THE CENTER FOR ALASKA NATIVE HEALTH RESEARCH STUDY: A COMMUNITY-BASED PARTICIPATORY RESEARCH STUDY OF OBESITY AND CHRONIC DISEASE-RELATED PROTECTIVE AND RISK FACTORS

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ABSTRACT

Objectives. To describe the background, approach and general results of the Center for Alaska Native Health Research (CANHR) study.
Study Design. This was a cross-sectional Community-Based Participatory Research (CBPR) study with one tribal group to assess risk and protection for obesity and the risk factors related to chronic disease, diabetes and cardiovascular disease.
Methods. A combination of biological, genetic, nutritional and psychosocial measurements were taken on 922 Alaska Native participants in ten communities in Southwestern Alaska. The paper reports on data from 753 adult participants.
Results. The prevalence of type 2 diabetes is 3.3% in the sample population. Metabolic syndrome is significantly lower among the males and equal for females when compared with Caucasians in the NHANES III sample. Obesity among adults is now at the national average. Risk factors for chronic disease include a shift to a Westernized diet, stress, obesity and impaired fasting glucose and protective factors include high levels of polyunsaturated fatty acid dietary intake. Articles in this issue present specific results in these areas.
Conclusions. The data strongly indicate that, in general, Yup'ik people in our study are metabolically healthy and that diet and life style provide a delicate combination of protective and risk factors. The results strongly indicate that solution focused research (1) utilizing primary and secondary prevention strategies may provide evidence for how to intervene to prevent further increases of chronic diseases. Research that focuses on relating the intrinsic strengths of indigenous worldviews and practices with basic research may contribute to positive transformations in community health.
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Keywords: Alaska Native health, health disparities, obesity, diabetes, metabolic syndrome, Yup'ik Eskimo

INTRODUCTION

The prevalence of obesity and type 2 diabetes mellitus (T2DM) has increased dramatically among Alaska Natives over the past several decades (2-5). Indeed, Alaska Natives have experienced a roughly 56% greater increase in the prevalence of T2DM compared with Native Americans in the lower 48 states (6). Within Alaska, there are substantial regional and ethnic differences in the prevalence of T2DM; prevalence estimates range from 0.8 to 150.8 per 1000 individuals based on a number of independent research studies. Although the prevalence of T2DM among Alaska Natives is still relatively low compared with national estimates, the increase is of considerable concern. It is unknown whether T2DM will develop into an epidemic as observed among many Native American groups. It has been hypothesized that the traditional Alaska Native lifestyle may serve to protect against the development of T2DM, which may explain its low prevalence. However, a shift in lifestyle over the past decade has altered the current Alaska Native environment, which may contribute to an increase in susceptibility.

The Alaska Native culture in the Yukon Kuskokwim Delta region in Southwest Alaska is considered among the most intact of all the indigenous groups in the state. As an example, Yup'ik, the region's indigenous language, is still the first language learned by most of the population in these rural communities. The population continues to engage in subsistence practices to generate much of their food. There are, therefore, many benefits to working in this region where we can learn about the potential power of cultural factors as influencing the protection from, or risk for, developing a chronic disease. Such knowledge is important for understanding

