nuuk believed Greenland will see increased immigration due to climate refugees from other countries. Participants in Nuuk expressed mixed opinions on the way climate change will impact the fishing industry, with most people acknowledging that climate pressures exacerbate existing management disputes between fishermen and scientists.

A few participants described how climate change will affect their children's future. One expressed some sadness that his children will not be able to play in snow the way he did as a child. Another woman described the climate crisis as unalarming for her children because they experience it as normal. The few participants who expressed sadness about the way climate change will affect their children tended to contextualize climate change within an array of global problems, indicating that the world is both a 'lovely world' and a 'horrible world'. Participants expressed reluctance to worry about their children being negatively impacted by climate change, expressing that you cannot predict the future and must focus on creating a positive childhood in the present.

Discussion

Our emergent themes indicate that for participants in Nuuk and Paamiut, fertility outcomes are proximately impacted by current development disparities, irrespective of disruptive effects of climate change. Interviews with men and women in Paamiut and Nuuk reveal a clear link between localized development, education, and career opportunities, and individual decisions about fertility timing, abortion, and parental readiness. Evidence from this study points to a complex relationship between individual fertility decisions and development context of each participant. Participants from Nuuk stood out in describing key opportunities throughout their lifetime that permitted them to achieve higher levels of education, fulfill personal goals, and find a meaningful career, with each opportunity successively contributing to their decision to delay childbearing. By comparison, participants in Paamiut described challenges related to housing, employment, and inadequate healthcare as directly contributing to difficult birthing and reproductive health events. Despite resource challenges, participants from Paamiut stressed

connection to their community, their family, cultural activities, and surrounding nature as grounding their fertility decisions and ability to raise healthy children.

For participants in this study, direct effects of climate change and concerns of a climate uncertain future were not described as reasons for translocation and subsequent shifts to individual fertility decision-making. Rather, it is opportunities presented to participants that drive movement and fertility decisions. Opportunities to acquire higher education, build a career, or travel were described as turning points that led people to move from small communities to Nuuk. Government-directed development mediates the opportunities and resources prospective or current parents are presented with in small communities in Greenland, with disproportionate focus granted to Nuuk. The decision to have an abortion was influenced by unmet housing needs and educational aspirations. This indicates that to support fertility and reproductive health in Greenland, housing must be a priority for the government, and expanding educational opportunities is critical to support reproductive-aged people. For policymakers, increased collaboration across housing, education, and healthcare sectors may holistically address underlying inequities that affect fertility outcomes in Greenland and simultaneously reduce climate vulnerability.

Participants from Paamiut were disappointed by poor housing and infrastructure and expressed a desire to empower the community into improved circumstances. Relatively simple changes were described as bringing hope to the community. Building playgrounds, demolishing derelict buildings, and improving access to alcohol treatment are among the many positive changes Paamiut community members envision for themselves and their children. Promoting self-organization, leveraging existing social networks, and targeting underlying socioeconomic

disparities is critical to reduce climate vulnerability in Greenland (5, 53, 103). Policymakers might facilitate equitable climate adaptation by allocating decision-making power and funding to existing community leaders to address development priorities or increasing frequency of community consultation on development needs.

Participants described dedication to teach their children about traditional Greenlandic values and lifestyle, while embracing a modern and multicultural Greenland. Almost all participants observed climate change effects on culturally important animals and natural spaces, but did not describe fear that their individual lifeways will be threatened by climate change. Many participants expressed personal commitment to passing down generational knowledge about hunting and subsistence despite fluctuations in animal populations and environmental conditions because of climate change. Furthermore, participants supported capitalizing on beneficial economic or diplomatic opportunities associated with climate change. This response is consistent with the connection between fate control, closeness with nature, and climate change in Greenland, wherein self-reported wellbeing is directly correlated to autonomy over one's environment (11, 54). Values of self-sufficiency highlight a critical nexus between fate control and positive development trajectories in Greenland, and the importance of sovereignty and local autonomy in shaping quality of life for Kalaallit people. Autonomous control over the management of Greenland's natural resources was very important to study participants, particularly relative to exploitative foreign interests. Addressing the ongoing ramifications of colonization may support sovereignty and unity in Greenland amidst future climate variability and challenges to Arctic security.

Strengths and Limitations

Results from this study are specific to Paamiut and Nuuk and may not apply to other Arctic Indigenous communities. However, by including Kalaallit knowledge holders as partners in this study, we captured perspectives and experiences that are common to many Inuit people. Recruiting English-speaking participants in Nuuk may have skewed towards higher levels of education than the general population but lead to longer interviews and deeper dialogue than we experienced in Paamiut. This may be related to regional differences in communication styles. Using CBPR principles to guide the study improved participant recruitment, trust between researchers and participants, and opportunities to validate findings within the Paamiut community.

Conclusion

Supporting fertility and reproductive health for Kalaallit communities amidst variable climate futures necessitates increased capacity to address localized development needs. People prioritized immediate improvements in education and opportunities for young people to support reproductive wellness. Findings from this study suggest that increasing collaboration across housing, education, and healthcare policy might support current fertility and reproductive health needs and facilitate equitable climate adaptation in Greenland.

CHAPTER FOUR

LIVELIHOOD TRANSITIONS AND FERTILITY OUTCOMES IN GREENLAND'S NATURAL RESOURCE ECONOMY: IMPLICATIONS FOR CLIMATE ADAPTATION POLICY

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Health & Place

Abstract

This qualitative study investigated linkages between natural resource availability and determinants of fertility outcomes in Greenland. We conducted 26 interviews with policymakers and key stakeholders in two communities about climate adaptation, natural resources, economic development, and fertility and reproductive health. Participants link fertility outcomes to disparate community socioeconomic circumstances that affect individual access to education and financial mobility. Workforce and education challenges in Greenland limit ability to expand culturally grounded reproductive healthcare. Coordinating healthcare, education, and housing policy may improve material resources to support fertility decisions in Greenland. We contextualize drivers of fertility decisions within Greenland's climate adaptation policy options.

Introduction

Kalaallit, the Inuit people of Greenland, have multifaceted relationships with Greenland's natural resources (5). Loss of sea ice, changes in terrestrial and marine animal populations, and other biophysical effects of climate change affect social, political, health, and economic processes in Greenland (5). The Intergovernmental Panel on Climate Change of the United Nations defines *climate adaptation* as "the process of adjustment to actual or expected climate and its effects in order to moderate harm or exploit beneficial opportunities" (6). *Climate adaptation policy* refers to actions taken by governments, organizations, communities, or individuals to facilitate climate adaptation for a specific region, population, or ecosystem (6). Formal government-directed climate adaptation planning is in its nascence in Greenland. Naalakkersuisut (the Government of Greenland) signed the Paris Agreement in 2023, initiating a

commitment to develop a climate strategy aligned with national economic goals and the Indigenous right to self-determination (104). The ability for Kalaallit to enact climate adaptation policy at the national level depends on social capital and organizing abilities of local communities, and how much power communities have to advocate for their policy needs within government institutions (2, 56).

Climate change and variability in natural resources impact location and livelihood for people in Greenland (2, 3, 7-11). Kalaallit have transitioned from a traditional subsistence hunting lifestyle to wage earning and a mixed cash-subsistence economy (105). Sixteen percent of the Greenlandic workforce is employed in fisheries and hunting, and in 2022 fisheries products accounted for 93 percent of Greenland's exports (15). Greenland's highly productive coastal waters may experience abrupt changes as climate change threatens oceanic biodiversity and fish stock, risking negative economic impacts (106-108). Urbanization has affected socioeconomic and cultural dynamics in Greenland (59). The capital, Nuuk, accounts for 30 percent of the country's population and is projected to increase to 40 percent of the population by 2030 (59). As cost-of-living increases in small towns, many people relocate to Nuuk. With limited jobs for women in small communities, Kalaallit women more frequently leave their hometown to pursue education, while men are more likely to remain in traditional hunting and fishing trades (15-17). Transitions in socioeconomic options and natural resource availability have affected population dynamics and disparate development trajectories throughout the country.

Climate change risks exacerbate health disparities related to gender, ethnicity, and socioeconomic status, including fertility and reproductive health disparities (12, 22). Pregnant

women and women of childbearing age are vulnerable to adverse health consequences of climate change, including food insecurity, supply and service disruption due to extreme weather events, and emotional distress (23-25). Women in countries with existing fertility and reproductive health disparities are more vulnerable to gendered health effects due to climate change (43, 44, 46, 47). This bears implications for Greenland, where an overburdened health system and sociocultural effects of colonization have contributed to poor fertility and reproductive health outcomes relative to other Arctic countries (16, 68, 109). Rates of sexually transmitted infections (STIs) in Greenland have exceeded rates among other Arctic Indigenous populations for decades (69, 70). Pregnancy and childbirth account for 30 percent of medical evacuations in Greenland, and women access healthcare 1.4 times as frequently as men, largely related to pregnancy, abortion, and domestic violence (110, 111). Greenland has one of the highest abortion rates in the world, and abortion rates have consistently exceeded live birth rates since 2017, warranting research into the policies and structural systems that affect fertility decisions throughout the country (18, 112).

Research has demonstrated that material resource needs and poor living conditions directly contribute to fertility decisions for people in small communities of Greenland (16, 20, 113). In North Greenland, compounding effects of climate change, natural resource extraction, and centralization contribute to material resource challenges and poor living conditions, which affect pregnancy and abortion decisions (16, 21). Despite deteriorating economic conditions families prioritize finding ways to remain in their community, emphasizing the need for climate adaptation policies that realistically reflect Kalaallit priorities. Connection to community and

regional resource availability have emerged as a drivers of fertility decisions and important variables affected by climate change and pursuant human adaptations (7, 16, 21, 113, 114).

The purpose of this study was to investigate linkages between natural resource availability and determinants of fertility outcomes in Greenland. We sought to contextualize contemporary drivers of fertility decisions within Greenland's climate adaptation policy options. We report on interviews exploring current policy priorities related to climate adaptation, natural resources, economic development, and fertility and reproductive health conducted with policymakers and key stakeholders in Greenland.

