Hawai‘i Journal of Health & Social Welfare
A Journal of Pacific Health & Social Welfare

February 2020, Volume 79, No. 2, ISSN 2641-5216

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Journal Contact Information:
Mailing Address: Hawai‘i Journal of Health & Social Welfare
677 Ala Moana Blvd., Suite 1016B
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Website: http://hawaiijournalhealth.org/
Email: hjhsw@hawaii.edu

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Hawai‘i Journal of Health & Social Welfare
ISSN 2641-5216 (Print), ISSN 2641-5224 (Online)

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In 1941, a journal then called The Hawai‘i Medical Journal was founded by the Hawai‘i Medical Association (HMA). The HMA had been incorporated in 1856 under the Hawaiian monarchy. In 2008, a separate journal called the Hawai‘i Journal of Public Health was established by a collaborative effort between the Hawai‘i State Department of Health and the University of Hawai‘i at Mānoa Office of Public Health Studies. In 2012, these two journals merged to form the Hawai‘i Journal of Medicine & Public Health, and this journal continued to be supported by the Hawai‘i State Department of Health and the John A. Burns School of Medicine.

In 2018, the number of partners providing financial backing for the journal expanded, and to reflect this expansion the name of the journal was changed in 2019 to the Hawai‘i Journal of Health & Social Welfare. The lead academic partners are now the six units of the UH College of Health Sciences and Social Welfare, including the John A. Burns School of Medicine, UH Public Health, the Myron B. Thompson School of Social Work, the School of Nursing and Dental Hygiene, the UH Cancer Center, and the Daniel K. Inouye College of Pharmacy. Other partners are the Hawai‘i State Department of Health and the UH Office of the Vice Chancellor for Research. The journal is fiscally managed by University Health Partners of Hawai‘i.

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HAWAI`I JOURNAL WATCH
KAREN ROWAN MS

Highlights of recent research from the University of Hawai`i and the Hawai`i State Department of Health

SUBSTANCE ABUSE TREATMENT PROGRAMS FOR NATIVE HAWAIIANS AND OTHER PACIFIC ISLANDERS

Among individuals in substance abuse treatment programs, Native Hawaiians and Other Pacific Islanders (NHOPIs) are less likely than Asians or whites to complete treatment. Researchers led by Meripa T. Godinet PhD, with the Myron B. Thompson School of Social Work, gathered information on nearly 130,000 treatment cases nationally from 2016. Findings indicated NHOPIs in outpatient non-intensive programs were more likely to complete treatment than those in out-patient intensive or in-patient settings, resonating with the idea of family/community support as essential for NHOPIs. In contrast, Asians and whites in outpatient non-intensive treatment settings were less likely to complete treatment than Asians and whites in the other two settings. The study emphasized the importance of disaggregating data from Asians and NHOPIs to better understand the factors affecting program completion rates. The paper (PubMed ID: 31846599) is published in Substance Use & Misuse.

SHARPER GENE-ANALYSIS TECHNIQUES ARE NEEDED TO STUDY TB CLUSTERS IN HAWAI`I

The Beijing and Manila families of Mycobacterium tuberculosis cause over two-thirds of TB cases in Hawai`i, but techniques commonly used to genetically analyze TB clusters are inadequate for studying them. Researchers including co-author E. Desmond PhD, with the Hawai`i DOH, used a newer tool called next-generation whole-genome sequencing (WGS) along with single-nucleotide polymorphism identification to analyze 19 apparent clusters in Hawai`i from 2003 to 2017. The analysis excluded transmission events in seven putative clusters, confirmed transmission in eight, and identified both transmission-linked and non-linked bacteria in four. The findings show WGS is a powerful tool for TB investigations in Hawai`i and the Pacific. The paper (PubMed ID: 30509214) is published in BMC Infectious Diseases.

NURSING PARTNERSHIP BENEFITS FACULTY, CLINICAL STAFF, AND PATIENTS

A 10-year partnership between the UHM School of Nursing and Dental Hygiene (SONDH) and The Queen’s Health Systems (QHS) has increased the research capacity of both organizations as a result of their deep strategic and tactical commitment to building the partnership. Researchers including senior author Mary Boland DrPH, RN, of the SONDH, investigated factors contributing to the success of the partnership and its outcomes. The authors reported the partnership has increased SONDH faculty opportunities to conduct clinical research, supported the QHS nurses in expanding their practice, and improved patient care. Twenty-eight evidence-based projects have been completed as a result of the partnership, and 17 resulted in peer-reviewed publications. The paper (PubMed ID: 31857058) is published in the Journal of Professional Nursing.

PHYSICAL ACTIVITY LEVELS AND E-CIGARETTE USE LINKED

Hawai`i college students who engage in higher levels of physical activity may be more likely to later use e-cigarettes. Researchers led by Pallav Pokhrel PhD, MPH, of the UH Cancer Center, looked at self-reported physical activity data and past-30-day cigarette smoking and e-cigarette use among 2401 college students on O`ahu. Higher levels of moderate and vigorous physical activity were linked with lower cigarette and e-cigarette use at a given time. However, higher physical activity at baseline was associated with increased e-cigarette use six months later. The findings suggest the relationship between cigarettes and physical activity differs from that between e-cigarette use and physical activity, the researchers concluded. The study (PubMed ID: 31193540) is published in the American Journal of Preventive Medicine.

PRE-EXPOSURE PROPHYLAXIS MEDICATIONS MAY PROTECT THE BRAIN

Pre-exposure prophylaxis (PrEP) medications, which can prevent human immunodeficiency virus (HIV) infection, may also protect the brain against the inflammation that can occur with HIV infection. Researchers including Joanna Kettlewell BS, of the John A. Burns School of Medicine, looked at an in vitro model of the blood-brain barrier populated with blood cells from HIV-negative participants who had recently initiated PrEP. Results showed that both the traditional PrEP medications (emtricitabine and tenofovir) as well as the PrEP medications plus an additional receptor inhibitor (Maraviroc) reduced the percentage of monocytes that were able to cross the blood-brain barrier, suggesting that PrEP protects the brain against inflammation. The paper (PubMed ID: 31828733) is published as a letter to the editor in Journal of Neuroimmune Pharmacology.

ENTERIC VIRUSES AND WATER QUALITY MONITORING

Water quality monitoring usually involves testing for fecal coliform bacteria species, but not enteric viruses, which can also cause infections. Researchers including Yuanan Lu PhD, of the Office of Public Health Studies, developed a testing method and used it to evaluate water from Poyang Lake, China’s largest freshwater lake, for three types of bacteria and several enteric viruses using two viral detection protocols. The detection of enteric viruses showed no significant correlation with bacteria indicators, suggesting enteric viruses can serve as an additional water quality indicator. In addition, the virus detection protocol developed at the Tianjin Institute of Health and Environmental Medicine was lengthy, but produced measurements of virus concentrations, whereas the method Lu’s team developed saved time but produced only qualitative results. This has relevance to Hawai`i given the importance of water quality to the state. The paper (PubMed ID: 31547457) is published in the International Journal of Environmental Research and Public Health.
The Relationship Between Food Deserts, Farmers’ Markets, and Food Assistance Programs in Hawai‘i Census Tracts

Andrea M. Brace PhD, CHES; Todd W. Moore PhD; and Todd L. Matthews PhD

Abstract

Due to inadequate resources and limited access to healthy foods, residents who live in food deserts struggle to maintain a healthful diet. Living in a food desert increases the risk of developing diet-related chronic diseases such as obesity. Local farmers’ markets serve as community-level interventions, bringing healthy food options to food deserts. This study explores the relationship between food deserts, placement of farmers’ markets, and availability of food assistance programs in the state of Hawai‘i. Data are from the 2017 United States Department of Agriculture (USDA) Food Access Research Atlas and the USDA Farmers’ Market Directory. Farmers’ market addresses were geocoded in ArcGIS 10.3. Descriptive statistics and spatial visualization were used to explore census tract level relationships. Of the Hawai‘i census tracts, 10% are food deserts. Sixteen of the 101 registered farmers markets are located within a food desert. Of these markets, 28.7% accept Farmers’ Market Nutrition Program coupons, 0% accept Women, Infants, and Children Fruit and Vegetable Checks, and 39.6% accept Supplemental Nutrition Assistance Program benefits. Fewer than 20% of farmers’ markets in Hawai‘i are located in food deserts, and few accept food assistance programs. Fresh food is less accessible to low-income residents in these areas and lack of access to fresh food is associated with diet-related chronic diseases. To reduce food insecurity, farmers’ markets could accept food assistance program funds. Additional farmers’ markets could be established in food deserts to increase availability of healthy food, thereby reducing the population’s risk of developing obesity and diet-related chronic diseases.

Keywords

food desert, farmers’ markets, food assistance programs, Hawai‘i, healthy food

Abbreviations/Acronyms

EBT = Electronic Benefits Transfer  
FMC = Farmers Market Coalition  
FMNP = Farmers Market Nutrition Program  
FNS = Food and Nutrition Service  
FVC = Fruit and Vegetable Checks  
LILA = low-income, low-access  
SFMNP = Seniors Farmers’ Market Nutrition Program  
SNAP = Supplemental Nutrition Assistance Programs  
US = United States  
USDA = United States Department of Agriculture  
WIC = Women, Infants and Children

Introduction

Limited access to healthy foods makes it difficult for residents in many low-income communities to maintain a well-balanced, nutritious diet. The United States Department of Agriculture (USDA) defines limited access to healthy foods as food insecurity. Therefore, a food desert is a geographic area that meets the USDA’s definition of food insecurity (low access and low-income). Food deserts are locations where residents live more than 1 mile in urban neighborhoods, and 10 miles or more in rural settings from a grocery store. Food deserts have become a prevalent problem in the United States (US), as approximately 54.4 million people (17.7%) are estimated to live within them.

The health of residents in food deserts is affected by the structure of the local food environment. Because residents lack access to fresh foods, they tend to purchase food from nearby locations—fast food restaurants, convenience stores, drugstores, and gas stations. Foods from these locations are often processed, pre-packaged, and high in calories, fat, sugar, sodium, and preservatives. The lack of access to fresh and nutritious foods fosters unhealthy eating habits, and therefore has the potential to increase the risk of overweight and obesity, diabetes, and other diet-related diseases such as hypertension and high cholesterol.

This issue is particularly concerning as the prevalence of obesity was 40% among US adults between 2015 and 2016 and the prevalence of diabetes was approximately 9% in 2016. In Hawai‘i, the prevalence of obesity was lower (approximately between 2012 and 2014), at 23% among adults. The self-reported prevalence of diabetes was approximately 9% in 2017. Overweight and obesity are preventable health conditions through diet modifications. A diet rich in fruits and vegetables, for example, can reduce the risk of overweight and obesity, as well as various other chronic diseases such as cardiovascular risk and certain cancers. Such a diet is difficult to afford and access for residents in food deserts. Studies have shown that living closer to a grocery store has the potential to increase intake of fruit and vegetables. Additionally, the prevalence of obesity is reduced in communities by 0.73 with a grocery store nearby.

Four of five counties in Hawai‘i are rural. However, 90% of Hawai‘i residents live in urban areas. Residents of urban food deserts, where grocery stores are more than one mile away, often need to walk to stores, or rely on friends, family, or public transportation to obtain fresh food. This problem is amplified for residents in rural food deserts, who often must travel ten to twenty miles to access fresh food. Distance-of-travel for fresh foods is a financial strain on many who live in food deserts. The lack of local food retailers is another factor that compounds the financial burden on the residents of food deserts.
Link Between Farmers’ Markets and Food Deserts

Between 1994 and 2014, the number of farmers’ markets in the US has grown at a compounded annual rate of 8.4%. Their growing popularity is due in part to an increased interest in fresh, local foods, as well as to the opportunity to interact directly with farmers. Farmers’ markets can provide communities with fresh fruits and vegetables, including recipients of food assistance. Farmers’ markets can also provide nutritional education and information on how to shop, preserve, and prepare food. As a result, the USDA recommends farmers’ markets as a community-level intervention to address food accessibility in food deserts. The USDA specifically notes farmers’ markets are “less expensive, require less space, and can be quicker to implement than programs that encourage new store development.”

However, farmers’ markets face obstacles when trying to succeed in low-income communities. They operate on a small budget making it difficult to advertise beyond social media. They also sell higher-priced food items in some locations, which can be a challenge for low-income residents. To help with the higher-priced items and support the development, improvement, and expansion of farmers’ markets, the USDA created the Farmers’ Market Promotion Program which advertises local farmers’ markets and promotes access to locally and regionally produced agricultural products. In addition, there are programs which aid low-income families. These programs include the Supplemental Nutrition Assistance Program (SNAP, formerly known as food stamps); the Farmers’ Market Nutrition Program (FMNP), which is associated with the Supplemental Nutrition Program for Women, Infants, and Children (WIC); and the Senior Farmers’ Market Nutrition Program (SFMNP). While food assistance programs are accepted at many farmers’ markets, they often are not accepted by those in rural food deserts, perhaps because of a lack of funding and/or electricity to equip Electronic Benefits Transfer (EBT) machines. The USDA covers the cost of EBT technology when it is used in retail stores such as grocery stores and mini marts. The USDA Food and Nutrition Service (FNS) and the Farmers Market Coalition (FMC) provide eligible farmers markets (ie, those that do not already have functioning EBT equipment or that received EBT equipment before May 2012) with free EBT equipment. The program is limited by the availability of funds, and is distributed on a first-come, first-serve basis. Other administrative costs that present obstacles include developing the process needed to successfully accept food assistance benefits at farmers’ markets; training market managers and farmers; hiring staff to work the EBT booths; promoting the food assistance programs; and reporting financial information responsibilities.