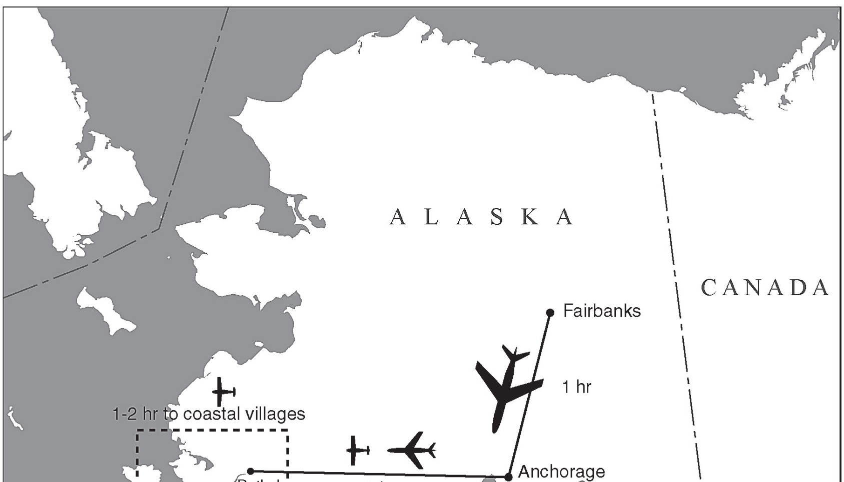

Figure 1. Map of CANHR research area.

how to improve the health status of indigenous communities.

The Center for Alaska Native Research was established to study obesity as a risk factor for chronic diseases, particularly T2DM and cardiovascular disease, on which research and prevention activities can occur. In this article, we report on the background, approach and general results of three interdependent studies supported by CANHR, which together are known as the CANHR study.

MATERIAL AND METHODS

The CANHR study. The University of Alaska Fairbanks established the Center for Alaska Native Health Research (CANHR) through the funding mechanism of the Centers of Biomedical Research Excellence (COBRE) at the National Center for Research Resources of the National Institutes of Health. The research theme is focused on obesity as a risk factor for chronic diseases, particularly T2DM and cardiovascular disease, among Yup'ik Eskimos. To address the obesity theme, three interdependent research projects were conducted in communities in Southwestern Alaska. The three projects focused respectively on genetic (Boyer, Project Principal Investigator), nutritional (Luick, Project Principal Investigator), and cultural-behavioral (Lardon, Project Principal Investigator) factors to understand the development of obesity and chronic disease-related risk factors. After being informed about the study, those interested in enrolling were asked to complete and sign an informed consent form. The studies were approved by the University of Alaska Institutional Review Board (IRB), Alaska Area IRB, National Indian Health Service IRB, and the Yukon-Kuskokwim Health Corporation Human Studies Committee.

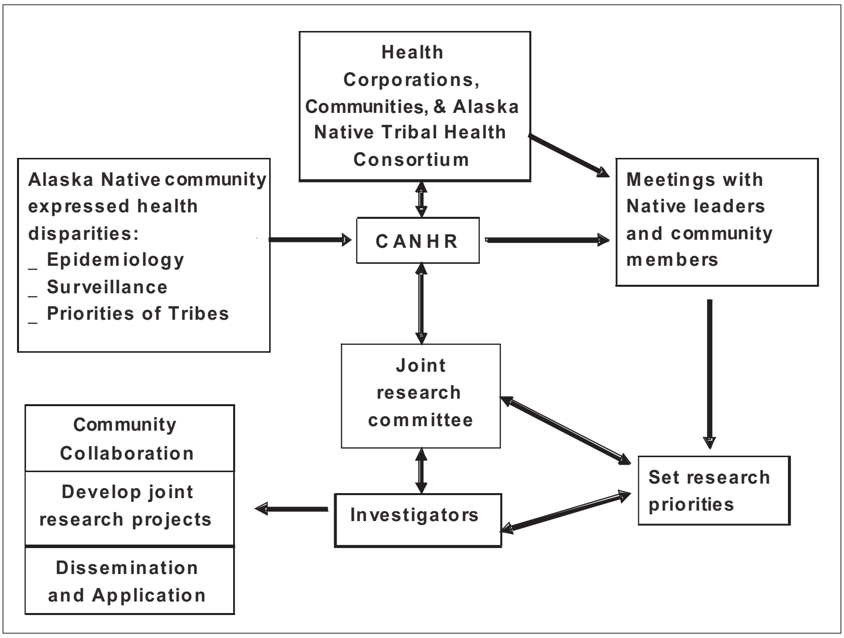

Figure 2. CANHR collaborative/participatory model.

The Community-Based Participatory Research (CBPR) approach. Initiating our research involved a series of stages designed to ensure that our work followed a community-based participatory research paradigm.