Methods

Study Area

This study occurred in Sermersooq Municipality in southwestern Greenland, in the communities of Nuuk and Paamiut **(Figure 5)**. In 2023 Greenland had a population of 56,609 people with 89 percent of the population ethnically Kalaallit (13, 14). Nuuk is the capital city with a population of 19,604 people, and is the location of government administration, scientific organizations, and natural resource management and healthcare authorities in Greenland (15). Paamiut has a population of 1,173 inhabitants and an economy centered around the local fish factory (13, 15). Nuuk was selected as a site because it is the headquarters for government, scientific institutions, and commercial fishing organizations. Paamiut was selected as a site based on existing research relationships and comparative context as a small fisheries-dependent community relative to Nuuk. Greenland's national languages are Kalaallisut (Greenlandic) and Danish, and English is taught as a third language in schools (15).

Figure 5. Map of Greenland and study sites, including municipality district boundaries. (A) inset shows Arctic countries. (B) sources: National Geographic, Esri, DeLorme, HERE, UNEP-WCMC, USGS, NASA, ESA, METI, NRCAN, GEBCO, NOAA, iPC.

Ethics

Ethical approval for this study was provided by the Montana State University Institutional Review Board and the Greenland Science Ethics Committee. Informed consent was provided for all participants.

Sample and Recruitment

A total of 26 semi-structured, in-depth interviews were conducted with policymakers and key stakeholders from Nuuk (n=19), Paamiut (n=6), and one participant residing elsewhere in Sermersooq Municipality. Participants included 15 women and 11 men, and interviews lasted an average of 55 minutes. Stakeholder mapping was conducted to identify participants for purposive recruitment based on their subject matter expertise or policy domain of employment **(Table 2)** (115, 116). Building upon recommendations of a prior study of reproductive health in North Greenland, policy domains included healthcare, fisheries and hunting management, and economic development (16, 20, 21, 26). Additional participants were recruited as tourism development and education emerged from the data as important policy domains (31, 117). Participants were contacted in English via email, messenger app, and in-person.

Table 2. Participant subject matter and policy domain expertise

Area of expertise	n	%
Development and Economics	4	15
Education	3	12
Fisheries Management	4	15
Health Promotion & Science	4	15
Hunting Management	1	4
Government Administration	2	8
Natural Resource Science & Economics	4	15
Tourism Development	4	15

Note. Categorization of subject matter expertise was determined based upon participant position at the time of the interview.

Data Collection

Semi-structured, in-depth interviews were conducted in-person and via teleconferencing to explore participant insights into natural resource management, climate change attitudes, beliefs about fertility decisions, and institutional climate adaptation policies. Interview guides included questions about living in Greenland; climate change and adaptation; hunting policy; fisheries policy; fertility decisions and healthcare; and hopes for the future of Greenland. Interviews were audio recorded in English and stored on a password protected device. Interviews were transcribed using Rev audio services (92).

Data Analysis

Constructivist grounded theory was used to collect and analyze data with sensitivity to Indigenous and Western worldviews that shape communication and recognizing the influence of the researcher in socially constructing knowledge (31, 93, 94). Data collection and analysis occurred concurrently as participants indicated key policies for further exploration. Following each interview, an initial analysis was conducted to compare content against prior interviews and field notes. Initial codes were developed through line-by-line analysis of interview transcripts using Atlas.ti, and iteratively compared against individual interviews to develop focused codes (94). Focused codes were iteratively compared against each other and against individual interviews to identify areas of convergence and divergence. Focused codes were narrowed in a second round of analysis, and grouped into a conclusive set of thematic areas that capture participant values and perspectives.

Results

Results are organized into six thematic areas, (1) fertility trends, (2) healthcare characteristics, (3) education and workforce challenges, (4) community capacity to direct development, (5) economic opportunities, and (6) climate change and adaptation perspectives.

Fertility Trends in Greenland

Participants described fertility trends in Greenland as differing based on community socioeconomic characteristics, and access to job and education opportunities. Participants described early childbearing and having large families as typical of small towns and settlements, where having children ensures a person's role in their community. Participants noted that Greenlanders in small communities may stop school after the 8th grade, and in absence of education opportunities young people seek fulfillment through parenthood. Some participants observed a "social heritage" of younger parents being less educated and having unstable living situations that can affect child development. Comparatively, participants indicated people living in Nuuk tend to delay fertility until later in their adulthood, and typically have smaller families than people in small towns. Participants from Nuuk exemplified their personal journey of delaying childbearing as they sought higher education abroad. As Denmark was a constant point of comparison for participants, they described people in Greenland having an accepting disposition about early childbearing and large family sizes compared to Danes.

Having children at a young age was characterized as a "natural" thing in Greenland, reinforced by culture, family, and government support. Participants described having children as the default in Greenlandic culture, and distinguished that the choice of abortion or having a child is a reactive response to pregnancy as opposed to a planned decision. 'Planning' fertility was

characterized as out of the norm for Greenland's opportunistic and adaptive culture. Several participants characterized fertility 'planning' in the context of improved life expectancy that is in living memory for the country. They noted that until recently, Kalaallit lived a traditional hunting lifestyle with high mortality wherein winter conditions and resource availability immediately determined fertility decisions, and 'planning' was unnecessary. Participants described fertility decisions as replicating family patterns, noting that people from large families may be eager to have their own large families. Older family members may encourage younger members to have children to ensure multigenerational care for the family. Participants described the cultural tradition of grandparents helping to raise their first-born grandchild as a social strategy that allows young people to obtain education, even if they become pregnant. Participants characterized fertility decisions within the Kalaallit values of autonomy and self-sufficiency, emphasizing that it is up to individuals to evaluate their own ability to provide for a child, and their own desire to have a pregnancy. Participants described a range of government programs to support parents, including the universal parenting program MANU, municipally sponsored daycare programs, free maternal and infant healthcare, and the Greenlandic child benefit program that pays qualifying families a monthly stipend per child (118). A participant explained the decision to have children:

> Well, you make it sound as though they have a choice, but sometimes it's just part of life. It's just part of you growing up…Some people will, of course, wait to have their children until they've got an education, but the support from our educational system is so that women with children can also get a room while they study. They can have their children at kindergartens and so on while they study. Our support system and our services in the educational sector are okay. It's normal for parents to go through the education so they can decide [to have a child], or by chance get a child and then they decide to get an education. It's not a hindrance for them to have a child.

Participants explained that large family size and young childbearing is not a concern for Greenlanders relative to other Western nations, but there is concern for the public health burden of high rates of STIs and abortions in the country. Participants connected sexual risk behaviors and low condom and contraceptive use to multigenerational social problems, including intrafamilial sexual abuse, alcohol misuse, and mental health challenges. They explained that children growing up in families that experience social problems are not taught about bodily boundaries or personal responsibility and may not learn how to care for themselves sexually or negotiate condom use with a partner. Several participants directly attributed generational trauma from colonization as influencing contemporary sexual health disparities. Sexuality education was described as something that occurs in school settings, but program delivery may be inconsistent across communities. Most participants indicated that they feel personally committed to teaching their own children about sexual health. Participants described structural and organizational transitions underway to address sexual health outcomes, including shifting sexuality education promotion to engage teachers rather than only students, and improving curricula delivery in small communities. High abortion rates were attributed to "no other option" due to income and housing challenges. Participants indicated abortion rates as symptomatic of a greater need for holistic and consistent reproductive healthcare counseling:

> For some people maybe it's hard to [have an abortion], but the third time, fourth time, fifth time, it's just something you do. You don't know the consequences. You don't. It's an abandonment from the system that they have been in. No one is catching them. No one is saying, 'Okay, I can see you have [had an abortion] five times. Can we have a conversation? We can take you to this [resource] to give you the right information.' I think it's just something you do, and then you're done, and then you come again.

Healthcare Characteristics

Participants described healthcare delivery as a challenge for the country, especially for small communities with inadequate staffing and equipment. Health services are provided by the government at no cost to the patient, but participants described lack of alternative options as a barrier to timely and consistent services. Healthcare in Nuuk was characterized as better than the rest of the country, but suffering compared to Denmark. Participants described a Greenlandic healthcare system that is overburdened and understaffed, with several participants characterizing the system as on the verge of "collapse". Participants described the Greenlandic healthcare system as entirely reliant on support from Danish healthcare workers who complete short-term residencies at health centers across the country. During their short residencies, Danish healthcare workers lack time to develop cultural and linguistic knowledge to fully support Greenlandic patients. Patients experience inconsistent services when visiting a new provider for each medical appointment. A participant in Paamiut described:

> I've heard there was even a nurse who said that if you get some kind of serious disease then hurry away from Paamiut. The healthcare is not what you could desire. We had problems with having permanent doctors, nurses, and the population also feel that when we have doctors, nurses, dentists, they usually come for shorter periods, a month or so, and then come a new one. People who have illnesses who have to go to the hospital, they feel that, 'Every time I come down there I have to tell my whole story over again.' I think that's some of the things that frustrate people. Of course [there are] those who come to the hospital a lot more than those who don't. The healthcare is not what we could wish for.

Specialty medical services necessitate patient travel to Denmark, and some participants described moving to Denmark for extended periods to support individual or familial health conditions. Extended medical travel is financially supported by Naalakkersuisut, but many patients incur additional expenses when seeking care in Denmark. Transportation costs for healthcare workers and patients were characterized as a significant financial burden for the country. One participant

indicated that the healthcare system is not a prioritized sector in the national finances of Greenland.

Midwives were described as critical support for expectant mothers, and a vulnerable asset in small communities. Patients described a Greenlandic healthcare approach to pregnancy and birth as having a "low level of urgency or danger" relative to other countries that may treat pregnant women like they have a "disease". Some participants expressed that increasing the number of midwives and resources for midwives might improve the experience of pregnancy, especially in smaller communities in Greenland. Birthing in Nuuk was described as safer than birthing in small communities that lack access to emergency surgical equipment and anesthesia. Comprehensive prenatal, labor, and birth services are unavailable in small communities, so mothers must fly to one of five centralized hospitals to give birth. Participants indicated that the process of flying a mother out of her home community and birthing without family support is challenging for the entire family, and there is a need for mental health services offered to the mother, father, and other children post-partum.