Eliminating food deserts has become a top priority in national-level food and nutrition policies. In particular, researchers have prioritized examining spatial inequalities to access healthy foods, along with changes in dietary habits. In line with this priority, this report explores the relationship between locations of farmers’ markets, participation in food assistance programs, and food desert status in Hawai’i. Hawai’i is a suitable state for analysis because approximately 370,000 residents of Hawai’i, including 127,000 children, live in food deserts. In 2014, over 193,000 residents of Hawai’i received SNAP benefits. The following research questions guide this report: (1) What is the relationship between location of farmers’ markets and food desert census tracts within Hawai’i; (2) What proportion of farmers’ markets in Hawai’i participate in food assistance programs; and (3) What is the average time farmers’ markets in Hawai’i are open, allowing residents to access their goods? By addressing these questions, this report provides a thorough understanding of the availability and effectiveness of food assistance programs through farmers’ markets.

Methods

Data sources include the 2017 USDA Food Access Research Atlas and the 2017 USDA Farmers Market Directory. The Food Access Research Atlas provides the following data: (1) census tract food desert designation across the US; (2) population data from the 2010 Census; (3) income data from the 2010 American Community Survey; and (4) food access data drawn from two 2010 lists of food stores selling all major categories of food. The linked datasets provide information to identify US residents who have low access to healthy food and are designated as low-income by the US Census Bureau (LILA). Low access for those in urban settings includes individuals who live more than one-half mile or 1 mile from a grocery store. Residents in rural settings who are low access live more than 10 miles or 20 miles from a grocery store. The maps display LILA data as LILA .05 & 10 for more conservative analysis (fewer people qualify), and LILA 1 & 20 for more inclusive analysis.

The USDA Farmers’ Market Directory is a self-reported registry of markets that provides a list of agricultural products for sale in physical locations at registered times. For each registered market, the USDA Farmers’ Market Directory provides the address, days and hours of operation, products, and the degree to which each market participates in food assistance programs.

Addresses of farmers’ markets were geocoded in ArcGIS 10.3. Quantitative data were analyzed using descriptive statistics in IBM SPSS Statistics version 21.0. Access to food programs, including the Farmers’ Market Nutrition Program (FMNP), WIC Fruit and Vegetable Checks (FVC), and Supplemental Nutrition Assistance Program (SNAP) were linked to farmers’ markets. These data were analyzed with the USDA Food Access Research Atlas tract data. Descriptive statistics and spatial visualization were used to analyze the relationship between locations of farmers’ markets, participation in food assistance programs, and food desert status by census tract in Hawai’i.
Results

Figure 1 shows locations of farmers’ markets in relation to food desert census tracts in Hawai‘i. There are 321 census tracts in Hawai‘i, and 10% of tracts were classified as food deserts. Food deserts were found scattered across the islands of Hawai‘i, Maui, and O‘ahu, and covering the entire islands of Lana‘i and Moloka‘i. There were 101 farmer’s markets registered in 2017, and 16% were located within a food desert tract. The 101 markets were located on the islands of Honolulu (44%), Hawai‘i (33%), Kaua‘i (14%), Maui (9%), and Moloka‘i (1%). The densest cluster of markets is on the island of O‘ahu in the Honolulu metropolitan area. Comparatively few appear in other areas with dense populations such as Hilo, Kailua, and Captain Cook on the Island of Hawai‘i. In rural areas, farmers’ markets are sparse.

Farmers’ markets were coded based on the availability of food assistance programs at each market (Figure 1). Within the state of Hawai‘i, 28 (28%) accept more than one type of food assistance program, 29 markets (29%) accept FMNP, zero (0%) accept FVC, 40 (40%) accept SNAP benefits, and 58 markets (57%) do not participate in any food assistance programs. Most of the markets that do not participate in any food assistance programs are located on Hawai‘i, Maui, and Kaua‘i Islands. On Hawai‘i Island, for example, none of the markets in Waimea-Pu‘u Anahulu, which is the food desert tract in the northwestern portion of the island, participate in food assistance programs. Similarly, none of the markets in and near the Spreckelsville and Hali‘imaile food desert tracts on Maui participate in any food assistance programs. Zero markets on Kaua‘i participate in food assistance programs. There are no food desert tracts on the Kaua‘i. In contrast to the markets on the other islands, most of the markets on O‘ahu participate, and many participate in two programs.

Approximately half (50 of the 101) of the farmers’ markets provide data on their months of operation, and all of these were open 12 months a year. Roughly 50% (49 of 101) also provide data on their hours of weekly operation. These markets operated between 1 and 65 hours per week, yielding a mean of 4.7 hours per week (median is 5 hours per week) and standard deviation
of 10.62 hours per week. Figure 2 indicates that most of the markets that were open more than 4 hours per week were located on Hawai‘i Island. Furthermore, most of these were within or proximate to tracts classified as food deserts. For example, multiple markets that are open 4.5–6 hours per week are located in the Waimea-Pu‘u Anahulu food desert tract on Hawai‘i Island. There are, similarly, multiple other markets open more than 4 hours per week within and near the food desert tracts on the northeastern portion of Hawai‘i Island. Most of the markets in Honolulu County on O‘ahu open 4 or fewer hours.

Discussion

This study integrated multiple datasets and used spatial analysis to examine essential community resources (ie, farmers’ markets) that can be used to improve access to fresh and healthy food, thus mitigating obesity in food deserts in the state of Hawai‘i. Food deserts are locations lacking traditional grocery stores, which offer constant, and affordable access to healthy foods. When grocery stores are absent, farmer’s markets can meet the needs of making fresh fruits and vegetables available. Fewer than 16% of farmers’ markets in Hawai‘i were found to be located in food deserts. Additionally, few of the markets on the islands of Hawai‘i, Maui, and Kaua‘i participate in any food assistance programs. Most of the markets on O‘ahu, however, participate in one or more food assistance programs. Accessing fresh food sold by farmers’ markets can present a major challenge for residents in food deserts. Another barrier to fresh food from farmers’ markets includes the limited hours of operations of many farmers’ markets throughout Hawai‘i. The mean hours-of-operation per week is only 4.7 hours, which could make it difficult to visit the markets. More than 80% of farmers’ markets that reported their hours of operation were open only one day a week. All of the markets were open 12 months a year.

Figure 2. Displays Food Desert Census Tracts within Hawai‘i and Farmers’ Market Locations Coded by Weekly Hours Each Market is Open for Business.
Residents of Hawai‘i, especially those on the islands of Hawai‘i, Maui, and Kaua‘i, who live in food deserts and depend on food assistance programs, have little access to fresh produce at farmers’ markets. Most of the markets on these islands do not participate in food assistance programs and their hours-of-operation are limited. This lack of fresh, healthy food is known to increase the risk of obesity and other diet-related chronic conditions. In Hawai‘i, lack of fresh and healthy food could be a contributor to overweight and obesity rate of 56.9% in 2017. In 2017, the national prevalence of overweight (35.3%) and obesity (31.6%) was 66.9%. In 2017, prevalence of diabetes in Hawai‘i was 9.2%.19

Healthy, affordable food must become accessible to reduce food insecurity in food deserts. Providing access via brick and mortar food retailers that offer fresh food and participate in food assistance programs would be ideal.47 However, due to a myriad of barriers, traditional grocery stores are not always a feasible solution to food accessibility.48 These barriers may include lack of supermarket interest in being in urban environments, economics, and availability of land.48

Farmers’ markets can provide fresh food to residents of food deserts. The authors recommend that more farmers’ markets should be established in low income areas with low access to fresh food. To ensure the barrier of increased cost of fresh, healthy food is reduced, increased acceptance of food assistance programs across the state could also be a positive factor in reducing food insecurity, particularly by utilizing EBT technologies. Additionally, emulation of partnerships such as those formed between farmers markets and the GreenWheel Food Hub in Honolulu could dramatically expand the overall health impact of the healthy foods sold at farmers markets.49 GreenWheel is building “micro markets” to expand the farmers markets to those who are unable to reach them, including residents of senior living facilities who lack mobility and low-income individuals who live in more remote rural locations.49 These socially entrepreneurial activities that involve public-private partnerships are a critical component of what is needed to promote sustainable change in this space, particularly as public investment in health promotion and prevention is significantly lagging. For a state like Hawai‘i, in which upwards of 90% of food is imported from thousands of miles away at a great cost,50 such local initiatives are critical if a serious reduction in food insecurity is to be attained.

Conflict of Interest

None of the authors identify any conflict of interest.

Acknowledgements

We would like to thank the Towson University Center for GIS and the College of Health Professions for supporting this project.

Authors’ Affiliations:
- Department of Health Sciences, Towson University, Towson, MD (AMB)
- Department of Geography and Environmental Planning, Towson University, Towson, MD (TWM)
- Department of Leadership and Organizational Development, Cabrini University, Radnor, PA (TLM)

Correspondence to:
Andrea M. Brace PhD; Department of Health Science, Towson University, 8000 York Road, Towson, MD 21252; Email: abrace@towson.edu

Another important consideration involves a broader critique that has emerged in the social science literature regarding the potential efficacy of farmers markets themselves as a means of addressing issues of food deserts.41-44 This critique has two primary dimensions. First, food deserts are not the primary causal factor, but instead result from concentrated poverty. This could indicate that access to nutritious food in a high poverty area will not necessarily result in the population being able to afford access to these new offerings.45,44 Thus, the emergence of new farmers markets should not be seen as a panacea to overcoming the broader issues of poverty plaguing census tracts, counties, or entire regions. Second, farmers markets have been criticized as being largely white, middle to upper class spaces.45,46,47,48 As such, non-whites or people of more modest socioeconomic background may feel unwelcome at farmers markets, which might result in the unintended intensification of the divide in access to, and consumption of, healthier foods. To overcome this issue, conscious efforts at inclusion of potentially marginalized populations should be undertaken through advertising and direct engagement with important voices in all communities near the farmers market.

Donald K. Hayes MD MPH; Ellen O. Boundy ScD, MS, RN, CNM; Heidi Hansen-Smith BA; and Carol L. Melcher MPH, RN

Abstract

Breastfeeding provides optimal nutrition for infants, including short- and long-term health benefits for baby and mother. Maternity care practices supporting breastfeeding after delivery increase the likelihood of exclusive breastfeeding. This study explores trends in early infant feeding practices by maternal race and other characteristics in Hawai‘i. Data from a linked 2008–2015 Hawai‘i Newborn Metabolic Screening and Birth Certificate file for 128,399 singleton term infants were analyzed. Early infant feeding occurring 24–48 hours after delivery and before discharge was categorized: Early formula feeding; early mixed feeding; and early exclusive breastfeeding. Differences were assessed over time by maternal race and other socio-demographic characteristics. Further assessment of maternal race included a generalized logit model adjusting for maternal age, marital status, county of residence, type of birth attendant, and birth year. Statewide, early exclusive breastfeeding increased from 58.8% in 2008 to 79.1% in 2015 (relative increase=+35%); early mixed feeding declined from 31.1% to 16.0% (relative decrease=-49%) and early formula feeding declined from 10.1% to 4.9% (relative decrease=-51%). Most maternal race subgroups experienced increases in early exclusive breastfeeding and decreases in mixed and formula. Japanese mothers were 2.15 (95%CI=1.90–2.42) and Korean mothers were 1.73 (95%CI=1.37–2.18) times more likely to practice early exclusive breastfeeding compared with white mothers. Several subgroups were less likely to practice early exclusive breastfeeding compared with white mothers. Substantial increases in early exclusive breastfeeding in Hawai‘i occurred across all subgroups. Development of culturally appropriate hospital practices, particularly in those with persistently lower estimates, could help improve early exclusive breastfeeding.

Keywords

early infant feeding, breastmilk, disparities, exclusive breastfeeding, Native Hawaiian, Other Pacific Islanders, Asians, Hawai‘i

Abbreviations

NHOPI = Native Hawaiian or Other Pacific Islander
OHSM = Office of Health Status and Monitoring
PRAMS = Pregnancy Risk Assessment Monitoring System
WIC = Special Supplemental Nutrition Program for Women, Infant, and Children

Background

Breastfeeding is cost-effective and provides medical, nutritional, developmental, psychological, social, economic, and environmental advantages for the health of both mother and child. In contrast, formula-fed children may require more doctor visits and are at higher risk for childhood obesity, diabetes, asthma, and other health issues. To increase the uptake of breastfeeding, several organizations endorse its benefits. For example, the American Academy of Pediatrics, American College of Obstetricians and Gynecologists, and the American Academy of Family Physicians promote exclusive breastfeeding for approximately the first 6 months after delivery, followed by continued breastfeeding with complementary foods introduction, and ongoing support of breastfeeding for at least one year or as long as mutually desired by mother and child.