Figure 2 represents the process used and how we fostered relationships with each community and with the local regional health corporation. Unlike many CBPR approaches, the theme and research question to be addressed were not generated by the community. Rather, we analyzed existing health data on acute and chronic diseases and matched our resources with the apparent emerging health research issues. We then met with the regional medical director and other health corporation executives to determine if our interests resonated with their perception of regional health research needs. We eventually agreed upon a set of research goals, identified potential communities, and an approach for participation and control of the research process involving the communities and the health corporation. At this point, the health corporation embraced the study provided that the communities were willing and interested in participating and that they were involved in all aspects of the research. We spent 18 more months building relationships with the communities, asking permissions from the communities, piloting our instruments and gaining IRB permission prior to gathering any data (7).

Sample Selection. The cross-sectional study was designed to achieve a representative sample of 1000 participants through a number of strategies. First, communities were identified through a nominative process led by leaders of the local tribal health corporation. We then selected communities based upon stratifying on a set of demographic and cultural variables including location (coastal or interior) and population. Second, we randomly sampled households in each participating community. We visited each of these households and invited residents 14 years of age or older to participate. We were also advised by the community leaders that we should invite all eligible community members to participate. We did this by using community-wide recruitment strategies that included announcements over the local radio and television stations, local newspapers, community meetings, posters and brochures. Third, we re-visited several of the communities with adequate size in order to increase participation of family members for the genetics study. We visited three communities a second time, doubling the number of participants in these communities. Fourth, we added three new communities to our group. We have now worked with ten rural communities and have exceeded our goal of 1000 participants.

RESULTS

The purpose of our summary of results is to 1) provide the reader of the supplement with an overall picture of our results on risk and protective factors studied, 2) note papers that present results from subprojects of our study; and 3) discuss the implications of our work for future research. This paper presents results from an interim analysis of our data indicating that this ethnic group seems to evolve in a similar way as other populations within the U.S. regarding overweight/obesity and T2DM, as also observed by Carter et al (8). To take into consideration that this paper presents interim results, we will also present 95%

confidence intervals (95% CI) for prevalence estimates. We will compare some of our data with data from the National Health and Nutrition Examination (NHANES) III (9).

Sample. To date, 922 people, ≥14 years of age, are enrolled in the CANHR study. We have complete data from 753 Alaska Native adult participants (non-pregnant) and are continuing to collect data on the enrolled participants. Data were analyzed from the 753 Alaska Native people ≥18 years; 403 (54%) are women and 350 (47%) are men (binomial test, 2P=0.06). Most of them (741, 98%) are of Yup'ik (702, 93%) or Cup'ik (39, 5%) origin, and 12 (2%) characterize themselves as Alaska Native without Yup'ik or Cup'ik ethnic background, including Aleut, Alutiq and Inupiaq. It is well known (10) that the prevalence of T2DM varies among different Alaska Native tribes, the highest being among the Aleut and the Tlingit, and lowest among Eskimo groups. Since only 2% of the CANHR participants are not Yup'ik or Cup'ik, we have included all tribal groups in our analysis, with the exception of the metabolic syndrome analysis. For this analysis, only participants with Yup'ik or Cup'ik ancestry were included, if they fasted at least eight hours, and had all data for the five components defining metabolic syndrome based on the Adult Treatment Panel III (ATP III) criteria (n=710).

Overweight/Obesity. Even though this ethnic group still relies on subsistence living and eats a mixture of traditional as well as Western foods, the prevalence of overweight and obesity is similar to that seen in the lower 48 states. Of the 753 participants, 64.5% are overweight or obese (CI 95%: 60.9-67.9), and 32% (CI 95%: 28.8-35.7) are obese. The average BMI is 28.1 and comparable to the BMI estimate of the NHANES III population, which is 27.0. Yup'ik women were significantly shorter than men. However, women were significantly more overweight (mean BMI 29.7) than men (mean of 26.1). Women also had a significantly larger waist circumference than men. Table I presents the data for obesity for the entire adult CANHR sample.

