Chapter 2

Health disparities: promoting Indigenous Peoples' health through traditional food systems and self-determination

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Key words > Indigenous Peoples, determinants of health, thrifty gene, undernutrition, overnutrition, type 2 diabetes, food security

> "We have a pot of gold when we have a meeting of the minds on medical sciences that is highly qualified in culture."
>
> Suttilak Smitasiri, Salaya, Thailand 2009

Abstract

Although there is considerable global diversity in indigenous cultures and ecosystems, one shared commonality is that Indigenous Peoples experience disparities across all dimensions of health. This chapter discusses the disparities in unhealthy body weights from under- to overnutrition, the emergence of type 2 diabetes mellitus, food security and micronutrient deficiencies, and longevity.

Indigenous Peoples living in arid or semi-arid areas that experience drought or seasonal fluctuations in food availability continue to suffer from underweight and malnourishment, while those living in remote, biodiverse areas and engaged in traditional activities with little reliance on market economies tend to be of normal weight. In sharp contrast, Indigenous Peoples living in developed countries have a risk of obesity that is generally 1.5 times greater than that observed for non-Indigenous Peoples residing in the same country or affiliated state. The thrifty gene, the thrifty phenotype and, more recently, the environmental programming hypotheses need to be researched within a context that does not ignore the profound contributions of other underlying causes of health disparities. Assaults on "indigeneity" and self-determination contribute to the health effects of disparities in poverty, education, nutrition, food security, household crowding, and poor access to and utilization of health care.

Multiple strategies are needed to help narrow the gap in nutrition-related chronic diseases. Successful programmes are likely to be those that improve health through the promotion of cultural strengths and self-determination, including traditional food systems. Although this is a challenge, improving the health and longevity of Indigenous Peoples is not an impossible task.

Introduction

> For Indigenous Peoples, determinants of health take on the additional dimensions of collective assaults on "indigeneity", where the end results are profound and far-reaching and contribute to the wide gaps in indigenous health and well-being.

There are an estimated 370 million indigenous people worldwide, with considerable cultural diversity. However, one commonality is that Indigenous Peoples experience disparities across all dimensions of health indicators (Anderson *et al.*, 2006; Cunningham, 2009; Montenegro and Stephens, 2006; Ohenjo *et al.*, 2006). The key to understanding the underlying causes of these disparities lies in the current relationship of Indigenous Peoples to the larger society. While the social determinants of population health are now widely appreciated (Glouberman and Millar, 2003), for Indigenous Peoples determinants of health take on the additional dimensions of assaults on "indigeneity", including colonization and disassociation from their land, cultural and linguistic heritage and even families – when there has been forced residential schooling. In these situations, self-esteem and individual and group identity and self-determination have been eroded. The end result of these collective assaults on "indigeneity" are profound and far-reaching, and contribute to the wide gaps in indigenous health and well-being (Cunningham, 2009; King, Smith and Gracey, 2009; Ohenjo *et al.*, 2006; Stephens *et al.*, 2006).

The dimensions of health and well-being cover a broad range of health outcomes, but this chapter is limited to disparities in unhealthy body weights, emerging type 2 diabetes mellitus (DM), micronutrient deficiencies, longevity and food security. The chapter ends with indigenous perspectives on health determinants, as a guide for identifying health promotions and interventions that will make a difference by improving health through the promotion of cultural strengths and self-determination, including traditional food systems.

Micronutrient deficiencies

Micronutrient deficiencies among Indigenous Peoples tend to mirror those that are prevalent in the larger society, but Indigenous Peoples face increased vulnerability, particularly to the extent that they suffer disproportionately from poverty. Micronutrient deficiencies rank among the top 20 risk factors for morbidity and impaired quality of life, with particular burdens falling on populations in poorer countries, women of reproductive age and young children. However, they are sufficiently prevalent (among more than 2 billion people globally) to affect almost all population segments to some degree (Lopez *et al.*, 2006). Amelioration of these deficiencies constitutes one of the most cost-effective public health interventions in terms of improving overall health, the outcomes of common infectious diseases and the quality of life (Jamison *et al.*, 1993; Tulchinsky, 2010; Harrison, 2010). A list of specific micronutrient deficiency conditions and qualitative estimates of their global prevalence is provided in Annex 2.1.

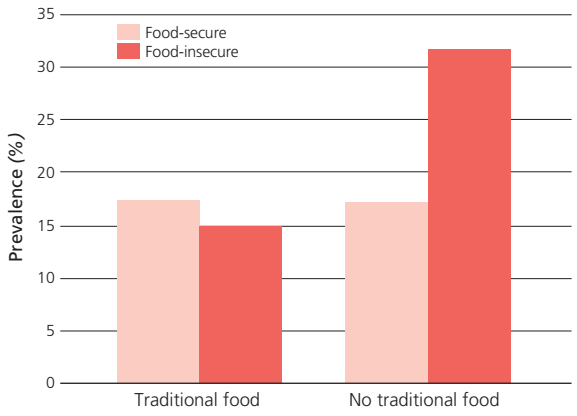
Although deficiencies of particular vitamins and minerals can be conceptualized singularly, it is important to remember that they usually occur in combination. Diets limited in variety and in foods of animal origin are most frequently deficient in micronutrients. On the public health agenda, deficiencies of vitamin A, iodine, iron, folic acid and to some extent zinc have had the most attention because of the evidence base for the efficacy of correcting these deficiencies and the feasibility of effective interventions. However, there is abundant evidence that the problems of micronutrient deficiencies are far from being solved globally.