The Ten-Steps to Successful Breastfeeding (Ten-Steps) is accepted as the standard of care for maternity care in hospitals in establishing and promoting breastfeeding. These steps are a set of evidence-based practices that improve the maternity care provided to patients in the hospital that support optimal breastfeeding outcomes and include: written policies; ensure appropriate training of staff; inform all pregnant women on the benefits and management of breastfeeding; timely initiation of breastfeeding; ensure women are educated on maintaining lactation; ensure no food or drink other than breast milk are provided to infants unless medically indicated; practice rooming in (sharing a bedroom with the infant); encourage breastfeeding on demand; no use of teats or pacifiers; and foster breastfeeding support groups that women can access upon discharge.

In 2010, the Hawai‘i State Department of Health developed an initiative to promote breastfeeding using the Ten-Steps through the Baby-Friendly Hawai‘i Project. This project improves maternity care practices in the critical early postpartum period by supporting health systems through staff training and on-going technical assistance to all birthing hospitals in the State. In 2011 the US Surgeon General Call to Action outlined many barriers to breastfeeding. The report included a lack of maternal knowledge on the benefits of breastfeeding, social norms favorable toward formula feeding, embarrassment, lactation problems, poor family and social support, lack of supportive environments at work, and health services-related barriers. Health services related barriers included the early hospital experience of breastfeeding. The Call to Action included the Ten-Steps to Successful Breastfeeding (Ten-Steps) in the final recommendations.

There are about 18,000 births annually amongst a population of nearly 1.4 million people in Hawai‘i. Hawai‘i is composed of a diverse population that may have differences in early infant feeding. Analysis of data collected in the state of Hawai‘i of-
fers an opportunity to understand differences in breastfeeding initiation or early experience of feeding among a wide variety of racial and ethnic subgroups including Asian and Native Hawaiian or Other Pacific Islander (NHOPI) subgroups. Asians and NHOPI are a diverse population consisting of several distinct subgroups with different characteristics that include language, occupations, culture, and length of residence in the United States.13-14

A Hawai’i Pregnancy Risk Assessment Monitoring System (PRAMS) study based on 2004-2008 data, prior to implementation of the Baby-Friendly Hawai’i Project, highlighted that Asian and NHOPI subgroups were less likely to exclusively breastfeed at least 8 weeks compared to white mothers.15 The study highlighted differences among the Asian and NHOPI subgroups at 8 weeks. However, it is unknown whether there are differences in early infant feeding experience in the hospital at the population level among the diverse race groups in Hawai’i.

An overall increase occurred statewide in early exclusive breastfeeding, indicated by Newborn Metabolic Screening data in Hawai’i between 2009 and 2014, covering the time since the Baby-Friendly Hawai’i Project started.16 However, it is unclear if these improvements were seen across various maternal race and other characteristic subgroups. The aims of this paper are to report the trends in early infant feeding practices by maternal race and other characteristics in Hawai’i and to explore further some differences in early infant feeding practices in maternal race compared with white mothers accounting for the other characteristics.

**Methods**

This is a retrospective, cross-sectional descriptive secondary analysis of de-identified linked data provided to the researcher after the linkage was completed. The analysis was considered as exempt from Institutional Review Board approval by the Hawai’i State Department of Health.

The Hawai’i Newborn Metabolic Screening Program collects information and a blood spot specimen to identify 33 rare metabolic conditions early for appropriate counseling and referral to treatment among families with affected newborns. The Hawai’i State Department of Health Office of Health Status and Monitoring (OHSN) collects vital statistics for the state on all births. Linkage of birth certificate and metabolic screening data based on patient identifiers (eg, names, dates, weight, times, institution) using a combination of 3-4 variables per each of 15 iterations was done by staff at OHSM. For the time period included in this manuscript, the linkage rate between the two sources was 99.4% (n=963 not linked). A de-identified analytic file covering data collected for births from 2008-2015 was provided to the researchers for analysis. A total of 150 589 births were identified in the linked data set. Information on early infant feeding was obtained from the Newborn Metabolic Screening program data while maternal race, other socio-demographic, and some clinical based information such as gestational age, birthweight, delivery method, and maternal factors complicating delivery were included in the linked OHSN birth certificate file. Analysis was limited to term singleton deliveries (gestational age ≥37 weeks) to minimize concerns about a multiple gestation or preterm infants having medical concerns that could influence early infant feeding. The potential samples of 132 867 were available for analysis.

The protocol for the Newborn Metabolic Screening test is to collect the blood spot specimen and other information between 24 and 48 hours post-delivery for both hospital and out of hospital births. Infant feeding information is based on an assessment of the last 24 hours at time of newborn metabolic testing. If an infant is discharged less than 24 hours after delivery, the specimen and other information is collected at time of discharge. Infant feeding practices were based on reporting at discharge. The information on infant feeding was categorized into three mutually exclusive categories used for analysis in this paper: Early exclusive breastfeeding (ie, received only human milk in the last 24 hours), early mixed feeding (ie received both human milk and formula, though not necessarily at the same time, during the last 24 hours), and early formula feeding (ie, received only infant formula in the last 24 hours). There were 4468 excluded records with a feeding status of “Other,” Nil per Os (“NPO”) or nothing by mouth, “Tube Feeding,” or missing, resulting in the final study sample of 128 399 observations.

The Hawai’i birth certificate collects information on all reported race groups at delivery for both parents. This information is converted to 1 of 22 single race groups by an algorithm implemented by OHSN.16 The algorithm prioritizes Hawaiian for those that list multiple race groups, followed by the first non-Caucasian race reported. Thus, those that report being Hawaiian in combination with another race group would be considered part-Hawaiian. All other multiple race groups without Hawaiian listed are coded to a single race group in the algorithm. For consistency with race reporting in Hawai’i, this analysis combines part-Hawaiian and Hawaiian single race groups together, referred to as Native Hawaiian. The 22 maternal single race groups provided by OHSN were categorized into 9 total race groups for this analysis which reflected those commonly reported in Hawai’i, and to ensure sufficient sample size for reliable estimates: white (Caucasian), black, Native Hawaiian (Hawaiian and part-Hawaiian), Samoan, Filipino, Japanese, Chinese, Korean, and all others (including Vietnamese, Asian Indian, Other Asian, Guamanian/Chamorro, other Pacific Islander, Puerto Rican, Portuguese, Cuban, Mexican, American Indian/Alaskan Native, all others). Maternal race was used for this analysis to be consistent with general reporting of birth outcomes by race.

Maternal age, calculated by mother’s age upon birth of the infant, was categorized into the following 5 year age groups other than at tails which included commonly used categories and ensured at least 10% in the youngest group: Under 20, 20–24, 25–29,
30–34, and 35 or more years. Marital status was considered married or unmarried as reported at time of delivery on the birth certificate. Birth attendant was categorized as physician, midwife, or other. The other group may include out of hospital deliveries attended by bystanders, non-licensed providers, or where the attendant is unknown, but that specific level of detail was not available in analytic data set. Resident zip code, as collected in the birth certificate data, was used to categorize into the four counties of residence in the State.

Annual estimates for the prevalence of each feeding type and bivariate associations with maternal race, maternal age, marital status, type of birth attendant, and county of residence were calculated. Relative changes from 2008 to 2015 were calculated for each feeding type overall and among all maternal race and other subgroups. The Cochran-Armitage Trend test assesses unadjusted trends in prevalence over time for each outcome (ie, early exclusive breastfeeding, early mixed feeding, and early formula feeding) overall and among all subgroups.

To assess trends over time in each maternal race subgroup while accounting for other factors, individual generalized logit modeling determined crude and adjusted odd ratios for early exclusive breastfeeding and early mixed feeding compared with the reference group of early formula feeding for each maternal race subgroup. The models for each maternal race subgroup were performed with birth year as a primary predictor (categorical with comparison from 2015 to 2008) with adjustment for maternal age, marital status, birth attendant, and county of residence. The factors were selected based on their availability in the database and review of the general literature as possible predictors of infant feeding. For simplicity, only the results of the birth year odds ratios stratified by maternal race for early exclusive breastfeeding compared with formula feeding are shown in the manuscript.

To assess differences among maternal race subgroups for the entire time period of the study while accounting for the influence of these other factors, a generalized logit model was developed with maternal race subgroup as the primary predictor and adjustment for the other factors noted previously for the trend model along with using birth year as a categorical variable. SAS version 9.4 (SAS Institute, Inc., Cary, North Carolina) was used for analysis with a two-tailed P-value of <.05 considered statistically significant.

**Results**

Within the final analytic sample (N=128,399), nearly two-thirds of births were to mothers who identified within the following race groups: Native Hawaiian (26.8%), white (23.7%), and Filipino (16.9%; Table 1). Over half the births were to mothers who were 25-29 (28.1%) or 30-34 (25.3%) years of age. Nearly two-thirds of the births were to married (62.7%) mothers and nearly all births were delivered by a physician (89.6%). Nearly three-quarters of the births in the sample were to mothers residing in Honolulu County (71.9%).

Statewide, the prevalence of early exclusive breastfeeding increased from 58.8% in 2008 to 79.1% in 2015 (a relative increase of +35%; Table 2). Early exclusive breastfeeding increased among all maternal race groups with Samoan mothers having the largest relative increase (+71%), followed by all others.*

**Table 1. Maternal Race and Other Characteristics, 2008–2015 (N=128,399)**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maternal Race</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>white</td>
<td>30,370</td>
<td>23.7</td>
</tr>
<tr>
<td>black</td>
<td>3,503</td>
<td>2.7</td>
</tr>
<tr>
<td>Native Hawaiian</td>
<td>34,326</td>
<td>26.8</td>
</tr>
<tr>
<td>Samoan</td>
<td>3,325</td>
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</tr>
<tr>
<td>Filipino</td>
<td>21,683</td>
<td>16.9</td>
</tr>
<tr>
<td>Japanese</td>
<td>12,031</td>
<td>9.4</td>
</tr>
<tr>
<td>Chinese</td>
<td>5,486</td>
<td>4.3</td>
</tr>
<tr>
<td>Korean</td>
<td>2,377</td>
<td>1.9</td>
</tr>
<tr>
<td>All others</td>
<td>15,048</td>
<td>11.7</td>
</tr>
<tr>
<td>Missing</td>
<td>250</td>
<td></td>
</tr>
<tr>
<td><strong>Maternal Age</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20 years</td>
<td>12,810</td>
<td>10.0</td>
</tr>
<tr>
<td>20–24 years</td>
<td>24,607</td>
<td>19.2</td>
</tr>
<tr>
<td>25–29 years</td>
<td>36,046</td>
<td>28.1</td>
</tr>
<tr>
<td>30–34 years</td>
<td>32,499</td>
<td>25.3</td>
</tr>
<tr>
<td>35 years and older</td>
<td>22,330</td>
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</tr>
<tr>
<td>Missing</td>
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<td></td>
</tr>
<tr>
<td><strong>Marital Status</strong></td>
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<td></td>
</tr>
<tr>
<td>Married</td>
<td>80,518</td>
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</tr>
<tr>
<td>Unmarried</td>
<td>47,878</td>
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</tr>
<tr>
<td>Missing</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td><strong>Birth Attendant</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td>114,936</td>
<td>89.6</td>
</tr>
<tr>
<td>Midwife</td>
<td>12,516</td>
<td>9.8</td>
</tr>
<tr>
<td>Other</td>
<td>894</td>
<td>0.7</td>
</tr>
<tr>
<td>Missing</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td><strong>County of Residence</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawai‘i</td>
<td>16,281</td>
<td>12.9</td>
</tr>
<tr>
<td>Honolulu</td>
<td>90,605</td>
<td>71.9</td>
</tr>
<tr>
<td>Kaua‘i</td>
<td>5,634</td>
<td>4.5</td>
</tr>
<tr>
<td>Maui</td>
<td>13,528</td>
<td>10.7</td>
</tr>
<tr>
<td>Missing</td>
<td>2,351</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Data source is the Newborn Metabolic Screening-Linked Birth Certificate File. Individual subgroup column totals may not sum to overall total due to missing/unknown data and row percentages may not sum to 100% due to rounding.