Working life for healthcare workers was described as stressful due to understaffing, especially in small communities that may only have a single physician staffed. One participant described changing careers because as a healthcare worker they were constantly on call in a high stress environment without any option for backup, to the point that it affected their personal health. Several participants indicated that introducing private healthcare options could improve alleviate the public health service of individuals who have financial resources to purchase healthcare, but that health privatization is a politically contentious subject. To improve healthcare

worker retention, participants discussed a need to create more options for Greenlanders to receive an education in health sciences and services in Greenland.

Education and Workforce Challenges

Expanding education options for people living in Greenland was emphasized as a solution to myriad challenges related to healthcare delivery, workforce needs, and improved development. Education and workforce development were posed as two sides of the same coin; the country is unable to improve their workforce capacity due to few higher education options, and simultaneously, education is impeded by lack of qualified teaching workforce. Participants described their own children experiencing weekly substitute teachers in daycare and school. Participants emphasized the importance of education for young people in small communities for whom school involvement could directly affect overall wellness and reduce susceptibility to social problems. In many small communities, students who wish to complete public school must leave their community after the eighth grade. For such students, returning to their home community is uncommon as there are no job opportunities, exacerbating existing workforce and development disparities. Many Greenlanders with advanced degrees may choose to leave the country to pursue careers in Denmark. Participants who were educators described an exhausting personal dedication to create continuity for their students, explaining that many teachers leave the position due to stress. Participants explained that in communities centered around fishing industry or professional hunting, young men can earn a good income without getting an education, but there are few options for women to find work which results in more women leaving their home communities than men.

Workforce limitations were connected to economic challenges and Greenland's ability to independently direct development without pressure from foreign interests. Participants indicated that the entire Greenlandic workforce is only around 26,000 people. Participants observed that many government positions are filled by Danish workers, while lower paying positions are increasingly filled by immigrants from southeast Asia. Participants indicated that Danish influence in government administration leads to the replication of characteristics of Danish society in Greenlandic policy and planning, from urban design to natural resource management. Participants described that management and government positions filled by foreigners disrupts ability to embed Greenlandic culture into policies and laws. The desire for *Greenlandic* systems that reflect *Greenlandic* culture and environment reinforced the need for improved education options to retain *Greenlandic* workforce. One participant remarked:

> …I wish that education was higher valued. Because what I see is that a lot of the time, the workforce consists of maximum 50 percent of local Greenland people, and the rest comes from Denmark or other places. And I think it's because there's a lack of education. And I don't know if that's because primary education is not doing a good enough job, or if there are underlying social issues that's preventing younger people from going further in their educations…So if the people with close attachment to this culture were in these management positions, were in these government positions, they could more easily communicate the needs of their own people to their own governments, more self-governed by themselves.

Community Capacity to Direct Development

Economic and governance disparities between small towns and Nuuk impact community capacity to direct development. Community capacity to address local needs was observationally correlated with productivity of local fisheries and municipality centers. In 2009, Greenland redistricted from 18 municipalities to five municipalities to distribute centralized power to municipal authorities (119). However, participants described the concentration of administrative

positions in Nuuk as reducing political power everywhere else. Reduced interaction between residents of small communities and authorities based in Nuuk can lead to a sense of disconnection. Participants explained that administration in Nuuk may end up "making decisions about places we'd never been". In Paamiut, physical disconnect between the population and government centers leads to a sense of community disempowerment. A participant in Paamiut described:

> I can hear that one of the things they feel is that the distance between the population in Paamiut and the authorities has become so huge that they feel they don't think about us here in Paamiut. I think that's a very common feeling. There are some problems you can't [solve] as you could earlier. You could just go down and talk to [the authorities]. You can't do that now because it takes 16 hours by ship and you don't go to Nuuk for 16 hours to talk to them for five minutes or so and then back again for 16 hours more!

Some sectors of government described efforts to bridge power deficits, for example, fisheries and hunting management described numerous strategies to incorporate public knowledge into management decisions. One participant reflected that the reorganization of municipalities in 2009 did not account for Greenlandic geography appropriately:

> I think we did it wrong back then. I think politically what should have happened was that we should have split things up into things that are strictly city specific and then things that are national, like the school system… It was just the whole municipality system was built on [how] it would've been done in Denmark… It logistically doesn't work very well.

Participants described smaller communities as having high cost of living and poor infrastructure relative to modern development in Nuuk. One participant indicated that banks will not lend to start-up businesses in small communities, delaying local ability to develop needed services. By comparison, Nuuk is experiencing rapid construction and infrastructure improvements. Participants offered mixed predictions about the redeveloped Nuuk International Airport, set to begin operating in 2024. Some participants expressed excitement for the economic advantages

the airport will bring to Greenland, including expanded tourism and direct exports of fish products. Other participants cautioned that the airport will exacerbate existing housing disparities as travel to Nuuk becomes cheaper and vacation rentals become popular. Housing was described as the most pressing development challenge for the country, with participants waiting up to 10 years to secure public housing. Expensive and inadequate housing was described as directly impacting young peoples' ability to pursue education. As policymakers prioritize sustainable development in the country, housing, health, and education were described as "so intertwined that you can't really separate them".

The centrality of the fishing industry to economy and social structure cannot be understated, with one participant stating fisheries "feed directly into every person's life in Greenland". Participants indicated that communities throughout West Greenland are built around a local fish factory, which guarantees employment and other services including stores and schools. Fishing industry was described as the primary driver of political decision-making, producing management negotiations and disputes between fishermen unions, scientists, and government agencies. Participants expressed that smaller communities, especially in North Greenland, have limited economic opportunities to support local employment outside of fishing industry. Many participants described the reliance on fisheries as creating vulnerability, particularly in context of shifts in fisheries stock due to climate change or unsustainable harvest practices. Participants described learning from historic fisheries collapses in Greenland, and what it meant for development capacity of small communities. In Paamiut, a participant described depopulation from the cod fishery collapse in the 1980s:

> They had actually thought that Paamiut would develop into becoming the second largest town in Greenland. But when the basis for this development disappeared,

> that started a bit like if you go up on the hill and start a snowball; the longer down it comes, the bigger it gets and it sort of gets worse and worse…First the basis for the society was pulled away. Then they also started moving other job facilities or job possibilities to Nuuk. They moved education…It's like a snowball that grew bigger and bigger.

As some fish factories become less productive, management decisions shift to uphold a government obligation to provide employment in coastal communities. Participants described this practice as a financial sink for the factory, and a threat to sustainable fisheries management. One participant explained:

> If we look at the quota setting for inshore fisheries for Greenlandic halibut, the government is setting the quotas higher than the advice has been for many years. So people's urgent needs are set above the advice given from [natural resource scientists] and I think there are a number of reasons for that, and unfortunately, I think it mostly has to do with the closeness of the government people, the politicians, and the societies. It's not for the Greenlandic good, but it's for the good of that particular settlement.

Participants described reactivity, opportunism, adaptation, and innovation as characteristics of fisheries management that buoy the industry despite regional economic and environmental changes. Fisheries collapse and technological innovations were linked in the context of climate risk:

> …If we don't know where the fish stock is we will be in big trouble, as we depend a lot on that. It happened actually, 12 years ago the cod disappeared which was due to a climate change…And first when it disappeared, we changed everything. Going more into shrimp fisheries, changing all the factories, changing all of that. Nobody knew this was coming, which meant that we had to react instead of act beforehand.

Economic Opportunities

Participants described embracing economic opportunities to increase national self-sufficiency, explicitly linking improved national economy to independence from Denmark. Participants described tourism as "a sustainable use of the living resources and an adaptation to a

changing world", and a way to bring jobs and development to small communities. Cultural tourism activities were described as permitting individuals in remote areas to maintain their preferred lifestyle of hunting and fishing while repurposing their equipment to support tourist activities. Activities included boat tours to see whales or glaciers, trophy hunting for muskox and reindeer, guided hikes, polar bear safaris, sled dogging, and backcountry 'glamping' adventures. Tourism may boost income for local artists and permit families to earn income by hosting in-home cultural experiences, such as the Greenlandic party tradition of *kaffemik*. Participants described a need for better transportation and accommodation options to support the growing tourism industry without straining resources for locals, noting that improved development for tourists inherently facilitates improvement for locals.

The Kalaallit value of sustainability and respect for nature was emphasized in all characterizations of economic opportunities. Participants often compared capitalizing on natural resources via tourism against other extractive industries, especially mining. Several participants contextualized mining within the history of international actors profiting from Greenlandic resources, with limited economic benefits to the country and high risks of environmental degradation. One participant explained:

> As we see in South Greenland, [mining] really can split communities completely and create a lot of tension. This question of mining or not, it's sort of like- What is more important? Development so that our young people stay here and can work here, and we can have our generations in this area? Or, 'We need to protect our environment and who we are as identities.'

<u>Climate Change and Adaptation Perspectives</u>

Participants specified differential climate change impacts based on geographic location. Participants most frequently described increased precipitation and worsening weather that affects

coastal fishing conditions, and reduced sea ice as impacting boat, sled dog, and snow machine travel for hunting. Participants described changes in animal populations and location, including reindeer travelling farther inland as glaciers recede; increased presence of orcas, pilot whales, and dolphins; changes in pelagic fish species moving north; and changes in seal populations due to ice conditions. Participants described ways that environmental degradation exacerbates existing pressure on animal health including marine pollution that affects apex predators like polar bears and orcas, overfishing, and overharvest of narwhal. Participants characterized climate risk in Greenland as low relative to disastrous climate events in other countries, indicating that Greenland will not experience flooding, drought, fires, and infrastructure collapse from permafrost thaw.

Participants described social impacts of climate change as dependent upon location and livelihood, indicating that for most people in Greenland climate change is obviously occurring, but isn't affecting them. They described hunters and fishermen as experiencing the most profound effects of climate change, creating food insecurity for communities that rely on sea ice for hunting. Settlements will be most vulnerable to the effects of climate change, as they are already experiencing a reduction in population and social resources. Participants noticed climate change as a "creepy normalcy", and that children are accustomed to climate change discourse and not alarmed by future uncertainties. Participants emphasized that it has always been a part of Inuit way of life to adapt to the changing environment:

> Just adapt. I think as we are open to adapt, they just have to teach the population how to adapt if it's fisheries, because all Greenlanders are used to the change in nature… There's a possibility that the Greenland people, they also have to evolve. We have always done that in the past, from the old Inuit time, they're traveling and adapting, and we can still do that.