Metabolic Syndrome. We determined whether participants had metabolic syndrome according to the ATP III criteria (11). The age adjusted prevalence of metabolic syndrome in our Yup'ik Eskimo study cohort (n=710) was 16.2% (age adjustment based on the U.S. census 2000 population, direct method; CI 95%: 13.6-19.1), and varied by sex with 9.5%

Table I. Obesity Related Traits in the CANHR Sample.

		CANHR			
	NHANES III	Total	Females	Males	
n	10,483	753	403	350	
Measurement	Mean±SD	Mean±SD	Mean±SD	Mean±SD	*p value
Height (cm)	166.4±10.0	161.0±8.9	155.6±6.4	167.1±7.4	≤ 0.001
Weight (kg)	74.7±18.0	72.6±15.6	72.0±17.1	73.2±13.6	0.068
BMI (kg/m^2)	27.0±5.8	28.1±6.1	29.7±6.9	26.1±4.2	≤ 0.001
Percentage Body Fat (%)**	not available	29.6±10.8	36.4±8.8	21.9±7.1	≤ 0.001
Waist circumference (cm)	92.4±14.5	91.6±14.3	93.0±15.8	90.1±12.1	0.02

* Mann Whitney test for sex difference within the CANHR sample
** Applied method: bioelectric impedance analysis (BIA)

(CI 95%: 6.5-13.2) of the men and 20.0% (CI 95%: 16.2-24.5) of the women having metabolic syndrome. By comparison, using the new International Diabetes Foundation and South Asian/Chinese waist circumference criteria (12), the age adjusted prevalence of metabolic syndrome increased slightly to 17.9% (10.8% among men and 22.3% among women). The most common risk factor for metabolic syndrome in Yup'ik Eskimos was large waist circumference. However, it is important to note that our participants have lower rates of metabolic syndrome than white Americans and other minorities.

Type 2 Diabetes Mellitus and Impaired Fasting Glucose. From 735 (97.6%) individuals, we obtained a fasting plasma glucose (i.e., participants fasted at least eight hours) while 18 (2.4%) provided a random blood glucose. We characterized participants as having normal glucose, impaired glucose, or T2DM based on their fasting or random blood glucose as defined by the American Diabetes Association (13), self-reports of T2DM, use of hypoglycemic medication, and medical chart reviews. We use the term "impaired glucose" (IG) for participants having fasting blood glucose values in the range of 100-125 mg/dl or a random glucose in the range 140-199 mg/dl.

Eighteen (CI 95%:2.4%; 1.4-3.8) of the participants had T2DM when entering the study according to their medical records, their self-report, and/or their reported use of medication. In the field, an additional seven participants were determined to potentially have T2DM; all seven provided a fasting sample for blood testing that was greater than or equal to 126 mg/dl, the American Diabetes Association criteria for diabetes. These seven individuals were referred for evaluation. If we include these seven, the overall the prevalence of T2DM was 3.3% (CI 95%: 2.2-4.9)

Table II. Age and Risk Factors for Obesity or Type 2 Diabetes Mellitus (T2DM) among Participants Having Normoglycemia (NG), Impaired Glucose (IG), or T2DM.