Existing case studies provide evidence that Indigenous Peoples suffer from micronutrient deficiencies at least as severely as the larger populations from which they are drawn, and probably even more so, given their disparities in poverty (Carino, 2009). Micronutrient deficiencies are not inconsistent with high levels of overweight and obesity, as shown by vitamin A deficiency documented in almost one-third of children aged two to ten years in Mand, Federated States of Micronesia, where adult obesity is very high (Englberger *et al.*, 2009). There is also evidence that as problems of food insecurity increase – through constraints in access to traditional food sources, lands and waterways – traditional practices that protect against micronutrient deficiencies may increase (see section on food insecurity on pp. 17 to 20). For example, the prevalence of total anaemia among Inuit preschoolers illustrates the potential for traditional foods to ameliorate food insecurity. Children who had consumed no traditional food the previous day and were food-insecure, based on the United States Department of Agriculture (USDA) assessment tool for food insecurity, had the highest prevalence of anaemia, while iron-deficiency anaemia prevalence was low among children who had consumed traditional food the previous day, regardless of food insecurity status (Egeland *et al.*, 2013) (Figures 2.1 and 2.2).

From under- to overnutrition

Currently, the risks of underweight and obesity vary considerably among Indigenous Peoples living in diverse settings. In general, Indigenous Peoples who live in remote areas with considerable biodiversity and who are engaged in traditional activities with little reliance on market economies tend to be of normal weight: among Awajún women of Peru, 92 percent had a body mass index (BMI) in what is considered the normal range of 18.5 to 24.9 kg/m^2 (Creed-Kanashiro *et al.*, 2009); among the Ingano of Colombia, 89 percent of women and 96.6 percent of men had normal healthy BMIs (Correal *et al.*, 2009); and for

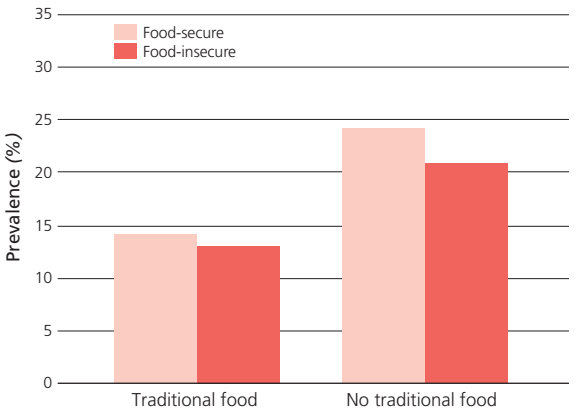
Figure 2.1 Percentage anaemic, by previous-day traditional food (TF) consumption (yes or no) and past-year child food security status



Anaemia defined as venous or capillary haemoglobin < 110 g/litre for three-to-four-year-olds and < 115 g/litre for five-year-olds.
$p < 0.10$ for the interaction term TF by food security in logistic regression model adjusting for age, sex and sampling method (capillary versus venous).

Sources: Data from Egeland *et al.*, 2011; Nunavut Inuit Child Health Survey 2007–2008.

Figure 2.2 Percentage iron-deficient, by previous-day traditional food (TF) consumption (yes or no) and past-year food security status



Iron deficiency defined as plasma ferritin < 12 µg/litre; those with hsCRP > 8 mg/litre were excluded.
$p < 0.06$, indicating a borderline significantly lower percentage of iron deficiency among Inuit preschoolers who consumed TF the previous day compared with non-TF consumers in logistic regression analyses, adjusting for age and sex.

Sources: Data from Egeland *et al.*, 2011; Nunavut Inuit Child Health Survey 2007–2008.

the Karen of Thailand, overweight was rare among children aged 0 to 12 years (Chotiboriboon *et al.*, 2009). In arid or semi-arid areas with less biodiversity and drought or seasonal fluctuations in food availability, underweight and malnutrition are prevalent: among the Maasai experiencing drought, between 25.1 and 35.7 percent of children were underweight and 46.1 to 60.3 percent were stunted (World Vision Kenya, 2004; Oiye *et al.*, 2009); in India, among landless Dalit working as farm labourers, chronic energy deficiency affected 42 percent of women (Salomeyesudas and Satheesh, 2009); malnutrition is also the primary concern for Bhil and other tribal populations in India (Bhattacharjee *et al.*, 2009; National Institute of Nutrition, 2000; Hamill *et al.*, 1977); and among the Igbo of Nigeria, 42 percent of children were stunted, 25 percent were underweight and 9 percent were wasted (Okeke *et al.*, 2009).

In sharp contrast, Indigenous Peoples living in developed countries have a risk of obesity that is generally at least 1.5 times greater than that observed for non-indigenous peoples residing in the same country or affiliated state. Obesity-related chronic diseases have increased from being rare to what is now considered an epidemic, particularly in type 2 DM.

In Pohnpei, Federated States of Micronesia, the prevalence of overweight and obesity has increased from almost zero immediately after the Second World War to its current levels, with a third of women being overweight (Pohnpei STEPS, 2002) and the population suffering unprecedented rates of obesity, hypertension and diabetes (Durand, 2007).