Participants described possible benefits of climate change, such as fishing new species; opening transportation routes as sea ice melts; mining opportunities as ice recedes and exposes land; and increasing Greenland's role in international diplomacy. Participants attributed climate anxiety and "dystopian" attitudes as Western ways of thinking that are seldom expressed in Greenland. Though many participants believed climate change was a global crisis, Greenland has limited ability to mitigate climate change. Participants felt that Inuit perspectives of climate change are not represented in international policy. They indicated that international climate change agreements do not reflect the lived environmental experiences of Kalaallit. One participant described noticing that the international research community miscommunicates climate change concepts in Greenland, particularly in settlements where research objectives are disconnected from the community's immediate challenges. One participant explained:

> It's this state formation, and how the governance of the country is as if there are Indigenous people who have a very Westphalian way of thinking about climate change… For the hunters up north, the ice is not solid enough. So it is as if the substance is taken away from them because they now need to change their way of living for hundreds of years into something else to earn money or have food on the table. So, you can sign the Paris Agreement- but why would we 'Go Green'? Why should we, we are so green compared to other countries in so many ways? Why should we do more?

Participants expressed that relative to other social problems and population health challenges in the country, climate adaptation is not an immediate policy priority. The primary policy domains that were described as including climate effects modelling were in the fisheries sector, with some inclusion in hunting management. Contemporary sustainable development planning was described as including climate action partnerships, but not explicitly climate adaptation policy. Improving healthcare, housing, and education were described as the most pressing policy priorities for the country.

Discussion

Our results indicate that healthcare, education, and workforce development are critically interconnected challenges that affect population health and development in Greenland, with immediate implications for fertility outcomes. Because living conditions and opportunities for education proximately influence fertility decisions for Kalaallit, intersectoral coordination of policies addressing socioeconomic inequities is necessary to support fertility, especially in small communities (16, 21, 113). As a country of 57,000 people, human resources are stretched to implement policies that address health and development inequities, emphasizing the need to leverage existing human capital to target cross-cutting goals that will improve living conditions and facilitate economic opportunities for young people in Greenland (120, 121). For example, development to support the growing tourism economy can laterally improve living conditions and provide jobs that permit people to remain in their home community. Fisheries impact where people live and relative development capacity of a community, but a dwindling workforce and shifting environmental conditions threaten the economic viability of an already subsidized industry. Participants in this study desired a diversified economy beyond fisheries but in alignment with Kalaallit values of sustainable and autonomous natural resource management. The extent to which individual economic opportunities will be realized within a Kalaallit vision of sustainability, however, lies in improved distribution of resources and decision-making power for communities (108, 122).

Our results support the value of programs that holistically address multiple layers of an individual's environment to support reproductive wellness, beyond individualized sexuality education or provision of free condoms and contraceptives. As centralization continues,

strategies to support reproductive health equity in small communities may require disproportionate funding but can improve the health burden in Nuuk. Expanding educational pathways and resources for midwives to lead reproductive care in small communities might simultaneously improve provider-patient trust that is challenged by cultural incongruities, improve consistent care for pregnant women, and increase national healthcare workforce (73). Our study reveals a need for care continuum services that can be coordinated with midwives, including mental health support and communication for all members of an expectant family.

Climate adaptation policy cannot be treated as separate from sustainable development in Greenland, as immediate improvements in sustainable development indicators will directly affect disparate climate vulnerabilities. Consistent with existing research into application of the UN Sustainable Development Goals in an Arctic context, findings from this study reveal a need for localized control of development trajectories, increased community consultation from government, and development that reflects Kalaallit values and way of life (123). Kalaallit have always adapted to climactic and environmental changes, and have built societies in which mobility and flexibility are cornerstones of resilience and social organization (114). However, top-down strategies of community consultation in policy implementation undermine the power of small communities to determine and solve local health and social problems. Participants described disparate climate vulnerabilities related to location and livelihood for Kalaallit, reinforcing the need for community directed adaptation policy to support geographically dependent health needs (44, 46, 48). Participants in this study expressed that until baseline social and health equity improves, Greenland policymakers will not prioritize climate adaptation policy. However, overreliance on Greenlandic opportunism and reactivity may lead to policy responses

that do not reflect Kalaallit cultural context and exacerbate existing development challenges under severe climate threats.

Policymakers and key stakeholders in this study consistently explored ways that social and economic advancements in Greenland will facilitate nation-building. Discourse of sustainable natural resource use was tied to economic independence from Denmark, and desires to expand national workforce were linked to embedding Kalaallit culture in national policies. As Greenland faces climate threats, participants described opportunities to leverage Greenlandic paradiplomacy to support self-governance amidst dependencies with Denmark. Sociocultural and biological reproduction is facilitated through human fertility outcomes, where Greenlandic identity is created. In the pursuit of sovereignty, supporting conditions by which Kalaallit make autonomous, just, and culturally grounded fertility decisions may be, in itself, an act of decolonization (124).

Strengths and Limitations

Results of this study are specific to Greenland and may not reflect conditions in other Arctic nations. Interviews were conducted in English, which is a third language for most participants. A strength of our approach was the prioritizing of trust-building between the interviewer and participants, contributing to deep dialogue. No healthcare providers agreed to participate in the study, citing unavailability and low self-perceived knowledge about study objectives. This recruitment challenge confirms our findings that short term residencies for health providers limit their ability to learn details of the Greenlandic health system.

Conclusion

Coordinated policies to improve living conditions and socioeconomic inequities in Greenland may directly improve fertility and reproductive health outcomes and reduce climate vulnerability. By increasing community power to direct sustainable development and climate adaptation, Kalaallit culture may be embedded in policies from the ground-up. Future research may investigate opportunities to coordinate policies in housing, education, and healthcare to address specific gender and reproductive health disparities.

CHAPTER FIVE

APPLYING COMMUNITY BASED PARTICIPATORY RESEARCH PRINCIPLES TO BUILD TRUST AND EQUITY IN HEALTH AND SOCIO-ECOLOGICAL STUDIES IN GREENLAND

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Abstract

Community based participatory research (CBPR) is a framework to improve social equity by engaging communities as equal partners in research design, conduct, and knowledge creation. CBPR has been limitedly used for research in Greenland, partially due to geographic and logistical limitations. In this manuscript we report on strategies to conduct equitable health and socioecological research in Greenland guided by the principles of CBPR. We describe 9 strategies used to conduct a study of fertility and reproductive health and climate adaptation in the community of Paamiut, rooted in the principles of CBPR. Using CBPR principles improved trust, participant recruitment, and the creation of community-valued research products in Paamiut. The methods described can be applied across other research disciplines to continue building equity, trust, and sustainability in international research partnerships in Greenland.

Introduction

Community based participatory research (CBPR) is a paradigm to improve social and health equity that has grown in popularity across Arctic geographies in the past two decades, especially to benefit Indigenous communities (125-128). CBPR uses community-directed research activities to address community-identified priorities (30). CBPR can be understood in contrast to research frameworks that prioritize institutional or individual research objectives *unto* a community, or research designs that engage community members as subjects or resource suppliers, but explore questions that are defined without consulting community members (30). As Greenland has become a fixture of climate change research, many communities have experienced ‘helicopter’ research, whereby practitioners fly in, collect data, and leave without returning results to the very

communities most directly affected by climate change (129). Communities and researchers have increasingly called for improved processes to meaningfully engage Greenlandic communities to produce locally valued research products, and reduce research fatigue (130, 131). Health research in Greenland has typically relied on population health surveys to explore epidemiological indicators, which limits community capacity to direct research objectives (132-134). However, CBPR has been used with promising outcomes to conduct two studies of sexual health and a study of community resilience in Greenland (135-137). CBPR seeks to restore equity and improve the validity of research conducted *with* communities, not *in* or *on* communities (30).

Challenges of Using CBPR in Greenland

Obvious challenges exist to conducting CBPR in Greenland. Communities in Greenland are disconnected and only accessible by boat or aircraft, with frequent disruptions due to weather. Accordingly, processes of community consultation and trust-building necessitate ample time and funding on the part of the researchers (138). The main languages of Greenland are Kalaallisut (Greenlandic) and Danish, necessitating translation services throughout international research collaborations. This can create undue strain on the time, energy, and emotions of community-based research partners, as they must constantly address the needs of the community and the needs of the research team (125). Third, historic practices of imposing hierarchal decision-making onto Greenlandic communities may create misunderstanding of the opportunities community members have to express their needs within CBPR (125). Researchers must dedicate time to trust-building and co-learning to establish what is possible through CBPR and adjust community member expectations. Finally, true CBPR requires a long research

timeline. Given institutional and financial constraints, some collaboratives cannot facilitate a multiyear partnership to practice true CBPR.

Background

From 2022 to 2024 we conducted a qualitative, exploratory and comparative study of fertility and reproductive health and climate adaptation in the communities of Paamiut and Nuuk **(Figure 6)** (113). The purpose of the study was to understand the economic, social, and environmental drivers of fertility decisions for Kalaallit from differing community socioeconomic circumstances. Our study aimed to build upon the findings of the CBPR study *Population Dynamics Greenland* that occurred in the North Greenland community of Kullorsuaq from 2013 to 2017 (16, 21, 26, 136). In this manuscript we present strategies employed in Paamiut, a fisheries community of 1,200 people in southwestern Greenland. This study occurred as part of the doctoral research of an American graduate student, meaning research activities needed to be completed within 3 years and with limited funding. Under such circumstances it would be easier to select methods that allow as much individual direction as possible and limit community consultation. However, our constraints presented an opportunity to explore the merits, logistics, and challenges of conducting research in Greenland guided by CBPR principles, without the benefit of a flexible research timeline.

