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Healthy aging diets other than the Mediterranean: A focus on the Okinawan diet

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ABSTRACT

The traditional diet in Okinawa is anchored by root vegetables (principally sweet potatoes), green and yellow vegetables, soybean-based foods, and medicinal plants. Marine foods, lean meats, fruit, medicinal garnishes and spices, tea, alcohol are also moderately consumed. Many characteristics of the traditional Okinawan diet are shared with other healthy dietary patterns, including the traditional Mediterranean diet, DASH diet, and Portfolio diet. All these dietary patterns are associated with reduced risk for cardiovascular disease, among other age-associated diseases. Overall, the important shared features of these healthy dietary patterns include: high intake of unrefined carbohydrates, moderate protein intake with emphasis on vegetables/legumes, fish, and lean meats as sources, and a healthy fat profile (higher in mono/polyunsaturated fats, lower in saturated fat; rich in omega-3). The healthy fat intake is likely one mechanism for reducing inflammation, optimizing cholesterol, and other risk factors. Additionally, the lower caloric density of plant-rich diets results in lower caloric intake with concomitant high intake of phytonutrients and antioxidants. Other shared features include low glycemic load, less inflammation and oxidative stress, and potential modulation of aging-related biological pathways. This may reduce risk for chronic age-associated diseases and promote healthy aging and longevity.

1. Introduction

Most deaths across nations (including low and middle income countries) are now due to chronic disease and the proportion of worldwide mortality from chronic age-associated disease is projected to escalate further, reaching 66 per cent in 2030 (World Health Organization, 2005).

This global increase in disease burden from cardiovascular disease, cancer, diabetes and other chronic age-associated diseases reflects social and economic changes, including lifestyle and diet, as well as population aging. Although the world-wide increase in life expectancy (at birth) is among the world's greatest achievements, the potential socio-economic costs of a higher chronic disease burden rise sharply with an aging society. The good news is that mounting evidence suggests effective public health policies and programs can do much to mitigate this risk and help people remain healthy as they age.

Reflecting this untapped potential for preventive public health efforts, the World Health Organization (WHO) and the U.S. Centers for Disease Control and Prevention (CDC) have estimated that 80 percent of coronary heart disease (CHD) and type-2 diabetes mellitus (T2DM) as well as 40 percent of cancers, could be prevented by improving three health behaviors: eating habits, physical activity, and tobacco use (World Health Organization, 2005; Centers for Disease Control and Prevention, 2009). Although difficult to quantify, of these three risk factors, dietary habits may have become the most important modifiable risk factor in many nations. Backing up this contention is a recent study that assessed 17 major risk factors and found that composition of the diet constituted the largest cluster of risk factors responsible for death (26%) and the highest percentage of disability-adjusted life years lost (14%) in the US (US Burden of Disease Collaborators, 2013).

Because nutritional issues play such a key role in a wide range of age-associated diseases and contribute so much to morbidity, disability and mortality as we age, the potential for better nutritional habits to improve health outcomes in older populations is a largely untapped (yet urgently needed) measure. Although

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some dietary patterns are well known to be associated with the prevention of chronic age-associated diseases, such as the traditional Mediterranean diet, the focus of this manuscript will be to explore other, less well known, dietary patterns that have also been linked to decreased risk for chronic age-associated diseases, such as the Okinawan diet. Okinawan elders, many of whom still eat a very healthy diet, represent one of the healthiest populations of seniors on the planet.

2. Achieving healthy aging: the art of the possible

What can we realistically achieve in terms of healthy human aging? There is ongoing debate that seems to swing between two poles. Some scientists optimistically argue that technological breakthroughs may soon extend human lifespan to a thousand or more years (de Grey et al., 2002). Others argue that we may have already "hit the wall" in terms of the potential for growth in human life expectancy and we might even witness declines in the 21st century due to obesity and the re-emergence of infectious disease threats (Olshansky et al., 2005).

Caloric restriction is among the most robust interventions in model organisms of aging for extending lifespan (Masoro, 2005). With the plethora of recent studies of primates, including humans, some argue that dietary interventions such as caloric restriction have the potential to significantly extend human lifespan – as they have in invertebrate and animal models (Anderson and Weindruch, 2012; Mercken et al., 2012). Although the evidence for dietary restriction effects in primates (including humans) is promising, and there are individuals who follow such a regimen, it is not practical as a public health policy. Nor are mechanistic studies of model organisms always applicable to humans thus caution must be used when extrapolating such findings to human populations.