In Australia, where undernutrition was of paramount concern for Indigenous Peoples 30 years ago (Gracey, 1976), an epidemic in overweight and obesity has led to disabling and often fatal chronic diseases (Gracey, 2007). A survey found that aboriginal and Torres Strait Islanders were 1.3 times more likely to be obese than non-indigenous Australians (Australian Bureau of Statistics and Australian Institute of Health and Welfare, 2005). In New Zealand, 41.7 percent of Maori were obese in the 2006/2007 health survey: a rate 1.5 times the 26.5 percent observed among New Zealanders of European descent (New Zealand Ministry of Health, 2008). In 1996, the lifetime risks of developing type 2 DM for Maori were 26 percent for

men and 32 percent for women, compared with 10 and 8 percent for men and women of European descent (New Zealand Ministry of Health, 2002).

In the United States of America, overweight and obesity are a notable health problem among American Indians and Alaska Natives. In a study of five-year-old children, 47 percent of boys and 41 percent of girls were overweight; 24 percent of the children attending 55 schools on 12 reservations were obese; and the risk of overweight and obesity increased with successive age groups evaluated (Zephier *et al.*, 2006). Indigenous Peoples in the United States were also twice as likely to suffer type 2 DM than non-Hispanic whites (Steele *et al.*, 2008), apart from in Alaska, where rates for type 2 DM were similar for indigenous and non-Hispanic whites (6 percent). There is evidence that type 2 DM is increasing among Alaska Natives and Greenlanders (Inuit), who have historically been spared from the epidemic observed among other Indigenous Peoples (Ebbesson *et al.*, 1998; Jørgensen *et al.*, 2002). The Pima Indians of Arizona suffer from an excessively high rate of type 2 DM, at five times that observed among the Pima Indians of remote mountainous northwestern Mexico, where a traditional lifestyle and diet and greater physical activity have been reported as accounting for reduced obesity and type 2 DM risk (Schulz *et al.*, 2006; Ravussin *et al.*, 1994).

In Canada, overweight and obesity rates are highly prevalent among Indigenous Peoples regardless of geographic location or ethnicity (Young and Sevenhuysen, 1989; Tjepkema, 2002; McIntyre and Shah, 1986; Kuhnlein *et al.*, 2004; Galloway, Young and Egeland, 2010). The prevalences of diabetes for First Nations Canadian men and women were respectively 3.6 and 5.3 times higher than those of the general Canadian population (Young *et al.*, 2000).

In addition to the high risk of overweight and obesity among Indigenous Peoples living in developed countries, there is evidence that overweight and obesity are emerging among Indigenous Peoples in low-income countries who are undergoing acculturation in the context of poverty. In these situations, indicators of overnutrition in adults coexist with indicators of undernutrition, particularly in children, indicating rapid nutrition transitions. Among the Suruí of the Amazon, 60.5 percent of 20 to 49.9-year-olds were either overweight or obese (Lourenço *et al.*, 2008), and among the Ribeirinhos of Brazil (Piperata, 2007) and Andean populations of Argentina (Romaguera *et al.*, 2008) overweight and obesity are prevalent and coexist with indicators of poor growth such as stunting.

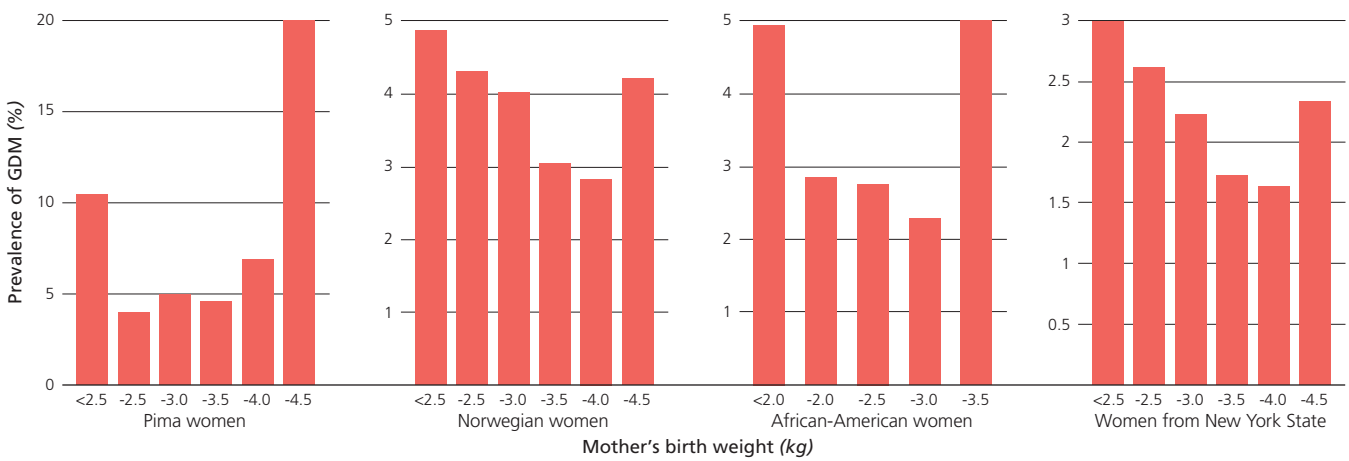
The thrifty gene hypothesis and environmental programming in context

> The "thrifty gene" hypothesis might have seemed like a good idea many years ago in the absence of experimental-based knowledge in the pre-genomic era. But, current research suggests that in most cases a single mutation in a single gene is unlikely to predispose an entire group of people to a complex outcome like type 2 diabetes.
>
> *Dr Robert Hegele*

A commonly cited underlying cause for the high rates of obesity and type 2 DM in Indigenous Peoples is the "thrifty gene" hypothesis, which postulates that there is inherited susceptibility for a biological incapacity to adapt to a modern sedentary lifestyle with a consistent supply of energy. However the thrifty gene hypothesis has been criticized as too simplistic (Paradies, Montoya and Fullerton, 2007; Fee, 2006), given that human beings are remarkably genetically similar, sharing 99.9 percent of their genomes, and have a relatively common and recent evolutionary history of hunting and gathering in periods of feast and famine, which essentially places all humans in a similar thrifty gene risk paradigm (Paradies, Montoya and Fullerton, 2007).