This manuscript was developed through iterative reflections between a Paamiut-based community research partner (AR), and an American graduate student (MP) about our successes and challenges throughout the study, after collecting feedback from the Paamiut community. The study was guided with the CBPR principles defined by Isael et. al. 2008 to generate community-driven research and community-valued products (see **Table 3).** In this manuscript we present 9

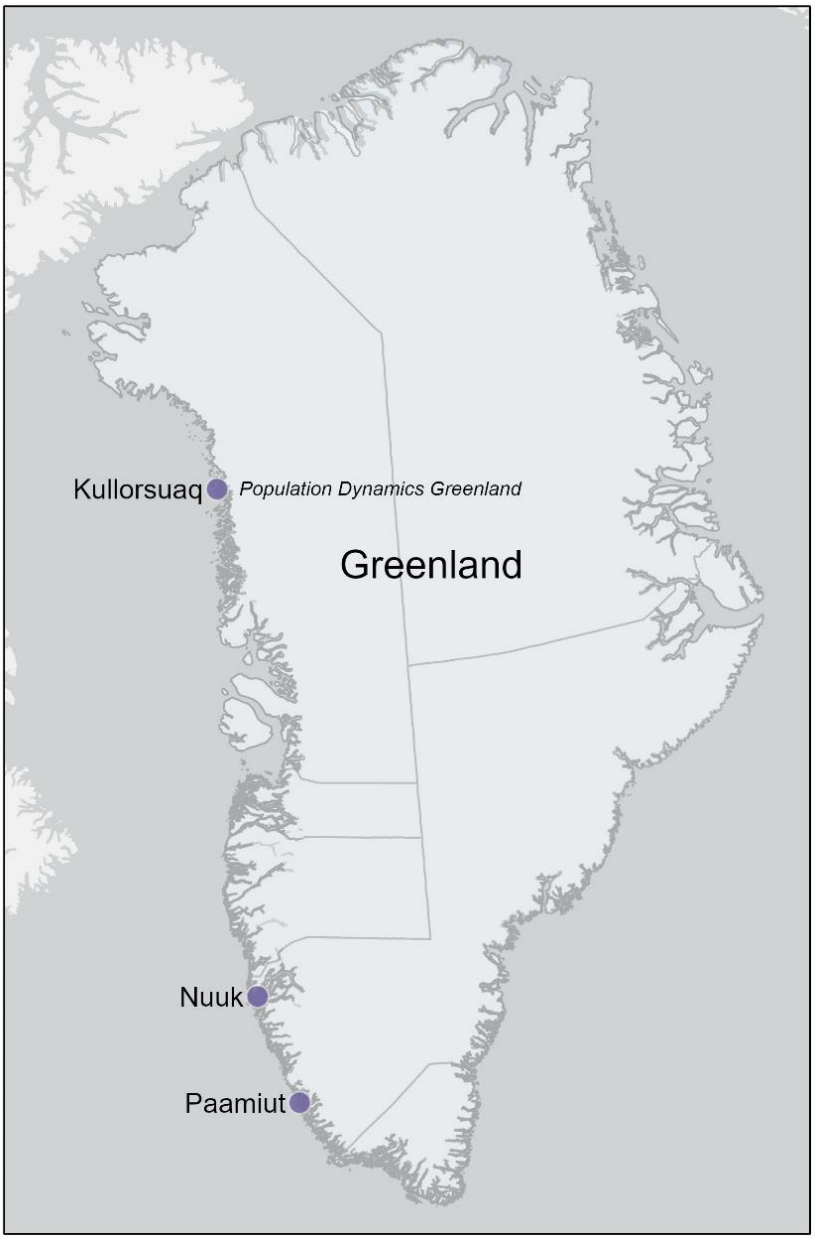

Figure 6. Map of Greenland with study sites and site of Population Dynamics Greenland. Credits: Esri, TomTom, FAO, NOAA, USGS.

strategies that we used to guide research activities with CBPR principles despite lacking the timeline and research team needed to truly adhere to CBPR. The strategies described can be incorporated into other health and socioecological research in Greenland to build trust and equity, even for researchers who are facing time or resource constraints.

Methods

In **Table 3** we describe the core principles of CBPR that were used to guide our study, and specific actions to realize each principle (139).

Define the Contextual Realities of the Research

To build a foundation of trust and communication in our research partnership, it was important that we identified inequities and social structures that the study occurred in, especially related to reproductive autonomy (30). Greenland is a self-governing Danish territory, and Kalaallit have experienced a history of discrimination and natural resource exploitation through Danish colonization. Beginning with European missionaries, the enforcement of Western gender roles and sexuality rooted in Christian beliefs separated Kalaallit families from traditional structure and kinship practices, and stories of trauma related to gender, sexuality, and fertility were presented in Paamiut (140). In recent years it was revealed that intrauterine devices were inserted in nearly half of all reproductive-aged women in Greenland in the 1960s and 1970s, often involuntarily and without parental consent for minors (63). Trust building between research partners necessitated communication about historic and contemporary reproductive health injustices, and how our respective positionality may impact research activities. Raised in Paamiut, AR brought a deep understanding of the social dynamics and research histories within the community and lived experience navigating reproductive, maternal, and child healthcare in Greenland. MP entered the research partnership with experience in sexual health services and CBPR alongside Indigenous communities of the United States. With our different backgrounds, we realized that typical research practices in Paamiut were not aligned with CBPR principles of equity and power-sharing. AR expressed initial hesitation about her level of decision-making

power in research activities and indicated that in the past she has been viewed as a ‘student’ or ‘translator’ and not a researcher. MP had not realized the extent of disconnection between researchers and community members in Paamiut, sometimes leading to misunderstandings when community members were asked for direct feedback in research activities. Our conflicting understandings of CBPR led to dialogue about research perceptions in Paamiut and the meaning of *participatory* research. These conversations required an interrogation of the ongoing ramifications of Danish power relations in community dynamics. For example, community members asked, ‘why me?’ when we sought their opinions about the study because they were accustomed to brief researcher visits, without personal interactions or explanations of their research purpose. Explicitly discussing underlying inequities was sometimes uncomfortable and we held different cultural approaches to conflict. However, inequities left unspoken can erode trust and dismantle research tasks. MP is a settler from a wealthy nation, whose lifetime access to education had directly facilitated her ability to come to Paamiut. AR is a Kalaallit mother who, herself, had experienced discrimination in medical and academic settings. As research partners, AR and MP had to openly discuss our lived histories of oppression or privilege within colonial systems to build trust and transparency. This permitted deeper exploration of underlying structures that influenced our study objectives and community participation. In some research spaces we experienced the implication that discussing race and colonization is problematic or damaging to social cohesion. Through transparency about the contextual realities of Greenlandic research, we were able to respectfully address microaggressions that threatened the integrity of the study.

Align Research Tasks and Timelines with Community Priorities

Our approach to planning and performing research tasks had to align with Kalaallit lifestyles. We approached activities with the concept, *Silarsuaq kisimi naalagaavoq:* "It depends on the weather and the season". Decision-making through all parts of the study reflected environmental conditions, such as weather, and social conditions, like relations between community members. 'In the moment' decision-making created minor challenges to reliably timing research activities, but community members responded positively to more relaxed timelines. Attention to seasonal activities was built into the research. While summer season may offer better weather for travel, community members are unavailable as they spend summer in nature hunting to provide for their families. Outside researchers descending upon Greenland during fair-weather periods with the expectation that communities will prioritize their research activities is a privileged practice, and risks overlooking sociocultural adaptations to weather and seasons. To build on the strengths and resources of Kalaallit communities, researchers should time activities to be seasonally relevant.

Trust-Building in the Community and Research by Invitation

It was critical that the study addressed a public health concern of the Paamiut community, and not merely of the researcher. Paamiut was selected as a study site specifically because of AR's expressed interest in exploring unmet fertility and reproductive health needs in Paamiut and her willingness to use her social connectivity to facilitate research. To foster true community participation, we needed to build trust between community members and MP. Physical presence in the community was crucial to the success of the study. We took frequent walks so we could

meet passerby and visited all local establishments to introduce MP and explain the study. We repeatedly visited community leaders to build familiarity and create opportunities for their input. We capitalized on opportunities to invite community members into research discussions to facilitate co-learning and the reciprocal transfer of knowledge. For example, we presented the premise of the study at the young adult learning center and asked for input on our questions and activities. We incorporated existing community resources into our study design by basing activities from the local museum, so we had a predictable location where community members could meet us. By building on existing resources and relationships in the community, we improved trust and cooperation throughout the study.

Design Instruments with Input from Community Partners

Using Local Dialect

Interview guides were adapted from *Population Dynamics Greenland* to include questions specific to Paamiut resource contexts and to explore attitudes about climate change (20). It was important that Paamiut community members were consulted in the adaptation of interview guides so that questions made sense and reflected local knowledge. We learned an important lesson to translate researcher materials into local Kalaallisut dialect whenever possible. Because our interview guides had been translated in Nuuk, the questions contained linguistic nuances that people in Paamiut felt were culturally Danish, evoking some negative reactions. To demonstrate that our research objectives were rooted in Paamiut, it was critical that all communications reflected local dialect.

Transparency About Funding and Bureaucracy

CBPR principles should be intentionally built into the funding structure of a study from the onset, and not as an afterthought. In this study, we budgeted to allow robust and equitable distribution of financial and intellectual capital in the Paamiut community as much as possible. Community engagement can perpetuate a transactional relationship between researchers and community members. Such transactions, like paying for translation services or logistics support, are not inherently imbalanced, but they can lead to inauthenticity. We learned the importance of speaking openly and up-front about financial resources, and especially about delays in funding distribution that are common in international research bureaucracy. As people in Paamiut waited for wire payments from American institutions, our ability to conduct research activities was tenuous. As research progressed, we used cash payments as often as possible. Part of the challenge of paying research partners stems from limited institutions within Greenland that could facilitate resource transfers. Future research rooted in CBPR principles should take care to discuss all transactions transparently and with full consent of community research partners should funding be delayed. Relatedly, participants in our study were offered a gift of tea and chocolates as a thank you for their time. Many reacted with surprise and gratitude and indicated that in prior studies they were not compensated for their participation. Based on our experience, we feel that the practice of financially compensating research participants in Greenland should be considered in ethics guidelines to equitably distribute resources from wealthy institutions into remote communities.