Measurement	NG Mean±SE	IG Mean±SE	T2DM Mean±SE
Age (yrs) [1,2]	38 ± 0.7	49 ± 1.2	56 ± 3.1
BMI (kg/m^2) [1,2,3]	27.5 ± 0.25	29.3 ± 0.49	32.5 ± 1.20
Waist Circumference (cm) [1,2,3]	90.2 ± 0.58	95.1 ± 1.11	102.6 ± 2.74
Systolic BP (mmHg) [1]	120.8 ± 0.59	124.5 ± 1.14	127.3 ± 2.82
Diastolic BP (mmHg) [1]	70.5 ± 0.42	74.3 ± 0.81	74.0 ± 2.02
Cholesterol (mg/dL)	219.5 ± 1.78	225.2 ± 3.44	208.6 ± 8.50
HDL (mg/dL) [2]	62.6 ± 0.71	59.7 ± 1.37	52.5 ± 3.39
LDL (mg/dL)	141.0 ± 1.54	145.6 ± 2.97	129.3 ± 7.34
VLDL (mg/dL) [1,2,3]	16.1 ± 0.41	19.9 ± 0.78	26.6 ± 1.96
Triglyceride (mg/dL) [1,2,3]	80.4 ± 2.05	99.5 ± 3.91	132.6 ± 19.80
Insulin (μU/mL) [1]	13.4 ± 0.34	17.9 ± 0.65	N/A
HOMA-IR (μUI *mmol) [1]	3.01 ± 0.09	4.65 ± 0.17	N/A
Fasting Blood Glucose (mg/dL) [1]	89.7 ± 0.45	105.9 ± 0.86	N/A
HbA1c (%) [1,2,3]	5.43 ± 0.02	5.59 ± 0.03	6.79 ± 0.08

*If age was a significant covariate, mean and SE were adjusted for age (ANOVA), and text was printed in bold. Pairwise comparisons (ANOVA, Bonferroni correction, nominal level = 0.05), significant differences between: [1]NG & IG groups, [2]NG & T2DM groups, and [3]IG & T2DM groups.

(age adjusted, according to the total U.S. population, 3.4%) (14). Twenty-four of these participants were of Yup'ik (n=20) or Cup'ik (n=4) origin and one was Inupiat. Of the 25 participants, 16 were women and 9 were men (binomial test, 2P=0.23). Their average age was 56 years (Table II); the youngest individual was 36 and the oldest 84 years old. Three individuals were in their thirties, all of them were women with a high BMI (BMI: 28, 39, and 63). An additional three participants were between 40 and 49 years old. However, most of these participants were in an age range of 50-59 (n=9) or ≥60 years (n=10). All of these participants, except one man, were overweight or obese (mean BMI: 33 [kg/cm^2], range: 21.8-62.7), 15 were obese (BMI ≥30); 18 fell within the parameters for metabolic syndrome according to the ATPIII criteria.

Excluding the 18 diabetic participants and those referred for evaluation from further analyses, we found that the prevalence for impaired glucose (IG) was 20.9% (CI 95%: 18.6-24.7) (n=157; age adjusted, according to the total U.S. population, 22%) (14) according to the guidelines of the American Diabetes Association (13); 571 participants were normoglycemic. Sex distributions did not deviate from the assumption of 50:50 in both groups (Binomial test, Bonferroni corrected α-level of 0.02, nominal level=0.05; IG group: 76 women, 81 men; NG group: 311 women, 260 men). In addition, the gender distribution was not significantly different in both groups (chi-square test, 2p>0,18; 55.1% normoglycemic women vs. 47.8% women with impaired glucose). Normoglycemic (NG) participants were significantly younger than people with IG or T2DM (Table II). Therefore, we adjusted for age when testing for significance of biomarkers among these three groups. Table II provides age-adjusted means when the effect of age was significant (age was not a significant covariate for diastolic blood pressure, very-low-density lipoproteins, triglycerides and HOMA-IR; ANOVA all p>0.05). When comparing the three groups with each other, we corrected for multiple testing applying the Bonferroni correction.

Since the group of diabetic or referred participants is small, we consider differences between this group and the other groups as exploratory results to generate hypotheses. An increase of weight as indicated by BMI and waist circumference is linked to the development of impaired glucose and T2DM. While total cholesterol and LDL-cholesterol do not significantly differ between the three groups, triglycerides significantly increase (on average) in the IG and diabetic participants. HDL-cholesterol values decrease in IG and T2DM individuals, these values are on average higher for the NG (62.6mg/dl) and IG (59.7 mg/dl) groups compared to those values within the NHANES III study population (50.9 mg/dl; secondary statistical analysis in our center) that is similar to the average HDL-cholesterol values in the T2DM group (52.5 mg/dl). However, only the differences between the NG and T2DM group were significant. The average total cholesterol is >200 mg/dl in all three groups (219.5 vs. 225.2 vs. 208.6) and appears to be due, in part, to fairly high HDL-cholesterol values. These data may indicate the positive effect of subsistence foods that in these communities mainly consists of fish and marine mammals that are high in polyunsaturated fatty acids.