Although there has been progress in genetic research, the aetiology of type 2 DM is complex and multifactoral, and current research suggests that " in most cases a single mutation in a single gene is unlikely to predispose an entire group of people to a complex outcome like type 2 diabetes" (R. Hegele, personal communication, 2009). One exception occurs among the Oji-Cree of northern Ontario, in whom hepatic nuclear factor-1alpha (HNF1A) G319S has been found to be associated with a distinct form of type 2 DM with an earlier age of onset, a lower BMI and a higher

Figure 2.3 Women's own birth weight and later prevalence of gestational diabetes (GDM)



Source: Adapted from Pettitt and Jovanovic, 2007.

post-challenge plasma glucose level than usually observed (Hegele, 2001). However, the genetic variant HNF1A G319S is highly specific to the Oji-Cree and has not been found among other Indigenous Peoples or even among other Canadian Cree with high rates of diabetes.

In recent years, the "thrifty genotype" hypothesis has been supplemented by recognition that what may be happening proximally as populations undergo rapid changes in environment and lifestyle is intergenerational transmission of a "thrifty phenotype". This concept was introduced by Hales *et al.* (1991) and proposes that environmental factors acting in early (intra-uterine) life, particularly undernutrition, may influence later risk of type 2 DM and other chronic diseases of adulthood. The hypothesis is based largely on consistent observations of the inverse relationship between birth weight and risk of future ischaemic heart disease in adulthood (Huxley *et al.*, 2007). However, a growing body of evidence suggests there is a U-shaped data curve between birth weight and chronic diseases (with more chronic disease at the lower and higher ends of birth weight), especially for diabetes. Among Pima Indians, for example, a U-shaped curve was identified between women's own birth weight and later risk of gestational diabetes (Pettitt and Knowler, 1998). These findings have also been observed in other study populations (Egeland, Skjaerven and Irgens, 2000; Williams *et al.*, 1999; Innes *et al.*, 2002; Pettitt and Jovanovic, 2007) (Figure 2.3). The data suggest that maternal obesity and diabetes may create susceptibility to later chronic disease in the offspring, through hyperglycaemic and epigenetic mechanisms (Smith *et al.*, 2009; Egeland and Meltzer, 2010; Dabelea, 2007; Pettitt *et al.*, 1998; Silverman *et al.*, 1998).

Emerging data suggest possible epigenetic effects (changes in gene expression transmissible intergenerationally but not involving alteration of DNA base sequences); the concept has been termed "environmental programming" (Lucas, 1991; Lindsay and Bennett, 2001).

However, as health disparities between Indigenous Peoples and their non-indigenous counterparts are observed across a broad range of health outcomes – including intentional and unintentional injuries, psychological distress and mental illness, birth defects, cancers, perinatal and post-neonatal mortality (Stephens *et al.*, 2006) – scientific research into the thrifty gene, the thrifty phenotype and the environmental programming hypotheses must take into account the profound contributions of other underlying causes of health disparities. The literature on Indigenous Peoples' health identifies poverty, low education, marginalization and racism, disassociation from land, culture and family, inadequate health care access and utilization, and

disparities in many other determinants of disease, such as food insecurity, as underlying causes for health inequities (Carino, 2009; Cunningham, 2009; Stephens *et al.*, 2006; King, Smith and Gracey, 2009; Ring and Brown, 2003).

Mortality disparities

Indigenous Peoples experience greater rates of health disparities and decreased longevity compared with non-Indigenous Peoples, regardless of the geographic area in which they live (Zinn, 1995; Stephens *et al.*, 2005; Ring and Brown, 2003; Ohenjo *et al.*, 2006; Montenegro and Stephens, 2006). However, incomplete data on indigenous status and health indicators make it difficult to estimate consistently the extent of disparities between indigenous and non-indigenous people by country (Stephens *et al.*, 2006). Indigenous Peoples in remote areas are usually underrepresented in the literature, and many countries do not identify ethnicity in their health statistics. In Latin America, studies indicate excessive infant mortality rates among Indigenous Peoples, which are three to four times as high as national averages of up to 30 per 1 000 live births with, for example, 99 to 100 per 1 000 live births for the Campa-Ashaninka and Machiguenga of the Peruvian Amazon, and 67 and 83 per 1 000 live births respectively for the Cumbas and Colimbuela of Ecuador (Montenegro and Stephens, 2006; Cardoso, Santos and Coimbra, 2005; Garnelo, Brandão and Levino, 2005). In Africa, excessive infant and under-five mortality have been noted among forest-dwelling Aka in the Central African Republic, the Twa in Uganda, and the Mbendjele in northern Congo, with a high death rate associated with infectious diseases (Ohenjo *et al.*, 2006).