Use Existing Social Networks for Participant Recruitment

We leveraged the power of existing social networks in Paamiut to recruit participants to the study, using AR's knowledge of people who had experience with our study objectives. For example, by presenting at community establishments, leaders informed their social connections about the study and how to participate. Likewise, community leaders at the fish factory, school, and municipal center advised on recruitment and 'hubs' of potential participants. Due to the sensitivity of our research topic, AR's social connectivity helped us provide space and respect to community members who had experienced negative reproductive health or family events. During data collection, participants described ways that social connectivity helped them survive in Paamiut through traumatic life events. AR's knowledge of local social connections helped us identify informal resource networks that supported fertility and reproductive health. Western approaches to health science may indicate that involving a community-based researcher in recruitment and interviews risks participant confidentiality. However, with full adherence to data security and informed consent, integrating existing social networks and Kalaallit relationality strengthened recruitment and prevented harm to participants.

Cooperative Data Collection and Analysis

Data collection and analysis were conducted collaboratively between MP and AR. During interviews, AR translated between Kalaallisut and English in real-time. This strategy might be contrasted against the practice of conducting interviews only in Kalaallisut, to be later translated to English. By collecting data together, both researchers were able to ask follow-up questions, explore nuanced concepts, and facilitate a deeper dialogue with participants. Data was analyzed through iterative discussions of interview content and emergent themes. We reflected on the

ways Kalaallit or Western world views shaped our interpretation of each interview. Collaborative analysis permitted AR to contextualize specific events that were referenced by participants. AR's full participation in analysis, regardless of her academic 'credentials', was critical to understanding fertility decisions in Paamiut. For example, many times a participant would not directly answer a question but would describe a story or experience in nature that touched on a parallel topic. From a Western perspective it may seem they did not understand or avoided the question as their response was nonspecific and indirect. However, through AR's insight we uncovered important environmental context and processes that shaped the participants' fertility decisions, expressed through a Kalaallit worldview of interconnectedness and relationality. Collaborative analysis supported co-learning and refinement of our respective research skills.

Disseminate Results in a Culturally Valued Way

CBPR emphasizes creating research products that are valued by community members, and strike a balance between research and action (139). To promote community understanding of our study findings and to elicit feedback, we disseminated study results directly to individuals throughout Paamiut. We originally considered hosting a public event where we could present results and collect feedback, but AR noticed that recent events had low attendance. Instead, we created a simple write-up of our study results and contact information, translated in Danish and Kalaallisut, and toured the town to individually distribute it to community members. It was important that results were delivered to our original study participants so they understood how their interview was used. We distributed results orally at all local establishments, including the fish factory, sports center, school, health center, and municipal building. Consistent with the CBPR principle of capacity building and co-learning, we returned to the young adult learning

center to present results and ask, '*Do these results match your experience? What would you add? What changes would you like to see based on these findings?'* By directly engaging community members in dissemination, we were able to validate that our findings accurately reflected the needs and experiences of the community. Furthermore, our continued presence sparked interest in research opportunities from young adults in the community, influencing future capacity to conduct true CBPR in Paamiut. Community members expressed gratitude that their concerns were heard and encouraged us to bring findings to policymakers in national government.

Advocate for Equal Representation in Academic Presentations and Publications

CBPR involves all partners in the dissemination process, including in professional scientific conferences and publications (139). AR is represented as an author on all professional products and included in communications and decisions related to the study. Funding was allocated to support AR's travel to a scientific conference, emphasizing the importance of including CBPR principles in project budgets from conceptualization. We experienced several instances in administrative communications where the concept of a community research partner was unclear, and MP needed to advocate for AR's equal inclusion in communications. We presented results together at a professional conference to demonstrate the value of community research partnerships and *how* CBPR principles strengthened the study. Equally crediting community research partners in all products is necessary to reduce research fatigue and sustain trust through research partnerships in Greenland.

Discussion

Using CBPR principles to guide study design and research activities in Paamiut improved the quality of the research, built trust between the researchers and the community, and improved equitable distribution of knowledge and resources. Nurturing a collaborative relationship between community-based and international research partners allowed us to carry out research tasks in a way that was respectful of existing cultural norms in Paamiut, and co-construct knowledge that reflected Kalaallit worldviews. Using existing community social networks and resources improved participant recruitment, community input, and dissemination in Paamiut. For example, participant recruitment in Paamiut was easier compared to recruitment in Nuuk because our community research partner had existing trust in the community and understood social connections that were relevant to our study objectives. Second, participants in Paamiut openly expressed their gratitude for our efforts to include them in research discussions and deliver results directly to the community. They contrasted this practice against their past interactions with researchers, reporting that they had not previously been compensated for their participation in research nor contacted with study results. Consistently showing up in the community, both physically and emotionally, allowed us to build potential for additional research projects in Paamiut. Although study participants represented a small part of the community, we anticipated that the findings reflected broader community experiences of fertility and reproductive health within changing environmental conditions in Paamiut. Using CBPR principles allowed us to engage community members in discussions to validate that the findings reflected their lived experiences, and to assess how they would like research findings translated into political action.

Limitations exist to successfully guiding research with CBPR principles in Greenland. We observed a need for guidelines for ethical research that reflect Kalaallit values and better institutional capabilities to facilitate a smooth transfer of funding and resources between Greenland and the United States. The lack of clear, Kalaallit-defined best practices for ethical research limits the ability for research teams and community members to establish a shared understanding of truly participatory research. In absence of institutional structures to regulate ethical research in Greenland, there are few options for communities to redirect 'helicopter' styles of research via institutional accountability. For example, climate change research led with Western cultural bias and using methods that limit researcher integration into communities may risk mischaracterizing empowered and innovative attitudes about climate change as uneducated or uncaring (141). Extractive research practices that create physical or social disturbance can deteriorate trust between community members and research institutions, and exploit systems of inequity that permit researchers from wealthy nations to arrive to Arctic Indigenous spaces without invitation or reciprocity. However, the recent publication of the National Strategy for Research in Greenland and the current movement to establish ethical research guidelines may improve CBPR opportunities in Greenland, and reduce research fatigue (142).

There were numerous characteristics of 'true' CBPR methods that we were not able to adhere to in this study. For example, we did not have resources to consult the community in defining their research priorities prior to the start of the study. However, Paamiut was explicitly selected as a research site because of AR's interest in participatory reproductive health research, and while an individual cannot represent the entire community, her invitation was critical to initiating a respectful research relationship attentive to local needs. True CBPR requires the

creation of a Community Advisory Board (CAB) for consultation on research activities. While we did not have established relationships, time, or funding to form a CAB, we were able to meet community members who are excellent candidates for future CBPR in Paamiut. Our experience demonstrates that CBPR principles can be applied at varying scales to improve equity and representation amidst international research efforts in climate science, sustainable development, health, and other disciplines in Greenland.

Table 3. Actions to guide research activities using community based participatory research principles in Greenland

CBPR[a] core principles[b]	Supporting actions employed in Paamiut
Recognize community as unit of identity.	• Identify Paamiut as a physical space with emotional connections and relations between community members and nature. • Distinguish identity terms including *Kalaallit* (Inuit of Greenland), *Greenlandic* (a person from Greenland), *Paamiormioq* (a person from Paamiut), and *Nuummioq* (a person from Nuuk). • Discuss characteristics that distinguish Paamiut from other Greenlandic towns, including the history of the fishing industry, and significant local arts, songs, and cultural events.
Build on strengths and resources within the community.	• Use existing social networks for participant recruitment by consulting community research partners and community leaders at the school, fish factory, young adult learning center, health center, and municipal center. • Base research activities from the local museum, a familiar public location. • Respond to participant and community member recommendations for research activities by explaining research objectives and asking for input. • Include social connectivity and resource networks into data collection, analysis, and policy recommendations. For example, build upon resources of the young adult learning center, and engage healthcare workers who understand local reproductive health challenges. • Build trust through proximate community relationships and presence at community events, such as *kaffemik* (Greenlandic party tradition), local concerts, and sports events.

Table 3 Continued.

CBPR[a] core principles[b]	Supporting actions employed in Paamiut
Facilitate collaborative, equitable partnership in all research phases and involve an empowering and power-sharing process that attends to social inequalities.	• Include community research partners in instrument design, data collection, analysis, and dissemination through iterative, cyclical discussions. • Distribute financial and intellectual capital equitably in the community and between co-researchers by paying partners for all contributions, hiring local services whenever possible, providing education about the research process in available venues, and compensating study participants for their time. • Consult community research partners in all project decisions and communications using email, personal messenger, and in-person meetings. • Advocate for equal inclusion of community research partners in professional publications and dedicate funding to support travel to scientific conferences.
Promote co-learning and capacity building among all partners.	• Collaborate on difficult research tasks, communicate challenges that arise, and brainstorm solutions between all partners. Avoid single researcher decisions for expediency. • Apply equal value to Indigenous knowledge and Western scientific perspectives to explore epistemological differences that may affect research activities. • Select theoretical and methodological frameworks that integrate Kalaallit and Western standpoint or exclusively use Indigenous methodologies. • Engage community members in research discussions and present study objectives throughout community venues to build trust, transparency, and opportunities for co-learning. • Inquire about past community experiences of research and identify how to replicate positive experiences and avoid harmful practices.

Table 3 Continued.

CBPR[a] core principles[b]	Supporting actions employed in Paamiut
Integrate and achieve a balance between research and action for the mutual benefit of all partners.	• Translate findings into actionable policy options and seek feedback from participants and other community members. Engage community leaders at the fish factory, school, municipal center, and other establishments in discussions about policy needs. • Disseminate findings to policymakers and key stakeholders in national government and professional scientific organizations and directly ask how findings will integrate into policy priorities. • Consult community members on their visions for future research priorities and follow through with continued communication by explaining who you communicate with, what is discussed, and what policy changes can be expected.
Emphasize public health problems of local relevance and ecological perspectives that attend to the multiple determinants of health and disease.	• Select study objectives and questions that align with researcher expertise and address the expressed interests of Paamiut community members. For example, as community priorities extend from reproductive health needs to development needs, elicit nominations for Kalaallit professionals with expertise in development. • Dedicate time to consulting with community research partners on the range of local health needs they perceive, what has been done to address local health issues in the past, and what they would like to see addressed in the short-term and long-term. • Identify study objectives that target multiple community priorities by exploring underlying drivers of health, environmental, and economic challenges. • Adjust questions and activities as needed throughout the study by iteratively presenting research progress and eliciting community member feedback.