Very-low-density lipoprotein values significantly increase within the IG and T2DM groups. Similarly, HbA1C levels significantly increase in these two groups.

Nutrition and physical activity among CANHR sample. Diet and physical activity were assessed in seven communities. A single 24-hour dietary recall was collected from 576 participants and a subset (n=282) completed a three-day diet record and wore pedometers for two to three days. Bersamin et al, in this supplement, present results on the dietary shift toward Westernized diet.

Yup'ik understanding of wellness. The cultural-behavioral project of CANHR had four goals: (1) to document a Yup'ik cultural conceptualization of health and wellness; (2) to develop, test, and validate a measure of health and wellness based on Yup'ik cultural values and beliefs; (3) to examine the relationships between cultural-behavioral health, nutrition, and weight in a Yup'ik sample; and (4) to evaluate a community-based health promotion program in one Yup'ik community. Wolsko et al, in this supplement, describes the results for the study of stress, wellness and health outcomes. Participants in our focus groups, and other people in our participating communities with whom we talked, repeatedly mentioned stress as a factor impacting their well-being.

Wellness and health promotion: A model for preventive interventions. Lardon has designed and implemented a community-based health promotion project (Piciryaratggun Calritllerkaq, or Healthy Living through a Healthy Lifestyle) targeted at increasing behaviors related to cardiovascular health (nutrition, physical activity, and stress) in one of the Yup'ik Eskimo communities included in the CANHR study. The project has been developed in collaboration with the host community and the regional tribal health corporation. The long-term goal is to develop this project into a model for conducting health promotion in the region. The community and Lardon, as co-researchers, hypothesized that a culturally-based community-development approach to health promotion will increase physical activity, increase consumption of subsistence foods and/or healthy substitutes, and decrease stress levels. Changes in these behaviors and participants' sense of well-being are expected to be related to an increase in protective blood lipid factors, healthy weight, and healthy blood pressure. The project will examine the specific ways in which this approach to cardiovascular health can develop a local infrastructure, knowledge base, and process to encourage and maintain lasting lifestyle improvements.

Piciryaratggun Calritllerkaq has utilized a CBPR process of engaging members of the community in identifying the health issues to focus on and in setting goals for health promotion. A recent comprehensive review of the CBPR literature identified co-learning by both researchers and community collaborators, sharing in decision making, and mutual ownership as central concepts of CBPR (15). Tribal Participatory Research, a model of CBPR developed specifically for working with American Indian and Alaska Native communities also emphasizes tribal oversight, the use of culturally specific assessment and intervention methods, and the importance of training and employing community members as staff. For Piciryaratggun Calritllerkaq, these concepts have been integrated into three core elements: (1) building infrastructure for health promotion, (2) developing local expertise in health promotion and community change, and (3) developing a process that combines elements of strategic planning, program evaluation, and health education with traditional Yup'ik health practices and leadership styles. The effectiveness of Piciryaratggun Calritllerkaq will be examined at six-month intervals to control for seasonal variations in the subsistence lifestyle of the host community. Lardon has submitted a National Institutes of Health research grant application to seek continued funding for Piciryaratggun Calritllerkaq.

DISCUSSION

In summary, the CANHR study has found that although the prevalence of both T2DM and the metabolic syndrome is low, a number of metabolic risk factors are present. In particular, comparable rates of obesity and impaired fasting glucose as manifested in the general U.S. population have been observed. Additionally, 15 of the 25 individuals who are within the diabetic range were obese highlighting the importance of this risk factor. Both primary and secondary prevention strategies are clearly needed. Data from this article, in addition to others in the present supplement, indicate that diet and lifestyle provide a delicate combination of protective and risk factors. Prevention efforts should be based on these findings.