On a more practical level, substantial population health gains may be possible in the future if we can delay the onset of common age-related diseases by currently available risk factor modification (Willcox et al., 2006, 2013; de la Torre, 2012; Yaffe et al., 2012). In order to further quantify the potentially achievable population-wide benefits of such an approach, public health scientists Olshansky et al. (2007) estimated that delaying typical age-related morbidity in Americans by just seven years would decrease the age-specific risk of disability and death by 50%, allowing a substantial improvement in both lifespan and more importantly, in *healthspan*. The authors label this the "longevity dividend".

Combining what we already know about modifying risk factors for chronic disease with a better understanding of the genetics of healthy aging may help optimize future targets for intervention. For example, a review by Cluett and Melzer (2009) of over 50 GWAS studies of four major aging-related phenotypes found that cell cycle, regrowth and tissue repair were the most common biological pathways across these aging-related phenotypes, and may represent good targets for intervention. Nevertheless, whether one uses pharmacologically active foods or food extracts to target specific aging-related biological pathways or nutritional interventions that target multiple pathways related to aging, it will be important to identify individual genetic susceptibility to particular risk factor interventions, such as optimizing blood sugar or reducing sodium or cholesterol (de Magalhães et al., 2012; Mercken et al., 2012; Morris, 2005; Rattan, 2012).

The scientific discipline of epidemiology, which includes genetic epidemiology and nutritional epidemiology, may provide clues as to where to begin and which path to follow. From an epidemiology of aging perspective, wide variability exists in the global prevalence of age-related diseases and past studies have suggested that while genes are important, the majority of the variation in overall human lifespan (Gögele et al., 2011) and perhaps more importantly, in healthspan (Rattan, 2012), has been shown to be environmental. That is, dietary habits, physical activity, smoking and other risk behaviors, access to health care, immunization and other public health practices, and other social determinants of health, account for the majority of variation in risk for age-related morbidity and mortality.

Backing up this contention is recent epidemiological research that has focused upon risk factors for healthy aging which has shown that avoiding nine common risk factors in mid-life may increase odds of healthy aging into octogenarian and nonagenarian years by over four-fold (Willcox et al., 2006). Moreover, nutritional epidemiological research on risk factor modification as well as dietary intervention studies have shown that the benefits on particular lipid and inflammatory-related risk factors (e.g. LDL cholesterol, C-reactive protein) from shifting to a healthier dietary pattern can be substantial and even rival that of pharmacotherapy (Jenkins et al., 2005). Therefore, it stands to reason that a population-wide shift to a healthier dietary pattern may facilitate significant delays in age-related morbidity and decrease the age-specific risk of disability and death – allowing for substantial improvement in both lifespan and healthspan. This would bring us closer to realizing the "longevity dividend".

Some large scale population-wide public health interventions that have used nutritional approaches (usually as part of a multi-intervention strategy) for age-associated diseases, such as cardiovascular disease reduction in the North Karelia Project, have been very successful, while others have been less so (Papadakis and Moroz, 2008; Puska, 2010). In North Karelia, Finland, a comprehensive lifestyle intervention that has lasted over three decades has been associated with an 80% risk reduction for cardiovascular disease (CVD) – three quarters of that risk was explained by reduction in common risk factors (e.g. cholesterol, blood pressure and smoking) (Vartiainen et al., 2010). While pharmacotherapy and other medical therapies also became more common during the intervention period, dietary change was a major factor in the CVD risk reduction. For example, statins for cholesterol reduction became popular during the public health intervention period but changes in dietary fat quality and cholesterol intake explained 65% of the cholesterol decrease in men and 60% of the decrease in women, with reductions in dietary saturated fat as the main explanatory factor (47% in men and 41% in women) (Valsta et al., 2010) The impact of lipid-lowering medication on observed cholesterol levels was found to be less important, at 16% among men, and 7% among women. Such comprehensive, long-term population studies are rare and there is a need for more such studies to support epidemiological findings and prior short-term, risk factor intervention trials.

Illustrating the potential of this approach for age-related diseases, some long-lived populations, such as the Japanese, already appear to be delaying typical age-related morbidity and have achieved a significantly longer life expectancy and much lower rates of disability than many western nations such as the US (US Burden of Disease Collaborators, 2013; Ikeda et al., 2011; Willcox et al., 2013). Such populations (or sub-populations) tend also to have higher numbers of oldest-old or long-lived individuals, such as nonagenarians or centenarians. The most remarkable of these populations have been referred to as "Blue Zones", a concept that refers to a demographic and/or geographic area with high population longevity and originating from the blue color on demographic maps (Poulain et al., 2004; Appel, 2008). There is even some preliminary evidence that the "Blue Zones" share some common healthy eating patterns (Davinelli et al., 2012; Appel, 2008). This is encouraging. The fact that the Japanese went from longevity laggards (low average life expectancy at birth) in the first half of the 20th century to longevity leaders in the second half (world's longest lifespan *and* healthspan) is due, in large part, to

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