Table 3 Continued.

CBPR[a] core principles[b]	Supporting actions employed in Paamiut
Involve systems development through a cyclical and iterative process.	• Engage in frequent and iterative discussions with research partners and community members about community needs, problem definition, data collection, interpretation, and policy options. • Maintain frequent professional communications, such as through email and meetings, as well as personal communications, such as through social media messaging and engagement. Create multiple opportunities for community members to communicate with research partners who are outsiders.
Disseminate findings and knowledge gained to all partners and involve all partners in the dissemination process	• Present findings in a simple and clear format with relatable concepts. Use local Kalaallisut language in all communications and provide materials in Danish by request. • Distribute research findings individually with written and oral explanations by meeting directly with community members. • Distribute findings through all community establishments to seek feedback and validate relevance. • Ensure that original study participants receive research findings, understand how interviews were used, and can provide feedback. • Deliver materials with study results to community leaders for discretionary distribution. • Ensure that community research partners are included in professional scientific communications, conferences, and publications.

Table 3 Continued.

CBPR[a] core principles[b]	Supporting actions employed in Paamiut
Long term process and commitment to sustainability	• Be transparent about interest and logistics of future research in Paamiut based on human resources realistic timelines. • Openly discuss the goals of CBPR and identify community members who are interested in participating in future research activities, especially as an education opportunity among young adults. • Discuss funding opportunities for future research with all community partners and explain resource or personnel limitations, and options for institutional support in Greenland.
Address issues of race, ethnicity, racism, and social class and embrace "cultural humility".	• Define the contextual realities of social structures and inequities that the research will occur in, including colonization and racism, privileging of Western culture over Kalaallit culture, hierarchal decision-making imposed onto Kalaallit communities, and wealth disparities between international research institutions and local communities. • Establish open communication about individual positionality and life experiences that affect research approaches and world views. Explicate experiences of personal gain or loss due to systems of oppression. • Communicate about conflicts that arise that may be influenced by cultural incongruities and be open to learning from one another. • Practice cultural humility throughout all research activities by dedicating time to learn Kalaallit culture, and redressing power imbalances between research partners. • Assume positive intentions of all research partners and colleagues but allow for respectful corrective discussions if microaggressions are identified in professional research spaces.

[a]Abbreviations: CBPR=Community based participatory research. [b]CBPR principles may vary between research contexts and collaboratives. The CBPR core principles listed in this table and used in our study are defined by Israel et. al. 2008 (see reference 139).

CHAPTER SIX

LESSONS LEARNED AND STRATEGIES FOR FUTURE RESEARCH INVOLVING HEALTH AND CLIMATE ADAPTATION POLICY IN GREENLAND

Purpose

The purpose of this chapter is to outline some of the challenges encountered and helpful lessons learned throughout this study in Greenland. This chapter is non-exhaustive but may provide helpful information for future American scholars participating in similar research in Greenland.

Locating Policy Documents

For the duration of this study, the website of Naalakkersuisut was inaccessible due to a hacking event. This meant that formal government reports detailing specific policies related to fertility and reproductive health were unavailable. Accordingly, accessing specific documents related to fertility and reproductive health policy as well as climate adaptation policy necessitated using citations from peer-reviewed research, as well as reports via the Centre for Public Health Research in Greenland and some outdated pdf documents available through general web searches. This is a major limitation to specifying policies of interest throughout the study. Since October of 2023, the Naalakkersuisut website has gradually reintegrated web pages for each department and has reissued press releases. Hopefully formal policy documents will continue to be issued on the government website. If they are not, I suggest directly contacting

researchers at the Centre for Public Health Research in Greenland for their personal copies of policies and procedures documents.

Second, documents available are typically in Danish and Kalaallisut. Using Google Translate can help to navigate websites, and in most cases, documents can be downloaded in Danish and uploaded to Google Translate for an English version.

Navigating Non-Peer-Reviewed Research

It was my experience that, frequently, epidemiological reviews engaging fertility and reproductive health outcomes in Greenland were not peer-reviewed and may not use statistical methods that would be considered rigorous and accurate by contemporary academic standards. This limited the inclusion of some available research in this dissertation study on the basis of the credibility of the research. This was relevant for several studies that presented statistics of abortions, a syphilis outbreak, and maternal health outcomes. This is an area of improvement that will continue to be addressed in Greenland, particularly through the increasingly robust work of the Centre for Public Health Research.

Engaging with Press

This study's investigation of abortion and contraceptive trust was of heightened interest to the greater public in Greenland. There has been little research that has specifically addressed the high abortion rates in Greenland, which leads to public speculation and curiosity. Additionally, during the timeframe of this study, details of the *spial* scandal came to light via independent journalism and two subsequent investigations were initiated from Naalakkersuisut and the Danish government. Based on these circumstances, this study attracted attention from

journalists at the national newspaper Sermitsiaq, and the Arctic Hub. After giving an interview, AR and MP quickly realized that many of our findings were omitted from subsequent press. Articles almost exclusively used parts of the interview that related to abortion and cast the outcomes in Paamiut in a negative light. This was very concerning for several reasons. First, we felt that it misrepresented the purpose and findings of the study. Second, we felt that it threatened the integrity of our relationship with the Paamiut community. We assumed an ethical responsibility to care for the stories of study participants and reflect them accurately. Third, throughout the course of this study the Supreme Court of the United States overturned *Roe v. Wade*, creating an environment of social scrutiny in any federally funded research that engages abortion. As this study was partially funded by the National Science Foundation, it was important that the research was not mischaracterized as exclusively 'abortion research'. Both articles in Greenland risked incorrectly portraying this expansive study as only focusing on abortion. To care for the study, protect participants, and protect researchers, we suggest only using written communication with press for any research related to sensitive fertility and reproductive health data. When in-person or oral interviews are given to press, it is extremely important to be cautious about how abortion is characterized, as there may be a socio-cultural tendency to discuss it in stigmatizing ways, especially if the journalist is not Greenlandic.

CHAPTER SEVEN

CONCLUSION

General Summary of Results

Results of this study indicate that housing, healthcare, and education are critical policy areas to support fertility and reproductive health for people living in Greenland. Disparate access to education and economic opportunities had impacts to the lifetime fertility decisions between participants in Nuuk and Paamiut. To holistically support fertility decisions and address key reproductive health disparities, policymakers and researchers must look beyond programming that only addresses individual sexual and reproductive health behaviors, and instead target household, community, and economic improvements.

For small communities in Greenland, increasing local ability to address development needs may help to support people in accessing stable and independent housing to support pregnancies and children. Additionally, participants indicated that low trust in healthcare settings and discomfort with hormonal contraceptives influenced their fertility outcomes. Improving cultural education for visiting healthcare workers and addressing issues of healthcare mistrust may positively support fertility and reproductive health outcomes in Greenland.

People in this study report positive outlooks on Greenland's ability to adapt as climate change impacts the physical environment and natural resources. Nonetheless, climate threats that disrupt resource-dependent economies in small coastal communities may exacerbate existing socioeconomic disparities that directly affect fertility decisions. Improving health equity

throughout Greenland will reduce climate vulnerability and support future generations of children and parents.

Guiding the study with CBPR principles improved community engagement, dissemination, discussions about future research opportunities, and trust and equity between American and Kalaallit researchers. Future health and socioecological studies can improve trust and equity in research located in Greenland by engaging communities as partners in research and adapting CBPR methodologies to fit the Greenlandic context.

Policy recommendations for leaders in Greenland are listed in **Table 4.**

Table 4. Implications and recommendations for policy in Greenland

Policy domain	Description
Health, Education, Housing	Improving housing and expanding educational opportunities is critical to support fertility and reproductive health for young people, especially in smaller communities in Greenland. Coordination of housing, education, and health policy may help to streamline actions that directly influence fertility and reproductive health outcomes.
Health, Education	Expanding the midwife workforce, educational options in midwifery, and improving resources for midwives may directly support fertility and reproductive health outcomes in Greenland.
Housing, Development, Financing	Small development projects, such as building playgrounds and expanding activity options for young people, may support young parents and people who become pregnant.
Health	Cultural education for visiting healthcare providers may help improve communication and trust between pregnant patients to ensure their needs are understood and addressed appropriately.

Key Messages

- Fertility and reproductive health in Greenland is influenced by the level of development in different communities.
- Stable housing, access to education, employment opportunities, and trust for healthcare contributed to decisions of when to have a child, when to have an abortion, and ability to support a child.
- Policies to support fertility and reproductive health must address material resources and social support that affect a family's wellbeing, in addition to supporting individual health behaviors and sexual health education.
- Empowering communities to determine local development can support family housing needs, expand activity options for young people, and promote trust between citizens and government.

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APPENDICES

APPENDIX A

KEY STAKEHOLDER/POLICYMAKER INTERVIEW GUIDE

Key Stakeholder/Policymaker Interview Guide

Fertility and reproductive health behaviors and outcomes in response to climate change and climate adaptation policy in Greenland

Date:

Participant number:

Participant Name, Age, Gender:

Section 1: General information

1. What do you do for work?
2. Where are you from?
3. How long have you lived in [Nuuk, Copenhagen, Paamiut]?
4. Tell me about who you are outside of work.

Section 2: Living in Greenland

1. What are things you like about living in [Nuuk, Paamiut]?
2. What are some of the challenges to living in [Nuuk, Paamiut]?
3. What do people do for a living in [Nuuk, Paamiut]?
4. What will [Nuuk, Paamiut] be like in 10 years? What changes do you see happening here?
5. What issues do you think will be most important for people living in [Nuuk, Paamiut] in 10 years?

6. What would you say are the priorities of the Government of Greenland at this time? [Economic, health, development].
7. What are the priorities of the local government of [Paamiut, Nuuk] at this time?
8. What trends, if any, do you see in the way people move into, out of, or around Greenland?