Excess mortality and disease-specific mortality for Indigenous Peoples have been noted in developed countries with generally good health surveillance systems (Bramley *et al.*, 2004). Although indigenous status is underreported in death records in Australia, the existing data indicate a fourfold excess age-adjusted death rate among indigenous compared with non-indigenous Australians from 2000 to 2004 (Australian Bureau of Statistics, 2002; 2003; 2004; 2005). In addition, while infant mortality has been decreasing over time, disparities in infant mortality between indigenous and non-indigenous Australians have increased, owing to greater reductions in mortality among non-indigenous infants (from 8.4 to 3.7 per 1 000 live births between 1980 to 1984 and 1998 to 2001) than among indigenous Australians (from 25 to 16.1 per 1 000 live births over the same period) (Freemantle *et al.*, 2006). The most recent data suggest that indigenous children are twice as likely to die than non-indigenous children (McCredie, 2008) and that infant mortality rates were three times higher for indigenous boys and 2.5 times higher for indigenous girls than for non-indigenous children between 2004 and 2006 (Australian Bureau of Statistics, 2007). At birth, Indigenous Peoples in Australia also face a 15- to 20-year reduction in life expectancy, with the leading cause of mortality now being cardiovascular diseases (Trewin and Madden, 2005). In New Zealand, the gap in life expectancy was eight years between Maori and non-Maori people in 1999, and although decreases in mortality have been noted over time, disparities persist (New Zealand Ministry of Social Development, 2004).

In the United States of America, American Indians and Alaska Natives born in 1999 to 2001 had a life expectancy that was 2.4 years less (at 74.5 versus 76.9 years) than that of the overall United States population (Indian Health Service, 2006). Infant mortality is approximately 20 percent higher among American Indians and Alaska Natives (at 8.3 per 1 000 live births in 2002 to 2004) than for the total United States population (at 6.9 per 1 000 live births in 2003) (Indian Health Service, 2009). In the Federated States of Micronesia, which is now independent but freely associated with the United States of America, improvements in infant mortality have been noted, but the rate remains excessively high at 33 deaths per 1 000 live births in 2007 (ESCAP, 2009).

In Canada most health indicators identify large disparities in morbidity and longevity between Indigenous Peoples and the general population, with gaps in life expectancy of 5.5 years for females and 8.1 years for males in 2000 (Health Canada, 2005). For

Inuit, the estimated average life expectancy is 15 years less than that of the general Canadian population. Infant mortality rates among Inuit, although decreasing over time, remain four times higher than those among the general population (Wilkins *et al.*, 2008).

Avoidable deaths and morbidity

A greater proportion of the mortality among Indigenous Peoples is avoidable than is among non-indigenous people (Ring and Brown, 2003). In New Zealand, the Ministry of Health estimates that the avoidable death rates among Maori are almost double those among New Zealanders of European or other descent (New Zealand Ministry of Health, 1999). In Australia, the risk of preventable infant deaths was 8.5 times higher among indigenous than non-indigenous Australians, with higher infant mortality rates attributable to infection and birth defects, particularly in remote areas (Freemantle *et al.*, 2006).

To reduce the gap in avoidable mortality, more emphasis should be placed on primary health care services for prevention and early diagnosis and treatment (Ring and Brown, 2003). In a global review of type 2 DM complication rates, Indigenous Peoples, regardless of their geographic location, experienced a disproportionate rate of complications relative to their non-indigenous counterparts (Naqshbandi *et al.*, 2008).

In addition to improving the availability of health care services and diagnostic screenings, there is also need for education to improve indigenous communities' awareness that services are available and accessible and that they can make a difference in promoting health (Reading, 2009).

Food insecurity

Food security is fundamental to population health and is a common theme of the case studies described in this volume. Populations are considered food-insecure when there is limited availability of, or ability to acquire, culturally acceptable, nutritionally adequate and safe foods on a sustained basis (FAO, 1996). Gradients of food security range from fully secure, to mild anxiety about not having enough food, to outright hunger. Even in developed countries, food-insecure people suffer from various degrees of poverty and have poorer perceived health and lower nutrient intakes or nutrition status than the food-secure (McIntyre *et al.*, 2003; Ledrou and Gervais, 2005; Kirkpatrick and Tarasuk, 2008; Vozoris and Tarasuk, 2003; Rose and Oliveira, 1997; Skalicky *et al.*, 2006; Zalilah and Tham, 2002). Among the Orang Asli (Timian) of Malaysia, a study of 64 children identified that 82 percent of homes with children reported food insecurity, which coexisted with high prevalence of underweight, stunting and wasting (at 45.3, 51.6 and 7.8 percent, respectively) and dietary intakes noted at less than two-thirds the recommended dietary allowance (RDA) levels for energy, calcium and iron, but remarkably good intakes of many other nutrients (Zalilah and Tham, 2002).

For Indigenous Peoples, the current definitions of food security are inadequate as they rely entirely on the assessment of monetary access to market food (Nord, Andrews and Carson, 2006), whereas Indigenous Peoples also consume traditional foods. Given the role of traditional food systems and food sharing networks in contributing to food security, nutrient intakes and cultural identity, the definition of food security for Indigenous Peoples should include assessment of traditional food intake and the stability of access to traditional foods (Egeland *et al.*, 2010; Power, 2008; Lambden, Receveur and Kuhnlein, 2007). The contribution of traditional food to nutrition status can be substantial, and assessments of the impact of food insecurity can be hindered when assessment tools consider only monetary access to market foods.

Food insecurity, with resulting outright hunger and undernourishment, remains a global public health challenge. In the case studies included in the CINE series, the Maasai of Kenya, the Dalit and Bhil of India and, to a lesser extent, the Igbo of Nigeria showed evidence of severe food insecurity resulting in high prevalence of undernutrition.