*All others include Vietnamese, Asian Indian, other Asian, Guamanian/Chamorro, other Pacific Islander, Puerto Rican, Portuguese, Cuban, Mexican, American Indian/Alaskan Native, and all others.
Table 2. Relative Changes in Early Infant Feeding* by Maternal Race and Other Characteristics, 2008–2015

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Early Exclusive Breastfeeding</th>
<th>Early Mixed Feeding</th>
<th>Early Formula Feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2008 %</td>
<td>2015 %</td>
<td>Relative Change</td>
</tr>
<tr>
<td>Maternal Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>white</td>
<td>75.9</td>
<td>87.7</td>
<td>16%</td>
</tr>
<tr>
<td>black</td>
<td>59.6</td>
<td>72.9</td>
<td>22%</td>
</tr>
<tr>
<td>Native Hawaiian</td>
<td>52.6</td>
<td>76.0</td>
<td>44%</td>
</tr>
<tr>
<td>Samoan</td>
<td>37.1</td>
<td>63.4</td>
<td>71%</td>
</tr>
<tr>
<td>Filipino</td>
<td>52.0</td>
<td>77.4</td>
<td>49%</td>
</tr>
<tr>
<td>Japanese</td>
<td>67.1</td>
<td>87.4</td>
<td>30%</td>
</tr>
<tr>
<td>Chinese</td>
<td>63.1</td>
<td>74.5</td>
<td>18%</td>
</tr>
<tr>
<td>Korean</td>
<td>66.1</td>
<td>83.9</td>
<td>27%</td>
</tr>
<tr>
<td>All othersa</td>
<td>45.8</td>
<td>70.7</td>
<td>54%</td>
</tr>
<tr>
<td>Maternal Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;20 years</td>
<td>51.1</td>
<td>77.2</td>
<td>51%</td>
</tr>
<tr>
<td>20–24 years</td>
<td>55.4</td>
<td>77.4</td>
<td>40%</td>
</tr>
<tr>
<td>25–29 years</td>
<td>59.9</td>
<td>78.7</td>
<td>31%</td>
</tr>
<tr>
<td>30–34 years</td>
<td>62.7</td>
<td>81.3</td>
<td>30%</td>
</tr>
<tr>
<td>35 years and older</td>
<td>61.4</td>
<td>79.2</td>
<td>29%</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>64.2</td>
<td>81.6</td>
<td>27%</td>
</tr>
<tr>
<td>Unmarried</td>
<td>49.7</td>
<td>74.9</td>
<td>51%</td>
</tr>
<tr>
<td>Birth Attendant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physician</td>
<td>57.7</td>
<td>77.5</td>
<td>34%</td>
</tr>
<tr>
<td>Midwife</td>
<td>70.6</td>
<td>90.5</td>
<td>28%</td>
</tr>
<tr>
<td>Other</td>
<td>69.7</td>
<td>88.2</td>
<td>27%</td>
</tr>
<tr>
<td>County of Residence</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hawai‘i</td>
<td>59.1</td>
<td>71.5</td>
<td>21%</td>
</tr>
<tr>
<td>Honolulu</td>
<td>58.2</td>
<td>79.4</td>
<td>36%</td>
</tr>
<tr>
<td>Kauai</td>
<td>80.3</td>
<td>92.5</td>
<td>15%</td>
</tr>
<tr>
<td>Maui</td>
<td>52.7</td>
<td>81.1</td>
<td>54%</td>
</tr>
<tr>
<td>Overall</td>
<td>58.8</td>
<td>79.1</td>
<td>35%</td>
</tr>
</tbody>
</table>

Notes: Data source is the Newborn Metabolic Screening-Linked Birth Certificate File. Individual subgroup column totals may not sum to overall total due to missing/unknown data and row percentages may not sum to 100% due to rounding.

*Early is based on time of newborn metabolic screening test, less than 48 hours from discharge.


Trend p-value based on Cochrane-Armitage Trend Test

All others include Vietnamese, Asian Indian, other Asian, Guamanian/Chamorro, other Pacific Islander, Puerto Rican, Portuguese, Cuban, Mexican, American Indian/Alaskan Native, and all others.

Others (+54%), Filipino (+49%), and Native Hawaiian (+44%) mothers (Table 2 and Figure 1). Increases in early exclusive breastfeeding were also seen across all characteristic subgroups categorized by maternal age, marital status, birth attendant, and county of residence (Table 2).

Conversely, the prevalence of early mixed feeding decreased from 31.1% in 2008 to 16.0% in 2015 (a relative decrease of -49%; Table 2). Early mixed feeding declined among all maternal race groups with Japanese mothers having the largest relative decrease (-61%), followed by Filipino (-53%), Korean (-52%), and Native Hawaiian (-48%) mothers (Table 2 and Figure 2). Declines in early mixed feeding were also seen across all characteristic subgroups categorized by maternal age, marital status, birth attendant (except other birth attendant), and county of residence (Table 2).

Statewide, the prevalence of early formula feeding decreased from 10.1% in 2008 to 4.9% in 2015 (a relative decrease of -51%; Table 2). Early formula feeding declined among all maternal

HAWAII JOURNAL OF HEALTH & SOCIAL WELFARE, FEBRUARY 2020, VOL 79, NO 2
Figure 1. Early Exclusive Breastfeeding by Maternal Race, Hawai‘i Newborn Metabolic Screening-Linked Birth Certificate, File, 2008-2015

Figure 2. Early Formula Feeding by Maternal Race, Hawai‘i Newborn Metabolic Screening-Linked Birth Certificate File, 2008-2015
race groups (except Korean mothers) with Japanese mothers having the largest relative decrease (-65%; Table 2 and Figure 3). Declines in early formula feeding were also seen across all characteristic subgroups categorized by maternal age, marital status, birth attendant, and county of residence (Table 2).

Overall, there was a 2.78 times greater odds of early exclusive breastfeeding versus early formula feeding in 2015 compared to 2008 after adjustment for maternal race, maternal age, marital status, birth attendant, and county of residence (Table 3). Additionally, within each maternal race subgroup, adjusted odds ratios indicated women who delivered in 2015 were more likely to practice early exclusive breastfeeding than early formula feeding compared with women who delivered in 2008 (Table 3).

In the generalized logit model to compare differences by maternal race subgroups, Japanese and Korean mothers were more likely to practice early exclusive breastfeeding (reference=early formula feeding) compared with white mothers after adjusting for maternal age, marital status, birth attendant, county of residence, and birth year (Table 4). However, Samoan, Black, Native Hawaiian, Filipino, Chinese, and all others were all less likely to practice early exclusive breastfeeding compared with white mothers. In the adjusted analysis for early mixed feeding (reference=early formula feeding), Japanese, Korean, Filipino, Chinese, Native Hawaiian, Samoan, and all others were more likely to practice early mixed feeding compared with white mothers.

**Table 3. Overall and Individual Maternal Race Subgroups Logistic Regression Models of Early Exclusive Infant Feeding for Birth year 2015 compared with 2008, 2008-2015**

<table>
<thead>
<tr>
<th>Maternal Race</th>
<th>Crude OR (95% CI)</th>
<th>Adjusted OR* (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>white</td>
<td>2.60 (2.11 - 3.21)</td>
<td>2.41 (1.95 - 2.99)</td>
</tr>
<tr>
<td>black</td>
<td>2.40 (1.54 - 3.72)</td>
<td>2.11 (1.35 - 3.32)</td>
</tr>
<tr>
<td>Native Hawaiian</td>
<td>2.97 (2.55 - 3.46)</td>
<td>3.05 (2.60 - 3.56)</td>
</tr>
<tr>
<td>Samoan</td>
<td>3.59 (2.35 - 5.49)</td>
<td>3.48 (2.23 - 5.44)</td>
</tr>
<tr>
<td>Filipino</td>
<td>3.17 (2.53 - 3.97)</td>
<td>3.29 (2.62 - 4.13)</td>
</tr>
<tr>
<td>Japanese</td>
<td>3.79 (2.34 - 6.13)</td>
<td>3.80 (2.29 - 6.31)</td>
</tr>
<tr>
<td>Chinese</td>
<td>1.97 (1.26 - 3.10)</td>
<td>2.20 (1.39 - 3.46)</td>
</tr>
<tr>
<td>Korean</td>
<td>2.98 (1.04 - 8.49)</td>
<td>2.68 (0.93 - 7.74)</td>
</tr>
<tr>
<td>All others†</td>
<td>2.77 (2.12 - 3.82)</td>
<td>2.97 (2.26 - 3.89)</td>
</tr>
<tr>
<td>Overall</td>
<td>2.80 (2.56 - 3.06)</td>
<td>2.78 (2.54 - 3.05)</td>
</tr>
</tbody>
</table>

Note: Data source is the Newborn Metabolic Screening-Linked Birth Certificate File. Individual models for each Maternal Race group and overall were used to assess trend difference between 2015 and 2008.

*CI denotes Confidence interval around the odds ratio estimate

†Individual models were adjusted for maternal age, marital status, birth attendant, and county of residence

‡All others include Vietnamese, Asian Indian, other Asian, Guamanian/Chamorro, other Pacific Islander, Puerto Rican, Portuguese, Cuban, Mexican, American Indian/Alaskan Native, and all others.

<table>
<thead>
<tr>
<th>Maternal Race</th>
<th>Early Exclusive Breastfeeding</th>
<th>Early Mixed Feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crude OR (95% CI)</td>
<td>Adjusted OR (95% CI)</td>
</tr>
<tr>
<td>white</td>
<td>ref ref</td>
<td>ref ref</td>
</tr>
<tr>
<td>black</td>
<td>0.44 (0.39–0.50)</td>
<td>0.48 (0.42–0.54)</td>
</tr>
<tr>
<td>Native Hawaiian</td>
<td>0.44 (0.42–0.47)</td>
<td>0.57 (0.53–0.61)</td>
</tr>
<tr>
<td>Samoan</td>
<td>0.20 (0.18–0.23)</td>
<td>0.25 (0.23–0.28)</td>
</tr>
<tr>
<td>Filipino</td>
<td>0.68 (0.63–0.73)</td>
<td>0.80 (0.74–0.86)</td>
</tr>
<tr>
<td>Japanese</td>
<td>1.77 (1.58–1.99)</td>
<td>2.15 (1.90–2.42)</td>
</tr>
<tr>
<td>Chinese</td>
<td>0.74 (0.66–0.84)</td>
<td>0.83 (0.73–0.94)</td>
</tr>
<tr>
<td>Korean</td>
<td>1.54 (1.22–1.94)</td>
<td>1.73 (1.37–2.18)</td>
</tr>
<tr>
<td>All others*</td>
<td>0.55 (0.51–0.59)</td>
<td>0.65 (0.60–0.71)</td>
</tr>
</tbody>
</table>

Note: Data source is the Newborn Metabolic Screening-Linked Birth Certificate File. Formula Feeding is the referent comparison group for each outcome.

CI denotes Confidence interval around the odds ratio estimate.

*Adjusted for maternal age, marital status, birth attendant, county of residence, and birth year.

*All others include Vietnamese, Asian Indian, other Asian, Guamanian/Chamorro, other Pacific Islander, Puerto Rican, Portuguese, Cuban, Mexican, American Indian/Alaskan Native, and all others.

Discussion

These findings highlight early infant feeding patterns among a diverse subgroup of maternal races not previously described in the general literature. There was an overall improvement in early exclusive breastfeeding and declines in early mixed feeding and in early formula feeding among almost all maternal race subgroups in Hawai‘i from 2008–2015. Further evaluation identified some persistent differences in maternal race subgroups. Additionally, there were improvements in early exclusive breastfeeding for other socio-demographic characteristics in the unadjusted analysis.

There are likely several factors contributing to the noted improvements in early infant feeding patterns seen among maternal race subgroups. In 2010, the Baby Friendly Hawai‘i Project started promoting breastfeeding support in hospitals, through maternity care practices without giving specific attention to high-risk populations. The study results, showing improvement in all maternal race and other subgroups, support the premise that this system level change helped improve early infant feeding rates for all women. Additionally, other system level factors including the establishment of Joint Commission measures in 2010 for breastfeeding at hospitals or other smaller scale interventions may have contributed to this large-scale improvement. The increasing awareness of the benefits of breastfeeding in society over time also likely contributed to the improvement. The descriptive nature of this study does not allow further exploration but are briefly mentioned here. For example, breastfeeding is promoted though legislative laws to protect the ability of women to breastfeed in the workplace and in public. The Hawai‘i’s Special Supplemental Nutrition Program for Women Infants and Children (WIC) provides education on infant feeding to nearly half the mothers in the state on breastfeeding and supports policy and workplace efforts across the state.

Despite the overall significant improvement noted, some notable differences remain in early infant feeding patterns, among maternal race subgroups. Understanding the reasons for these differences could help inform the development of programs to address disparities. Rates of breastfeeding change as immigrant populations become acculturated to living in the United States. Other key factors including employment where breastfeeding is not supported and general societal expectations are also important for breastfeeding. Finally, other factors including health literacy may also be related to early infant feeding as it has been associated with other perinatal outcomes in Hawai‘i including low birth weight, cesarean delivery, obstetric trauma, medical decision making, and vaginal birth after cesarean and in other settings for breastfeeding. Understanding and learning from differences within the diverse race groups in Hawai‘i is challenging but clarifying the influence due to immigration, acculturation, health literacy, employment, and cultural factors through both quantitative and qualitative approaches could be helpful in developing targeted interventions among these particular subgroups.