Section 3: Climate change and climate adaptation

1. How do you think climate change will affect Greenland in the future? [Health, economic, agriculture, food security, environmental]?
2. What are Greenlanders' attitudes about climate change?
3. Are there ways that attitudes about climate change differ between men and women?
4. What do you think about the way the Government of Greenland has responded to climate change so far?
5. Do you think climate change has affected [Nuuk, Paamiut]? If so, how?
6. In what ways are you or your agency preparing for climate change in your work?
7. Among the challenges you face as a professional, can you describe the relative importance of climate change? How much of a priority is this issue for your organization?
8. Does your organization have plans to facilitate adaptation to climate change?
9. Are there groups of people in your community that are more vulnerable to climate change impacts? [flooding, severe weather, food insecurity]? If so please describe these groups [women, children, elderly].

Section 4: Hunting policy

1. How would you describe hunting policy in Greenland?
2. What does hunting mean to Greenlanders?
3. How do people in [Nuuk, Paamiut] practice hunting?
4. Where do people in [Nuuk, Paamiut] go to hunt?
5. What role does hunting play in household economy for Greenlanders?
6. What role does hunting play in family relationships and community relationships for Greenlanders?
7. How does hunting affect women in [Nuuk, Paamiut, Greenland]?
8. What are ways that hunting differs between outer settlements and cities?
9. How has hunting in [Paamiut, Nuuk] been affected by modernization?
10. How has hunting in [Paamiut, Nuuk] been affected by climate change?
11. Who are the agencies, groups, or people responsible for making decisions about hunting in [Nuuk, Paamiut, Greenland]?
12. What are the main considerations that guide hunting regulations and decisions in Greenland? And in [Nuuk, Paamiut]?
13. How are hunting quotas determined in [Nuuk, Paamiut, Greenland]
14. How are the needs of Greenlanders considered in hunting regulations?
15. How has the licensing system affected hunting in Greenland?
16. How did redrawing the municipalities in 2009 affect hunters in [Nuuk, Paamiut, Greenland]?

17. What relationships do you see between hunting, identity, and mental health for Greenlanders?
18. What is your opinion on hunting tourism in Greenland?
19. How do you think hunting policy might change in the next 10 years?

Section 5: Fisheries policy

1. How would you describe fisheries policy in Greenland?
2. How do fisheries affect daily life for Greenlanders?
3. What role do fisheries play in household economy and food for people in [Nuuk, Paamiut]?
4. How do fisheries impact the community in [Nuuk, Paamiut]?
5. In what ways have fisheries in [Paamiut, Nuuk] been affected by modernization?
6. In what ways have fisheries in [Paamiut, Nuuk] been affected by climate change?
7. Who are the agencies, groups, or people responsible for making decisions about fisheries in [Nuuk, Paamiut, Greenland]?
8. What are the main considerations that guide fisheries regulations and decisions in Greenland? And in [Nuuk, Paamiut]?
9. How are fishing/seafood harvest quotas determined in [Nuuk, Paamiut, Greenland]?
10. How are the needs of Greenlanders considered in fisheries policy?
11. What relationships do you see between fisheries and identity for Greenlanders?
12. What are the most important issues for fisheries in [Nuuk, Paamiut, Greenland] right now?

13. How do you think fisheries policy might change in the next 10 years?

For both hunting and fishing experts:

1. In your professional opinion, what are the priorities of the (formerly Ministry of Hunting and Fisheries, now the Department of Fisheries and Catching) at this time?
2. Do you see any connections between hunting and fishing and choices about having children for Greenlanders?

Section 4: Fertility choices & healthcare

1. How do people in Greenland make decisions about fertility [having a child, not having a child, adopting a child, abortion]?
2. Are there differences between fertility decisions in the outer settlements and fertility decisions in the cities?
3. What kind of place is [Nuuk, Paamiut] like to have children and raise a family?
4. What is healthcare like in [Nuuk, Paamiut, Greenland]?
5. How do people get birth control, condoms, and other contraception in [Nuuk, Paamiut]?
6. What kinds of sexual and reproductive services are available to people living in [Nuuk, Paamiut]?
7. What are some things that influence a family's choice to have a child in Greenland? And in [Nuuk, Paamiut]?
8. What are some things that influence a family's choice to have an abortion in Greenland? And in [Nuuk, Paamiut]?

9. What is the process of labor and delivery like in [Nuuk, Paamiut]?
10. What are the priorities for your agency right now?
11. When providing sexual and reproductive health services, what are strengths of healthcare system in [Nuuk, Paamiut, Greenland]?
12. When providing sexual and reproductive health services, what are the weaknesses of the healthcare system in [Nuuk, Paamiut, Greenland]?
13. In your professional experience, what are the most important things that Greenlanders need to have healthy pregnancies and raise healthy children?
14. Do you see any ways that climate change might influence Greenlanders' fertility choices or their ability to raise healthy families?

Section 6: Conclusion

1. What is your dream for the future of [Nuuk, Paamiut, Greenland]?
2. Is there anything else I should know about before we conclude this interview?

APPENDIX B

INDIVIDUAL MALE/FEMALE INTERVIEW GUIDE

Individual Male/Female Interview Guide

Fertility and reproductive health behaviors and outcomes in response to climate change and climate adaptation policy in Greenland

Participant number:

Participant gender:

Date:

Section 1: General information

1. How old are you?
2. Where do you live?
3. Who do you live with?
4. How many children do you have?
5. Describe your education?

Section 2: Living in Greenland

1. What are things you like about living in [Nuuk, Paamiut]?
2. What are some of the challenges to living in [Nuuk, Paamiut]?
3. What will [Nuuk, Paamiut] be like in 10 years? What changes do you see happening here?
4. What are important issues that people talk about a lot in [Nuuk, Paamiut]?
5. What would you say are the priorities of the Government of Greenland at this time? [Economic, health, development].

6. What are the priorities of the local government of [Paamiut, Nuuk] at this time?

Section 3: Work

1. What do you do for work?
2. What kinds of things do people in [Nuuk, Paamiut] do for a living?
3. What is your opinion about the economics in [Nuuk, Paamiut]?
4. How does your work influence your time with your family and children?
5. What kind of work/livelihoods options will there be in [Nuuk, Paamiut] in 10 years?

Section 4: Fertility choices

1. What kind of place is [Nuuk, Paamiut] like to raise children?
2. How does the community of [Nuuk, Paamiut] influence your emotions about your family and children or how you think about having a family?
3. What are some things that influence a family's choice to have a child in [Nuuk, Paamiut]?
4. Thinking about the rest of the country, what are some things that influence a family's choice to have an abortion in Greenland? And in [Nuuk, Paamiut]?
5. What are some resources in [Nuuk, Paamiut] that you use to raise healthy children, [such as daycare, grandparents, nature]?
6. What is your relationship like with your partner?
7. How many children did/do you want to have?
8. What are the ages are your children?
9. Do you or your husband want more kids?

For men

10. What things did you consider when you decided to have a family?
11. What was your wife/partner's experience of pregnancy like?
12. What was your partner's pregnancy like for you?

For women

10. What things did you consider when you decided to have a family?
11. What was your pregnancy like? [physically, emotionally]
12. What was it like for your husband/partner?

Section 5: Healthcare

1. What is healthcare like in [Nuuk, Paamiut]?
2. What kinds of sexual and reproductive services are available to people living in [Nuuk, Paamiut]?
3. How does the process of labor and delivery work in [Nuuk, Paamiut]?
4. What are the most important for people in [Nuuk, Paamiut] in order to have a healthy pregnancy?

Section 6: Natural environment

1. What parts of nature around [Nuuk, Paamiut] are important to you?
2. What did you learn about nature from your parents/grandparents/family?
3. How does nature around [Nuuk, Paamiut] influence your emotions?
4. What changes have you seen in nature in [Nuuk, Paamiut]?

5. How have these changes influenced your way of life?
6. How have changes you have seen in nature over time influence how you feel/think about having a family?

Section 7: Climate change

1. How do you think climate change will affect Greenland in the future? [Health, economic, agriculture, food security, environmental]?
2. Do you think climate change has affected [Nuuk, Paamiut]? If so, how?
3. What are people's attitudes about climate change in [Nuuk, Paamiut]?
4. Has climate change affected your family personally?

Section 8: Hunting - choice

1. What does hunting mean in your life?
2. What does hunting mean to Greenlanders?
3. What do people in [Nuuk, Paamiut] hunt?
4. Where do people in [Nuuk, Paamiut] go to hunt?
5. What role does hunting play in your family relationships and community relationships?
6. How does hunting affect women in [Nuuk, Paamiut, Greenland]?
7. In what ways has hunting changed in your lifetime?
8. Who are the agencies, groups, or people responsible for making decisions about hunting in [Nuuk, Paamiut, Greenland]?
9. What is your opinion on the quota system in Greenland?

10. How has the licensing system affected hunting in Greenland?
11. What is your opinion about how these decisions are made?
12. How does hunting (or being married to a hunter) influence your feelings about yourself?
13. What is your opinion on hunting tourism in Greenland?
14. What do you think hunting will be like in [Nuuk, Paamiut] in 10 years?

Section 9: Fisheries

1. How do fisheries affect daily life for people in [Nuuk, Paamiut]?
2. What role do fisheries play in household economy and food for people in [Nuuk, Paamiut]?
3. How do fisheries impact the community in [Nuuk, Paamiut]?
4. How have fisheries in [Greenland, Paamiut, Nuuk] been affected by modernization?
5. Do you think fisheries in [Paamiut, Nuuk] been affected by climate change?
6. Who are the agencies, groups, or people responsible for making decisions about fisheries in [Nuuk, Paamiut, Greenland]?
7. What is your opinion on fishing quotas?
8. How do fisheries and fishing influence your feelings and decisions about family?
9. What do you think fishing will be like in [Nuuk, Paamiut] in 10 years?

Section 10: Conclusion

1. What is your dream for the future of [Nuuk, Paamiut, Greenland]?
2. What do you hope for your children as they grow up in [Nuuk, Paamiut]?

3. Is there anything else I should know about before we conclude this interview?