Paradoxically, however, food insecurity has not been consistently related to undernourishment (Renzaho, 2004; Zalilah and Tham, 2002), and studies now report either a greater risk of obesity or no

differences in adiposity by food security status (Casey *et al.*, 2006; Jiménez-Cruz, Bacardí-Gascón and Spindler, 2003; Gundersen *et al.*, 2008; Townsend *et al.*, 2001; Dinour, Bergen and Yeh, 2007; CDC, 2003; Rose and Bodor, 2006; Whitaker and Orzol, 2006). Variable gradients in the severity of food insecurity and differences in the local cultural and economic context of the amounts and types of food obtained and the extent of physical activity are likely to contribute to the conflicting findings between food insecurity and adiposity in the literature.

Food security for Indigenous Peoples is affected by changing environments, including environmental contamination and degradation, climate change, urban growth, modern farming and ranching and other infringements on traditional lands. Global market forces and colonization also play an omnipresent role in influencing dietary and lifestyle habits, as they generally increase dependence on highly processed food of poor nutrient quality, usually in the form of refined grains, and food with added sugar and fat, which increase the energy density of food consumed. All of these factors can work in tandem to reduce the viability of traditional food systems, and are serious threats to sustaining food security, especially for marginalized Indigenous Peoples (Thrupp, 2000). The dietary changes associated with globalization and colonization were cited as contributing to the recent epidemic of obesity and obesity-related chronic diseases in the Pacific Island countries and East Africa (Hughes and Lawrence, 2005; Raschke and Cheema, 2008).

An inverse relationship between the energy density of food and energy costs has been reported, and energy-dense and nutrient-poor food provides kilocalories at affordable cost; the high palatability of added sugar, sodium and fat in highly processed food can also lead to overconsumption of energy, and has been suggested as a mechanism by which poverty and food insecurity can lead to obesity and type 2 DM, both of which follow a socio-economic gradient in risk (Drewnowski and Specter, 2004; Drewnowski, 2009). In Guam, 49 percent of Chamorros were obese and Chamorros had a high dietary energy density, with 1.9 kcal per gram of food consumed compared with 1.6 kcal/g among Filipinos, of whom only 20 percent were obese (Guerrero *et al.*, 2008). The high energy density of the diet in the Federated States of Micronesia is coupled with low physical activity, with 64.0 to 77.2 percent of youth not meeting recommended levels of physical activity in a recent survey (Lippe *et al.*, 2008). A shift in energy balance occurs when energy-dense processed market food is adopted, while physical activity is reduced as traditional activities are abandoned, both leading to weight gain.

From the biodiverse tropical areas to the far reaches of the Arctic, Indigenous Peoples' food security situation is highly variable, reflecting not only changes or degradation in ecosystems, but also geopolitical factors such as civil unrest, global economic forces, and urbanization and development. Environmental degradation can lead to loss of biodiversity, thereby threatening food security. In the highlands of Papua New Guinea, for example, the degradation of soil and vegetation has led to an overdependence on sweet potato on the high-altitude plateau and the dry grasslands, with women and children being more vulnerable to reduced dietary diversity (Bayliss-Smith, 2009). For the Maasai of Kenya, access to land for grazing their cattle (a cornerstone of their traditional diet) is increasingly limited as the growth of Nairobi and other large cities consumes more land, imposing barriers to free movement for Maasai and their cattle. In the biodiverse western Amazon area, Indigenous Peoples such as the Sacha Runa of Ecuador, the Ingano of Colombia and the Awajún of Peru actively cultivate biodiversity, and utilize both wild forests and cultivated fields for sustaining resilience in their ecosystem, to support their food security, medicinal care and cultural heritage (Garí, 2001; Creed-Kanashiro *et al.*, 2009; Correal *et al.*, 2009).

As proposed development projects involving oil, mineral and timber extraction and agrodevelopment encroach on to the lands of Indigenous Peoples in the Amazon, food security is threatened unless an alternative paradigm of development is promoted in which indigenous agro-ecology and biodiversity can continue to thrive. The Ingano made historic progress by being the principal actors in the development and management

of a protected area fully recognized by the State, the Indiwasi National Park. Conserved land areas represent a means by which Indigenous Peoples can conserve biodiversity and cultural integrity, promote food security and reach the Millennium Development Goals (Pathak, Kothari and Roe, 2005). In addition, climate change is threatening small island states (Barnett, Dessai and Jones, 2007) and the Inuit traditional food system (Chapter 9 – Egeland *et al.*, 2013), and is projected to have sweeping effects globally on food security, especially for Indigenous Peoples, who often live in vulnerable and extreme environments (FAO, 2008a).

Many indigenous communities, including those in Australia, Canada, the United States of America, Japan, New Zealand, India (the Bhil) and the Federated States of Micronesia, depend largely on market economies for access to basic foodstuffs, and supplement their market food diets to varying degrees with hunted, caught and cultivated traditional foods. In the context of cash-poor economies and a volatile global market of fluctuating food prices, the maintenance of cultural knowledge and traditions regarding food is a matter not only of cultural identity and transmission, but also of maintaining food security and nutritional health. Global market forces, including the utilization of grain for supplying biofuels, resulted in exorbitant price increases for basic food grain staples in 2007/2008, with direct effects on increasing hunger among the disadvantaged (FAO, 2008b). While grain supply costs declined somewhat in 2009, following a peak in mid-2008, the global economic crisis continues to undermine food security (Harrison, Tirado and Galal, 2010). Given the high rates of poverty among Indigenous Peoples, the current global economic crisis will undoubtedly put a disproportionate burden on the food security of Indigenous Peoples. The prices of food purchased are also heavily influenced by the costs of transportation, with effects on food security for remote communities.