The accuracy of the feeding pattern reported on the Newborn Metabolic Screening data and the quality of the data collection may vary from hospital to hospital and for births outside a hospital potentially influencing our results. Additionally, the analysis is based on the feeding pattern noted within the first 24–48 hours of life only, but this is a critical time period that is predictive of future breastfeeding patterns. This analysis was limited to term newborns to minimize concerns about...
medical conditions associated with prematurity that could influence early breastfeeding, but overall results without this exclusion demonstrated very similar patterns and rates (data not shown). Moreover, race was based on the maternal single race provided by OHSM, which limits the ability to generalize these results to all Asian and NHOPI subgroups particularly due to the inability to separate out those women who were of more than 1 race. Additionally, the number of births among some of the other smaller Asian or NHOPI subgroups were too small (ie, Vietnamese, Micronesian) to be analyzed and may result in different patterns. Moreover, race is a social construct that is not even homogenous within a population and thus there are limitations on its use to characterize populations. Further, the ability to look at the combination of mother and father race or of proportions of various race groups for those that were multi-race were not possible with the data provided. Other limitations include the lack of ability to look at other social determinants (ie, income, household federal poverty level, and insurance status) and cultural practices that likely influence infant feeding patterns. The data did not include a woman’s past experience with breastfeeding or familial support of breastfeeding, which are both important predictors for breastfeeding experience and continuation.\textsuperscript{20,39,40} Finally, this study was based on a diverse population in Hawai’i and although many of these same populations live in communities across the country, these results may not be generalizable to those populations due to acculturation and cultural differences from those found outside Hawai’i. However, these results may provide insight into early infant feeding patterns in these subgroups, and it will be important to validate these results in other states.

**Conclusions**

There was substantial improvement in early exclusive breastfeeding in the state of Hawai’i, coinciding with systemic changes implemented by hospitals. However, some persistent disparities exist among maternal race groups. Further understanding of reasons why certain maternal race subgroups continue to have lower while others have high estimates of early exclusive breastfeeding may help in the development of culturally appropriate hospital practices to address disparities in early infant feeding in Hawai’i.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention or the Hawai’i State Department of Health.

**Conflict of Interest**

None of the authors identify a conflict of interest.

**Disclosure**

Donald Hayes initiated his work on the reported research while affiliated with the Hawai’i State Department of Health. Currently, he is affiliated with the Centers for Disease Control and Prevention’s Division for Heart Disease and Stroke Prevention. The research in this manuscript was completed and submitted outside of the official duties of his current position.

**Acknowledgements**

BFHP was funded by Cooperative Agreement CDC-RFA-DP09-90101ARRA09, from the Centers for Disease Control and Prevention Communities Putting Prevention to Work (CPPW) and the Healthy Hawai’i Initiative Tobacco Settlement Special Fund. We would like to thank the Hawai’i State Department of Health, Newborn Metabolic Screening Program for providing the Newborn Metabolic Screening data that we used in this manuscript and the Hawai’i State Department of Health, Office of Health Status and Monitoring for conducting the linkage and providing the information from the birth certificate used in this analysis. The authors would like to thank Ms. Meghan McGurk from the University of Hawai’i, Office of Public Health Studies for her contribution in providing critical input throughout the development of the manuscript. The authors also appreciate the assistance from the Maternal and Child Health Epidemiology Team, Division of Reproductive Health and the Division of Nutrition and Physical Activity and Obesity at the Centers for Disease Control and Prevention who assisted in oversight and review of the analysis.

Authors’ Affiliations:
- Centers for Disease Control and Prevention, Division of Reproductive Health, Atlanta, GA (DKH)
- Hawai’i State Department of Health, Family Health Services Division, Honolulu, HI (DKH)
- Centers for Disease Control and Prevention, Epidemic Intelligence Service, Atlanta, GA (EOB)
- Centers for Disease Control and Prevention, Division of Nutrition, Physical Activity, and Obesity, Atlanta, GA (EOB)
- Hawai’i State Department of Health, Chronic Disease Prevention and Health Promotion Division, Honolulu, HI (HHS, CLM)

Correspondence to:
Donald K Hayes MD, MPH; Division for Heart Disease and Stroke Prevention, Centers for Disease Control & Prevention, 4770 Buford Hwy, MS S107-1, Atlanta, GA 30341; Email: Bkh0@cdc.gov
References


Fish Consumption for the Adult Population of Hawai‘i, Collected with a Self-Reported Household Survey

Kathleen Kromer Baker PhD; Corilee A. Watters PhD, RD; James E. Dannemiller MA; Scott T. Iwamura RD; and Barbara A. Brooks PhD

Abstract

The population of Hawai‘i has traditionally been high in average fish consumption when compared to the national average. However, information is lacking on patterns of fish consumption among subpopulations. Data on fish consumption in the last 30 days from 11,293 adults was collected with the use of the Hawai‘i Health Survey (an annual telephone survey of households and household members) during the years 2007 and 2008 and weighted to represent the adult population of Hawai‘i. The US Department of Agriculture’s, Environmental Protection Agency, and the United States Food and Drug Administration, recommend 8-12 ounces of fish per week for associated health benefits. Present estimates of fish consumption were skewed to the right (mean 10.5 and median 7.9 ounces) with some adults eating large amounts of fish per day and frequently. It may be of concern, given high amounts of methylmercury in select fish, that 13.7% of adults were eating fish 20 or more times per month. In addition, the serving size increased with increasing number of times per week fish was eaten.

Introduction

High Average Fish Consumption in Hawai‘i

Hawai‘i, with its multicultural population and location in the Pacific Ocean, is an ideal environment for assessing fish consumption patterns and associated health variables. Historically, average annual fish consumption estimates for the population of Hawai‘i (production plus imports minus exports of seafood) have been higher than the national average. The estimate for total per capita seafood consumption (excluding non-commercial catch; including resident civilian, military, and visitors) in Hawai‘i from 1970-1977 was 20.9 lbs/year (1.7 times higher than the national average). In 1983 consumption for Hawai‘i’s population was 24 lbs/year (2 times higher the national average). And from 2000-2009 consumption in Hawai‘i was 28.5 lbs/year (1.8 times higher than the national average). Two factors may have contributed to higher consumption in Hawai‘i: increasing visitors, and increasing number of immigrants from countries with higher fish consumption.

Benefits of Eating Fish

Why eat fish or seafood? Seafood is a dietary source of omega-3 polyunsaturated fatty acids. Numerous health benefits have been associated with intake of omega-3 fatty acids by consuming fish, including decreased incidence of ischemic stroke, coronary heart disease (and related mortality), and dementia. Additionally, omega-3 fatty acids possess anti-inflammatory properties and may confer therapeutic benefits for individuals with chronic inflammatory health conditions such as rheumatoid arthritis.

The omega-3 polyunsaturated fatty acids include alpha-linolenic acid (ALA) derived from plant oils, and eicosapentaenoic acid (EPA-acid) and docosahexaenoic acid (DHA) both originally derived from fish consuming phytoplankton that synthetize EPA-acid and DHA. Even though reviews on fish oil and omega-3 fatty acids are numerous, omega-3 fatty acids derived from fish appear to confer greater benefits, particularly in anti-inflammatory health conditions.
fatty acids supplements that include EPA-acid and DHA have reported inconsistent findings on health benefits, the National Institute of Health’s Office of Dietary Supplements has approved a ‘qualified’ health claim that fish and dietary supplements that contain omega-3 fatty acids, EPA-acid, and DHA, may reduce the risk of coronary heart disease.10

Amount of Fish

How much, how often, and what fish are best for consumption? Recommendations have evolved from the 2004 Environmental Protection Agency (EPA) and the FDA guidelines, which encouraged fish consumption and listed four types of fish to avoid to limit exposure to methylmercury (tilefish, shark, swordfish, and king mackerel).11 Then in 2017, the EPA and the FDA updated guidelines and continued recommendations of 8-12 ounces of fish and grouped fish into consumption categories: “Best Choices” (2-3 servings per week, 8-12 oz/week), “Good Choices” (1 serving per week), and “Choices to Avoid”.12 13 However, recently, after a peer review, the recommendations are being revised. Recently, recommendations have been revised in 2019.14 Present advice recommends that women and children eat two to three servings of 8-12 ounces for adults and children >10, with smaller amounts for younger children. The advice includes eating a variety of fish and shellfish each week. A PDF chart showing how often to eat more than 60 types of fish and shellfish, can be downloaded.

The 2015–2020 Dietary Guidelines for Americans also recommend consumption of about 8 ounces per week of a variety of seafood, and for women 8–12 ounces per week from fish lower in methylmercury. Seafood that are higher in EPA-acid and DHA and lower in methylmercury are salmon, anchovies, herring, shad, sardines, Pacific oysters, trout, and Atlantic and Pacific mackerel (not King mackerel).15 Methylmercury is a neurotoxic compound that has been shown to have deleterious neurological health effects especially among children.15 The Hawaii Department of Health (DOH) has developed detailed fish consumption guidelines for pregnant women, nursing mothers and children based on mercury testing of locally caught fish.16 17

Table 1 summarizes advice for type of fish consumed in Hawai‘i, given the concerns of methylmercury, taken from information published by the DOH Women, Infants, and Children program (WIC).13 Advice includes eating 8-12 ounces of fish low in methylmercury every week for adults and children >10 years with children ≤10 eating smaller portions.

Goals

Given the health benefits of consuming fish, it is relevant to study patterns of fish consumption among Hawai‘i adults by demographics, ethnicity, and socio-economic variables. Previous measures of import and exports of seafood do not give estimates for segments of the population and provide only an overall measure. The Hawaii Health Survey (HHS) was used to provide information on the following questions;

• What is the average fish consumption among adults in Hawai‘i and how does it compare to averages calculated for the nation as a whole?
• Are all adults eating the recommended amount of fish or does consumption vary?
• Is there an association between fish consumption and self-rated health?

Methods

Hawaii Health Survey (HHS)

The HHS is an annual survey of households and adults that are living in Hawai‘i that became a telephone survey in 1996 and, as an anonymous survey, is exempt from the Internal Review Board process (IRB, B. Woods, PhD, DOH IRB Administrator, Hawai‘i Department of Health, Email October 2018). In each household, a knowledgeable adult (> 18 years) was interviewed on their fish consumption for the last 30 days. The sample frame for the two study years (2007 and 2008) was all households with landline telephone service in the State of Hawai‘i. The Office of Health Status Monitoring (OHSM) contracted with SMS Research & Marketing Services, Inc. of Hawai‘i to conduct the survey using Computer-Assisted Telephone Interviewing (CATI) software. The sample totaled 11,293 adult respondents. Missing values for age (0.7%) and income (25%) were imputed using a hot-deck method.18 Other missing values were not imputed (fish consumption questions < 2.8% missing responses). Response rates to telephone-based surveys have been declining.19 The estimated response rates (Council of American Survey Research Organizations — CASRO) for landline telephones was 36% for the years measured.

<table>
<thead>
<tr>
<th>Amount to Eat</th>
<th>Do Not Eat</th>
<th>No More Than Once Every Two Weeks</th>
<th>No More Than Once a Week</th>
<th>Anytime</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Kajiki (Pacific Blue marlin)</td>
<td>• Ahi (bigeye, tombo, yellowfin tuna)</td>
<td>• Aku (skipjack tuna)</td>
<td>• Akule (Aku (skipjack tuna))</td>
<td></td>
</tr>
<tr>
<td>• Shark</td>
<td>• Ono (Wahoo)</td>
<td>• Canned tuna</td>
<td>• Awa (milkfish)</td>
<td></td>
</tr>
<tr>
<td>• Swordfish (shu-tome)</td>
<td>• Opah (moonfish)</td>
<td>• Cod (butterfish)</td>
<td>• Moli (Moli (butterfish))</td>
<td></td>
</tr>
<tr>
<td>• Pollock</td>
<td>• Mahimahi (dolphin fish)</td>
<td>• Grouper</td>
<td>• Opelu (Grouper (dolphin fish))</td>
<td></td>
</tr>
<tr>
<td>• Orange roughy</td>
<td>• Halibut</td>
<td>• Nairagi (striped marlin)</td>
<td>• Salmon</td>
<td></td>
</tr>
</tbody>
</table>

Table 1. Hawai‘i Department of Health. A Local Guide to Eating Fish Safely. WIC Services Branch. 2012.15
Fish Consumption Questions

Respondents were questioned on the number of times fish was consumed in the last 30 days. Consumption was not significantly different by year and 2007 and 2008 data were combined. Both years included a question on the size of an average serving in ounces. Three ounces were compared to a deck of cards. Questions were also asked on concerns of eating fish from Hawai’i and type of fish consumed (Appendix A Survey Questions).

Independent variables assessed included county, age, sex, education, marital status, employment, poverty, ethnicity/race, health insurance status, a general health question (part of the SF12 Survey®, Optum SF™ Health Surveys), and mental and physical component summary scores, calculated from the 12 questions on physical and emotional well-being (SF12 Survey®). A higher score indicates a healthier score. Ethnicity was determined by questions on both parent ethnicities. Any Native Hawaiian was coded first, and if none the next ethnicity (other than White) for the father, and if none the next ethnicity (other than White) for the mother, and if none and White was present the respondent was coded White. The groups included Native Hawaiian, Chinese, Filipino, White, Japanese, and Other.

Percent poverty was calculated using the US Department of Health and Human Services poverty guidelines for Hawai’i, household income, and household size. A higher value of percent poverty indicates higher income and/or lower household size.