In this supplement, we have not reported upon the genetics project. The reason for this is twofold. First, analyses are on-going. Second, sensitive ethical issues, discussed in this supplement, are being discussed with the tribal health corporation about how to present general results of the genetics project. We have a guiding principle in our research that we do not report results in the literature until we have presented them to the community participants and tribal health corporation. We expect to report on our results after extensive discussions with an advisory board of the corporation and genetic ethicists about what we can and should report and how to report findings. Boyer et al discuss issues concerning ethics and genetic reporting in an article in this supplement.

A question that has been raised by the community members and tribal health corporation leadership is what this research leads to in terms of future research directions and implications for health services. We are guided by what is left unanswered and by the goals of the communities. The communities desire to see interventions that will be of benefit by enhancing protection and reducing risk for the development of chronic diseases. What is left unanswered is what factors can best predict lower increases in prevalence or lower risk factors. At times, researchers think that they can answer this question through two interrelated processes. First, we must analyze our data in more depth to broaden our findings and create hypotheses for more epidemiological research on what is most predictive of change in health status. This is best done longitudinally through a cohort study. Second, following these analyses, we would design interventions to reduce risk or enhance protection and test them rigorously.

As a case in point, an important general finding of our study is that the prevalence of diabetes remains very low; however, the prevalence of impaired glucose is now at the national average of nearly 22 percent. Given that this is the lowest prevalence of T2DM within Alaska, it suggests that there are protective factors at work in this population that need further exploration. Additionally, the reported increasing prevalence of diabetes over the past 10 years, coupled with the prevalence of impaired glucose tolerance and other risk factors such as rates of obesity, suggest that both universal and indicated prevention efforts are warranted. Papers within this supplement point out various life style risks such as stress, dietary changes and lack of physical activity. Our sense is that our data point to significant cultural protective factors associated with diet and lifestyle that could be enhanced to protect individuals from increased chronic disease risk. Such factors include the amount of omega-3-fatty acids intake from traditional cultural practices such as subsistence hunting and gathering, and increased physical activity through traditional dancing and sports. Both can serve as the basis for increasing protection and reducing risk.

In response to this, scientists have continued to conduct epidemiological studies for many years prior to designing intervention studies. An alternative has been proposed by Robinson and Sirard (1) called Solutions Focused Research. They proposed the methods for the study of childhood obesity but it has implications for many other diseases or conditions. In summary, they proposed that scientists generate hypotheses for how to reduce a risk factor or enhance a protective factor and then carefully design an intervention project to test the hypotheses. This is in contrast to continuing to study the condition through further epidemiology. An example of this is what Lardon is doing with Piciryaratggun Calritllerkaq. She is developing a model intervention from a health promotion framework that hypothesizes that an empowerment approach best fits collectivist cultures that have experienced significant disempowerment. Community members have set the goals for the intervention so that it reflects their cultural perspective for how to achieve wellness. After careful feasibility testing, she can examine this in a larger study in multiple communities that will lead to more generalizable findings. Luick has taken his preliminary experience in Southwestern Alaska to design an indicated or selective prevention research project with Alaska Native males to enhance diet and physical activity and study the results using specific hypotheses to guide his intervention. Each has or will spend time within the communities designing a study that fits their aspirations and needs. In each case, the investigator is using a CBPR and solutions-focused paradigm for testing hypotheses about risk and protection while we continue basic research to test hypotheses through populations-based studies. The epidemiology research we have done in the first CANHR study gave us the information necessary to make specific hypotheses about what are protective and risk factors in this population. It is clear that communities want evidence about what will work to prevent chronic diseases or reduce their prevalence. A solutions-focused paradigm is the logical method to use in this context because it brings together the desire of a community with rigorous scientific methods. This, within a community-based participatory research paradigm and methodology, is the focus of future CANHR research.

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