Food insecurity is reported among Indigenous Peoples in developed countries. In New Zealand, women, Pacific Islanders and Maori were at greater risk of food insecurity than the overall population (Parnell *et al.*, 2001). In Canada, poverty rates are twice as high among aboriginal peoples than non-aboriginal Canadians (Canadian Council on Social Development, 2003), and 33 percent of aboriginal people were food-insecure compared with 9 percent among non-aboriginal Canadian households (Willows *et al.*, 2009). Inuit, who reside in remote communities, face even greater challenges to food security than other Indigenous Peoples in Canada. For Inuit, climate change threatens traditional food species reproduction and survival and limits the human navigation that is essential for hunting (Chapter 9 – Egeland *et al.*, 2013). This in turn would limit access to traditional food and threaten food security and nutrition status (Egeland *et al.*, 2009; Johnson-Down and Egeland, 2010; Kuhnlein and Receveur, 2007). In focus groups in six Inuit communities, participants stated that "a lot of people are living near poverty" and having difficulty obtaining enough food to eat (Chan *et al.*, 2006). Despite large Canadian subsidies for a food mail programme (of CAD 46 million in 2006/2007) for northern communities, food costs in most remote communities are at least double those in southern Canadian cities or towns closer to food distribution routes (Indian and Northern Affairs Canada, 2007). The combination of inability to afford market food, lack of access to hunting and fishing and/or lack of a hunter in the family contribute to food insecurity in Canadian Arctic communities, particularly among households headed by women (Duhaime, Chabot and Gaudreault, 2002; Lambden *et al.*, 2006).

Among the case studies in this volume, the one in which traditional food systems were closest to being entirely lost is that of the Ainu of Japan. Strong assimilation policies by the Japanese Government over a fairly long period have stopped food insecurity (in the usual definition of inadequate access to enough food) from being a problem, but have also resulted in loss of identification of traditional foods and dishes. A recent effort aims to reidentify traditional Ainu foods and culture before the relevant knowledge is lost. The Government of Japan has now officially recognized the Ainu as an Indigenous People and has publicly recognized the hardships and poverty they have endured (Ito, 2008), which represents progress for the Ainu.

Food security is complex, relying on local food culture and ecosystems, fluctuations in precipitation and climate, soil quality, and socio-economic aspects of trade and food purchasing behaviour. Where soils are poor and weather extreme, food diversity and adequacy are compromised, and macro- and micronutrient deficiencies may be evident, depending on the predominant dietary practices. For example, in areas with low consumption of animal food, low vitamin D, calcium, n-3 fatty acids and B_{12} would be expected, whereas in areas with low fruit and vegetable consumption, carotenoids and phytonutrients may be compromised (Wahlqvist and Lee, 2007). An additional consideration is the growing body of evidence indicating that micronutrient deficiencies are more common among obese than normal-weight people in a wide variety of populations and age groups (Garcia, Long and Rosado, 2009). This evidence is fairly robust and includes antioxidant nutrients, vitamins A, D, C, B_{12} and folate, iron and zinc. There are several plausible biological mechanisms to explain this, and it is not yet clear in which direction any causal pathways may be operating. However, it is clear that the presence of overweight and obesity is consistent with, and may even be associated with, higher risk for impaired micronutrient status.

Where do we go from here?

Indigenous Peoples' knowledge and food systems are fast disappearing but are of utmost importance, not only for sustaining Indigenous Peoples but also for providing alternative paradigms for coping with diverse ecosystems in a changing global environment.

The challenge is to retain traditional food knowledge and food systems, including market food, through sound governance for food security. Indigenous Peoples have been remarkably resilient, and collectively provide a vast tapestry of culturally diverse examples of human ingenuity in food systems that are adaptive to different and often harsh ecosystems. However, Indigenous Peoples' knowledge and food systems are poorly documented and fast disappearing, even though they are of utmost importance not only for sustaining Indigenous Peoples but also for providing alternative paradigms for coping with diverse ecosystems in a changing global environment.

While the social determinants of health are now widely accepted, Indigenous Peoples suffer from additional assaults on "indigeneity" and self-determination, which contribute to disparities in poverty, education, nutrition and food security, household crowding, poor access to and utilization of health care, and preventable diseases. Thus, Indigenous Peoples' health problems "cannot be resolved solely through health interventions"; policies with a stronger emphasis on indigenous rights are needed (Stephens *et al.*, 2006; Gracey and King, 2009; UNPFII, 2009). In addition, governments need to collect health information on needs and conditions, and should allocate adequate resources to addressing the socio-economic inequities between indigenous and non-indigenous people, to narrow the disparities in health and disease (Gracey and King, 2009). Specific programmes that target mothers and children, nutritional deficiencies, improvements in sanitation and household crowding as a means of reducing infectious diseases, improving living conditions and opportunities for urban residents, and addressing diseases of acculturation are among the top priorities (Gracey and King, 2009). Opportunities for reducing micronutrient deficiency disease through food fortification (Harrison, 2010) should be examined carefully, with a view to identifying the potential effects on the diets of indigenous populations.