Weighting Survey Data and Statistical Analysis

Sample data were weighted and adjusted for oversampling of islands other than O’ahu, survey nonresponse, and age and sex strata to represent the adult population of Hawai’i. SMS research used its population growth model to adjust Census population 2010 data for 2007 and 2008 estimates.

The amount of fish consumed in an average week was calculated from the number of times fish was eaten in the last 30 days (divided by 30 and multiplied by 7) times the serving size. Results are presented as age-adjusted predicted marginal prevalence (%) and odds ratios of adults that consumed at least 8 or more ounces of fish per week (8orMFW). The cutoff for inclusion was a sample size of 50 respondents for the denominator and <0.30 relative standard error for estimates.

Univariate age-adjusted logistic regression models for the binary outcome yes/no consumed 8orMFW were constructed for each independent variable with a logit-transformed probability. All statistical analyses were done with SAS/STAT® software 9.4 (SAS Institute, Inc., Cary, NC) and SUDAAN (version 11.0, Research Triangle Park, NC) software with significance set at α<.05 for a two-tailed test on weighted data.

Results

Average Fish Consumption

The sample size was 11,293 adult respondents representing 947,521 adult residents in Hawai’i in 2007 and 2008. An estimated 89.9% adults consumed at least some fish in the past 30 days. The average adult fish consumption was skewed to the right with many adults eating larger amounts of fish and frequently (mean 10.5 oz/week, 10.1-10.8 95% CI; median 7.9 oz/week, 7.3-8.6 95% CI). The average serving size increased with the number of times fish was eaten (Figure 1). Fish consumption for adults was converted from oz/week to lbs/year for comparison to historical estimates (mean 34.1 lbs/year, 33.0-35.3 95% CI).

Patterns of Fish Consumption

Men’s fish consumption was significantly higher than women’s at P <.001 (Table 2). Consumption decreased significantly at and above 75 years for both men and women for both the mean and median. The highest prevalence for 8orMFW occurred for those who were living in counties other than Honolulu for both men and women (men P = .002, women P < .001), ages 18-74 years (both sexes significant at P < .001), adults that were employed (men P <.001, women P =.023), and women who were married (P=.013). Native Hawaiian and Filipino men (53.6% and 52.2%) had the highest prevalence of consuming 8orMFW (P=.030 for men’s ethnicity) with the pattern reversed for women, Filipino 37.2%, Native Hawaiian 36.4% (P < .001 for women’s ethnicity) (Table 3).

Adults who ranked their general health as excellent/very good/good compared to fair/poor had higher prevalence of consuming 8orMFW at P = .015 for men and P = .023 for women (Table 4). A higher mental health score was associated with consuming higher 8orMFW for men (P=.047).

Concerns of Eating Fish and Type of Fish Consumed

Among adults surveyed, 22% listed concerns about consuming fish with the most common concerns mercury (11.4%), ciguatera poisoning (9.3%), pollution (6.8%), and parasites (0.9%). In contrast, higher fish consumption was associated with adults listing concerns (age and gender adjusted, P = .002). Estimates of type of fish consumed indicated 25% was canned tuna, 66% from fresh ocean fish, and 9% fish from freshwater lakes and streams.

Discussion

Total Consumption

Fish are an important part of the diet throughout the Asia-Pacific
Table 2. Ounces of Fish Consumed Per Week in the Last 30 Days for Adults in Hawai‘i by Age and Sex, Hawai‘i Health Survey 2007 and 2008 Weighted Average.

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean</th>
<th>95% CI</th>
<th>P-value*</th>
<th>Median</th>
<th>95% CI</th>
<th>P-value**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(95% CI)</td>
<td></td>
<td></td>
<td>(95% CI)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(11.8-13.0)</td>
<td>&lt;.001</td>
<td>7.9</td>
<td>(7.0-8.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>18-34</td>
<td>12.6</td>
<td>(11.0-14.2)</td>
<td>&lt;.001</td>
<td>7.0</td>
<td>(5.8-8.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>35-44</td>
<td>13.6</td>
<td>(12.1-15.2)</td>
<td>&lt;.001</td>
<td>9.5</td>
<td>(8.3-11.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>45-54</td>
<td>12.9</td>
<td>(11.7-14.1)</td>
<td>&lt;.001</td>
<td>8.2</td>
<td>(7.1-9.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>55-64</td>
<td>12.5</td>
<td>(11.5-13.4)</td>
<td>&lt;.001</td>
<td>8.2</td>
<td>(7.4-9.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>65-74</td>
<td>11.7</td>
<td>(10.3-13.0)</td>
<td>&lt;.001</td>
<td>7.2</td>
<td>(6.3-8.3)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>≥ 75</td>
<td>8.5</td>
<td>(7.3-9.7)</td>
<td>referent</td>
<td>5.1</td>
<td>(4.2-6.0)</td>
<td>referent</td>
</tr>
</tbody>
</table>

P-value <.001 for mean of men compared to women for both mean and median

Figure 1. The Number of Times per Week in the Last 30 days Adults in Hawai‘i Ate Fish and Their Average Serving Size in Ounces (95% CI), Hawai‘i Health Survey 2007 and 2008 Weighted Average. DOH, OHSM
<table>
<thead>
<tr>
<th>Demographic Variables</th>
<th>Men</th>
<th></th>
<th></th>
<th></th>
<th>Women</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adj. Prevalence&lt;sup&gt;9&lt;/sup&gt;</td>
<td>95% CI</td>
<td>Odds Ratio</td>
<td>95% CI</td>
<td>Wald F P-value</td>
<td>Adj. Prevalence&lt;sup&gt;9&lt;/sup&gt;</td>
<td>95% CI</td>
<td>Odds Ratio</td>
</tr>
<tr>
<td>All Adults</td>
<td>47.3%</td>
<td>(45.1-49.2)</td>
<td>1.86</td>
<td>(1.67-2.07)</td>
<td>&lt;.001</td>
<td>33%</td>
<td>(31.2-34.2)</td>
<td></td>
</tr>
<tr>
<td>County</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Honolulu</td>
<td>45.7%</td>
<td>(42.9-48.4)</td>
<td>referent</td>
<td></td>
<td></td>
<td>30.5%</td>
<td>(28.6-32.5)</td>
<td>referent</td>
</tr>
<tr>
<td>Hawai‘i</td>
<td>49.7%</td>
<td>(46.0-53.4)</td>
<td>1.18</td>
<td>(0.98-1.42)</td>
<td>.002</td>
<td>36.7%</td>
<td>(34.2-39.2)</td>
<td>1.32</td>
</tr>
<tr>
<td>Kaua‘i</td>
<td>55.1%</td>
<td>(50.0-60.1)</td>
<td>1.47</td>
<td>(1.16-1.86)</td>
<td></td>
<td>37.4%</td>
<td>(33.9-40.9)</td>
<td>1.36</td>
</tr>
<tr>
<td>Maui</td>
<td>52.4%</td>
<td>(48.7-56.1)</td>
<td>1.32</td>
<td>(1.09-1.59)</td>
<td></td>
<td>37.1%</td>
<td>(34.5-39.8)</td>
<td>1.35</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-34</td>
<td>46.3%</td>
<td>(41.1-51.6)</td>
<td>1.95</td>
<td>(1.41-2.7)</td>
<td>&lt;.001</td>
<td>30.5%</td>
<td>(26.6-34.6)</td>
<td>1.56</td>
</tr>
<tr>
<td>35-44</td>
<td>54.4%</td>
<td>(49.0-59.6)</td>
<td>2.69</td>
<td>(1.94-3.7)</td>
<td></td>
<td>32.3%</td>
<td>(29.0-35.9)</td>
<td>1.70</td>
</tr>
<tr>
<td>45-54</td>
<td>48.6%</td>
<td>(44.6-52.6)</td>
<td>2.13</td>
<td>(1.59-2.9)</td>
<td>&lt;.001</td>
<td>38.4%</td>
<td>(35.4-41.5)</td>
<td>2.22</td>
</tr>
<tr>
<td>55-64</td>
<td>49.8%</td>
<td>(46.1-53.6)</td>
<td>2.24</td>
<td>(1.68-3.0)</td>
<td></td>
<td>36.4%</td>
<td>(33.6-39.3)</td>
<td>2.04</td>
</tr>
<tr>
<td>65-74</td>
<td>44.9%</td>
<td>(40.1-49.7)</td>
<td>1.84</td>
<td>(1.34-2.5)</td>
<td></td>
<td>29.3%</td>
<td>(26.1-32.7)</td>
<td>1.48</td>
</tr>
<tr>
<td>≥ 75</td>
<td>30.7%</td>
<td>(25.8-36.1)</td>
<td>referent</td>
<td></td>
<td></td>
<td>21.9%</td>
<td>(18.9-25.3)</td>
<td>referent</td>
</tr>
<tr>
<td>Marital Status</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Married</td>
<td>49.3%</td>
<td>(46.6-52.0)</td>
<td>1.19</td>
<td>(0.99-1.41)</td>
<td>.057</td>
<td>34.1%</td>
<td>(32.2-36.0)</td>
<td>1.21</td>
</tr>
<tr>
<td>All Other</td>
<td>45.1%</td>
<td>(41.9-48.5)</td>
<td>referent</td>
<td></td>
<td></td>
<td>30.0%</td>
<td>(27.6-32.6)</td>
<td>referent</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None-11th Grade</td>
<td>46.2%</td>
<td>(35.3-57.4)</td>
<td>referent</td>
<td></td>
<td></td>
<td>28.6%</td>
<td>(22.6-35.4)</td>
<td>referent</td>
</tr>
<tr>
<td>HS Grad/GED</td>
<td>47.7%</td>
<td>(43.5-51.9)</td>
<td>1.06</td>
<td>(0.65-1.73)</td>
<td>.340</td>
<td>31.1%</td>
<td>(28.3-34.2)</td>
<td>1.13</td>
</tr>
<tr>
<td>College 1-4 Years</td>
<td>49.0%</td>
<td>(46.3-51.8)</td>
<td>1.12</td>
<td>(0.70-1.79)</td>
<td></td>
<td>33.9%</td>
<td>(32.1-35.8)</td>
<td>1.29</td>
</tr>
<tr>
<td>&lt;25 Years</td>
<td>39.4%</td>
<td>(30.6-49.0)</td>
<td>0.76</td>
<td>(0.41-1.41)</td>
<td></td>
<td>27.5%</td>
<td>(20.3-36.1)</td>
<td>0.94</td>
</tr>
<tr>
<td>Ethnicity/ Race</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Native Hawaiian/Part</td>
<td>53.6%</td>
<td>(48.5-58.7)</td>
<td>1.55</td>
<td>(1.02-2.36)</td>
<td>.030</td>
<td>36.4%</td>
<td>(33.0-39.9)</td>
<td>1.51</td>
</tr>
<tr>
<td>Filipino</td>
<td>52.2%</td>
<td>(45.8-58.4)</td>
<td>1.46</td>
<td>(0.94-2.29)</td>
<td></td>
<td>37.2%</td>
<td>(33.0-41.6)</td>
<td>1.56</td>
</tr>
<tr>
<td>Japanese</td>
<td>48.6%</td>
<td>(43.9-53.4)</td>
<td>1.27</td>
<td>(0.85-1.90)</td>
<td></td>
<td>26.3%</td>
<td>(23.5-29.4)</td>
<td>0.94</td>
</tr>
<tr>
<td>White</td>
<td>44.4%</td>
<td>(41.0-47.9)</td>
<td>1.07</td>
<td>(0.73-1.57)</td>
<td></td>
<td>32.2%</td>
<td>(29.7-34.8)</td>
<td>1.25</td>
</tr>
<tr>
<td>Chinese</td>
<td>42.8%</td>
<td>(34.5-51.7)</td>
<td>referent</td>
<td></td>
<td></td>
<td>27.6%</td>
<td>(21.5-34.6)</td>
<td>referent</td>
</tr>
<tr>
<td>Other</td>
<td>44.4%</td>
<td>(37.9-51.1)</td>
<td>1.07</td>
<td>(0.68-1.68)</td>
<td></td>
<td>34.7%</td>
<td>(29.4-40.3)</td>
<td>1.40</td>
</tr>
<tr>
<td>Employment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Employed</td>
<td>51.1%</td>
<td>(48.4-53.9)</td>
<td>1.56</td>
<td>(1.26-1.92)</td>
<td>&lt;.001</td>
<td>34.1%</td>
<td>(32.0-36.3)</td>
<td>1.21</td>
</tr>
<tr>
<td>Not Employed</td>
<td>40.3%</td>
<td>(36.4-44.3)</td>
<td>referent</td>
<td></td>
<td></td>
<td>30.0%</td>
<td>(27.6-32.6)</td>
<td>referent</td>
</tr>
<tr>
<td>Poverty</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Below Poverty - Poor &lt;100%</td>
<td>39.0%</td>
<td>(30.4-48.4)</td>
<td>referent</td>
<td></td>
<td></td>
<td>29.1%</td>
<td>(24.1-34.6)</td>
<td>referent</td>
</tr>
<tr>
<td>Near Poor 100-199%</td>
<td>43.5%</td>
<td>(37.9-49.2)</td>
<td>1.20</td>
<td>(0.76-1.90)</td>
<td>.051</td>
<td>29.7%</td>
<td>(26.0-33.7)</td>
<td>1.03</td>
</tr>
<tr>
<td>Middle and High Income &gt;199%</td>
<td>48.6%</td>
<td>(46.3-50.9)</td>
<td>1.49</td>
<td>(1.00-2.22)</td>
<td></td>
<td>33.2%</td>
<td>(31.5-34.9)</td>
<td>1.21</td>
</tr>
<tr>
<td>Health Insurance Plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Private Insurance Plan/ Military Tricare</td>
<td>49.3%</td>
<td>(46.8-51.8)</td>
<td>1.32</td>
<td>(1.01-1.73)</td>
<td>.046</td>
<td>32.8%</td>
<td>(31.1-34.5)</td>
<td>1.01</td>
</tr>
<tr>
<td>Quest, Medicaid</td>
<td>40.2%</td>
<td>(32.9-47.9)</td>
<td>0.91</td>
<td>(0.61-1.36)</td>
<td></td>
<td>30.2%</td>
<td>(24.7-36.4)</td>
<td>0.90</td>
</tr>
<tr>
<td>Medicare</td>
<td>47.7%</td>
<td>(40.9-54.5)</td>
<td>1.24</td>
<td>(0.85-1.80)</td>
<td></td>
<td>31.3%</td>
<td>(26.7-36.2)</td>
<td>0.95</td>
</tr>
<tr>
<td>Uninsured/ Other</td>
<td>42.4%</td>
<td>(36.7-48.3)</td>
<td>referent</td>
<td></td>
<td></td>
<td>32.5%</td>
<td>(27.6-37.9)</td>
<td>referent</td>
</tr>
</tbody>
</table>