To identify the next steps in reducing the enormous health disparities that exist, Indigenous Peoples' conceptualization of health and the determinants of their health framework also needs to be understood (Mowbray and WHO Commission on Social Determinants of Health, 2007). Indigenous Peoples' view of health is not limited to individual health and the absence of disease, but also encompasses the health of the entire community and of the ecosystem on which it relies; this includes the concept of well-being, which is more than the absence of disease (King, Smith and Gracey, 2009). The traditional holistic view of health covers spiritual, mental, physical and emotional well-

being. Where colonization is part of the history of indigenous groups, it features as a prominent determinant of poor health because it relates to the disruption of ties to the land and traditional food systems that had an omnipresent role in defining traditional social arrangements, self-identity with defined roles for community members, and systems of knowledge. The weakening or destruction of cultural practices and language, disconnectedness from cultural identity and ongoing marginalization in which Indigenous Peoples are not recognized or understood by society's institutions all contribute to health disparities. The disruptions associated with colonization, which lead to lack of autonomy and self-esteem, are linked closely to poor health status (Durie, Milroy and Hunter, 2009).

Reversing the effects of colonization therefore depends on efforts to encourage self-determination in all facets of life. This will promote collective and individual identity, self-esteem and a greater locus of control, which can improve a broad range of health outcomes for Indigenous Peoples. In addition, international collaboration among Indigenous Peoples can foster innovative health research and help identify solutions to commonly shared problems (Reading, 2009).

Traditional food systems provide a strong foundation for cultural identity, a basis for social support networks and medicinal remedies, and nutritional health. The promotion of traditional food and food systems assists Indigenous Peoples in gaining greater autonomy and self-determination and promotes health. Policies need to encourage sound environmental husbandry by all sectors of society, and provide opportunities for Indigenous Peoples to continue or enhance their utilization of traditional food systems. Nutrition and health education and making healthy market foods affordable provide a highly worthwhile complementary approach, which is needed to reduce the disparities in nutrition-related chronic diseases.

Improved primary health care and models of health care delivery in cross-cultural settings are also needed. Community-led or -partnered programmes will enhance acceptability among community members and are likely to improve the performance indicators of programmes' successes (Ring and Brown, 2003; Gracey and King, 2009). Indigenous Peoples are taking leadership in the development of community-based programmes that emphasize nutrition and physical activity, such as the Unity of First People of Australia innovative health promotion programme in Kimberley Region, where positive changes in knowledge about food, nutrition and exercise are having an impact on diabetes risk factors (Gracey *et al.*, 2006). Another success has been the community-led Kahawá:ke Diabetes Prevention Project, in which a decline in the incidence of type 2 DM between 1986/1988 and 1992/1994 coincided with the Mohawk community's mobilization of prevention efforts (Horn *et al.*, 2007).

The many initiatives described in the CINE case study series indicate how the collaborative ties that Indigenous Peoples have can make a difference in the health of their communities. There is no single successful strategy; multiple strategies are needed to help narrow the gap in nutrition-related chronic diseases. However, successful programmes will likely be those that include Indigenous Peoples' initiatives and perspectives and local food resources; partnerships among and within communities; community partnerships with nutritionists, health care providers and health care specialists; the involvement of government and non-governmental agencies; and locally operated points for health care screening and feedback tied to health education. Improving Indigenous Peoples' health is a "critical but complex challenge" (Stephens *et al.*, 2005), but not an impossible task

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Annex 2.1 Micronutrient deficiency conditions and their worldwide prevalence

Micronutrient	*Deficiency prevalence*	*Major deficiency disorders*
Iodine	2 billion at risk	Goitre, hypothyroidism, iodine deficiency disorders, increased risk of stillbirth, birth defects, infant mortality, cognitive impairment
Iron	2 billion	Iron deficiency, anaemia, reduced learning and work capacity, increased maternal and infant mortality, low birth weight
Zinc	Estimated as high in developing countries	Poor pregnancy outcomes, impaired growth (stunting), genetic disorders, decreased resistance to infectious diseases
Vitamin A	254 million preschool children	Night blindness, xerophthalmia, increased risk of mortality in children and pregnant women
Folate (vitamin B_6)	Insufficient data	Megaloblastic anaemia, neural tube and other birth defects, heart disease, stroke, impaired cognitive function, depression
Cobalamine (vitamin B_{12})	Insufficient data	Megaloblastic anaemia (associated with *Helicobacter pylori*-induced gastric atrophy)
Thiamine (vitamin B_1)	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Beriberi (cardiac and neurologic), Wernicke and Korsakov syndromes (alcoholic confusion and paralysis)
Riboflavin (vitamin B_2)	Insufficient data, estimated as common in developing countries	Non-specific – fatigue, eye changes, dermatitis, brain dysfunction, impaired iron absorption
Niacin (vitamin B_3)	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Pellagra (dermatitis, diarrhoea, dementia, death)
Vitamin B_6	Insufficient data, estimated as common in developing countries and in famines, displaced persons	Dermatitis, neurological disorders, convulsions, anaemia, elevated plasma homocysteine
Vitamin C	Common in famines, displaced persons	Scurvy (fatigue, haemorrhages, low resistance to infection, anaemia)
Vitamin D	Widespread in all age groups, low exposure to ultraviolet rays of sun	Rickets, osteomalacia, osteoporosis, colorectal cancer
Calcium	Insufficient data, estimated as widespread	Decreased bone mineralization, rickets, osteoporosis
Selenium	Insufficient data, common in Asia, Scandinavia, Siberia	Cardiomyopathy, increased cancer and cardiovascular risk
Fluoride	Widespread	Increased dental decay, affects bone health

Source: Tulchinsky, 2010, adapted from Allen *et al.*, 2006: Table 1.2, pp. 6–10.