*Adjusted for age. Hawai‘i Health Survey, DOH, OHSM
Table 4. Logistic Regression of Adults in Hawai‘i by Sex that Ate 8 or More Ounces of Fish Per Week in the Last 30 Days by Health Variables, Hawai‘i Health Survey 2007 and 2008 Weighted Average.

<table>
<thead>
<tr>
<th>Health Variable</th>
<th>Men Adj. Prevalence*</th>
<th>95% CI</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>Wald F P-value</th>
<th>Women Adj. Prevalence*</th>
<th>95% CI</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>Wald F P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excellent</td>
<td>49.4%</td>
<td>(44.9-53.9)</td>
<td>1.51</td>
<td>(1.14-2.01)</td>
<td>.015</td>
<td>34.0%</td>
<td>(30.7-37.5)</td>
<td>1.26</td>
<td>(0.99-1.59)</td>
<td>.023</td>
</tr>
<tr>
<td>Very Good</td>
<td>48.7%</td>
<td>(44.8-52.5)</td>
<td>1.47</td>
<td>(1.22-1.93)</td>
<td></td>
<td>35.3%</td>
<td>(32.5-38.1)</td>
<td>1.33</td>
<td>(1.07-1.65)</td>
<td>.051</td>
</tr>
<tr>
<td>Good</td>
<td>48.5%</td>
<td>(45.0-51.9)</td>
<td>1.46</td>
<td>(1.13-1.89)</td>
<td></td>
<td>30.8%</td>
<td>(28.4-33.3)</td>
<td>1.08</td>
<td>(0.88-1.34)</td>
<td>.163</td>
</tr>
<tr>
<td>Fair/ Poor</td>
<td>39.3%</td>
<td>(34.2-44.7)</td>
<td>referent</td>
<td></td>
<td></td>
<td>29.1%</td>
<td>(25.6-32.9)</td>
<td>referent</td>
<td></td>
<td>.125</td>
</tr>
<tr>
<td>Mental Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 1 SD above mean</td>
<td>46.9%</td>
<td>(42.7-51.1)</td>
<td>1.32</td>
<td>(0.91-1.92)</td>
<td>.047</td>
<td>32.8%</td>
<td>(29.5-36.3)</td>
<td>0.96</td>
<td>(0.71-1.30)</td>
<td>.689</td>
</tr>
<tr>
<td>Mean + 1 SD</td>
<td>50.0%</td>
<td>(47.1-52.8)</td>
<td>1.50</td>
<td>(1.05-2.13)</td>
<td></td>
<td>32.6%</td>
<td>(30.6-34.6)</td>
<td>0.95</td>
<td>(0.72-1.25)</td>
<td>.002</td>
</tr>
<tr>
<td>Mean - 1 SD</td>
<td>43.6%</td>
<td>(38.2-49.1)</td>
<td>1.15</td>
<td>(0.77-1.73)</td>
<td></td>
<td>33.0%</td>
<td>(29.5-36.8)</td>
<td>0.97</td>
<td>(0.71-1.320</td>
<td>.190</td>
</tr>
<tr>
<td>&gt; 1 SD below mean</td>
<td>40.1%</td>
<td>(32.5-48.3)</td>
<td>referent</td>
<td></td>
<td></td>
<td>33.7%</td>
<td>(28.2-39.7)</td>
<td>referent</td>
<td></td>
<td>.015</td>
</tr>
<tr>
<td>Physical Health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 1 SD above mean</td>
<td>51.5%</td>
<td>(40.1-62.6)</td>
<td>1.38</td>
<td>(0.82-2.33)</td>
<td>.104</td>
<td>33.1%</td>
<td>(25.1-42.2)</td>
<td>1.11</td>
<td>(0.71-1.71)</td>
<td>.089</td>
</tr>
<tr>
<td>Mean + 1 SD</td>
<td>49.2%</td>
<td>(46.6-51.7)</td>
<td>1.26</td>
<td>(0.97-1.63)</td>
<td></td>
<td>33.4%</td>
<td>(31.5-35.3)</td>
<td>1.12</td>
<td>(0.91-1.39)</td>
<td>.005</td>
</tr>
<tr>
<td>Mean - 1 SD</td>
<td>43.9%</td>
<td>(39.4-48.5)</td>
<td>1.02</td>
<td>(0.76-1.37)</td>
<td></td>
<td>31.9%</td>
<td>(28.8-35.2)</td>
<td>1.05</td>
<td>(0.82-1.33)</td>
<td>.008</td>
</tr>
<tr>
<td>&gt; 1 SD below mean</td>
<td>43.5%</td>
<td>(37.7-49.4)</td>
<td>referent</td>
<td></td>
<td></td>
<td>30.9%</td>
<td>(27.0-35.2)</td>
<td>referent</td>
<td></td>
<td>.123</td>
</tr>
</tbody>
</table>

*Adjusted for age. Hawai‘i Health Survey, DOH, OHSM

region and Hawai‘i is no exception with self-reported adult mean fish consumption estimated at 34.1 lbs/year (33.0-35.3 95% CI) comparable (although methods differ) to the 2000-2009 estimate for Hawai‘i of average per capita live weight pounds of seafood consumption at 36.9 lbs/year (commercial and non-commercial).4

These data support that adults in Hawai‘i on average consume more fish than adults on the mainland. The island heritage and cultural heritage of Asian and Pacific Islanders may play a part in the higher total consumption compared to the national average. The mean ounces of fish consumption per day for the adult population of Hawai‘i for age ≥21 years is approximately 3.2 times higher and the median 2.6 times higher in comparison to the 2003–2010 National Health and Nutrition Examination Survey (NHANES- survey data using total usual prepared weight finfish consumption for adults ≥21 years and a complex statistical methodology).26

The Native Hawaiian raw fish dish, poke, may play a part in increased consumption of fish. Also, consumption of canned tuna may account for part of the increased consumption in Hawai‘i as canned tuna was 25% of the total consumption for Hawai‘i compared to the national average at 17% for the same years (2007 and 2008).27 Greater consumption of canned tuna is concerning as canned tuna (canned and fresh) was one of the dominant seafood contributing to the edible supply of seafood and associated methylmercury intake in the nation.28 Hawai‘i’s adults in comparison to other Pacific Islands, as measured by the Food and Agriculture Organization (FAO) household survey study, are low in average fish consumption compared to islands such as Tuvalu (with the highest consumption per capita at 244 lbs/year) and Samoa (the next highest at 142 lbs/year). The adult consumption in Hawai‘i measured by the HHS was comparable to Papua New Guinea with an average of 28.7 lbs/year per capita.29 Consumption may be lower in Hawai‘i due to influence of ethnicities other than Pacific Islanders and Asian and the high cost of living.

Subpopulation Fish Consumption

Information on fish consumption by ethnicity in the nation is limited especially among Asian and Pacific Islander groups that are often grouped into ‘other’ or not included as a separate category for analysis.30 When Asians and Pacific Islanders have been included in surveys they have had high rates of consumption compared to other groups.31,32 In the present study, Native Hawaiians, with the unique history of herding fish and cultivating baby fish in Hawaiian fish ponds had the highest prevalence for men consuming 8orMFW and the second highest for women (53.6% and 36.4%). Filipino men had the second highest prevalence for men and for women the highest prevalence of consuming 8orMFW (52.2% and 37.2%). Chinese and Other ethnicities had the lowest consumption of 8orMFW for men, (42.8% and 44.4%), Japanese, and Chinese for women (26.3% and 27.6%). That Chinese consume less fish than Filipinos has also been
found in the FAO household survey study for the Asia-Pacific region where Filipinos consumed more than four times the amount of fish than the Chinese per capita. However, using fish consumption calculations from capture and aquaculture, fish utilization, and international trade to calculate apparent fish consumption the pattern was reversed with Chinese consuming more than Filipinos.

Numbers from the 2003–2008 National Health and Nutrition Examination Survey (NHANES) on fish consumption also indicated an average fish consumption below recommended levels (and lower in women than men). The mean usual intake of total fish was 0.61 ± 0.03 oz/day and the median was 0.43 oz/day (equivalent to a mean of 4.3 oz/week and a median of 3.0 oz per week), both below the recommended amount. Data indicated people from older age groups ate more fish, however, ages ≥51 were combined and it is impossible to tell fish consumption by smaller age groups. The 2003-2010 NHANES study found, as in the present study, lower fish consumption for ages ≥65. Of particular concern is the low fish intake among women of reproductive age.

It is possible that pregnant and nursing women avoided eating fish due to local and national public health advisories regarding mercury and other contaminants. Although research has suggested that contaminants in fish (especially among long-lived predatory species) are a legitimate concern for women of child-bearing age, the benefits of regular fish consumption likely outweigh the potential health risks.

The NHANES 2003-2010 study revealed lower income and education levels were associated with lower fish consumption. The decreased consumption with lower income and lower education was attributed to the correlation of income and education. It was hypothesized that cost, perceived, or real, may be a barrier to consumption of seafood.

The present study also supports the contention that adults with a higher economic status (education above a high school degree, lower level of poverty, and employed) are associated with higher consumption of fish comparable to other studies. Purchased fish may be out of the price range of many adults in Hawai‘i.

Fish portion sizes increased with the frequency of eating fish. Because seafood is an important staple in most Polynesian and Asian cultures, larger fish portions, in addition to higher intake of fish consumption may be of concern. Many adults were consuming large quantities of fish; 13.7% of adults ate ≥20 ounces of fish per week. Eating higher amounts than recommended levels may have dangerous health effects given that select fish have potentially high methylmercury levels.

A healthier ranking in self-reported general health for both sexes and a higher MCS-12 score for men were associated with higher prevalence of eating the recommended 8-oz MFW per week. An association of mental health and higher consumption of fish has also been noted in other studies. It is difficult to conclude the benefits are from the omega-3 content of the fish or seafood, other components of the seafood, substitution of fish for less healthful foods, a healthier lifestyle, or a combination of factors. The association of healthier self-rated health with fish consumption does not imply causation and may be more associated with a healthier life style and higher economic status.

Increasing Fish Consumption

Boosting fish consumption is complicated and may involve factors other than promoting health-related beliefs and consumer knowledge. Will there be enough fish to supply our population if everyone ate the recommended amount of fish? There has been a history of overexploitation of fish populations, however, efforts to restore marine fisheries ecosystems and promote aquaculture have been increasing. There have been advances in managing and sustaining fish populations worldwide that provide hope for ensuring sustainability.

In addition, detailed information on the complicated subject of which fish to eat can be considered from many points of view including toxicological, nutritional, ecological, and economic and advice is offered on multiple sites.

Increasing omega-3 fatty acids by supplementation, food additives, or other alternate food sources may provide an alternative to fish consumption but the data are mixed on benefits. The American Heart Association’s advisory concluded that physicians should consider prescribing fish oil to patients with recent coronary heart disease, a heart attack, or with prevalent heart failure with reduced left ventricular function. However, a recent meta-analysis of 10 clinical trials concluded omega-3 fatty acid supplements do little to protect patients from cardiovascular or heart disease. Improved diets with greater fish consumption and previous treatment may have reduced the effect of subsequently adding fish oil supplements. Notably, clinical trials have been underway to further study Vitamin D and/or Omega-3 supplements. The ASCEND trial reports no significant risk of serious vascular events between those participants (with diabetes but without evidence of cardiovascular disease) who received n-3 fatty acid supplementation and a placebo.
The VITAL and other Vitamin D trials showed a significant reduction in cancer mortality but not for incidence of cancer or cardiovascular endpoints. Additional research is needed to determine who would benefit from vitamin D supplementation.14

It is recommended that all adults, especially the elderly and women, eat the recommended amount of fish, (at least 8orMFW) but also limit fish consumption to recommended levels and types of fish to reduce intake of methylmercury.14

Limitations

The survey is a point-in-time collection of data. Reporting and recall errors in the frequency and serving size of fish consumed were likely present during the collection of the data. Bias may be introduced as households without landlines or adults with cell phones only were not included and the bias may be different for different communities or subpopulations. Given that in 2008 adults ≥65 years had the highest percentage of landline only phones13 and in the HHS data lower fish consumption estimates, present estimates may be biased toward lower estimates of fish consumption. Also, rounding the estimates of fish consumption per week and the number of ounces may introduce error. The present report does not include types of fish and thus does not have information on mercury exposure. Native Hawaiians and other ethnicities in Hawai‘i consume poke, raw fish mixed with other ingredients. However, whether the fish was raw or cooked was not asked. Because raw fish is cubed, it may be difficult to accurately estimate serving size.

Conclusion

Average fish intake among adults in Hawai‘i was higher than for adults nationally. Consuming the recommended 8orMFW was higher for counties other than Honolulu, men, ages <75 years, married, Native Hawaiian, Filipino, and employed adults. Importantly, the present study found an association of higher self-rated health and higher prevalence of 8orMFW for both men and women. Fish consumption was associated with economic status (higher prevalence for married, college educated, employed, and low poverty — higher income adults). Thus, commercial sources of fish may be beyond the price range of lower income families.

Although the benefits and potential risks of fish consumption are well known and recommended consumption suggestions have been well established, fish consumption for many adults in Hawai‘i remains well below the recommended intakes. It is an important health concern that 53.1% of adults in Hawai‘i are not consuming the recommended amount of fish per week. Increased consumption of fish (species low in methylmercury) is recommended especially for women of childbearing age, elderly, and lower income adults.

Conflict of Interest

None of the authors identify any conflict of interest.

Correspondence to:
Kathleen Kromer Baker PhD; Email: kathleen.baker@doh.hawaii.gov

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Appendix A

Survey Questions

2007 and 2008 Questions on Fish Consumption

1) Alright, now a few questions about your diet. Whether it is breakfast, lunch, or dinner - canned, frozen, or fresh. How many times did you eat fish in the last 30 days?

2) How many times in the last 30 days did you eat large, fresh fish from the ocean?

3) How many times in the last 30 days did you eat small fish from Hawai’i freshwater lakes and streams? Fish like Tilapia, Barracuda, Papiro.

4) How many times in the last 30 days did you eat canned tuna?

5) When you eat fish how large a serving, in ounces do you eat? 3 ounces is about the size and thickness of a deck of playing cards or a computer mouse.

6) Have you ever been concerned about eating fish in Hawai’i?

a) Yes
b) No
c) Do not know
d) Refused

7) What are your concerns?

a) Mercury
b) Parasites
c) Chemical contamination
d) Sewage contamination
e) Ciguatera
f) Other [SPECIFY]
g) Do not know
h) Refused

8) Do you know the size and thickness of a deck of playing cards or a computer mouse.

9) Do you know what are your concerns?

10) What is your concern about eating fish in Hawai’i?

a) Yes
b) No
c) Do not know
d) Refused

11) Where are you from?

a) Hawai’i
b) Mainland

12) Where did you learn about eating fish in Hawai’i?

a) Fish market
b) Restaurant
c) TV

13) Do you know what is your concern about eating fish in Hawai’i?

a) Yes
b) No
c) Do not know
d) Refused

14) How many times in the last 30 days did you eat canned tuna?

a) Yes
b) No
c) Do not know
d) Refused

15) What is your concern about eating fish in Hawai’i?

a) Yes
b) No
c) Do not know
d) Refused
Population Health: Proactive Solutions for Healthy Outcomes

Gary Glauberman PhD, RN, PHNA-BC, NHDP-BC; Michele Bray DNP, RN, PHNA-BC; Joanne R. Loos PhD; and Kristine Qureshi PhD, RN, CEN, PHNA-BC, FAAN

The Spotlight on Nursing is a recurring column from the University of Hawai‘i at Mānoa’s School of Nursing and Dental Hygiene (UHM SONDH). It is edited by Mary G. Boland DrPH, RN, FAAN, Dean of UHM SONDH; Kristine Qureshi PhD, RN, CEN, PHNA-BC, FAAN, Associate Dean of Research for UHM SONDH and HJH&SW Contributing Editor; and Joanne R. Loos PhD, Science Writer for UHM SONDH.

“The true sources of health are not the drugs we take and the doctors we see, nor how much we eat and how often we go to the gym. Instead, our health is determined by the world in which we live. The safety of our neighborhood, the amount of money we make, the people we interact with, the love and hate we encounter, the justice of our laws, the cleanliness of our air and water, the choices made by political leaders, and sometimes just sheer luck are what really decide whether we get sick or stay well.” – Sandro Galeo MD, MPH, DrPH

Social environments contribute directly to a wide range of health outcomes. The social determinants of health refer to conditions in the environments in which people live, work, play, worship, and age.1 Traditionally, the public health sector factored the social determinants of health into practice, while the hospital sector focused on individual factors, such as illness and the provision of episodic curative services. However, health care in the US is evolving. These separate views are no longer sufficient, and population health is now considered the solution. Population health addresses the full range of the determinants of health and involves measuring and optimizing the health of groups by embracing the traditional social determinants of health as well as health care delivery.2 The purpose of this article is to provide an overview of population health, highlight examples of how it is taking shape in Hawai‘i, and discuss how the University of Hawai‘i at Mānoa School of Nursing and Dental Hygiene (UHM SONDH) is preparing its graduate nursing students for new roles in population health in Hawai‘i.

Population health represents a change in the focus of health care financing and delivery in our country. While there are several definitions, the term refers to “the health outcomes of a group of individuals, including the distribution of such outcomes within the group.”3 It is distinguished from the more commonly recognized term “public health,” which connotes a set of activities that are carried out by agencies with official functions that focus on the general public.4 Population health includes some public health activities but goes further to give specific attention to aggregate populations. The population health approach incorporates outcome-driven strategies to manage health for specific groups of individuals, which can be defined in various ways, such as those in geographic areas (local communities or small aggregate populations such as homeless people in a community) or those who have other characteristics in common (ethnicity, religion, health maintenance organization [HMO] membership).4 Population health interventions are generally driven by health care organizations that target health among a specific aggregate population for which they are accountable, such as members of a health plan or individuals categorized by a health status indicator like high blood pressure or diabetes.5 The goal of population health aligns with the Institute for Healthcare Improvement’s “Triple Aim,” which seeks to (1) improve the patient experience of care; (2) improve the health of populations; and (3) reduce the per capita cost of health care.6,7 During 2014, the State of Hawai‘i issued its Healthcare Innovation Plan with an overall goal of transforming health care in Hawai‘i. This plan includes the Triple Aim plus one additional goal of reducing health disparities across the state.8 The passage of the 2010 Patient Protection and Affordable Care Act (PPACA) put into place policies that prompted the US health care system to place more emphasis on primary and preventive care.9 These policies included the adoption of expansive coverage in health insurance and health screening programs.9 Currently, many types of health care organizations are using a population health approach to move beyond episodic patient encounters and direct efforts to also address the social determinants of health to improve long-term health outcomes to meet specific health care metrics.10 The concept of population health reflects a fundamental shift in the approach to health care services, moving away from reactive responses to an individual’s curative health needs toward a more outcomes-based, proactive view of health care delivery.11

Nurses as Key Partners for Implementing Population Health Approaches

In the United States, nurses represent the largest segment of the health care workforce and are the most trusted of the health
Registered Nurses (RNs) Play a Central Role in Hawai‘i’s Population Health

Within the Hawai‘i health care community, different models for population health are taking shape, with nursing playing a central role. These models can be seen in the practices of the most widely used health systems in the state.

The Queen’s Health Systems is opening multiple family health centers with the goal of providing patients with enhanced primary care services (H. Taylor, MSN, FNP-BC, APR-Rx, written communication, December 2019). These facilities are being designed to provide a wide range of ambulatory care services such as primary care, after-hours/urgent care, diagnostic labs and imaging. Consistent with the population health approach, community members will also be invited to participate in health promotion and wellness activities within these centers. These centers will integrate state-of-the-art technology, allow patients to interact with clinicians in non-traditional ways, and employ a team-based care model to manage the health of high-risk groups of patients. While serving as members of interdisciplinary care teams, RNs will conduct annual wellness visits, provide direct patient care, and manage care coordination for complex patients.

RNs can also serve key population health roles in federally qualified health centers (FQHCs) across the state of Hawai‘i. FQHCs provide essential services to vulnerable populations and serve as the cornerstone of the health care system for the underserved in Hawai‘i, with more than 127,000 covered lives statewide. RNs are the anchor of care coordination teams at many of these facilities. At the Kalihi-Palama Health Center in Honolulu, teams of RNs work closely with the surrounding area’s acute care facilities to assure a continuum of care for patients seen at multiple facilities (M. dela Cruz, MSN, RN, PCMH CCE, written communication, December 2019). RNs collaborate with patients, families, and caregivers to develop care plans that address barriers and incorporate patient preferences and lifestyle goals. They also link clients with community resources and provide health education to prevent adverse patient outcomes, such as readmission to the hospital after discharge.

In an integrated system, such as Kaiser Permanente Hawaii (KPHI), population health management includes programs or initiatives that improve individual health through chronic disease care management, health education, outreach, and follow-up. These programs complement primary care services with the goal of reducing the need for inpatient and emergency care. In KPHI, according to A. N. Busekrus, RN, MSN, Advanced Public Health Nurse-BC, CDE (written communication, December 2019), RNs manage the care of patients with complex chronic diseases using a population health approach. For example, teams of population health RNs monitor diabetic patients to prevent gaps in care. Using real-time data from electronic health records (EHRs), these RNs monitor important indicators that may lead to adverse health outcomes and track medication refills, ap-
pointent health information pertinent to the patient’s care. In partnership with primary and specialty care providers, they start and adjust medications and insulin based on protocols and provide case management services and support for improved disease self-management. With the goal of helping patients manage their own health and close care gaps, population health RNs provide health education teaching sessions in person, by phone or by email, and follow-up with any interventions that they, or the primary care team, initiated.

Hawaiʻi Health Partners (HHP), the accountable care organization of Hawaiʻi Pacific Health, has a complex care management (CCM) department that plays a significant role in supporting population health, according to Laura Pladson RN, BSN, manager of CCM for HHP (written communication, December 2019). HHP’s CCM team consists of an RN, a care coordinator, and a community health worker. This team works closely with the primary care provider team to deliver complex care services to patient populations that have challenging chronic health conditions that are difficult to manage and that often result in high emergency department utilization and/or require frequent hospitalizations. The CCM team members work together to coordinate care services, perform medication reconciliation, provide health education, assess ongoing client needs, and support access to community resources as needed. They also engage with patients and caregivers during home or clinic visits to promote greater understanding of personal health risks and consequences. The CCM team works to empower patients to become effective self-managers of their health.

**Educating Hawaiʻi’s Health Care Providers**

Keeping up with the demand for nurses with the skills to practice in population health requires that schools of nursing begin educational redesign. The focus is shifting away from setting, volume, and procedures and toward preparing nurses for the restructuring of care delivery toward meeting outcome metrics designed to improve patient outcomes and reduce costs. The University of Hawaiʻi at Mānoa School of Nursing and Dental Hygiene regularly meets with members of the Hawaiʻi health care community to assess how population health nursing is taking hold in our island community. The School of Nursing and Dental Hygiene offers the Advanced Population Health Nursing (APHN) Program, a 30-credit, online distance-based master’s degree for RNs who wish to practice in Hawaiʻi, the US mainland or in an international setting.

The APHN program focuses on population-level health, wellness, health promotion, and disease prevention. Students gain opportunities to develop critical population health skills such as community and population assessment, complex project/program management, disaster nursing, health services research, and health policy analysis. This skill set has been identified by leading organizations and educators as essential for population health practice.15,16 APHN graduates gain employment across a range of agencies, including insurers, health centers, community-based organizations, and health systems in the state.

**Conclusion**

The focus on population health is leading to the redesign of nursing education and health care delivery across all settings in Hawaiʻi. RNs have the potential to contribute to the success of care teams, the achievement of metrics, and improved outcomes across the state. Globally, RNs have been recognized as essential members of interprofessional teams that deliver population-based health care around the world. Population health nursing has taken root and continues to grow in Hawaiʻi and beyond.

**Authors’ Affiliation:**
School of Nursing and Dental Hygiene, University of Hawaiʻi at Mānoa, Honolulu, HI

**References**

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**Statistical software:** Specify in the statistical analysis section the statistical software used for analysis (version, manufacturer, and manufacturer’s location), eg, SAS software, version 9.2 (SAS Institute Inc., Cary, NC).

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